

# A Practical Guide to Hospital Dentistry



K George Varghese

*Foreword*

Varghese Mani

JAYPEE

**A Practical Guide  
to  
Hospital Dentistry**

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**A Practical Guide to Hospital Dentistry**

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Dedicated

to

the loving memory of  
my beloved parents

Prof. KV Varghese

and

Mrs. Rosakutty Varghese

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# Foreword

Dentistry in general and maxillofacial surgery in particular has seen an unprecedented advancement by leaps and bounds during the past decade. Dental and maxillofacial surgery has become an inevitable part of the Trauma, Head and Neck and Aesthetic Surgery teams. Dentistry is keeping pace with the fast track progress technology is making. Dental surgeons who work in a hospital set up need to update their knowledge on in-patient management.

Dr. George Varghese, a renowned maxillofacial surgeon and a teacher with repute for the past two decades and more, working in close quarters with Plastic, ENT, Neuro and general surgeons is the apt person to pen this book, 'A Practical Guide to Hospital Dentistry'.

I am sure this book will be helpful for house-surgeons, post-graduate students and general dental surgeons who work in hospitals. This is a reference book not only to dental surgeons but to other specialists as well. One of the first of its kind, I am sure, this will be a hotly sought after practical guide.

**Varghese Mani**

Oral and Maxillofacial Surgeon

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# Preface

During the past two decades the hospital environment, needs and expectations of the society as well as the medical profession have made a quantum leap. In the past, with minimal personnel and material support the hospital dentist cared for patients in primitive ambulatory care facilities and operating rooms. Their work was mainly restricted to management of acute infections and dentoalveolar trauma. The advances made in modern diagnostic and therapeutic dentistry as well as in maxillofacial surgery has widened the scope of hospital dental practice. And at the same time it has increased the duties and responsibilities of the dentists working in hospitals.

This book is intended mainly for postgraduate students, fresh graduates and students who are about to start or continue their training in the hospital environment and also for the general dentists who are members of the hospital dental department or serve as part time consultants in hospitals. This book also will be a guide to the administrators to establish and direct the dental department in an efficient manner consistent with the needs of the hospital, the profession and the society.

Even though certain books are available on hospital dental practice, they are published from western countries which are written to suit to their existing needs and requirements.

**K George Varghese**

# Acknowledgements

At the outset we thank the God Almighty, who has made our dream of writing this book a reality. Nothing is possible without his blessings.

I acknowledge with great respect my post graduate teacher Dr. PI John, Former Professor and Head of the Department of Oral and Maxillofacial Surgery, Government Dental College, Thiruvananthapuram for teaching the basics of maxillofacial surgery and who inducted me into the speciality.

I am indebted to Dr. VK Kuriakose (late) whom I consider as my mentor. Under his guidance I started my career as a maxillofacial surgeon.

My sincere thanks to Dr. Varghese Mani, Principal, Mar Baselios Dental College, Kothamangalam who blessed me with a befitting foreword for this book.

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My special thanks to my wife Alice for her constant support and encouragement to accomplish this endeavor.

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# Contents

<b>1. Organization of Dental Department .....</b>	<b>1</b>
<b>2. Admission and Medical Record .....</b>	<b>4</b>
<b>3. Casualty Service .....</b>	<b>9</b>
<b>4. The Medically Compromised Patient .....</b>	<b>26</b>
<b>5. Management of Odontogenic Infections .....</b>	<b>58</b>
<b>6. Common Medical and Nursing Procedures .....</b>	<b>72</b>
<b>7. Conscious Sedation .....</b>	<b>92</b>
<b>8. Infection Control in Dental Practice .....</b>	<b>111</b>
<b>9. Preoperative Preparations .....</b>	<b>127</b>
<b>10. Operation Theater Setup and Aseptic Procedures .....</b>	<b>139</b>
<b>11. Postoperative Management .....</b>	<b>148</b>
<b>12. Management of Shock in Trauma .....</b>	<b>155</b>
<b>13. Intravenous Fluids and Postoperative Fluid Management .....</b>	<b>166</b>
<b>14. Transfusion of Blood and Blood Products .....</b>	<b>173</b>
<b>15. Surgical Site Infection .....</b>	<b>191</b>
<b>16. Prevention and Management of Oral Problems of Cancer Therapy .....</b>	<b>194</b>
<b>17. Dental Jurisprudence .....</b>	<b>213</b>
<b>18. Medical Negligence .....</b>	<b>225</b>
<b>19. Consumer Protection Act and its Relevance to Dental Practice.....</b>	<b>234</b>
<i>Appendices .....</i>	<i>241</i>
<i>Index .....</i>	<i>247</i>

# 1

# Organization of Dental Department

**K George Varghese**

In the past, dentistry was considered a division of the Department of Surgery and thus a department constituent rather than a discrete department. Because of this, hospital dentistry experienced limitations in exposure, staffing, privileges, care of patients and care associated with the performance of routine and major extraoral surgery. The overall effect was that it lacked the recognition that it rightfully deserved.

Currently this concept has been changed. The dental department is now organised as a separate and independent department as the Department of Surgery or the Department of Medicine. This gives the opportunity and responsibility to exercise judgment in staffing, generating protocols for operations and establish training programs.

The organization of a dental department requires the same approach and structure as those used for surgery or medicine and other independent clinical departments in the hospital. This means that staff of the Dental Department has to comply with rules, regulations as that of all other clinical departments. Possessing the same authority and responsibilities as members of other department, staff members of the Dental Department are required to obtain medical support for admission history, physical examination and management of medical problems during the hospital stay. The availability of an experienced oral and maxillofacial surgeons in the dental department is mandatory in managing casualty and inpatients.

## **MAJOR SERVICE UNITS OF THE DENTAL DEPARTMENT**

Within the departmental organization there are four major service units:

- Admitting service
- Outpatient service
- Casualty service (emergency service)
- Consultation service

### **Admitting Service**

The admitting service allows the general dentist or the specialist in the faculty to admit patients and care for them in the operating room of the institution. Dentists who use the hospital for inpatient and ambulatory surgical care are usually general dentists treating handicapped or mentally challenged patients, oral and maxillofacial surgeons who require operating theatre because of the nature of surgery; periodontists and pedodontists whose patient's age and disease require general anesthesia in hospital setting. The admitting service is responsible for the care of the inpatients as well their discharge and follow up.

### **Outpatient Service**

In most hospitals the outpatient service performs the outpatient treatment, follow up of discharged patients. In smaller hospitals this service performs the consultation also. The team consists of general dentists, oral and

## **2 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY**

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maxillofacial surgeons, pedodontists, orthodontist, periodontist, prosthodontist and endodontist and conservative dentist. While the first three are essential as full time faculty, the other specialists may be considered either for full time or part time consultants depending on the nature of work and needs of the community.

### **Casualty Service**

This service otherwise known as Emergency service is prepared to care for patients requiring immediate and emergency care. Patients seldom seek emergency care for routine dental complaints such as dental pain and mild infections. Those reporting to hospital casualty who need dental procedures require the services of an oral and maxillofacial surgeon for the management of faciomaxillary injuries or severe dental infections. Very often the oral and maxillofacial surgeon is called for the emergency management of poly trauma cases along with other medical specialists. These opportunities should be considered as one of the best opportunity to serve the community as well as to demonstrate the mettle of the dental profession.

### **Consultation Service**

The necessity for dental consultation in hospitals was first accepted when it was noted that patients with major diseases also had orofacial and intraoral complaints. Such diseases often have the potential to influence the outcomes of required surgical and medical therapy. Bleeding gums, loose and carious teeth, unexplained facial pain, ulcerations of oral cavity, oral manifestations of systemic diseases intraoral infections limitation of mouth opening and oral metastatic disease contribute to the need for dental consultation.

Currently dental department respond to consultation requests from the following departments:

1. *General medicine*: The dental department helps to identify the focus of infection and oral manifestation of systemic diseases.
2. *Cardiology*: The dental department provides service for patients undergoing major cardiac surgery who require presurgical dental extraction, oral prophylaxis,

and restorative and periodontal therapy. Patients with history of ischemic heart diseases, those with pace maker or valve replacements, after by pass surgery (CABG) and with rheumatic heart disease or congenital heart diseases are referred for dental department for treatment which require special attention.

3. *Plastic surgery*: The dental department helps care for patients requiring construction of obturators and similar maxillofacial prosthesis. They work closely with the plastic surgeons for the management and rehabilitation of cleft palate patients.
4. *Dermatology*: Patients are often referred to the dental department to rule out oral focus of infection, oral manifestation of dermatological diseases, and for biopsy of oral lesions.
5. *ENT*: To rule out oral focus in the management of unexplained facial pain or in the management of sinusitis very often dental consultation is sought. Similarly for the fabrication of surgical obturators and final obturators following maxillectomy the services of the dental department is essential.
6. *Oncology department*: Dental consultation and treatment forms an integral part of preparation of patient scheduled for chemotherapy and radiotherapy of patients (Refer Chapter 16). These patients require removal of focal infection, restoration of carious lesions, and maintenance before, during and after therapy.
7. *Intensive care unit*: Patients in intensive care unit who require diagnosis and treatment of orofacial and dental diseases that is associated or exacerbate acute diseases need dental consultation.
8. *Sleep apnea syndrome laboratory*: This service which has gained wide acceptance in western countries had not gained due recognition in the India. The dental department aids in the preparation and construction of antisnoring devices and helps in the preparation of patients for surgical correction of skeletal deformities influencing the condition.

Thus, by providing the necessary services to the above category of patients, the dental department forms an

integral member of multidisciplinary health care team. The staff of the dental department should always be on the look out for the opportunity for providing additional services to the patients by taking active part in clinical discussions and case presentations. Recent advances in dentistry which has implications in the dental management of hospital patients should be conveyed to the medical staff when ever an opportunity arises.

***Referrals from General Dental Practitioners***

A positive relationship between the dental department and general dental practitioners is vital to both areas of practice. Very often the general dental practitioner hesitate to manage patients with moderate and severe systemic disease in dental office because of the possibility of development of emergency situation while treating such patients. Hospital dentistry benefits those patients who need specialized dental care.

# 2

# Admission and Medical Record

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Each hospital will have its own procedures and protocols for admission and it should be followed from admission till discharge. These are intended to arrive at a working diagnosis, order appropriate investigations and record the progress of the patient in the hospital.

## **ADMISSION PROCESS**

A patient may be admitted to the hospital in either of the following ways:

- A. Elective admission
- B. Nonelective admission

### **Elective Admission**

These are instances where admission is made when the patient has been given an appointment for surgical procedure or specialized investigations that must take place in the hospital. By utilizing the facilities in the hospital the patient can be closely monitored and the best possible treatment given to the patient. Conditions that require hospital dental care are:

- 1. Patient with complex medical problems that require oral surgical or dental procedures. For example, patients who had undergone valve replacement and are on anticoagulant therapy requiring dental extraction. Other medical conditions that may require transfusions or parenteral medications.
- 2. Emotionally or mentally challenged patients or pediatric cases incapable of tolerating dental procedures in conventional settings.
- 3. Major maxillofacial surgical procedures which require treatment under general anesthesia.

- 4. Management of difficult impactions.
- 5. Procedures that may cause localized swelling and airway compromise.

### **Nonelective Admissions**

Admissions from casualty constitute nonelective admissions. This mainly includes maxillofacial trauma cases and severe odontogenic infections. Patients with maxillofacial trauma who are unconscious or those who have sustained polytrauma are generally admitted in trauma unit or under general surgery unit. These units then consults with the dental service regarding the care of the patient. Similarly, a patient suffering from odontogenic infection who is severely diabetic may be admitted under medical unit and then requests a dental consultation. However, if the patient has no other injuries and does not have serious systemic disease requiring immediate medical management, the dental service may admit the patient. Conditions requiring nonelective admission to the dental unit are:

- 1. Fractures of the facial bone requiring reduction and fixation in the operation theater.
- 2. Extensive soft tissue injuries that require wound care and observation.
- 3. Conditions requiring administration of intravenous fluids or parenteral antibiotics.
- 4. Rapidly spreading odontogenic infections requiring incision and drainage.
- 5. Infection or injury that are likely to compromise the airway.

## THE MEDICAL RECORD

The medical record is the document that charts the patient's stay in the hospital from admission till discharge. The purpose of the medical record is to record all the relevant information regarding the patient and a means of communication between the members of health care team. All members of the health care team involved in the management of patient participates in the writing of the medical record. The following are the seven major parts of the medical record are:

1. Admission notes.
2. Progress notes and doctors orders.
3. Laboratory results.
4. Preoperative, operative and postoperative notes.
5. Consultations.
6. Nursing notes.
7. Discharge summary.

The medical record should be written legibly with utmost care avoiding errors and omissions. This is important not only for the proper management of the patient but also from the view point of medicolegal aspect. Any corrections made should be signed. All entries must be signed and show the date and time they were made. Abbreviations should be kept to the minimum possible.

### Admission Note

This explains in detail the reasons for the patient's admission to the hospital. This includes the following:

- a. Chief complaint
- b. History of Illness
- c. Past history—medical and dental
- d. Habits
- e. Family history
- f. Physical examination
- g. Tentative diagnosis

While admitting patients who have drug allergy, uncontrolled systemic disease, bleeding diathesis, anticoagulant therapy, head injury, cervical spine injury, and medicolegal cases (e.g. road traffic accidents and assault) it should be **written boldly** on the cover page of the medical record to capture the attention of all members of the health care team.

### Progress Notes and Doctors Orders

This details the progress of the patient in the hospital preoperatively and postoperatively as well the drugs, intravenous fluids to be administered daily and the nutritional management of the patient. Any new laboratory tests to be performed or consultations to be done are also listed here for quick reference. For example a diabetic patient on insulin will require periodic assessment of blood sugar, urine sugar, and medical consultation as and when required for adjusting the dose of insulin. All these should be included in the progress note for easy reference.

### Laboratory Results

Results of the examination of blood, urine, sputum should be entered in the sheet provided. When ever the same investigation is repeated and the result is entered the date and time also should be mentioned. ECG results and Blood group also should be included. Positive findings of radiographic examination, CT or MRI scan and biopsy report also should be entered and the full report attached to the case record.

### Preoperative, Operative and Postoperative Notes

#### *Preoperative Notes*

Those patients who are being prepared to undergo surgery under general anesthesia require preanesthetic consultation a day or two before surgery. Those who patients who have cardiac diseases it is mandatory to get a clearance of the cardiologist before sending the patient for preanesthetic evaluation. Similarly approval of the physician is advisable in case of patients with systemic disease. Ensure that the following investigations are completed before sending the patient for pre anesthetic evaluation:

- a. *Routine blood examination:* TLC, DC, Hb, ESR, BT, CT, Blood Sugar, Blood Urea (Liver function test, Renal function test and Serum electrolytes when ever it is required).
- b. *Urine examination:* Albumin, Sugar, Deposits; and Acetone in diabetic patients.
- c. Blood grouping and cross matching.

## **6 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY**

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- d. ECG: All leads.
- e. X-ray chest: PA view.
- f. Any other relevant investigation results particular to the case.

While writing preanesthetic consultation, the following points should be included for the information of the Anesthesiologist:

- a. Time and date of surgery.
- b. Type of anesthesia required (GA/LA).
- c. Diagnosis.
- d. Type of surgery being performed.
- e. Approximate duration.
- f. Whether hypotensive anesthesia is required.
- g. Whether severe bleeding is anticipated and the quantity of blood arranged.
- h. Type of intubation required (Orotracheal/ oronasal).

The above information will be of invaluable help to the anesthesiologist in the preanesthetic evaluation of the patient and planning the anesthetic procedure.

### **Operative Notes**

It summarize all events that has occurred during and immediately after the surgery till the patient is transferred from the operation theatre to the recovery room. It consists of Anesthesiologist's Notes and Surgeon's Notes. The former is written from the induction of anesthesia, continues during the procedure till the recovery of the patient from anesthesia. Usually the anesthesiologist or the assistant does the writing. The surgeon's note is written by the surgeon. It abridge all activities that has occurred during the surgery. The following points should be included in the surgeons note:

- Date
- Name of the operation
- Name of surgeons and anesthesiologists
- Type and duration of anesthesia used
- Preoperative diagnosis
- Postoperative diagnosis
- Summary of the procedure: Incision, operative procedure in brief, operative findings, discussion of any complications, type and location of drains, type

of suture and suturing method, description of pathology specimen and whether it has been send for frozen section or routine histopathological examination.

- Amount and type of fluids including blood transfusion.
- Patient's condition on leaving the OT.

### **Consultations**

In the management of a hospital patient the knowledge and skill of other specialists are often needed. For this the patient has to be evaluated by other specialists and these are referred to as consultation.

The following information should be included in the request for consultation:

- Date and time of request
- Salutation (Sir/Madam/Name of the Physician)
- Brief history of patient
- Reason for request for consultation
- Anything special expected from consultation
- Name of requesting doctor or service
- Means of contact in case of emergency consultation.

The doctor after examining the patient should include the following information in the response:

- The date and time of examination
- Acknowledging the request by thanking for the consultation
- Confirmation of the history of the patient
- Review of pertinent clinical findings
- Opinion regarding the present condition
- Suggestions/Advice regarding the management of the patient
- Name of the doctor or service
- Means of contact in case of emergency.

(Format for request for consultation and response to consultation is included in the appendix).

### **Nursing Notes**

Nursing notes also forms an important part of the medical record. They provide vital information regarding the patient's status as seen from the view point of the nurse's approach to patient care.<sup>1</sup>

## Discharge Summary

It summarises all the events that has occurred during the patient's stay in the hospital. It should be written at the time of discharge and a copy given to the patient for future reference. It generally include the following:

- Name, age/date of birth, sex and address
- Referring doctor's or hospital's name
- Date of admission and discharge
- Admitting diagnosis and discharge diagnosis
- Name of the attending surgeon and the unit
- Summary of pertinent findings from history, physical examination and lab investigations
- Consultation by specialists
- Diagnostic and therapeutic procedures performed
- Surgery performed and date of operation
- Postoperative period and progress
- Condition at the time of discharge (relieved/unchanged)
- Discharge medications
- Discharge instructions, including follow-up date, diet instructions, and restriction of activity.

## MAKING CORRECTIONS IN THE MEDICAL RECORD

This is an area doctors should exercise restraint and extreme caution. A medical record that is unaltered is essential for medicolegal aspects and also for maintaining the trust of the patient. Any change in the medical record is sure to be noted and highlighted if there is litigation.<sup>2</sup> Any corrections made while writing the record should be made by drawing a line through the incorrect entry and then initialing, dating and recording the time of correction. Should any corrections or additions are needed in a previous entry, the doctor should indicate the date, time and reason for change. Make note that the original entry must never be covered or eliminated.

One of the strongest defenses in any medical negligence litigation is a complete and accurate medical record showing chronological entry and continuous care of the patient. On the other hand, incomplete, altered or destroyed medical record can be catastrophic.

## INFORMED CONSENT

A doctor performing a medical or surgical procedure must obtain the patient's written informed consent to the procedure. Informed consent is a concept that is more than 300 years old.<sup>3</sup> The doctor must disclose in a reasonable manner all significant medical information that he/she possesses that is pertinent to the intelligent decision by the patient. It benefits the patient/ guardian as well as the surgeon by the exchange of information and unanimous agreement on treatment. More over it empowers the patient to make the final decision regarding the treatment. The following are the advantages of informed consent:

1. Helps to build a trusting relationship between the doctor and the patient.
2. Patient education regarding the nature and extent of the condition, proposed treatment, risks of the treatment, prognosis, alternatives to proposed treatment and no treatment.
3. Prepares the patient for negative outcomes.
4. Evaluates the patient's level of understanding and additional education needed if it is inadequate.

Simple sharing of information does not offer protection from lawsuits. Always note that an oral consent (implied consent) is not a substitute for a written consent and the latter should be obtained whenever possible. This does not imply that written consent is an absolute defense in an "informed consent" case. Even a standardized written consent form may be inadequate to prevent legal proceedings.<sup>4</sup> Hence, many authorities are against the use of standardized consent form and recommend tailoring the consent form to the particular procedure preferably written in patients own handwriting.

Depending on the situation, the consent form vary but must include the following elements:<sup>5</sup> Diagnosis and nature of patient's condition

- a. Purpose of treatment and its benefits (including no treatment).
- b. Options and alternatives.
- c. Treatment procedure.
- d. Risks involved.
- e. Expectations.
- f. Course of action if treatment is not accepted.

## **8 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY**

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The consent form should be signed by the patient or by the guardian in case of a minor. If the patient is physically unable to sign the form, after full discussion with and consent by the patient, the doctor may sign the form. It must then include a written note indicating the reason for the absence of patient's signature. If the patient does not have the mental capacity to consent, the doctor must document that and then a family member or a close friend may sign on patient's behalf. (A sample consent form is included in the appendix no.5 which has to be modified depending on the situation/case)

(For detailed description regarding consent refer Chapter 18).

### **WARD ROUNDS**

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Ward rounds are essential daily activities that provide a means of updating the status of the patients in the ward, and are particularly important for house officers and students as a teaching exercise in total patient care. The following points should be observed while performing ward rounds:

1. Ward rounds should be conducted at least once a day, preferably first thing in the morning.
2. Arrive early and make sure you are totally familiar with the case details for each of the patients on the ward, and take particular note of any new admissions over the preceding 24 hours.
3. Have all radiographs and updated results available for perusal by senior colleagues.

4. Inform the charge sister of the ward when the rounds will be commencing so that a representative of the nursing staff can be present to take notes on clinical decisions made during the rounds.
5. Before commencing the ward rounds, brief senior colleagues of any major, urgent or confidential problems before entering the wards.
6. Lead the ward round to each patient's bedside and present a concise clinical summary with brief mention of the important results of any procedures and relevant investigations. Avoid raising contentious issues within earshot of the patient.
7. Keep an eye on the patient during the round in case comments have been misconstrued, and if so, return to the patient's bedside at the end of the ward round to clarify.
8. Keep notes during the rounds so that at the end you can record in the patient's notes what future management has been decided.

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# 3

## Casualty Service

**K George Varghese**

Casualty Service in more advanced hospitals have a dental team available for dental, oral and maxillofacial emergencies. As specialists most qualified to diagnose and treat traumas and diseases of the mouth, face and neck, the dental surgeons should involve themselves actively in the casualty service of the hospital. Dental surgeons are called to examine and treat patients after initial assessments are made by triage officers regarding whether the illnesses or injuries require dental and oral surgical care.

### **WHAT IS ON CALL ?**

The term *on call* describes that the duty doctor or the resident medical officer should be available to provide emergency care for the sick in the casualty department or inpatient consultation.

Resident dentists or maxillofacial surgeons on call may be available either by physical presence in the hospital or by pager or phone call at home. Physical presence in the hospital is the preferred form of on call, although the practitioner must understand that absence from the building is usually construed by the hospital administration as dereliction of duty. Availability by pager or phone call at home is undesirable for many reasons. The casualty staff may not call the resident dentist at all because such a method of contact takes too long to get the help needed. The net effect is that the resident dentist receives little experience regarding the management of emergency

patients. Moreover the opportunity for promoting dental department's presence in the casualty is lost.

A great deal of learning and teaching occurs during on-call hours when unexpected and unanticipated medical and surgical problems require immediate response. Being available for consultation and intervention provides an unparalleled opportunity for dental practitioners to add to their broad base of knowledge, and skill.

- A great deal of learning and teaching occurs during on-call hours
- Physical presence in the hospital is the preferred form of on call
- Absence from the building is considered as dereliction of duty.

The final diagnosis of any dental, oral or maxillofacial condition should be made by a member of the Dental casualty service. The treatment of facial, dental, oral, and maxillofacial problems should not be left to other services if the patient is to receive the best possible care. Dentists and Oral and Maxillofacial surgeons should be available to the Causalty to diagnose and treat diseases and injuries ranging from simple tooth ache to life threatening facial injuries and swellings causing airway obstruction.

The first interventions performed in the casualty are the following:

1. Establish and maintain a patent airway.
2. Control of bleeding.

## 10 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

### 3. Prevention of shock.

The oral and maxillofacial surgeons have traditionally been the first dental professionals called to provide casualty consultations. They provide advice and care for a multitude of problems:

- Maxillofacial injuries
- Perioral and facial laceration
- Abrasions and hematoma
- Minor dentoalveolar trauma
- Facial infections
- Dental pain
- Temporomandibular joint dislocations
- Postextraction bleeding.

## INJURIES OF THE MAXILLOFACIAL REGION

Face is the most prominent, attractive and expressive part of human body. Since it is very prominent it is easily subjected to trauma. Recently there has been a tremendous increase in the incidence of maxillofacial trauma. Hence it is mandatory that the on call casualty dental surgeon also be aware of the basics of management of maxillofacial injuries.

### Golden Hour

It is well known and accepted that mortality from trauma has a trimodal distribution with three clearly defined peaks. The **first peak** is within seconds to minutes of the event, where the degree of injury sustained is such that survival is only a remote possibility even in the most optimal circumstances. Death in this group is due to severe injury to the brain and major cardiovascular structures such as the heart and great vessels.

The **second peak** occurs within some minutes to one or more hours after the event. Death in this group is attributed to unrecognized serious complications such as airway and ventilatory compromise, hemorrhage and head injury. This second peak of mortality is amenable to active professional intervention and is referred to as the "Golden Hour" of saving the life of the patient. The development of the Advanced Trauma Life Support (ATLS), first popularized and promulgated by the American College of Surgeons Committee of Trauma, has standardized the management of trauma in many countries in the world.

The **third peak** occurs days to weeks after the event, when multiorgan failure and sepsis leads to death. This often occurs as a result of inadequate treatment in the "Golden hour". The active and aggressive approach in ATLS has also reduced the number of patients dying in the third peak as active resuscitation leads to fewer instances of late organ failure.

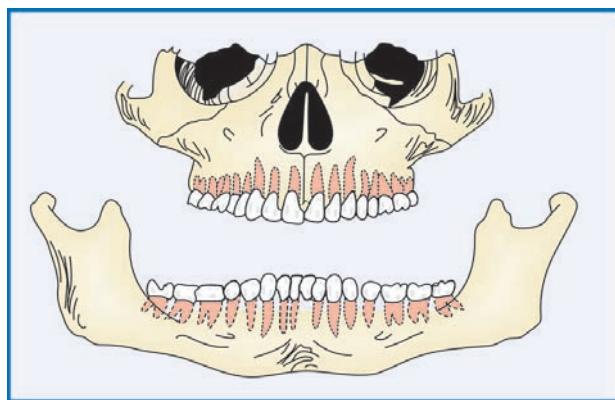
Hence, a multidisciplinary approach involving various surgical specialists is essential for the proper management of a patient with faciomaxillary injury in a polytrauma patient.

The surgical anatomy of the maxillofacial region is complicated because it is closely related to the base of the skull, nasopharynx, orbital contents, cranial nerves and paranasal sinuses. A thorough knowledge of the surgical anatomy of the maxillofacial region is essential to understand the pattern of injuries, possible associated complications and also to plan a proper management.

### Maxillofacial injuries

Injuries of the face involving the middle third and the lower third of the facial skeleton

For the easy understanding of the facial skeleton, it can be arbitrarily divided into lower third, middle third and upper third. The skeleton of the **lower third** is formed by the mandible. The **middle third** of the facial skeleton is defined as an area demarcated above by a line drawn across the facial skeleton from the zygomatico-frontal suture across the fronto-nasal and fronto maxillary sutures to the zygomatico-frontal suture of the opposite side. And below, by the occlusal plane of the upper teeth or the alveolar crest in edentulous patients (Fig. 3.1).



**FIGURE 3.1:** Bony component of the middle third and lower third of face

Posteriorly the area is limited by the spheno-ethmoidal junction, including the free margins of the pterygoid laminae. **The upper third** of the facial skeleton is formed by the frontal bone.

Injuries of the middle third and/or the lower one third (mandible) of the facial skeleton are called maxillofacial injuries.

## Primary Care in Maxillofacial Injuries

### Preliminary Examination and Care

Maxillofacial injuries at times present as themselves, or are associated with certain emergency or life threatening situations (Figs 3.2 and 3.3). Hence, before a definite evaluation of the fracture is done and a treatment plan formulated, preliminary examination and care aimed at managing these emergency situations is necessary.



**FIGURE 3.2:** Patient after facial trauma (note the nasotracheal tube placed)

Two important factors that can lead to the death of a patient are:

1. Respiratory obstruction.
2. Massive hemorrhage leading to shock.

### Respiratory Obstruction

Severe maxillofacial injuries can lead to the death of the patient primarily due to respiratory obstruction leading to asphyxia, particularly in patients who are unconscious. The factors which are responsible for an inadequate airway in these situations are:



**FIGURE 3.3:** Immediately after fixation of fracture and closure

1. Obstruction of the nasal and oral airway by blood clot, vomitus, saliva, bone, teeth, dentures and foreign bodies or inhalation of any of these.
2. In bilateral parasympyseal fractures of the mandible, a bodily backward displacement of the tongue and its attachments can lead to closure of both the nasopharynx and oropharynx (Fig. 3.4).
3. A downward and backward displacement of the fractured maxilla can occlude the oro-nasopharynx
4. Airway obstruction may occur as a result of a large hematoma formation in the floor of the mouth or due to pharyngeal or laryngeal edema or surgical emphysema.



**FIGURE 3.4:** Comminuted fracture of the symphysis. Tongue has fallen back. Airway is obstructed

## 12 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

### ABCD of Maxillofacial Trauma Management

- |             |                |
|-------------|----------------|
| A. Airway   | C. Circulation |
| B. Bleeding | D. Drugs       |

#### Management of Airway Obstruction

1. The first step towards the management of airway obstruction should be focussed on **clearing the oro and nasopharynx**. Under a good vision the mouth should be examined and cleared from blood clots, mucus, broken teeth, dentures or other foreign bodies with the help of a powerful suction and wet swabs.
2. **If the tongue falls backward, it should be brought bodily forward** with a finger placed over the posterior third to open up the oropharyngeal airway and the fractured central segment should be aligned and temporarily immobilized. Also a **tongue suture** should be inserted. The suture should enclose a maximum amount of the tongue muscle and should be placed as posteriorly as possible. The ends of the suture should be brought out extraorally and secured

#### Tongue suture

- ◆ Enclose maximum amount of tongue muscle
- ◆ Place it as posteriorly as possible

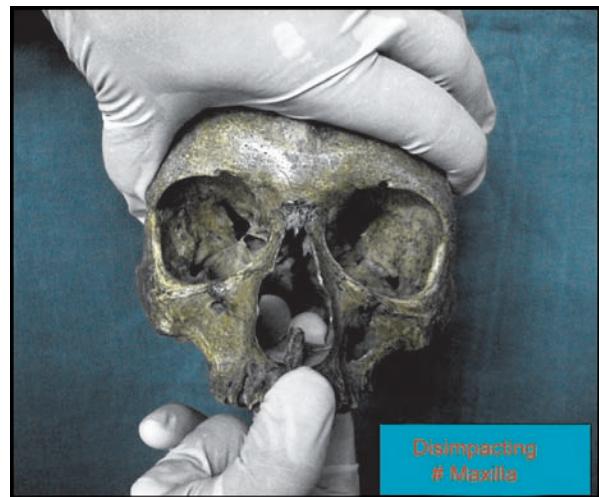
3. **By forcibly disimpacting the maxilla**, obstruction due to the fractured maxilla can be relieved. This is done by passing the index and middle fingers into the mouth with the tips hooked behind and above the soft palate into the posterior nasal opening and with the thumb placed on the alveolus in the incisal region.

Counter pressure is then exerted by the other hand on the forehead and strong anterior traction applied to the upper jaw (Fig. 3.5).

4. In a patient with maxillofacial injury, the semiprone or lateral position is preferable.

Supine position should be avoided if possible. This will maintain a clear airway by allowing drainage of blood, saliva and CSF from the airway and preventing partially avulsed soft tissues of the lips or cheeks from obstructing the airway.

5. If the airway is becoming considerably compromised or the obstruction is increasing then endotracheal



**FIGURE 3.5:** Forcefully disimpacting impacted maxilla (note the position of fingers)

- intubation should be carried out. This is the only satisfactory way of maintaining a clear airway.
6. In certain situations, a **tracheostomy** has to be done to secure a clear airway. In an extreme emergency situation, **laryngotomy**, where a percutaneous incision of the cricothyroid membrane is done. The indications of tracheostomy is, when the endotracheal intubation is not possible due to laryngeal edema. In addition, if the airway has to be kept for a longer period of time (e.g. postoperatively for a few days), tracheostomy is to be preferred.

Before doing any procedures in maxillofacial injuries exclude cervical spine injury

#### Hemorrhage

Severe hemorrhage associated with soft tissue laceration of an extensive nature is rare in the maxillofacial region. Although severe and prolonged bleeding rarely occurs, a large vessel may require clamping and ligation.

If there is severe bleeding from the inferior alveolar artery, immediate open reduction and control of bleeding should be carried out. Severe bleeding from the palatine vessels can be controlled by inserting a deep suture down to the bone, to include the vessel and the mucoperiosteum in a single bite. In extreme cases, ligation of the external carotid artery or one of its branches may be necessary.

Another troublesome bleeding is from the nose. Generally this ceases spontaneously. If not, an anterior

or posterior nasal pack should be inserted depending upon the site of hemorrhage.

### Shock

Though the bleeding from facial injuries can be considerable; very rarely, they are the sole cause for a systemic shock. The rare instance being extensive soft tissue injuries involving large blood vessels in the neck.

**Therefore, in a patient with maxillofacial injuries, exhibiting signs of shock, other source of bleeding, e.g. internal hemorrhage in the abdomen, should be sought for.**

**Signs of shock:** Shock in maxillofacial injuries is always due to hypovolemia and characterized by (1) cold skin, (2) increase in respiratory rate, (3) tachycardia and (4) hypotension, (5) dilation of pupils may also be seen.

- ◆ Bleeding from facial injuries rarely a cause for shock
- ◆ Signs of shock - look for other sources of bleeding

### Principles of Treatment

- a. Re-establish intravascular fluid volume.
- b. Discover and correct the cause.

**Control of pain and infection:** If the maxillofacial injury is associated with severe pain, a suitable analgesic should be administered. However, it should be remembered that the use of narcotic analgesics such as morphine are contraindicated as they depress the cough reflex and respiratory center and mask pain which can be diagnostically important (e.g. from a ruptured spleen). It can also interfere with the pupillary reaction. In all maxillofacial injuries where there is a compound fracture, like fracture of the mandible involving teeth, suitable antibiotics should be administered. Immunity against infections like Tetanus should be boosted by giving an injection of tetanus toxoid if the patient was previously immunized; otherwise, passive immunity using antisera should be administered.

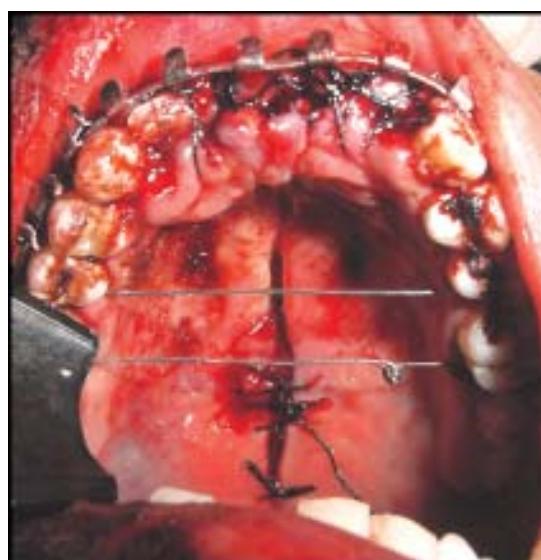
Avoid narcotic analgesics in maxillofacial injuries

**Temporary support:** Temporary splinting of the fractured fragments with the help of devices like barrel

bandage, is usually unnecessary and in some instances may cause the patient only additional discomfort. However, temporary horizontal wiring may be very useful in certain cases of displaced mandibular fractures. These types of wiring prevents further displacement of fractured fragments. In cases of midline split of the hard palate transpalatal wiring helps to approximate the displaced palatal segments (Figs 3.6 to 3.8).



**FIGURE 3.6:** Showing fracture maxilla with palatal split



**FIGURE 3.7:** Showing Arch bar wiring and transpalatal wiring



FIGURE 3.8: After final healing

### Clinical Examination of the Maxillofacial Region

After instituting the life saving measures, a systematic examination of the patient should be carried out under the following order:

- History of injury
- General examination
- Local examination of the maxillofacial region.

#### History of Injury

A detailed history regarding the injury should be obtained either from the patient if he is conscious and well oriented, or from the companions and reliable witnesses.

**Date and time of injury:** It is important from the clinical point of view to know whether it is a recent injury or an old injury. This will give a clue regarding the possibility of infection at the site of fracture. This information is also needed for medicolegal purposes.

**Mode of injury:** Knowing the magnitude and direction of impact may give an indication regarding the possible extent and pattern of injury.

**History regarding level of consciousness:** Evaluating the level of consciousness is the most important step in assessing cerebral damage. The degree and duration of loss of consciousness indicate the amount of cerebral damage. Inability to remember the events leading up to the accident is called *pre-traumatic or retrograde amnesia*.

Inability to remember the events immediately following the accident is called *post-traumatic or anterograde amnesia*. It should be borne in mind that

the sudden loss of consciousness might also follow a cerebrovascular accident or an attack of epileptic fits (which causes the injury). The level of consciousness is also influenced by factors like consumption of alcohol, intake of certain drugs and a hypoglycemic or hyperglycemic state.

**History of treatment prior to admission:** If the patient has received any first aid treatment prior to admission, details of the drugs taken like prophylaxis against tetanus, antibiotic therapy and intake of certain drugs like morphine, should be obtained from the patient's record. It is a well documented fact that morphine in addition to depressing the respiration also leads to constriction of the pupils, which might mask the onset of pupillary changes due to increase in intracranial pressure.

#### General Examination

A general systemic examination of the patient is very essential prior to the local examination of the maxillofacial region, to exclude the possibilities of more serious injuries elsewhere in the body.

First the **cranium** should be inspected and palpated for soft tissue laceration and bony damage. The **level of consciousness** should also be determined and the patient graded as: clear/confused/disoriented.

**Eyes** should be examined to look for any injury to the globe and to ascertain any cerebral damage.

Effort should be made to record the vision, pupillary size and its reaction to illumination. Progressive dilatation of pupil and loss of reaction to light is an indication of increase in intracranial pressure. A fixed dilatation of pupil is a sign of oculomotor paralysis.

**Ear and nose** are examined for any **bleeding or CSF leak**.

In patients with stiff neck following trauma, an **injury to cervical spine** should be suspected. The whole of the spinal cord should be palpated and whenever a spinal injury is suspected it should be confirmed with a suitable radiograph.

**Chest and abdomen** are inspected and palpated to determine any injury to the thoracic cage and injury to viscera and other organs in the abdomen.

Finally **all the limbs** should be palpated for tenderness and deformity.

### *Local Examination*

Following a thorough general examination and institution of any emergency and resuscitation measure, examination is focused on the detailed assessment of local injuries to the maxillofacial region. Prior to the commencement of examination, face and mouth should be carefully cleared of blood clots, road dirt, broken teeth or dentures or any other foreign bodies.

This will facilitate proper examination and might reveal many obscured underlying soft tissue and hard tissue injuries.

### *Examination of the Mandible (Figs 3.13 to 3.16)*

**Extraoral inspection:** Presence of inflammatory swelling, ecchymosis or soft tissue laceration is the commonest finding over a fractured site. A minor contor defect may not be noticed in the early period due to the presence of edema. When there is a gross displacement of fractured ends, it not only produces contor defect but also the patient will have difficulty in opening and closing of the mouth. A fracture in the teeth bearing area will always be compound into the oral cavity. In fresh injuries there will be dribbling of blood stained saliva from the corner of the mouth.

### *Examination of the Maxilla*

The premaxillary region is grasped with fingers of right hand and the left hand thumb and index finger is placed over bridge of the nose at frontomaxillary and frontonasal junction and upward pressure is exerted at the premaxillary region, which confirms the movement of the middle third facial skeleton (Fig. 3.9).

Injuries to the teeth are noted and carefully recorded. Teeth are examined to verify avulsion (loss), fracture, mobility, intrusion, and extrusion. If certain teeth are lost prior to accident and if the patient is wearing partial or full denture that also should be mentioned in the records. Any loose tooth extracted following trauma is noted. A neck and a chest radiograph may be taken if swallowing/aspiration of tooth is suspected (Fig. 3.10).

## **Fractures of the Mandible**

### *Classification*

The aim of any classification is to group the fractures separately for the purpose of diagnosis and treatment planning.



**FIGURE 3.9:** Examination of fractured maxilla



**FIGURE 3.10:** Neck radiograph showing a swallowed tooth. Note the Ryle's tube in position

Just like fractures elsewhere in the body, fractures of the mandible can be classified in to **simple, compound, comminuted, pathological and green stick**.

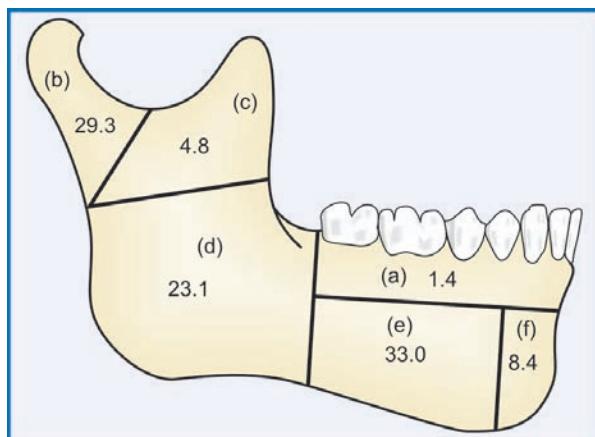
Fractures occurring in the non-tooth bearing areas are often simple while fractures occurring in the tooth bearing areas in dentulous cases are compound in to the mouth

## 16 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

through the periodontal space. Comminuted fractures are caused by extreme violence and pathological fractures occur owing to mild trauma on the mandible, which is already weakened by disease like osteomyelitis, cysts or tumors. In a greenstick fracture, only one cortex is breached; this usually occurs in children where the bone is more elastic.

The most common classification of fractures of mandible is given below (Fig. 3.11).

- a. Dento-alveolar 1.4 percent
- b. Condylar 29.3 percent
- c. Ramus and Coronoid 4.8 percent
- d. Angle 23.1 percent
- e. Body (Horizontal portion up to pre-molar area) 33 percent
- f. Symphysial region 8.4 percent



**FIGURE 3.11:** Classification of mandibular fractures

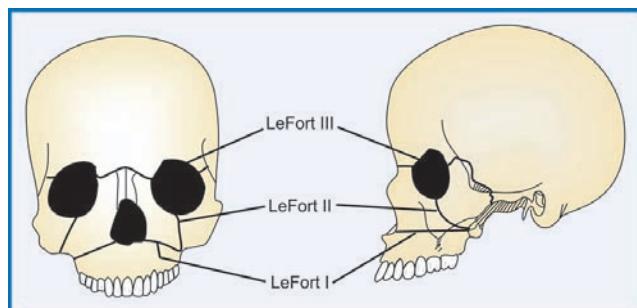
### Fractures of the Middle Third of the Face

#### Classification

Since the middle third of the face comprises of many bones joined together it is rather more convenient to classify these fractures on an anatomical basis rather than taking them individually.

Because of the complex nature of the middle third of the face these fractures are seen in varying combinations. For better clarity and ease of description fractures are described as:

1. Nasal complex fractures.
2. Zygomatic complex fractures including the orbit.
3. Dento alveolar fractures.
4. Le Fort I fractures.
5. Le Fort II fractures
6. Le Fort III fractures (Fig. 3.12).



**FIGURE 3.12:** Classification of maxillary fractures



**FIGURE 3.13:** Examination of fracture mandible



**FIGURE 3.14:** Examination of condyle



**FIGURE 3.15:** Malocclusion associated with fracture mandible



**FIGURE 3.16:** Lingual hematoma associated with fracture mandible

## Radiology of the Facial Injuries

A thorough knowledge of the surgical anatomy and a meticulous clinical examination usually enable the examiner to come to an accurate diagnosis of the fractures of the maxillofacial region. **Many a time clinical examination should be considered more valuable than radiological investigation. The multiplicity and overlapping of bony structures with associated airspaces may confuse the radiological diagnosis of fractures in the maxillofacial region.**

Radiographs are always two dimensional and to get a three dimensional understanding, pictures are usually taken in planes perpendicular to one another. However, in the maxillofacial regions more than two views may become necessary to assess accurately the nature of the fracture.

Radiographs are essential for a few reasons. There are certain fractures which cannot be properly understood by clinical examinations alone. And when edema or emphysema has set in it is not easy to pin point the fracture sites. Moreover, in medicolegal cases proper X-rays are obligatory. Clinical examination gives a general idea of the sites, which have to be further investigated. The following radiographic views are useful in the diagnosis of fractures of facial skeleton (Figs 3.17 to 3.19):

1. PA View of Skull and mandible.
2. Rt. and Lt. Lateral oblique view of mandible.
3. PNS View of Maxilla.
4. Orthopantomogram (OPG).
5. Occlusal and Periapical radiographs.
6. CT Scans – in fractures of middle third of the face.

### Radiographic examination — points to remember

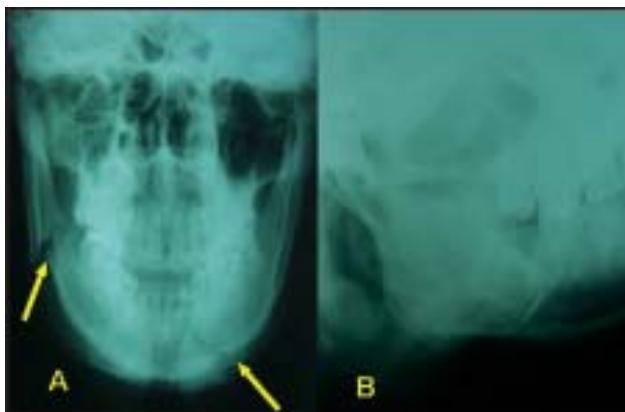
- Many a time clinical examination more valuable
- For three dimensional evaluation take pictures in planes perpendicular to one another.

In modern practice, no midface trauma should be treated until a CT scan is obtained. The CT scan is the best instrument available to demonstrate the extent of four major types of facial bone fractures (Figs 3.20 to 3.22):

1. LeFort fractures
2. Solitary blow out fractures of the orbit
3. Zygomatico-maxillary fractures
4. Nasal bone fractures



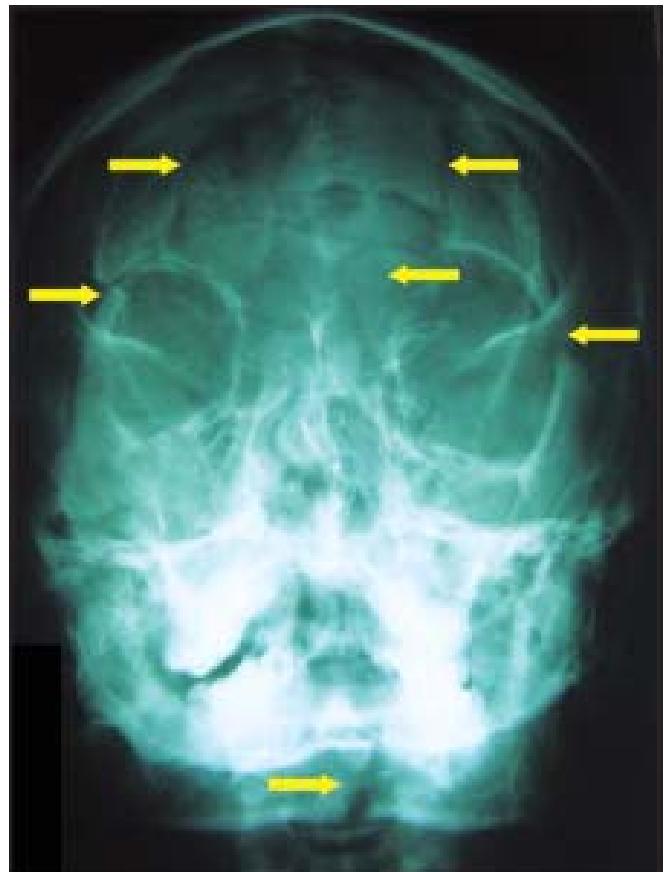
**FIGURE 3.17:** Lateral oblique view X-ray of mandible showing fracture of right angle



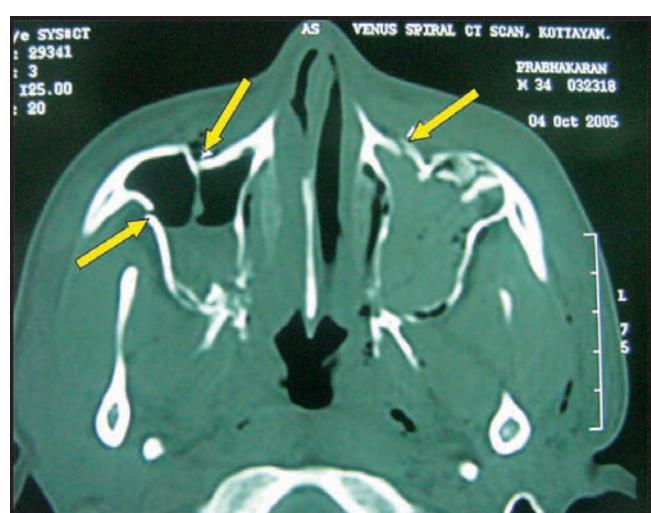
**FIGURES 3.18A AND B:** Usefulness of X-ray PA view of skull and mandible. (A) shows fracture of left parasymphysis and right angle of mandible, (B) the latter of which is not visible in the lateral oblique X-ray



**FIGURE 3.19:** PNS view X-ray showing fracture of left zygomatic complex



**FIGURE 3.20:** Occipitomental view showing LeFort fracture, fracture of frontal bone, zygomatic complex and mandible



**FIGURE 3.21:** Axial CT scan showing extensive fracture of maxilla with hematoma in the antrum



**FIGURE 3.22:** Coronal CT scan showing fracture of orbital floor with prolapse of orbital contents

Generally, after a diagnosis of a specific midface injury is made, the patient is admitted for treatment. Occasionally, a patient with a minimally displaced LeFort fracture may be treated under local anesthesia as an outpatient. However, all patients with bone fractures of midface should be admitted before proceeding with the definitive management of the case.

## Definitive Treatment of Maxillofacial Fractures

### Principles of Treatment of Bony Injuries

The basic principles are **reduction, fixation and immobilization**. However, the injury to the surrounding tissues also should be taken in to consideration and the bony injuries should be taken as a part of the total wounding process. It should be remembered that bone healing is better where healthy tissues surround the injured bone, and “earlier the treatment, better the results”. Delay brings in greater risk of infection and slower healing. In compound fractures, closure of soft tissue wounds should be done as early as possible to facilitate coverage of the fracture and prevention of infection.

Face is an area which has an abundant blood supply. Hence a conservative approach is advisable, rather than a radical removal of bone fragments in comminuted fractures.

It is not necessary that teeth involved in the fracture line be removed immediately. Each case should be

considered individually and a decision taken on its merit. Many a time removal of teeth may result in displacement of fragments, converting a favorable fracture in to an unfavorable one.

The restoration of function and appearance is the most important aim in the treatment. The success of the treatment depends on the achievement of this aim with speed, simplicity and safety.

- Early treatment - Better result
- Healthy soft tissue covering - Better bone healing
- Face has abundant blood supply - Minimum débridement
- Teeth in fracture line ? - Wait !!

### Facial Lacerations

A patient with facial lacerations must receive treatment as quickly as possible, with the goal being to stabilize the patient’s condition. The patient should then receive appropriate X-ray examinations to rule out fractures. The lacerations most commonly treated by the dental surgical team occur in the facial and intraoral region. Proper local anesthesia must be provided during treatment of lacerations, and the clinician should consider the anatomy of the lacerated area when choosing an anesthetic. Block anesthesia may be used when possible, although most lacerations can be treated with infiltration. The anesthetic agent should be deposited around the wound edges and deep into the muscle layers, if needed. After good anesthesia is attained, the wound may be debrided.

The wound is carefully washed with normal saline solution and a mild soap. Some operators use povidone-iodine (Betadine) and hydrogen peroxide for irrigation, but these solutions occasionally burn and destroy tissue and therefore are not the best irrigation choices. Tissue tags and irregular wound edges are removed using a #15 blade or iridectomy scissors. Carefully search for foreign bodies in the wound, especially glass, gravel, paint chips, and tooth fragments.

Length and depth of lacerations and size of abrasion, contusion and hematoma should be recorded carefully for medicolegal purposes

## 20 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

Perform a layer-by-layer closure by identifying the deepest layer and closing it first. The mucoperiosteum should be closed with a resorbable suture such as 3-0 chromic catgut. The muscles and subcutaneous layers are closed with 3-0 plain; the clinician must be careful to align the layers properly. The skin is closed with 5-0 silk or 6-0 nylon. If the wound enters the oral cavity, the clinician should suture the mucous membranes with 3-0 or 4-0 silk. Silk is preferred to resorbable suture material in the mouth because it is easier to handle and less irritating to tissues and because it may be removed in 5 to 7 days. Certain authors prefer vicryl to catgut.

**Facial lacerations may damage important structures such as the parotid duct and the facial and trigeminal nerves.** If a **parotid duct transection** is suspected, the duct's integrity should be investigated, a lacrimal probe may be used to identify the structure. Branches of nerves, including the facial and trigeminal nerves, are small and nearly impossible to identify for repair without microsurgical technologies. Opinion of the appropriate specialist is sought, in case such injuries are suspected.

Facial lacerations that penetrate into the oral cavity should be treated as two separate wounds. Debridement and preparation of the wound is the same on the extraoral and intraoral surfaces. In multiple intraoral laceration, the intraoral wound is repaired before the extraoral portion. The intraoral wound should be watertight before the extraoral wound is closed. Wiring of teeth is performed preferably before any soft tissue treatment if time permits.

Other common soft tissue injuries include **hematomas and abrasions.** Hematomas should be evaluated and treated according to their sizes, locations, and rapidity of growth. If a hematoma is restricted to one area, treatment is conservative, consisting of the use of ice packs and analgesics. However, if the swelling progresses, exploratory surgery may be necessary to identify and ligate the damaged vasculature. Drainage of facial hematomas occasionally may be necessary if liquefaction or infection occurs. Drainage, or evacuation, of a hematoma requires follow-up antibiotic therapy. The **cephalosporins are the drug of choice.**

Abrasions are most often the last areas to receive care and may be the most difficult to treat. If they are allowed

### Technique of Wound Closure

1. Secure hemostasis
2. Remove foreign bodies
3. Excise dead tissues
4. Accurately appose tissues
5. Obliterate all dead space

**Approximate—Do not strangulate !!!**

to go untreated, abrasions may produce the most devastating cosmetic results for patients. Abrasions should be carefully washed and irrigated with normal saline solution under regional anesthesia. Examination under bright light may reveal fine embedded particles of dirt and debris, which must be removed to prevent permanent scarring. Dressings coated with antibiotic ointment and made from nonirritating materials (Sofratulle, Vasaline gauze) are appropriate for wound protection.

### Definitive Treatment of Fracture Mandible

The following are the commonly used methods of reduction and fixation of fracture mandible.

#### A. Closed reduction and indirect skeletal fixation:

1. Dental wiring: (direct, eyelet or ivyloop, continuous or multiple loop, Risdon's wiring).
2. Arch bars
3. Cap splints
4. Gunning type splints
5. Pin fixation

#### B. Open reduction and direct skeletal fixation:

1. Transosseous wiring or osteosynthesis
2. Bone plating
  - a. Mini plating
  - b. Compression plating
3. Use of lag screws
4. Bone staples
5. Bone clamps

### Definitive Management of Middle Third Fractures

As earlier mentioned, the middle third is comprised of a number of slender bony struts directed towards the base of skull. It is very rare to have a single bone fracture; as very often multiple bones are involved. The line of management in middle third fracture is basically the same

as in other fractures viz: reduction and fixation. Fixation in mandibular fractures can be attained by fixing the mandible to the maxilla, because the maxilla forms a stable structure. But in middle third fractures, it cannot be fixed to the mandible alone, for the mandible is a mobile structure capable of movement. If intermaxillary fixation alone is done, the mandible tends to pull the maxilla along and immobilization is not achieved. Thus, to obtain immobilization, the fractured maxilla has to be fixed to a stable base. Usually the cranium forms such a base.

The methods devised for a proper fixation of the fractured maxillary complex are divided into two:

- A. Extraoral immobilization
- B. Immobilization within the tissues
  - 1. Transosseous wiring
  - 2. Bone plate osteosynthesis
  - 3. Transfixation using Kirschner wire
  - 4. Internal wire suspension

#### *Duration of Treatment*

The duration of treatment varies depending on the site of fracture, condition of each case and treatment modality. As a general rule the maxillary mandibular fixation has to be kept in position for a period of 3 to 4 weeks in children and in adolescents. In adults the period of fixation is 5 to 6 weeks. In old patients and in infected cases the period of fixation has to increased for 7 to 10 days more.

Currently there is a progressive move towards direct internal fixation of fracture; thus avoiding maxillary mandibular fixation. This concept has undoubtedly revolutionarized the definitive management of maxillofacial trauma. Internal fixation is achieved by the use of wires, plates and/or screws made of titanium or stainless steel.

#### **Protocol for the Management of Faciomaxillary Injuries**

Once the patient's condition has been stabilized, the duty dental surgeon /oral and maxillofacial surgeon can direct his attention to diagnose and treat fractures of the facial bones. The dental practitioner should interrogate the

patient or the bystander regarding the nature and cause of the injury:

1. How and when did the trauma occur?
2. What was the nature of accident or with what type of instrument did it occur?
3. Whether there was loss of consciousness?

A quick evaluation of the patient gives the clue as to which of the facial bones are fractured. He then decides which X-ray films are needed to support the clinical diagnosis and may order routine facial bone X-ray films or more sophisticated CT scans. Routine X-rays for mandibular trauma include posteroanterior (P-A) films, Towne's projections, right and left lateral oblique films, and panoramic X-ray films of the mandible. Standard X-ray films ordered for suspected maxillary or midface trauma include Waters' projections, submentovertebral films, lateral view of maxilla and orbital views.

In certain cases these mandibular and maxillary films are sufficient to confirm the clinical diagnosis and reach a definitive treatment plan. The clinician must then decide whether to admit the patient and choose an open or closed reduction method of treating the fracture. If multiple fractures of the mandible have occurred along with massive swelling routine X-ray films are not sufficient to a proper diagnosis. CT scans have now become important aids in diagnosis and in treatment planning to obtain optimal results. Before the CT scan was available as a screening tool, the surgeon repaired facial soft tissue injuries without concern for hidden fractures. In modern practice, no midface trauma should be treated until a CT scan is obtained.

#### **MANAGEMENT OF HEAD INJURY**

Approximately 50 percent of all trauma deaths are associated with head injury, and more than 60 percent of vehicular trauma deaths are due to head injury. Because of the immense importance of head injury, the doctor who sees patients soon after injury, but is not an expert in the comprehensive management of head injuries must develop a practical knowledge of the initial care of these patients.

### Assessment of Head Injuries

#### History

To make the correct management decisions, it is helpful to know what kind of head injury can result from a certain kind of trauma. For example, simply knowing that the patient was injured in fall instead of a vehicular crash quadruples the patient's risk of having an intracranial hematoma. Alcoholism and other pre-existing conditions like diabetes, epilepsy, etc that may influence head injury assessment should be taken into account.

#### Initial Assessment

##### **Exclude cervical spine injury**

Initial assessment provides the baseline for sequential reassessment, which is the critical basis for subsequent decisions in management.

#### Assessment of Vital Signs

- In the presence of hypotension always look for other injuries like abdominal or thoracic injury. Although bleeding from scalp lacerations can cause hemorrhagic shock in small children, intracranial bleeding will not produce shock from blood loss alone.
- The combination of progressive hypertension associated with bradycardia and diminished respiratory rate is a specific response to an acute and potentially lethal rise in intracranial pressure. Such cases may require immediate neurosurgical intervention.

#### Mini-neurological Examination

A mini-neurological examination is directed towards determining the presence or severity of gross neurologic deficits, especially those that may require urgent surgical intervention. The examination assesses: (1) The level of consciousness (2) Pupillary function (3) Lateralized extremity weakness. Generally, a patient with abnormalities of all three components will have a mass lesion that may require surgery.

##### **MINI-NEUROLOGICAL EXAMINATION**

- Level of consciousness
- Pupillary reaction
- Lateralised extremity weakness

*Glasgow coma scale (GCS):* Provides a quantitative measure of the patient's level of consciousness. The GCS can be used to categorize patients:

- Severe head injury if GCS is 8 or less.
- Moderate injury if the score is 9 to 12.
- Minor injury if the score is 13-15.
- A decrease in the GCS of two or more in subsequent examinations clearly means the patient's condition has deteriorated. A decrease of three or more points is catastrophic.

#### **GLASGOW COMA SCALE**

<i>Eye opening</i>	<i>Motor response</i>	<i>Verbal response</i>	
Spontaneous	4 Obeys Commands	6 Oriented	5
To Call	3 Localises Pain	5 Confused	4
To Pain	2 Normal Withdrawal	4 Inappropriate	3
None	1 Abnormal Flexion Extension	3 Incomprehensible	2
	None	2 None	1
		1	

*Severe head injury:* Irrespective of the GCS, a patient is considered to have a severe head injury in the presence of the following findings:

- Unequal pupils.
- Unequal motor response.
- Open head injury with CSF leak or exposed brain tissue.
- Neurological deterioration.
- Depressed Fracture Skull.

It may be emphasized that the initial neurologic examination is only the beginning. The initial findings are only the reference with which to compare results of repeated neurologic examinations to determine whether a patient's condition is deteriorating or improving.

##### **All patients with head injury must have a chart**

#### Special Assessment

*Skull X-rays:* Skull X-rays are of little value in the early management of patients with obvious head injuries except in cases of penetrating injuries. The unconscious patient should have skull X-rays only if the care of the cardio-respiratory status system is assured.

*CT scan:* The CT Scan has revolutionized the diagnosis and management of head injury and is the diagnostic

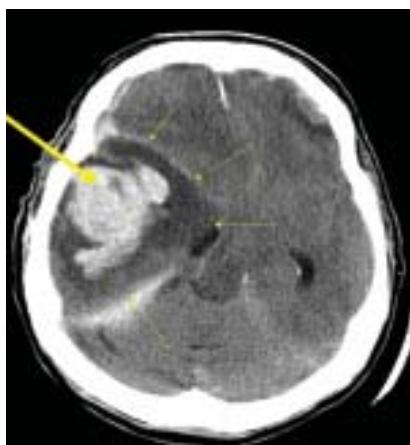
procedure of choice for patients who have serious head injury. It should be remembered that CT Scan should be done only after the initial resuscitation is completed and adequate resuscitation should be maintained during the scan (Figs 3.23 to 3.26).



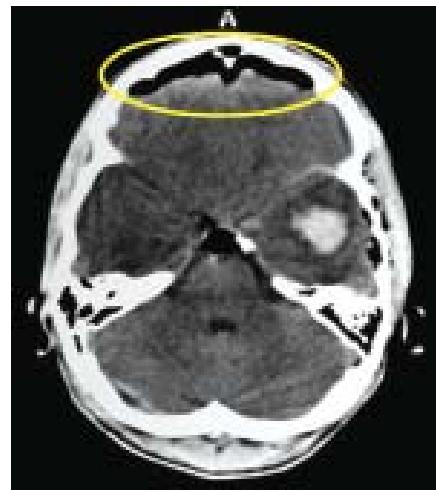
**FIGURE 3.23:** CT scan showing extra dural hematoma



**FIGURE 3.24:** CT scan showing subdural hematoma with shift in midline



**FIGURE 3.25:** CT scan showing intraparenchymal hemorrhage



**FIGURE 3.26:** CT scan showing air in cranial cavity

### Emergency Management of Head Injury

1. The initial management principle of any trauma case applies to head injured patients also. This included Airway Management, Maintenance of Breathing and Circulation. **Keeping airway patent should be the first priority in the management of head injury** (Fig. 3.27).

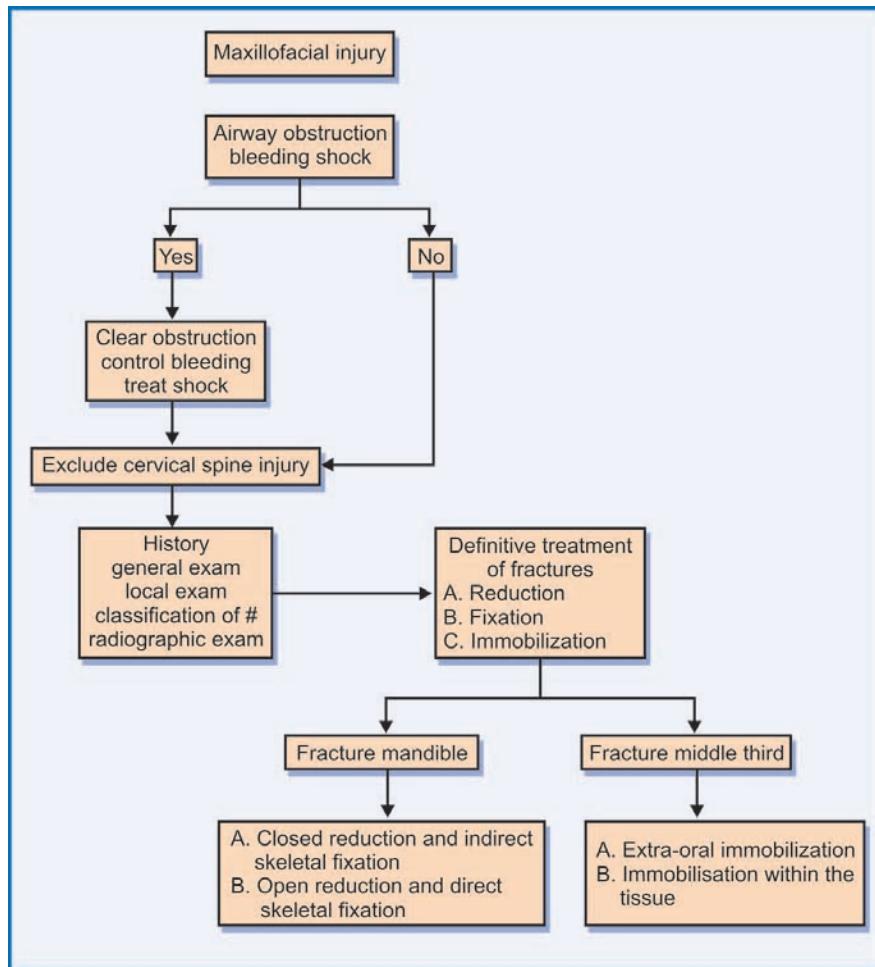
**A tracheal tube may save the patient's life**

2. After assessing the vital signs **if the patient is hypotensive, look for other injuries** and the neurological assessment and investigations need be done only after stabilizing the hemodynamic status of the patient.

**If a patient with head injury is shocked look for other injuries**

3. It is better to avoid giving hyposmolar solutions like glucose drip to patients with head injury. The recommended fluid is **Ringer lactate or Normal Saline**.
4. Head Injury is often associated with **cervical injury** also and a cervical collar may be advised.

**Examination of a head injury patient is never complete without proper examination of the neck**



**FIGURE 3.27:** Flow chart for the management of maxillofacial injuries

5. Perform the **mini-neurological examination** and arrive at a working diagnosis. It is important to decide whether the patient requires a neurosurgical intervention. The diagnostic triage system given below can be used for arriving at a work plan for management. Those cases that require neurosurgical care should be referred to the nearest neurosurgical center.
6. **Scalp injuries** are seen in most of the head injuries. The first priority in management of scalp wound should be locating and stopping the bleeding. Simple scalp suturing with irrigation with copious amount of saline should be done before reference.
7. In cases of **raised intracranial tension** where surgical intervention is not needed or deferred, patients can be put on **Intravenous Mannitol**. The

suggested dosage is 150 mL of 20 percent solution every 4-6 th hourly through a large gauge needle (either 18 or 16) and the fluid should run in 10-15 minutes. Small needles, and scalp vein sets should not be used for mannitol administration. **Frusemide** at doses of 40 to 80 mg can also be given for management of brain edema. Latter this can be replaced with Oral Glycerine 15-30 mL eighth hourly.

8. **Seizures** can occur with any type of head injury. In most of the cases seizures are well controlled with Phenytoin (Dilantin), 100 mg Intravenously repeated every eighty hourly.

In prolonged or repetitive seizures 10 mg. of diazepam should be given intravenously and repeated if required. Phenytoin 1g intravenous at

- the rate of 50 mg/minute should be started immediately. If the seizure still uncontrolled it is, better to give general anesthesia and ventilate the patient.
9. **Restlessness** frequently accompanies head trauma. Its development in a previously quite patient may be first sign of a developing intracranial mass lesion. Another major cause is cerebral hypoxemia and airway maintenance is important in such cases. Systemic hypoxia, pain from injuries, a distended bladder, painful bandages, etc. can also cause restlessness. If the cause of the restlessness is handled, Chlorpromazine 10 to 25 mg can be given intravenously.
10. **Hyperthermia** is disastrous to a patient with brain injury. This will increase the brain metabolism and brain edema. Temperature should always be kept below 90° F. Simple antipyretic like Paracetamol, tepid sponging, and when available hypothermia blanket can be used. Chlorpromazine is also can be given in doses of 10 to 25 mg.
11. **Antibiotics** are indicated in presence of basal skull fracture, compound vault fracture and suspected or proven meningitis.
12. **Pain** is controlled with simple analgesics like Paracetamol. For fear of respiratory depression and change in the level of consciousness, opiates are better avoided.
13. Head Injury patient often suffer from **gastro-intestinal bleeding**. All cases of moderate to severe head injury should be put on antacids preferably H<sub>2</sub> antagonists, Ranitidine 50 mg eighth hourly.

#### IMMEDIATE MANAGEMENT OF ACUTE HEAD INJURY

- *Airway with Cervical Spine Control:* Keep airway patent with endotracheal intubation and keep a cervical collar if cervical fracture is suspected
- *Breathing:* Assisted breathing if necessary with ambubag/ventilator.
- *Circulation:* If mean arterial blood pressure is, <80 mm Hg infuse with **Ringer lactate solution**.
- *Dysfunction of Central Nervous System:* Check score on Coma Scale, Pupils, and Limb Movements.

# 4

# The Medically Compromised Patient

**K George Varghese**

Advances in modern medicine have resulted in the improved survival of people with significant medical conditions. As a result people are living longer and receiving treatment for disorders that were fatal a few years ago. For example, damaged heart valves are surgically replaced, occluded coronary are surgically bypassed, or opened by balloons, organs are transplanted, severe hypertension is medically controlled and many types of malignancies and immune deficiencies are managed or controlled. These patients have a relatively higher risk of developing complications from dental procedures. Hence it is imperative that the dental surgeon be competent to recognize and manage such cases in the safest possible manner. Apart from the fate of the patient, neglect of the medical history can result in unpleasant medicolegal problems.

There are three basic aspects regarding the dental management of medically compromised patient. The first is to detect such patients. This is a difficult task, especially when there are no significant symptoms or if the patient is uneducated and have no idea about the disease and the drug therapy. However, this does not preclude the responsibility of the dental surgeon in the event any complications occur. Secondly, if the patient is found to have a systemic disease it is essential to determine the implications of the disease or its treatment on the dental management. Finally, to formulate a protocol of management for the particular patient after necessary investigations and consultation with the physician.

## **THE MEDICAL HISTORY**

In an ordinary dental surgery setting, it is unlikely that the dental surgeon will undertake a full medical examination of the patient prior to any surgical procedures. Instead the operator must rely on a proper medical history that will help to identify those patients with medical conditions that will require precautionary measures. A written questionnaire will help as a screening measure to recognize such patients (Table 4.1). Alternatively, if the patient is not literate the dental surgeon or the assistant can do thorough interrogation and the matter entered in the case record. The basic example is as follows:

## **SIGNIFICANCE OF MEDICAL EVALUATION**

A proper medical history enables the operator to take the necessary precautions that will ensure patient's safety during the dental surgical procedures. These may be either one or a combination of the following precautions:

1. Additional investigations—clotting screen for those with history of bleeding.
2. Alteration of patient's current medication to facilitate surgery. For example, stopping warfarin preoperatively. Such measures must only be taken in consultation with the patient's physician.
3. Administration of preoperative medication:  
(a) antibiotic cover, (b) steroid cover, (c) oral sedation



## 28 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

### MEDICAL CONDITIONS OF SIGNIFICANCE IN DENTAL PRACTICE

The following are the common medical conditions that have significant impact in the management of dental patients:

1. Cardiovascular diseases
  - a. Hypertension
  - b. Infective endocarditis
  - c. Ischemic heart disease
  - d. Thromboembolic disorders (patients on anti-coagulants)
2. Endocrine diseases
  - a. Diabetes mellitus
  - b. Hyperthyroidism
  - c. Adrenal insufficiency
3. Bleeding disorders
4. Respiratory diseases
  - a. Bronchial asthma
  - b. Chronic obstructive pulmonary disease(COPD)
5. Liver disease
  - a. Chronic alcoholism and Liver cirrhosis
  - b. Viral hepatitis
6. Pregnancy
7. AIDS and HIV infection
8. Prosthetic joint replacements
9. Neurological Disorders
  - a. Epilepsy
  - b. Stroke
  - c. Parkinson's disease
10. Patients with organ transplantation
11. Chronic renal failure

### CARDIOVASCULAR DISEASES

Patients with various cardiovascular diseases are especially vulnerable to physical or emotional challenges that may be encountered during dental treatment. Hence the following **general stress management protocol** should be followed:

- Open communication about patient's fears and concerns
- Establish honest, supportive relationship with patient
- Short appointments
- Morning appointments

- Preoperative vital signs
- Preoperative sedation- Short acting benzodiazepine (e.g. triazolam 0.125-0.25 mg) night before and 1 hour before the procedure
- Intraoperative sedation -  $N_2O_2 / O_2$  if facilities are available
- Profound local anesthesia; topical used prior to injection
- Adequate postoperative pain control
- Patient contacted evening of the procedure

#### Hypertension

Hypertension is a persistently raised blood pressure resulting from increased peripheral vascular resistance. In adults a sustained diastolic blood pressure of 90 mm Hg or greater and a sustained systolic blood pressure of 140 mm Hg or greater are abnormal. Dental management can be complicated since any procedure causing stress can further increase blood pressure and can precipitate acute complications such as cardiac arrest, or cerebro-vascular accident. Chronic complications of hypertension such as impaired renal function can affect dental management.

Management of hypertension can be broadly classified into two categories:

1. Nondrug measures: This include weight reduction, decrease in salt intake, stopping smoking, stress reduction and stopping oral contraceptives.
2. Medication: Once commenced, drug therapy is continued for life. The following broad categories of medication may be used, sometimes in combination depending on patient's response:
  - a. Diuretics—for fluid overload, e.g. chlorothiazide
  - b. Beta-blockers—to dampen the sympathetic input that increases the activity of the heart, e.g. propranolol (Inderal)
  - c. Vasodilators—to decrease peripheral vascular resistance, e.g. hydralazine.
  - d. Centrally acting—drugs that compete with neurotransmitter chemicals of sympathetic nervous system responsible for increased heart activity, thereby sympathetic mediated increased heart activity, e.g. methyl dopa (Aldomet)

***Precautions to be Taken in Hypertensive Patients***

1. Minimize stress levels- **general stress management protocol** should be followed
  2. Avoid adrenalin containing local anesthetic solutions since adrenalin is a cardiac stimulant, resulting in an untoward increase in blood pressure or development of an arrhythmia. However this may have little bearing on well controlled hypertensive patients. Although adrenalin increases systolic pressure, the mean arterial pressure remains virtually unaffected because the diastolic pressure is concomitantly reduced.
- Recent studies have shown that use of 1 to 2 cartridges (1.8 ml-3.6 ml) of 2 percent lignocaine containing 1: 100,000 adrenalin can be safely used in most patients with hypertension or other cardiovascular diseases. This amounts to 0.036 mg of adrenalin.
3. Safer to perform procedures under local anesthesia whenever possible since general anesthesia may evoke wild fluctuations in blood pressure that can be dangerous. When general anesthesia is planned inform the anesthetist, who may request further investigations.
  4. Provide gradual changes of position to prevent postural hypotension
  5. Avoid stimulating gag reflex.
  6. Dismiss the patient if stress appears excessive.
  7. Primary and reactive hemorrhage from the surgical site can be a problem where there is uncontrolled hypertension.

**Infective Endocarditis**

Infective endocarditis (IE) is caused by microbial infection of heart valves or endocardium and are most often related to congenital or acquired cardiac defects. A similar disease, infective endarteritis (IEA) involves a patent ductus arteriosus, coarctation of the aorta, surgical grafts of major vessels, and surgical arteriovenous shunts. Bacteria most often cause these diseases. However, in recent years, researchers have identified fungi and other microorganisms as the cause.

The following conditions predispose to the development of endocarditis:

1. Congenital heart lesions.

2. Acquired heart lesions e.g. rheumatic fever.
3. Turbulent blood flow, e.g. resulting from prosthetic heart valve.

Antibiotic prophylaxis is recommended for all dental procedures that are likely to cause bleeding. Prophylaxis is designed against alpha-hemolytic streptococci. These organisms are by far the most common ones found in transient dental bacteremia. Heart conditions requiring antibiotic prophylaxis can be divided into two groups (American Heart Association recommendation 1997—Table 4.2).

- a. *High-risk conditions*
  - Prosthetic heart valves
  - History of endocarditis
  - Complex cyanotic congenital heart disease (tetralogy of Fallot)
  - Surgically constructed systemic –pulmonary shunts.
- b. *Moderate risk conditions*
  - Acquired valvular dysfunction (e.g. rheumatic heart disease)
  - Surgically repaired valves
  - Most congenital heart conditions
  - Hypertrophic cardiomyopathy
  - Mitral valve prolapse with valvular regurgitation
  - Surgical repair within 6 months.

*Low-risk conditions (antibiotic prophylaxis is of questionable value and hence not recommended)*

- Atrial septal defect
- Ventricular septal defect
- Patent ductus arteriosus
- Cardiac pacemakers and implanted defibrillators
- Previous coronary artery bypass graft surgery
- Mitral valve prolapse without valvular regurgitation
- Previous rheumatic fever without valvular dysfunction.

The recommendations of American Heart Association (1997) for standard prophylactic regimen for dental procedures is given in Table 4.3.

***Additional Guidelines***

1. For high risk cases certain authors advice to add to the standard regimen Gentamicin 2 mg/kg IV /IM 30 mts. before surgery.
2. Chlorhexidine 0.2% or 1% povidone- iodine mouth rinse prior to oral surgical procedure is desirable.

## 30 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

**Table 4.2:** Recommendation of American Heart Association (1997) for antibiotic prophylaxis for dental procedures

<i>Endocarditis prophylaxis recommended</i>	<i>Endocarditis prophylaxis not recommended</i>
<ul style="list-style-type: none"> <li>Dental extractions</li> <li>Periodontal surgery, scaling, root planning, probing</li> <li>Placement of dental implants</li> <li>Reimplantation of avulsed teeth</li> <li>Endodontic instruments or surgery beyond apex of teeth</li> <li>Intraligamentary local anesthetic injections</li> <li>Initial placement of orthodontic bands</li> <li>Subgingival placement of fibers/strips</li> </ul>	<ul style="list-style-type: none"> <li>Restorative dentistry (operative and prosthodontic)</li> <li>Local anesthetic injection</li> <li>Intracanal endodontic treatment, postplacement, and crown buildup</li> <li>Placement of rubber dams</li> <li>Postoperative suture removal</li> <li>Taking oral impressions</li> <li>Shedding of primary teeth</li> <li>Placement of removable prostheses and orthodontic appliances</li> </ul>

**Table 4.3:** Recommendations of American Heart Association (1997) for standard prophylactic regimen for dental procedures

<i>Not allergic to Penicillin</i>	<i>Allergic to Penicillin</i>
<p><i>Oral</i>  <i>Adults</i>—Amoxicillin 2 gm orally, 1 hr before surgery  <i>Children</i>—Amoxicillin 50 mg/kg orally, 1 hr before surgery</p> <p><i>Parenteral</i>  <i>Adults</i>—Ampicillin 2 gm. IV or IM 30 mts. before surgery  <i>Children</i>—Ampicillin 50 mg./kg. IV or IM 30 mts before</p>	<p><i>Oral</i>  <i>Adults</i>—Clindamycin 600 mg 1 hr before surgery  <i>Children</i>—Clindamycin 10 mg / kg 1 hour before surgery, followed by half dose 6 hrs later</p> <p><i>Parenteral</i>  <i>Adults</i>—Clindamycin 600 mg / kg. IV 30 mts before surgery  <i>Children</i>—Clindamycin 10 mg / kg. 30 mts before surgery</p> <p><b>Alternative regimen</b></p> <p><i>Oral</i>  <i>Adults</i>—Cephalexin or Cephadroxil 2 gm 1 hr before  <i>Children</i>—Cephalexin or Cephadroxil 50 mg / kg 1 hr before  <i>Adults</i>—Azithromycin or Clarithromycin 500 mg orally 1 hr before surgery</p>

- Patient compliance is best for oral regimes and worst for parenteral regimes.
- Avoid intramuscular injections for patients on anticoagulants.
- In cases of repeated prophylaxis, the lapse of 9 days or longer between coverage periods is adequate to prevent problem of resistant bacteria that could have developed as a result of the preceding prophylaxis. If concerned about the presence of resistant bacteria (for coverage within 9 days) clindamycin may be used instead of amoxicillin.
- The dental surgeon should plan to do as much treatment as possible during each coverage period (the time a patient is taking antibiotics) so that the patient's dental treatment will not spread over too long

a time and thus the number of necessary coverage periods can be kept to a minimum.

- Rarely a situation can arise when both the dental surgeon and the patient realizes after the dental procedure that antibiotic prophylaxis has not taken. Although this situation should be avoided, the American Heart Association recommends that antibiotics be administered within 2 hours of the procedure.

### Ischemic Heart Disease

This results from insufficient blood flow through the coronary arteries that supply the nutrients and oxygen essential for myocardial function. Ischemic heart disease has two principal clinical manifestations:

1. Angina pectoris—Characterized by chest pain particularly on exertion, that is relieved by rest and nitroglycerine medication.
2. Myocardial infarction—Persistent and severe chest pain lasting longer than 30 minutes, which is not relieved by rest or nitroglycerine.

*Dental Management Consideration for Patients with Angina Pectoris or History of Myocardial Infarction*

1. Stress reduction protocol.
2. Comfortable chair position.
3. Pretreatment vital signs.
4. Nitroglycerine readily available.
5. Limited use of vasoconstrictor (maximum 0.036 mg adrenalin i.e. 4 ml of 2 percent lignicaine with 100,000 adrenalin) applicable if the patient is taking a nonselective betablocker like atenolol. Always bear in mind that adrenalin is a cardiac stimulant that can precipitate angina.
6. Avoid adrenalin impregnated gingival retraction cord.
7. Avoid anticholinergics (e.g. atropine and scopolamine)
8. If coronary artery stent is in place and if it is more than 24 weeks after placement, antibiotic prophylaxis is not necessary.
9. It is safe to perform procedures under local anesthesia and sedation whenever possible since GA may evoke wild fluctuations in cardiac rhythm that can be dangerous for the patient with ischemic heart disease.
10. Avoid dental extractions (especially under GA), for patients who had a myocardial infarction or coronary bypass graft within 6 months
11. Some patients may be on low dose aspirin, which will cause persistent bleeding from an extraction wound. In consultation with patient's physician it may be stopped 4 to 5 days prior to surgery. If not stopped strict attention to local hemostasis is essential to control bleeding.
12. Dental surgeon and ancillary staff be familiar with CPR (Cardiopulmonary resuscitation)

*Dental Management Consideration for Patients with Unstable Angina Pectoris or Recent Myocardial Infarction*

Patients who had myocardial infarction have some degree of residual damage to the heart. The condition depends on the extent and location of the damage and its effect on the function on the heart. Damage may be minimal, with little effect on the patient's daily activity or may be extensive, resulting in cardiac instability and inability of the heart to function properly (e.g. heart failure). When the patient had myocardial infarction; for several days after the incident the risk for cardiac instability, arrhythmias, and reinfarction may be increased. These effects decrease with time, assuming the electric conduction system of the heart has not been seriously damaged. The following precautions to be taken for patients with unstable angina pectoris or recent myocardial infarction:

1. Avoid elective procedures.
2. Consult with physician.
3. If treatment is necessary, perform minimal treatment aimed at pain reduction and control of infection.
4. Antiplatelet drugs or anticoagulants may be continued/ stopped when necessary after consultation with the physician.
5. Prophylactic nitroglycerine to be considered.
6. Placement of I/V line.
7. ECG monitoring.
8. Connect pulse oximeter.

**Thromboembolic Disorders (Patients on Anticoagulants)**

These are disorders of circulation where there is an abnormal propensity for the formation of blood clots (thrombi), which move freely in the circulation as emboli and lodge at distant sites causing ischemic damage to tissues supplied by the blocked vessel.

The following disorders predispose to thromboembolism:

1. Atrial fibrillation
2. Postmyocardial infarction
3. Varicose veins in lower extremities- deep vein thrombosis

## 32 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

4. Carotid endarteritis.
5. Infective endocarditis—heart valve disease.

Patients on oral anticoagulants will have persistent bleeding after surgical procedures or dental extraction. When dental extraction is planned, the dental surgeon must contact the patients physician to discuss the possibility of stopping or modifying the therapy prior to the surgery. The following are the most common situations:

1. Patients on aspirin—Aspirin through its antiplatelet action prevents the aggregation of platelets. It affects platelet function for the life of the platelet, so it should be stopped 7 to 10 days prior to the planned extraction and restarted 24 hours postoperatively.

Certain authors advice against stopping aspirin and advocate local measures to control bleeding.

2. Patients on warfarin (coumarin) therapy—Warfarin should be stopped at least three days prior to planned surgery and recommenced on the day of extraction since it takes about two days for effective anticoagulant activity to be restored. An international normalizing ratio (INR) test on the day of surgery is useful in deciding whether clotting activity has returned to near normal to safely carry out the extraction. Ideally, the value should be less than two, although very minor procedures such as a single tooth extraction may be performed with value up to 2.5.

3. Patients too unstable to cease anticoagulant therapy—e.g. patients who had undergone prosthetic valve replacements require life time anticoagulant therapy.

These patients are best treated in hospital where they are placed on IV heparin once warfarin is stopped. After stopping warfarin, heparin is administered in the dose of 10,000 IU subcutaneously twice daily for two days. On the third day, the morning dose of heparin is skipped and the INR value estimated. If the INR value is 1.5 to 2 times the normal, dental extraction is performed as atraumatically as possible. Heparin is recommended 6 to 8 hours after surgery if there is no bleeding and continued for 2 days until warfarin which is also recommended on the day of surgery, becomes effective once again before the patient discharged. (Each hospital may have their own protocol regarding the dose of heparin e.g. 8,000 IU given

subcutaneously thrice daily). Control of bleeding using local measures like pressure packs, gelform, thrombin, oxycel, surgical, microfibrillar collagen have also been advocated to promote hemostasis.

Postoperative topical mouthwashes consisting of tranexamic acid, an antifibrinolytic, have proven a useful alternative to ceasing warfarin and may be used for simple extractions.

The dental surgeon must be aware that the certain drugs will affect the action of warfarin (Table 4.4):

**Table 4.4: Drug interactions with warfarin**

<i>Drugs that potentiate the action of warfarin</i>	<i>Drugs that antagonize the action of warfarin</i>
1. Acetaminophen	1. Barbiturates
2. Metronidazole	2. Steroids
3. Salicylates	3. Naftillin
4. Broad-spectrum antibiotics	4. Others—carbamazepine, rifampin, griseofulvin, cholestyramine
5. Erythromycin	
6. COX-2 inhibitors e.g. Rofecoxib	
7. Others—Cimetidine, chloral hydrate, phenytoin, propranolol, and thyroid drugs	

Postoperative pain control can be obtained by using minimal dosage of acetaminophen with or without codeine. Aspirin and NSAID'S must be avoided.

4. Patients on Heparin therapy—Patients receiving hemodialysis are treated with heparin. The half life of heparin is only 1 to 2 hours, thus by waiting until the day after dialysis these patients can receive invasive dental treatment.
5. The dental surgeon may also see patients being treated on an outpatient basis with low molecular weight heparin(LMWH). These would include patients with recent total hip or knee replacement, deep vein thrombosis, or asymptomatic pulmonary embolism. No clear guidelines are available for managing these patients for invasive dental procedures. Elective surgical procedures can be delayed until the patient is off the LMWH, which in most cases will be in 3 to

6 months. If an invasive procedure must be performed, the dental surgeon has several options. First, the dental surgeon should consult with the patient's physician regarding the need for and type of surgery. The half life of LMWH is much less than a day. The physician could suggest that the drug be stopped and the surgery be performed within 1 or 2 days. The other option is to go ahead with the surgery and deal any bleeding complication on a local basis.

## **ENDOCRINE DISEASES**

### **Diabetes Mellitus**

Diabetes Mellitus is a disease complex with metabolic and vascular components. This chronic disease is characterized by hyperglycemia and complications that include microvascular disease of the kidney and eye and a variety of other neuropathies. The metabolic component involves the elevation of blood glucose associated with alterations in lipid protein metabolism, resulting from a relative or absolute lack of insulin. The vascular component includes an accelerated onset of nonspecific atherosclerosis and a more specific microangiopathy that particularly affects the eyes and kidneys.

#### *Classification of Diabetes Mellitus (American Diabetic Association 1997)*

1. Type I—Diabetes with absolute insulin deficiency (Beta-cell destruction or defect in beta-cell function).
2. Type II—Insulin resistance with insulin secretory defect.
3. Other specific types like- Genetic defects of beta-cell function, pancreatic disease, drug or chemical-induced diabetes, impaired glucose tolerance, and gestational diabetes.

The following questions should be asked to establish the nature, the degree of control and the severity of disease:

1. When were you first diagnosed as a diabetic?
2. Are you being treated by a physician? When did you visit your physician last?
3. Are you on diet control or drugs?
4. What medication are you taking—insulin or oral hypoglycemic drugs? Dose?
5. What is the usual level of blood glucose?

**Table 4.5: Treatment of diabetes**

Type I Diabetes	Type II Diabetes
Diet and physical activity	Diet and physical activity
Insulin	Oral hypoglycemic agents
1. Conventional	Insulin plus oral
2. Multiple Injection	Hypoglycemic agents
3. Continuous infusion	Insulin
4. Pancreatic transplantation	

6. What was the level of blood glucose at the time of last measurement?
7. Do you test your urine/blood for glucose?
8. Are you suffering from any complication associated with diabetes?

Table 4.5 shows the summary of treatment of diabetes.

#### *Dental Management*

Diabetic patients who is receiving good medical management and is under good glycemic control without serious complication such as renal disease, hypertension or coronary heart disease can receive any indicated dental treatment. However, studies have indicated that many dental patients with diabetes are not under good glycemic control and elevated fasting blood glucose level render dental patients more susceptible to complications.

1. In noninsulin dependent patient all procedures can be performed without special precautions, unless complications of diabetes is present.
2. Avoid extractions or surgical procedures in uncontrolled or poorly controlled diabetes since wound healing is usually significantly delayed and the risk of postoperative infection is very high.

The risk of infection in patients with diabetes is directly related to their fasting blood glucose levels.<sup>1</sup> If the fasting blood glucose level is below 206 mg/100 ml, no increased risk is present. However, if the fasting blood glucose level is between 207 and 229 mg/100 ml, the risk increased by 20 percent. Additionally, if the fasting blood glucose level rose above 230 mg/100 ml, an 80 percent increase in the risk of infection is observed. Therefore dental surgeon must be aware of the level of glycemic control in patients undergoing complex oral surgical

## **34 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY**

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procedures because of their increased risk of infection. Judicious monitoring and appropriate use of antibiotics must be considered in the management of these patients. In cases where the fasting blood glucose level is greater than 200 mg/100 ml, it is best to defer elective treatment and refer the patient to a physician.

3. A major goal in the dental management of patients with diabetes who is being treated with insulin is to prevent insulin shock occurring during dental appointment. Ensure that the dental procedure does not interfere with the patient's dietary intake and the patient takes their regular dose of insulin or hypoglycemic medication.
4. Morning appointments are usually best.
5. When the planned surgery is likely to be associated with swelling and trismus, the patient should be advised to take semisolid and liquid diet. If the surgery is expected to significantly hinder food intake, then the patient is best managed in a hospital environment.
6. Be prepared for hypoglycemic attack at all times; so have glucose readily available.
7. Antibiotic prophylaxis can be considered for patients with brittle diabetes (i.e. difficult to control, requires high dose of insulin) and who also have chronic states of oral infection.
8. When acute oral infection is present, patients receiving insulin usually require additional insulin which should be prescribed by their physician. While noninsulin-controlled patients may need more aggressive medical management of their diabetes, which may include insulin during this period. Oral infection must be treated with incision and drainage, antibiotic and extraction. Attention must be paid to the patients fluid and electrolyte balance and dietary needs.
9. Adrenalin antagonizes the effects of insulin. So theoretically it might be best to avoid using adrenalin containing local anesthetic solutions. However, in clinical practice this precaution may be unnecessary considering the minute dose used.

### **Hyperthyroidism (thyrotoxicosis)**

Hyperthyroidism consists of persistently high levels of thyroid hormone T<sub>4</sub> and T<sub>3</sub> resulting clinical features

characteristic of thyrotoxicosis. This may be caused by Grave's disease (toxic goiter), ectopic thyroid tissue, multinodular goiter, thyroid adenoma or subacute thyroiditis. Compared to others Grave's disease forms the major cause for hyperthyroidism. This disorder is much more common in women (7:1) and may manifest itself at puberty, pregnancy or menopause.

The main clinical features of thyrotoxicosis are:

- a. Weight loss with increased appetite and frequent defecation.
- b. Dislike of hot weather.
- c. Irritability, sweating, itching, and fine tremor.
- d. Exophthalmos—ophthalmoplegia with lag of eyelid.
- e. Tachycardia with atrial fibrillation.
- f. Edema—in the periorbital region.

The following points to be observed when planning surgery on patients with thyrotoxicosis:

1. A thyroid crisis may be precipitated by infection or surgery. So, consult the physician and take the necessary precautions.
2. If a thyroid crisis occurs, the dental surgeon should be able to recognize what is happening, begin emergency treatment, and seek immediate medical assistance. The following initial therapy instituted:
  - a. Patient cooled with cold towels and ice packs
  - b. I/V Hydrocortisone (100 to 300 mg)
  - c. I/V infusion of hypertonic glucose
  - d. Vital signs monitored
  - e. CPR initiated if necessary
3. When using local anesthetics containing adrenalin there is a theoretical risk of development of cardiac dysrhythmias.
4. Minimize anxiety and hyperexcitability of the patient using sedation.
5. Avoid general anesthetics since it may precipitate cardiac arrhythmias.
6. Patients with atrial fibrillation may be on oral anticoagulants, which needs to be addressed prior to surgery.

### **Hypothyroidism**

Hypothyroidism causes cretinism in children and myxedema in adults. It is characterized by:

- a. Dull expression
- b. Puffy eye lids
- c. Alopecia of the outer third of the eyebrow
- d. Dry rough skin
- e. Dry, brittle and coarse hair
- f. Slowing of physical and mental activity
- g. Increased size of tongue

In general patients with mild symptoms of untreated hypothyroidism is not in danger when receiving dental treatment. CNS depressants, sedatives, or narcotic analgesics may cause an exaggerated response in patients with mild to severe hypothyroidism. These drugs must be avoided in all patients with severe hypothyroidism and used with care in patients with mild hypothyroidism. Rarely a myxedematous coma may be precipitated by CNS depressants, surgical procedure and infections. Myxedematous coma is managed by:

- a. Seeking medical aid
- b. I/V hydrocortisone (100 to 300 mg)
- c. Artificial respiration

Patients under good medical treatment present no special problems in terms of dental management.

### **Adrenal Insufficiency**

The adrenal gland secretes cortisol and a variety of other important hormones. Adrenal insufficiency may result from disease or drugs leading to inability of the individual to respond to stress. Evidence indicates that the vast majority of patients with adrenal insufficiency can receive routine dental treatment without the need for supplemental glucocorticoids. Individuals at risk for adrenal crisis are those who undergo stressful surgical procedures and have extremely low adrenal function.

While planning dental management of patients with possible adrenal insufficiency the following categories of patients have to be considered and the management modified accordingly:

- a. Patients with past history of systemic corticosteroid use
- b. Patients currently using systemic corticosteroid
- c. Patients not taking systemic corticosteroid, but may have adrenal insufficiency.

To identify who needs supplementation for moderate to severe surgical procedures, the ACTH stimulation test

can be performed. A low biochemical test result demonstrating inadequate adrenal cortical function indicates that supplemental steroids should be provided at a level sufficient for stress response. *However, this test does not necessarily reflect how the patient will react clinically or whether an adverse reaction will occur.* Four factors appear to contribute to risk of adrenal crisis during surgery. They are: (a) the severity of surgery, (b) drugs administered, (c) overall health of the patient, (d) amount of pain control.

### **Dental Management**

1. Medical history and evaluate patient.
2. Determine type, dose and duration of systemic corticosteroid used.
3. Identify signs and symptoms of possible adrenal insufficiency.
4. For diagnostic and minimally invasive procedures, have patient take the usual daily dose of steroid in the morning and then perform the procedure shortly after. For example, an asthmatic patient who takes 5 mg of prednisone every other day should receive 5 mg of prednisone preoperatively.
5. Surgery scheduled in the morning when cortisol levels are highest.
6. Implement stress reduction measures as anxiety increases the demand for cortisol. Use of nitrous oxide-oxygen or benzodiazepine IV sedation is helpful since plasma cortisol levels are not reduced by these agents.
7. Record BP during the procedure at 5 minutes intervals and before the patient leaves the office.
8. For major invasive oral procedure, consult with physician regarding status and stability. Implement the following **steroid supplementation protocol**:
  - Discontinue drugs that decrease cortisol levels (e.g. ketokenazole) at least 24 hrs before surgery with the consent of the patient's physician.
  - Perform procedure in hospital setting.
  - Have patient take the morning dose and provide supplemental hydrocortisone pre- and intraoperatively to achieve 100 mg within first hour of surgery. Hydrocortisone 25 mg (equivalent to 6 mg prednisone) every 8 hours subsequent to surgery for 24 to 48 hours.

## 36 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

- Provide adequate operative and post-operative analgesia. Consider using long acting local anesthetic (e.g. bupivacaine) at the end of the procedure.
- Use barbiturates with caution and knowledge of the potential for adverse effect on plasma cortisol levels.
- Patients who take anticoagulants are also at a greater risk of postsurgical bleeding and hypotension
- Monitor BP and blood loss during the procedure. If BP falls below 100 mmHg, and the patient is unresponsive to fluid replacement and vasopressive measures, administer supplemental steroids.
- Communicate with the patient at the end of appointment and within 4 hrs post-operatively to determine whether features of weak pulse, hypotension, dysnea, myalgia, arthralgia and fever are present.
- Immediate treatment of adrenal crisis consists of administration of 100 mg of hydrocortisone or 4 mg of dexamethasone IV and immediate transportation to a hospital.

Factors that can complicate the post-operative course and exacerbate adrenal insufficiency include liver dysfunction, sepsis and certain drugs-like ketokenazole, aminoglutethimide, etomidate, phenytoin, barbiturates and rifampicin.

While treating patients with long term steroid therapy the following factors also should be considered:

- a. Risk of peptic ulcer disease. Hence drugs like aspirin and NSAID's to be avoided
- b. Possibility for osteoporosis and periodontal bone destruction

### BLEEDING DISORDERS

Normal hemostasis involves blood vessels, platelets and coagulation pathways. Disease, drugs or deficiency affecting any one of the three mechanisms involved in hemostasis will result in persistent bleeding following surgery that could be life threatening for the patient. Inherited bleeding disorders are genetically transmitted. Acquired bleeding disorders occur secondary to disease affecting vascular wall integrity, platelets, coagulation factors, drugs, radiation, or chemotherapy for cancer.

Evaluation of a patient with suspected bleeding disorder include—history taking and investigations:

1. **History taking**—Attention should be focused on the following aspect of patient's medical history:
  - a. Family history of bleeding problems
  - b. Excessive bleeding following surgical procedures or dental extraction
  - c. Prolonged or persistent bleeding following minor trauma
  - d. Occurrence of spontaneous bleeding
  - e. Medication, e.g. warfarin, aspirin
  - f. Chronic liver, kidney or bowel disease-vitamin K deficiency
  - g. Chronic alcoholism

**Table 4.6: Causes of bleeding disorders**

A. Vascular defects	B. Platelet disorders	C. Coagulation defects
<ol style="list-style-type: none"><li>1. Corticosteroid treatment</li><li>2. Henoch- Schonlein purpura</li><li>3. Ehlers-Danlos syndrome</li><li>4. Hereditary hemorrhagic telangiectasia</li><li>5. Scurvy</li></ol>	<ol style="list-style-type: none"><li>1. Thrombocytopenia<ul style="list-style-type: none"><li>• ITP</li><li>• Connective tissue diseases- platelet antibody formation</li><li>• Leukemias</li></ul></li><li>2. von Willebrand's disease</li><li>3. Drugs<ul style="list-style-type: none"><li>• Aspirin</li><li>• Carbamazepine</li><li>• Imipramine</li><li>• Methyldopa</li><li>• Phenytoin</li><li>• Chloramphenicol</li></ul></li></ol>	<p>Coagulation defects</p> <ul style="list-style-type: none"><li>• Hemophilia A</li><li>• Christmas disease</li><li>• von Willebrand's disease-purpura more common</li><li>• Other clotting factor deficiency</li><li>• Disseminated intravascular coagulation</li><li>• Liver disease</li><li>• Obstructive jaundice</li><li>• Anticoagulant therapy</li></ul>

2. **Physical examination:** Look for jaundice, pallor, spider angiomas, ecchymosis, petechiae, oral ulcers, hamarthrosis, hyperplastic gingival tissue.
3. **Investigations:** required and their interpretation is given in Table 4.7.

It is important to note that clotting time is not mentioned. Bleeding time offers only some information as it does not discriminate among vessel defects, platelet number or quality.

### **Causes of Bleeding Disorders (Table 4.6)**

#### *Vascular Defects*

Bleeding disorders caused by vascular defects may be caused by structural malformation of vessels, hereditary disorders of connective tissue, and acquired connective tissue disorders. Vascular defects rarely cause serious bleeding. Bleeding into skin or mucous membrane starts immediately after trauma but ceases within 24 to 48 hours.

#### *Platelet Disorders*

It can be of two types:

*Reduction in number*—Thrombocytopenic purpura—e.g. ITP. If the total number of circulating platelets falls below

50,000 /mm<sup>3</sup> of blood, the patient can have bleeding. In some cases the total platelet count is reduced by unknown mechanism; this is called *primary or idiopathic thrombocytopenic purpura* (ITP). Chemicals, radiation, and various systemic disease (e.g. leukemia) may have a direct effect on the bone marrow and may result in *secondary thrombocytopenia*.

ITP is the most common platelet disorder

*Defective in quality*—Nonthrombocytopenic purpura e.g. von Willebrand's disease, Bernard-Soulier disease, Glanzmann's thrombasthenia.

von Willebrand's disease (pseudohemophilia) is the most common inherited bleeding disorder. Unlike hemophilia it can occur in women as well. This is a disease of both coagulation factors and platelets. However, it is less alarming than hemophilia. It is caused by an inherited defect involving platelet adhesion. Platelet adhesion is affected because of a deficiency of von Willebrand's factor (vWF) or a qualitative defect in the factor. Normally vWF binds factor VIII in circulating blood. Unbound factor VIII is destroyed in circulation. Hence variants of vWF or with a vWF that is unable to bind factor VIII can show signs and symptoms of hemophilia in addition to those associated with defective platelet adhesion.

**Table 4.7: Investigations and the abnormality detected**

<i>Test</i>	<i>Abnormality detected</i>
Peripheral smear	Anemia, leukemia, disseminated intravascular coagulation
Platelet count	Thrombocytopenia
Bleeding time	Test of platelet-vessel wall interaction, e.g. von Willebrand's disease
Activated partial thromboplastin time (APTT) <b>Best single screening test for coagulation disorders</b>	Deficiency of all coagulation factors except VII, <b>especially factors VIII and IX</b> ; heparin
Prothrombin time (PT)	Deficiency of factors I,II,V,VII, and X; warfarin
Thrombin time	Hypofibrinogenemia or dysfibrinogenemia; heparin; fibrin degradation products
Special assays	
1. INR value	
2. Platelet function tests	
3. Factor assays-VIII, IX etc.	
4. Fibrinogen levels	

## 38 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

This disease has three variants—Type 1, 2 and 3. Type 1 disease has a partial deficiency of vWF, while Type 2 and its variants (2A, 2B, 2M, 2N) and Type 3 has moderate to severe deficiency of vWF. Type 3 requires replacement of clotting factors for its correction.

### Coagulation Defects

**Hemophilia A:** is the most common coagulation defect with a prevalence of about of 6 per 10,000 of the population. It is 10 times as common as hemophilia B. Inherited as X-linked recessive trait, hemophilia A affects males. The hemostatic abnormality in hemophilia A is caused by a deficiency/defect of factor VIII. Until recently, factor VIII was thought to be produced by endothelial cells and not by the liver as most coagulation factors. Now it has been found that liver parenchymal cells also produce factor VIII.

The defective gene is located on the X chromosome. An affected man will not transmit the disease to his sons; however all his daughters will be carriers of the trait. A female carrier will transmit the disorder to half of her sons and carrier state to half her daughters. A family history can, however, be obtained in only 65 percent of cases.

Normal hemostasis requires at least 30 percent factor VIII activity. Symptomatic patients usually will have factor

activity below 5 percent. The most characteristic bleeding manifestation associated with hemophilia A is hemarthrosis, often develops without significant trauma.

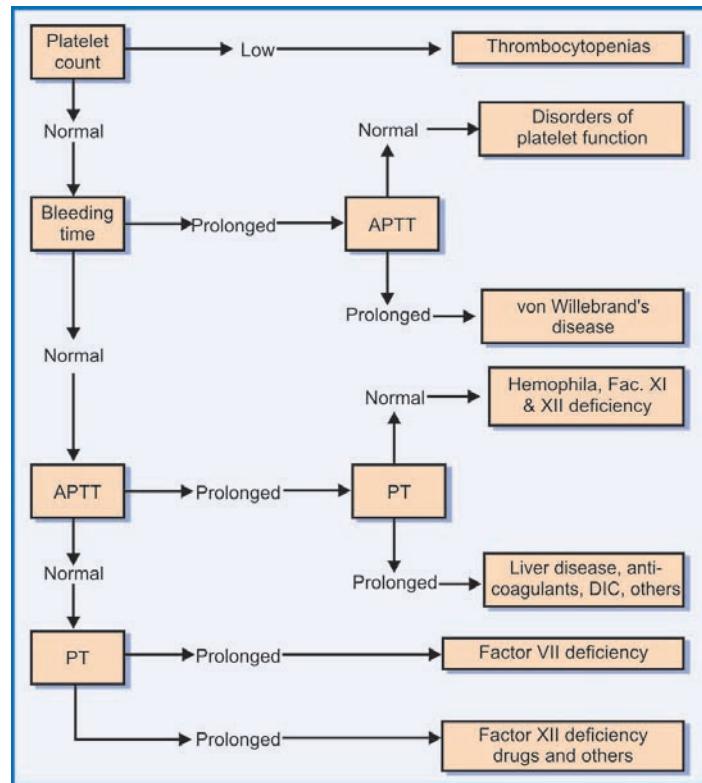
Table 4.8 shows the clinical differences between von Willebrand's disease and hemophilia.

**Hemophilia B (Christmas disease):** Factor IX is deficient or defective. It is inherited as X-linked recessive trait. Like Hemophilia A, the disease primarily affects males and the clinical manifestations of the two are identical. Severely affected patients are less common than Hemophilia A.

**Disseminated Intravascular coagulation (DIC):** Is a condition that results when the clotting system is activated in all or a major part of vascular system. Despite wide spread fibrin production, the major clinical problem is bleeding, not thrombosis. DIC is associated with a number of disorders such as infection, obstetric complications, cancer and snakebites. Worldwide, the most common cause is snakebites. Symptoms of acute DIC include severe bleeding from small wounds, purpura, and spontaneous bleeding from nose, gingival, GIT, or urinary tract. DIC is an acute emergency and dental treatment is highly unlikely to be considered except in survivors.

**Table 4.8: Clinical differences between von Willebrand's disease and hemophilia**

	<i>von Willebrand's disease</i>	<i>Hemophilia</i>
Inheritance	Autosomal dominant –Type 1 and 2 Autosomal recessive- Type 3	Autosomal recessive-
Bruising	Small bruises	Large bruises
Hemarthroses	Rare	Common
Epistaxes	Very common	Uncommon
Gastrointestinal bleeding	Very common	Common
Hematuria	Uncommon	Common
Menorrhagia	Very common	None (Males)
Postextraction bleeding	Starts immediately. Lasts 24 to 48 hours, often controlled by pressure	Starts 1-4 hours after trauma, lasts 3-40 days. Not controlled by pressure
Lab investigations	Prolonged BT, prolonged APPT, normal platelet count, normal PT, normal TT	Normal bleeding time, Normal PT, Prolonged APTT Low level of factor VIII

**FLOW CHART 4.1:** Showing investigations for diagnosis of bleeding disorder

## Dental Management of the Patient with a Serious Bleeding Disorder

The dental treatment of patients with thrombocytopenia, hemophilia A and von Willebrand's disease is explained below to show how patients with serious bleeding disorders are managed. Flow chart 4.1 showing investigations for diagnosis of bleeding disorder.

### General Consideration

- Before any dental treatment, the dental surgeon must consider the patient's physician to determine the severity of the disorder and the need for any special preparations before dental treatment.
- Patients with severe coagulation disorder require hospitalization. A hematologist, physician should be involved with diagnosis, presurgical evaluation, preparation, and postsurgical management.

- Care should be taken in the placement of intraoral radiographic film to avoid trauma to oral tissues.
- In general block anesthesia and intramuscular injections must be avoided.
- Infiltration may be given without replacement therapy.
- Simple restorative procedures can often be performed without replacement therapy or endodontic treatment of nonvital tooth. Avoid over instrumentation and over filling during endodontic treatment.
- Care must be taken during the placement of wedges and bands (restorative or orthodontic).
- Conservative periodontal procedures including polishing with a prophylaxis cup and supragingival calculus removal can be done without replacement therapy.
- Primary teeth can be removed soon after they become loose. Local bleeding control can be achieved by use of pressure, thrombin or microfibrillar collagen. If bleeding continues, topical AHF can be applied to wounds.

## 40 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

### Special Consideration

#### Thrombocytopenia

1. The platelet count should be at least 50,000/mm<sup>3</sup> before surgery is attempted. Continuous transfusion of platelets may be required, or a single preoperative platelet transfusion can be given 30 minutes before the dental surgery.
2. All bleeding sites should be packed with microfibrillar collagen and EACA (100 mg / kg) given orally, just before surgery and then continued for 8 days (50 mg / kg every 6 hours, orally). Post operative tranexamic acid mouthwash for 3 days have been suggested.

**Thrombocytopenia**—platelet count should be at least 50,000/mm<sup>3</sup> before any surgery is attempted.

3. In children with acute idiopathic thrombocytopenia (ITP) with platelets less than 20,000/mm<sup>3</sup>, prednisone or IV gamma globulin increases the platelet count to more than 50,000/mm<sup>3</sup> within 48 hours in about 90% of cases. Once the platelet count is over 50,000/mm<sup>3</sup>, the needed surgical procedures can be performed.
4. Patients with platelet count greater than 60,000/mm<sup>3</sup> rarely have spontaneous bleeding and may require treatment if extensive surgery are planned.

#### Hemophilia

Investigations will show a prolonged APPT, normal PT and BT and low levels of Factor VIII.

1. The hematologist first establishes the diagnosis and determines the degree of factor VIII efficiency, whether any factor VIII inhibitors are present, and need for hospitalization. This is followed by the selection of the type and dosage of replacement material by the hematologist.
2. Tables 4.9 and 4.10 shows the management depending on severity of hemophilia:

#### Dental Management in Hemophiliacs

##### Preoperative Care:

1. Treat any acute oral infection
2. Establish good oral hygiene
3. Protective acrylic splints (though advocated earlier) is now rarely used, since it may cause mucosal trauma and promote sepsis. But they are sometimes useful in palate.

##### Operative Care:

1. Provided factor VIII level is maintained above 30 percent local anesthetic (LA) can be used. LA infiltration is preferable. Intraligamentary or intraosseous LA injection is safer. Lingual infiltration

**Table 4.9: Management of Mild hemophilia**

Drug	Mode of action	Dosage
1. Desmopressin(deamino-8-D arginine desopressin:DDAVP)	Release of Factor VIII C, von Willebrand's factor and tissue plasminogen activator from storage sites in endothelium	Slow I/V infusion over 20 mts. 0.3 micrograms/kg. Maximum dose of 20-24 micrograms 1 hr. before procedure
2. Epsilon- aminocaproic acid (EACA)	Antifibrinolytic effect. It inhibits plasminogen activators present in oral secretions and stabilize clot formation	6 gm. 6 hourly orally for adults and 100 mg. 6 hourly for children for 3-4 days following dental extraction
3. Tranexamic acid (a synthetic derivative of lysine)	Antifibrinolytic effect	Oral dose- 1 gm. (30 mg./kg) started 1 hour before and continued qid for 5 days. I/V infusion- 10 mg./kg. in 20ml. saline over 20 mts. and continued as oral dose of 1 g. tid. for 5 days Child dose- 20mg./kg.

**Table 4.10:** Management of moderate and severe hemophilia

Drug	Dose
Factor VIII replacement	Loading dose: 30-40 U/kg.I/V, 10-30 mts. before procedure. Factor VIII have a half life of 8–12 hrs. If bleeding continues after 8 to 12 hrs. additional infusion of factor VIII is required.
EACA	Orally—6 gm. 6 hourly for 3-5 days

should be avoided. Block injections and intramuscular injections should not be given. Hematoma, airway obstruction and death have occurred as complication following block anesthesia.

2. Conservative dentistry treatment—When using matrix band care must be taken not to injure gingival tissues. Rubber dam when used, its clamps should be carefully applied. Trauma from saliva ejectors can be minimized by resting it on a gauze swab in the floor of the mouth.
3. Endodontic treatment—Special precautions should be taken to avoid instrumentation beyond root apex. Use of RVG and electronic endodontic equipment will be of great use. Intracanal injection of LA containing adrenalin or topical application of 1:1000 adrenalin are useful to minimize bleeding. However in severe hemophiliacs bleeding from pulp and periapical tissues can be troublesome.
4. Periodontal treatment—In all but severe hemophiliacs, scaling can be done under antifibrinolytic cover.
5. Orthodontic treatment —There is no contraindication to movement of teeth. However there must be no sharp edges to appliances which might traumatise the mucosa.
6. Extraction and dentoalveolar surgery—
  - a. Ideally all necessary surgery should be performed at one sitting. A factor VIII level between 50 and 70 percent is required.
  - b. Panoramic radiographs should be taken to rule out any pathology that might create trouble in future.
  - c. Use of LA should be as discussed above. General anesthesia is avoided if possible. When absolutely

essential, oral intubation is employed and nasal intubation avoided.

- d. Surgery carried out with minimum trauma to hard and soft tissues.
- e. Suturing is desirable to stabilize gum flap and promote healing. Atraumatic vicryl suture (absorbable) or silk sutures are used. Catgut is best avoided. If there is postoperative bleeding due to inadequate replacement therapy of factor VIII, suturing carries with it the risk of postoperative hematoma leading to respiratory obstruction.
- f. The lingual tissues in the lower molar region is left undisturbed, since trauma may open the tissue planes causing the blood to track down.
- g. The buccal approach to lower third molar is safer. Minimal bone should be removed. Tooth should be sectioned when required to minimize bone removal.
- h. Packing of extraction socket is unnecessary if replacement therapy has been adequate. However, oxidised cellulose soaked in tranexamic acid packed into the socket or collagen or cyanoacrylate or fibrin glue may be used. Fibrin sealant which contain mainly fibrinogen and thrombin provide adequate hemostasis as well as tissue sealing and adhesion. Use of tranexamic acid mouthwash before and after dental extraction also helps to stop bleeding
- i. Prophylactic broad spectrum antibiotic like amoxicillin is used to prevent infection and the risk of postoperative hemorrhage. It is continued for 7 days.
- j. Following head and neck trauma in hemophiliacs; factor VIII replacement therapy to achieve a level of 100 percent is essential because of the risk of bleeding into the cranial cavity or into the fascial spaces of neck.

#### *Postoperative:*

1. Patients will require additional dose of DDAVP, factor VIII or other agents. Patients given factor VIII replacement need to be examined for signs of allergy.
2. Avoid aspirin, and NSAIDS. New COX-2 specific inhibitors such as Etoricoxib can be used. Acetaminophen with or without codine is suggested for patients.

## 42 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

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3. Examine the patient 24 to 48 hours after surgery and observe the following:
  - a. Postoperatively, a diet of cold liquid and minced solid should be given for up to 5-10 days.
  - b. Look for signs of infection- treat if present
  - c. Bleeding—Use local measures to control. If not effective use systemic measures as indicated.
  - d. Watch carefully for the development of hematoma and ensure the patency of airway.
6. Control bleeding using local measures—pressure packs, microfibrillar collagen, gelfoam with thrombin, fibrin glue or tranexamic acid.
7. Aspirin and NSAIDS should be avoided. Acetaminophen with or without codeine can be used. Cox-2-specific inhibitors also can be used.
8. Examine for signs of infection or delayed bleeding within 24 to 48 hours.
9. Bleeding can be managed by local measures.
10. If these fail additional dose of factor VIII, DDVP or EACA may be needed.

Hemophiliacs with factor VIII inhibitors: A complication that pose great difficulty in the management of hemophiliacs is the appearance of factor VIII inhibitors. These inhibitors are usually immunoglobulin G (IgG) and develop in patients who have received multiple factor VIII replacement therapy. About 10 to 20 percent hemophiliacs have factor VIII inhibitors. The level of factor VIII inhibitors is checked preoperatively. In general, patients with low level of inhibitors can have dental treatment in the same way as with no inhibitors. For those with high titre inhibitors, surgery needs special care. Traumatic procedures must be avoided unless absolutely essential. Such patients should not receive human factor VIII replacement for the control of bleeding. Instead, high doses of porcine factor VIII, prothrombin complex concentrates (PCC), activated prothrombin complex concentrates (APCC) are found to be effective.

### *von Willebrand's Disease (vWD)*

Investigations will show a prolonged bleeding time, usually prolonged APTT and low levels of von Willebrand's factor. The common pattern is bleeding from, and purpura of, mucous membrane. Gingival hemorrhage is more common than in hemophilia.

#### *Dental Management*

1. Consult the hematologist.
2. Surgical procedures can be performed in patients with mild vWD by using DDAVP and EACA. Patients with severe types of vWD will require cryoprecipitate or factor VIII concentrate.
3. Treat any acute oral infection. Maintain good oral hygiene.
4. Local anesthetic infiltration is generally used.
5. Atraumatic surgical procedure

## RESPIRATORY DISEASES

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### **Asthma**

Asthma is a chronic inflammatory respiratory disease consisting of recurrent episodes of dyspnea, coughing, and wheezing resulting from hyper responsiveness of the tracheobronchial tree. The bronchiole lung tissue of patients with asthma is particularly sensitive to a variety of stimuli.

Asthma is a multifactorial disease whose exact etiology is not well defined. There are two main types of asthma:

1. Extrinsic (allergic)—may be precipitated particularly by allergens and is the typical asthma in children. This tends to resolve by adult life.
2. Intrinsic (nonallergic)—appears to relate to mast cell instability and hyper-responsive airways.

Episodes of either type of asthma can be initiated by:  
(a) infections, (b) irritating fumes, (c) exercise, (d) emotional stress, (e) certain foods or food additives, (f) drugs—aspirin, NSAIDS, beta blockers, (g) weather changes.

Typical symptoms of the disease consist of reversible episodes of breathlessness, chest tightness, wheezing, cough that is worse at night, and flushing. Onset usually is sudden. Respiration becomes difficult and are accompanied by expiratory wheezing. Tachypnea and prolonged expiration are characteristic. The termination of an attack is commonly accompanied by a productive cough with stringy mucous. Episodes usually are self limiting, though severe episodes may require immediate medical attention.

**Dental Management of Patients with Asthma**

The goal of management of asthmatic patients should be identifying the patient and prevention of asthmatic attack.

1. Detailed history—age of onset, severity of asthma, precipitating factors, medications being taken and necessity for emergency care.
2. Medical consultation for severe active asthmatic patients.
3. Elective dental care should be deferred in severe asthmatics until they are in a better phase.
4. Provide stress free environment through establishment of rapport, since stress is implicated as a precipitating factor.
5. Oral premedication may be accomplished with small dose short acting of benzodiazepine and it is used with caution. Benzodiazepines can precipitate respiratory failure.
6. Local anesthetic is preferred and general anesthesia (GA) is best avoided. GA may be complicated by hypoxia, and hypercapnia, leading to pulmonary edema. The risk of postoperative collapse of lung or pneumothorax is increased.
7. If conscious sedation is used nitrous oxide oxygen is preferred to I/V sedation.
8. Patients with nocturnal asthma should be scheduled for late morning appointments.
9. Operatory odorants (e.g. methyl methacrylate) should be reduced before the patient is treated.
10. Patients are instructed to bring their usual medication/inhaler for every appointment and keep it available. Prophylactic inhalation of patient's bronchodilator at the beginning of appointment is a valuable method of preventing asthmatic attack.
11. Use of pulse oximeter is valuable for determining oxygen saturation of the patient. A drop below 90% indicates poor oxygen exchange and the need for intervention.
12. Drug considerations:
  - Avoid aspirin and NSAIDS (use acetaminophen)
  - Allergy to penicillin may be more frequent.
  - Interactions of theophylline with adrenalin, erythromycin, azithromycin, clarithromycin, ciprofloxacin or clindamycin may result in

dangerously high levels of theophylline and resulting in theophylline toxicity (Theophylline toxicity is characterized by anorexia, nausea, nervousness, insomnia, agitation, thirst, vomiting, headache, cardiac arrhythmias, and convulsions.

- Avoidance of barbiturates and narcotics (histamine release) since asthmatic attack may be precipitated by these drugs.
- Avoid local anesthetic solution containing adrenalin or levonordefrin because of sulfite preservative. Sulfites may precipitate an asthmatic attack. Also adrenalin is contraindicated in patients using theophylline as it may precipitate dysrhythmias. (Previously it was considered that adrenalin containing local anesthetic may be safely used since beta - adrenergic receptors serve to reverse the effects of an asthmatic attack).
- Patients who are on long term systemic steroids require supplementation.
- When GA is used halothane, isoflurane, or enflurane are preferred anesthetics.

**Management of an Acute Asthmatic Attack**

1. Stop the surgical procedure and clear the airway.
2. Seat the patient upright.
3. Take two puffs on their inhaler.
4. Administration of fast acting bronchodilator (corticosteroids have delayed onset of action).
5. Provide positive-flow oxygenation.
6. Monitor vital signs.
7. If needed subcutaneous 0.3 to 0.5 ml of adrenalin (1:1000) is administered.
8. Activating emergency medical system.

**Chronic Obstructive Pulmonary Disease**

Chronic obstructive pulmonary disease (COPD) is a chronic, slowly progressive, irreversible disease characterized by breathlessness and wheeze, cough, and sputum production. COPD is most frequently a combination chronic bronchitis and emphysema. These two may be regarded as discrete entities, but are usually seen together,

## **44 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY**

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and are exceedingly common. **Chronic bronchitis** is excessive production of mucous and persistent cough with expectoration, for at least three months of the year for more than two consecutive years. **Emphysema** is the distention of air spaces distal to the terminal bronchioles because of destruction of alveolar walls. The most important causes of COPD include: cigarette smoking, environment pollution, or occupational exposure to chemicals.

### *Dental Management of Patients with COPD*

1. Assess the severity of the patient's disease and its control.
2. Review history for evidence of concurrent coronary heart disease or hypertension and take appropriate precautions.
3. If the patient is on steroids, consider supplemental steroids.
4. Avoid dental treatment if upper respiratory infection is present.
5. Treat the patient in upright chair position /semi supine.
6. Use local anesthetic as usual. However, use of bilateral mandibular blocks or bilateral palatal blocks can cause unpleasant airway constriction sensation in some patients.
7. Avoid use of rubber dam in severe disease.
8. Use pulse oximetry to monitor oxygen saturation—consider low flow (2 to 3L/min) supplemental oxygen when oxygen saturation drops below 95 percent.
9. Avoid nitrous oxide- oxygen inhalation sedation with severe COPD because the gas may accumulate in the air spaces of the diseased lung.
10. General anesthesia is given when absolutely essential. I/V barbiturates are absolutely contraindicated.
11. Consider low dose oral diazepam or other benzodiazepine (these are respiratory depressants and also may cause oral dryness).
12. Avoid use of barbiturates and narcotics since they are respiratory depressants.
13. Antihistaminics and anticholinergics are generally not used because of their drying properties and the resultant increase of mucous tenacity.

14. Avoid erythromycin, macrolide antibiotics (azithromycin) and ciprofloxacin for patients taking theophylline, since these can retard the metabolism of theophylline, resulting in theophylline toxicity.
15. Do not use out patient general anesthesia.

## **LIVER DISEASE**

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### **Chronic Alcoholism and Liver Cirrhosis**

Chronic alcoholism is where repeated alcohol intake becomes detrimental to work or social life.

The pathological effects of alcohol on the liver are expressed by one of three disease entities. These conditions may exist alone but commonly appear in combination. The earliest change seen in alcoholic liver disease is a fatty infiltrate. However they are considered reversible. A second and more serious form of liver disease is alcoholic hepatitis. This is characterized by destructive cellular changes, some of which may be reversible. The third and most serious form of liver disease is cirrhosis, which is generally considered an irreversible condition characterized by progressive fibrosis and abnormal regeneration of liver architecture. Cirrhosis results in progressive deterioration of the metabolic and excretory functions of the liver and ultimately leads to hepatic failure.

### *Dental Management*

If the patients gives a history of alcohol abuse or alcoholic liver disease, the physician should be consulted to verify the patients current status, medications, contraindications for medications, surgery or other treatment.

Three major dental treatment considerations exist for a patient with alcoholism:

1. Bleeding tendencies
2. Unpredictable metabolism of certain drugs.
3. Risk or spread of infection.

**Bleeding tendencies:** Are a significant feature in advanced liver disease. The reason for the diathesis is due to a deficiency of coagulation factors, especially the thrombin group (factors II, VII, IX, and X). All these factors rely on vitamin K for synthesis. Hepatocellular destruction decreases the ability of liver for storage and conversion of vitamin K, leading to deficiency of

prothrombin dependent coagulation factors. In addition, thrombocytopenia may be caused by hypersplenism secondary to portal hypertension and bone marrow suppression. Associated anemia and leukopenia also may be present due to toxic effect of alcohol on bone marrow and nutritional deficiencies.

In cases where the patient has not been seen by a physician within past several months, screening laboratory tests should be conducted, including complete blood count, platelet count, thrombin time and prothrombin time before invasive procedure. Bleeding diathesis should be managed in conjunction with a physician and may entail the use of local hemostatic agents, fresh frozen plasma, vitamin K, platelets, and antifibrinolytic agents.

**Unpredictable metabolism of certain drugs**—Here the concern is two fold:

- Significant enzyme reduction leading to increased tolerance of local anesthetics, sedatives, hypnotics and general anesthesia. Thus larger than normal dose of these medications may be required to obtain desired effects.
- Drug metabolism may be markedly diminished and can lead to an increased or unexpected effect. For example if acetaminophen is used in usual therapeutic dose in chronic alcoholism, severe hepatocellular disease with mortality has resulted. The drugs shown in Table 4.11 should be used with caution, or adjust their dose (e.g. half the dose) or avoid their use if advised by physician while treating patients with chronic alcoholism.

Local anesthetics like lidocaine, mepivacaine, prilocaine bupivacaine appear safe for use in liver disease when used in appropriate amount.

**Table: 4.11: Drugs that should be used with caution / avoided in liver disease**

Analgesics	Sedatives	Antibiotics
Aspirin	Diazepam	Ampicillin
Acetaminophen	Barbiturates	Tetracycline
Codeine		Metronidazole
Ibuprofen		Vancomycin
Meperidine		

**Risk or spread of infection:** Risk increases with surgical procedures or trauma, as oral microorganisms can be

introduced into the blood circulation and may not be eliminated by reticuloendothelial system. More over these patients have altered cell-mediated immune function. Despite the lack of evidence, antibiotic prophylaxis for these patients is recommended by certain authors. A greater concern is the risk of spread of an ongoing infection, as bacterial infections are serious and sometimes fatal in patients with liver disease. Clinician should also identify whether a history of bacterial infection (e.g. spontaneous bacterial peritonitis, pneumonia, bacteraemia) exists. Antibiotics should be given when infection is present and is unlikely to resolve without it.

In addition to the above the following factors also may be considered while treating patients with liver disease:

- Aggressive behavior and erratic attendance
- Poor compliance with postoperative instructions
- Dental neglect—advanced caries and periodontal disease
- Increased incidence of dry socket and osteomyelitis
- Metronidazole cause nausea and vomiting when taken with alcohol
- Alcoholics are often heavy smokers, thereby increasing the possibility for COPD
- When admitted, alcoholic patients should be placed on chlormethiazole to keep them from experiencing withdrawal symptoms during their hospital stay.

### Viral Hepatitis

Viral Hepatitis is the most common form of infectious hepatitis. Five distinct viruses- types A, B, C, D, E are associated with the disease. These viruses infect the liver and cause damage to liver cells thereby compromising the liver function. Hepatitis B, C and D (HBV, HCV and HDV) may progress to a chronic phase leading to gradual erosion of hepatic function or persist as a carrier state that harbour the potential to transmit the disease to others. Hepatitis B, C and D are of great concern in dental practice, since these are transmitted by parenteral route. Blood, plasma, serum or saliva can be infectious. As little as 0.0000001 ml of HBsAg-positive serum can transmit hepatitis B. The main danger is from needle stick injuries. If needle stick injury occurs, injection of hepatitis B immune globulin within 24 hours of contact with HBV may protect from developing hepatitis. The injured person

## **46 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY**

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also should receive the first dose of hepatitis vaccine. Human bite can also transmit these diseases.

### *Dental Management of Patients with Hepatitis*

The identification of potential or actual carriers of HBV, HCV and HDV is problematic because in most instances carriers cannot be identified by history. The inability to identify potentially infected patients extends to HIV infection and other sexually transmitted diseases. Therefore all patients with history of viral hepatitis must be managed as though they are potentially infectious. It is strongly recommended that all dental health care workers receive vaccination against hepatitis B and implement universal precautions.

Very often carriers of HBV, HCV and HDV are unaware they have had hepatitis. The reason is that many cases of hepatitis are mild, sub clinical and nonicteric. These cases are asymptomatic and therefore go undetected. Routine screening of all dental patients to identify these carriers will be impractical. The only practical method of protection is to adopt strict asepsis for all patients, practice universal precautions and hepatitis B vaccination for all dental personnel.

All patients with history of viral hepatitis must be managed as though they are potentially infectious

### *Patients with Active Hepatitis*

- No dental treatment other than urgent one should be given to patients with active hepatitis.
- Urgent care should be provided only in isolated operatory adhering to strict universal precautions.
- Aerosols should be minimized and drugs metabolized in liver avoided as far as possible.
- If surgery is necessary, a preoperative prothrombin time and bleeding time should be obtained and results discussed with the physician. Platelet function analysis also may be performed to determine the need for platelet replacement.
- Before giving routine dental treatment the patient should be clinically and biochemically recovered.
- Drugs that are metabolized in liver must be used with caution
- Cross infection in dental practice should be avoided by strict asepsis and practice of universal precautions.

### *Identifying High Risk Patients*

1. Recent overseas travel—especially to countries where the disease is endemic.
2. Sexual practices—homosexuals and prostitutes.
3. History of intravenous drug use—particularly where needles have been shared.
4. Blood transfusion—prior to introduction of universal screening.

## **PREGNANCY**

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Pregnancy is major event in women's life and hence an emotionally charged one. It is associated with physiological changes affecting the endocrine, cardiovascular and hematological systems and often attitude, and behavior. Fetal development during the first 3 months (trimester) of pregnancy is a complex process of organogenesis and the fetus is especially at risk from developmental defects. The most critical period is the 3rd to 8th week. Hence, precautions from time of first missed menstruation will be adequate. An exception to this is the fetal dentition, which is susceptible to staining caused by administration of tetracycline during later part of pregnancy. Generally, all drugs should be avoided unless the benefits outweighs potential risks.

### **Supine Hypotensive Syndrome**

This a phenomenon that may occur during late pregnancy, manifested by abrupt fall in BP, bradycardia, sweating, nausea, weakness, and air hunger when the patient is in supine position. These symptoms are caused by impaired venous return to the heart resulting from compression of inferior vena cava by the gravid uterus. This leads to decreased BP, decreased cardiac output, and loss of consciousness. The management is to roll the patient over to left side, which lifts the uterus off the vena cava and the BP will rapidly return to normal.

### *Dental Management During Pregnancy*

Management recommendation during pregnancy should be viewed as general guidelines, not absolute rules. A thorough medical history including history of gestational diabetes, hypertension, miscarriage, morning sickness and complication associated with pregnancy should be made.

The patient's obstetrician should be contacted before planning treatment. The following aspects require special attention:

- Other than good plaque control program, elective dental care is best avoided during first trimester because of potential vulnerability of fetus.
- The second trimester is the safest period to provide routine dental treatment. Dental extractions are best performed in the second trimester. Because of risk of hypoxia, extractions are performed with the patient semi reclining or sitting upright.
- Emergency procedures for serious odontogenic infections should be performed at any time with caution.
- The early part of third trimester is still a good time to provide routine dental care; but after middle of third trimester, elective dental care is best postponed.
- Prolonged time in dental chair should be avoided to prevent the complication of supine hypotension.
- Extensive surgical procedures are best postponed until delivery.
- Dental X-rays should be avoided especially during first trimester of pregnancy, because of the possibility of fetal abnormality. Use of fast exposure (e.g. high-speed film, or digital imaging), filtration, collimation and lead apron can markedly reduce the effect of radiation. Of all these, the most important is the protective lead apron.
- The risk of disseminated intravascular coagulation (DIC) may lead to profuse bleeding after dental extraction, which should be treated with local hemostatic agents.
- Avoid sedation and general anesthesia whenever possible.
- When using local anesthetic avoid prilocaine and octapressin.

#### *Drug Administration During Pregnancy*

The principal concern is that a drug may cross placenta and be toxic to the fetus. Additionally, any drug that is respiratory depressant can cause maternal hypoxia, resulting in fetal hypoxia, injury and death. Ideally, no drug should be given during pregnancy, especially during first trimester. Counseling should be provided to make

sure that pregnant woman clearly understand the nature and magnitude of risk associated with a drug. Most of the commonly used drugs in dental practice can be given with relative safety with a few exceptions.

#### *Drug Administration During Breastfeeding*

A potential problem arises when a nursing mother requires the administration of drug during the course of dental treatment. The concern is that the administered drug can enter the breast milk of and be transferred to the infant, resulting in adverse effects. Studies have shown that the amount of drug excreted in breast milk is usually not more than 1 to 2 percent of the maternal dose. Hence most drugs are of limited pharmacological significance to the infant.<sup>2</sup> However drugs like lithium, anticancer drugs, radioactive pharmaceuticals and phenindione are definitely contraindicated in nursing mothers. Aspirin, dextropropoxyphene, tetracycline, aminoglycosides, co-trimoxazole, metronidazole, barbiturates and benzodiazepines should be avoided if at all possible. In addition to careful drug selection, nursing mother may take the drug immediately after breast feeding and avoid nursing for 4 hours or more. This will result in decreased drug concentration in breast milk.

Table 4.12 shows the relative safety of commonly used drugs for use in pregnancy.

## **AIDS AND HIV INFECTION**

The acquired immune deficiency syndrome (AIDS) is an infectious disease caused by human immunodeficiency virus (HIV). This disease as the name suggests has an underlying immune deficiency and is transmitted predominantly by intimate sexual contact and by parenteral means. The latter mode of transmission holds great significance for the disease in dental practice considering the high incidence of HIV positive cases in the country and a large number of them undetected.

The Centre for Disease Control USA (1993), defined an AIDS case, when the cluster of differentiation 4 (CD4) lymphocyte count is less than 200 in a patient who is HIV infected. From the time of diagnosis, 30 percent of AIDS patients can be expected to live approximately 2 to 3 years, with most others living 10 years or longer.

## 48 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

**Table 4.12:** Relative safety of commonly used drugs for use in pregnancy

Category	Safe	Unsafe
Antibiotics	Penicillin's Cephalosporins Clindamycin Cephalexin	Erythromycin (estolate form) maternal hepatotoxicity Tetracycline- hypoplasia and discoloration of teeth Metronidazole- risk of midline clefts, oncogenesis Aminoglycosides-fetal ototoxicity and nephrotoxicity Cotrimoxazole—neonatal hemolysis, teratogenicity Ciprofloxacin Doxycycline Aciclovir- risk of teratogenicity
Analgesics	Acetaminophen Ibuprofen-avoid in 2nd half-cause delayed labor	Aspirin } Premature closure of ductus arteriosus, post partum NSAIDS } hemorrhage, Persistent pulmonary hypertension Narcotics Paracetamol(1st trimester) Rofecoxib Diflunisal
Local anesthetic	Lignocaine Etidocaine	Octapressin-similar to vasopressin, causes contraction of uterus Bupivacaine and Mepivacaine- fetal bradycardia Prilocaine-large dose cause methemoglobinemia resulting in hypoxia in mother and fetus
Sedatives and General anesthetics	Ketamine	Nitrous oxide—congenital abnormalities(best used in 2nd and 3rd trimester for less than 30 minutes)) Benzodiazepines- orofacial clefts,cardiac defects, and hernias Barbiturates - neonatal respiratory depression Codeine, pentazocaine—neonatal respiratory depression
Others		Alcohol- fetal alcohol syndrome Steroids (even topical)- adrenal suppression, growth retardation Carbamazepine-neural tube defects, vitamin K impairment, bleeding Phenytoin Povidone –iodine Warfarin—long bone and cartilage abnormalities, bleeding tendency Felypressin - oxytocic

Death usually results from opportunistic infection like pulmonary tuberculosis, recurrent episodes of pneumonia, or other life threatening infections and in some cases from various malignancies seen in AIDS. The onset of these complications generally is associated with a low CD4 count.

### Transmission of HIV

HIV is present in high concentrations in blood and semen, although it is rarely recovered from saliva, tears and breast milk. Spread of HIV may be via:

- Parenteral exposure to infected blood and blood products
- Sharing of IV needles between drug addicts
- Anal or vaginal intercourse
- Perinatally to infants from infected mothers:

### Identifying High-risk Patients

Because of the variable incubation period of HIV, from a few months up to 6 years, the manifestation of the disease will be slow. Hence it is important to consider the following high-risk group while giving dental treatment.

- Male homosexuals
- History of IV drug use
- Heterosexual partners of above
- Babies born to HIV infected mothers
- Hemophiliacs and other blood transfusion recipients - particularly those who received blood prior to the introduction of wide spread testing of blood for HIV.

### Diagnosis of HIV Infection

It is from the history and clinical criteria. Lymphopenia, low CD4 count and low CD4/CD8 ratio are typical. HIV infection must be confirmed by testing for serum HIV antibodies; which includes ELISA and western blot test. The ELISA (enzyme linked immunosorbent assay) or agglutination screening tests for serum antibodies to HIV are the first step. Antibodies are usually detectable from about 6 to 8 weeks after infection. The ELISA test has a sensitivity of about 98 percent under optimal conditions. It is rapid and easy to use, but there may be false-positive or false-negative results. Hence, for the diagnosis of AIDS it is important to apply two methodically different assays for HIV infection and repeat the test 2 to 3 months later.

The oral lesions associated with HIV/AIDS are not specific for the diagnosis of the disease. However, the common oral manifestation of HIV infection are outlined in Table 4.13.

### Dental Management of HIV infected/AIDS Patients

The major considerations in the management of HIV/AIDS patients are: a) possibility of transmission of HIV from the patient to dental surgeon, their staff and other

patients, b) determining the current level of CD4 lymphocyte cell count and the level of immunosuppression, c) viral overload and susceptibility of opportunistic infections, d) oral manifestation of AIDS, e) drug therapy. Patients who are HIV seropositive but are asymptomatic may receive all indicated dental treatment. Generally these patients have a CD4 count of more than 400, no significant immunosuppression or neutropenia or thrombocytopenia.

#### *Special Precautions*

Must be taken to avoid accidental cross infection during dental procedures. Such precautions should be observed for all cases (universal precautions and barrier techniques), regardless of whether the patient is in a high-risk category for HIV or not. This is because in some instances the asymptomatic patient may be unaware of the disease or otherwise may be concealing their disease. Moreover, it has been found that most HIV carriers and more than 80 percent HBsAg carriers cannot be identified on the basis of recommended clinical screening procedures.

#### *Oral Lesions*

Found should be diagnosed and then managed by appropriate local and systemic treatment or referred for treatment depending on one's experience in the management of these lesions.

#### *Surgery*

Prophylactic antibiotic should be given before dental extraction or surgery because of the depressed immune

**Table 4.13:** Common oral manifestation of HIV infection

<i>Group I Lesions Strongly associated with HIV infection</i>	<i>Group II Lesions Commonly associated with HIV infection</i>	<i>Group III Lesions Possibly associated with HIV infection</i>
Cervical lymphadenopathy Candidosis Hairy leukoplakia Kaposi's sarcoma Non-Hodgkin's lymphoma HIV- gingivitis Necrotizing ulcerative gingivitis HIV- periodontitis Other infections	Atypical ulceration(oropharyngeal) Aphthous-like ulcer ITP Dry mouth Salivary gland disease Viral infections- Cytomegalovirus, Herpes simplex virus, human papilloma virus, herpes zoster, and varicella	Mycobacterial ulcers Cryptococcal ulcers Histoplasma ulcers Addisonian pigmentation Osteomyelitis Cranial neuropathies

status and neutropenia often found in HIV patients. Defer surgery when T-cell count is low. Patients with severe thrombocytopenia may require special precautions before surgery. Aspirin should be avoided as it may aggravate any bleeding tendency.

### *Accidental Exposure and Postexposure Prophylaxis (PEP)*

Accidental exposure can happen with needle stick injuries or injury following slippage of instruments. The risk is related to the prevalence of HIV among patients, the frequency of exposure to infected blood, and the method of exposure. The magnitude of risk is thus difficult to assess for any given situation. The risk of transmission of HIV from an infected patient to a health care worker through needle stick injury is 0.3 to 1 percent. This is far lower than the risk of transmission of Hepatitis B (26%), and Hepatitis C (10%) following needle stick injury. In most health care workers who have acquired HIV, the infection has been sexually transmitted. There have been, as yet(2004), only two reports of dental staff contracting HIV as a consequence of occupation even in endemic areas.

Three types of injury are recognized as being of high risk: percutaneous injury, exposure of broken skin, exposure of mucous membranes (including the eyes). The highest risk is from blood or blood-stained body fluids. Other high risk body fluids are: cerebrospinal fluid, peritoneal fluid, synovial fluid, pericardial fluid, pleural fluid, unfixed organs and tissues, semen, vaginal secretions, amniotic fluid, breast milk, and saliva in association with dentistry. If an injury results in exposure to infected material, postexposure counseling, treatment and follow up should be done. Wound exposed to blood or body fluids should be washed with soap and water. The exposure should be evaluated for potential to transmit HIV infection. PEP is a short term antiretroviral treatment to lessen the likelihood of HIV infection after potential exposure and it should be started as soon as possible after exposure to HIV. This antiretroviral treatment reduces the ability of the virus to replicate, allowing the intact immune system an opportunity to clear the virus and thereby reduce the risk of seroconversion.

The current guidelines state that a suspicion of contamination should be obtained by reviewing clinical

details of the source patient (history, examination, and pathology results). If the injury is thought to carry a high risk for HIV transmission, the patient's consent should be sought and, if obtained, blood should be taken from the source patient for HIV testing. In a situation carrying a high risk, PEP should be started immediately, preferably within one hour, and not delayed for blood test results (although starting PEP up to two weeks after exposure may still be beneficial.) Treatment with zidovudine has been shown to reduce the risk of seroconversion by 80 percent. The use of triple antiretroviral therapy is thought to reduce further the risk of transmission and prevent an increase in zidovudine resistance. The current recommended prophylaxis is: zidovudine 200 mg three times daily or 250 mg twice daily, lamivudine 150 mg twice daily, and indinavir 800 mg three times daily for four weeks. The regimen may be altered in the light of knowledge about the particular HIV strain involved, drug allergies, whether the health care worker is pregnant, and the likelihood of interaction with other prescribed drugs.

In a situation carrying a high risk, PEP should be started immediately, preferably within one hour, and not delayed for blood test results

(For detailed description on postexposure prophylaxis refer chapter 8)

The following are some of the guidelines that have emerged regarding the rights of dental surgeon and a patient with AIDS:

1. It is unethical to withhold dental treatment from any patient on the basis of a moral judgment that a patient's lifestyle might have contributed to the condition for which treatment was being sought. However, if the dental surgeon and the patient agree, the patient may be referred to someone who would be more willing to give treatment.
2. HIV testing should be done only after obtaining informed consent and should include appropriate counseling and case referral.
3. Relatives cannot give consent for an HIV test.
4. Dental treatment may not be withheld because the patient refuses testing for HIV exposure.
5. An infected dental surgeon should either inform the patient of the HIV status and receive consent or not perform invasive procedures.

## PROSTHETIC JOINT REPLACEMENTS

Patients with prosthetic joint replacements, in particular total hip replacements, may succumb to an infection that will result in the destruction and subsequent removal of the prosthetic joint. Such infections can be caused by bacteremia arising from oral cavity during dental extraction. It has been suggested that antibiotic prophylaxis should be provided for all oral surgical procedures undertaken in patients with prosthetic joint replacements. However, there are no documented cases of infection of total joint prosthesis as a result of dental procedures. Dental surgeon planning dental extraction on a patient with prosthetic joint must always inform the patient's orthopedic surgeon. In cases where the orthopedic surgeon recommends antibiotic prophylaxis, the same antibiotic regime as used for infective endocarditis may be employed.

## NEUROLOGICAL DISORDERS

- a. Epilepsy
- b. Stroke
- c. Parkinson's disease

### Epilepsy

Epilepsy is a term that describes a group of disorders characterised by chronic, recurrent, paroxysmal changes in neurologic function (seizure) caused by abnormal and spontaneous electrical activity in brain. Although seizures are required for the diagnosis of epilepsy, not all seizures imply epilepsy. Seizures may be associated with many medical or neurological illness including stress, sleep deprivation, fever, alcohol or drug withdrawal and syncope.

Although there are different types of epilepsy, the commonest type that the dental surgeon is likely to encounter is the idiopathic grand mal type(generalized tonic-clonic seizure) which represents the most severe expression of the disease.

#### *Clinical Manifestation*

Clinical manifestation of grand mal seizures are classic. An aura precedes the convulsion in one third of the cases. This is a momentary sensory alteration that produces an

unusual smell or visual disturbance. Irritability is another premonitory signal. After the aura, the patient emits a sudden "epileptic cry" (caused by spasm of diaphragmatic muscles) and immediately loses consciousness. This is followed by tonic phase which consists of generalized muscle rigidity, pupil dilation, eyes rolling upward or to the side, loss of consciousness. Breathing may stop because of spasm of respiratory muscles. The clonic phase follows this, which consists of uncoordinated beating movements of the limb and the head, forcible jaw closing and head rocking. Incontinence of urine or feces may occur. After a few minutes movement ceases, muscles relax and a gradual return to consciousness occurs. This is accompanied by stupor, headache, confusion and depression. Several hours of rest or sleep may be needed to fully regain cognitive and physical abilities.

A serious complication of epilepsy (especially tonic-clonic) is the occurrence of repeated seizures over a short time without recovery period. This is called status epilepticus and constitutes a medical emergency. Patients may become seriously hypoxic and acidotic during the event and suffer permanent brain damage or death.

#### *Dental Management*

1. Detailed history of seizure- type of seizure, age at the time of onset, causes of seizure, medications, degree of control, frequency of visit to physician, date of last seizure, precipitating factors, seizure related injury.
2. Patients who are on regular anticonvulsant drugs and well controlled seizures can receive routine dental treatment.
3. Poorly controlled seizures require consultation with the physician. These patients will require additional anticonvulsant medication as directed by the physician.
4. Preventive measures—(a) schedule the appointment within a few hours of taking the anticonvulsant medication, (b) remove dentures, (c) use a ligated mouth prop, (d) tell the patient the urgency of mentioning an aura as soon as it is sensed. Irritability is often a symptom of impending seizure, (e) if sensed sufficiently early, 0.5 to 2 mg of lorazepam given sublingually or 2 to 10 mg diazepam intravenously can be given to prevent seizure.

## 52 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

5. **Seizure management**—In spite of preventive measures taken, the possibility of occurrence of seizure while the patient is in dental chair exists. The dental surgeon should anticipate this and be prepared to manage. The primary aim is to protect the patient and try to prevent injury. No attempt should be made to move the patient to floor. Clear the instrument tray with the instruments from the area. Support the chair firmly in a supine position, either with hand or operating stool. No attempt is made to restrain the patient. Passive restraint is used to prevent injury to the patient from falling down or hitting nearby object. Patients airway should be maintained patent.

If a mouth prop is used it should be inserted at the beginning of the procedure and ligated. Trying to insert a mouth prop during a seizure is not advisable as it is a difficult task and may injure the patient's teeth or oral soft tissues.

Seizure generally do not last for more than a few minutes. The patient may fall into a deep sleep and can not be aroused. Maintenance of patent airway, administration of 100 percent oxygen and suctioning of oral cavity is done. Alternatively, patient can be turned to the side to maintain the airway and prevent aspiration of secretions. In a few minutes the patient will gradually regain consciousness, but may be confused or disoriented. Headache is a prominent feature of this period. If the patient does not respond within a few minutes, the seizure may be associated with low serum glucose and glucose may be administered.

No further dental treatment is attempted after a seizure. Patient is examined for injuries sustained. If avulsion or fracture of teeth or fracture of appliance is suspected, attempt is made to locate the fractured fragment. A chest radiograph is taken to rule out aspiration. If the seizure is prolonged (*status epilepticus*) or if repeated, intravenous diazepam 10 mg or lorazepam 4 to 8 mg is used to control it. The latter is more efficacious and longer lasting. Oxygen and respiratory support is provided.

Patients on anticonvulsant therapy may suffer from toxic effect of these drugs or may have drug interactions and the dental surgeon must be aware of this:

Table 4.14 shows toxicity, untoward effects and drug interactions of anticonvulsant drugs.

### Stroke

Stroke is a generic term used to refer to a cerebrovascular accident caused by sudden interruption of oxygenated blood to the brain most commonly by thrombosis (60 to 80%). Other common causes are cerebral embolism and intracranial hemorrhage. This results in focal necrosis of brain tissue and possibly death.

#### Dental Management of Stroke Patient

1. Identification of risk factors- hypertension, diabetes mellitus, coronary artery disease, smoking, elevated blood cholesterol.
2. Stroke patient's have a feeling of grief, loss and depression. They should be treated with compassion.

**Table 4.14:** Toxicity, untoward effects and Drug interactions of anticonvulsant drugs

Drug	Dental consideration/side effects
Phenytoin, carbamazepine, valporic acid	Bone marrow suppression, leucopenia, and thrombocytopenia resulting in infection, delayed healing, gingival and postoperative bleeding
Valporic acid	Decreased platelet aggregation leading to spontaneous bleeding
Phenytoin	Gingival hyperplasia
Propoxyphene and erythromycin	Interferes with metabolism of carbamazepine leading to toxic level of the drug
Aspirin and NSAIDS	Along with valporic acid, they can further decrease platelet aggregation leading to hemorrhagic episodes

3. Be positive. Do not overestimate the patient's abilities. Use slower, less complex pattern of speech.
4. Medical consultation is done to assess the fitness.
5. Patient's with previous history of stroke are at a higher risk for having another one. Hence, always be cautious.
6. Urgent dental treatment are only done during the first 6 months.
7. Patient's who are on antiplatelet and anticoagulant drugs predispose to bleeding:
  - Aspirin, dipyridamole or other antiplatelet drugs—bleeding time should be estimated. Bleeding time greater than 10 minutes has increased risk for bleeding. Postoperative pain management is with acetaminophen.
  - Coumarin anticoagulants—pretreatment prothrombin time or International normalized ratio (INR) level is estimated. An INR level of 2.5 is acceptable for performing common invasive dental treatment.
  - Heparin—with the permission of the physician discontinue heparin 6 to 12 hours before surgery. Restart heparin after clot forms; usually 6 hours later. Patient's who are on low molecular weight heparin generally requires no changes.
8. Appointments should be short and are scheduled in the morning. **General stress management protocol** should be followed.
9. Local anesthetic with 1:100,000 or 1: 200,000 adrenalin may be used in small amounts (4 ml. or less). Gingival retraction cord impregnated with adrenalin should not be used.
10. Blood pressure should be monitored and a pulse oxymeter should be used to ensure oxygenation is adequate.
11. **Patient's who develop signs of stroke in dental office:** Should be given oxygen and transported to a medical facility immediately. Thrombolytic agents should be administered within 3 hours to be most effective in reestablishing arterial flow.

### **Parkinson's Disease**

This disease first described by James Parkinson in 1817, is a progressive neurodegenerative disorder of neurons

that produce dopamine. The loss of these neurons results in characteristic motor disturbances like tremor, stiffness, shuffling gait, and diminished facial expression.

*Dental Management: is aimed at minimizing the adverse outcome of muscle rigidity and tremor*

1. Maintenance of oral hygiene. If the patient is unable to provide adequate home care, alternative solution should be provided by way of mechanical tooth brushes or mouth rinses. Excessive salivation can result in drooling.
2. Orthostatic hypotension and rigidity are common in patient's with Parkinson's disease. To reduce chances of fall from dental chair, patient should be assisted to and out of dental chair. At the end of procedure the chair should be inclined slowly to allow for re-equilibration.
3. Patients should receive dental treatment at the time of the day when the medication has the maximum effect (generally 2 to 3 hours after taking the drug)
4. Presence of tremors may require the use of soft arm restraints. Conscious sedation is safe.
5. The possibility of drug interactions that should be considered is given in Table 4.15.

### **PATIENTS WITH ORGAN TRANSPLANTATION**

With the development of effective immunosuppressive agents, improved surgical techniques and the acceptance of the concept of "brain death" as a definition for determining the death of potential donors, major advances in organ transplantation has occurred. Kidney, heart, liver, lung, pancreas and bone marrow are the commonly transplanted organs. The ideal combination involves the transplantation of an organ from an identical twin to the other twin (syngeneic). The next best match for organ survival is transplantation of an organ from one living relative to another (allogeneic). This is followed by transplantation of an organ between living nonrelated individuals (xenograft).

### **Dental Management**

Requires consideration in the two phases of transplantation.

## 54 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

**Table 4.15:** Drug interactions of concern

Drug	Dental consideration
Antiparkinson's drugs	Generally CNS depressants. Hence sedatives have an additive effect. Most of the drugs cause xerostomia; resulting in dysphagia and poor denture retention. Use of salivary substitutes and in dentate cases topical fluoride application to be considered.
Catechol-O-methyltransferase (COMT) inhibitors-Tolcapone(Tasmar), Entacapone (Comtan)	Caution with use of vasoconstrictors. Adrenalin may interact with COMT inhibitors to cause tachycardia, dysrhythmias and hypertension. Limit the dose of LA to maximum 2 cartridges containing 1:100,000 adrenalin (36 microgram) and monitor the patient
Dopamine Agonist—Pramipexole (Mirapex)	Adversely reacts with Erythromycin. Hence Erythromycin should not be given
Dopamine Agonist—Pramipexole (Mirapex)	Causes sudden onset of sleepiness
Dopamine Agonist—Pergolide (Permax)	May induce cardiac valvulopathy; need for endocarditis prophylaxis to be considered

- A. Pretransplant period- a number of medical problems must be considered during the dental management of patient's being prepared for transplantation
- B. Post-transplant period- here the patients fall into three groups:
  - 1. Immediate post-transplant period
  - 2. Stable transplant period
  - 3. Chronic rejection period
- 5. Laboratory tests- PT, APTT, BT, Platelet count, WBC and DC.

### *Post-transplant Period*

*Immediate post-transplant period (6 months):* During this phase operative complications and acute rejection of graft are the major medical concerns.

- Avoid routine dental treatment
- Continue oral hygiene measures
- Provide emergency dental care as needed after medical consultation. Only noninvasive and conservative measures are employed.

*Stable graft period*—Once the graft has healed and the acute rejection reaction has been controlled, the patient is considered to be in the stable phase. This period should be confirmed with the transplant surgeon. Usually any indicated dental treatment can be performed during this period provided the necessary precautions are taken. However, some problems can occur depending on the organ that has been transplanted like increased risk of infection, viral infection, excessive bleeding, adverse reaction to stress and hypertension.

- Maintain oral hygiene measures and periodic recall program.
- Medical consultation regarding present status of patient
- Treat all new dental disease
- Employ universal precautions

### *Pretransplant Period*

Patient being prepared for transplantation should be evaluated for their dental status. Patient with active dental disease should receive the necessary treatment before transplantation. Oral cavity is cleared of all focus of infection.

- 1. Medical consultation is done before starting any invasive dental treatment to assess- degree of organ failure, need for antibiotic prophylaxis, need to modify drug selection or dosage, precautions to avoid excessive bleeding and other special management procedures that may be required.
- 2. Extraction of nonrestorable teeth and those with advanced periodontal disease.
- 3. Endodontic treatment when indicated.
- 4. Initiate active oral hygiene measures- oral prophylaxis, tooth brushing, flossing, topical fluoride application and plaque control measures.

**Table 4.16:** Relative safety of drugs commonly used in dentistry and primarily metabolized by liver and kidney

<i>Drug</i>	<i>Relative safety in normal dose</i>	<i>Any dose adjustment required</i>
<b>Local anesthetic</b> —Lidocaine	Yes	Not required
<b>Analgesics</b> —Aspirin	No	Avoid if possible
Acetaminophen	No	Avoid if possible
Ibuprofen	Yes	Not required
Propoxyphene	Yes	Not required
Codeine	Yes	Not required
Meperidine	Yes	Not required
<b>Antibiotics</b> —Penicillin V	No	Increase interval between doses
Erythromycin	Yes	Not required
Cephalexin	No	Increase interval between doses
Tetracycline	No	Avoid if possible
Diazepam	Yes	Not required

- Avoid infection- antibiotic prophylaxis, WBC count, DC, CD4 and CD8 counts
  - Avoid excessive bleeding
  - Selection of drug and dose based on its safety in liver and kidney disease
- Table 4.16 shows the relative safety of drugs commonly used in dentistry and primarily metabolized by liver and kidney.
- Identify the need for steroid supplements before dental treatment
  - Examine for oral signs and symptoms of over immunosuppression or graft rejection. Oral findings that may indicate over immunosuppression include mucositis, herpes simplex infection, herpes zoster, CMV, candidiasis, large and slow to heal aphthous ulcers, alveolar bone loss, rarely lymphoma, Kaposi's sarcoma, hairy leukoplakia and squamous cell carcinoma of lip. Oral findings associated with graft rejection are same as those found in patients with organ failure before transplantation

The recommendation for antibiotic prophylaxis in post transplantation patients are somewhat different from infective endocarditis prophylaxis. The basic prophylactic regimen is as follows:

- Amoxicillin 2 gm orally + Metronidazole 500 mg 1 hour preoperatively

- If allergic to penicillin- Vancomycin 1gm I/V infused slowly 1 hour preoperatively
  - If unable to take oral medication- Ampicillin 2 gm I/V + Metronidazole 500 mg 1 hour preoperatively
- Chronic rejection period:* The third post transplant period begins when significant signs and symptoms appear of chronic rejection of the graft. This phase should be established by medical consultation
- Render only immediate or emergency dental treatment.

### Chronic Renal failure

Chronic renal failure (CRF) results from progressive and irreversible renal damage as indicated by a reduced glomerular filtration rate. The causes of CRF include chronic glomerulonephritis, chronic pyelonephritis, congenital renal anomalies, hypertension and diabetes. In CRF renal malfunction is asymptomatic at first, but later on there is significant impairment of all renal functions with effect on nearly all body systems. The symptoms and signs of CRF depend on the degree of renal malfunction. Early features include nocturia, anorexia and vomiting. In the later stages, CRF is complicated by other problems like hypertension, anemia, congestive cardiac failure, infections, bleeding tendency, electrolyte imbalance and biochemical disturbances.

## 56 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

### Dental Management of Patients with Chronic Renal Failure

The dental management is complicated by the following associated problems of the disease:

1. Impaired drug excretion
2. Corticosteroid or other immunosuppressive therapy following renal transplantation
3. Hypertension
4. Infections at arteriovenous shunts
5. Bleeding tendency and anticoagulant therapy
6. Infections and Hepatitis B carrier state
7. Anemia

**Drugs:** Many of the drugs are excreted by the kidney and may therefore have undesirably enhanced or prolonged activity if dosages are not reduced. While certain other drugs will aggravate the damage of the diseased kidney. Table 4.17 shows drugs that should be used with caution or avoided in chronic renal failure. It is recommended that drugs should be prescribed only after consultation with the nephrologist, except in emergency.

**General anesthetics:** Procedures requiring general anesthesia should not be carried out in the dental surgery in patients with CRF. Moreover, patients with CRF are highly sensitive to the myocardial depressant effects of halothane and may develop hypotension at moderate levels of anesthesia.

**Antacids:** These drugs containing magnesium salts should not be given as there may be magnesium retention. Antacids containing calcium or aluminum bases may impair the absorption particularly of tetracyclines, but also of penicillin-V and sulphonamides.

Patients with renal transplants are immunosuppressed, usually with corticosteroids and may need steroid supplementation before dental procedure. Dental surgery should be carried out under antibiotic prophylaxis due to the susceptibility of immunosuppressed patients to infections especially at the arteriovenous fistulas. Many of the patients may be on antihypertensive therapy, digoxin and diuretics which may also complicate the management.

**Bleeding tendency:** Hemostasis is impaired in CRF as a result of reduced platelet function. Patients on hemodialysis are heparinized during dialysis. Hence careful hemostasis should therefore be ensured if oral surgical procedures are necessary. Dental treatment is best carried out on the day after dialysis, when there has been maximum benefit from dialysis and the effect of the heparin has worn off. But the hematologist / nephrologist should first be consulted before planning the treatment.

**Infections:** In patients with CRF odontogenic infections should be treated vigorously due to reduced host resistance. Oral candidosis can be managed with topical nystatin or miconazole.

**Table 4.17:** Recommended drug usage in chronic renal failure

Type of drug	Avoid	Reduce dosage	No dosage change
Antimicrobials	Tetracycline Oxytetracycline Streptomycin Gentamicin Sulphonamides	Benzylpenicillin Ampicillin Amoxycillin Methicillin Cephalexin Metronidazole Co-trimoxazole	Cloxacillin Erythromycin Cephalothin Doxycycline
Analgesics	Aspirin Paracetamol Phenacetin	Opiates Propoxyphene	Codeine Pentazocine
Hypnotics and sedatives	Phenobarbitone Antihistamines	Chlorpromazine Promethazine Chlordiazepoxide	Diazepam Chloral hydrate

**Anemia:** CRF is invariably complicated by anemia. General anesthesia is contraindicated if the hemoglobin level is below 10 mg/dl.

### Nephrotic Syndrome

Nephrotic syndrome is characterized by massive proteinuria with hypoalbuminemia, edema, and hyperlipidemia. Edema of the face, lower limb and genitals develop. Loss of immunoglobulins in urine predisposes to infections. Unlike in CRF initially there is neither hypertension nor increased blood urea. But serum cholesterol is raised.

#### Dental Management of Patients with Nephritic Syndrome

Many of the considerations in the management of the patient with chronic renal failure are also applicable to the nephrotic patient. Long term corticosteroid therapy is the main problem.

Patients with nephrotic syndrome are susceptible to cardiovascular disease because of hypercholesterolemia.

The blood concentrations of factor VIII, fibrinogen and other clotting factors are raised in the nephrotic syndrome leading to a hypercoagulable state. This may lead to spontaneous thrombosis. Hence patients are often treated with heparin, which in turn will affect the dental management of these patients.

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# 5

# Management of Odontogenic Infections

**George Philip**

Odontogenic infection, being the most common infections of the head and neck region, is always challenging to the Dental Surgeons. Most of these infections subside with simple treatments like antibiotics and extraction of the offending tooth, but some of them can progress to life threatening infections. Hence early intervention is required to prevent the unwanted spread of the infection to other areas.

## **FACTORS INFLUENCING THE SPREAD OF INFECTIONS**

### **General**

Include host resistance and bacterial virulence and quantity.

In a healthy individual, the microorganism should have sufficient concentration and a high degree of invasiveness to overcome the host resistance for the disease to set in. But when the person's resistance is compromised as in uncontrolled diabetics, rapid bacterial multiplication and spread can result even with a few organisms of relatively low virulence.

### **Local**

Odontogenic infections first involve the periodontal structures and causes periapical infection.

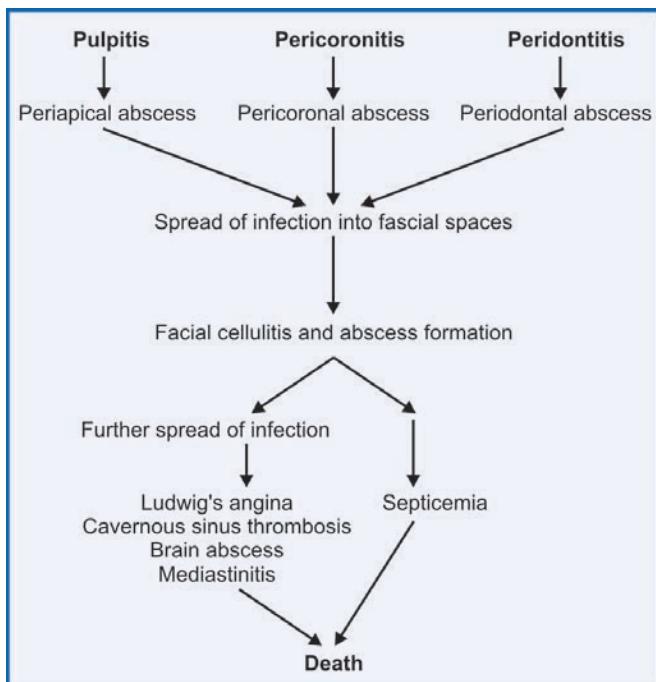
The body tries to confine the infection to local anatomic areas. The alveolar bone represents the first locally limiting barrier to the further spread of a periapical

infection. Once this barrier is crossed, it is the periosteum which tries to limit further spread, producing a sub periosteal abscess. But periosteum being a thin barrier, the infection spreads to the surrounding soft tissue. Then the anatomic arrangement of the adjacent muscles and fascia determines the spread or localization of the infection. The so called 'fascial spaces' of the head and neck are potential spaces in the anatomic area which communicate with each other directly or indirectly. They are only relative barriers and if either the host resistance or proper medical and surgical treatment does not control the spread of infection, it can extend down to the deeper regions of the neck and even into the mediastinum (Fig. 5.1).

## **SITES OF LOCALIZATION OF DENTAL INFECTION**

### **Primary Sites of Localization of Dental Infections**

As already mentioned, the alveolar bone tries to confine the infection within it. But if the balance between host resistance and bacterial activity is such that spread of infection is favoured, then the bone erodes to give way to the further spread of infection. This is in a relatively radial manner, until it comes out through one of the cortical plates. Thus this penetration occurs at the area of least resistance and a knowledge of the relation of the root apices to the alveolar process helps us to predict the area of perforation. Further localization is also influenced by the muscle or fascial attachments of the area.



**FIGURE 5.1:** The flow chart shows the natural course of acute odontogenic infection

Table 5.1 summarizes the areas of localization of infection originating from various teeth.

A knowledge of the anatomy of the different fascial spaces of the head and neck area is necessary to predict the localization, spread of the infection and also to design the incision for drainage. Once pus is formed, proper drainage is essential for the resolution of the disease process.

The so called ‘fascial spaces’ are not actually existing as spaces or lacunae within the body. Shapiro states that “the fascial spaces are potential areas between layers of fascia. These areas are normally filled with loose connective tissue which readily breaks down when invaded by infection”.

A study of the detailed anatomy of the different tissue and fascial spaces into which odontogenic infection can spread is not possible to be confined to a single chapter. However at least a rough idea of the boundaries of different spaces, clinical features when that space is invaded by infection and the anatomic landmarks for incision to drain the pus, is essential for the proper management of the infection.

**Table 5.1: Areas of localization of odontogenic infections**

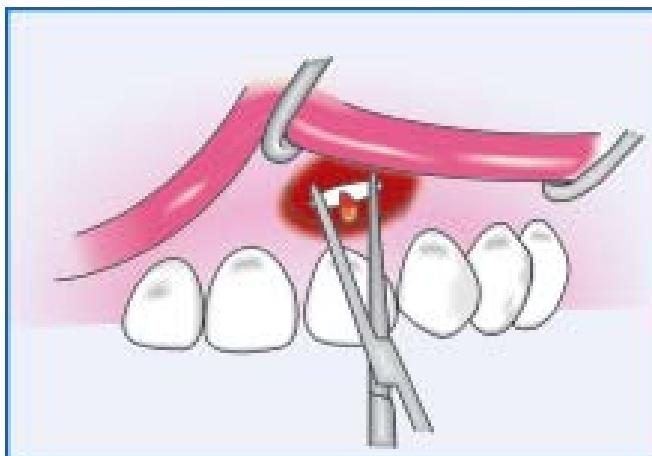
Tooth	Area of Localization
<b>Maxillary teeth</b>	
Central incisor	Oral vestibule (labially)
Lateral incisor	Oral vestibule if root tip is labial Palate if root tip is palatal
Canine	Oral vestibule if apex is below the attachment of muscles (levator muscles of the lip) Canine space if the apex is above the muscle attachment. (This produces a bulge lateral to the nose obliterating the nasolabial fold)
Premolars	Oral vestibule (buccally) Palate (if infection exists palatally) Canine space (rarely in long rooted first premolars)
Molars	Oral vestibule (if attachment of buccinator is above the apex) Buccal space (if buccinator attached below the root apex) Palate (if palatal root is involved) Maxillary antrum (if root is in the antrum)
<b>Mandibular Teeth</b>	
Incisors	Oral vestibule (if mentalis muscle is attached below the root apex) Submental space (if muscle is attached above the root apex)
Canine	Oral vestibule (Labially)
Premolars	Oral vestibule (buccally)
First molar	Oral vestibule (if attachment of buccinator below the root apex) Buccal space (if attachment is above the root apex) Sublingual space (if the exit of infection is lingual)
Second molar	Oral vestibule (if exit is buccal above the buccinator) Buccal space (if exit is buccal below the buccinator) Sublingual space (if the exit is lingual above the mylohyoid, i.e. the muscle attachment below the root apex)
Third molar	Submandibular space (if the exit is lingual below the mylohyoid, i.e. the muscle attached above the root apex) Submandibular or pterygomandibular space—as the exit is usually lingual Submasseteric space—due to buccal spread usually from pericoronitis or when root apex of an impacted tooth is abnormally close to the buccal surface

### Oral Vestibule and Palate

**Boundaries:** When the abscess is localized within the oral vestibule or palate, the collection of pus is sub periosteal—between the mucoperiosteum and the alveolar bone.

**Clinical features:** A fluctuant swelling in an area corresponding to the focus of infection (offending tooth).

**Incision for drainage**—At the most dependant part of the swelling. Make sure the periosteum is incised and bone is contacted (Fig. 5.2). A rubber drain is placed if necessary and sutured in place.



**FIGURE 5.2: Hilton's method of abscess drainage**—A small incision is made using a # 11 or # 15 blade. A mosquito forceps is inserted closed through the incision and then gently opened to establish drainage of pus.



**B. Incision using 11 blade**



**C. Pus drained**



**A. Abscess**



**D. Drainage completed**

**FIGURES 5.3A TO D:** Steps in the intraoral incision and drainage of abscess

### *Canine Space*

**Boundaries:** Between the levator muscles of the lip and the anterior surface of the maxilla.

**Clinical features:** A swelling lateral to the nose (Fig. 5.4) obliterating the nasolabial fold. It may point near the inner canthus of the eye.



**A.** Clinical appearance



**B.** Intraoral bulge showing abscess formation

**FIGURES 5.4A AND B:** Canine space infection

**Incision for drainage:** Intraorally high in the maxillary labial vestibule. A sinus forceps or artery forceps can be inserted up to reach the abscess cavity and a drain placed.

### *Buccal Space*

**Boundaries:**

**Medially**—The buccinator muscle and the covering buccopharyngeal fascia.

**Laterally**—The skin and subcutaneous tissues.

**Anteriorly**—The posterior border of the zygomaticus major muscle above and depressor anguli oris muscle below.

**Posteriorly**—The anterior edge of the masseter muscle.

**Superiorly**—The zygomatic arch.

**Inferiorly**—The lower border of the mandible.

**Clinical features:** Dome shaped swelling of the buccal area (Fig. 5.5) limited above by zygomatic arch, below till the lower border of mandible, posteriorly till the area of the anterior border of masseter muscle.



**FIGURE 5.5:** Buccal space infection

**Incision for drainage**—Intraoral incision can be made through buccinator muscle below the occlusal line just above the depth of the vestibule. But the muscle contraction will easily close the opening.

Extraoral incision is preferred. It is placed below the lower border of the mandible to avoid visible scar. Sinus forceps is used to break the tissues and enter the space.

### *Submental Space*

**Boundaries:** Located in the midline and bounded laterally by the anterior belly of digastric, superiorly by the mylohyoid and inferiorly by the skin, superficial fascia, platysma muscle and deep cervical fascia.

**Clinical features:** Swelling limited to the point of the chin (Fig. 5.6) and the region immediately below it.

**FIGURE 5.6:** Submental space infection

*Incision for drainage:* One or two incisions at the lower margin, hiding it below or behind the lower border of the mandible

#### *Sublingual Space*

*Boundaries:* Inferiorly mylohyoid muscle, laterally and anteriorly the lingual surface of the mandible, superiorly the mucosa of the floor of mouth, posteriorly at the midline by the body of the hyoid bone, and medially by the geniohyoid, genioglossus and styloglossus.

*Clinical features:* Swelling of the floor of the mouth and subsequent elevation of the tongue (Fig. 5.7). Infection from this space can easily cross over to the other side and also can spread down.

**FIGURE 5.7:** Sublingual space infection

*Incision for drainage:* Intraorally at the base of the alveolar process in the lingual sulcus, taking care of the sublingual gland, lingual nerve and submandibular duct. It may be necessary to incise the periosteum on the inner surface of the mandible at the area of the offending tooth. If the sublingual space is involved bilaterally, incision should be placed on both sides.

#### *Submandibular Space*

##### *Boundaries:*

*Laterally*—The skin, superficial fascia, platysma and superficial layer of the deep cervical fascia.

*Medially*—The mylohyoid, hyoglossus and styloglossus.

*Inferiorly*—The anterior and posterior bellies of digastric

*Superiorly*—The medial aspect of the mandible and the mylohyoid attachment.

*Clinical features:* Swelling of the triangular area beginning at the lower border of the mandible and extending to the level of the hyoid bone. Patient may have pain on swallowing. Trismus is absent or mild (Fig. 5.8).

**FIGURE 5.8:** Submandibular space infection

*Incision for drainage:* Placed below the lower border of mandible and dissection is done with a sinus forceps or curved artery forceps. Sinus forceps is introduced in all the directions to break the locules of pus. A drain is then secured.

Bilateral involvement of the submental, sublingual and submandibular spaces is referred to as Ludwig's angina. This is a serious clinical condition warranting immediate treatment with separate incisions for drainage of all the spaces (Discussed in detail later in the chapter).

### *Pterygomandibular Space*

#### *Boundaries:*

*Laterally*—By the medial surface of the ramus of mandible.

*Medially*—By the medial pterygoid muscle.

*Anteriorly*—By the pterygomandibular raphe.

*Inferiorly*—By the pterygomasseteric sling.

*Superiorly*—By the lateral pterygoid.

*Posteriorly*—By the deep part of the parotid and communicates with the lateral pharyngeal space.

It is into this space that we insert the needle for the inferior alveolar nerve block.

*Clinical features:* Characterised by absence of external swelling if this space is involved alone. The trismus will be marked and may hinder proper intraoral examination (Fig. 5.9). Intraorally, there will be anterior bulging of half the soft palate and anterior tonsillar pillar with resultant deviation of the uvula to the unaffected side. This has to be differentiated from Quinsy (peri tonsillar abscess) where the swelling is more posterior with less trismus and no dental involvement.



**FIGURE 5.9:** Pterygomandibular space infection

*Incision for drainage:* Intra orally through the mucosa in the area between the medial aspect of the ramus and the pterygomandibular raphe (where we insert the needle for inferior alveolar nerve block).

### *Submasseteric Space*

#### *Boundaries:*

*Laterally*—The masseter muscle

*Medially*—The lateral surface of the ramus of the mandible.

*Anteriorly*—The parotido masseteric fascia,

*Posteriorly*—The parotid gland and fascia.

*Superiorly*—It extends to the level of the zygomatic arch and communicates with infratemporal space.

*Clinical features:* Severe pain and tenderness over the ramus of mandible along with severe trismus. The swelling is mainly at the angle of the mandible and is limited to the zygomatic arch superiorly and the anterior border of the masseter muscle anteriorly (thus limiting posterior to the posterior boundary of the buccal space infection).

*Incision for drainage:* Intraoral—vertical incision along the external oblique line of the mandible. A sinus forceps or artery forceps is inserted posteriorly along the lateral aspect of the ramus of mandible to the abscess area.

*Extraoral:* Below the angle of the mandible to hide the scar. It will be necessary to incise or bluntly dissect the fibres of the masseter to enter the abscess cavity.

### **Secondary Sites of Spread of Odontogenic Infections**

Since many of the fascial spaces of the head and neck region communicate with each other directly or indirectly, the infection, if not controlled, can spread from one to other and can reach even up to the mediastinum. Some of the spaces involved are summarized below.

### *Parotid Space*

*Boundaries:* Formed by the superficial layer of the deep cervical fascia surrounding the parotid gland.

**Route of spread**—Usually blood borne or through the parotid duct. It also has close proximity to submasseteric, pterygomandibular and lateral pharyngeal spaces and rarely infection can spread from these spaces.

**Clinical features:** Severe pain which increases at times of eating. Patient may be dehydrated. There will be swelling of the preauricular region, the angle region of mandible and retromandibular region characteristically lifting the ear lobule. If the space is involved alone, trismus may not be that marked.

**Incision for drainage:** Extraoral incision behind the posterior border of the mandible from lobule of ear to the angle of mandible. The various lacunae can be approached by blunt dissection.

### Infratemporal Space

**Boundaries:**

**Medially**—The lateral pterygoid plate, part of lateral pterygoid muscle and lateral pharyngeal wall

**Superiorly**—Greater wing of sphenoid

**Laterally**—The coronoid process and the tendon of temporalis

**Anteriorly**—Infratemporal surface of the maxilla

**Inferiorly**—It communicates with the pterygomandibular space.

**Routes of spread**—Can be from the pterygomandibular space or buccal space. From the infratemporal space, infection can spread into the cavernous sinus through the pterygoid plexus of veins.

**Clinical features**—Extraoral swelling may be noticed over the region of sigmoid notch. Intraoral swelling is in the tuberosity area. There will be marked trismus.

**Incision for drainage**—Intraorally, a vertical incision just medial to the upper part of the anterior border of the ramus of mandible. A sinus forceps or artery forceps may be inserted just medial to the coronoid process into the space. It can also be approached extraorally by a small horizontal incision posterior to the junction of the frontal and temporal processes of the zygoma.

### Temporal Space Infection

**Boundaries:** There are two temporal spaces—a superficial and a deep.

**Superficial temporal space** is bounded laterally by the temporalis fascia and medially by the temporalis muscle.

**Deep temporal space** is bounded laterally by the medial surface of the temporalis muscle and medially by the temporal bone and the greater wing of sphenoid.

**Clinical features:** Superficial temporal space infection produces a swelling limited superiorly and laterally by the limits of the temporalis fascia and inferiorly by the zygomatic arch. When this is associated with a buccal space abscess the swelling will have a characteristic dumb bell shape as there will not be any swelling in the zygomatic arch area. Extended fascia causes severe pain and involvement of the muscle results in marked trismus.

Deep temporal space abscess does not produce a marked swelling. Pain and trismus will be severe. Both these spaces communicate with each other indirectly via the infratemporal space and the ascending infections in most cases involve both the spaces simultaneously.

**Route of spread:** is by ascending infection from the infra temporal space. So infection from the molars secondarily involves this space.

**Incision for drainage**—Intraorally the same incision as that used for draining infratemporal space can be used. An instrument passed up lateral to the coronoid process enters the superficial temporal space, and that passed medial to the process will enter the deep temporal space.

Extraorally a horizontal incision above the zygomatic arch (as for infratemporal space) can be used for drainage. Intraoral incision provides a completely dependent drainage and also avoids the problem of the muscle fibres contracting and closing the incision wound as may occur in case of extraoral drainage.

### Pharyngeal Space Infection

#### Lateral Pharyngeal Space

**Boundaries**

**Medially**—The lateral wall of the pharynx

**Laterally**—The fascia of the medial pterygoid and deep capsule of parotid.

**Posteriorly**—The carotid sheath and the stylohyoid, styloglossus and stylopharyngeus muscles.

*Superiorly*—The base of the skull.

*Inferiorly*—It extends up to the level of the hyoid bone.

*Clinical features*—Severe pain on the affected side of throat and difficulty in swallowing. There may be signs of sepsis. Trismus will be severe and will hinder proper intraoral and intralaryngeal examination.

*Routes of spread*—Usually from the pterygomandibular, submandibular and sublingual spaces.

*Further spread of infection*—From this space, infection can spread upwards to the base of skull and up into the cranial fossae causing cavernous sinus thrombosis, meningitis or brain abscess. It can also spread posteriorly into the retropharyngeal space and carotid sheath.

*Incision for drainage*: Intraoral incision similar to that used for draining pterygomandibular space. The instrument has to be passed posteromedially into the lateral pharyngeal space.

*Extraoral incision*—Anterior and inferior to the angle of the mandible and a sinus forceps or artery forceps is passed superiorly and medially medial to the medial pterygoid.

### **Retropharyngeal Space**

#### *Boundaries*

*Anteriorly*—The posterior wall of the pharynx.

*Posteriorly*—The vertebral column and alar fascia

*Clinical features*—Pain, dysphagia, dyspnea and nuchal rigidity. Lateral soft tissue X-rays can show the bulge and narrowing of the airway. CT scan also may be helpful.

*Routes of spread*—Usually from the lateral pharyngeal space.

*Further spread of infection*—Infection can spread from here to the mediastinum causing mediastinitis (Fig. 5.10).

*Incision for drainage*—Drainage of the lateral pharyngeal space may be sufficient to drain this space as well. If independent drainage is required a vertical incision may be given in the mucosa of the posterior pharyngeal wall lateral to the midline. The patient should be in a Trendelenburg position to avoid aspiration of the pus.



**FIGURE 5.10:** Spread of odontogenic infection from the neck leading to mediastinitis

If there is concern about rupture of the abscess during intubation, tracheotomy may be necessary to avoid aspiration.

### **COMPLICATIONS OF ODONTOGENIC INFECTION**

#### **Ludwig's Angina**

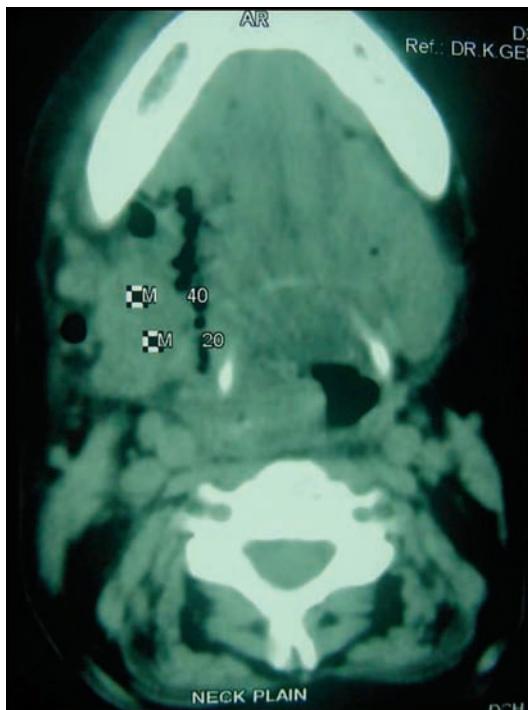
This is defined as a bilateral swelling of the sublingual, submandibular and submental spaces. Though this has been described as a clinical entity from olden days, the name was given following Ludwig's classic description of the condition in 1836.

The swelling develops and spreads rapidly. It will be brawny, nonfluctuant and tender. The floor of the mouth and tongue will get elevated with resultant difficulty in breathing and drooling of saliva from the mouth (Fig. 5.11). If untreated, this can lead to edema of the glottis, with danger of asphyxiation. It can also spread to the mediastinum and can cause septicemia, mediastinitis or aspiration pneumonia (Fig. 5.12).

*Treatment*—To relieve airway obstruction, either endotracheal intubation or tracheostomy may be needed urgently.



**FIGURE 5.11:** Ludwig's angina—Clinical appearance



**FIGURE 5.12:** CT scan of the patient in Fig.5.11 showing spread of infection to parapharyngeal space

Bilateral separate incision for drainage of submandibular, submental and intraoral incision for sublingual spaces are required. Even though there may not be any pus, incisions are advocated to relieve the tension. High dose of antibiotics are required empirically and may be changed after culture and sensitivity tests.

### Cavernous Sinus Thrombosis

This is one of the major complications of abscess of the orofacial region. This may occur as a result of direct extension through the venous system (septic thrombophlebitis) or by spread of infected emboli.

The infection can originate from the teeth or from furunculosis or infected hair follicles in the nose. The organism responsible is usually staphylococci.

The initial symptoms are usually pain in the eye and tenderness to pressure. There may be high fluctuating fever, chills, rapid pulse and sweating. There may be edema of the eyelids, lacrimation, proptosis and retinal hemorrhages. There will also be involvement of cranial nerves—occulomotor, trochlear, abducent, ophthalmic division of the trigeminal and carotid sympathetic plexus—resulting in ophthalmoplegia, altered or absent corneal reflex, ptosis and dilatation of the pupil. This may progress to toxemia and meningitis and mortality is high.

Eagleton suggested the following criteria for diagnosis of cavernous sinus thrombosis: (1) known site of infection (2) evidence of blood stream infection (3) early signs of venous obstruction in the retina, conjunctiva or eyelid (4) paresis of the third, fourth and sixth cranial nerves (5) abscess formation in the neighboring soft tissue (6) evidence of meningeal irritation.

Treatment is by high dose of broad spectrum antibiotics, the choice of which has to be justified with culture and sensitivity. The use of anticoagulants to prevent venous thrombosis has been recommended.

Even with modern antibiotics, successful outcome of the treatment cannot be guaranteed especially if the condition is already well established.

### Brain Abscess

This is due to organisms reaching the brain from bacteremia accompanying an odontogenic infection, causing inflammation, edema and septic thrombosis. Organisms mostly responsible are streptococcus viridans, streptococcus pyogenes and staphylococcus aureus.

Signs and symptoms vary depending on the site involved. There may be headache, nausea and vomiting. There may also be hemiplegia, papilledema, convulsions, alteration in personality, confusion and abducent palsy. CT Scanning may be helpful in diagnosis.

Treatment includes drugs like steroids and mannitol in addition to antibiotics to reduce cerebral edema. Craniotomy and surgical evacuation of pus may be required. Early treatment is required for a better prognosis.

### Meningitis

The bacteria from odontogenic infections can reach the lepto meninges in septic emboli through the veins or arteries, causing meningitis.

The condition is characterized by headache, fever, stiffness of the neck and vomiting. The patient may become confused and can go into coma. Convulsion may occur. Kernig's sign and Brudzinski's sign may be present. Lumbar puncture and CSF analysis may be required for diagnosis.

The treatment is medical rather than surgical. High dose of antibiotics supplemented with proper hydration and electrolyte balance and measures to avoid vascular collapse and shock are required in the treatment.

### Necrotizing Fasciitis

This is an aggressive infection that affects the superficial fascia with undermining of the overlying soft tissues. This more commonly occurs in the fascia of trunk and extremities but though rare can occur in the maxillofacial region especially involving the lower face and neck. The disease usually affects medically compromised patients like debilitated patients or those with diabetes mellitus. This condition is also referred to as hospital gangrene, gangrenous erysipelas or hemolytic streptococcal gangrene. This is a possible complication due to spread of odontogenic infection to the neck.

The affected area becomes swollen and erythematous and patient may have low grade pyrexia initially. With progression of the disease, pain may subside as cutaneous nerves become necrotic and this may result in anesthesia of the area. The skin overlying the necrosed fascia will appear dusky and gas may form beneath it. As nutrient

vessels to the skin get thrombosed, skin develops bullae (Fig: 5.13 A) and starts to necrose. Frank gangrene later results with sloughing of the skin, exposing the underlying necrotizing fascia and subcutaneous fat (Fig: 5.13 B).

Systemic manifestations include sepsis, hemolysis, and shock. Jaundice and hemoglobinuria can occur as a result



**A. At the time of admission**



**B. 10th day**

of hemolysis. If not treated promptly at an early stage, mortality rate is high.

Microorganisms responsible for the condition include hemolytic streptococci, *Staphylococcus aureus* and anaerobes.

Treatment includes management of both local and systemic problems. Shock should be corrected by proper fluid replacement. Renal function should be monitored.



C. 16th day



D. One week after admission skin grafting

**FIGURES 5.13A TO D:** Necrotizing Fasciitis

The affected area should be debrided as early as possible with removal of necrotic tissue and clearing the infected planes. The undermined areas should be packed with gauze impregnated with antibacterials like sulfadiazine. Debridement should be carried out daily.

Antibiotics should be given intravenously in high doses. Samples should be sent early enough for culture and sensitivity and antibiotics may be changed based on the results. Combination of antibiotics may be required to cover gram positive, gram negative and anaerobic organisms. Once the infection has resolved, the skin reattaches to the fascia and regains vascularity. Lost skin can be replaced by skin grafting (Figs 5.13 C and D),

as extensive necrosis can result in disfigurement of the area.

### **GENERAL MANAGEMENT OF ODONTOGENIC INFECTION**

The specific treatment of an odontogenic infection varies depending on the stage of the infection and the physiologic response of the patient.

A patient having periapical osteitis (infection) or cellulitis without any toxic symptoms (chills, sweating, malaise or anorexia) may be treated with oral antibiotics and analgesics and extraction of the offending tooth.

However patients with toxic symptoms are best treated on an inpatient basis. Investigations to be done at the time of admission include

1. Routine blood examination including differential count—this will show leukocytosis with neutrophilia. The neutrophils may show a shift to the left with more number of less mature cells.
2. Urine sugar and blood sugar—Undetected or uncontrolled diabetes mellitus may be the reason for the sudden onset of the disease process and has to be ruled out.
3. Relevant X-rays or CT scan—To help confirm the focus of infection and also to rule out any undetected pathology on clinical examination. Lateral oblique or panoramic view of the jaws may be sufficient to note the possible focus of infection. Additional periapical radiographs may be taken if required.

Lateral soft tissue X-ray of the neck is helpful in ruling out retropharyngeal space infection. CT scan is helpful in finding out deep seated infection and distant spread of infection.

4. Culture and sensitivity tests—if there is spontaneous drainage of pus or if an incision and drainage is planned, specimen should be sent for culture and sensitivity, if possible before giving any antibiotic. But in toxic cases incision and drainage may better be delayed till a prophylactic antibiotic dosage is given. In such cases the antibiotic being given should clearly be mentioned in the requisition for the test.

Antiseptics should be avoided in preparing the site of incision for drainage of the abscess. If at all used, the area should be thoroughly cleansed with normal saline to remove any antiseptic left behind.

The specimen should be collected in a sterile way, placed in a sterile container with a suitable medium, properly labeled and transported immediately to the lab. Separate specimens should be given for aerobic and anaerobic cultures and gram staining.

### Obtaining Specimen/pus for Microbiological Examination

Culture and sensitivity of pus can be of great assistance to the dental surgeon undertaking the treatment of infections of dental origin, for not only can pathogenic microorganism be isolated but their sensitivity to various antibiotics can be determined by means of *in vitro* tests. Therefore the dental surgeon should lose no opportunity of enlisting the aid of an experienced microbiologist. Special care should be taken during the collection of samples for microbiological examination, in order to ensure that the specimen reaches the laboratory in optimum condition. Different microbiological laboratories favor differing methods of collection, packaging and disposal of specimens, and the dental surgeon should ensure that he is fully conversant with, and observes, the requirements of the particular laboratory. Containers and swabs should be obtained in advance from the microbiological laboratory and ready at hand so that they are available when required.

Whenever possible, samples of pus should be obtained by means of aspiration. After cleansing the skin or mucosa overlying the collection of pus with saline, the tissue is punctured with a sterile large-bore needle. Pus is then obtained by means of aspiration into a sterile syringe and transferred to a sterile, labelled, screw-capped bottle of appropriate size, and sent immediately to the microbiological laboratory. Fluid specimens should never be sent in test-tubes plugged with cotton-wool, since this may result in spillage of the specimen.

Specimens being sent for examination should be accompanied by a request form containing the following details:

- Patient particulars
- Summary of the case history
- Provisional diagnosis
- Examination desired (e.g. culture and sensitivity test)
- Any particular culture methods desired.

- Type, amount, and timing of antibiotic therapy already given

Swabs can also be obtained at the time of incision and drainage. When an extra-oral incision is made, the type of swab illustrated in the Figure 5.14 may be employed. It consists of a thin wooden stick, around one end of which some cotton-wool is twisted. The whole is enclosed in a long test tube, the mouth of which is closed with a cotton-wool plug. The swab and its container are sterilized prior to use.



**FIGURE 5.14:** Microbiological swab

It is most convenient if an assistant takes a swab of the pus which is liberated when the operator opens the blades of the sinus forceps as shown in the figure. The sterile swab is removed from its container just before the sinus forceps are inserted (Figs 5.15A to C). The swab is then withdrawn, taking care that it does not touch any other site before being replaced in the container. It is then sent to the laboratory along with the requisition form containing details listed above.

The specific treatment of infection involves surgical, medical and supportive therapy.

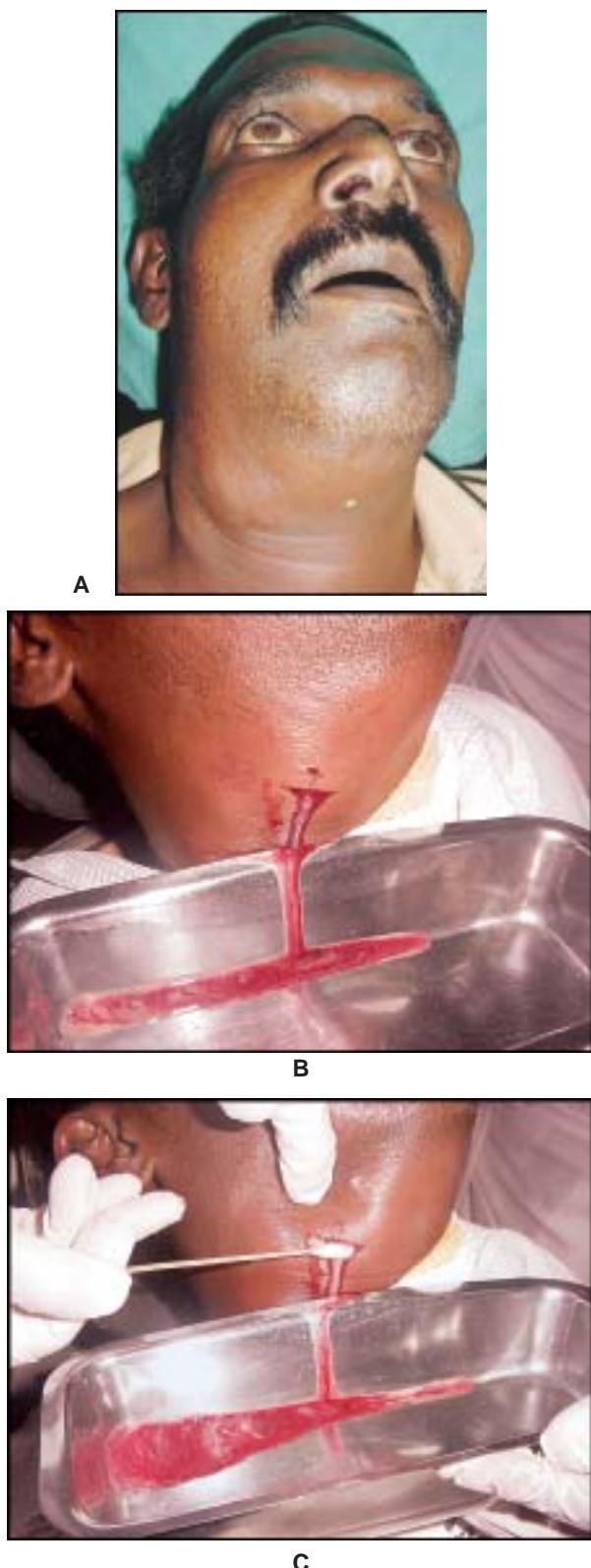
#### Surgical

This consists of extraction of the offending tooth or teeth, incision and drainage or a combination of the two. In nontoxic, nonabscessed cases, extraction of the tooth alone may be necessary.

**But in established abscesses or toxic cases, incision and drainage may have to be done first and the tooth extraction may be done as a secondary procedure.**

Before performing incision and drainage presence of pus has to be confirmed by aspiration using a wide bore needle or by bimanual palpation to elicit fluctuation as shown in the Figure 5.16.

In deep seated infection it may be difficult to elicit fluctuation by palpation. In such cases the presence of

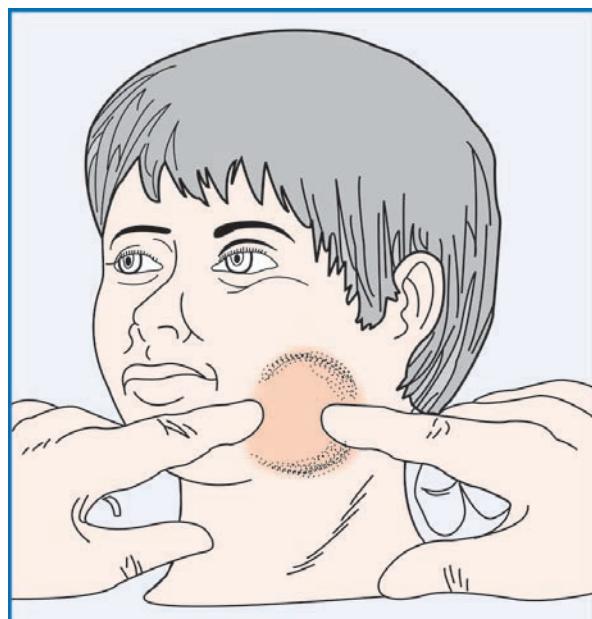


**FIGURES 5.15A TO C:** Steps in the collection of pus for culture and sensitivity test

pus can be confirmed by ultrasonography. No time should be wasted to wait for development of fluctuation in the days ahead. Usually it takes a minimum of three days for pus to form. When in doubt ultrasonography is a very useful tool. In cases there is a delay in the formation of pus certain authors advice application of extra oral dressings containing glycerin magsulf on a gauze pad. This will either hasten the formation of pus or cause a reduction in pain and edema. Once incision and drainage has been done glycerin magsulf should not be used.

The incision and drainage is done at various sites depending on the area or space involved. Whatever be the site, the general method followed is based on Hilton's principles

- The incision should be placed at the most dependent area
- Avoid incision at the most fluctuant area as the vascularity of the area is already compromised and the area may necrose.
- Use a sinus forceps or artery forceps with blunt ends to insert into the cavity and break all the locules of pus. The instrument has to be passed in all directions. It has to be inserted in a closed position, open within the cavity and taken out in an open position. This



**FIGURE 5.16:** Method of palpating a fluctuant swelling- One finger(indicating finger) is used to press and the other finger (palpating finger) is used to feel the movement of fluid in tissue space

helps to avoid inadvertent damage by clipping on to vital structures within the abscess cavity.

- A proper drain should be placed to keep the opening patent.

Gauze impregnated with antiseptic may be sufficient to be used as a drain intraorally. Corrugated rubber drain, Penrose drain or tube drain may be used extraorally, which has to be securely fixed to the adjacent tissue.

- Avoid vital structures like nerves and vessels while planning the incisions.

### *Medical Treatment*

Mainly includes antibiotics and analgesics. The general principles of antibiotic therapy include:

1. Antibiotic with narrowest spectrum depending on the organisms involved should be used
2. Bactericidal antibiotics (e.g. Aminoglycosides, Penicillins, Cephalosporins, Vancomycin etc.) are preferred over bacteriostatic antibiotics (e.g. Chloramphenicol, Clindamycin, Erythromycin, Lincomycin, Tetracyclines, etc.)
3. Never use combination of bactericidal and bacteriostatic drugs.
4. Those effective antibiotics with the least amount of toxicity should be selected.
5. Antibiotics should be given in sufficiently high doses to achieve a maximal therapeutic level. (3 or 4 times the minimum inhibitory concentration for the specific organism).
6. The route and interval of administration should be adequate—oral route is usually four times the plasma half life of the drug.

Initially we may have to start the treatment with an antibiotic on empirical basis. Since most of the odontogenic infections are caused by streptococci and staphylococci which are sensitive to penicillin, in patients who are not allergic, this should be the drug of choice.

A course of oral Amoxycillin 500 mg three times a day for 5 or 7 days may be sufficient in nontoxic cases. Erythromycin may be prescribed to patients who are allergic to penicillin. Toxic cases may require systemic administration of Ampicillin 500 mg to 1 gm at 6 hour interval till the toxic symptoms subside. This may be followed up with oral regimen.

Cephalosporin also may be indicated in severe infections.

A large number of studies suggest presence of anaerobic organisms especially in deep seated infections. Hence it is advocated by many that oral or systemic metronidazole also may be given along with other antibiotics.

The antibiotic should be changed if needed depending on the results of the culture and sensitivity tests and depending on the response to treatment.

Analgesics and antipyretics may be required as necessary and paracetamol in most cases serve the dual purpose. Additional analgesics may be given (NSAIDS like Diclofenac sodium, mefenamic acid etc. or synthetic opioids like Tramadol) as required. Enzymatic preparations like Trypsin, Chymotrypsin and serratiopeptidase which are prescribed to control postoperative edema are better avoided in infections. They tend to hasten the spread of infection rather than confining it and can affect the prognosis adversely.

### *Supportive Care*

*Hydration of the patient:* Most of the patients with acute odontogenic infections will be dehydrated as they lose fluid through perspiration and urination and also as most of them cannot take oral fluids or food. Adequate hydration is necessary for proper functioning of the host defenses. Those who tolerate oral fluids should be encouraged to drink liquids in larger quantities and if not, intravenous fluids should be administered.

*Use of thermal agents:* There has been controversy regarding the use of thermal agents in infection with some authors advocating application of cold while some others advocate use of warmth. Generally application of heat is preferred as it increases the vascularity and aids rapid resolution of the infection. Patient may be asked to use frequent warm saline mouth rinses. Moist heat application extra orally has been recommended by some authors.

### **SUGGESTED READINGS**

1. Oral and Maxillofacial Infections—Topazian, Goldberg and Hupp. 4th ed. 2002: WB Saunders.
2. Oral and Maxillofacial Surgery—Vol 2 Daniel M, Laskin CV Mosby and AITBS, Reprint 2002.
3. Text Book of Oral and Maxillofacial Surgery—Gustav O Kruger 6th edn. (First Indian edition) 1990. Mosby and Jaypee.

# 6

# Common Medical and Nursing Procedures

***TR Sreedevi, K George Varghese***

Patients admitted in hospitals will have to undergo noninvasive and invasive procedures based on their condition. Invasive procedures require puncture or incision of the skin which should be done under strict aseptic precaution. Noninvasive procedures require only clean articles and clean technique.

The dental surgeon working in a hospital setting should be thorough with the following procedures:

1. Administration of injections.

2. Oxygen therapy.
3. Nasogastric tube (Ryle's tube) insertion.
4. Urinary catheterization.
5. Oral hygiene measures.
6. Endotracheal Intubation.
7. Tracheostomy and its care.
8. Venous cutdown.
9. Wound dressing.
10. Biopsy.
11. Specimen collection for common investigations

**Table 6.1: Comparison of parenteral routes**

	<i>Intradermal</i>	<i>Subcutaneous (s/c)</i>	<i>Intramuscular (i/m)</i>	<i>Intravenous (i/v)</i>
Purpose	Allergy testing	Injecting small amount of medication e.g. Heparin	For irritating medicines, larger volumes that cannot be given S/C or intradermally	For infusing larger volumes that cannot be given via other route
Syringe	Tuberculin	Insulin, 2 ml, 2.5 ml, 3 ml	2, 2.5, 3, 5 ml	Depends on dosage and type of medicine
Needle length	3/8 to 5/8 inch	1/2 to 5/8 inch	1-3 inches	I/V cannula 1 to 1.5 inch
Needle gauge	26-27	25-27	20-25	18-21G
Recommended inj. volumes	< 0.1 ml	<1ml	<5 ml for single inj	Any volume
Common sites	Inner aspect of the forearm, upper chest and back beneath the scapula	Vascular areas around the outer aspect of the upper arms, anterior aspect of the thighs, abdomen below the costal margins to the iliac crests	Deltoidmuscle, Ventrogluteal, Vastus lateralis  Dorsogluteal	Central veins, peripheral veins

## INJECTIONS

Administering an injection is an invasive procedure that must be performed using aseptic technique.

### Purposes of Injection

1. To get a rapid and systematic effect of the drug.
2. When oral medications are contraindicated.

### Locating the Sites for Injection

#### *Intramuscular Injection*

Injections into the muscle tissue are called intramuscular (IM) injections. Absorption is more quicker than subcutaneous injections because of greater blood supply to muscles.

An important consideration in the selection of site for intramuscular injection is a safe site located away from large blood vessels, nerves and bone. The common sites used are deltoid, ventrogluteal, vastus lateralis and dorsogluteal site.

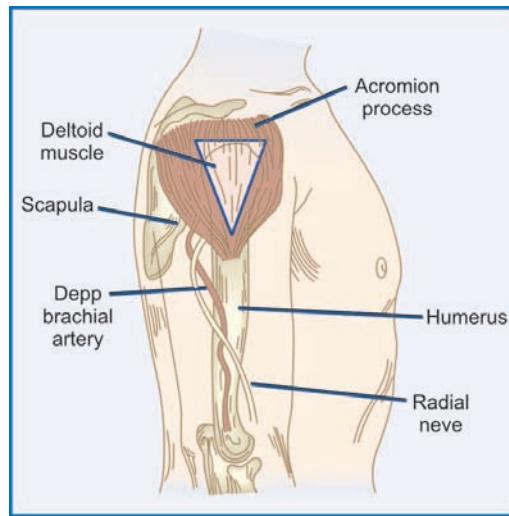
#### *Deltoid Site*

The deltoid muscle is situated on the lateral aspect of the upper arm. To locate the site place four fingers across the deltoid muscle, with the first finger on the acromion process. The site is three fingers breadth below the acromion process. (Fig. 6.1)

#### *Ventrogluteal Site*

It is in the gluteus medius muscle. It is the preferred site for IM injection because the area contains no large nerves or blood vessels and less fat than the buttock area. (Fig. 6.2)

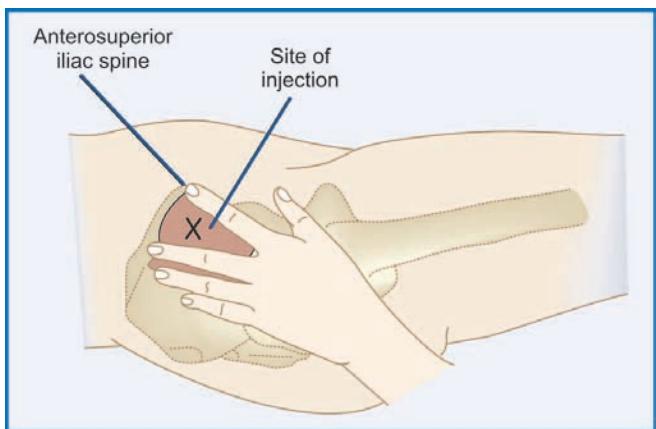
The client lies on either side with knee bent. Locate the muscle by placing the palm of the hand over the greater trochanter and index finger on the anterior superior iliac spine of the client's hip. The right hand is used for the left hip; and the left hand is used for the right hip. Point the thumb toward the client's groin and fingers toward the client's head. Spread the middle finger back along the iliac crest toward the buttock. The index finger, the middle finger and the iliac crest form a triangle and the injection site is the center of it.



**FIGURE 6.1:** Site and landmark of IM deltoid injection

#### *Vastus lateralis Site*

The vastus lateralis muscle is usually thick and well developed in both adults and children. This site is recommended for intramuscular injection for children under one year because gluteal muscles are poorly developed. There are no major blood vessels or nerves in this area. It is situated on the antero-lateral aspect of the infant's thigh. The middle third of the muscle is suggested as the site. The landmark is established by



**FIGURE 6.2:** Site and landmark of IM ventrogluteal injection

dividing the area between the greater trochanter of the femur and the lateral femoral condyle into thirds and selecting the middle third.

#### Dorsogluteal Site

This site is composed of the thick gluteal muscles of the buttocks. To locate the site identify the trochanter of the

femur and the posterior superior iliac spine. Draw an imaginary line between these two bony landmarks. Site will be the upper and outer quadrant. Another method to locate the dorsogluteal site is to divide the buttocks into four regions by imaginary lines and select the site at the upper outer quadrant. These muscles are developed by walking and hence this site is not used for children less than three years.

#### Subcutaneous Injections

These are usually given on the outer aspect of the upper arm, posterior chest wall below the scapula, anterior abdominal wall from below the breast to the iliac crest and the anterior and lateral aspect of the thigh.

Subcutaneous injection sites need to be rotated (Fig-6.3) in an orderly fashion to minimize tissue damage, aid absorption and avoid discomfort. This is important for patients receiving repeated injections as in diabetes mellitus. Insulin is absorbed at different rates at different parts of the body. So there can be variation in blood glucose level when various sites are used. To prevent this, rotate injection sites within an anatomical area

#### Six RIGHTS for administration of Medication

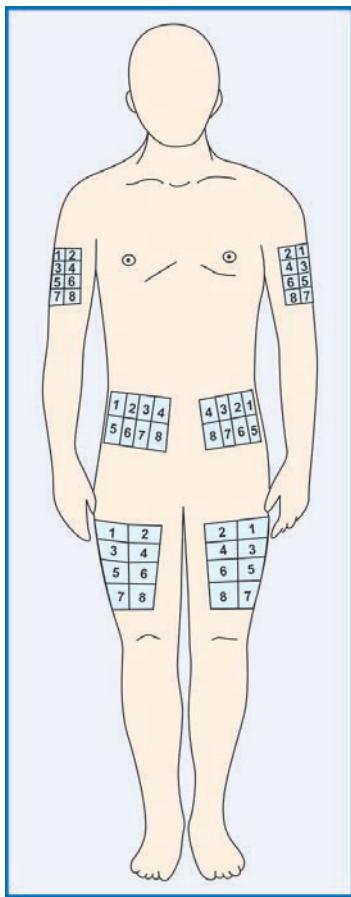
- Right drug
- Right dose
- Right client
- Right route
- Right time
- Right documentation

#### Procedure

1. Assess the client: for any allergies to medicine, client's age and weight to determine the site and needle size.

**Table 6.2:** Materials required for administering injections

Materials required	Purpose
1. A clean tray containing disposable syringes and needles of various sizes according to the need.	There should be minimum two needles. One to withdraw the other to administer the medicine from the vial and the other to administer the injection. The needle which is used to pierce the rubber stopper should not be used to give the injection.
2. Alcohol swab in a sterile container	To clean the site.
3. Disposal containers	To dispose used syringe, needle and used cotton.
4. Needed medications in vial or ampoule.	To dissolve powdered medicines.
5. Distilled water	To open the vial/ampule.
6. File	



**FIGURE 6.3:** Common sites (rotation of sites) for s/c injections

2. Explain the client about the need for injection, discuss with him the site to be selected and inform him about the slight pain and discomfort he will be experiencing.
3. Select a site free of skin lesions, tenderness, swelling, hardness, localized inflammation and that has not been used frequently.
4. Wash hands and don gloves.
5. Prepare the medication from the vial or ampule.
6. Clean the site with an antiseptic swab using a circular motion starting at the centre and move outward about 3-5 cm (Tables 6.1 and 6.2).

#### *Intradermal Injection*

Grasp middle of client's forearm from underneath, hold the skin taut with your thumb and fingers and with bevel of needle facing up, insert needle almost flat against client's skin at about a 15 degree angle to the skin. Bevel should be visible just under the skin.

Inject medicine slowly. The drug produces a small bleb just under the skin. The needle is then withdrawn gently and quickly. The site is very lightly touched with an antiseptic swab. The area is not massaged.

Massaging alter test results. It disperses medicine into the tissue or out through the needle insertion site

Mark skin around injection site and note the time with an indelible pen. This is to observe the area for reactionary changes after 15 minutes to 1 hour. The area will be reddened, the wheal will be increased, or client may complain of itching at the site and elsewhere in the body in case of any reaction.

#### *Subcutaneous Injection*

Use nondominant hand to spread skin tightly across injection site or grasp tissue, creating a roll of 1/2 inch. Inject needle quickly and firmly at 45 degree angle. Then release skin if pinched (Fig. 6.4).

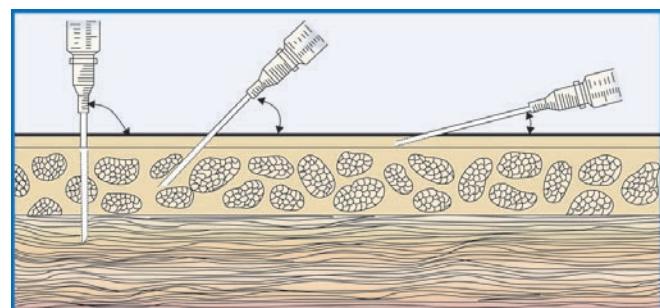
Grasp the end of plunger with nondominant hand. Aspirate by pulling back on the plunger. If blood appears in the syringe, withdraw the needle, discard the syringe and medicine and prepare a new injection. If blood does not appear inject the medicine slowly and steadily.

Remove the needle quickly, site is very lightly wiped with an antiseptic swab.

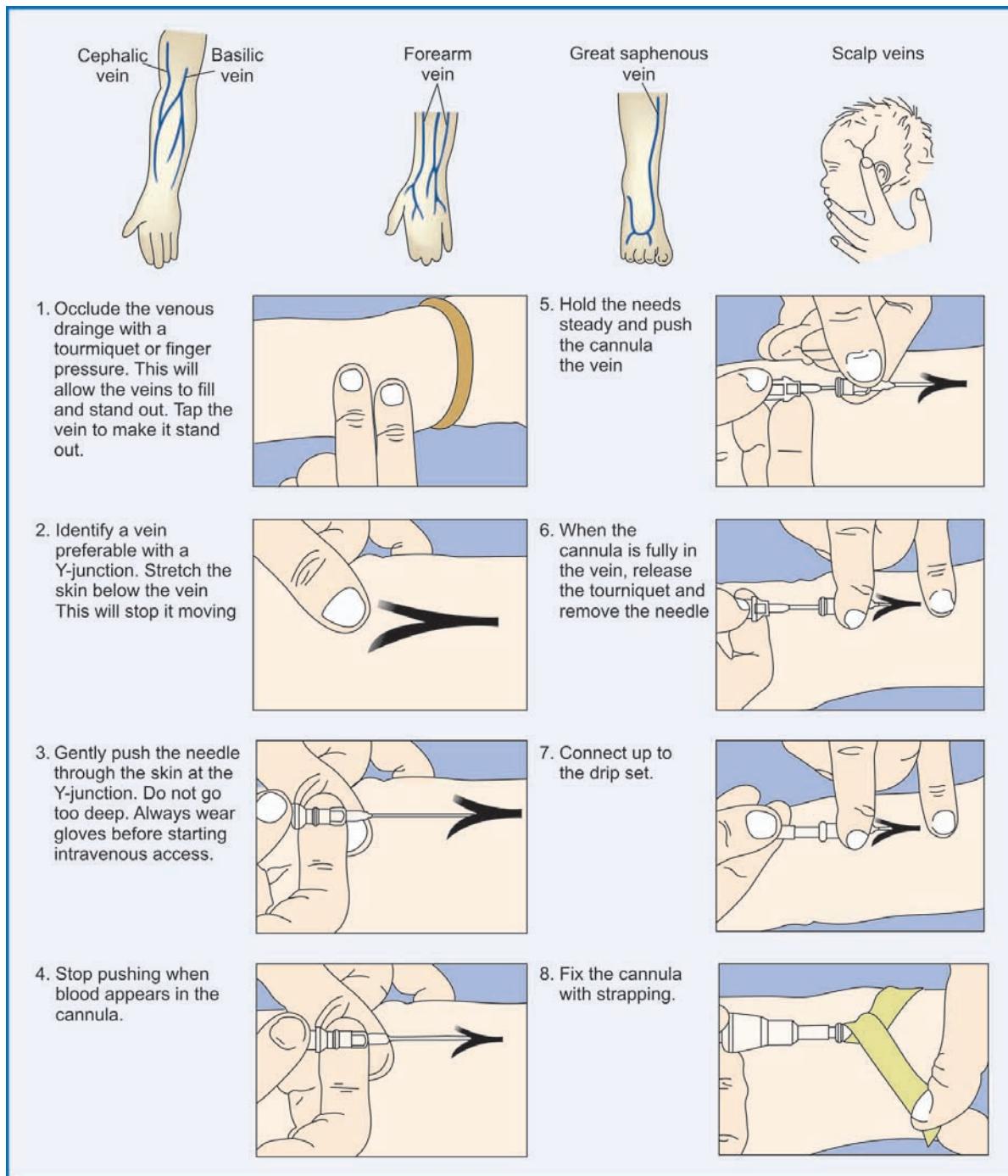
Do not aspirate while injecting Heparin. Aspiration of Heparin injection may cause the needle to move, creating tissue damage and bleeding.

#### *Intramuscular Injection*

1. Position nondominant hand at proper anatomical landmarks and spread skin tightly.



**FIGURE 6.4:** Comparison of the angle of insertion of I/M (90°) S/C (45°) and I/D (15°)



**FIGURE 6.5:** Sites of IV injection and steps in performing intravenous cannulation

2. Inject needle quickly at 90 degree angle in to muscle.  
If client's muscle mass is small, grasp body of muscle between thumb and other fingers.
3. Aspirate as in subcutaneous injection.
4. Inject medicine slowly.
5. Withdraw the needle quickly. Massage the site.

#### *Intravenous Injection*

1. Place the extremity in a dependent position (lower than the client's heart)
2. Locate the vein apply a tourniquet firmly 6 to 8 inches proximal to venipuncture site.
3. Massage the vein in the direction of the venous flow.
4. Encourage the client to clench and unclench the fist rapidly to distend the vein.
5. Lightly tap the vein with your finger tips. Clean the area with an antiseptic swab.
6. Grasp the arm distally to the point of entry of the needle. Place left thumb one inch below the expected point of entry. Pull the skin taut.
7. Holding the needle at a 30 degree angle with the bevel up, pierce the skin lateral to the vein.
8. Once the needle enter the skin lower the angle of the needle so that it becomes parallel with the skin.
9. Follow the course of the vein and pierce the side of the vein.
10. When back flow of blood occurs in to the needle, insert the needle further up, in to the vein about 3/4 - 1 inch.
11. Release the tourniquet and inject the medicine slowly.
12. Apply pressure at the site of venipuncture after the needle is withdrawn.
13. Discard the uncapped needle and attached syringe in to the proper receptacle.

#### Never Recap The Needle

Remove gloves. Wash hands.

Document time of administration, name of medicine, dose, route, client's reaction and put the signature.

## **OXYGEN THERAPY**

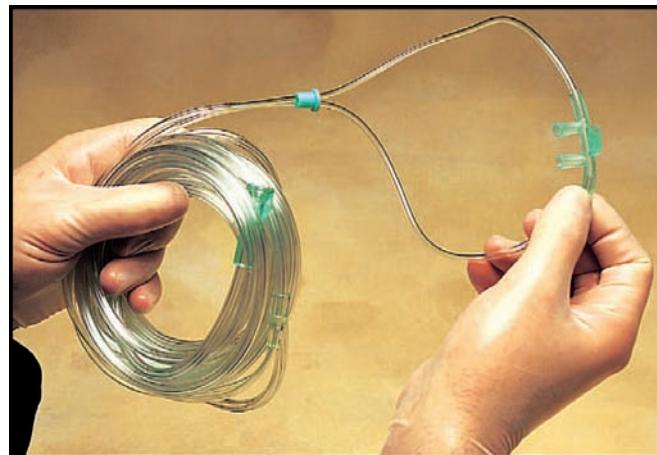
Oxygen is given to clients with respiratory dysfunctions to relieve anoxemia or hypoxemia.

#### **Methods of Oxygen Delivery**

- Nasal cannula
- Nasal catheter
- Face mask

#### *Nasal Cannula*

A nasal cannula is a simple, comfortable device. The two cannulae, about 1.5 cm long, protrude from the center of a disposable tube and are inserted in to the nares. Oxygen is delivered via the cannulae with a flow rate of up to 6 L/mt (Figs 6.6 and 6.7).



**FIGURE 6.6:** Nasal cannula



**FIGURE 6.7:** Nasal Cannula in place

### Nasal Catheter

Nasal catheters are used less frequently than nasal cannulae. In this catheter is introduced in to the nose to the oropharynx. Catheter has to be changed frequently and check for blockage due to mucus secretion.

### Oxygen Masks

An Oxygen mask is shaped to fit snugly over the mouth and nose, and secured in place with a strap. The simple face mask (Fig. 6.8) is used for short-term oxygen therapy. It delivers oxygen concentrations from 30 to 60 percent.



**FIGURE 6.8:** Simple face mask

Approximate inspired oxygen concentration ( $\text{FiO}_2$ ) with nasal cannula and simple face mask

Nasal cannula	Simple face mask
1 L	24%
2 L	28%
3 L	32%
4 L	36%
5 L	40%
6 L	44%

### Equipment

Oxygen supply, e.g. piped oxygen or oxygen cylinder with its accessories as the regulator, flow meter, humidifier, connecting tube, etc.

Oxygen mask or nasal cannulae/nasal catheter

“No smoking” signs

Receptacle for soiled disposables.

### Procedure

1. Assess the client and identify the correct percentage of oxygen needed.
2. Explain the dangers of smoking to the client, family and friends and display ‘No smoking’ signs.
3. Collect and assemble the equipment as required so that everything is at hand. Wash hands.
4. Help the client to a comfortable position.
5. Observe the client throughout for any adverse effect or for improvement in respiratory function.
6. Give only humidified oxygen. See that the humidifier contain adequate sterile water.
7. Adjust the flow rate as per the client’s need.
8. If a nasal catheter is used, measure the length of the nasal catheter from the tip of the nose to the earlobe so that the tip of the catheter reaches the oropharynx. If the tip of the catheter is not reaching the oropharynx there is a chance for oxygen lost through the open mouth.
9. Lubricate the tip of the catheter with water soluble jelly
10. Introduce catheter slowly in to one of the nostril to the previously marked distance.
11. If any obstruction is encountered withdraw the catheter a little, rotate it and introduce it again. Never force it.
12. Fix the catheter over the bridge of the nose or over the forehead.

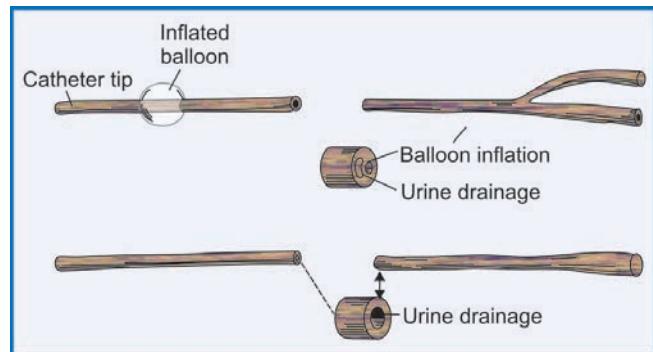
If a **mask** is used, place the mask in the correct position and adjust it to fit firmly and comfortably over the client’s nose and mouth.

In case of a **cannula**, place tips of cannula in to client’s nares and take the rest of the tubing above the ears and then under the neck.

13. Check the nasal catheter frequently to check its patency as the mucus may plug the opening of the catheter and block the oxygen supply.
14. Inspect client for relief of symptoms associated with hypoxia. When the oxygen is to be discontinued, do it gradually.

## NEBULIZATION

Nebulization is a process of adding moisture or medication to inspired air. A nebulizer uses the aerosol principle to suspend a maximum number of water drops or particles of the desired size in inspired air. The moisture added to the respiratory system through nebulization improves clearance of pulmonary secretions. Water or medications are broken down into fine drops or particles and when inspired with air or oxygen, these particles will be deposited throughout the tracheobronchial tree.



**FIGURE 6.9:** Types of urinary catheters. A, Indwelling catheter; B, Straight catheter

## URINARY CATHETERIZATION

It is the passing of a catheter through the urethral orifice into the bladder.

### Indications

- To empty the bladder in urinary retention
- To get a sterile urine specimen for diagnostic purposes.
- To maintain a dry environment in urinary incontinence
- To empty the bladder preoperatively prior to surgery involving rectum, vagina and pelvic organ, thereby preventing injury to the distended bladder
- To monitor fluid balance in a seriously ill client
- To facilitate bladder irrigation procedures.

### Types of Catheterization

#### Intermittent Catheterization

A straight single use catheter is used to drain the bladder and immediately the catheter is removed. It has a single lumen.

#### Indwelling Retention Catheterization

An indwelling or foley catheter (Fig. 6.9) remains in place until the client is able to void completely and voluntarily. It has a small inflatable balloon that encircles the catheter just below the tip. When inflated the balloon rests against the bladder outlet to anchor the catheter in place. It has 2 or 3 lumens within the body of the catheter. One lumen drains urine through the catheter to the drainage bag. A second lumen carries sterile water to and from the lumen when inflated or deflated. A third lumen may be used to instill fluids or medications to the bladder.

### Equipment

- Trolley
- Good light source

#### Sterile gloves

- Sterile catheterization pack or dressing pack which contains artery forceps -1, thumb forceps -1, cotton and gauze pieces
- Sterile antiseptic solution for cleaning the genitalia
- Sterile watersoluble lubricant to lubricate the catheter
- Sterile catheter of required size and type
- Sterile urine collection bag(closed drainage system)
- Sterile specimen container appropriately labeled
- Receptacle for soiled disposables

Size: 12 to 14 FG is the suitable size

### Procedure

1. Explain the procedure to the client to obtain consent and cooperation
2. Collect and prepare the articles
3. Provide adequate privacy
4. Position the client-
  - Female: supine position with knees bent, hips flexed and feet resting on the bed wide apart. This position provides good access and visualization of the genitalia
  - Male: supine position
5. Place an incontinent pad or water proof sheet under the client's buttocks to prevent soiling
6. Arrange good lighting
7. Wash the hands and put on sterile gloves
8. Open and arrange the articles, maintaining sterility

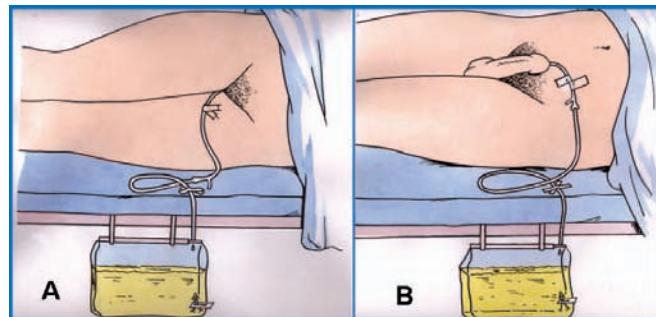
### Female Catheterization

1. Clean the perineum with the cottonball dipped in antiseptic lotion using the forceps.
2. Cleanse labia majora on both sides and inside, labia minora on both sides and the vulva in one direction from clitoris to the anus using one swab for one swabbing.
3. Using the nondominant hand, keep the labia minora separated and pulled upwards from the time the vulva is cleaned until the catheter is introduced. This helps in visualization of urinary meatus and prevent contamination of the tip of the catheter.
4. With the nondominant hand cleanse the urethral meatus to prevent introduction of microorganisms into the urethra and bladder and position the sterile receiver to collect the urine from the catheter.
5. Insert the lubricated catheter into the urethra about 7.5 cms in an upward and backward direction which follows the anatomical route of the female urethra. The urine starts draining. If the urine does not flow, gently rotate the catheter.
6. Release the labia minora and hold the catheter with the same fingers. Maintain this position until balloon on indwelling catheter is inflated (Inflate the catheter according to manufacturer's instruction.)
7. If it is not intended that the catheter is left insitu, gently remove the catheter when the urine flow ceases.
8. In case of an indwelling catheter, attach a drainage system and anchor the catheter properly (Fig. 6.10A)
9. Ensure the client is comfortable
10. Dispose the soiled articles safely, clean and sterilize or autoclave the reusable articles to reduce any health hazard.
11. Document the procedure appropriately.

### Male Client

1. Withdraw the client's foreskin with the nondominant hand, cleanse the glans penis and urethral meatus with the dominant hand. Maintain this position until the completion of insertion of the catheter to prevent recontamination of the urethral meatus by the foreskin after cleaning.

2. Insert the lignocaine gel and leave for 2 minutes to allow the local anaesthetic to act.
3. Draw the penis upward and forward at 90 degree angle to the client's legs in order to straighten the urethra before the catheter is introduced.
4. Insert the lubricated catheter into the urethral meatus about 20 to 25 cm until urine flows. Position the sterile receiver.
5. In case of an indwelling catheter inflate the balloon as per manufacturer's instruction.
6. Replace the client's foreskin over the glans penis, otherwise paraphimosis may develop.
7. Anchor the catheter with drainage bag. Ensure the comfort of the client. Document the procedure (Fig. 6.10B).



**FIGURES 6.10A AND B:** Securing the catheter for female and male

### ORAL HYGIENE

Good oral hygiene ensures cleanliness, comfort and moisturizing of mouth. Proper care prevents oral disease. To encourage health promotion and restoration, instruct clients to brush their teeth after each meal, before bed time and to floss once daily. Acidic fruits in the client's diet can reduce plaque formation. A well balanced diet ensures the integrity of oral tissues.

1. **Brushing:** A tooth brush should have a straight handle and brush small enough to reach all areas of the mouth. All tooth surfaces should be brushed thoroughly.

Client's who receive cancer chemotherapy, radiation or immunosuppression agents may develop stomatitis. They need special care to reduce the discomfort of stomatitis.

**2. Flossing:** Dental flossing is necessary to remove plaque and tartar between teeth. Flossing involves inserting waxed or unwaxed dental floss between all tooth surfaces, one at a time. The seesaw motion used to pull floss between teeth removes plaque and tartar from tooth enamel. If tooth paste is applied to the teeth before flossing, fluoride can come in direct contact with tooth surfaces, aiding in cavity prevention.

**3. Denture care:** Clients should be encouraged to clean their dentures on a regular basis to avoid gingival infection and irritation. Dentures should be removed at night to give the gums a rest and prevent bacterial buildup. Dentures should be kept covered in water when they are not worn and stored in an enclosed labeled cup.

### Oral Hygiene for an Unconscious Client

Unconscious client needs special attention. While giving oral hygiene protect the client from choking and aspiration. Perform mouthcare atleast two hourly.

#### Equipment

- Anti-infective solution (e.g. diluted hydrogen peroxide to loosen the crusts)
- Small soft-bristled toothbrush
- Dentifrice
- Padded tongue blade
- Face towel
- Emesis basin
- Water in a glass
- Water soluble lip lubricant
- Clean gloves.

#### Procedure

1. Wash hands, don clean gloves
2. Test for presence of gag reflex by placing tongue blade on back of tongue. This reveals whether client is at risk of aspiration.
3. Inspect condition of oral cavity
4. Position client on side with head turned well toward dependant side and head of bed lowered. This allows secretion to drain from mouth instead of collecting in back of pharynx and prevents aspiration.

5. Explain procedure to client, unconscious client may retain ability to hear.
6. Provide privacy
7. Place towel under client's head and emesis basin under chin.
8. Carefully separate upper and lower teeth with padded tongue blade between back molars. Do not use force. This prevents client from biting on your fingers and provide access to oral cavity.
9. Clean mouth using brush moistened with peroxide and water.
10. Clean chewing and inner tooth surfaces first. Clean outer tooth surfaces. Swab roof of mouth, gums and inside cheeks. Gently swab or brush tongue. Rinse with moist clean swab several times.
11. Repeated rinsing removes peroxide, which can be irritating to mucosa.
12. Suction secretion if necessary
13. Reposition client comfortably
14. Remove gloves, wash hands, clean and replace articles.
15. Dispose soiled items properly.

## NASOGASTRIC TUBE (RYLE'S TUBE) INSERTION

#### Purposes

- To administer feeds and medication to clients unable to eat by mouth, or swallow sufficient diet without aspirating food or fluid into the lungs
- To establish a means for suctioning stomach contents to prevent gastric distension, nausea and vomiting
- To remove stomach contents for lab analysis
- To lavage (wash) the stomach in case of poisoning or overdose of medications.

#### Materials Required

A tray containing:

- Nasogastric tube 8-12 FG
- Lubricant jelly to lubricate the catheter
- Syringe to aspirate the content
- Stethoscope
- Cotton or gauze pieces in a bowl
- Adhesive plaster and scissors
- Kidney tray
- A bowl with water
- A pair of clean gloves

### Procedure

1. Explain the procedure to the patient. Instruct the client to swallow, breathe through the mouth and to control the cough reflex. This will ease the passing of the tube.
2. Wash hands and don gloves
3. Place the patient in a sitting position with head slightly flexed or elevate head of the bed to 30-45 degrees.
4. Inspect the nose and determine the patency by having the patient breathe through one nostril while the other is occluded temporarily.
5. Estimate the length of the feeding tube to be inserted by measuring the distance from the tip of the nose to the earlobe and from the earlobe to the xiphisternum as shown in Figure 6.11.
6. Lubricate the tube for about 6 to 8 inches using a gauze piece.
7. Hold the tube coiled in the right hand and introduce the tip into the nostril.
8. Pass the tube gently but quickly backwards and downwards. Momentary resistance may occur as the tube is passed into the nasopharynx. Have the client flex the head.
9. When the tube reaches the pharynx the client may gag. Allow him to rest for a moment.

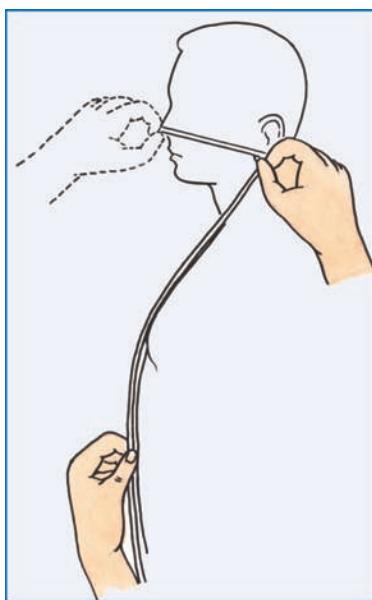


FIGURE 6.11: Estimating the length of Ryle's tube

10. Have the client take sips of water and swallow.
11. Continue to advance the tube until it reaches the previously designated mark.
12. Check the placement of the tube in the stomach by either.
  - a. Aspirating the gastric contents with a syringe.
  - b. In case of no aspiration push in 5 to 10 cc air using a syringe and auscultate over the epigastric region for any bubbling sound (if the client shows any signs of distress the other end of the tube is placed in a bowl of water and check for any bubbling which indicates the tube is in the respiratory passage. In that case quickly remove the tube).
13. The tube is secured to the bridge of the nose with a tape.
14. Feed the client first with plain water and then with the required feed. After every feed the feeding tube must be rinsed with 5 to 10 ml of plain water to maintain the patency of the tube.

### INTUBATION

It is the insertion of an endotracheal tube into the trachea through the nose or mouth.

### Purposes

1. To establish and maintain an airway.
  2. To remove secretions.
  3. To administer oxygen.
  4. To ventilate the lung using a resuscitation bag.
  5. To administer the anesthetic drug during surgery.
- Endotracheal intubation is usually done with an oral tube by direct laryngoscopy. A nasal tube may be inserted by direct laryngoscopy or blind nasal intubations or fiber optic laryngoscopy. These tubes are open at both ends. Most have a built in cuff that is inflated with a measured amount of air, water or saline after insertion to occlude the trachea. Tube may be made of plastic, silicone or rubber. The endotracheal tube must be securely fixed in place to prevent irritation of trachea and to maintain ventilation. Muscle relaxants are given before intubation to relax the jaw and larynx.

Approximate size of the endotracheal tubes for different age groups:

Age	Diameter (mm)
Preterm	2.5-3
Newborn	3
Infant	3.5-4
Children	4.5-7
Adult	7-7.5

### Materials Required (Fig. 10.3)

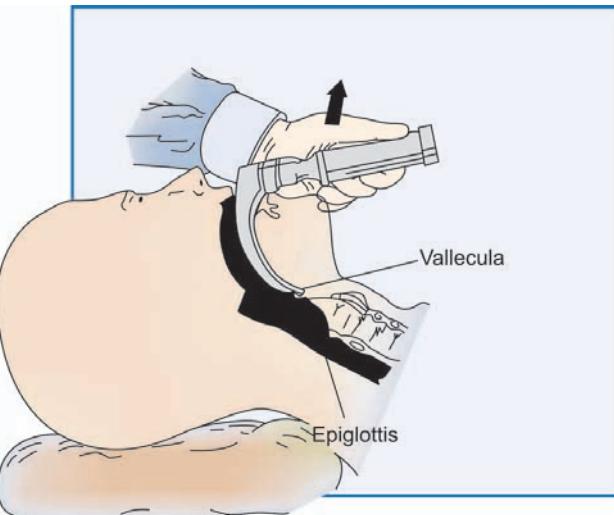
- Endotracheal intubation tubes of appropriate size with an adapter to connect to the ambu bag or ventilator
- Syringe 10 ml to inflate the cuff
- Flexible copper stylet to serve as guide during insertion and to give the tube greater rigidity
- Ambu bag to ventilate the lung
- Oral airway
- Gauze wipes, gloves, adhesive plaster to fix the tube in place
- Magill's intubation forceps to direct endotracheal tube into the trachea
- Oxygen supply
- Suction apparatus
- Lignocaine 1 percent spray, KY Jelly (lubricant).

### Procedure

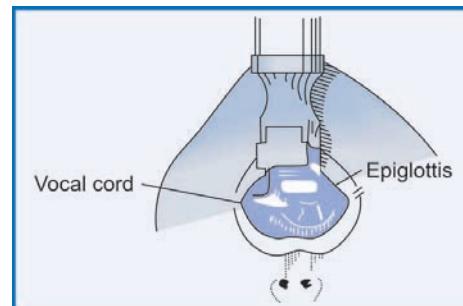
1. Explain the procedure to the patient if he is conscious and/or to the relatives.
2. Remove dentures if any.
3. Position the patient supine, tilt the head and neck to straighten the airway and to obtain maximum laryngeal exposure (Fig. 6.12 and 6.13).
4. Pass the endotracheal tube under direct laryngoscopy (Fig. 6.14).
5. Assure the location by observing the patient's breathing/auscultation/by inflating the lungs by ambubag.
6. Inflate the cuff with 2 ml of air and fix the tube to the patient's face.

Proper inflation and deflation of the cuff is very important. Irritation and pressure of the cuff against the tracheal wall can cause damage such as ulceration and necrosis of the mucosa

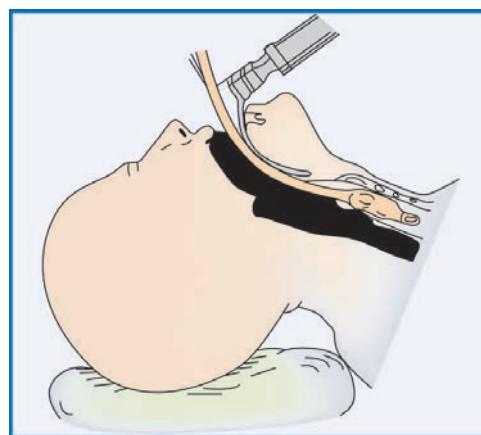
7. Insert an airway into the patient's mouth to prevent biting on the endotracheal tube.



**FIGURE 6.12:** Proper head position for intubation. Tip of the curved laryngoscope blade placed in vallecula. Arrow shows direction laryngoscope should be lifted to expose larynx



**FIGURE 6.13:** View of larynx from mouth



**FIGURE 6.14:** Intubation—Insertion of endotracheal tube

8. Connect it to oxygen supply or to ventilator.
9. Remove secretions by suctioning.
10. Continuously monitor the patient for patent airway, any respiratory difficulty, complications such as laryngeal edema, hemorrhage.

### INSERTION OF ORAL AIRWAY

(Refer Chapter 7 for various types of oral airway and see Figures 7.14 and 7.15).

#### Indications

- In unconscious patient's when the flaccid tongue fall back and obstruct the airway
- Inflammation and swelling of the mouth and pharynx following surgical procedures in the mouth or nose
- When endotracheal tube is in situ

#### Procedure

1. Choose airway of correct length so as to reach the oropharynx.
2. Remove dentures.
3. Insert the airway gently over the tongue.
4. Perform suctioning by inserting the suction catheter through the airway and keep the airway patent.
5. Frequent cleaning of the airway is very important
6. Watch the patient carefully for signs of respiratory obstruction.

### CARE OF TRACHEOSTOMY

Tracheostomy is an artificial opening made in the trachea into which a tube is inserted through which the patient breathes.

#### Indications

- Obstruction in the air passages in the upper part of the trachea due to tumors, stenosis, edema of the larynx and trachea, laryngeal and tracheal trauma and paralysis.
- Patient's who develops intolerance to endotracheal tube.

Tracheostomy tubes—consists of 3 parts: (a) outer cannula, (b) inner cannula, (c) obturator or pilot.

The outer tube is held in position by a ribbon or a tie which is passed through the loops on either side of the opening of the tube. The inner tube/cannula fits inside the outer tube. The inner tube is periodically removed and cleaned to prevent blockage by crusting of the secretions. It is reused after sterilization. It must be replaced

immediately within the outer cannula so that the outer remains free of crusting. Recently used plastic tubes do not require an outer cannula because they remain free of crust. The obturator provides a smooth tip during tube insertion to prevent trauma to the tracheal wall. It should be kept ready at the bedside for emergency if the outer tube is expelled from the trachea. Some tubes have a built in soft cuff that is inflated to eliminate any free space between the tube and the tracheal wall, thus preventing aspiration of drainage down the trachea. A pilot balloon(bulb) in the inflation line attached to the outer cannula indicates cuff inflation or deflation.

Proper inflation and deflation of the cuff is very important. The amount of air needed for inflation varies with the size of the trachea and the tube. Usually 2-5 ml of air provides a closed system. Irritation and pressure of the cuff against the tracheal wall can cause damage such as ulceration and necrosis of the mucosa which can lead to infection, tracheobronchial fistula, erosion into the innominate artery and stenosis and scarring. Precautionary measures includes deflation at regular intervals and constant monitoring.

#### Surgical Procedure of Tracheostomy

The patient is positioned on the back with a pillow under the shoulders. Hyper extend the head and neck so that the trachea becomes prominent. Under local anesthesia a horizontal incision is made in the neck at the level of the second and the third tracheal ring. By blunt dissection, thyroid isthmus is identified and divided if necessary. The trachea is then incised through the second and the third rings. Suctioning of the trachea is then done and the tracheostomy tube is introduced. The tube is then tied around the neck.

#### Care of the Tracheostomy Tube

Articles needed:

- Suction apparatus with sterile suction tubes, sterile bowl with sterile water
- Sterile dressing pack containing artery forceps and thumb forceps
- Ambu bag and oxygen supply
- Sterile gloves and kidney tray.

Practice strict aseptic technique to prevent infection of the respiratory tract. Anything that touches the tracheostomy tube should be sterile in order to prevent introducing infection

## Procedure

1. Wash hands and don gloves.
2. Explain the procedure to the patient.
3. Pinch the suction catheter and gently insert into trachea.
4. Release the pinch gently and slowly withdraw the catheter rotating it and applying suction.
5. Continue suction until secretions are cleared.
6. Oxygenate the patient in between suctioning. Do not continue suction more than 5-10 seconds to prevent hypoxia.
7. Rinse the catheter with normal saline to keep it patent.
8. Clean the area around tracheostomy tube with normal saline and gauze and dry the area.
9. A few layers of sterile wet gauze kept over the tracheostomy tube to filter and humidify the air.
10. Change the gauze as and when needed.
11. Keep the skin around the tracheostomy tube clean and dry.
12. Maintain adequate fluid intake to keep the mucous membrane of the respiratory tract moist.
13. Practice strict aseptic technique to prevent infection of the respiratory tract. Any thing that touches the tracheostomy tube should be sterile in order to prevent introducing infection into the respiratory tract.

## Venous Cutdown

Venous cutdown is used to secure entry into the vascular system when percutaneous cannulation is not possible. It is a reliable and safe method of administering large volume of fluid or blood. A saphenous vein or antecubital vein is the common sites for cutdown.

**Contraindications:** Phlebitis, previous thrombosis, or arterial insufficiency in the area of cutdown.

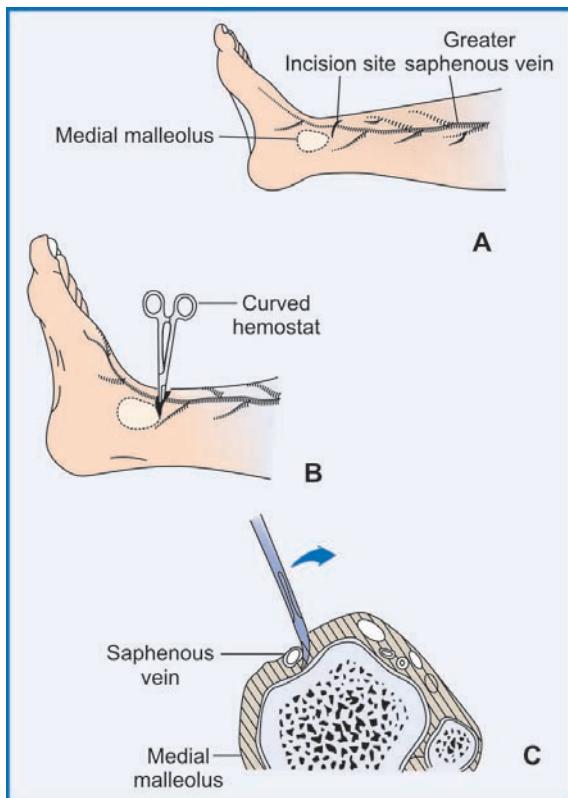
## Saphenous Vein Cutdown—Procedure

**Instruments required:**

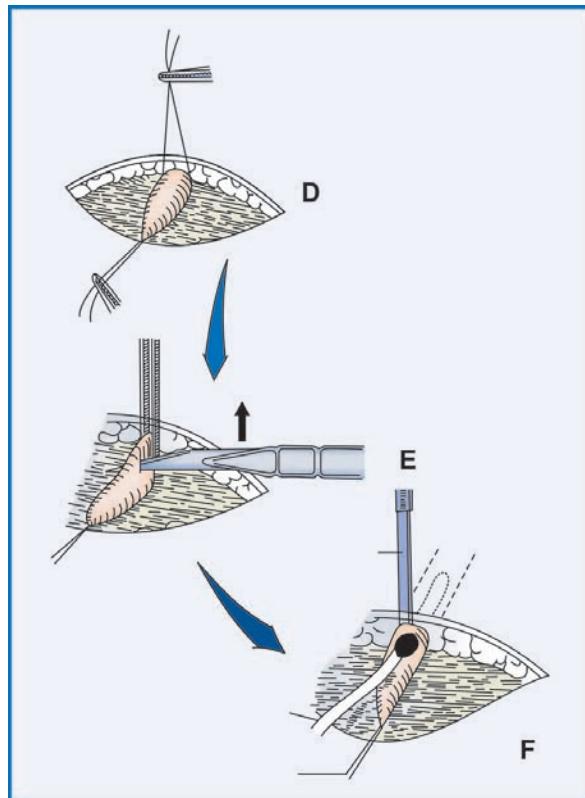
- Tourniquet, sterile sponges, # 11 and # 15 B.P. blades and handle, two curved and two straight mosquito hemostat, self retaining retractors, 3-0 silk sutures, fine toothed forceps, vein lifter, suture scissors, needle holder.
- Aseptic and sterile field—antiseptic solution, sterile sponges, gloves and gown, draping towels, towel clips.
- Anesthesia—Local anesthesia (Lignocaine 1%).

## Procedure

1. Explain the procedure to the patient and get an informed consent.
2. Place the patient in the supine position with the angle abducted.
3. Locate the saphenous vein, which is anterior to the medial malleolus, by applying a tourniquet above the ankle.
4. Don sterile gloves, mask and gown.
5. Prepare the skin with antiseptic solution and drape a sterile field.
6. Administer local anesthesia by injecting 1% lignocaine into the skin slightly anterior and superior to the medial malleolus. Then advance the needle beneath the skin along each side of the vein to anesthetize deeper tissues.
7. Make a superficial transverse skin incision 2 or 3 cm (Fig. 6.15 A) over the vein just above the medial malleolus (If the incision is too deep, it will transect the vein).
8. Spread the edges of the incision using a hemostat.
9. Insert a mosquito forceps into the anterior angle of the incision and push it firmly down to the periosteum (Fig. 6.15 B).
10. With a sweeping motion, curve the hemostat posteriorly while pressing it against the periosteum (Fig. 6.15 C). Curl the clamp completely under the vein and then lift the vein upward.
11. Isolate the vein. Carefully open the clamp so that the subcutaneous tissue can be spread away from the vein surface.
12. When the vein is exposed, pull a silk ligature back under the vein with the clamp and tie it distally.



**FIGURE 6.15:** Saphenous vein cutdown (1) (A) Make a superficial incision just above medial malleolus. (B) Insert curved mosquito clamp into anterior angle of skin incision. (C) Curl mosquito clamp under saphenous vein by sweeping it posteriorly. Lift the clamp and vein upward



**FIGURE 6.16:** Saphenous vein cutdown continued—(D) Place ligature around proximal and distal end of vein. (E) Perform venotomy. (F) Insert catheter into vein

Slip a second suture beneath the proximal end of the vein, but do not tie it. Clip both ligatures with separate straight clamps (Fig. 6.16 D).

13. Using a # 11 scalpel blade to incise the vein through one third to one half its anterior surface (Fig. 6.16 E).
14. Place the vein lifter into the proximal venotomy, lift it upward, and expose the lumen of the vein. Insert the catheter forward under the vein lifter so that it lies well within the vein (Fig. 6.16 F). Remove the vein lifter and advance the catheter as far as necessary.
15. Attach a 10 ml syringe to the catheter and aspirate to determine whether blood returns and the catheter is in the vein and not lodged against the vessel wall. Remove the syringe and connect the catheter to intravenous infusion line.

16. Tie the proximal ligature around the vein and catheter. It should be tight enough to prevent leakage of blood but not so tight as to constrict to the catheter. Tie the distal ligature around the catheter to prevent slippage.
17. Irrigate the wound with sterile saline and close the incision with 3-0 nylon. Apply sterile dressing.
18. Stabilize the leg with a leg restraint.
19. Daily inspect the wound and replace the dressing if required.

**Complications:** (a) Damage to adjacent vessels, nerves and lymphatics, (b) infection, (c) phlebitis and thrombosis—the longer the catheter remains in the vein the higher the chance for phlebitis, (d) hematoma—this may compromise the arterial supply to the extremity e) inadvertent arterial cannulation—which occurs primarily in patients in shock.

## WOUND DRESSING

When the post-operative environment is not satisfactory wound dressing remains the choice. Dressings are usually protective from a functional point of view and give the patient a sense of security.

Surgical dressing is a protective sterile covering applied over the wound after cleaning it with aseptic precautions.

### Purposes

- To protect the wound from further injury and contamination
- To facilitate wound healing
- Immobilise or splint the wound
- Absorb exudate
- Hold medicine in place over the wound and promote healing
- Promote hemostasis as in pressure dressing
- Provides physical and mental comfort to patient

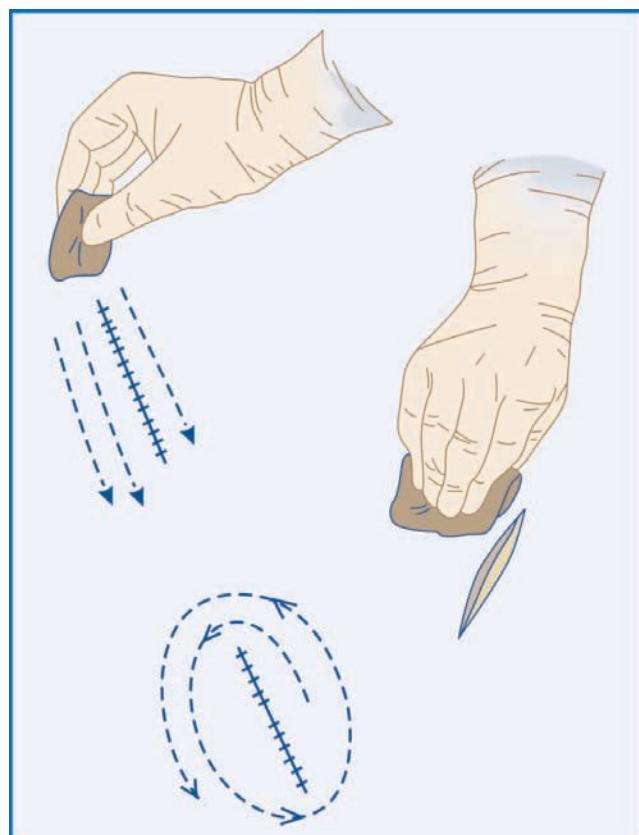
Materials required—Sterile dressing set containing:

- Artery forceps
- Dressing forceps
- Cotton balls, gauze pieces, and dressing pads as required
- A small bowl to take antiseptic solution/normal saline/savlon solution
- Sofra tulle (paraffin gauze)
- Sterile gloves
- Transfer forceps/ Cheatle forceps in a sterile container
- Kidney tray
- Adhesive plaster, scissors and bandages

- Practice strict aseptic techniques to prevent cross infection from and to the wound
- Assure sterility of dressing material
- Keep everything ready before hand for dressing
- Clean wounds should be dressed first and those with drainage later
- Clean wound from inside to outside area and the surrounding skin
- Dressing stuck to the wound should be moistened by sterile saline solution
- Avoid coughing and sneezing when the wound is opened

### Procedure (Fig. 6.18)

1. Wear mask and don gown if necessary.
2. Explain the procedure to the patient, mentioning that he/she is likely to have some discomfort.
3. Using disposable gloves remove the old dressing at the wound site. Observe the dressing for the type, odor, amount and color of the discharge.
4. Wash hands thoroughly.
5. Don sterile gloves, establish a sterile field.
6. With assistance open the sterile tray.
7. Assistant can pour small amount of cleansing solution into the bowl.
8. Using dissecting forceps, pick up the cotton ball, dip it in the cleansing solution and squeeze it the help of artery forceps and clean the wound.
9. Clean the wound from the centre to the periphery using one swab for one cleaning (See figure 6.17). Repeat cleaning only with fresh swab till wound is clean.



**FIGURE 6.17:** Schematic diagram—wiping from inside to outside

10. After thoroughly cleaning, dry the wound with dry swabs. Do not rub
11. Apply antiseptic ointment if required
12. Cover the wound with sofra tulle (paraffin gauze), then with gauze pieces and dressing pads
13. Secure the dressing with adhesive tape or bandages.  
A correct way to apply adhesive tape is to place the tape at the centre of the dressing. Then press the tape down both sides. This will give tension away from the midline. thus prevents wrinkling and pulling of the skin which occur when the tape is fixed on one end and pulled over the dressing
14. Remove the gloves and dispose all the soiled articles safely
15. Record time of dressing, condition of the wound on the chart.

### *Wound Left Open*

Wounds of facial laceration, skin graft on smooth surface and pedicle flap etc. are usually left open. The very first dressing on a clean, dry incised wound is left in place till suture is removed. If it is removed in between it is not replaced. The wound is left open. The following are the advantages of not using any dressing are:

- Eliminates conditions like warmth, moisture and darkness which promotes the growth of organisms
- Allows better observation of wound site and early elimination of discomfort, if any
- Tends to minimize post operative dressing procedures and avoid adhesive tape reaction
- Facilitates bathing and other daily activities of the patient
- Economical in terms of time and material

In such cases, the suture line is gently cleaned and the wound is protected with sprays such as "Healex spray" (Fig. 6.18 I).

## **BIOPSY**

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Biopsy is histopathological examination of tissue removed surgically from a living body and it assist the surgeon in a variety of ways. Although biopsy may be of great value in both diagnosis and treatment planning it must always be remembered that in many tumours the histological pattern may vary in different parts of the same

lesion, and so other methods of diagnosis must not be neglected.

Even though different techniques are there, the two common types of biopsy used in clinical practice are:

- Excision biopsy
- Incision biopsy

Hence a detailed description of these two alone will be given.

### **Excision Biopsy**

When dealing with lesions which, upon clinical examination appear to be benign this technique should be employed whenever it is possible. This is because not only the whole of the lesion made available for examination (Fig. 6.19), but also complete excision of the lesion is possible. For most of the conditions usually this is only form of treatment available.

After excision of the lesion, the mucosa surrounding the wound should be undermined and advanced. It is possible by this means to close the mucosal defect without tension and obtain healing by first intention. In certain cases it may only be possible to reduce the size of the area left to heal by granulation, by advancing the undermined mucosa and suture it to the underlying tissues. If the resulting wound is on a surface covered with attached mucoperiosteum, it is usual to cover the defect with either an acrylic plate or denture lined with zinc-oxide impression paste or tissue conditioner, or with a ribbon-gauze pack soaked in Whitehead's varnish or antibiotic cream.

### **Incision Biopsy**

When this technique is employed, only part of a lesion is removed for histopathological examination and it is usually used to obtain specimens of lesions which might prove difficult to excise completely, owing to either their extent or situation. In the oral cavity the commonest lesions of this type are the white hyperkeratotic lesions. Areas with induration, ulceration, bleeding and pain should be selected for taking incision biopsy. The most thickly keratotic area should not be chosen for biopsy, as the areas covered with thin atrophic mucosa or granulation tissue are potentially more dangerous. Figure 6.20 shows the procedure of incision biopsy.



**FIGURES 6.18A TO I:** Various steps showing removal of suction drain and wound dressing in a patient who had undergone subtotal mandibulectomy. Note the arrangement of various items in dressing trolley (Fig. 6.18B) and the use of Healex spray (Fig. 6.18I) to protect the wound

If the tissues removed tends to curl, it should be laid on a piece of blotting paper before it is put into the fixing solution. Incisional biopsy should not be performed on either pigmented or vascular lesions. Melanomas are highly metastatic and so pigmented lesions should be excised with generous margin of macroscopically normal tissues around and beneath them.

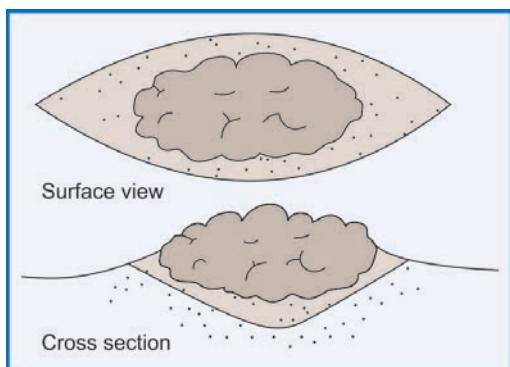
#### *Instruments Required*

1. Syringe, needle and local anesthetic solution
2. Tooth tissue forceps (medium size)
3. B.P. blade (# 11 and # 15) and Handle

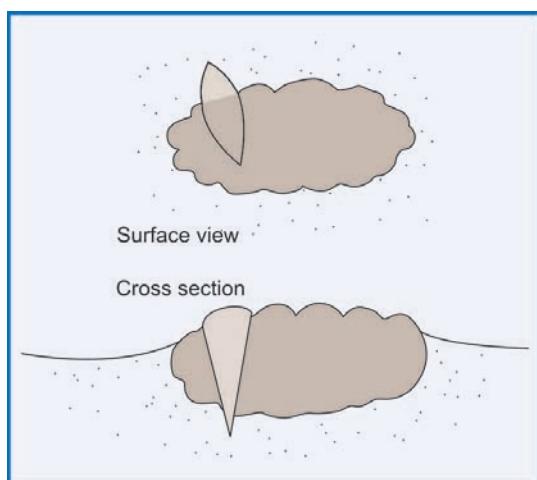
4. Mayo scissors (medium size)
5. Needle holder and suture (needle preferably round bodied)
6. Suture cutting scissors
7. Allie's tissue forceps
8. Gauze for mopping
9. Suction

The following points should be observed while taking biopsy:

- If possible, the pathologist should see the patient with the surgeon so that both the site and extent of biopsy can be mutually determined. This may not be possible in majority of cases.



**FIGURE 6.19:** Excision biopsy



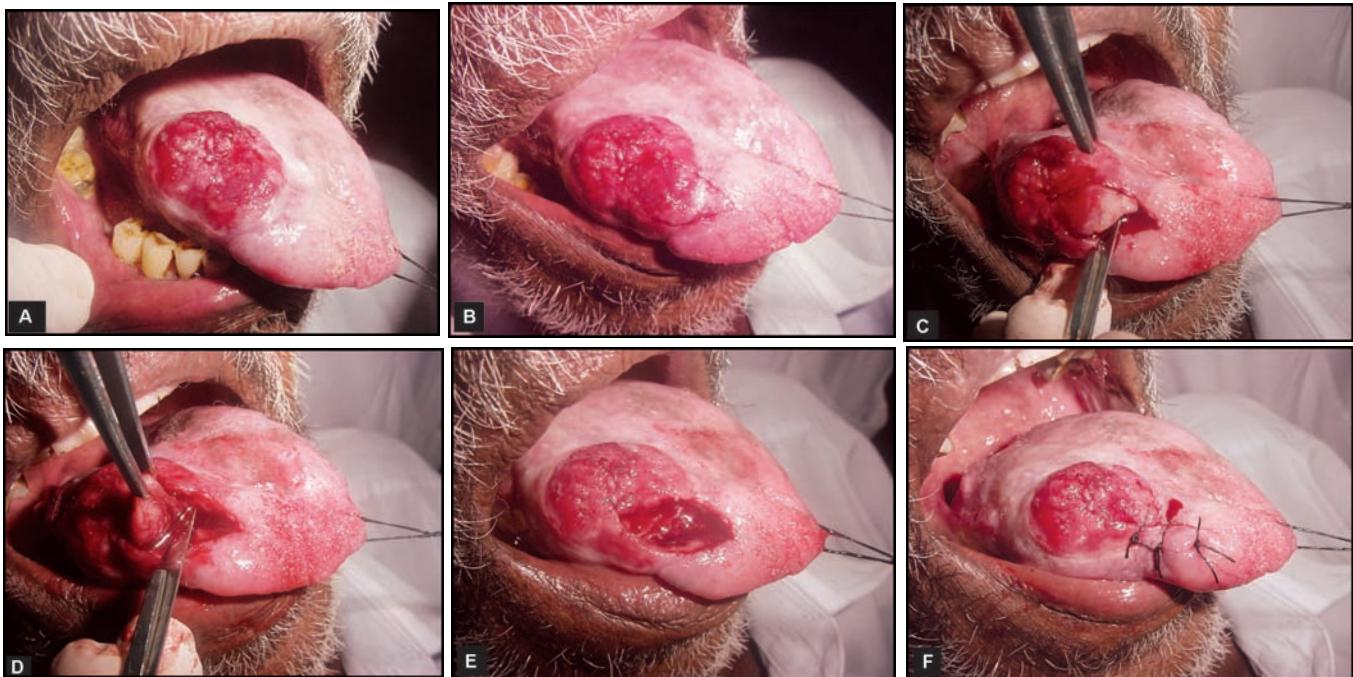
**FIGURE 6.20:** Incision biopsy

- Hence the specimen when sent to the laboratory must be accompanied by a requisition form showing the patient details like age, sex, site of the lesion, symptoms, its duration and the clinical features in detail. Clinical diagnosis if any should be mentioned. Special mention should be made regarding the nature of regional lymph nodes. Radiographic features and results of other investigations will aid the pathologist in arriving at the diagnosis. It is a good practice to make a drawing outlining the lesion and indicating the exact site from where the specimen was taken.
- Antiseptics should not be applied to the lesion prior to biopsy.
- Local anesthetic solution should be deposited away from the site from where the tissue is removed.

- Tissues should be handled very gently at all times and not crushed with the beaks of forceps/hemostats or torn or burned. Electrosurgery is not advisable for taking biopsy as burning tissues makes histological examination difficult.
- Certain authors advice passing a suture through the specimen which will help to orient it.
- If the lesion is suspected to be malignant and is closely related to bone, care should be taken not to penetrate the periosteum when a biopsy is taken
- Adequate amount of tissue must be removed. It must be remembered that excised tissue shrinks and the specimen should be at least 1 cm.X ½ cm. size
- Specimen removed should include a portion of normal tissue also.
- Once the specimen is taken it must be gently rinsed to remove the blood and then put in a labeled bottle containing 10 percent formalin solution for fixing. This is to avoid autolysis. Ideally the volume of fixative should be 10 times the volume of the specimen

**Table 6.3: Specimen collection**

Test	Quantity	Type of specimen container	Remarks
1. Routine examination (Hb, TC, DC, ESR, platelet count)	2 ml	EDTA	Mix well.
2. ESR only	2 ml	EDTA	Mix well.
3. Prothrombin time	1.8 ml	Citrate 0.2 ml	Mix well
4. Serum cholesterol	3 ml	Plain Bottle	-
5. Lipid Profile	4 ml	Plain Bottle	Fasting specimen
6. LFT	4 ml	Plain Bottle	-
7. RFT	3 ml	Plain Bottle	-
8. Blood Sugar	1-2 ml	Sodium Fluoride/ Plain Bottle	-
9. Electrolytes	3 ml	Plain Bottle	-
10. HIV (1+2) ELISA	4 ml	Plain Bottle	-
11. HB <sub>s</sub> Ag ELISA Screening test	4 ml	Plain Bottle	-
12. Culture Child	3 ml	Plain Bottle	-
	3 ml	Special Bottle	To be obtained from the lab.
Adult	5 ml	Special Bottle	as above
13. Cross matching	2 ml	Plain bottle	-



**FIGURES 6.21A TO F:** Shows the various steps in the incision biopsy of suspected carcinoma in the dorsum of tongue. (A) Lesion in the tongue, (B) Incision marked, (C) Incision started including the normal tissue, (D) Biopsy in progress, (E) Site after removal of tissue, (F) Closure

- If for any reason fixative is not available, the specimen should not be put into either water or normal saline which will hasten autolysis. Rather it may be wrapped in moist cotton-wool and kept in a refrigerator.

## SPECIMEN COLLECTION FOR COMMON INVESTIGATIONS

### Blood

See Table 6.3.

### Sputum

Sterile bottle needed for routine and culture.

### Swabs

For culture and sensitivity- sterile tube needed.

### Aspirated Fluid

Sterile bottle.

### Urine

- For routine examination, a clear voided specimen is required.
- A midstream specimen is needed for bacteriologic culture.

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# 7

# Conscious Sedation

**Sajeesh Kuriakose**

Today both practitioners and the public are better educated about pain and anxiety control. In patients who are fit and healthy, conscious sedation is seen as a benefit for long procedures, difficult procedures and for the disproportionately anxious patients. Some patients just want a high level of comfort for treatment.

Conscious sedation is a powerful tool. Many patients who previously relied on general anesthesia are learning to cope and accept treatment with conscious sedation. As a profession we are informing our patients better and providing quality written information. Both practitioners and patients are taking on their responsibilities at a level that was inconceivable possibly even a decade ago. Anecdotally there is increasing demand, but high-quality evidence for this is becoming increasingly available. The need for conscious sedation in Oral and Maxillofacial surgery is high.

Conscious sedation is very safe. To maintain the highest standards, education needs to improve but the profession can be proud of leading the field in this respect.

Safe conscious sedation has been available to Maxillofacial surgeons and more importantly their patients for many years. A renaissance in attitudes to pain and anxiety control throughout the medical profession is beginning to highlight the importance of conscious sedation for our patients. The challenge is improved educational pathways for the benefit of patients' safe, gentle and comfortable care.

## **SAFETY FIRST**

As a profession we have a lot of indications for using conscious sedation. The question commonly asked is whether it is dangerous? Most sedative drugs are anesthetic drugs used in a different way, therefore a badly used sedative could result in uncontrolled anesthesia. Without doubt, uncontrolled anesthesia puts patients at potential risk.

The profession has an enviable record in safety in conscious sedation, with mortality of only a handful in millions of administrations in the last two decades. Conversely, mortality in other medical specialities, particularly endoscopy, has been as high as 1 in 2,500. Even when one accounts for the higher risk patients and other contributing factors, the mortality and morbidity associated with the sedation must be seriously questioned. Each speciality has specific challenges that need to be addressed by that speciality alone.

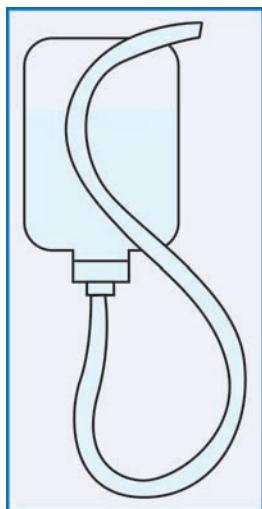
The safety of a sedative procedure relates to proper patient selection, technique selection, the training and experience of the sedationist and associated maxillofacial team and an appropriate environment in which to carry it out.

## **WHAT IS CONSCIOUS SEDATION?**

Conscious sedation is defined as the administration of pharmacological agents to produce a medically controlled state of depressed consciousness that:

- Allows protective reflexes to be maintained;
  - Retains the patient's ability to maintain a patent airway independently and continuously;
  - Permits appropriate responses by the patient.
- Unconscious sedation is sedation associated with loss of protective reflexes.

The goals of procedural sedation are to provide analgesia, amnesia, and anxiolysis during a potentially painful or frightening procedure. Patients who receive conscious sedation usually are able to speak and respond to verbal cues throughout the procedure, communicating any discomfort they experience to the provider. A brief period of amnesia may erase any memory of the procedure.



**FIGURE 7.1:** The goals of conscious sedation are to provide analgesia, amnesia, and anxiolysis during a potentially painful or frightening procedure

## TYPES OF SEDATION ADMINISTRATION

- **Enteral:** Any technique of administration in which the agent is absorbed through the gastrointestinal tract or oral mucosa (i.e., oral, rectal, and sublingual).
- **Parenteral:** A technique of administration in which the drug bypasses the gastrointestinal tract (i.e., intramuscular, intravenous, intranasal, submucosal, subcutaneous, and intraocular).
- **Transdermal/transmucosal:** A technique of administration in which the drug is administered by patch or iontophoresis.
- **Inhalation:** A technique of administration in which a gaseous or volatile agent is introduced into the pulmonary tree and whose primary effect is due to absorption through the pulmonary bed.

## Enteral Conscious Sedation (ECS)

Enteral conscious sedation is primarily used to curb anxiety and fear in a patient without rendering them unconscious. Dentists use ECS in 10 percent of cases in the US, in procedures ranging from prophylaxis to fillings and surgeries.

Prior to the 1960s, alcohol and barbiturates were used to relax patients. Once benzodiazepines hit the market, they became the drugs of choice for dentists. Triazolam is the benzodiazepine most commonly used by dentists because of its rapid onset, reported high margin of safety, and the availability of the antagonist flumazenil. Triazolam's popularity with dentists also stems from the drug's short half-life and duration. Peak plasma concentration of 0.25 mg to 0.50 mg occurs in about one hour. The elimination half-time is 1.7 hours. "The combination of probable amnesia and somnolence has brought triazolam into the forefront as a preferred sedative among dentists who use oral sedation in their practice," according to a 2002 study reported in "The Dental Clinics of North America", titled "Inhalation and enteral conscious sedation for the adult dental patient."

IV or inhalation sedation is more ideally suited to titration because the effect upon the patient is immediate. "It gets into body quickly. The dentists can measure the effect and give more if necessary. With oral conscious sedation the effect would take an hour or two. It might take all day to titrate appropriately." The slow absorption makes it more difficult for dentists to assess whether or not they over-sedated the patient.

"The major drawback of oral sedation is that absorption rates are highly variable. Nitrous oxide goes right to the lungs. IV is delivered straight into the bloodstream—it doesn't have to go through a process."

The absorption process for ECS can vary depending on the amount of food in the patient's stomach and the other medication they are taking.

### Drugs Used for Oral Sedation

1. Diazepam (Valium), 0.2 to 0.3 mg/kg, maximum to 10 mg, orally 45 to 60 minutes before procedure
2. Chloral hydrate, 75 to 100 mg/kg, maximum to 2.0 g, orally or rectally 60 minutes before procedure

## Intravenous Conscious Sedation

Intravenous conscious sedation (IVCS) is a minimally depressed level of consciousness that retains the patient's ability to maintain a patent airway independently and continuously and respond appropriately to physical stimulation and verbal commands. IVCS may be administered during therapeutic, diagnostic or surgical procedures. The drugs, dosages and techniques utilized for IVCS are not intended to produce loss of consciousness. Conscious sedation should be distinguished from two other levels of consciousness: deep sedation and general anesthesia. Deep sedation is a controlled state of depressed consciousness or unconsciousness from which the patient is not easily aroused, accompanied by a partial or complete loss of protective reflexes, including the ability to maintain a patent airway independently and respond purposefully to physical stimulation or verbal command. General anesthesia is a controlled state of unconsciousness accompanied by a loss of protective reflexes, including loss of the ability to maintain a patent airway or to respond purposefully to physical stimulation or verbal command.

In actuality, a continuum exists among conscious sedation, deep sedation and general anesthesia. The patient's age and preexisting medical conditions may significantly



**FIGURE 7.2:** Intravenous Conscious Sedation (IVCS) is a minimally depressed level of consciousness that retains the patient's ability to maintain a patent airway independently and continuously and respond appropriately to physical stimulation and verbal commands

alter the dosing requirements needed for IVCS. If either deep sedation or general anesthesia is required for the procedure, skilled anesthesia personnel should be available to assist in the management of the patient.

Local anesthetics are used to control regional pain. Sedative drugs and techniques may control fear and anxiety, but do not by themselves fully control pain and, thus, are commonly used in conjunction with local anesthetics. General anesthesia provides complete relief from both anxiety and pain.

### Definitions

In order to know how sedated the patient is, one must be familiar with a few definitions. Practicing within the confines of conscious sedation mandates that your patient does not become too sedated. A few important definitions are listed below:

#### *Light sedation*

the administration of medications for the reduction of anxiety. In this stage the following should be present:

1. Normal respirations
2. Normal eye movements; and
3. Intact protective reflexes.

Amnesia may or may not be present. The patient is technically awake, but under the influence of the drug administered.

If a patient becomes difficult to arouse or loses ability to maintain a continuously patent airway spontaneously, then they have gone past conscious sedation to deep sedation.

#### *Conscious sedation (Fig. 7.3)*

A medically controlled state of depressed consciousness that

1. Allows protective reflexes to be maintained;
2. Retains the patient's ability to maintain a patent airway independently and continuously; and
3. Permits appropriate response by the patient to physical stimulation or verbal command, for example, "open your eyes."

The drugs, doses, and techniques used are not intended to produce a loss of consciousness. The author use the terms "sedation/analgesia" synonymously with "conscious sedation"

### Deep sedation

A medically controlled state of depressed consciousness or unconsciousness from which the patient is not easily aroused. It may be accompanied by a partial or complete loss of protective reflexes, and includes the inability to maintain a patent airway independently and respond purposefully to physical stimulation or verbal command.

General Anesthesia is a controlled state of unconsciousness accompanied by a loss of protective reflexes, including loss of the ability to maintain a patent airway independently or to respond purposefully to physical stimulation or verbal command.

### Signs of Sedation

The patient may take a few deeper breaths; the speech (e.g. counting backwards) becomes slower, softer, slurred, cognitive errors occur, and speech ceases; the face assumes a more relaxed appearance and facial tone sags, breathing becomes more shallow and slow; if airway is not supported, the lips may splutter with expirations; the

patient no longer flutters eyelids when the lashes are gently stroked with a finger; the patient no longer responds to a noxious stimulus. The patient should still maintain his respiration and vital signs should be adequate and stable. Awakening occurs in reverse order. Amnesia is neither immediate nor invariable.

### Patient Selection

Sedation-related risk factors include significant medical conditions, such as extremes of age; severe pulmonary, cardiac, renal or hepatic disease; pregnancy; the abuse of drugs or alcohol; uncooperative patients; or a potentially difficult airway for intubation. The American Society of Anesthesiologists (ASA) Taskforce states that airway management may be difficult in the following situations:

1. Patients with previous problems with anesthesia or sedation.
2. Patients with a history of stridor, snoring, or sleep apnea.
3. Patients with dysmorphic facial features- such as Pierre-Robin syndrome or trisomy-21.

Sedation Score	Level of Sedation	Level of Consciousness	Response-Verbal	Response-Tactile	Airway Patency	Ventilation, Oxygenation
0	None	Fully aware of self and surroundings	P	P	P	P
1	"Light"	Mostly aware of self and surrounding, but sedate	P-L	P	P	P
2	"Moderate"	Slightly aware of self and surroundings, usually somnolent, arouses easily with stimuli	L-A	P-L	P-L §	P-L •
3	"Deep"	Not aware of self or surroundings, little arousal with stimuli	A	L (to pain)	L-A	L
4	General Anesthesia	Uncosconscious, no arousal with painful stimuli	A	A (to pain)	L-A	L-A

P: Present, adequate, or normal  
L: Limited, partial, mildly abnormal  
A: Absent, inadequate

\*: May need supplemental oxygen to keep  $\text{SAO}_2 > 90\%$   
§: Airway may need limited support

FIGURE 7.3: Levels of conscious sedation

## 96 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

4. Patients with oral abnormalities -such as a small opening (<3 cm in an adult), edentulous patients, protruding incisors, loose or capped teeth, high arched palate, macroglossia, tonsillar hypertrophy, or a non-visible uvula.
5. Patients with neck abnormalities—such as obesity involving the neck and facial structures, short neck, limited neck extension, decreased hyoid-mental distance (<3 cm in an adult), neck mass, cervical spine disease or trauma, tracheal deviation, or advanced rheumatoid arthritis.
6. Patients with jaw abnormalities- such as micrognathia, retrognathia, trismus, or significant malocclusion.

Patients should be triaged to the appropriate ASA Physical Status Classification before conscious sedation is performed.

### ASA Classification

- ASA I: Normally healthy
- ASA II: Patient with mild systemic disease (e.g. hypertension)
- ASA III: Patient with severe systemic disease (e.g. CHF), non-decompensated
- ASA IV: Patient with severe systemic disease, decompensated
- ASA V: Moribund patient, survival unlikely

Additional consideration should be given to those candidates who are over 65 years of age. Dose increments should be smaller and the rate of injection slower, as the bioavailability of benzodiazepines, as with most drugs, changes dramatically with age. This is especially so with the patient who has been pre-medicated with opioids.

### Additional precautions

- Use of supplemental oxygen by nasal prongs
- Use of pulse oximetry. The alarms should be set very close to the room air saturation of the individual patient.
- Constant one-on-one supervision, especially in a patient who has other health problems. Particular care should be exercised regarding the respiratory rate and verbal responsiveness.
- Appropriate airway and resuscitation equipment and the competency to utilize the same.

*Consulting the anesthesiologist:* Consultation with the anesthesia department is mandatory before providing conscious sedation in the following situations:

1. Sleep apnea.
2. Extremes of age.
3. Pregnancy.
4. Patients with severe cardiac, pulmonary, hepatic, renal or CNS disease.
5. Drug or alcohol abuse.
6. Morbid obesity.
7. Emergency/unprepared patients.
8. Metabolic and airway difficulties.
9. Patients requiring deep sedation.
10. Uncooperative patients.

Furthermore, anesthesiologist must be consulted immediately in situations where the patient is observed to have lost protective reflexes.

*Equipment:* Appropriate emergency equipment for maintaining the patient's airway, ventilatory status and cardiac status should be readily available when sedation/analgesia medications are given to the patient. Equipment must be suitable for the size and age of the patient. The following equipment is essential, but not limited to:

- Emergency cart with defibrillator (Fig. 7.4) immediately accessible
- Suction at bedside

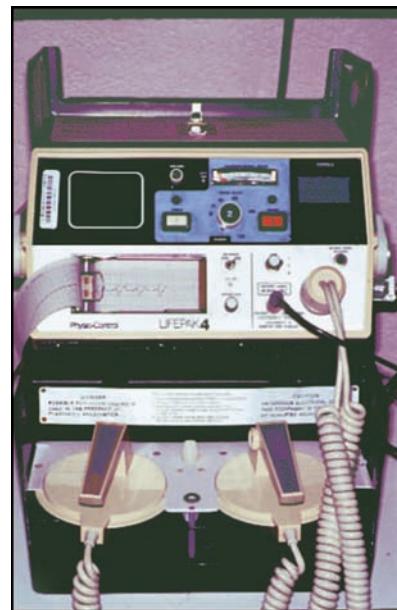


FIGURE 7.4: Emergency cart with defibrillator

- Oxygen and oxygen delivery devices (cannula, mask)
- Appropriate oral and nasal airways (pediatric and adult as appropriate)
- Continuous noninvasive BP monitoring device
- Cardiac monitor
- Pulse oximeter
- Ambu bag
- Intubation tray
- Reversal agents (naloxone and flumazenil)
- IV supplies

*Medication combinations for conscious sedation:*

1. Ketamine, atropine (or glycopyrrolate), and benzodiazepine.
2. Benzodiazepine and analgesic.
3. Systemic agents (propofol or etomidate) and analgesic.

### Patient Monitoring

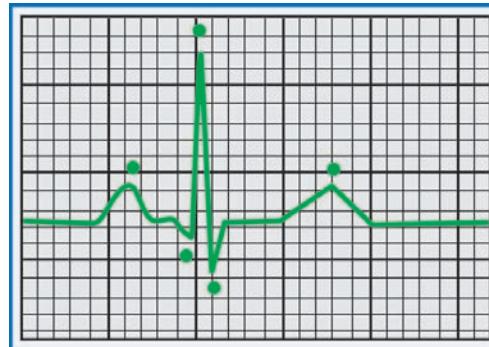
The conscious sedation protocol mandates monitoring of blood pressure, pulse, respiratory rate, level of consciousness and blood oxygen saturation at least every 5 minutes. It will be assumed that the reader is familiar with most of these devices, since a prerequisite to providing conscious sedation includes education in these matters. This section will focus on how these devices function and discuss their limitations.

**Visual assessments:** Before discussing the mechanical monitoring devices, it is important emphasize that the most important monitoring device is the skill of the clinician. Where monitors can fail, a finger on the pulse can tell something about rate, rhythm and strength of cardiac pulsations. The “ABCs” of basic life support should not be forgotten when high-tech monitors are used: Does the patient have a patent airway? Are they breathing? Do they have adequate circulation? With this in mind, we will discuss how the more technical monitors work.

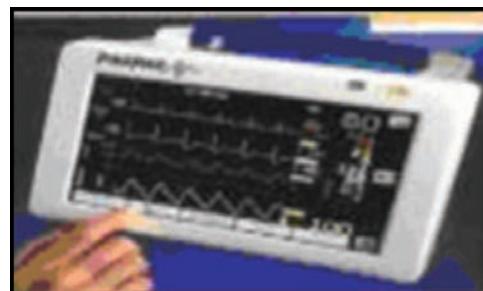
**Pulse:** Heart rate can be measured in multiple ways:

1. *Electrocardiogram:* The ECG provides information on the cardiac conductivity of the heart, but does not indicate what pulse is generated from that activity. In most instances the pulse rate matches the ECG rate, and is usually an accurate indicator of pulse rate.

In situations where the ECG is showing a regular heart rate, but no pulse is generated (and therefore no blood pressure), an electromechanical dissociation is said to occur, and ACLS protocols should be initiated. Continuous ECG monitoring can also give early indication of arrhythmias associated with hypoxia or coexisting disease (Fig. 7.5 and 7.6).

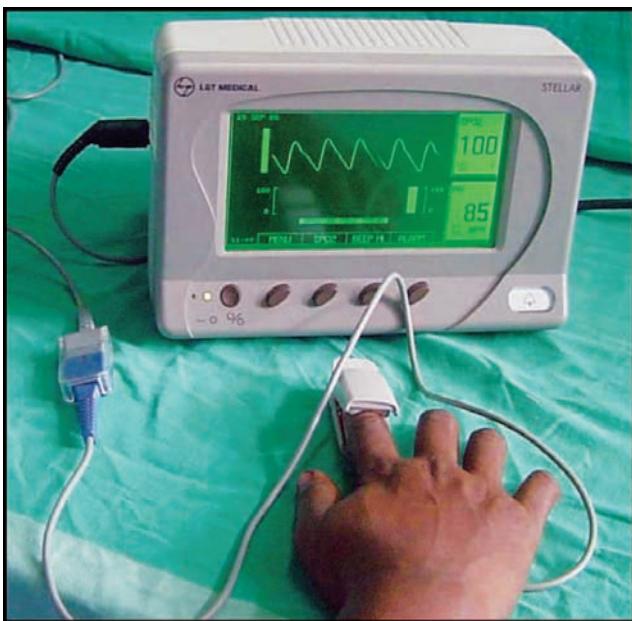


**FIGURE 7.5:** Normal Electrocardiogram



**FIGURE 7.6:** Continuous ECG monitoring can also give early indication of arrhythmias associated with hypoxia or coexisting disease.

2. *Direct measurements:* The pulse oximeter and blood pressure cuff require a pulse for reading, and are reliable indicators of the patient’s pulse. Best assessments of the quality of the pulse are measured through direct palpation or auscultation, and when a question of the patient’s pulse arise, these methods should be used immediately.
3. *Pulse oximetry:* Studies have proven that respiratory events occur frequently during and shortly after conscious sedation, and that far more of these are recognized when pulse oximetry is continuously used. Indeed, pulse oximetry is the standard of care in anesthesia (Fig. 7.7).

**FIGURE 7.7:** Pulse oximeter

*How it works:* The absorption of light passing through a sample of hemoglobin is a logarithmic function of its oxygen saturation. Two wavelengths of light are typically used to distinguish oxyhemoglobin from reduced hemoglobin, 660 nm and 940 nm. This technology is called spectrophotometry. In addition, pulse oximeters use plethysmography to distinguish between arterial, pulsating blood and venous, nonpulsatile blood.

#### *Limitations of pulse oximetry*

Pulse oximetry ( $\text{SpO}_2$ ) will differ from arterial oxygen saturation ( $\text{SaO}_2$ ) in a few situations; when there is a significant amount of carboxyhemoglobin or methemoglobin in the blood, when the oxygen saturation falls off of the steep part of the oxyhemoglobin dissociation curve ( $\text{SaO}_2$  less than 70%), or when there is a substance in the blood that absorbs light in the red or infrared spectrum, such as methylene blue.

The pulse oximeter has other limitations as well. Hypotension, hypothermia or the use of vasoconstricting drugs may reduce the pulsatile flow. Ambient light may interfere and cause incorrect readings. Motion of a finger probe may cause failure. The pulse oximeter detects adequacy of oxygenation, but fails to detect adequacy of ventilation (carbon dioxide exchange), and may miss a significant amount of hypoventilation. With these limitations in mind, however, pulse oximetry provides valuable and early information during procedures using sedation and analgesia.

**FIGURE 7.8:** Automated blood pressure cuff

*Automated blood pressure cuffs:* Automated non-invasive measurements of blood pressure frequently use the technology of oscillometry (Fig. 7.8). This technology is felt to be a reliable representation of true arterial blood pressure. With this technology the points of maximal fluctuations in cuff pressure are sensed while the cuff is deflated. In a typical microprocessor-controlled oscillotonometer the cuff is inflated with an air pump and the pressure is held constant while a sample of oscillations is gathered. If no oscillations are detected, some of the pressure is relieved and another sample is gathered. This is repeated in a step-wise fashion, and algorithms are used to filter artifact.

*Cuff size:* Proper cuff size and fit are required for adequate measurement (Fig. 7.9). False low estimates will be generated if the cuff is too large, and false high estimates will be generated if the cuff is too small. The cuff is considered the proper size when the bladder width is approximately 40 percent of the circumference of the extremity and the bladder length is sufficient to encircle at least 60 percent of the extremity.

**FIGURE 7.9:** Proper cuff size and fit are required for adequate measurement

#### *Procedure*

##### *Using Ketamine, atropine and a benzodiazepine*

- This is an excellent combination for children under 11 years of age. Older children and adults do not require the addition of atropine.

- Emergence reactions are more common in adults, and combination treatment with a benzodiazepine may alleviate this.
- Ketamine is an excellent sedation agent for asthmatics, as it does not cause airway hyper-reactivity

*Time*

0 min	Attach monitoring equipment and obtain baseline readings
+1 min	Ketamine 1-2 mg/kg IV OR 3-5 mg IM, PLUS atropine 0.01 mg/kg IV/IM, OR glycopyrrolate 0.005 mg/kg IM/IV PLUS midazolam 0.05 mg/kg IV/IM
+5-10 min	Begin procedure
+30-120 min	Recover patient

*Using analgesic and a benzodiazepine**Time*

0 min	Attach monitoring equipment and obtain baseline readings
+1 min	fentanyl 0.001-0.002 mg/kg IV OR morphine 0.1-0.2 mg IV, PLUS midazolam OR lorazepam 0.05 mg/kg IV
+3.5 min	Begin procedure
+10-120 min	Recover patient

*Using a systemic agent and an analgesic**Time*

0 min	Attach monitoring equipment and obtain baseline readings
+1 min	Propofol 1-2 mg/kg IV OR etomidate 0.3 mg/kg IV, PLUS morphine 0.05 mg/kg IV (NOTE THE LOWER DOSE OF ANALGESIA...this is due to the synergistic effect of the anesthetic.)
+3.5 min	Begin procedure
+10-120 min	Recover patient

*Reversal of Sedation*

Rarely should reversal of agents used in procedural sedation be necessary if they are titrated appropriately.

Naloxone is a competitive antagonist of the opioid receptors; it is used for reversal of narcotic analgesics. Use 0.001 mg/kg IM/IV titrated to effect. Be aware that the duration of naloxone is less than the duration of action for most opiates. Be prepared to re-bolus the naloxone, or use a naloxone drip at 0.01-0.05 mg/min.

Flumazenil is a pure benzodiazepine antagonist, and can be used for reversal of benzodiazepine sedation. Like naloxone, it has a shorter duration of action than the benzodiazepine agents it reverses. Prepare to re-bolus with flumazenil, or run a flumazenil drip at 0.1 mg/min. Use 0.2 mg IV every 2-5 minutes titrated to effect, or up to 2 to 3 mg in total if needed.

Pharmacologic agents used in procedural sedation are of three general classes: sedatives, analgesics, and systemic agents. Using a combination of a sedative/analgesic provides a synergistic combination that generally gives consistent clinical results; using systemic agents provides very rapid sedation and relaxation with some analgesia. Patients should be NPO for at least 4-6 hours prior to procedure if at all possible.

*Pharmacology*

The basic principles of pharmacology as it relates to sedation/analgesia and the commonly used agents are the following.

*Opioids*

Natural opioids are derived from the poppy plant, which contains as many as 20 pharmacologically active alkaloids. In addition, many synthetic opioids have been developed, each with distinct pharmacological characteristics. Depending on the chemical structure, naturally occurring opioids can be classified as phenanthrenes (five-ring structures) or benzoisoquinolines (three-ring structures). Semisynthetic and synthetic opioids can be subdivided further. Of the purely synthetic opioids, the phenylpiperidine series is the most important, including meperidine, alfentanil, sufentanil and fentanyl.

Opioid receptors are located throughout the brain and spinal cord, and consist of several types, including mu (m), kappa (k), delta (d) and sigma (s). The most important types of receptors in opioid pharmacology are mu and kappa, which provide analgesia. Mu receptors can be further subdivided into mu<sub>1</sub> and mu<sub>2</sub>. Stimulation of mu<sub>2</sub> receptors produces respiratory depression. Most pharmacological agents that stimulate mu receptors do not preferentially bind to mu<sub>1</sub> or mu<sub>2</sub>, hence respiratory depression is a concern with the administration of mu-receptor agonists. Opioid receptors, which are continuously being formed, have a life-span between 1 ½ to 4 days.

In order for one of these receptors to be stimulated or blocked, a chemical must have a T-shape.

Common features of opioids include: (1) Central analgesic effect on the dorsal horn of the spinal cord, (2) mood elevation, (3) cough suppression with certain chemical classes, (4) respiratory depression, (5) nausea and vomiting, (6) decreased gastric emptying and reduced intestinal motility, (7) constriction of pupils, and (8) urinary retention.

Respiratory depression is the most serious side effect of opioid when administering them for conscious sedation, and an understanding of this mechanism is important. At low doses of opioids, tidal volume is unaffected and only respiratory rate is decreased. At increasing doses, both tidal volume and respiratory rate are affected. It is important to note the effect of opioids on ventilatory drive. In healthy individuals who have not been administered opioids, ventilatory drive is due largely to the level of carbon dioxide in the blood. The administration of opioids alters the ventilatory response to carbon dioxide, and shifts the driving mechanism to hypoxia. It is therefore possible to further diminish the respiratory drive by delivering high concentrations of supplementary oxygen.

### **Fentanyl**

The potency of fentanyl is on the order of 100-times that of morphine. Given in 25 mcg increments to a total dose of 1-3 mcg/kg, it has a duration of action of 0.5-1 hour, making it a good choice for short diagnostic or therapeutic procedures. It is 7000 times more lipid soluble than morphine, therefore it penetrates membranes more easily. Muscle rigidity, which can occur with any opioid, occurs more frequently with fentanyl due to its high lipid solubility and rapid absorption into the Central Nervous System (CNS). This can cause chest wall rigidity with a large bolus injection, making ventilation difficult or impossible. This complication may necessitate the injection of a muscle relaxant and temporary respiratory support with positive pressure ventilation.

### **Meperidine**

Meperidine was the first synthetic opioid to be introduced into clinical practice. It belongs to the phenylpiperidine class. It is less potent than morphine, 75 mg of meperidine

is equivalent to 10 mg of morphine. It is usually given in increments of 12.5 mg and has a duration of action of 1-2 hours. Unlike other opioids, meperidine does not tend to have a vagolytic (bradycardic) effect, due to its atropine-like chemical structure. Meperidine can cause histamine release, which should be avoided in patients with a history of asthma.

### **Morphine**

Morphine is a naturally occurring opioid of the phenanthrene (5-ring) type. It is the prototypical opioid agonist, to which all others are compared. To relieve acute pain or discomfort, doses of 2 to 3 mg are given intravenously, repeated every 2 to 3 minutes until the pain is relieved. Typically a total dose of 5 to 10 mg is given. The duration of action of morphine is 2-3 hours, and the analgesic effect is due at least in part to the action of its active metabolites. For patients who are receiving an analgesic on an outpatient basis, morphine may not be the best choice because of its longer duration of action.

### **Benzodiazepines**

Benzodiazepines are sedative-hypnotic drugs which facilitate neurotransmission at gamma aminobutyric acid (GABA) synapses, a primary inhibitory system in the CNS. There are more than 25 benzodiazepines available including chlordiazepoxide (Librium), diazepam (Valium) and midazolam (Fused).

The GABA receptor has at least 3 binding sites, one site for GABA (the natural neurotransmitter), a separate site that binds barbiturates and another site that binds benzodiazepines. Binding of GABA by agonist benzodiazepines or barbiturates causes a conformational change in the receptor site which opens chloride channels. An influx of chloride ions hyperpolarizes the neuron, making it less likely to transmit an action potential.

A continuum of effects can be seen with benzodiazepines with increasing doses, ranging from anxiolysis to anticonvulsant effect, slight sedation, reduced attention, amnesia, intense sedation, muscle relaxation and general anesthesia. The exact mechanism of action is unknown, but large numbers of GABA receptors are found in the limbic system of the brain. The limbic system is responsible for emotions, and it is likely that this is the site of action for the anti-anxiety effect of benzodiazepines. Muscle

relaxation is achieved with benzodiazepines through direct action on the spinal cord.

In addition to receptors located in the CNS, peripheral benzodiazepine receptors have been shown to exist. Their role is not well understood, but may contribute to hemodynamic changes that can accompany sedation. Benzodiazepine receptors have been found in the myocardium, kidney, mast cells, platelets and adrenals.

Benzodiazepines given alone can cause respiratory depression, although much less so than barbiturates. This effect is accentuated when given in combination with opioids, an important fact to remember when administering conscious sedation. It should also be noted that benzodiazepines are contraindicated in acute narrow angle glaucoma.

### **Diazepam**

Given in doses of 2.5-5 mg diazepam has a duration of action of 0.25-1 hour. It is prepared with a solubilizer, propylene glycol, which can cause local complications such as pain on injection, thrombophlebitis, and venous thrombosis. Diazepam has two active metabolites, desmethyldiazepam and oxazepam, and when given in excess these metabolites may accumulate and prolong the sedation. Diazepam is widely used in the acute treatment of seizures.

### **Midazolam**

When giving midazolam careful titration to effect is important in order to avoid over sedation and respiratory depression. The package insert outlines one method of titration, pointing out that some patients may respond to as little as 1 mg. For patients under age 60, the recommended method is to titrate no more 2.5 mg over a period of at least 2 minutes. An interval of 2 or more minutes should then pass to fully evaluate the sedative effect. If further titration is necessary, the recommended method is to continue to titrate, using small increments, to the appropriate level of sedation, e.g. slurring of speech. Two or more minutes should pass after each increment to fully evaluate the sedative effect. A total dose greater than 5 mg is not usually necessary to reach the desired endpoint. If narcotic premedication or other CNS depressants are used, patients will require approximately 30 percent less midazolam than unpremedicated patients.

The duration of action of midazolam is 1 to 6 hours, and is usually less than 2 hours.

### **Reversal Agents**

An important clinical advantage of opioids and benzodiazepines is the effectiveness of reversal agents. When unwanted side effects (i.e. respiratory depression) are encountered with opioids or benzodiazepines, the reversal agents can be used as "rescue drugs." It should be noted that in cases of overdose of either benzodiazepines or opioids, the side effects may recur as the reversal agent wears off.

### **Flumazenil**

Flumazenil acts at the benzodiazepine site of the GABA receptor, but does not cause a conformational change in the receptor. Therefore it acts as a competitive antagonist to other benzodiazepines. In order to reduce the sedation caused by benzodiazepines, 0.2 mg should initially be given over 15 seconds. If there is no response, an additional 0.1 mg should be given every minute until the desired effect is achieved or a total of 1 to 2 mg has been given. Careful patient monitoring is important after giving this reversal agent as it is when giving naloxone. Duration of action of flumazenil is 30 minutes, and the patient may become sedated again when it wears off. Another dose may be given if this occurs, or an infusion may be started.

### **Naloxone**

Naloxone is an opioid-receptor antagonist used to counteract overdoses of opioid agonists. It antagonizes mu, kappa, delta and sigma receptors. It is indicated for opioid-induced respiratory depression, but also antagonizes analgesia. If given in sufficient quantities to completely reverse analgesia, the intense pain that can be associated with its administration may precipitate a large catecholamine release, resulting in pulmonary edema and even death. Naloxone is distributed in 1ml vials of 0.4 mg, which should be diluted when given for respiratory depression associated with conscious sedation. Diluting one vial to 10 ml by adding 9 ml of normal saline, and giving 1ml (40 mcg) every  $\frac{1}{2}$  to 1 minute until adequate spontaneous ventilation resumes is the safest way to administer naloxone in this setting. The duration

of action of naloxone is only 10 minutes, so it is possible that the patient may re-narcotize after receiving naloxone.

#### *Other Drugs*

There are a host of other drugs in a variety of categories that can be given in the setting of conscious sedation. A few of them are reviewed here.

#### **Chloral hydrate**

Chloral hydrate is a drug occasionally used for sedation, typically in the elderly or young. It is only given by mouth, in doses of 30 to 50 milligrams per kilogram, and a metabolite is thought to be the active substance. Chloral hydrate has no analgesic properties. In normal situations, it has little effect on blood pressure or heart rate, and it does not interfere with the Rapid Eye Movement stage of sleep.

#### **Droperidol**

Droperidol is in a class of drugs called butyrophenones. This class of drug has similar effects to phenothiazines. They block dopamine receptors in the brain, decreasing neurotransmission. They reduce motor activity and “dissociate” the patient from the environment causing apparent anxiolysis. There is little or no hypnotic effect. These agents also have a potent antiemetic effect. Use of these agents can cause a decrease in blood pressure which is associated with alpha-adrenergic blockade.

Droperidol is usually given as an oral, intramuscular or intravenous dose of 5 to 10 mg. If it is being used solely for its antiemetic effect a lower dose may be used, 0.25 to 0.5 mg.

#### **Haloperidol**

Haloperidol is in a class of drugs called butyrophenones. This class of drug has similar effects to phenothiazines. They block dopamine receptors in the brain, decreasing neurotransmission. They reduce motor activity and “dissociate” the patient from the environment causing apparent anxiolysis. There is little or no hypnotic effect. These agents also have a potent antiemetic effect. Use of these agents can cause a decrease in blood pressure which is associated with alpha-adrenergic blockade.

Haloperidol is useful in the acutely agitated patient and when given for conscious sedation is given

intramuscularly. An initial dose of 10 mg is used, and repeat doses may be given up to a total dose of 50 mg.

#### **Ketorolac**

Ketorolac is in a class of drugs called nonsteroidal anti-inflammatory drugs (NSAIDs). These drugs are a valuable alternative to opioid analgesics, and may be just as potent in some situations. Unlike opioids, these agents primarily work peripherally, interfering with metabolism at the site of the sensory nerve terminal. In particular, the cyclooxygenase pathway is inhibited, which results in the prevention of the accumulation of prostaglandins, prostacyclin and thromboxane from accumulating at the site of injury. Blocking the formation of these pain mediators decreases the level of pain. While it may be important to have opioid-sparing options in analgesia, serious complications can occur with the use of NSAIDs, including reduced platelet aggregation, hemorrhage and renal dysfunction.

Ketorolac is a frequently used NSAID in the acute care setting. It may be given by mouth, intramuscular injection or intravenous injection. The typical intravenous dose is 30 mg and the analgesic effects are greatest if given before the painful stimulus. It should be avoided in patients with impaired renal function, and decreases platelet aggregation.

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## **PERSONNEL**

The Maxillofacial surgeon responsible for administering the drugs and treating the patient must remain immediately available until the patient is stable/alert. In addition, at least one other individual (Doctor/ dentist, Registered Nurse or technician) trained to monitor the appropriate parameters should be present to assist the responsible person with the procedure or management of any problems that may arise.

## **Patient Management and Monitoring**

The Intravenous Conscious Sedation (IVCS) policy should call for the development and use of a standard, time-based (i.e., in real time) form, to be included in the medical record, in which the patient's management and monitoring during IVCS would be documented.

The IVCS policy should contain a list of recommended drugs and dosages, with particular attention given

to those drugs which should not be administered by non-anesthesia practitioners. The IVCS policy should include the following patient management and monitoring guidelines:

#### *Prior to Procedure*

It should be ascertained that:

- The patient's state of consciousness and medical condition are appropriate for the use of conscious sedation;
- Preparatory studies appropriate to the procedure and patient have been done;
- There is a sedation order given by the physician who will perform the procedure, unless that physician will be administering the medication him/herself;
- The patient has no allergy or sensitivity to the prescribed medication;
- The patient's pertinent medical history, including current drug regimen, has been obtained/reviewed;
- The patient has been NPO for at least six hours prior to the planned procedure, except for clear liquids which may be given up to two hours before the procedure. Medications may be administered with a sip of water. In cases of emergencies, where the patient has not been NPO, IVCS may be dangerous. It should either not be administered or administered judiciously to avoid unconsciousness or suppression of protective airway reflexes.
- Informed consent has been obtained. The patient/guardian must be informed of the risks and alternatives to IVCS; documentation must be in the medical record prior to procedure;
- A physical exam has been conducted which includes assessing/measuring the patient's:
  - Estimated weight,
  - Vital signs (baseline blood pressure; heart rate; respiratory rate, pattern and quality),
  - Baseline oxygen saturation,
  - Airway (i.e., an evaluation performed in anticipation of possible intubation, e.g., checking condition of teeth; range of neck motion; ability to open mouth),
  - Chest and cardiac status,

- General neurologic status (e.g., assessing mental status; presence or absence of stroke deficits), and
- Physical status (e.g., ASA physical status category);
- The patient has a functioning IV line or heparin lock;
- The patient's oxygen requirements are evaluated. The need for administration of supplemental oxygen via nasal prongs should be considered. Patients who are over the age of 60 or who have a medical history significant for heart, lung or kidney disease should be routinely given supplemental oxygen unless specifically contraindicated; and
- The patient has been instructed to report any problems associated with the procedure or the IVCS (e.g., pain, difficulty in breathing) to the individual responsible for monitoring the patient.

If any difficulty with the patient or procedure is anticipated, appropriate medical consultation should be obtained.

#### *Contraindications*

1. Recent (<2 hr) ingestion of large food or fluid volumes
2. ASA Physical status class III or greater
3. Lack of support staff or monitoring equipment
4. Lack of experience/credentialing on part of clinician

#### *During the Procedure*

The individual responsible for monitoring the patient should ascertain and record:

- All medication administered (route, site, time, drug, dose);
- The amount and means of oxygen administered;
- The patient's vital signs (blood pressure, respiratory rate and quality, heart rate, and level of responsiveness) every 5 - 10 minutes. If the patient has been classified ASA III or greater or has a history of cardio-pulmonary disease, the heart rate and rhythm should be displayed continuously by cardiac monitor; and
- The patient's oxygen saturation (which is displayed continuously by pulse oximeter) every 5 - 10 minutes.

The patient's head position should be checked frequently to ensure a patent airway. If the patient

becomes unstable during the procedure, appropriate medical consultation should be sought immediately.

#### *Following the Procedure*

The individual whose responsibility it is to monitor the patient should ascertain and record the patient's vital signs (as defined directly above) every 5 to 10 minutes for a minimum of 30 minutes following the last administered dose of IV sedation. Beyond this 30 minute period and, if stable, vital signs should be recorded every 15 minutes until the patient returns to his/her pre-procedure state. Oxygen saturation levels should be obtained if indicated. The patient must be observed for a minimum of 30 minutes following the procedure.

The IVCS policy should include patient discharge criteria for in-patients and ambulatory care patients, as appropriate to the facility. These criteria should include:

- Patient has stable vital signs and oxygen saturation level;
- Patient's swallow, cough and gag reflexes are present, or appropriate to baseline;
- Patient is alert or appropriate to baseline;
- Patient can sit unaided if appropriate to baseline and procedure;
- Patient can walk with assistance if appropriate to baseline and procedure;
- Nausea and dizziness are minimal;
- Hydration is adequate;
- Dressing/procedure site have been checked if applicable; and
- Discharge order has been written by treating doctor.

If the procedure was done on an outpatient or ambulatory care basis, the patient should be given:

1. Written instructions that include an explanation of potential or anticipated limitations on activities, behavior and diet.

2. A 24-hour emergency contact prior to discharge.

Ambulatory care patients should not leave the premises unless they are under the care of a competent adult; they should be advised to refrain from operating heavy machinery, driving a car, consuming alcohol and making important decisions for 12 to 24 hours.

If the patient is being transferred for further care within the facility, standard criteria for inter-unit transfer should be met.

#### **Discharge Requirements:**

Discharge instructions should also include the following precautions because the effects of the medications used can last up to 24 hours.

- Strongly recommend to the patient that an escort take the patient home either by car or taxi.
- Strongly recommend to the patient that an escort stay with the patient overnight on the day of surgery.

#### **Risk Management**

Appropriate educational preparation, while necessary, is not by itself sufficient to ensure safe and effective use of conscious sedation, deep sedation and general anesthesia. There is some degree of risk associated with the use of any drug, even when administered by trained individuals. Dentists who are qualified to utilize conscious sedation, deep sedation and/or general anesthesia have a responsibility to minimize risk to patients undergoing dental treatment by:

- Using only those drugs and techniques with which they are thoroughly familiar, i.e., understand the indications, contraindications, adverse reactions and their management, drug interactions and proper dosage for the desired effect;
- Limiting use of these modalities to patients who require them due to such factors as the extent and type of the operative procedure, psychological need or medical status;
- Conducting comprehensive preoperative evaluation of each patient to include a comprehensive medical history, assessment of current physical and psychological status, age and preference for and past experience with sedation and anesthesia;
- Conducting physiologic and visual monitoring of the patient as needed from onset of anesthesia/sedation through recovery;
- Having available appropriate emergency drugs, equipment and facilities and maintaining competency in their use;
- Maintaining fully documented records of drugs used, dosage, vital signs monitored, adverse reactions, recovery from the anesthetic, and, if applicable, emergency procedures employed;

- Utilizing sufficient support personnel who are properly trained for the functions they are assigned to perform;
- Treating high-risk patients in a setting equipped to provide for their care.

## Complication: Prevention and Management

1. Inadequate amnesia or analgesia:
  - a. Dosage of amnesic or analgesic agents are based upon patient weight. Make sure weights are accurate, and dosages are adequate. As a general rule, the elderly need less, muscular young men need more, and agitated children may also require slightly more medication.
  - b. Allow sufficient time for the agents to work. It is tempting to start the procedure(s) immediately upon drug administration, but do allow time to titrate the effect of the sedation medications.
2. Decreasing oxygen saturation: apply nasal cannula or a non-rebreather mask for increased oxygenation. Occasionally, a bag-valve-mask with positive pressure ventilation may be required transiently.
3. Prolonged recovery: prolonged offset of sedation is dependent on several factors of which the most important are drug distribution in the patient, and the patient's own clearance of the sedation agents. Be prepared to recover the patient for a prolonged period, with adequate oxygenation and clearance of any airway secretions.

## Suggested Drugs and Dosages for Sedation

This is not intended to be all-inclusive, but should serve as a guide to an upper safe limit for those individuals not having extensive experience with the use of these medications. Some departments may have approved protocols that permit higher or lower doses than noted here. Certain specialists (e.g., anesthesiologists) may routinely exceed these guidelines.

Certain patients may not tolerate even these recommended doses. Furthermore, many of these medications have synergistic respiratory depressant effects; when administered in combination these drugs should be used at lower than those stated below.

Finally, these medications should not be given without familiarity with the rest of the guidelines, and without having the necessary resuscitation equipment and skill at hand.

## Medications for Conscious Sedation

### Opioids

Morphine sulfate, 0.05 to 0.10 mg/kg IV over 1 to 2 minutes given 5 minutes before procedure.

Fentanyl, 1 to 2  $\mu$ g/kg (0.001 to 0.002 mg/kg) IV 3 minutes before procedure.

Fentanyl Oralet, 5 to 15  $\mu$ g/kg, maximum to 400  $\mu$ g, orally 20 to 40 minutes before procedure †

Meperidine (if morphine sulfate or fentanyl is not available), 0.5 to 1.0 mg/kg IV over 1 to 2 minutes given 2 to 5 minutes before procedure or 1.5 mg/kg orally 45 to 60 minutes before procedure.

### Sedatives

Diazepam (Valium), 0.2 to 0.3 mg/kg, maximum to 10 mg, orally 45 to 60 minutes before procedure.

Midazolam (Versed), 0.2 to 0.4 mg/kg, maximum to 15 mg (IV solution), orally 30 to 45 minutes, or 0.05 mg/kg IV 3 minutes before procedure.

Pentobarbital (Nembutal), 1 to 3 mg/kg IV boluses to maximum of 100 mg until asleep.

Chloral hydrate, 75 to 100 mg/kg, maximum to 2.0 g, orally or rectally 60 minutes before procedure.

### Infant (less than 3 months)

Avoid sedation if at all possible

Use only reversible agents

### Pediatric Sedation

	Dose	Onset	Duration
Nasal Midazolam (Reversible)	0.2-0.4mg/kg	10-15 min	45 min
Chloral hydrate	50-75 mg/kg PO or PR	30-60min	1-8hr
Propofol	1 mg/kg IV bolus then 0.05-0.1 mg/kg/min drip	30 sec  after stopping drip	8-10 min

## AIRWAY MANAGEMENT

The basic principles of airway management include the head-tilt/chin-lift, the jaw thrust, oropharyngeal airways, nasopharyngeal airways and bag-valve-masks.

Theoretically airway management should never be an issue during conscious sedation because by definition the patient is able to maintain his own airway spontaneously. However, on occasion conscious sedation may inadvertently progress to deep sedation and airway management becomes important. All providers of conscious sedation therefore must be familiar with basic airway management techniques.

Assessing the adequacy of the airway is the first step to managing it. Visual assessment provides early detection of a failed airway. Many times apnea is a result of airway obstruction, and the patient will continue to ventilate spontaneously as long as the obstruction is removed. When the patient is experiencing airway obstruction, sternal retractions may be observed without the movement of air. This happens typically because soft tissue in the airway, typically the posterior aspect of the tongue, falls back against the posterior pharynx (Fig. 7.10). Several techniques can help this situation, and each must be familiar to the provider of conscious sedation. The anesthesia department should be consulted immediately when difficulty is encountered with a patient's airway.

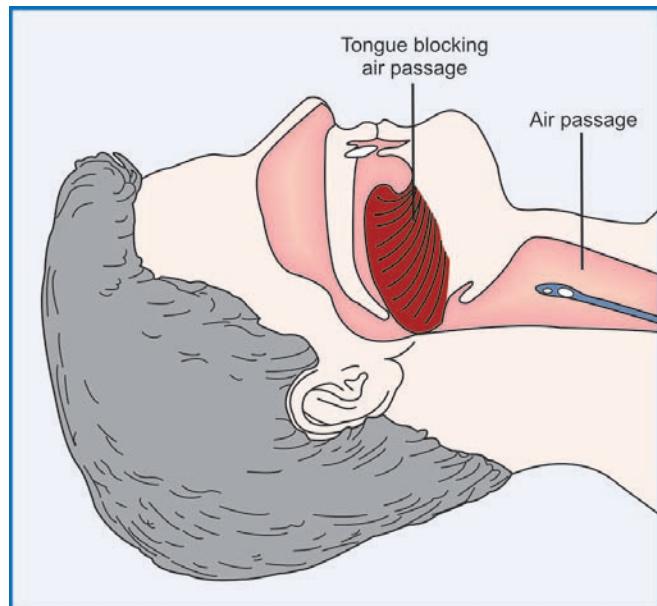
### Head-tilt/Chin-lift (Fig. 7.11)

This is an easy maneuver to learn and is the procedure of choice for airway occlusion. This technique is performed by placing the palm of one hand on the forehead and the fingertips of the other hand on the bony aspect of the chin. The head is tilted backward by gently pushing the chin in the cephalad direction, while stabilizing the forehead.

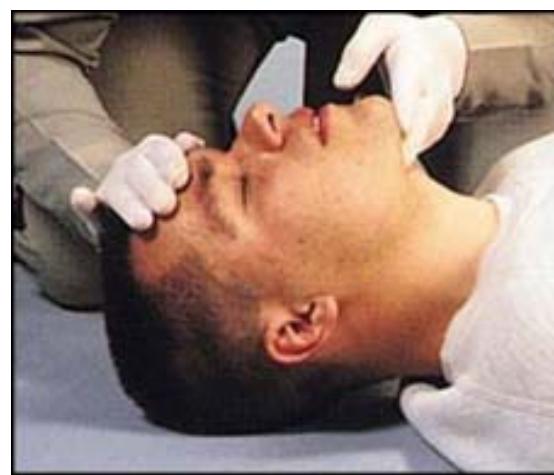
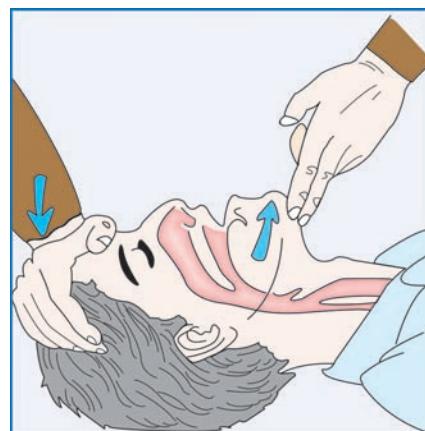
If a spontaneously open airway is not quickly restored, it may become necessary for invasive measures. Two devices are simple and readily available, the nasopharyngeal airway and the oropharyngeal airway.

### Jaw-thrust (Fig. 7.12)

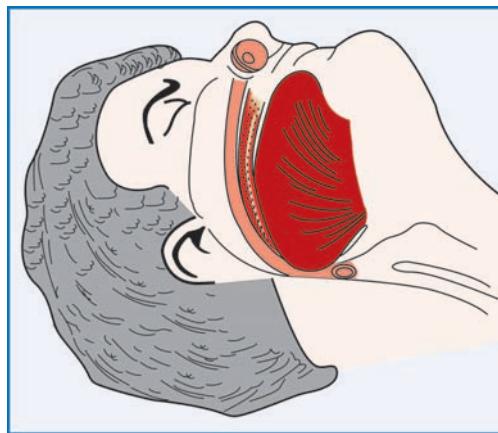
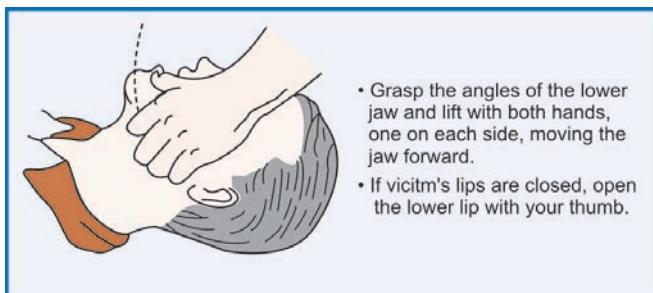
This maneuver is considered slightly more difficult, but is the technique of choice in a patient with a cervical spine injury. One hand is placed on each side of the face, and the mandible is displaced anteriorly using the index or middle fingers pushing against the angle of the mandible. In both of these maneuvers care should be taken to avoid pushing against the soft tissue of the neck or chin.



**FIGURE 7.10:** Tongue blocking the airway



**FIGURE 7.11:** Head-tilt / Chin-lift



**FIGURE 7.12:** Jaw thrust

## Artificial Airways

**Nasopharyngeal airway:** This is a compliant tube approximately 15 cm in length designed so that its distal tip sits in the posterior pharynx, with its proximal tip in the nares. This device is usually tolerated better in the semiconscious patient who maintains a gag reflex. Insertion is performed with the assistance of lubricant (a 2% lidocaine lubricant helps anesthetize the soft tissue). The bevel of the airway is positioned against the nasal septum and gentle pressure is applied to slide the device until the flange is at the tip of the nares (Fig. 7.13).

## Oropharyngeal Airway

This device is a semi curved piece of tubular plastic that is placed on top of the tongue, with the tip in the posterior pharynx (Fig. 7.14). Appropriate size of the device is approximated by choosing an airway that extends from the tragus to the corner of the mouth when held by the patient's cheek. If a tongue blade is available, the airway is inserted right side up over the tongue that is depressed with a tongue blade. If no tongue blade is available, the device can be inserted upside down and rotated 180 degrees when the distal tip reaches the soft palate. Complications of these invasive devices include improper

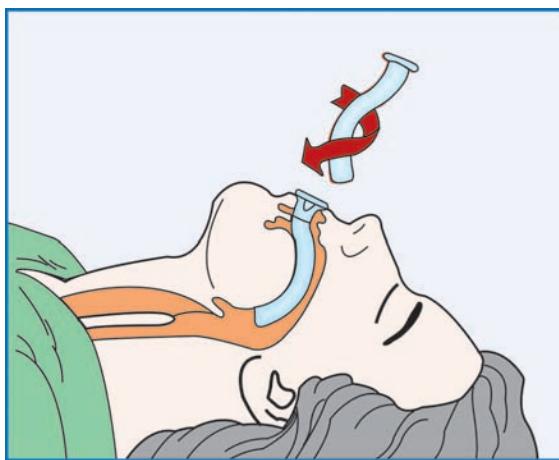
placement, stimulation of vomiting, and bleeding (Fig. 7.15).

Adequate respirations include adequate ventilation and adequate oxygenation. The techniques listed above are designed to aid ventilation and the exchange of carbon dioxide.

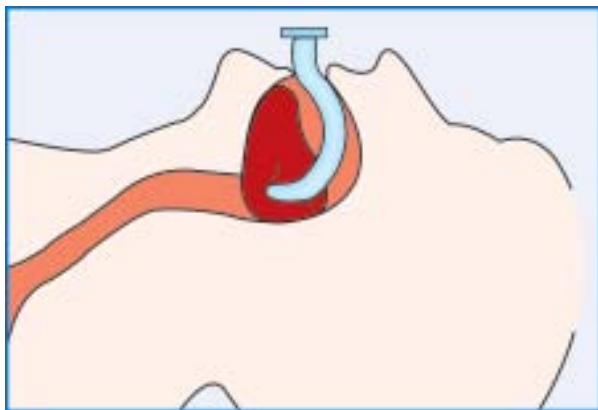
## Oxygen Delivery

### Nasal Cannula (Fig. 6.6 and 6.7)

This oxygen administration device delivers oxygen at a rate of 2 to 6 liters per minute, at concentrations of 24 to 40 percent. It is a well tolerated device and is useful when low oxygen concentrations are desired. In patients with Chronic Obstructive Pulmonary Disease, hypercarbia loses its value as a stimulus to breath and hypoxia becomes more valuable. In these patients lower oxygen concentrations are probably more appropriate than high concentrations. The inspired percent of oxygen ( $\text{FiO}_2$ ) is not well controlled with this device, however. Therefore, in a patient with respiratory distress who is breathing through the mouth, an oxygen mask is a more effective oxygen delivery device.



**FIGURE 7.14:** Oropharyngeal airway and correct method of inserting it



**FIGURE 7.15:** Wrong method of inserting oropharyngeal airway

#### Oxygen Mask (Fig. 6.8)

Three basic styles of oxygen mask are available, the simple mask, the nonrebreathing mask, and the venturi mask. The simple mask has a number of small vents on each side and can deliver up to 50 percent oxygen.

There is a large variability in actual inspired oxygen concentration with the simple mask due to entry of room air. The nonrebreathing mask uses flutter valves on each side to prevent entry of room air, and uses a reservoir bag to hold a supply of 100 percent oxygen (Fig. 7.16). This device can deliver up to an inspiratory oxygen concentration of 90 percent. The venturi mask is similar to the basic mask, but allows relatively fixed concentrations of supplemental oxygen in concentrations ranging from 24 to 40 percent (Fig. 7.17).

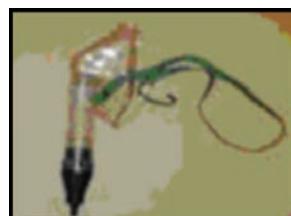
**Bag-valve mask:** A self-inflating resuscitation bag allows manual positive pressure ventilation to a patient who has stopped ventilating spontaneously. With an attached oxygen reservoir and a flow rate of 10-15 L/min, an  $\text{FiO}_2$  of up to 90 percent may be delivered. Due to problems with mask fit, an air leak may prevent adequate ventilation. However, the self-inflating reservoir bag may also be attached to an endotracheal tube.

#### *Endotracheal Intubation*

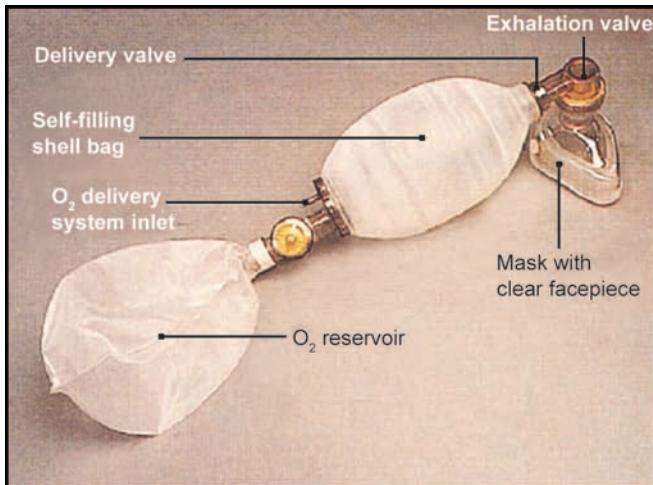
The most definitive means of securing an airway in the nonbreathing patient is via a tube placed in the trachea.



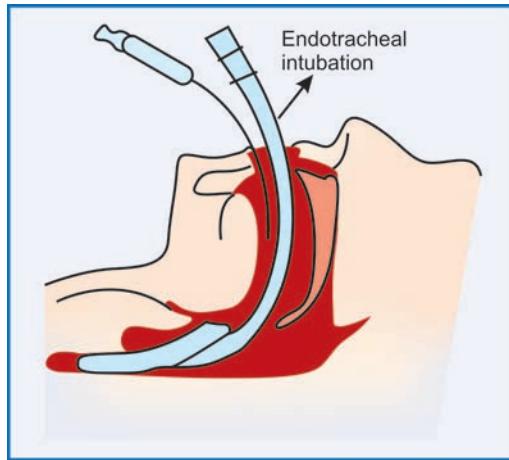
**FIGURE 7.16:** Non rebreathing mask



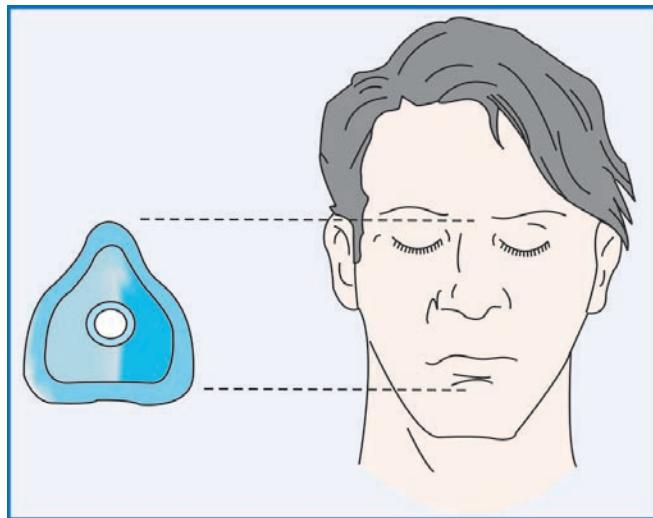
**FIGURE 7.17:** Venturi mask



**FIGURE 7.18:** Bag-valve mask



**FIGURE 7.20:** The most definitive means of securing an airway in the non breathing patient is via a tube placed in the trachea



**FIGURE 7.19:** Select the correct mask size

A correctly placed endotracheal tube with an inflated cuff allows precise control of ventilations.

#### Legal Aspects

When sedation and analgesia are given intravenously, changes in the patient's consciousness and respiratory system can happen quickly, even with small amounts of medication. In order to prevent harm to patients, and legal action against doctors, a review of legal matters will focus on prevention of complications.

#### Responsibilities

Obtaining informed consent is an important aspect of preventing legal action. It should be noted that the nurse

is often responsible for witnessing the signature, but the explanation of the procedure along with risks and benefits is the responsibility of the treating dentist/maxillofacial surgeon. The nurse witnessing the signature does have the responsibility of ensuring that the patient knows what they are signing. If the patient cannot read or understand the document, then the nurse would be negligent to simply have them sign the form.

Monitoring the patient and ensuring patient safety is a responsibility of everybody involved, including the anesthetist, the dentist/maxillofacial surgeon performing the procedure, and the nurse administering the medication. This may include a person who is not present when an adverse event occurs, such as a person who took an inadequate history that led to an adverse event.

Lawsuits involving anesthetic agents are difficult to defend because the patient has no control over the outcome, and because the outcomes are usually severe (i.e. death or brain damage). **However, adverse outcomes usually do not result from a single mistake, rather a series of mistakes usually occur to cause the adverse outcome.** When defending the suit, standard of care issues will be raised. Authoritative Society of Anesthesiologists will be consulted in order to review current practice standards. It is important, therefore, that the dentist be very familiar with the institutional conscious sedation protocol.

## Protection

In addition to becoming familiar with the protocol, there are some other measures that can protect the dentist from involvement in lawsuits. Attending seminars and acquiring specialty certifications such as Advanced Cardiac Life Support (ACLS) show an attention to the issues at hand. Safety should always be the primary concern: If there is an option between a safe method and a quick method, the safe method should always be chosen. Doses of emergency medications should all be calculated before the procedure begins. Defending cases where medications were given incorrectly is nearly impossible.

## Research

The use of conscious sedation, deep sedation and general anesthesia in maxillofacial surgery will be significantly affected by research findings and advances in these areas. It urges institutions and agencies that fund and sponsor research to place a high priority on this type of research, which should include: (1) epidemiological studies which provide data on the number of these procedures performed and on morbidity and mortality rates, (2) clinical studies of drug safety and efficacy, (3) basic research on the development of safer and more effective drugs and techniques, (4) studies on improving patient monitoring, and (5) research on behavioral and other non-pharmacological approaches to anxiety and pain control.

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# 8

# Infection Control in Dental Practice

**R Sajith Kumar**

Dental surgeons belong to the group of clinicians who are at a very high risk of getting diseases from their clients. They may be exposed to infectious materials, contaminated equipments and other materials, unhygienic environments, unclean water or air even though there has been a tremendous advancement in modern dental practice vis-à-vis yester years.



**FIGURE 8.1:** A modern dental clinic

Dental patients and dental surgeons can be exposed to many pathogenic microorganisms including cytomegalovirus (CMV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), herpes simplex viruses (HSV 1 and 2), HIV, *Mycobacterium tuberculosis*, *staphylococci*, *streptococci*,

and many other microorganisms that colonize or infect the oral cavity and respiratory tract. These organisms tend to get transmitted in dental clinics by (1) direct contact with blood, oral fluids, or other patient materials; (2) indirect contact with contaminated objects (e.g. instruments, equipment, or environmental surfaces); (3) contact of conjunctival, nasal, or oral mucosa with droplets (e.g. spatter) containing microorganisms generated from an infected person by coughing, sneezing, or talking; and (4) inhalation of airborne microorganisms.

Infection through any route requires all of the following conditions. (i) a pathogenic organism, (ii) reservoir or source, (iii) mode of transmission, (iv)a portal of entry and (v) a susceptible host. All infection-control practices act by interrupting one of these links.

Earlier days, the concept of universal precautions was promoted. This was based on the concept that all blood and body fluids should be considered as infectious because patients with blood-borne infections can be unaware that they are infected. Practices used to reduce blood exposures, particularly percutaneous exposures, include (1) careful handling of sharp instruments, (2) hand washing; and (3) use of protective barriers. The relevance of universal precautions to other aspects of disease transmission was recognized, and in 1996, Center for Disease Control, Atlanta (CDC) expanded the concept and changed the term to *standard precautions*. Standard precautions integrate and expand the elements of universal precautions into a standard of care designed

to protect health staff and patients from pathogens that can be spread by blood or any other body fluid, excretion, or secretion. Standard precautions apply to contact with (1) blood; (2) all body fluids, secretions, and excretions (except sweat), regardless of whether they contain blood; (3) nonintact skin; and (4) mucous membranes. (*Saliva has always been considered a potentially infectious material in dental infection control; thus, no operational difference exists in clinical dental practice between universal precautions and standard precautions.*)<sup>1</sup>

In addition, other measures might be necessary to prevent spread of certain diseases (e.g. TB, influenza, and varicella) that are transmitted through airborne, droplet, or contact transmission (e.g. sneezing, coughing, and contact with skin). When acutely ill with these diseases, patients do not usually seek routine dental outpatient care. However, a general understanding of precautions for these is critical because (1) some dental surgeons are hospital-based or work part-time in hospital settings; (2) patients infected with these diseases might seek urgent treatment at outpatient dental offices; and (3) dental surgeons might become infected with these diseases. Necessary transmission-based precautions might include isolation, adequate ventilation, respiratory protection with masks, or postponement of non-emergency dental procedures.

## **PERSONNEL HEALTH ELEMENTS OF AN INFECTION-CONTROL PROGRAM**

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A protective health component for dental surgeons is an integral part of a dental practice infection-control program. The objectives are to educate dental surgeons regarding the principles of infection control, identify work-related infection risks, institute preventive measures, and ensure prompt exposure management and medical follow-up.

### **Education and Training**

Personnel are more likely to comply with an infection-control program and exposure-control plan if they understand its rationale. Clearly written policies, procedures, and guidelines can help ensure consistency, efficiency, and effective coordination of activities.

Personnel subject to occupational exposure should receive infection-control training on initial assignment, when new tasks or procedures affect their occupational exposure, and at least once every year.

### **Immunization Programs**

Dental surgeons are at risk for exposure to, and possible infection with, infectious organisms. Immunizations substantially reduce both the number of dental surgeons susceptible to these diseases and the potential for disease transmission to other dental surgeons and patients. Thus, immunizations are an essential part of prevention and infection-control programs for dental surgeons, and a comprehensive immunization policy should be implemented for all dental health-care facilities

On the basis of documented health-care—associated transmission, health staff are considered to be at substantial risk for acquiring or transmitting hepatitis B, influenza, measles, mumps, rubella, and varicella. All of these diseases are vaccine-preventable. It is recommended that all health staff be vaccinated to have documented immunity to as many of these diseases as possible. There is no vaccine for HCV. Dental surgeons must be immunized before they start work.

### **Exposure Prevention and Postexposure Management**

Avoiding exposure to blood and other potentially infectious material (OPIM), as well as protection by immunization, remain primary strategies for reducing occupationally acquired infections, but occupational exposures can still occur.

#### *Preventing Transmission of Blood-borne Pathogens*

Although transmission of blood-borne pathogens (e.g. HBV, HCV, and HIV) in dental health-care settings can have serious consequences, such transmission is rare. Exposure to infected blood can result in transmission from patient to dental surgeons, from dental surgeons to patient, and from one patient to another. The opportunity for transmission is greatest from patient to dental surgeons, who frequently encounter patient blood and blood-contaminated saliva during dental procedures.

### Dental Surgeons to Patients

Since 1992, no HIV transmission from dental surgeons to patients has been reported, and the last HBV transmission from dental surgeons to patients was reported in 1987. HCV transmission from dental surgeons to patients has not been reported. This is the statistics from the developed world. There has been no efficient reporting system in our country. The majority of dental surgeons infected with a blood-borne virus do not pose a risk to patients because they do not perform activities meeting the necessary conditions for transmission. For dental surgeons to pose a risk for blood-borne virus transmission to patients, dental surgeons must (1) be viremic (i.e., have infectious virus circulating in the bloodstream); (2) be injured or have a condition (e.g. weeping dermatitis) that allows direct exposure to their blood or other infectious body fluids; and (3) enable their blood or infectious body fluid to gain direct access to a patient's wound, traumatized tissue, mucous membranes, or similar portal of entry. Although an infected dental surgeon might be viremic, unless the second and third conditions are also met, transmission cannot occur.

## SPECIFIC MICROORGANISM RELATED ISSUES

### Hepatitis B Virus (HBV)

HBV is a well-recognized occupational risk for all health staff. HBV is transmitted by percutaneous or mucosal exposure to blood or body fluids of a person with either acute or chronic HBV infection. Persons infected with HBV can transmit the virus even when they are asymptomatic. The risk of HBV transmission is highly related to the HBe Ag status of the source person (22%–31% vs 1%–6% in HBe Ag positive and negative persons).<sup>2</sup> HBsAg is also found in nasopharyngeal washings and saliva. However, the majority of body fluids are not efficient vehicles for transmission because they contain low quantities of infectious HBV, despite the presence of HBsAg. In addition, HBV has been demonstrated to survive in dried blood at room temperature on environmental surfaces for <1 week.

Reports published during 1970–1987 describe nine clusters in which patients were thought to be infected with

HBV through treatment by an infected dental surgeon. However, transmission of HBV from dentist to patient has not been reported since 1987, possibly reflecting such factors as (1) adoption of universal precautions, (2) routine glove use, (3) increased levels of immunity as a result of hepatitis B vaccination of dental surgeons and (4) incomplete ascertainment and reporting. Only one case of patient-to-patient transmission of HBV in the dental setting has been documented (CDC, 2003). Vaccination can protect both dental surgeons and patients from HBV infection and, should be completed in dental surgeons in training before they have contact with blood. Prevaccination serological testing for previous infection is not indicated. Anti-HBs antibodies must be estimated 1–2 months after completion of the 3-dose vaccination. Those who do not develop an adequate antibody response (i.e., anti-HBs <10 mIU/mL) to the primary vaccine series should complete a second 3-dose vaccine series or be evaluated. Revaccinated persons should be retested for anti-HBs at the completion of the second vaccine series. Approximately half of nonresponders to the primary series will respond to a second 3-dose series. Nonresponders to vaccination who are HBsAg-negative should be considered susceptible to HBV infection. They should be counseled regarding precautions to prevent HBV infection and the need to obtain HBIG prophylaxis for any known or probable parenteral exposure to HBsAg-positive blood. Vaccine-induced antibodies decline gradually over time, and 60 percent of persons who initially respond to vaccination will lose detectable antibodies over 12 years. Even so, immunity continues to prevent clinical disease or detectable viral infection.<sup>3</sup>

### Hepatitis D Virus

An estimated 4 percent of persons with acute HBV infection are also infected with hepatitis Delta virus (HDV). Discovered in 1977, HDV is a defective blood-borne virus requiring the presence of HBV to replicate. Patients coinfected with HBV and HDV have substantially higher mortality rates than those infected with HBV alone. Because HDV infection is dependent on HBV for replication, immunization to prevent HBV infection, through either pre- or postexposure prophylaxis, can also prevent HDV infection.<sup>4</sup>

### Hepatitis C Virus

Hepatitis C virus appears not to be transmitted efficiently through occupational exposures to blood. Follow-up studies of health staff exposed to HCV-infected blood through percutaneous or other sharps injuries have determined a low incidence of seroconversion (1.8%). One study determined transmission occurred from hollow-bore needles but not other sharps. Although these studies have not documented seroconversion associated with mucous membrane or nonintact skin exposure, at least two cases of HCV transmission from a blood splash to the conjunctiva and one case of simultaneous transmission of HCV and HIV after non intact skin exposure have been reported. HCV has been detected in the saliva of patients with chronic hepatitis who are undergoing dental treatment, and there is a report of HCV being transmitted via a human bite. The same precautions that protect against hepatitis B virus (HBV) and HIV offer protection against HCV.<sup>5</sup>

### Human Immunodeficiency Virus

Transmission of HIV to six patients of a single dentist with AIDS has been reported, but the mode of transmission could not be determined.<sup>6</sup> Prospective studies worldwide indicate the average risk of HIV infection after a single percutaneous exposure to HIV-infected blood is 0.3% (range: 0.2%—0.5%). After an exposure of mucous membranes in the eye, nose, or mouth, the risk is approximately 0.1 percent. The precise risk of transmission after skin exposure remains unknown but is believed to be even smaller than that for mucous membrane exposure.<sup>7</sup>

Certain factors affect the risk of HIV transmission after an occupational exposure. Laboratory studies have demonstrated that if needles that pass through latex gloves are solid rather than hollow-bore, or are of small gauge (e.g. anesthetic needles commonly used in dentistry), they transfer less blood. In a retrospective case-control study of HCP, an increased risk for HIV infection was associated with exposure to a relatively large volume of blood, as indicated by a deep injury with a device that was visibly contaminated with the patient's blood, or a procedure that involved a needle placed in a vein or artery.<sup>8</sup> The risk was also increased if the exposure was to blood from

patients with terminal illnesses, possibly reflecting the higher titer of HIV in late-stage AIDS.

### EXPOSURE PREVENTION METHODS

Avoiding occupational exposures to blood is the primary way to prevent transmission of HBV, HCV, and HIV, to health staff in health-care settings. Exposures occur through percutaneous injury (e.g. a needle stick or cut with a sharp object), as well as through contact between potentially infectious blood, tissues, or other body fluids and mucous membranes of the eye, nose, mouth, or nonintact skin (e.g. exposed skin that is abraded, or shows signs of dermatitis). Percutaneous injuries among dental surgeons usually (1) occur outside the patient's mouth, thereby posing less risk for re contact with patient tissues; (2) involve limited amounts of blood; and (3) are caused by burs, syringe needles, laboratory knives, and other sharp instruments. Injuries among oral surgeons might occur more frequently during fracture reductions using wires.

Standard precautions include use of PPE (e.g. gloves, masks, protective eyewear or face shield, and gowns) intended to prevent skin and mucous membrane exposures. Other protective equipment (e.g. finger guards while suturing) might also reduce injuries during dental procedures.

Engineering controls are the primary method to reduce exposures to blood and OPIM from sharp instruments and needles. These controls are frequently technology-based and often incorporate safer designs of instruments and devices (e.g. self-sheathing anesthetic needles and dental units designed to shield burs in handpieces). Aspirating anesthetic syringes that incorporate safety features have been developed for dental procedures, but the low injury rates in dentistry limit assessment of their effect on reducing injuries among dental surgeons.

Work-practice controls establish practices to protect dental surgeons whose responsibilities include handling, using, assembling, or processing sharp devices (e.g. needles, scalers, laboratory utility knives, burs, explorers, and endodontic files) or sharps disposal containers. Work-practice controls can include removing burs before disassembling the handpiece from the dental unit,

restricting use of fingers in tissue retraction or palpation during suturing and administration of anesthesia, and minimizing potentially uncontrolled movements of such instruments as scalers or laboratory knives.<sup>9</sup>

Work-practice controls include placing used disposable syringes and needles, scalpel blades, and other sharp items in appropriate puncture-resistant containers located as close as feasible to where the items were used. In addition, used needles should never be recapped or otherwise manipulated by using both hands or any other technique that involves directing the point of a needle toward any part of the body.<sup>10</sup> A one-handed scoop technique, a mechanical device designed for holding the needle cap to facilitate one-handed recapping, or an engineered sharps injury protection device (e.g. needles with resheathing mechanisms) should be employed for recapping needles between uses and before disposal. Dental surgeons should never bend or break needles before disposal because this practice requires unnecessary manipulation. Before attempting to remove needles from non-disposable aspirating syringes, dental surgeons should very cautiously recap them to prevent injuries. For procedures involving multiple injections with a single needle, the practitioner should recap the needle between injections by using a one-handed technique or use a device with a needle-resheathing mechanism. Passing a syringe with an unsheathed needle should be avoided because of the potential for injury.

## POSTEXPOSURE MANAGEMENT AND PROPHYLAXIS

Postexposure management is an integral component of a complete program to prevent infection after an occupational exposure to blood. During dental procedures, saliva is predictably contaminated with blood. Even when blood is not visible, it can still be present in limited quantities and therefore is considered a potentially infectious material. A qualified health-care professional should evaluate any occupational exposure incident to blood or OPIM, including saliva, regardless of whether blood is visible, in dental settings. Educational programs for dental surgeons and students should emphasize reporting all exposures to blood or OPIM as soon as

possible, because certain interventions have to be initiated promptly to be effective.

After an occupational blood exposure, first aid should be administered as necessary. Puncture wounds and other injuries to the skin should be washed with soap and water; mucous membranes should be flushed with water. No evidence exists that using antiseptics for wound care or expressing fluid by squeezing the wound further reduces the risk of blood-borne pathogen transmission; however, use of antiseptics is not contraindicated. The application of caustic agents (e.g. bleach) or the injection of antiseptics or disinfectants into the wound is not recommended).

Each occupational exposure should be evaluated individually for its potential to transmit HBV, HCV, and HIV, based on the following:

- The type and amount of body substance involved.
- The type of exposure (e.g. percutaneous injury, mucous membrane or nonintact skin exposure, or bites resulting in blood exposure to either person involved).
- The infection status of the source.
- The susceptibility of the exposed person.

All of these factors should be considered in assessing the risk for infection and the need for further follow-up (e.g. PEP).

The following is the protocol for post exposure prophylaxis:

### Postexposure Prophylaxis (PEP) Following Occupational Exposure

#### Contact with Known HIV/HVB Infected Material Resulting

- Percutaneous inoculation (Needle stick, cut with a sharp etc.)
- Contamination of an open wound
- Contamination of breached skin (chapped, abraded, dermatitis)
- Contamination of a mucous membrane including conjunctiva

#### Postexposure Management

- Wash with water open skin wound or breached skin
- Apply antiseptic on breached skin, exposed mucous membrane

## 116 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

- Report employee's name, date, time and place of accident, circumstances around accident, action taken to immediate superior officer.
- Initial consultation -easy access to medical advice and counseling.
- Laboratory testing - immediately after exposure, after 6 weeks, 12 weeks and 24 weeks (after consent and counseling).
- Clinical follow up for fever, pharyngitis, rash, malaise, lymphadenopathy, myalgia, and arthralgia within 6 months.
- If the health care worker (HCW) tests negative 1 year after the accident, it means that the HCW is not infected.

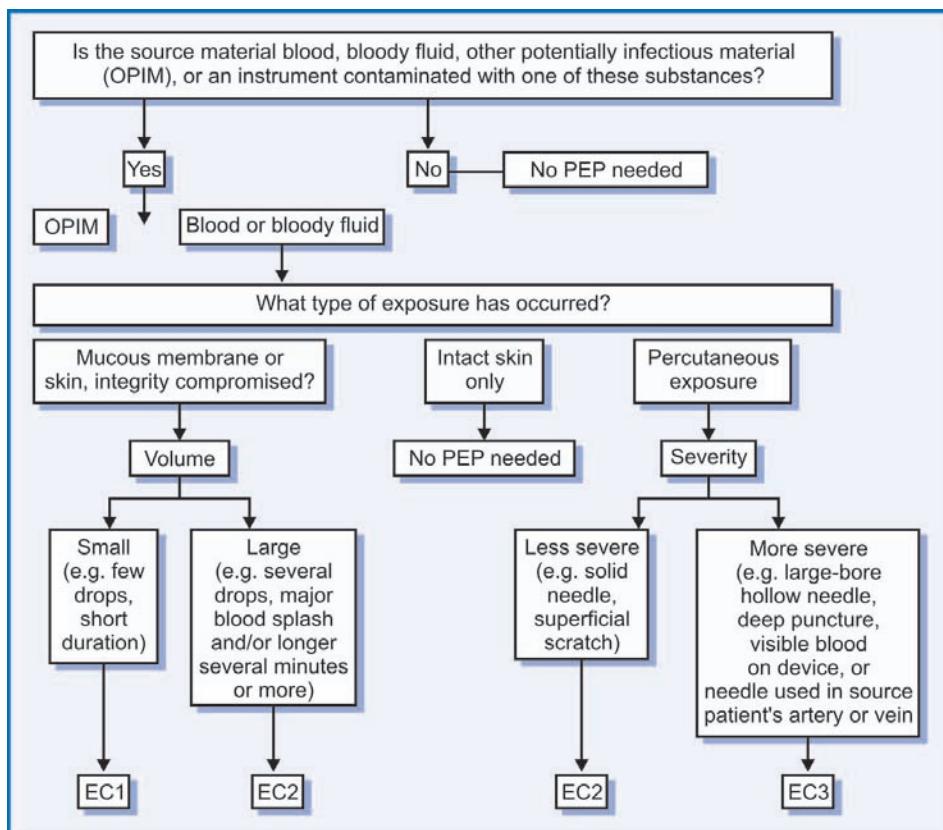
*Postexposure prophylaxis:* The decision to start PEP is taken after deciding the severity of exposure (Exposure Code) and HIV (Status Code) of infecting source determined as per Step 1 and 2 and then corroborated as per Step 3.

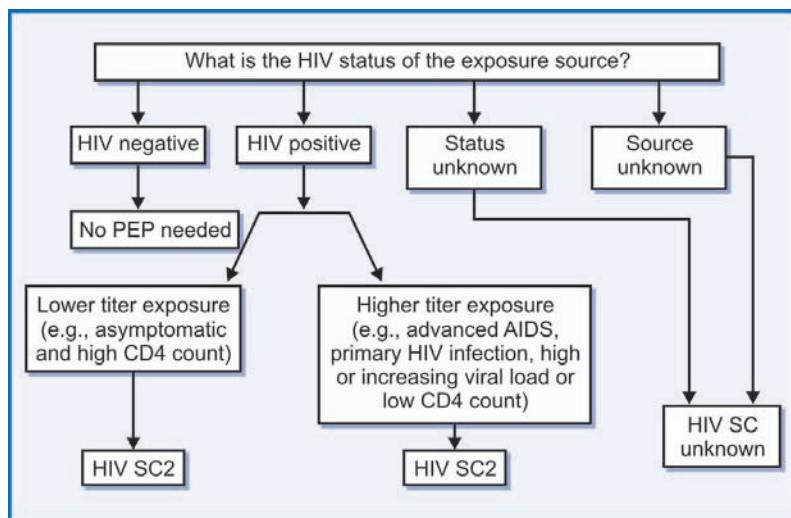
1. *Basic Regimen:* Zidovudine 300 mg x BD + Lamivudine 150 mg x BD
2. *Expanded Regimen:* Basic Regimen + Saquinavir 600 mg TDS (or any one protease inhibitor)  
The optimal course of treatment is unknown; but 4 weeks of PEP appears to provide good enough protection against HIV infection. If tolerated, treatment should be taken for at least 4 weeks.

### Hand Hygiene

Hand hygiene (e.g. hand washing, hand antisepsis, or surgical hand antisepsis) substantially reduces potential pathogens on the hands and is considered the single most critical measure for reducing the risk of transmitting organisms to patients and health staff. Hospital-based studies have demonstrated that noncompliance with hand hygiene practices is associated with health-care-associated infections and the spread of multi resistant organisms. Transient flora, which colonize the superficial

**FLOW CHART 1A:** Determination of the exposure code (EC)



**FLOW CHART 1B:** Determination of the HIV status code (HIV SC)**FLOW CHART 1C:** Determine the PEP recommendation

EC	HIV SC	PEP recommendation
1	1	PEP may not be warranted. Exposure type does not pose a known risk for HIV transmission. Whether the risk for drug toxicity outweighs the benefit of PEP should be decided by the exposed HCW and treating clinician.
1	2	Consider basic regimen. Exposure type poses a negligible risk for HIV transmission. A high HIV titre in the source may justify consideration of PEP should be decided by the exposed HCW and treating clinician.
2	1	Recommend basic regimen. Most HIV exposures are in this category; no increased risk for HIV transmission has been observed but use of PEP is appropriate.
2	2	Recommend expended regimen. Exposure type represents an increased HIV transmission risk.
2/3	Unknown	If the source, (in the case of an unknown source), the setting where the exposure occurred suggests a possible risk for HIV exposure and the EC is 2 or 3, consider PEP basic regimen.

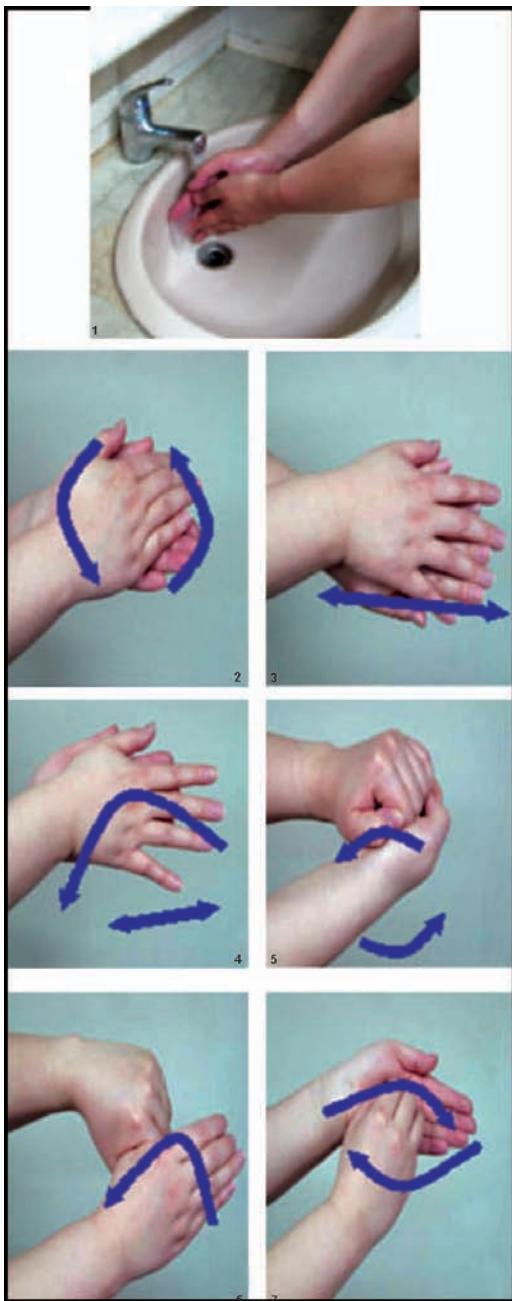
layers of the skin, are easier to remove by routine hand washing. The preferred method for hand hygiene depends on the type of procedure, the degree of contamination, and the desired persistence of antimicrobial action on the skin. For routine dental examinations and non surgical procedures, hand washing and hand antisepsis is achieved by using either plain or antimicrobial soap and water. If the hands are not visibly soiled, an alcohol-based hand rub is adequate.

The purpose of surgical hand antisepsis is to eliminate transient flora and reduce resident flora for the duration of a procedure to prevent introduction of organisms in

the operative wound, if gloves become punctured or torn. Alcohol hand rubs are rapidly germicidal when applied to the skin.

#### *Fingernails and Jewelry*

Although the relationship between fingernail length and wound infection is unknown, keeping nails short is considered key because the majority of flora on the hands are found under and around the fingernails. Studies have demonstrated that skin underneath rings is more heavily colonized with gram-negative bacilli and *Staphylococcus aureus* than comparable areas of skin on fingers without



**FIGURE 8.2:** Steps in hand washing

rings. Rings and decorative nail jewelry can make donning gloves more difficult and cause gloves to tear more readily.

The following are the various steps involved in hand washing (Fig. 8.2):

1. Wet hands and wrists. Apply soap
2. Wash with palms rubbing each other.
3. Right palm over left, left over right.
4. Palm to palm, fingers interlaced.

5. Back fingers to opposing fingers interlocked.
6. Rotational rubbing of right thumb clasped in left palm and vice versa.
7. Rotational rubbing backwards and forwards with tops of fingers and thumb of right hand in left and vice versa.

#### *Personal Protective Equipment (PPE)*

PPE is designed to protect the skin and the mucous membranes of the eyes, nose, and mouth of dental surgeons from exposure to blood or OPIM. Use of rotary dental and surgical instruments (e.g. handpieces or ultrasonic scalers) and air-water syringes creates a visible spray that contains primarily large-particle droplets of water, saliva, blood, microorganisms, and other debris. This spatter travels only a short distance and settles out quickly landing on the floor, nearby operatory surfaces, dental surgeon, assistant, or the patient. The spray also might contain certain aerosols (i.e., particles of respirable size,  $<10\text{ }\mu\text{m}$ ). Aerosols can remain airborne for extended periods and can be inhaled. However, they should not be confused with the large-particle spatter that makes up the bulk of the spray from handpieces and ultrasonic scalers. Appropriate work practices, including use of dental dams and high-velocity air evacuation, should minimize dissemination of droplets, spatter, and aerosols.



**FIGURE 8.3:** Dental personal wearing personal protective equipments

Primary PPE used in oral health-care settings includes gloves, surgical masks, protective eyewear, face shields, and protective clothing (e.g. gowns and jackets). All PPE should be removed before dental surgeons leave patient-

care areas. Reusable PPE (e.g. clinician or patient protective eyewear and face shields) should be cleaned with soap and water, and when visibly soiled and disinfected between patients.

### Masks, Protective Eyewear, Face Shields

A surgical mask that covers both the nose and mouth and protective eyewear with solid side shields or a face shield should be worn by dental surgeons during procedures and patient-care activities likely to generate splashes or sprays of blood or body fluids. Protective eyewear for patients shields their eyes from spatter or debris generated during dental procedures. A surgical mask protects against microorganisms generated by the wearer, with >95 percent bacterial filtration efficiency, and also protects dental surgeons from large-particle droplet spatter that might contain blood-borne pathogens or other infectious microorganisms. When a mask becomes wet from exhaled moist air, the resistance to airflow through the mask increases, causing more airflow to pass around edges of the mask. If the mask becomes wet, it should be changed between patients or even during patient treatment, when possible.

### Protective Clothing

Protective clothing and equipment (e.g. gowns, lab coats, gloves, masks, and protective eyewear or face shield) should be worn to prevent contamination of street clothing and to protect the skin of dental surgeons from exposures to blood and body substances. All protective clothing should be removed before leaving the work area.<sup>13</sup>

### Gloves and Gloving

Dental surgeons wear gloves to prevent contamination of their hands when touching mucous membranes, blood, saliva, or OPIM, and also to reduce the likelihood that microorganisms present on the hands of dental surgeons will be transmitted to patients during surgical or other patient-care procedures. Medical gloves, both patient examination and surgeon's gloves, are manufactured as single-use disposable items that should be used for only one patient, then discarded. Gloves should be changed between patients and when torn or punctured.

Wearing gloves does not eliminate the need for hand washing. Hand hygiene should be performed immediately

before donning gloves. Gloves can have small, unapparent defects or can be torn during use, and hands can become contaminated during glove removal. These circumstances increase the risk of operative wound contamination and exposure of the dental surgeon's hands to microorganisms from patients. In addition, bacteria can multiply rapidly in the moist environments underneath gloves, and thus, the hands should be dried thoroughly before donning gloves and washed again immediately after glove removal. Washing latex gloves with plain soap, chlorhexidine, or alcohol can lead to the formation of glove micropunctures and subsequent hand contamination. Because this condition, known as wicking, can allow penetration of liquids through undetected holes, washing gloves is not recommended. After a hand rub with alcohol, the hands should be thoroughly dried before gloving, because hands still wet with an alcohol-based hand hygiene product can increase the risk of glove perforation.<sup>11</sup> Certain limited studies have determined no difference in postoperative infection rates after routine tooth extractions when surgeons wore either sterile or nonsterile gloves. Although the effectiveness of wearing two pairs of gloves in preventing disease transmission has not been demonstrated, the majority of studies among health staff and dental surgeons have demonstrated a lower frequency of inner glove perforation and visible blood on the surgeon's hands when double gloves are worn. Double gloving does not appear to substantially reduce either manual dexterity or tactile sensitivity.

### Sterilization and Disinfection of Patient-Care Items

Patient-care items (dental instruments, devices, and equipment) are categorized as critical, semicritical, or noncritical, depending on the potential risk for infection associated with their intended use. Critical items used to penetrate soft tissue or bone have the greatest risk of transmitting infection and should be sterilized by heat. Semicritical items touch mucous membranes or non intact skin and have a lower risk of transmission; because the majority of semicritical items in dentistry are heat-tolerant, they also should be sterilized by using heat. If a semicritical item is heat-sensitive, it should, at a minimum, be

processed with high-level disinfection. Non critical patient-care items pose the least risk of transmission of infection, contacting only intact skin, which can serve as an effective barrier to microorganisms. In the majority of cases, cleaning, or if visibly soiled, cleaning followed by disinfection is adequate. Cleaning or disinfection of certain noncritical patient-care items can be difficult or damage the surfaces; therefore, use of disposable barrier protection of these surfaces might be a preferred alternative.

Three levels of disinfection, high, intermediate, and low, are used for patient-care devices that do not require sterility and two levels, intermediate and low, for environmental surfaces. The intended use of the patient-care item should determine the recommended level of disinfection.

### *Sterilization*

The sterilization section of the processing area should include the sterilizers and related supplies, with adequate space for loading, unloading, and cool down. The area can also include incubators for analyzing spore tests and enclosed storage for sterile items and disposable (single-use) items.

*Sterilization procedures.* Heat-tolerant dental instruments usually are sterilized by (1) steam under pressure (autoclaving), (2) dry heat, or (3) unsaturated chemical vapor. The sterilization times, temperatures, and other operating parameters recommended by the manufacturer of the equipment used, as well as instructions for correct use of containers, wraps, and chemical or biological indicators, should always be followed.

Items to be sterilized should be arranged to permit free circulation of the sterilizing agent (e.g. steam, chemical vapor, or dry heat); manufacturer's instructions for loading the sterilizer should be followed. Instrument packs should be allowed to dry inside the sterilizer chamber before removing and handling. Packs should not be touched until they are cool and dry because hot packs act as wicks, absorbing moisture, and hence, bacteria from hands. The ability of equipment to attain physical parameters required to achieve sterilization should be monitored by mechanical, chemical, and biological indicators.

*Steam sterilization:* Among sterilization methods, steam sterilization, which is dependable and economical, is the

most widely used for wrapped and unwrapped critical and semicritical items that are not sensitive to heat and moisture. Steam sterilization requires exposure of each item to direct steam contact at a required temperature and pressure for a specified time needed to kill microorganisms.

*Unsaturated chemical-vapor sterilization:* Unsaturated chemical-vapor sterilization involves heating a chemical solution of primarily alcohol with 0.23 percent formaldehyde in a closed pressurized chamber. Unsaturated chemical vapor sterilization of carbon steel instruments (e.g. dental burs) causes less corrosion than steam sterilization because of the low level of water present during the cycle. Instruments should be dry before sterilizing.

*Dry-heat sterilization:* Dry heat is used to sterilize materials that might be damaged by moist heat (e.g. burs and certain orthodontic instruments). Although dry heat has the advantages of low operating cost and being non corrosive, it is a prolonged process and the high temperatures required are not suitable for certain patient-care items and devices.

*Chemical methods:* Heat-sensitive critical and semicritical instruments and devices can be sterilized by immersing them in liquid chemical germicides. When using a liquid chemical germicide for sterilization, certain post sterilization procedures are essential. Items need to be (1) rinsed with sterile water after removal to remove toxic or irritating residues; (2) handled using sterile gloves and dried with sterile towels; and (3) delivered to the point of use in an aseptic manner. If stored before use, the instrument should not be considered sterile and should be sterilized again just before use. In addition, the sterilization process with liquid chemical sterilants cannot be verified with biological indicators.

Because of these limitations and because liquid chemical sterilants can require approximately 12 hours of complete immersion, they are almost never used to sterilize instruments. Rather, these chemicals are more often used for high-level disinfection. Shorter immersion times (12-90 minutes) are used to achieve high-level disinfection of semicritical instruments or items. These powerful, sporicidal chemicals (e.g. glutaraldehyde,



**FIGURE 8.4:** Liquid disinfectant for instruments

peracetic acid, and hydrogen peroxide) are highly toxic. When using appropriate precautions (e.g. closed containers to limit vapor release, chemically resistant gloves and aprons, goggles, and face shields), glutaraldehyde-based products can be used without tissue irritation or adverse health effects. However, dermatologic, eye irritation, respiratory effects, and skin sensitization have been reported.

*Low-temperature sterilization with ethylene oxide gas (ETO)* has been used extensively in larger health-care facilities. Its primary advantage is the ability to sterilize heat- and moisture-sensitive patient-care items with reduced deleterious effects. However, extended sterilization times of 10-48 hours and potential hazards to patients and dental surgeons requiring stringent health and safety requirements make this method impractical for small settings. Handpieces cannot be effectively sterilized with this method because of decreased penetration of ETO gas flow through a small lumen.

**Sterilization monitoring:** Monitoring of sterilization procedures should include a combination of process parameters, including mechanical, chemical, and biological. These parameters evaluate both the sterilizing conditions and the procedure's effectiveness. Mechanical techniques for monitoring sterilization include assessing cycle time, temperature, and pressure by observing the

gauges or displays on the sterilizer and noting these parameters for each load. Correct readings do not ensure sterilization, but incorrect readings can be the first indication of a problem with the sterilization cycle.

Chemical indicators, internal and external, use sensitive chemicals to assess physical conditions (e.g. time and temperature) during the sterilization process. Although chemical indicators do not prove sterilization has been achieved, they allow detection of certain equipment malfunctions, and they can help identify procedural errors. External indicators applied to the outside of a package (e.g. chemical indicator tape or special markings) change color rapidly when a specific parameter is reached, and they verify that the package has been exposed to the sterilization process. Internal chemical indicators should be used inside each package to ensure the sterilizing agent has penetrated the packaging material and actually reached the instruments inside.

Biological indicators (BIs) (i.e., spore tests) are the most accepted method for monitoring the sterilization process because they assess it directly by killing known highly resistant microorganisms (e.g. *Geobacillus* or *Bacillus* species), rather than merely testing the physical and chemical conditions necessary for sterilization. Because spores used in BIs are more resistant and present in greater numbers than the common microbial contaminants found on patient-care equipment, an inactivated BI indicates other potential pathogens in the load have been killed.<sup>13</sup>

### Environmental Infection Control

In the dental practice, environmental surfaces (i.e., a surface or equipment that does not contact patients directly) can become contaminated during patient care. Certain surfaces, especially the ones touched frequently (e.g. light handles, unit switches, and drawer knobs) can serve as reservoirs of microbial contamination, although they have not been associated directly with transmission of infection to either dental surgeons or patients. Transfer of microorganisms from contaminated environmental surfaces to patients occurs primarily through dental surgeons hand contact. When these surfaces are touched, microbial agents can be transferred to instruments, other environmental surfaces, or to the nose, mouth, or eyes

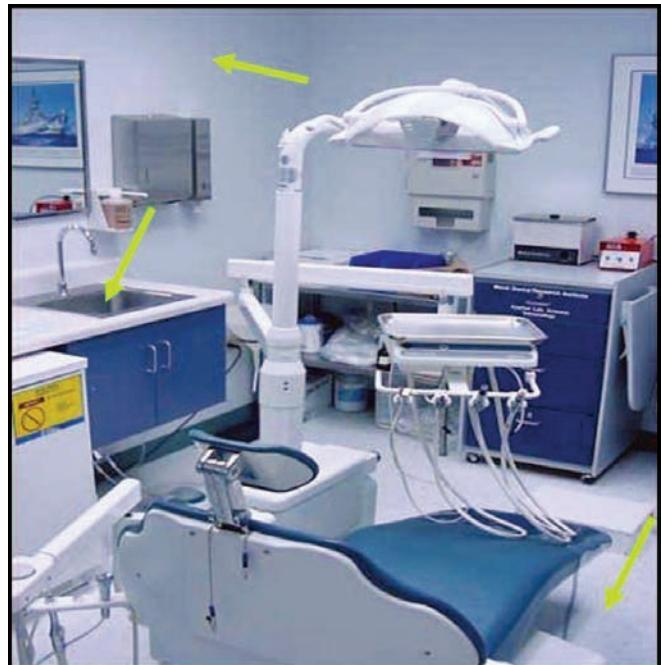
of workers or patients. Although hand hygiene is key to minimizing this transferal, barrier protection or cleaning and disinfecting of environmental surfaces also protects against health-care—associated infections.

Environmental surfaces can be divided into ***clinical contact surfaces*** and ***housekeeping surfaces*** (Fig. 8.5 and 8.6). Because housekeeping surfaces (e.g. floors, walls, and sinks) have limited risk of disease transmission, they can be decontaminated with less rigorous methods than those used on dental patient-care items and clinical contact surfaces. Cleaning is the necessary first step of any disinfection process. Cleaning renders the environmental surface safe by removing organic matter, salts, and visible soils, all of which interfere with microbial inactivation. The physical action of scrubbing with detergents and surfactants and rinsing with water removes substantial numbers of microorganisms.



**FIGURE 8.5:** Clinical contact surfaces

Clinical contact surfaces can be directly contaminated from patient materials either by direct spray or spatter generated during dental procedures or by contact with dental surgeons gloved hands. These surfaces can subsequently contaminate other instruments, devices, hands, or gloves. Examples of such surfaces include light handles, switches, dental radiograph equipment, dental chair side computers, reusable containers of dental materials, drawer handles, faucet handles, countertops, pens, telephones, and doorknobs. General cleaning and disinfection are recommended for clinical contact surfaces, dental unit surfaces, and countertops at the end of daily work activities and are required if surfaces have



**FIGURE 8.6:** Housekeeping surfaces

become contaminated since their last cleaning. To facilitate daily cleaning, treatment areas should be kept free of unnecessary equipment and supplies.

Evidence does not support that housekeeping surfaces (e.g. floors, walls, and sinks) pose a risk for disease transmission in dental health-care settings. Actual, physical removal of microorganisms and soil by wiping or scrubbing is probably as critical, if not more so, than any antimicrobial effect provided by the agent used.<sup>14</sup>

## SPECIAL CONSIDERATIONS IN DENTISTRY

### Dental Handpieces and Other Devices Attached to Air and Waterlines

Multiple semi critical dental devices that touch mucous membranes are attached to the air or waterlines of the dental unit. Among these devices are high- and low-speed handpieces, ultrasonic and sonic scaling tips, air abrasion devices, and air and water syringe tips. Although no epidemiologic evidence implicates these instruments in disease transmission, studies of high-speed handpieces using dye expulsion have confirmed the potential for retracting oral fluids into internal compartments of the device. This determination indicates that retained patient

material can be expelled intraorally during subsequent uses. Studies using laboratory models also indicate the possibility for retention of viral DNA and viable virus inside both high-speed handpieces and prophylaxis angles. The potential for contamination of the internal surfaces of other devices (e.g. low-speed handpieces and ultrasonic scalers), has not been studied, but restricted physical access limits their cleaning. Accordingly, any dental device connected to the dental air/water system that enters the patient's mouth should be run to discharge water, air, or a combination for a minimum of 20 to 30 seconds after each patient. This procedure is intended to help physically flush out patient material that might have entered the turbine and air and waterlines.

Heat methods can sterilize dental handpieces and other intraoral devices attached to air or waterlines. For processing any dental device that can be removed from the dental unit air or waterlines, neither surface disinfection nor immersion in chemical germicides is an acceptable method. Ethylene oxide gas cannot adequately sterilize internal components of handpieces. In clinical evaluations of high-speed handpieces, cleaning and lubrication were the most critical factors in determining performance and durability. Some components of dental instruments are permanently attached to dental unit waterlines and although they do not enter the patient's oral cavity, they are likely to become contaminated with oral fluids during treatment procedures. Such components (e.g. handles or dental unit attachments of saliva ejectors, high-speed air evacuators, and air/water syringes) should be covered with impervious barriers that are changed after each use. If the item becomes visibly contaminated during use, dental surgeons should clean and disinfect with a disinfectant (intermediate-level) before use on the next patient.<sup>14</sup>

### Saliva Ejectors

Backflow from low-volume saliva ejectors occurs when the pressure in the patient's mouth is less than that in the evacuator but microorganisms can be present in the lines retracted into the patient's mouth when a seal around the saliva ejector is created (e.g. by a patient closing lips around the tip of the ejector, creating a partial vacuum). This backflow can be a potential source of cross-

contamination; occurrence is variable because the quality of the seal formed varies between patients. Furthermore, gravity pulls fluid back toward the patient's mouth whenever a length of the suction tubing holding the tip is positioned above the patient's mouth, or during simultaneous use of other evacuation (high-volume) equipment. Although no adverse health effects associated with the saliva ejector have been reported, practitioners should be aware that in certain situations, backflow could occur when using a saliva ejector.

### Dental Radiology

When taking radiographs, the potential to cross-contaminate equipment and environmental surfaces with blood or saliva is high if aseptic technique is not practiced. Gloves should be worn when taking radiographs and handling contaminated film packets. Other PPE (e.g. mask, protective eyewear, and gowns) should be used if spattering of blood or other body fluids is likely. After exposure of the radiograph and before glove removal, the film should be dried with disposable gauze or a paper towel to remove blood or excess saliva and placed in a container (e.g. disposable cup) for transport to the developing area. Radiography equipment (e.g. radiograph tube head and control panel) should be protected with surface barriers that are changed after each patient. If barriers are not used, equipment that has come into contact with dental surgeons' gloved hands or contaminated film packets should be cleaned and then disinfected after each patient use. Digital radiography sensors and other high-technology instruments (e.g. intraoral camera, electronic periodontal probe, occlusal analyzers, and lasers) come into contact with mucous membranes and are considered semicritical devices. They should be cleaned and ideally heat-sterilized or high-level disinfected between patients.

### Aseptic Technique for Parenteral Medications

Safe handling of parenteral medications and fluid infusion systems is required to prevent health-care associated infections among patients undergoing conscious sedation. Parenteral medications can be packaged in single-dose ampules, vials or prefilled syringes, usually without bacteriostatic/preservative agents, and intended for use

on a single patient. Multidose vials, used for more than one patient, can have a preservative, but both types of containers of medication should be handled with aseptic techniques to prevent contamination. Single-dose vials should be used for parenteral medications whenever possible. The leftover contents of a single-dose vial should be discarded and never combined with medications for use on another patient. Medication from a single-dose syringe should not be administered to multiple patients, even if the needle on the syringe is changed.

The overall risk for extrinsic contamination of multidose vials is probably minimal, although the consequences of contamination might result in life-threatening infection. If necessary to use a multidose vial, its access diaphragm should be cleansed with 70 percent alcohol before inserting a sterile device into the vial. A multidose vial should be discarded if sterility is compromised.

### **Single-Use or Disposable Devices**

A single-use device, also called a disposable device, is designed to be used on one patient and then discarded, not reprocessed for use on another patient (e.g. cleaned, disinfected, or sterilized). Single-use devices in dentistry are usually not heat-tolerant and cannot be reliably cleaned. Examples include syringe, needles, prophylaxis cups and brushes, and plastic orthodontic brackets. Certain items (e.g. prophylaxis angles, saliva ejectors, high-volume evacuator tips, and air/water syringe tips) are commonly available in a disposable form and should be disposed of appropriately after each use. Single-use devices and items (e.g. cotton rolls, gauze, and irrigating syringes) for use during oral surgical procedures should be sterile at the time of use.

Because of the physical construction of certain devices (e.g. burs, endodontic files, and broaches) cleaning can be difficult. In addition, deterioration can occur on the cutting surfaces of some carbide/diamond burs and endodontic files during processing and after repeated processing cycles, leading to potential breakage during patient treatment. These factors, coupled with the knowledge that burs and endodontic instruments exhibit signs of wear during normal use, might make it practical to consider them as single-use devices.

### **Oral Surgical Procedures**

The oral cavity is colonized with numerous microorganisms. Oral surgical procedures present an opportunity for entry of microorganisms (i.e., exogenous and endogenous) into the vascular system and other normally sterile areas of the oral cavity (e.g. bone or subcutaneous tissue); therefore, an increased potential exists for localized or systemic infection. Oral surgical procedures involve the incision, excision, or reflection of tissue that exposes the normally sterile areas of the oral cavity. Examples include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth (e.g. removal of erupted or unerupted tooth requiring elevation of mucoperiosteal flap, removal of bone or section of tooth, and suturing if needed).

### **Dental Laboratory**

Dental prostheses, appliances, and items used in their fabrication (e.g. impressions, occlusal rims, and bite registrations) are potential sources for cross-contamination and should be handled in a manner that prevents exposure of dental surgeons, patients, or the office environment to infectious agents. Appliances and prostheses delivered to the patient should be free of contamination. Dental prostheses or impressions brought into the laboratory can be contaminated with bacteria, viruses, and fungi. Dental prostheses, impressions, orthodontic appliances, and other prosthodontic materials (e.g. occlusal rims, temporary prostheses, bite registrations, or extracted teeth) should be thoroughly cleaned (i.e., blood and bioburden removed), disinfected with a disinfectant and thoroughly rinsed before being handled in the laboratory. The best time to clean and disinfect impressions, prostheses, or appliances is as soon as possible after removal from the patient's mouth before drying of blood or other bioburden can occur. Certain microbes have been demonstrated to remain viable within gypsum cast materials for <7 days. If laboratory items (e.g. burs, polishing points, rag wheels, or laboratory knives) are used on contaminated or potentially contaminated appliances, prostheses, or other material, they should be heat-sterilized, disinfected between patients, or discarded (i.e., disposable items should be used). Unless waste generated in the dental laboratory (e.g. disposable trays

or impression materials) falls under the category of biomedical waste, it can be discarded with general waste. Personnel should dispose of sharp items (e.g. burs, disposable blades, and orthodontic wires) in puncture-resistant containers.<sup>15</sup>

### **General Waste and Biomedical Waste**

General waste from hospitals or other health-care facilities (e.g. dental practices or clinical/research laboratories) is no more infective than residential waste. The majority of soiled items in dental units are general medical waste and thus can be disposed of with ordinary waste. Examples include used gloves, masks, gowns, lightly soiled gauze or cotton rolls, and environmental barriers (e.g. plastic sheets or bags) used to cover equipment during treatment.

Although any item that has had contact with blood, exudates, or secretions might be infective, treating all such waste as infective is neither necessary nor practical. Infectious waste that carries a substantial risk of causing infection during handling and disposal is biomedical waste. Biomedical waste is only a limited subset of waste: 9 to 15 percent of total waste in hospitals and 1 to 2 percent of total waste in dental clinics. This requires special storage, handling, neutralization, and disposal and is covered by Environment protection Act 1986 and the Biomedical waste (Management and Handling) Rules 1998 published in Gazette of India on 20th July 1998. Examples of such waste found in dental-practice settings are solid waste soaked or saturated with blood or saliva (e.g. gauze saturated with blood after surgery), extracted teeth, surgically removed hard and soft tissues, and contaminated sharp items (e.g. needles, scalpel blades, and wires). Puncture-resistant containers with a specific label, located at the point of use (i.e., sharps containers), are used as containment for scalpel blades, needles, syringes, and unused sterile sharps.

### **Discharging Blood or Other Body Fluids to Sanitary Sewers or Septic Tanks**

All containers with blood or saliva (e.g. suctioned fluids) can be carefully poured down a utility sink, drain, or toilet. Appropriate PPE (e.g. gloves, gown, mask, and protective eyewear) should be worn when performing this. Multiple

blood-borne pathogens, particularly viruses, are not stable in the environment for long periods and the discharge of limited quantities of blood and other body fluids into the sanitary sewer is considered a safe method for disposing of these waste materials.

### **Handling of Extracted Teeth**

Extracted teeth that are being discarded are considered to be potentially infectious material that should be disposed in medical waste containers. Extracted teeth sent to a dental laboratory for shade or size comparisons should be cleaned, surface-disinfected with a disinfectant with intermediate-level activity. Extracted teeth containing dental amalgam should not be placed in a medical waste container that uses incineration for final disposal.

Thus a general awareness about the ways of transmission of microorganisms and judicial use of adaptive attitudes and protective measures have become absolutely essential in the management of scientific dentistry now.

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## **126 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY**

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# 9

# Preoperative Preparations

**Selliamma Kuruvilla**

Whatever be the purpose and type, surgery is a fearful, stress producing and major event in a person's life. About two decades ago, the patient scheduled for surgery would be admitted to the hospital at least 2 to 3 days before surgery for evaluation and preparation. Today many patients arrive at the hospital the morning of surgery and go home soon after recovering from anesthesia. Out of all elective surgeries, about 60 percent are now performed in an ambulatory or out patient setting. (Russell, Williams and Bulstrode, 2000).

Patients who require considerable period of hospital stays are those with trauma, acute illness, undergoing major surgeries and with comorbid condition. Surgical procedures are being done at various settings—physician's office, clinics, ambulatory surgery centers and full service hospitals. Whatever be the setting, a comprehensive preoperative preparation and post operative care is required for the patient and the family, for an uneventful surgery and recovery.

The term surgery probably leads anyone to focus exclusively on the time spent in the operation room. But the surgical outcome depends largely on the optimal physiological and psychological status before and after surgical experience. Care of a surgical patient comprises three phases—preoperative, intraoperative and post operative, together known as perioperative care (Table 9.1).

Preoperative phase begins when the decision for surgery is made and ends when the patient is transferred to the operating room.

Intraoperative phase begins with the patient's entry into the operation room and ends with admittance to the post anesthesia care unit (PACU) or recovery room.

Postoperative phase begins with the patient's admittance to the PACU and ends with the patient's complete recovery from the surgical intervention.

## **CATEGORIES OF SURGERY**

Surgical procedures are classified on different basis—based on purpose (Table 9.2) and based on degree of urgency.

According to the degree of urgency involved, surgery may be classified as follows:

1. Emergent—done for a life threatening condition without any delay.  
E.g. Tracheostomy, repair of ruptured lung or control of internal hemorrhage. Here there is only limited preoperative time period.
2. Urgent—prompt attention is required within 24 to 30 hrs.

**TABLE 9.1: Perioperative care**

Phase—1	Phase—2	Phase—3
Preoperative Period from decision for surgery to transfer of patient to OR	Intraoperative Period from transfer of patient to OR table, to transfer to PACU.	Postoperative Period from admission to PACU to follow up evalutaion in the clinical setting or at home.

**Table 9.2:** Classification based on purpose

Classification	Description	Example
1. Diagnostic	Removal and study of tissue to make an accurate diagnosis.	Tongue, liver, and kidney biopsies
2. Exploratory	Requires opening a body cavity. Helps to diagnose and to find the extent of a disease process.	Exploratory laparotomy.
3. Curative	Removal of diseased tissue or correction of a defect. (The term ablation is used to refer to removal of tissues)	Appendectomy. Repair of cleft lip or palate. Hernia repair.
4. Palliative	Relief of symptoms or improvement in function without correcting the basic problem.	Insertion of a gastrostomy tube in patients who cannot swallow food.
5. Cosmetic	Correction of defects that improves the appearance.	Maxillary or mandibular osteotomies or facelift surgery.

E.g. Incision and drainage of dental abscess, acute gallbladder infection, renal stones.

3. Elective—as in case of hernia repair, patient needs to have surgery, but failure to do so is not catastrophic.

4. Optional—decision for surgery rests with the patient.

E.g. cosmetic surgery.

Surgeries may also be classified as minor and major.

A simple surgery which poses little risk to life is referred to as minor. Major surgery usually is performed in a well equipped hospital setting, under general or regional anesthesia, and it may involve considerable risk of life.

Ambulatory surgery is one which does not require overnight hospital stay. The patient is admitted to the hospital or ambulatory surgical center on the day of surgery, remains there for postoperative care and is discharged before the end of the day. In some centers patient is admitted for surgery on the day of operation only, mainly to reduce the health care costs. (Same day surgery). Most of the preoperative preparations will be done on an out-patient basis. Patients are responsible for their own physical preparation for surgery.

## IMPACT OF SURGERY ON THE PATIENT AND FAMILY

For each patient, surgery is a unique experience. The procedures considered as minor by hospital personnel, will be a major, complex, stressful experience for the patient and family. Physiologic, psychologic and social

**Table 9.3:** Common surgical suffixes.

Suffix	Description	Example
-ectomy	Removal of a body part.	Appendectomy, Tonsillectomy
-rrhaphy	Repair.	Herniorraphy
-ostomy	Stoma or opening made into.	Gastrostomy, Colostomy
-otomy	Cutting into.	Tracheotomy
-plasty	Plastic repair.	Urethroplasty
-scopy	Looking into.	Gastroscopy

stress reactions are produced, which requires many adaptations by patient and family.

Physiologic stress reactions are mostly due to stimulation of sympathetic nervous system. Elective or emergency surgery produces an elevated heart rate and blood pressure. Increased adrenocortical activity leads to fluid retention and high blood glucose levels.

Stress of surgery produces fear and anxiety. Psychologic responses are influenced by many factors viz. patient's past experiences, perceptions of what surgery means to self image, possible changes in lifestyle, postoperative pain and discomfort, changes to body image, possible loss of function, increased dependency etc.

Extreme anxiety during the preoperative period should be intervened by giving opportunity to verbalize their concerns and fears.

## THE PREOPERATIVE PERIOD

This period is aimed at identifying and stabilizing those conditions which have a negative impact on the surgery and recovery. A detailed health history is obtained and a thorough physical examination is performed. Preoperative assessment can commence prior to admission for surgery. But in case of emergency surgery, time may not permit a complete assessment, but possible thorough preparation must be done.

A medical history and psychological history is collected. Thorough physical examination, cognitive assessment and diagnostic testing also are to be done, mainly to establish a baseline database. Specific focus must be given on factors that pose a risk for surgery. Be alert for signs of abuse.

**Health history:** Review of medical history helps to determine operative risk. The preliminary contact with the client and health care team provides opportunities to ask questions and to become acquainted with the intraoperative and postoperative care givers.

The essential components of past medical history are:

- Serious illness or trauma.
- Allergy
- Bleeding tendencies
- Use of medications like corticosteroids and anti-coagulants
- Previous surgery and experience with anesthesia
- Diseases like diabetes mellitus or arthritis
- Previous embolic events
- Use of alcohol, recreational drug or nicotine

**Serious illness or trauma**—Any illness that affect the outcome of surgery must be elicited. Allergy to medications, chemicals and other environmental products (soaps and cleaning solutions, iodine, latex, adhesive tape) must be reported to anesthesia and surgical personnel before the beginning of surgery. Either an allergy band may be placed on the patients arm or the matter may be recorded in the patient's medical record.

Bleeding tendencies or the use of medications that affect clotting like aspirin, heparin, warfarin sodium, may be asked for.

## MEDICATIONS THAT AFFECT SURGICAL EXPERIENCE

- Antibiotics.
- Anticoagulants.
- Antiseizure medications.
- Corticosteroids.
- Diuretics.
- Phenothiazines.
- Tranquilizers.
- Insulin
- Monoamine oxidase inhibitors.

Diabetes mellitus may delay the healing and so it must be brought under control by the time of surgery. There is chance of recurrence of previous embolic events. Arthritis of the back or neck must be considered because it affects positioning during surgery and intubation. Clients who have immunosuppression are at risk for postoperative infection. Report of any untoward reactions, during previous surgery and anesthesia if any, like prolonged nausea and vomiting, malignant hyperthermia, will help the anesthetist to modify the type of anesthesia.

Use of alcohol or recreational drug poses risk with safe administration of anesthesia and analgesia. Alcoholics often will be malnourished; they also will develop unpredictable reactions to anesthetic agents. These drugs are withdrawn during postoperative period. Patients who use only two drinks per day even can develop withdrawal symptoms. Use of tobacco or inhaled drugs reduce hemoglobin levels. Smokers are susceptible to develop thrombus formation and they probably have lung damage. Moreover nicotine is a potent vasoconstrictor. All these reasons necessitates that the patient must stop smoking and the use of nicotine in any form at least one week prior to surgery. Patients who take considerable amount of coffee may experience headache during NPO (Nil per oral) period, when their caffeine intake ceases abruptly. This headache should not be misinterpreted as a medical problem.

Persons with a sedentary lifestyle can develop complications during the course of surgery because of poor muscle tone, limited cardiac and respiratory reserves and decreased stress response. An overly active client may be noncompliant to postoperative restrictions.

## PHYSICAL EXAMINATION

A thorough physical examination on all patients undergoing surgery is mandatory. The part of the body that will be operated on is examined first, followed by general systems assessment.

- Nutritional and fluid status—assessment gives information on obesity, under nutrition, weight loss, deficiencies in specific nutrients, metabolic abnormalities and malnutrition. Patient must be in optimal nutrition to help wound healing and to resist infections. Evaluation of nutritional status include measurement of Body Mass Index (BMI), waist circumference, biochemical measurements (albumin, transferrin, total lymphocyte count, electrolyte levels), clinical examination findings and dietary data. Any nutritional deficiency need to be corrected prior to surgery. Nutrients needed for wound healing include protein, vit C, thiamine, vit A, vit K, iron, zinc, folic acid, vitamin B<sub>12</sub>, niacin and riboflavin. Appropriate calories help to spare protein. Water also is essential to replace fluid lost through vomiting and to maintain homeostasis.

Surgery under general anesthesia is usually postponed when the patient has respiratory infection.

- Respiratory assessment—examine for the presence of shortness of breath, wheezing, clubbed fingers, cyanosis and productive cough, because these may herald any chronic lung condition as emphysema, asthma or bronchitis. Complete history of smoking, respiratory allergies and infections may be obtained. Severe respiratory disease may be managed with aerosol therapy, postural drainage and antibiotics. Emphasize to stop smoking. Diagnostic test used will include chest X-ray, ABG (Arterial Blood Gas) analysis, or other pulmonary function tests in specific candidates if a risk is suspected. Surgery under general anesthesia is usually postponed when the patient has respiratory infection.
- Cardiovascular system—optimal functioning of cardiovascular system is essential to meet the oxygen, fluid and nutritional needs of the patient. There are many cardiovascular diseases that increase the risk for surgical complications—coronary artery disease,

previous myocardial infarction, dysrhythmias, cardiac failure, hypertension, prosthetic heart valves, hemorrhagic disorders and thromboembolism. All cardiac conditions can lead to decreased surgical tissue perfusion with impairment of wound healing. Shortness of breath on minor exertion, hypertension, heart murmurs or chest pain must be documented. Usual investigations to study cardiovascular function include electrocardiogram, hemoglobin values, hematocrit and serum electrolytes.

Table 9.4 shows the normal values of common preoperative investigations.

- Musculoskeletal assessment focuses on history of fractures, contractures and joint injury. Passive and active range of motion help to detect musculoskeletal problems that hinder positioning.
- Skin assessment reveals any lesions, pressure ulcers and skin turgor. Proper padding and positioning equipment can be used to protect the skin during surgery.
- Hepatic and renal function—biotransformation of anesthetic compounds is taking place in the liver. Liver disorder affects the metabolism of anesthetic agents and other medications. Various liver function tests are to be done (serum bilirubin, protein studies, prothrombin time, serum alkaline phosphatase, transferase). Diseases like cirrhosis increases surgical risk. Metabolism of carbohydrate, fats and proteins also will be impaired. Low albumin levels predispose clients to coagulation disorders, fluid shifts and delayed wound healing.

Adequate renal function is necessary to eliminate protein wastes, to preserve fluid and electrolyte balance, and to remove anesthetic agents. Surgery is contraindicated when a patient has acute nephritis and acute renal insufficiency with oliguria or anuria. Renal status is assessed by asking urinary patterns such as frequency and dysuria. Appearance of urine also is noted on a collected sample. Intake and output recording is to be done. Tests to assess renal function include urinalysis, Blood Urea Nitrogen (BUN), and serum creatinine. Serious renal disease and urinary infections must be treated before surgery.

**Table 9.4:** Common Preoperative blood tests

1. Albumin Test		3.5-5.0 g/dl (varies with the reagents and methods)
2. Blood Urea Nitrogen		6-20 mg/dl
3. Calcium		8.6-10.2 m Eq/L
4. Carbon Dioxide		23-31 m Eq/L
5. Chloride		98-107 m Eq/L
6. Creatinine		0.6-1.2 mg/dl
7. Glucose	Fasting (FBS) Post Prandial (PPBS) Random (RBS)	60-110 mg/dl 60-140 mg/dl 80-140 mg/dl
8. Leukocyte count	Total Neutrophils Eosinophils Basophils Lymphocytes Monocytes	4500-11000 /cu mm 45-73 % 0-4 % 0-1 % 20-40 % 2-8 %
9. Hematocrit		35-47 %
10. Hemoglobin		Females 11.7-16 g/dl Males 13.1-17.2 g/dl
11. Prothrombin Time (PT)		11-15 sec
12. Partial Thromboplastin Time (aPPT)		35 sec
13. Potassium		3.5-5 m Eq/L
14. Sodium		136-146 m Eq/L
15. Phosphorous		2.7-4.5 mg/dl
16. Cholesterol		150-250 mg/dl
17. Liver Function Test (LFT)		
Bilirubin	Total Direct	0.5-1.0 mg/dl 0.2-0.5 mg.dl
	SGOT (AST) SGPT (ALT) ALP (Alkaline phosphatase)	Less than 40 U/L Less than 40 U/L 35-141 U/L
	Total Protein Albumin Globulin (total)	6.5-8.5 gm/dl 3.5-5.0 gm/dl 2.5 gm of protein

**Urinalysis**

1. Average amount in 24 hours		1000-1500 ml
2. Albumin		Negative
3. Sugar		Negative
4. Ketones		Negative
5. pH		4.5 - 8
6. Specific gravity		1.003-1.030
7. Cells	Erythrocytes Leukocytes Epithelium Casts Crystals Parasites Bacteria or fungi	< 3 cells/HPF < 4 cells/ HPF < 10 cells/HPF Moderate clear protein casts Small amount None None or <1000/ml
8. Deposits		

- Neurologic assessment—surgical risk is increased with pre existing neurologic diseases like epilepsy, Parkinson's disease, severe headache etc. Baseline neurologic function should be assessed by testing cranial nerves, motor and sensory reflexes and orientation to time, place and person. Temporary cognitive deficiencies are normal after surgery.
- Endocrine assessment includes determination of the presence of diabetes mellitus, thyroid abnormalities and adrenal malfunction.

Diabetes mellitus predisposes the patient for hypoglycemia or hyperglycemia and poor wound healing; complications of cardiovascular, neurologic, visual and renal systems also may accompany. Surgical risk is low when diabetes is controlled.

Thyroid abnormalities can be either hypothyroidism or hyperthyroidism. If patient is taking thyroid medications, it must be continued throughout perioperatively. Presence of hypothyroidism increases the risk of hypotension and cardiac arrest during anesthetic administration. Improper management of hyperthyroidism may lead to thyroid storm, manifested by hypertension, tachycardia and hyperthermia.

Special preoperative attention is needed for patients undergoing ambulatory surgery, the geriatric patient, those who are obese, those with a disability and those undergoing emergency surgery.

The conditions that make the patient at risk for surgical complications are given below:

- Extremes of age and weight
- Nutritional deficiencies
- Hypovolemia
- Electrolyte imbalance
- Infection and sepsis
- Immunologic abnormalities
- Obstructive pulmonary disease
- Respiratory infection
- Urinary tract infection
- Decreased renal function
- Coronary artery disease
- Hypertension
- Cardiac failure
- Dysrhythmias
- Prosthetic heart valve

- Thromboembolism
- Cerebro vascular disease
- Diabetes mellitus
- Thyroid malfunction
- Liver cirrhosis
- Hepatitis
- Mental disorders

Only a brief period is obtained for the care giver to interact with the ambulatory surgery patient. A quick comprehensive assessment anticipating the patient's needs must be done. Instruct them that they will have to spend some time in the preoperative holding area before entering into actual surgery; also brief period will be spent in postanesthesia care unit before being discharged.

The elderly poses a greater risk because they might have multiple health problems. Their cardiac reserves are lower; renal and hepatic functions are depressed and gastrointestinal activity also may be reduced. Impaired sensory function makes them prone to injuries. Proper positioning and ambulation may be difficult due to joint diseases.

Oral cavity assessment is so important from the anesthetic view point. Decayed teeth and dental prosthesis may become dislodged during intubation. The skin of the elderly is easily fragile. Decreased ability to perspire makes it prone to dry and itchy; so adequate precaution is needed while moving an elderly patient.

Obese clients are at risk for surgical complications. Fatty tissues are susceptible to infection. Wound dehiscence and wound infections, abdominal distension, phlebitis and pulmonary complications are likely to occur.

Mentally and physically disabled patients require assistive devices like hearing aids, eye glasses, prostheses etc. Specific strategies must be adopted while caring such patients.

## **IMMEDIATE PREOPERATIVE CARE**

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Skin preparation needs to be done the day before surgery. Instruct patient to have a shower bath the previous day if surgery is an elective one. The operative site also is cleaned with soap and water to reduce the number of microbes. Special attention is to be given to the gastrointestinal tract in the evening before surgery. This

helps to reduce the possibility of vomiting and aspiration. Preparation includes withholding food and fluid for 8 to 10 hours prior to surgery, administering enemas as needed and inserting a naso-gastric tube. Patients must be instructed not to eat or drink anything after midnight. If the client has eaten or drunk anything after midnight, the surgery may be delayed or postponed. If some important medications are to be taken orally, small sips of water are permitted. Enemas are ordered for surgeries of gastrointestinal tract, peri-anal or perineal areas and the pelvic cavity. The client may perform the enema at home, or it will be given at the hospital.

**Preparation of Oral cavity-** Acute infections are controlled well in advance. Oral prophylaxis is performed. All oral focus of infection are cleared either by extraction of teeth, filling or endodontic treatment. Removable prosthesis if any are removed and all loose teeth especially the upper and lower anterior teeth are extracted as these may be accidentally dislodged during use of laryngoscope or passage of endotracheal tube. Maxillary –mandibular fixation if any is released sufficiently early, so that the patient can practice oral hygiene measures and the oral cavity is kept clean. Shaving of the surgical site and face is done on the previous day of surgery. Presence of beard can interfere with fixing of endotracheal tube. Hence, shaving of face is advisable unless there is any social or religious reasons for avoiding it.

## **PREOPERATIVE TEACHING**

Studies conducted by O'Connor et al (1990) has shown that surgical patients receiving preoperative teaching and supportive interventions had less pain and anxiety, experienced fewer complications, were discharged sooner, were more satisfied with their care and returned to normal activities sooner.

Patient teaching should begin as early as possible. Amount of information desired varies from patient to patient.

### **Diaphragmatic Breathing (Fig. 9.1A)**

It refers to flattening of the dome of the diaphragm during inspiration with enlargement of the upper abdomen as air rushes in. During expiration the abdominal muscles contract. Breathing exercises are particularly effective for

patients at risk for developing pulmonary complications such as atelectasis or pneumonia. Risk factors for pulmonary complications include general anesthesia, abdominal or thoracic surgery, history of smoking, chronic lung disease, obesity and advanced age.

The purpose of diaphragmatic breathing is to promote lung expansion and ventilation and enhance blood oxygenation. The following is the step by step procedure:

- The patient performs it commonly while assuming a semi-fowlers position, with the back and shoulders well supported with pillows.
- Allow the hands to rest lightly on the front of the lower ribs- fingernails against lower chest, (with the hands in a loose position) to feel the movements.
- Instruct the patient to breathe in deeply through the nose, allowing the chest and abdomen to expand.
- Have the patient to hold breath for a count of 5.
- Tell the patient to exhale completely through pursed lips, allowing the chest and abdomen to deflate.
- Allow the patient to repeat the exercise five times consecutively.
- Encourage the patient to perform diaphragmatic exercise every 1-2 hours while awake.

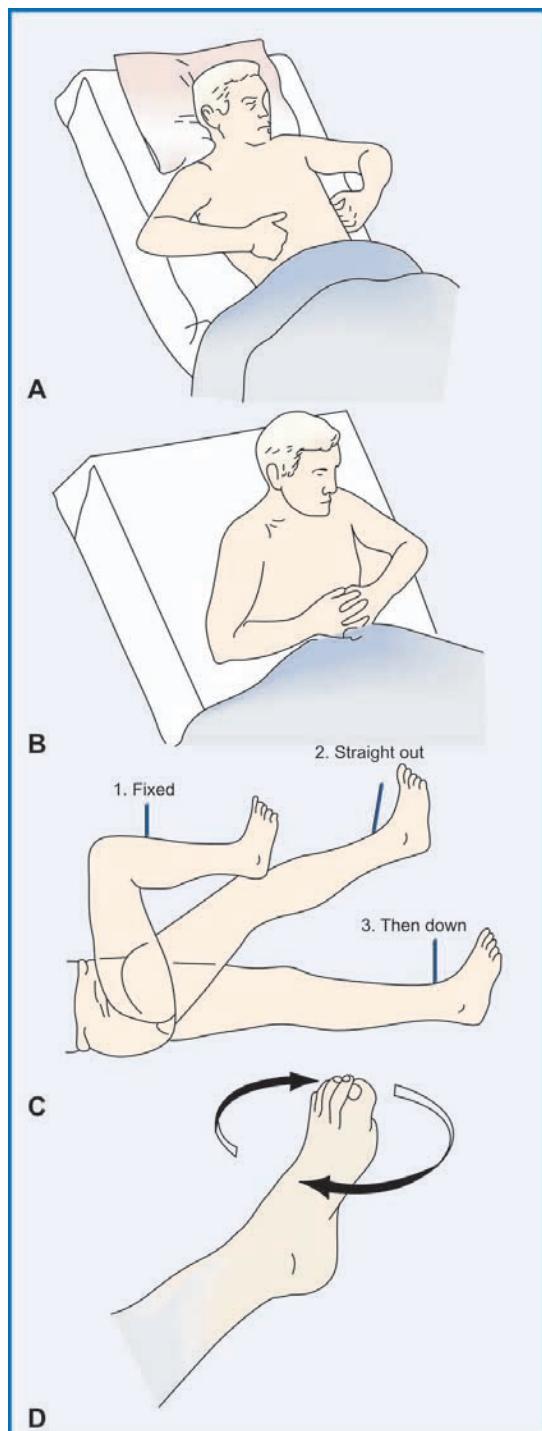
### **Coughing Exercise (Fig. 9.1B)**

This exercise is performed to loosen, mobilise and remove pulmonary secretions. This is taught to patients who are at risk of developing pulmonary complications. While performing, if the patient splints the incision with interlocked hands or pillow, physical and psychological discomfort will be decreased. The procedure is as follows:

- Assist the patient to assume comfortable position.
- Ask the patient to splint the incision.
- Tell the patient to take three deep breaths and then cough forcefully
- Have the patient repeat the exercise five times consecutively every two hours while awake.

### **Leg, Ankle and Foot Exercises (Fig. 9.1C and D)**

Leg exercises help to prevent the development of thrombophlebitis in high-risk patient. Risk factors for development of thrombophlebitis include decreased mobility, impaired peripheral circulation, and cardiovascular, pelvic or lower extremity surgeries. Leg exercises



**FIGURES 9.1A TO D:** Preoperative exercises

promote venous return from the extremities. This is performed as follows:

- The patient lies on the bed in the supine position.
- Bend the knee and raise it towards the chest.

- Straighten out leg and hold for a few seconds; then lower it to the bed.
  - Perform this about five times with one leg and then repeat with the other leg.
  - Rotate both ankles by making complete circles, first to the right and then to the left.
  - Repeat five times and then relax.
  - With feet together, point toes toward the head and then toward the foot of the bed.
  - Repeat this ten times and then relax.
- Most of the teaching is carried out prior to surgery and continued throughout the post operative period.

### Informed Consent

It is a written permission required before surgery or certain diagnostic or therapeutic procedures. It protects the patient, health care team and the hospital. It is a legal document and should include the following information:

- Description, purpose and the need for the procedure.
- Benefits and risks
- Alternative treatment available

The surgeon who performs the procedure gives necessary information and the patient voluntarily consents, without any coercion.

The patient must be able to understand the given information presented. Therefore, children or a sedated, confused, unconscious or mentally incompetent patient cannot sign an informed consent. In such circumstances, a parent, spouse or a legally appointed guardian may give consent. Legal age in India for signing consent is 18 years. In emergency situation a telegram or a witnessed telephone call is accepted as permission.

(Please refer chapter 18 regarding informed consent).

Once the patient and the bystander has given the consent for the surgery, the nature of surgery has to be informed to the hospital staff who are involved in the management of surgical patient. This is by way of preparation of operation list and sending a copy to each one concerned.

### PREPARATION OF OPERATION LIST

Each hospital will have their own protocol regarding intimating the anesthetist and the theatre staff regarding

proposed surgery. Whatever may be the procedure that is being followed in each hospital, it is always ideal that the surgeon should send the list of the patients who are being operated well in advance to the (a) anesthetist, (b) operation theatre nurse, (c) ward nurse, (d) blood bank and (e) to the hospital administration/billing section. This greatly helps the personnel who are involved in patient care in the following ways:

**Anesthetist**—The anesthetist will perform a preanesthetic evaluation of the patient either in the ward or in the preanesthetic clinic on the previous day or on the same day of surgery. If any further investigations or consultation (e.g. cardiology or medical consultation) is required, that will be demanded by the anesthetist following the preanesthetic consultation. The patient will be reevaluated before the surgery with the new results.

**Theatre nurse**—Helps to set the instruments required for surgery. Any additional instruments if required other than the routine ones should also be requested well in advance so that the theatre nurse will get sufficient time to sterilize and keep it ready. Searching for an instrument not included in the instrument trolley can hinder the smooth progress of surgery and loss of valuable theater time while

the patient is under general anesthesia.

**Ward nurse**—Helps to arrange the preanesthetic consultation, perform the necessary presurgical preparation in the ward and send the patient to the operation theatre at the requested date and time after administering the premedication.

**Blood bank**—Keep the required blood ready on the day of surgery after grouping and cross matching

**Hospital administration**—To keep track of the patients who are being operated and for billing purpose

The operation list should have the following particulars of the patient included in it and signed by the head of the unit:

### **PREPARING THE PATIENT ON THE DAY OF SURGERY**

Final preoperative preparation begins 1-2 hours before surgery for clients in the hospital. Make sure that the client understands the operative procedure to be performed. Assess for any sign of anxiety. Most hospitals use a preoperative checklist to make sure that every aspect is cared for systematically.

<b>Name of the Unit:</b>		<b>Date of operation</b>				<b>Theater no.</b>			
Sl. no.	Name of the patient	Age	Sex	I. P. No.	Ward No.	Diagnosis	Surgery (Procedure)	Anesthesia (GA/ LA)	Blood-Group and Quantity required
1.									
2.									
3.									
4.									

Signature of Head of unit:  
Date: \_\_\_\_\_

The above format may have to be modified depending requirement of each hospital. For example the name of surgeons operating also can be included

(See below for sample preoperative checklist)

## Preoperative checklist

Hospital..... Date.....

Patient's name.....

Age.....

I.P.No:..... Height..... Weight.....

Identification band present.....

History and physical examination report present.....

Lab records present.....

CBC..... HB..... Urine..... Hct.....

Informed consent signed.....

Surgical site prepared.....

Natural teeth present.....

Dentures removed (yes/no).....

Contact lenses removed (yes/no).....

Other prosthesis (specify).....

Jewelry removed (yes/no).....

Valuables secured (yes/no).....

Premedication given (Yes/No) ..... Time .....

Voided..... Catherized.....

Vital signs:-Temp..... Pulse..... Resp..... BP.....

Special problems.....

Allergies.....

Signature of nurse.....

Date and time.....

Patient changes into a hospital gown that is open in the back. Long hair may be braided, remove hair pins, and cover the head completely with a disposable cap. Inspect the mouth; remove dentures or plates, remove jewelry; if patient objects removal of wedding ring, securely fasten it to the finger with adhesive tape. All personal belongings must be handed over to the relatives, or are clearly labeled and stored in a safe place, according

to institutional policy. Ask patient to void immediately before going to the operating room. (Preferably, before administering premedication).

**PREANESTHETIC MEDICATION**

It is administered either in the ward itself or in the operation room. After administration, the patient is kept in bed with the side rails raised because the medication can cause drowsiness. The immediate surroundings must be kept quiet to promote relaxation. Any delay or change in the schedule of operation must be intimated promptly to the patient.

Complete the preoperative checklist. All efforts are to be taken to respect the cultural, spiritual and religious beliefs. When all the preparations are complete, transport the patient to the operating room with all documents attached to the patient's medical record. (Consent form and all laboratory reports).

Transfer to the pre-surgical area is done 30 to 60 minutes before the anesthetic is to be given. Consider the comfort and safety of the patient during transportation. Adequate coverings are mandatory to protect from chilling. A small head pillow is to be provided. Take care to avoid unpleasant conversation because the sedated patient may overhear or misinterpret them.

Give prompt recognition to the family members. Keep them informed of the patient's progress. Every effort must be taken to keep them comfortable in the waiting area.

A variety of drugs are to be administered on the previous day or the day of surgery. They serve the following purpose:- (a) Provide analgesia, (b) Prevents nausea and vomiting, (c) Promote sedation and amnesia, (d) Decrease the amount of anesthetics and facilitating induction of anesthesia, (e) Relieves anxiety, (f) Prevents autonomic reflex, responses and decreases respiratory and gastrointestinal secretions.

Antibiotics, eye drops and other prescribed medications also may be given. Most patients may have to continue routine cardiac, anti hypertensive and respiratory medications on the day of surgery. In a diabetic patient getting insulin, specific instructions are needed regarding the time, amount and type of insulin, and route of administration on the day of surgery.

Oral, subcutaneous, intravenous or intramuscular routes may be used for drug administration. Because there is restriction of food and fluids, oral medications need to be given 60 to 90 minutes before sending to the operation room. Only the minimum amount of fluid to swallow the medication is to be given. Clear documentation is mandatory. After administering pre medication, patient should not be allowed to walk, and must be lying in a calm and quiet environment.

### Commonly used Premedications

Many drugs are used. An ideal preanesthetic should be analgesic, anxiolytic, sedative and amnesic. It should not produce undue depression of major body systems—

cardiovascular, respiratory and nervous system. Several factors are to be considered while selecting drugs like age, sex, bodyweight, physical and psychological status, nature, site and duration of surgery, posture of patient etc.

A list of common premedications is given in Table 9.5.

### **ELDERLY UNDERGOING SURGERY**

Structural changes of cells and organs associated with ageing, chronic illnesses and health problems and the specific disease condition for which surgery is indicated make the elderly vulnerable to complications during and

**Table 9.5:** Commonly used premedication

Drug	Usual dose	Effect
<b>1. Narcotic analgesics</b>		
• Morphine	0.1-0.2 mg/kg. usually 5-15 mg for intramuscular (I/M) smaller doses for intravenous (I/V) administration.	Analgesic, hypnotic, sedative and anxiolytic. Causes respiratory depression, hypotension, circulatory depression, vomiting.
• Pethidine	1.5-2 mg/kg. 75-100 mg.	Analgesic, sedative
• Pentazocine	1 mg/kg 20-60 mg	Analgesic, sedative
<b>2. Tranquilizers</b>		
• Promethazine (Phenergan)	25 mg I/M Phenergan Syrup 0.5 mg/kg for children	Sedative, Antihistaminic.
• Tri fluopromazine	5-10 mg I/M	Antiemetic, Sedative.
• Diazepam	0.1-0.2 mg/kg oral or 5-10 mg oral in adult	Anxiolytic
• Midazolam	0.25 -0.5 mg/kg oral or 0.25 mg/kg I/M	Anxiolytic and sedative
<b>3. Neuroleptics</b>		
• Droperidol	0.2 mg/kg oral 0.1 mg/ kg I/M	Sedative and antiemetic
<b>4. Anticholinergics</b>		
• Atropine sulphate.	0.4-0.6 mg I/M in adult 0.02 mg /kg in children	Controls secretions
• Glycopyrrrolate	0.2 mg I/M in adult 0.01 mg /kg in children	Controls secretions
<b>5. Antiemetics</b>		
• Metochlopramide	5 to 10 mg	Prevents vomiting
<b>6. H<sub>2</sub>-Receptor Antagonists</b>		
• Ranitidine	150 mg oral or 50 mg I/V	Controls gastric secretions
• Famotidine	20-40 mg orally/ I/V	and reduces acidity
• Pantoprazol	40 mg I/V	(increases PH)

after surgery. Hazards of surgery for the aged are proportional to the number and severity of the coexisting health problems. They have less physiologic reserve; renal, hepatic and cardiac functions are lowered; gastrointestinal function is diminished; vision, hearing and other sensations may be altered; thermoregulation is reduced; joint movement is limited—all of these invite constant monitoring and special precautions before and after surgery.

Common age related changes which have implications on surgery, anesthesia and post-operative recovery are represented below.

### **Cardiovascular System**

Decreased cardiac output, prolonged circulation time, decreased organ perfusion, coronary artery disease, left ventricular hypertrophy, hypertension, diminished ability to respond to stress, reduced cardiac reserve and myocardial fibre atrophy occurs. Slowing of blood flow and diminished circulation to vital organs may lead to several postoperative complications like hypertension, thrombosis, pulmonary embolism delayed wound healing, confusion and decreased response to stress. Prolonged circulation time may delay the onset of drug action. The elderly depends on an increase in end diastolic volume for an increased cardiac output. Congestive heart failure is more likely to develop in an elderly when a large volume of intravenous fluid is administered.

### **Respiratory System**

Decrease in vital capacity, gas exchange and generalized reduction of elasticity leads to many consequences. Atelactasis, pneumonia and confusion are more. Close monitoring of oxygen saturation during anesthesia and postoperative period is required. They also require higher inspired intraoperative concentrations of oxygen.

### **Urinary System**

Effect of ageing on renal vasculature, profoundly reduces glomerular, filtration rate by 6-8 percent per decade.

Decrease in bladder muscle tone and weak perineal muscles lead to urinary stasis and even incontinence. Renal function is insufficient to withstand fluid and electrolyte imbalance. Also renal elimination of drugs is impaired.

### **Integumentary System**

Decreased ability to perspire, leads to dry, itchy skin, which is easily abraded. Decreased subcutaneous fat makes the elderly susceptible to temperature changes. Use a light weight cotton blanket to cover the patient, while moving in and out of the operation theatre. Gentle handling while moving, keeping appropriate room temperature to prevent hypothermia, adequate padding of bony prominences and proper support to joints and extremities are additions to patient safety.

### **Nervous System**

It is believed that ageing leads to progressive decline in nervous system activity in relation to decrease in neuronal density, cerebral metabolic oxygen consumption, blood flow and the synthesis of neuro transmitters. Every anesthetic agent administered has an effect on the nervous system. The geriatric patient requires decreased amount of anesthetic.

### **Hepatobiliary System**

As cardiac output decreases, hepatic blood flow diminishes. There will be diminished ability to metabolize anesthetics. Reduced capacity to excrete drug, contribute to prolonged duration of drug effect.

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### **SUGGESTED READINGS**

1. Paul, Arunkumar. Drugs and Equipments in Anesthetic Practice (3rd Edn) B.I. Churchill Livingstone.
2. Russel R, Williams N, Bulstrode C. Bailey and Love's Short Practice of Surgery (23rd Edn) New York: Oxford University Press Inc., 2000.
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# 10

# Operation Theater Setup and Aseptic Procedures

**K George Varghese**

## **CONDITION OF OPERATING SUITE**

The responsibility of the surgeon to his patient in the operating suite begins before the wielding of the knife. Much can be done to assure the patients comfort by placing him in a quiet atmosphere out of the hospital traffic. The placing of the sedated patient on a trolley in the hallway or just outside the operating room door for more than a few moments is considered cruel and unreasonable. Most properly equipped operating suites will have an anesthesia induction room to protect the patient from such disturbances. Here patients who have been given premedication and are waiting for surgery are kept. The anesthetist once again reviews the patient here, who has already been examined in the preanesthetic clinic on the previous day. There after the patient is wheeled into operation room with the permission of the anesthetist.

## **MAINTAINING THE STERILITY OF THE OPERATION THEATER**

The access to operation theater and recovery area is restricted to operation theater personnel only, who are required to don clean scrub dress, cap, mask and shoes. This is to maintain the sterility of the operation theater.

The ceiling, walls and floors of the operation rooms are regularly disinfected prior to surgery. This is done by fumigation. Fumigation can be achieved by the use of fumigators. The chemical used is 40 percent formalin.

Fumigator is set for 30 minutes. The parameters and the optimum levels for effective fumigation are as follows:

1. Relative humidity (RH)—play a significant role in fumigation. A minimum of 70 percent is essential. Higher the humidity, better is the disinfection. Water used in the fumigator along with the fumigant (formalin) helps to achieve and maintain the desired RH.
2. Temperature—Evaporation of gaseous fumigant is more at the higher temperature. The use of fumigator makes the temperature factor less important since it allows the formation of mist in the operation theater.
3. Formaldehyde levels in the air—should be ideally 5 ppm or more. The dose of formalin is usually decided by the size of the room. As a general rule, about 180 ml is used for a room of the size 1000 cubic feet ( $=10 \times 10 \times 10$  feet)

Parameters	Optimum levels for effective fumigation
Relative humidity	Over 70 %
Temperature	30-40 ° C
Formaldehyde levels	5 ppm or more

Following fumigation, ideally swabs are taken and culture done to ensure the sterility of the operation room.

## **CHANGING ROOM, SEMI STERILE AND STERILE AREAS**

Before the surgeon and theater staff enters the operation room they have to change to the clean scrub suit/theater

dress in the changing room. The scrub suits consists of linen trousers, and short sleeved shirt. Cap, mask and theater shoes are worn at this point. Only then one can proceed to the **semi sterile areas** like the preanesthetic room and scrub room/area which are included in the restricted areas of the operation suite. Operating room, instrument setting room and recovery rooms are considered to be **sterile areas**. Theater dress, disposable masks, caps, and theater shoes that are worn by the operating room staff before they enter the theater helps to minimize wound contamination from outside sources. If these garments are worn outside the restricted area of the operating suite they must be replaced with fresh ones to ensure that the surgeon and his assistants are doing everything possible to reduce extraneous contamination.

### Masks

Disposable masks with flexible nosebands are available which follow facial contours and retain high efficiency of filtration. Masks provide protection for the surgeon from aerosols and blood borne infections. Full facial visors offer better protection.

### Eye Protection

It is advisable to wear eye protection during any procedure which is likely to generate aerosols, droplets of blood or other body fluids. It also protects mucous membrane of the eyes and transmission of blood borne viral infections. Light weight goggles or full cover transparent visors/face shields are available for this purpose.

### Hair Cover

Long hair must be tied up. All hair must be completely covered by a close fitting cap. Similarly beard and mustache also should be completely covered.

### Foot Wear

Operating theater personnel should wear clean, comfortable, antislip and antistatic shoes. Sole of the footwear should be hard enough to protect the feet from sharps injury.

The importance of excluding personnel with even a small, innocuous septic lesion in sterile areas cannot be

overemphasized. Sneezing and coughing and those with respiratory infection are not permitted in operation room.

## SCRUBBING AND DONNING STERILE GOWN AND GLOVES

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Hand scrubbing is the single most important method of controlling infection in the hospital environment. Investigations have revealed that about one quarter of rubber gloves used in oral surgery are perforated during use. Hence, it is obvious that the wearing of gloves does not diminish the importance of cleaning the hands by scrubbing.

1. Before scrubbing make sure that the finger nails are cut short and all nail polish removed. Wrist watches, rings, bracelets and bangles are also removed. Any adjustments of the cap, mask and protective eye wear/glasses required should be done before starting the scrubbing.
2. The hands and forearms are scrubbed up to the elbows with brush and soap (or povidone iodine scrub) in *running water* according to prescribed plan. In many hospitals the recommended scrub technique is posted directly over the scrub sinks. Recommended time for scrub is 5 to 10 minutes. Two minute scrub between operations is acceptable. During the scrubbing, fingernails and webs of fingers should be given more attention. The hands are cleaned along with the forearms and the scrubbing is progressed towards the elbow, extending two inches above the elbow.
3. After scrubbing both the arms, the brush and the soap are discarded and the arms are rinsed of excess soap. This rinse should be done with the arms elevated above the elbow height to enable the water to drain from the fingertips progressing down the arms and the elbows.
4. The hands are then dried with a sterile hand towel handed over to the surgeon by the scrub nurse. The technique of drying begins at the finger tips of one hand and progresses down the arm. Then, with the opposite side of the towel, the other arm is dried in a similar manner.
5. Application of hand gels/disinfectants—There are certain proprietary preparations available to be applied to the hand after scrubbing and drying (e.g. Sterillium).



**FIGURES 10.1A TO F:** Steps in apron wearing

They help to give protection against hepatitis B and HIV for about five hours in case of injury during surgical procedure. These gels should be completely dry before donning the gloves.

6. **Wearing a sterile apron (gown)**—The surgeon can now wear the sterile surgical gown with the help of an assistant (**see the Figs 10.1A to 10.1F on apron wearing**).

- Pick up the gown by holding its inner surface.
- Insert the right arm into the sleeve without touching the out side of the gown.
- Then insert the left arm.
- An assistant who is not scrubbed- up secures the gown ties at the surgeon's back. The surgeon's back as well as the gown below the level of the waist are considered unsterile.

7. **Wearing sterile gloves**—The surgeon is either helped into his gloves by a properly gowned and gloved surgical assistant or he wears the gloves himself (**see Figs. 10.2A to E**). This is done in a such a manner that only the interior of the gloves is touched by his/her bare hands. (The exterior and not the interior of the rubber glove is considered sterile)

- The glove powder or the dusting agent provided is applied to the hand prior to wearing the gloves to facilitate the smooth passage of the palm into the gloves.
- Pick out the left glove by grasping its folded cuff with the right hand.
- Draw the left glove on to the hand without touching its outer surface.
- Pick up the right glove by inserting the gloved left hand under its folded cuff.
- Draw the right glove on to the hand turning the cuff on to the sleeve of the gown.
- Turn the cuff of the left glove on to the sleeve of the gown.

8. The surgeon should take extreme care, so that the gown and gloves should not touch any area or objects that is not sterile. The backs of those who are gowned are considered unsterile, and also those areas below the waist. Hence one must be careful to keep the arms above the waist, when not operating. The mask and the cap are not sterile, hence also should not be touched with gloved hand.

Certain operation theater lights have handles that are detachable and are sterilizable. These can be adjusted



**FIGURES 10.2A TO E:** Steps in wearing gloves

by the surgeon. Other lights must be adjusted by the operating room personnel.

It must be remembered that, in addition to protecting the patient from outside contamination, the surgeon and his staff also are protecting themselves from potentially infected material such as blood, pus, saliva, and other possibly contaminated body fluids. Recognition of this fact is particularly important in light of the rapidly rising rate of hepatitis carriers.

### HANDLING OF STERILE INSTRUMENTS

Once the instruments have been sterilized they must neither be handled nor laid down on a nonsterile surface. The top of an operating trolley is thoroughly cleaned by application of alcoholic chlorhexidine solution and dried. Using two sterile Cheatele forceps this is covered first with a sterile waterproof towel and then with a sterile towel. The risk of contamination should a wet instrument be placed upon an ordinary towel during surgery makes the use of waterproof towel essential. The dry instruments are laid out with their handles pointing towards the operator in the order in which they will be used. The use of wet instruments should be avoided, especially when gloves are not being worn, because bacteria from

operator's hands may be carried in fluid which runs down the handles, on to the blades and into the wound. If there is a delay before the operation is commenced, the trolley top should be protected from contamination by covering it with a sterile towel applied with sterile Cheatele forceps.

### Patient Positioning on Operating Table

The patient undergoing surgery on the head and neck usually is positioned best with his head and back elevated, his hips and knees flexed, and his feet on a level just above the knees. This position provides better venous drainage in the legs, reduces venous pressure in the head and neck, and permits more physiological cardiopulmonary function, since the weight of the viscera is not on the diaphragm. Pressure points on the heels, elbows, and hands must be avoided at the risk of peripheral nerve injury and stasis damage to the skin.

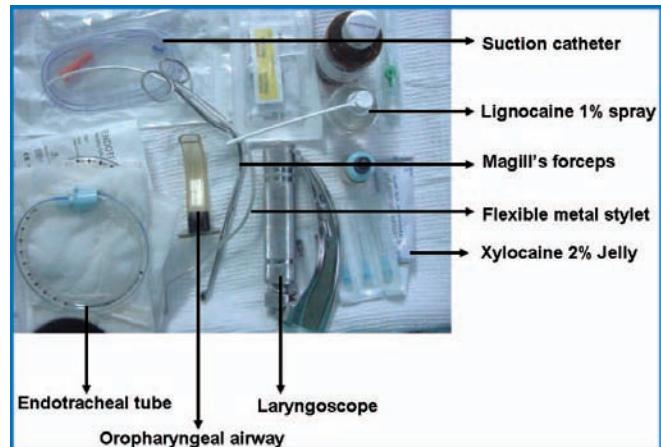
The surgeon should discuss with the anesthetist before hand the type of procedure planned, the severity of bleeding anticipated, approximate duration of the procedure and any complication expected. This will greatly help the anesthetist regarding the selection of drugs for induction and maintenance of general anesthesia. Requirement for hypotensive anesthesia or permission

to use adrenalin saline injection to reduce bleeding also be intimated to the anesthetist well in advance. For intra oral procedures request the anesthetist for nasotracheal intubation, so that endotracheal tube will not interfere with procedure inside the mouth. For extra oral procedures, orotracheal intubation is sufficient. In those cases where there is restricted mouth opening, the cause for the restriction should be discussed with the anesthetist. When the restriction is due to muscle spasm, it will generally be improved after the administration of muscle relaxant. For cases due to other reasons, like temporomandibular joint ankylosis, the anesthetist will have to plan for fiber optic laryngoscopy or blind nasal intubation.

No drug should be injected by the surgeon during surgery without the permission of the anesthetist.

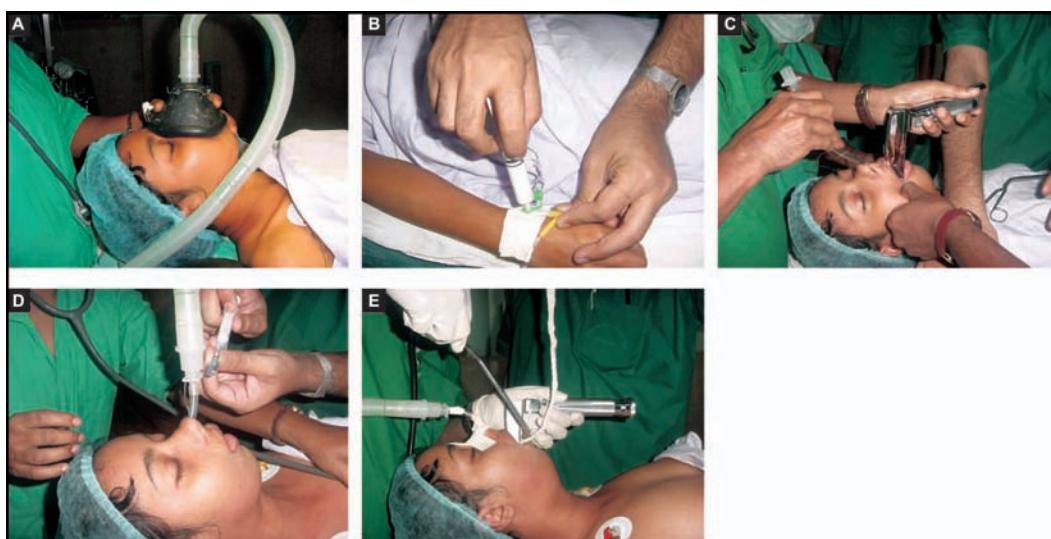
### Induction of Anesthesia and Intubation (Fig. 10.3 and 10.4A to E)

Once the patient is properly positioned, the anesthetist starts the IV line (if not already placed). All necessary monitoring devices (BP apparatus, pulse oximeter, ECG monitor or multichannel monitors) are connected. This is followed by the induction of general anesthesia with short acting muscle relaxants and ultra short acting



**FIGURE 10.3:** Tray setup for endotracheal intubation

barbiturates. Once both has taken its effect, endotracheal intubation is done by the anesthetist and the endotracheal tube is connected to the anesthesia machine (Boyles machine). The anesthetist then auscultates to make sure that the endotracheal tube is within the bronchus and both the lungs are equally ventilated. This step is crucial to make sure that the tube is not in the pharynx and there is one lung anesthesia, since the former can result in the death of the patient and the latter can lead to collapse of the unventilated lung. Once the correct



**FIGURES 10.4A TO E:** Steps in endotracheal intubation (ETT), (A) Pre-oxygenation, (B) Induction, (C) Introduction of ET tube, (D) Inflating cuff of ET tube, (E) Inserting throat pack

position of the endotracheal tube is ascertained, the cuff of the tube is inflated to obtain an adequate seal at the laryngeal opening.

If Ryle's tube feeding is desired after surgery, the Ryle's tube is inserted at this stage. This is because passing the Ryle's tube through the most patent nose before surgery can jeopardise the passage of nasoendotracheal tube (when it is absolutely indicated) through the less patent adjacent nostril.

After the patient has been anesthetized and intubated either nasoendotracheally or oroendotracheally, or if the anesthesia is being administered through tracheostomy tube, it is desirable to insert some form of moistened sterile gauze pack (throat pack) into the oropharynx to screen it from the oral cavity. Most endotracheal tubes are cuffed so that they will prevent the passage of blood, water, or other secretions into the trachea around the endotracheal tube. For various reasons, however, the cuff may not provide a complete seal. During lengthy procedures, it is wise to deflate the cuff periodically to prevent possible pressure against the tracheal mucosa. The throat pack should be placed carefully and gently so that unnecessary irritation to the oral and pharyngeal mucosa is avoided. The pack so placed functions as a protective screen, preventing foreign bodies from passing into the pharynx.

The surgeon should inform the anesthetist in advance the approximate duration of the surgery, so that the anesthetist can plan accordingly regarding the administration of muscle relaxants and the anesthetic agents. Early planning will ensure a fast and smooth recovery from an anesthesia.

### **SURGICAL SITE PREPARATION AND DRAPING THE PATIENT (FIGS 10.5A TO F)**

Complete sterilization of the skin or oral cavity cannot be accomplished. However, the bacterial count can be reduced significantly. Shaving of hair-bearing skin should be done as near to the time of surgery as possible to prevent bacterial colonization of the unavoidable abrasions caused by shaving. Subsequently the operative site can be cleansed vigorously with a suitable detergent. At the present time the iodophors or povidone-iodine preparations are popular for cleansing. Studies have

shown that povidone-iodine mouthwash reduced bacteremia during exodontics. Of the patients treated with the iodine preparation, 28 percent had bacteremia as compared to 56 percent of the group receiving placebos. The properly performed intraoral preparation supplemented with appropriate prophylactic antibiotics for patients susceptible to endocarditis is recommended highly. The routine preoperative preparation of the oral cavity, with either a suitable mouthwash for the patient under local anesthesia or with a physical scrubbing and application of one of the iodophors for patients under general anesthesia, is to be highly recommended prior to the extraction of teeth and other intraoral surgical procedures.

Cleansing of the surgical site(skin) in the extraoral region is done using povidone iodine (Betadine)solution (Fig. 10.5A). The cleaning should begin in the center of the site to be prepared and move outward concentrically away from the site of operation. This avoids contamination of the already cleaned area.

Prior to draping, with the patient under general anesthesia, the eyelids should be closed carefully so that no eyelashes are turned under, and the lids should be taped shut with paper tape to protect the cornea and the sclera. Methylcellulose (artificial tears or Liquifilm) drops or an ophthalmic ointment of low allergenicity may be placed in the conjunctival fold as an additional measure. The eyes are then covered with sterile ophthalmic pads or some form of metallic eye shields such as the Fox eye shield that is taped from the supraorbital rim to malar eminence. It is important that female patients be requested to remove all eye makeup the evening prior to surgery.

The patient is now ready to be draped with sterile sheets and towels appropriate to the indicated surgical procedure (Fig. 10.5A to F). The recent availability of sterile, disposable, transparent or semitransparent plastic drapes with large or small apertures has provided new sophistication in draping the patient for intraoral or extraoral procedures.

Once the patient is prepared and draped, only those personnel, who have scrubbed, gowned and gloved should work at the surgical site.

In the preparation for an intraoral procedure, the lips and oral commissure should be anointed thoroughly



**FIGURES 10.5A TO F:** Steps in draping the patient (A) Cleaning with antiseptic  
(B) Draping started (C) (D) (E) (F) Draping complete

with a water-soluble cream, preferably containing one of the corticosteroid agents, to reduce postoperative cheilitis. Petroleum lubricants such as petrolatum jelly (Vaseline) and others are not as satisfactory as the suggested creams because the petroleum base material tends to macerate the skin. Repeated usage of the corticosteroid creams throughout the procedure markedly reduces the incidence of pressure necrosis and cheilitis after oral surgery. This is particularly useful in the patient with dermatographia.

Make sure that the position of operation table, the anesthesia machine, surgeon, the assistant, the nurse and the instrument trolley are all nearby and in unhindered position for the smooth conduct of the operation. The position of the anesthetist should be such that he/she can monitor the patient throughout the surgery and interact with the surgeon (Fig. 10.6).

Before placing the first incision, it is a good practice to tell the anesthetist that the surgery is going to begin and the approximate time required to complete the procedure. An experienced assistant and the theater nurse can anticipate the next move of the surgeon and keep the instrument ready. While handing the instrument to the operating surgeon, place the handle of the instrument

in the surgeon's hand and not the beak. Extreme care should be taken while handling sharp instruments to avoid accidental injury. The tone and nature of the conversation should be extremely courteous. By no means the surgeon should speak rudely to the assistant or the theater sister. Throwing away the instruments and blaming the assistant or the nurse is considered uncivilized. Surgery should be



**FIGURE 10.6:** Note the position of the anesthetist, anesthesia machine, surgeon, assistant, the nurse and the instrument trolley

performed in an unhurried systematic manner. If the surgeon experience any difficulty during the operation it may be conveyed in a gentle manner. Any change in color of blood should be informed to the anesthetist. Five to ten minutes before finishing the procedure, the surgeon should tell the anesthetist the surgery is going to be over. This will help the anesthetist to prepare to administer the reversal drugs.

## ASSISTING THE SURGEON

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The main objective of assisting is to provide the surgeon with unimpeded access to the operative field at all times.

1. **Retraction**—the assistant must stand in a position where the operative field can be seen (not always possible) and the retractors are held in a comfortable manner that will minimize fatigue. The positioning of the retractors is at the total discretion of the operating surgeon so the assistant must relax the grip on the retractor when the surgeon is attempting to reposition it.
2. **Suction**—keeping the field clear of blood and irrigation solution requires a sensible approach that does not interfere with the surgeon's line of sight or instrumentation. It is best to place the suction at the most gravitationally dependent point in the operative field, preferably on bone.
3. Be alert to anticipate the surgeon's next move and any difficulties encountered. Feed instruments and swabs back to the nurse as necessary.
4. Notify if you become concerned about the patient's color, handpiece or diathermy function, or some endangered vital structure.
5. Ensure that you can see well enough when cutting sutures as directed.
6. Do not hesitate to warn the surgeon if you are not feeling well and need to unscrub.

Once the surgery is complete, suction the oral cavity and the throat. If there is no bleeding, with the permission of the anesthetist, the surgeon may remove the throat pack. (Certain anesthetists prefers to remove it themselves) It is a good practice on the part of the surgeon to remain with the patient till the anesthetist removes the endotracheal tube and the patient is awake. Ensure once

more that the hemostasis is complete before the endotracheal tube is removed. The surgeon should always make it a point to thank the anesthetist, the assistant and the nurse before leaving the operation room. Spending a few minutes with the relatives of the patient after the surgery and briefly explaining regarding surgery and post operative period will help to develop rapport with them.

**Malignant hyperthermia** is a serious operative complication and the surgeon must be watchful of it. This complication is described as a syndrome of rapid increase in temperature while the patient is under anesthesia. It occurs usually in apparently healthy children and young adults with an average age of 21 years. There is no sex differential. The syndrome reportedly may follow a familial pattern, indicating a nonsex-linked autosomal dominance. Metabolic causes are believed to be related to the uncoupling of oxidative phosphorylation. Other theories suggest that there is an aberration in hypothalamic control or that it may be related to a latent or known myotonia, which produces a muscular rigidity subsequent to the administration of succinylcholine chloride. Other causes for the elevation of temperature may be one of the following:

1. Loss of cooling mechanisms by radiation, evaporation, conduction, or convection;
2. Infection;
3. Dehydration;
4. Allergic reactions;
5. Belladonna derivatives;
6. Shivering; and
7. Endocrine mechanisms such as thyrotoxicosis or pheochromocytoma.

The clinical picture generally develops approximately 2 hours after the anesthesia has started. There is an increased temperature accompanied with flushing and sweating rising at an approximate rate of  $1^{\circ}\text{F}$  every 10 to 15 minutes. Tachycardia, tachypnea, hypoxia secondary to metabolic uptake, metabolic acidosis a warm soda lime container caused by high carbon dioxide production, hypovolemia due to extracellular fluid loss, convulsions, sialadenopathy, disseminated intravascular clotting, myoglobinuria are symptoms associated with this usually fatal syndrome.

The treatment of malignant hyperthermia consists of immediate rapid cooling of the patient. Everything else is incidental unless this is accomplished. This may be done by the following methods:

1. Using water blankets, ice, chilled gastric lavage, iced intravenous solutions of lactated Ringers, a pump bypass with a cooling system if available
2. Hyperventilation with 100% oxygen
3. Correction of acidosis and administration of bicarbonate solution, THAM buffer, or TRIS buffer
4. Administration of calcium ion
5. Diuresis to prevent renal failure secondary to myoglobinuria
6. Nondepolarizing muscle relaxants (of questionable effectiveness)
7. Haloperidol to block the uncoupling

# 11

# Postoperative Management

**K George Varghese**

One of the most critical periods for the surgical patient is the immediate postoperative phase, covering the period of time from the end of the operation until the time when he regains consciousness. It is during this phase that the danger of aspiration, cardiac arrest, and circulatory or respiratory depression is greatest.

## **OPERATING ROOM TO RECOVERY ROOM**

The best method of removing the patient from the operating table to the recovery room bed generally is by placing him on a roller, thus protecting the patient's and the attendants' vertebral columns. The attending surgeon or the responsible assistant should accompany the patient to the recovery room with a recovery room note made on the patient's chart and written post-operative orders.

Once the patient is inside the recovery room he / she should be laid in a position to permit the drainage of saliva or blood and to prevent the aspiration of the same. Use humidified oxygen by mask, catheter or other appliance, if desired. (A  $\text{Po}_2$  of less than 40,  $\text{Pco}_2$  greater than 65 with an arterial pH of under 7.25 are absolute indications, in most cases, for respiratory assistance.) Intermittent positive pressure breathing apparatus may be desired to assist in the ventilation of the patient.

The patient is kept in the recovery till he/ she recovers from the effects of an anesthesia and later shifted to the postoperative intensive care or ward with the permission of the anesthetist. Before the patient is send to the

postoperative intensive care or ward the case record should be completed with- (a) operative notes, (b) postoperative instructions and (c) postoperative orders of drugs as detailed below:

## **OPERATIVE NOTES**

It summarize all events that has occurred during and immediately after the surgery till the patient is transferred from the operation theatre to the recovery room. It consists of Anesthesiologist's Notes and Surgeon's Notes. The former is written from the induction of anesthesia, continues during the procedure till the recovery of the patient from anesthesia. Usually the anesthesiologist or the assistant does the writing. The surgeon's note is written by the surgeon. It abridge all activities that has occurred during the surgery. The following points should be included in the surgeons note:

- Date
- Name of the operation
- Name of surgeons and anesthesiologists
- Type and duration of anesthesia used
- Preoperative Diagnosis
- Postoperative Diagnosis
- Summary of the procedure- Incision, operative procedure in brief, operative findings, discussion of any complications, type and location of drains, type of suture and suturing method, description of pathology specimen and whether it has been send

for frozen section or routine histopathological examination.

- Amount and type of fluids including blood transfusion.
- Patient's condition on leaving the OT

## POSTOPERATIVE INSTRUCTIONS AND POSTOPERATIVE ORDERS/ DRUGS

### Postoperative Instructions

The following points should be included in the postoperative instructions:

- When the oral hemostatic packs can be removed/ watch for bleeding
- When the patient can begin oral intake
- The type of diet (liquid or semi solid)
- Wound care- e.g. oral hygiene measures
- Patient handling and positioning e.g. avoid pressure on elevated zygoma, so patient to be placed for recovery on the opposite side face down.
- Patient to be made to lie on one side (tonsillectomy position) to permit draining of saliva or blood, till the consciousness is fully regained
- Periodic/½ hourly recording of BP, pulse, respiration and temperature. Pulse oximeter to be connected to observe the oxygen saturation
- Care of the suction drain/urinary catheter
- Ice packs or cold compresses to desired areas, if indicated. (The application of bilateral flat ice packs over the sites of osteotomies or third molar extractions is useful in reducing postoperative edema, pain and bleeding).
- Regular observation of eyes particularly where zygomatico-orbital surgery is performed
- Contact names and numbers in the event of queries or emergency.

### Postoperative Drugs

- Patient's own regular medication, e.g. salbutamol inhaler, antihypertensive medication, etc. In diabetic patients insulin to be restarted based on postoperative blood report
- Analgesics, e.g. parenteral narcotics or oral NSAID/

narcotic combinations

- Antiemetics, e.g. 10 mg metoclopramide IM or 12.5 mg phenergan IM, especially where narcotics are prescribed
- Antibiotics (IV or oral) as required
- Sedatives, e.g. diazepam 10 mg orally at night as required, since many patients find it difficult to sleep in the strange hospital environment
- Ranitidine (50 mg IM/IV or 150 mg orally BD) or Antacids—may be useful for patients stressed by major surgery or trauma. When steroids are given ranitidine should be given to prevent gastric irritation
- Steroids are commenced in theatre and continued postoperatively to help minimize swelling after major surgery, e.g. Ing. Dexona 8 mg IV TID/BD in the first day and tapered in the subsequent days before stopping.(Instead of steroids, enzyme preparations like serratiopeptidase also may be given)
- Intravenous fluids will be required following major surgery where oral intake may be compromised for a few days. For minor oral surgery, IV fluids given at the start of the operation may be all that is required, unless the patient is vomiting. In such cases intravenous fluids should continue until vomiting ceases (see Chapter 13 on IV fluid therapy).

### Postoperative Care

Once the patient leaves the OT, depending on the condition of the patient he/she may be kept in the recovery room for short while and then shifted to the intensive care room or the postoperative ward. Postoperative care is simple in healthy patients who have undergone minor oral surgery, but becomes complex after major surgery and in medically compromised patients.

#### *During the First 24 Hours*

While the patient is in the recovery room/intensive care room or in the postoperative ward following points should be evaluated and recorded at periodic intervals until the patient is stable:

- Level of consciousness
- Airway patency and breathing pattern

- Skin warmth and color
- Vital signs—blood pressure, pulse rate, respiratory rate and temperature (every 30 minutes to 1 hour). Following major surgery oxygenation monitored continuously by pulse oximeter
- Fluid input and output—blood, IV fluids, urine output. If the patient is catheterized, a 30 to 50 ml urine per hour output
- Physical examination: coronary—rate and rhythm, pulmonary—clear to auscultation and air entry adequate or not, abdomen—bowel sounds, whether distended or not
- Condition of extremities
- Bleeding from operative site—either intraorally or soaking of dressing
- Care of nasoendotracheal tube—frequent suctioning to avoid tube blockage
- Care of urinary catheters and nasogastric tube when placed
- Survey of nurse's notes
- Consultation with the anesthesiologist or other specialist when ever required

The results of the duty doctor's interaction with the patient postoperatively should be the guideline in outlining the further course of action. ***Even the most minor complaints of the patient should not be dismissed without proper examination.***

#### *During the Subsequent Days (Postoperative rounds)*

Patients should be visited by the house officer/medical officer on duty at least twice daily. The patient's progress in terms of surgical wound healing and general physical and mental well-being must be carefully monitored and recorded:

- Examination of the surgical wound (including donor site)—the wound must be inspected daily while patient remains in hospital. Check for significant pain, bleeding, discharge or wound dehiscence
- Intravenous fluid administration should be evaluated daily with the objective of stopping IV fluids as soon as the patient is able to take adequate amounts of fluids by mouth. It is recommended that the IV access is changed every 2 to 3 days to minimize the risk

of infection and phlebitis. The hydration status of the patient may be monitored with daily urea and electrolyte tests or, in intensive care units, using a central venous pressure line and urinary catheters. If fluid overload occurs, sit the patient upright, slow the infusion and give a diuretic such as 40 mg frusemide

- Dressings—are often removed 24 to 48 hours after surgery. They are replaced with non-adhesive dressings only if there is an open wound or copious discharge, or if the wound is constantly irritated by clothing
- Drain tubes—check amount of drainage in the previous 24 hours. Make sure vacuum drains are still functioning. Remove drains when there is little or no drainage (usually 1 to 3 days). Drains kept in too long can result in ascending infection
- Suture removal—for extraoral wounds (e.g. coronal incision, chest flap, etc.) may be undertaken on a progressive basis, e.g. alternate suture or staple may be removed on day 5th day and the rest on the 7th day.
- Ensure that there are clear instructions to nursing staff about when to stop parenteral administration of drugs and to commence oral intake.

### **Postoperative Complications**

#### **Acute Ventilatory Failure**

This is the most urgent of all postoperative complication. The common causes are obstructions by secretions, foreign bodies, local trauma, or swelling. Ventilatory failure can be eliminated or bypassed immediately by intubation or tracheostomy. The position of the patient's head and neck may be the cause of a serious obstruction of the upper airway in the unconscious patient. Narcotics and sedatives should be administered with extreme caution in the restless patient until it is certain that the restlessness is not related to cerebral hypoxia rather than pain. Strict asepsis is absolutely essential especially with respect to the suction catheter, in any patient with tracheal intubation. Sterile catheters used by individuals wearing sterile gloves should be mandatory. This prevent the entry of pathogenic organisms in the tracheobronchial

tree. Emergency tracheostomy has thus become justifiable only when tracheal intubation is not possible. If the endotracheal tube has to be kept for longer periods, then tracheostomy is preferable.

#### *Aspiration of Gastric Contents or Blood*

Aspiration of gastric contents or blood during the induction or recovery from anesthesia can lead to significant pulmonary ventilatory problems. Restlessness, tachycardia, tachypnea, and occasionally cyanosis should alert the surgeon to this possibility. Physical examination of the chest, auscultation of the breath sounds, and an upright chest film can be used to confirm the diagnosis almost invariably. By early recognition and prompt removal of foreign material, from the tracheobronchial tree, secondary sequelae may be reduced or avoided. The prophylactic use of corticosteroids every 6 hours and significant doses of broad-spectrum antibiotic agents supplemented by adequate ventilation therapy are indicated. These complications can be avoided often by ascertaining that the stomach is empty prior to surgery. Intubating the patient in the head down position and maintaining the patient on his side or in a head down position during the period of unconsciousness will reduce the instance of aspiration. The use of cuffed endotracheal tubes is recommended, yet the cuff cannot be relied on entirely, because it may be improperly inflated or may leak enough air to permit the passage of blood or gastric contents into the trachea.

#### *Edema of the Airway*

This can occur after either oral or nasal intubation. This problem is more likely to occur in infants and children because of the peculiar anatomy of the subglottal trachea. The attending surgeon and others responsible for the care of the patient must be on constant alert for evidences of sudden or gradual obstruction of the airway. The judicious use of glucocorticoids, ultrasonic nebulizers with oxygen therapy, and, reintubation or a tracheostomy are measures that must be available in the postoperative armamentarium. Tracheostomy in the infant is an extremely dangerous procedure and is to be avoided whenever possible because of serious longterm complications. Bag and mask or mouth-to-mouth

respiration will force air through a laryngospasm in almost every case.

#### *Epistaxis*

Epistaxis after nasal intubation may be reduced or controlled with preoperative and postoperative nasal vasoconstrictor agents (0.25% phenylephrine solution), elevation of the patient's head, sedation, and, if necessary, judicious and gentle packing of the bleeding site with well-lubricated  $\frac{1}{4}$  - or  $\frac{1}{2}$ , inch gauze. Should these measures fail, it may be necessary to insert a posterior nasal pack.

#### *Sore Throat or Pharyngitis*

This is not an uncommon complication after intubation, and the possibility of this uncomfortable situation should be explained to the patient preoperatively. The early use of a cool mist vaporizer or ultrasonic nebulizer, as well as oral troches containing a topical anesthetic agent, (if the patient is not allergic to the topical anesthetic), is successful in reducing postoperative complaints of this type. The uncomfortable symptoms usually disappear within 8 to 12 hours after intubation. If they should worsen, the surgeon should be alerted to the possibility of pharyngeal mucosal tears and infection, which subsequently may extend into the pharyngeal spaces or mediastinum.

#### *Postoperative Nausea and Vomiting*

It can occur during normal recovery from general anesthesia. When protracted nausea and vomiting occur in the postoperative period, the possibility of something of a more serious nature should be suspected.

*Unrelieved, acute gastric dilatation* may be lethal within 1 to 2 hours if not relieved. Tachycardia and hypotension are often associated with this. The dilated epigastrium extends into the left thoracic cavity. Elevation of the left diaphragm and radiographic evidence of a large gastric bubble are highly suggestive. Certain authors advice use of gastric suction in cases of protracted nausea and vomiting. Insertion of a nasogastric tube prior to extubation is recommended. The nasogastric tube is then attached to a low pressure suction apparatus. This will

facilitate the emptying of the stomach of swallowed blood or secretions and thereby reduce the chance of vomiting in the postoperative period. In the absence of intestinal obstruction and electrolyte imbalance, the maintenance of continuous gastric suction should restore the stomach to functional tone within 36 to 48 hours. Because of the usual loss of potassium and sodium salts during surgery, these elements must be replaced along with the proper fluids to restore the body's chemical balance.

*Other causes of postoperative nausea and vomiting are: ileus, cardiac failure, uremia, gastric atony, infections and drugs that have emetic tendencies.* The occurrence of projectile vomiting indicates the need for a neurological evaluation for the presence of increased intracranial pressure.

If ileus, uremia, gastric atony, and hypokalemia can be eliminated as possible causes of the nausea and vomiting, then a suitable phenothiazine is indicated for the control of nausea and vomiting.

Generally, it is wise to avoid all oral fluids and medications until the patient is reacting well and bowel sounds are present. Until this status has been reached, medications, fluids, and nutrients may be supplied by the parenteral route. When intraoral surgery has been carried out, good hemostasis to prevent ingestion of blood from the surgical wound is needed. Oral medications usually are tolerated more successfully if taken with foods; this dilutes any irritant effect on the gastric mucosa.

### ***Edema***

Edema in the oral surgery patient may have many causes, the most common being physical trauma, infection, increased venous pressure, and decreased lymphatic flow. Other less likely causes are decreased arterial blood flow, decreased intravascular oncotic pressure, excessive sodium retention, and cardiac failure and immobility. This undesirable postoperative complication may be reduced by maintaining the operating table in such a position that the field of surgery is elevated above the level of the heart, by maintaining good hemostasis through careful handling of tissues, by the judicious administration of corticosteroids preoperatively, and by the cooling, and compression of the area of surgery during the immediate postoperative period.

### ***Postoperative Fever***

The most common causes of postoperative fever are wound infection, urinary tract infection, pulmonary complications, thrombophlebitis, and increased osmolarity because of lack of water or salt excess. Bacteremia or septicemia secondary to acute thrombophlebitis complicating a continuous intravenous infusion has become a prominent cause of "third-day surgical fever." The careless use of intravenous catheters for the administration of drugs, and the tendency to leave them in as long as possible is to be avoided. When continuous intravenous solutions are required over a period of days, a change of the intravenous setup at 24- to 48-hour intervals, is recommended with a change in venipuncture site. Less common causes of postoperative fever are drug reactions, central neurological disturbances and bacterial enterocolitis. It is needless to say that elective surgery should be postponed in a patient who is febrile until recovery has been established. This does not mean that surgery has to be postponed when it may represent a crucial diagnostic maneuver to establish the process causing the fever. An oral body temperature of 100° F. in the immediate postoperative period or fever that persists for more than 6 hours, must prompt the surgeon to consider certain specific problems that often complicate recovery.

To determine the cause of the postoperative fever, the following procedures should begin immediately:

1. The patient's entire clinical status should be carefully appraised with particular reference to the state of hydration, the relationship of the febrile course to any of the medications being used, and the possibility of a hypersensitivity phenomenon having occurred in the patient's past medical history.
2. Examination of the wounds, and cultures should be performed if there is evidence of infection.
3. Clinical evaluation of the lungs and urinary tract and appropriate studies of the urine and sputum with cultures when indicated should be done. Gram stain examination of the sputum or urine may also be useful.
4. Blood cultures should be obtained whenever there is the slightest suggestion of sepsis, bacteremia, or peripheral vascular collapse of unexplained cause.

5. Chest radiographs should be taken if pulmonary embolism or infection is suspected.
6. ECG and liver function test.

*Management*—depends on the cause:

- Symptomatic—external body cooling and NSAID's
- Local measures—drain pus or hematoma, remove necrotic tissues or foreign bodies, remove infected IV cannulas and catheters
- Systemic measures—antibiotics, medical treatment of myocardial infarction or thyroid crisis, treatment of pulmonary embolus.

It should be recalled that fever as a sign of postoperative infection may be absent or markedly depressed if the patient has been placed on corticosteroid drugs.

### **Shock**

Shock is an acute circulatory failure with inadequate or inappropriately distributed tissue perfusion resulting in generalized cellular hypoxia. Shock in the postoperative patient may be related to hypoxia, hypercarbia (inadequate ventilation), coronary insufficiency, arrhythmia, or electrolyte imbalance. Other causes may be endotoxic shock, pulmonary embolus, and excessive medication. Miscellaneous causes may be related to drug reactions, transfusion reactions, fat embolism, hepatic failure, and anaphylaxis.

### **Fat Embolism**

It occurs when fat appears in the circulating blood in droplets that are large enough to obstruct arteries and capillaries. Fat globules may present in the urine and sputum. The classic case is described as a person, who is recovering from an accident involving fractures of the long bones, pelvis, or ribs or from an operation, or a person in fine health who becomes short of breath, then febrile and disoriented. Hypertension follows with a fast pulse and oliguria, and, finally, the patient becomes comatose. The diagnosis is made certain by the discovery of petechiae over the neck and anterior chest and inner aspects of the thighs. The level of serum lipase, is of diagnostic value because the lung parenchyma produces lipase in an attempt to remove the emboli of neutral fat from the lung. Because of the involvement of oral

and maxillofacial surgeon in the management of the trauma victims there is a need to recognize this entity.

### *Transient Emotional Upsets*

These are not uncommon in the immediate postoperative period. They usually become manifest about the third postoperative day as an anxiety or depressive reaction that may produce insomnia, poor appetite, fear, apprehension, and decreased pain threshold. Anxiety in rare cases may progress to a point of acute depersonalization, causing the patient to make sudden and unpredictable suicidal or assaultive attempts. Most of the postoperative emotional upsets are of a nature that respond to discussion and reassurance by the surgeon as well as use of sedatives.

### *Hypertension*

Hypertension can be a problem in the postoperative management of the oral surgery patient. If the condition has occurred preoperatively and is of a relatively long-standing duration, the patient probably will be under specific treatment, and perhaps a diagnosis is known. A persistent elevation of the diastolic blood pressure above 90 to 96 mm Hg with a corresponding rise of the systolic pressure of 150 to 200 mm Hg is cause for concern in the postoperative patient, unless this has been a pressure to which the patient has been accustomed for some time. Common causes of hypertension are postoperative pain, hypercarbia, mechanical errors in taking the measurement or administration of, vasopressor or catecholamine agents. If these factors can be eliminated readily and the hypertension continues to mount upward, immediate consultation with the anesthetist or physician is indicated in preventing a blood pressure elevation to the point at which the patient goes into left heart failure or has a cerebrovascular accident. An undiagnosed pheochromocytoma or hypercalcemia related to hyperparathyroid activity or the infusion of calcium salts may be implicated.

### *Hypotension*

When the BP falls below 100/60 mm Hg, it is prudent to investigate the cause and treat accordingly. If the cause is pain, then provide adequate analgesia. More often

it is due to inadequate hydration of the patient, requiring IV infusion of fluids (colloids) to restore the circulatory volume. The possibility of drug over dosage (especially narcotics) and myocardial infarction should also be considered.

#### *Deep Venous Thrombosis and Pulmonary Embolism*

Unless the patient has had surgery in the pelvis or leg for harvesting grafts, or major flap reconstruction, there is little reason why patients who have undergone oral and maxillofacial surgery cannot be ambulatory within 24 to 48 hours after the operation. Early ambulation helps to minimize the incidence of deep venous thrombosis (DVT) and the risk of pulmonary embolism (PE). In addition, patients at risk of DVT undergoing lengthy oral and maxillofacial surgery should be fitted with compression stockings, provided with intermittent calf stimulation during surgery and considered for low-dose prophylactic heparin (5000 units given subcutaneously every 8th hourly). Oral contraception should

be stopped at least one month prior to major elective maxillofacial surgery.

#### *Convulsions*

This may be one of the most distressing and rare complication in the postoperative period. The most common causes of the occurrence of convulsions, particularly in children, are hyperthermia, anoxia, hypocalcemic tetany, and toxemia resulting from an infection or drug sensitivity. Whatever the cause, it must be investigated and definitive therapy instituted to correct the situation. The intravenous administration of diazepam or barbiturates will generally control the convulsions. Attention must also be directed toward adequate ventilation of the patient.

#### *Cardiorespiratory Arrest*

Though rare, it can occur in the postoperative period. If it happens, call for help and immediately assess airway, breathing and circulation. Commence cardiopulmonary resuscitation (CPR) until the emergency service arrives.

# 12

## Management of Shock in Trauma

**Susamma Andrews**

Shock is an acute circulatory failure with inadequate or inappropriately distributed tissue perfusion resulting in generalized cellular hypoxia.

Shock in trauma victims can be hypovolemic, cardiogenic, distributive or obstructive.

### Hypovolemic

- Hemorrhage
- Plasma loss- burns

### Cardiogenic

- Myocardial contusion
- Myocardial infarction
- Congestive cardiac failure
- Arrhythmias

### Distributive

- Neurogenic-spinal trauma
- Septic shock

### Obstructive

- Pericardial tamponade
- Tension pneumothorax
- Pulmonary embolism

### Septic shock

- Septic shock immediately after injury is uncommon

Blood loss is the most common cause of shock after injury

A rising pulse rate is an earlier and reliable sign of hypovolemia

### Trimodal Distribution of Trauma Deaths

The first peak of trauma death occurs within a few minutes of injury and is secondary to laceration of heart or nervous system. These patients receive little or benefit from trauma care.

The second peak of death occurs approximately one and half hours after injury and is caused by uncorrected hemorrhagic shock secondary to visceral injury and extensive fractures. These patients receive maximum benefit from advanced trauma life support (ATLS).

The third peak occurs about seven to ten days after injury. These are caused by severe head injury, sepsis and multiorgan failure. Slow and inadequate shock resuscitation during initial phase of trauma will set into sepsis and multiorgan failure.

### Hemorrhagic Shock in the Injured Patient

Hemorrhage is the most common cause of shock. The response to blood loss must be considered in the context of fluid changes associated with soft tissue injury and the changes associated with severe prolonged shock and the response to resuscitation and reperfusion.

An understanding of the pathophysiology is required to prevent the inappropriate use of vasopressors

Early circulatory responses to blood loss are compensatory that is progressive vasoconstriction of cutaneous, muscular and visceral circulation to preserve

blood flow to vital organs. Tachycardia is the earliest reasonable sign.

Central nervous system initiates the body's homeostatic response to acute injury and blood loss. Multiple afferent stimuli (arterial and venous pressure and volume osmolality, pH, hypoxia, pain, anxiety and tissue damage) reach the hypothalamus where they are integrated and relayed into the sympathetic nervous system and adrenal medulla. Simultaneously anterior pituitary initiates the humoral response to injury. The main objective of the body's response is to maintain the perfusion of vital organs- heart, brain and kidneys. So the first homeostatic response will be peripheral (skin, muscles, GIT, etc.) vasoconstriction, tachycardia and increased myocardial contractility.

In short, the response of the central nervous system to shock is as given below in the box:

Progressive catecholamine secretion during shock tends to reduce the renal blood flow and glomerular filtration rate. Toxic pigments like free hemoglobin crystalises, leading to acute tubular necrosis. These all can lead to acute renal failure.

At the cellular level inadequately perfused and oxygenated cells initially compensate by shifting to anaerobic metabolism resulting in accumulation of lactic acid leading to metabolic acidosis. If shock is prolonged cellular membrane loses its ability to maintain normal electrical gradient and cellular swelling occurs, finally

death of cells and tissue edema. Resuscitation with fluids may increase the interstitial edema (the result of reperfusion injury). The hypovolemic shock can be due to hemorrhage from internal or concealed bleeding (into the peritoneal or pleural cavity or tissue planes) or external bleeding.

The management of shock includes recognition, resuscitation and control of bleeding

#### *Assessment of Blood loss*

To assess the blood loss, we should have an idea of blood volume of the patient. Normal adult blood volume is 7 percent of body weight. In children it comes to about 8 to 9 percent of body weight. In obese patients it is estimated according to the ideal body weight, otherwise it will be an over estimation.

#### **Blood loss with closed fractures**

Pelvis	1 to 5 L	Femur	1 to 2.5 L
Tibia	0.5 to 1.5 L	Humerus	0.5 to 1.5 L

Give importance to the obligatory edema that occurs in injured soft tissues, that consists of extra cellular fluid.

100 ml of blood covers an area of 30 cm<sup>2</sup>  
Volume of a fist of blood clot equals 500 ml of blood  
For each fracture rib seen in X-ray estimate 100 ml loss of blood

Sympatho-adrenal	→ Increased sympathetic activity Release of catecholamines	Vasoconstriction Tachycardia Increased myocardial contractility Increased cardiac output
Renal	Stimulation of juxtaglomerular apparatus, activation of renin angiotensin-aldosterone system	Vasoconstriction (angiotensin-II) Sodium and water retention Volume maintenance
Pituitary	ACTH, GH, Glucocorticoids ADH (Vasopressin) Beta endorphine Insulin level decreases and also its sensitivity	Maintain intravascular volume Mobilize energy sources, Compensate stress  Blood sugar rises (diabetes of trauma)

For rapid assessment of hypovolemic shock-

- Skin color / pallor, pulse rate and volume
- Correlation of systolic BP with palpable pulse-
  - If carotid pulse palpable, systolic BP > 60 mm of Hg
  - Palpable femoral pulse BP > 70 mm of Hg
  - Palpable radial pulse BP > 80 mm of Hg

### Initial Management of Hemorrhagic Shock

Diagnosis and treatment must be performed in rapid succession. Physical examination is directed at the immediate diagnosis of life threatening injuries and includes assessment of the ABC's. Baseline recordings of vital signs are important to the subsequent monitoring.

1. Airway and breathing – Establish a patent airway and adequate oxygenation and ventilatory exchange.
2. Circulation
  - Control of hemorrhage
  - Adequate venous access
  - Pneumatic antishock trousers
  - Direct pressure to the bleeding sites
3. Monitoring
4. Analgesia
5. Myocardial support
6. Disability
7. Exposure
  - Neurologic examination
  - Complete examination prevent iatrogenic hypothermia
  - Needs decompression
8. Gastric dilations
9. Urinary catheterization

### Classes of Hemorrhage Based on Percentage of Blood Loss (Table 12.1)

Class I: Up to 15 percent loss (750 ml in 70 kg patient)

- Minimal physiological changes like transient postural hypotension.
- Needs 1 to 2 L of balanced salt solution

- Crystalloids [Balanced salt solution (BSS)]

Ringer lactate 1st choice

Normal saline 2nd choice

Class II: 15 to 30 percent of blood loss (750 to 1500 ml)

- Tachycardia
- Decreased systolic BP } decreased pulse pressure
- Increased diastolic BP }
- Tachypnea

Rapidly infuse 1 to 2 L BSS

Reevaluate and continue replacement

Class III: 30 to 40 percent (1500 to 2000 ml loss)

- In addition to above signs
- Decreased capillary refilling
- Decreasing urine output
- Apprehensive, altered sesorium.

Rapidly infuse 2 L BSS in 30 minutes.

Replace blood loss with 3 volumes of BSS or blood.

Class IV: More than 40 percent blood loss (> 2 liters)

- Cold pale skin, sweating
- Tachycardia
- Profound hypotension or unobtainable BP
- Anuria
- Reduced level of consciousness

Rapidly infuse 2 to 3 L of BSS

Blood is needed for survival

Cannulation of peripheral vein is the first choice with two or three large bore cannula (16 or 18 g). There is no point in setting up an infusion in an injured limb or in lower limb in case of pelvic abdominal injuries in trauma victims.

Central vein cannulation if possible:

- Subclavian
- Internal jugular
- Femoral

### Adjuncts to Venous Cannulation

1. *Intraosseous infusion*: Emergency fluid resuscitation can be initiated through bone marrow of tibia in case

of children and that of anterior superior iliac spine or sternum in the case of adults.

Complications:

- Osteomyelitis
- Pneumothorax
- Arterial thromboembolism
- Subcutaneous abscess

2. Pneumatic antishock garments (PASG) or Military antishock trousers (MAST) can be used to enhance venous cannulation.
3. *Trendelenburg position—not advisable:* Causes cerebral congestion, may decrease cerebral blood flow, causes diaphragmatic splinting.

The legs can be raised to increase the venous return to the heart.

#### IV Fluids commonly used

Crystalloids	Colloids or plasma expanders
Ringer lactate	Hydroxy ethyl starch
Normal saline	Dextran 40, 70 Poly gelatin Hemacel

If crystalloids are used volume to be replaced is very large (1:3 – for 1ml. blood loss 3ml. crystalloids). Water and electrolytes distribute throughout all the water compartments of the body. Ringer lactate is the ideal crystalloid.

If colloids are used less volume is needed (1:1) for the rapid correction of cardiac output. If there is any

capillary damage (increased capillary permeability due to shock) protein may leak into interstitial space and it is difficult to clear if pulmonary edema occurs.

Crystalloids may be better choice to replace the interstitial fluid volume in early shock, but colloid may be appropriate in late stages.

#### Evaluation of Fluid Correction

##### 1. General

- Pulse rate
- Pulse pressure—Returning to normal
- BP
- Improvement in CNS status
- Skin circulation
- Central venous pressure

##### 2. Urine output

- 1 ml / kg/ hr. for adult
- 2 ml / kg / hr. for children

3. Acid base status: Persistent acidosis in normothermic patient should be corrected with more fluids.

Therapeutic decision is based on initial fluid resuscitation:

- a. **Rapid response:** There will be a rapid response to initial fluid bolus of 1 to 2 liters for adult and for children 20 ml/kg and remain stable. Patients with less than 20% blood loss show this response.
- b. **Transient response:** Patients showing response to initial bolus, but may deteriorate indicating ongoing

**Table 12.1: Estimated fluid and blood losses based on patients initial presentation**

	Class I	Class II	Class III	Class IV
Blood loss (ml)	Up to 750	750-1500	1500-200	>2000
Blood loss (%Bv)	Up to 15%	15-30%	30 to 40%	>40%
Pulse rate	<100	>100	>120	>140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure	Normal or increased	Decreased	Decreased	Decreased
Respiratory rate	14 to 20	20-30	30-40	>35
Urine output (ml/hr)	>30	20-30	5-15	Negligible
CNS (mental status)	Slightly anxious	Anxious	Anxious and confused	Confused and lethargic
Fluid replacement	Crystalloid or colloid	Crystalloid and colloid	Crystalloid and blood	Crystalloid and blood

blood loss or inadequate resuscitation. Continue fluid replacement and blood. If still deteriorating they need surgical interventions.

- c. **Minimal response:** If the patients are showing minimal response to fluid therapy surgical intervention is needed to control bleeding or it may be pump failure or cardiac tamponade. CVP helps to differentiate the causes of shock.

#### Blood Replacement

- Packed cells with crystalloids can be used.
- Warm fluids to prevent hypothermia.
- Coagulopathy is a rare problem and usually it is dilutional

#### Pitfalls in the Diagnosis and Treatment of Shock

1. *Equating BP with cardiac output:* BP is directly proportional to cardiac output and peripheral resistance. The resistance to flow is greater in shock due to vasoconstriction. So initially BP will be normal.

- Age:** Old age patients may have in addition to hypovolemic shock, myocardial infarction or cerebrovascular accident.
- Athletes:** Response to hypovolemia may not be manifested even though significant blood loss might have occurred.
- Previous Medication:** Like Beta-adrenergic agents and calcium antagonists alter the hemodynamic response to hemorrhage.
- Hypothermia:** Shows resistance to blood and fluid resuscitation.

#### Fluid Overload and CVP Monitoring

- A minimal rise in CVP with fluid therapy suggests the need for further fluids.
- A declining CVP suggests ongoing blood loss.
- An abnormal or persistent rise shows adequate fluid correction or the cardiac function is compromised.

Figure 12.1 shows the algorithm in the management of shock.

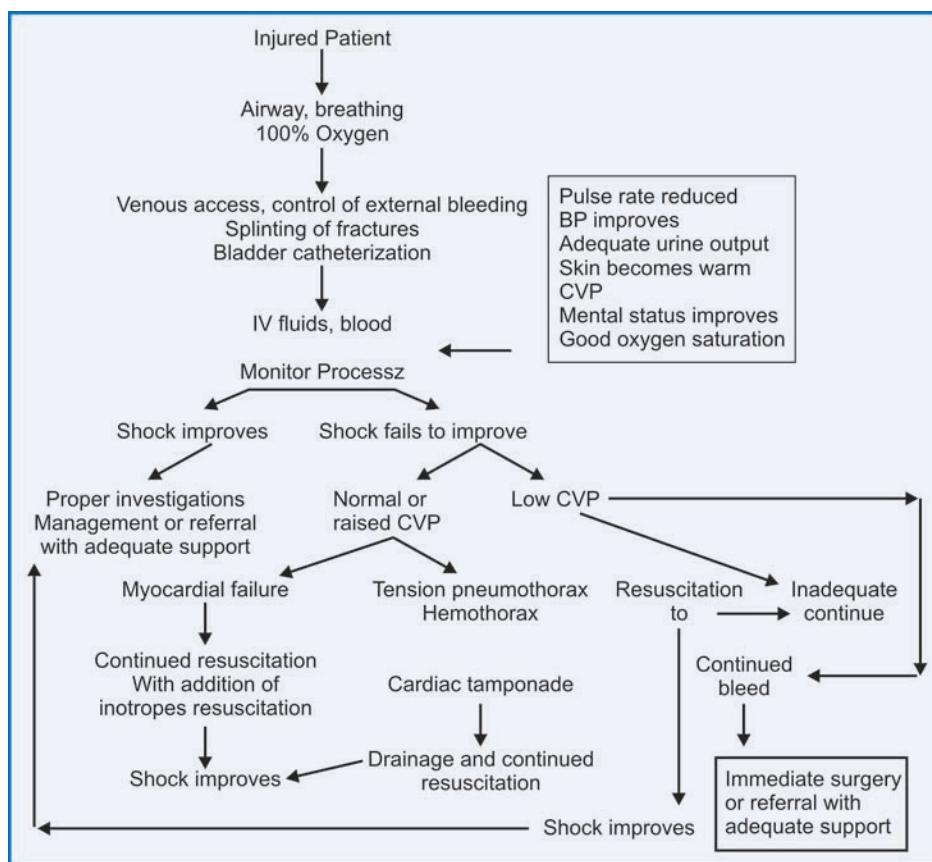


Figure 12.1: Shock management algorithm

1. Blood loss is the most common cause of shock
2. A rising pulse rate is an earlier and reliable sign of hypovolemia
3. In all forms of shock the main aim of treatment is to restore oxygen delivery to the tissues. So maintain airway and oxygenation
4. Treatment of hypovolemia is volume replacement and not dopamine
5. Shocked patient must have a catheter in his /her bladder

## BLOOD TRANSFUSION IN SURGICAL PATIENTS

Blood transfusion practices in surgical patients have been shown to be remarkably inconsistent and it is common to find wide variations in blood usage for the same procedure. These differences are not only apparent between countries, but also between hospitals in the same country and even between different theatre teams in the same hospital. Many factors can account for this, including variations in the medical condition of patients presenting for surgery, differences in surgical or anesthetic techniques, differing attitudes and concerns of both clinicians and patients towards blood transfusion and differences in the cost and availability of blood.

The decision to transfuse a surgical patient can often be a difficult judgment. There is no one sign or measurement, including a single hemoglobin estimation, which accurately predicts that the oxygen supply to the tissues is becoming inadequate. It is necessary to rely on the careful assessment of a variety of factors and clinical signs, which themselves may be masked or attenuated by the effects of general anesthesia. Furthermore, patients' individual responses to blood loss vary considerably, often as a result of age or underlying cardiorespiratory disease.

The following key points should be remembered while planning blood transfusion in surgical patients:

1. Most elective surgery does not result in sufficient blood loss to require a blood transfusion.
2. The careful assessment and management of patients prior to surgery will reduce patient morbidity and mortality. This should include:

- Diagnosis, investigation and treatment of anemia
  - Treatment and optimizing coexisting cardio respiratory disorders
  - Detection of coagulation and platelet disorders preoperatively.
3. There is rarely justification for the use of preoperative blood transfusion simply to facilitate elective surgery.
  4. Operative blood loss can be significantly reduced by:
    - Meticulous surgical technique
    - Use of posture
    - Use of vasoconstrictors
    - Use of tourniquets
    - Anesthetic techniques
    - Use of antifibrinolytic drugs.
  5. A significant degree of surgical blood loss can often safely be incurred before blood transfusion becomes necessary, provided that the loss is replaced with intravenous replacement fluids to maintain normovolemia.
  6. Autologous transfusion is an effective technique in both elective and emergency surgery to reduce or eliminate the need for homologous blood. However, it should only be considered where it is anticipated that the surgery will result in sufficient blood loss to require homologous transfusion.
  7. Blood loss and hypovolemia can still develop in the postoperative period. Vigilant monitoring of vital signs and the surgical site is an essential part of patient management.

### Preoperative Hemoglobin level and Surgery

The judgment on what is an adequate preoperative hemoglobin level for patients undergoing elective surgery must be made for each individual patient. It should be based on the clinical condition of the patient and the nature of the procedure being planned. Many practitioners will accept a threshold hemoglobin level of approximately 7–8 g/dl in a well-compensated and otherwise healthy patient presenting for minor surgery. However, a higher preoperative hemoglobin level will be needed in the following circumstances.

1. Where the patient has symptoms or signs indicating that there is inadequate compensation for the anemia and the oxygen supply to the organs and tissues is insufficient, such as:

- Evidence of angina
  - Increasing dyspnea
  - Dependent edema
  - Frank cardiac failure as a result of the reduced oxygen-carrying capacity of blood.
2. Where the patient may have coexisting cardiorespiratory disease which may limit his or her ability to further compensate for a reduction in oxygen supply due to operative blood loss or the effects of anesthetic agents. For example:
- Significant ischemic heart disease
  - Obstructive airways disease.
3. When major surgery is planned and it is anticipated that operative blood loss may be more than 10 ml/kg.
- The presence of one or more of the above factors in anemic patients undergoing surgery has been shown to increase morbidity and mortality. It is therefore unjustified to subject patients to unnecessary risk in elective surgery when it is often a simple process to correct the anemia preoperatively.
4. Congenital or acquired coagulation/platelet disorders. Undiagnosed and untreated disorders of coagulation in surgical patients may result in excessive operative blood loss, uncontrolled hemorrhage and death of the patient.

## Techniques to Reduce Operative Blood Loss

Operative blood loss can be significantly reduced by the following techniques during surgery:

- Meticulous surgical technique
- Use of posture
- Use of vasoconstrictors
- Use of tourniquets
- Anesthetic techniques
- Use of antifibrinolytic drugs.

### Surgical Technique

The training, experience and care of the surgeon performing the procedure is the most crucial factor in reducing operative blood loss. The importance of surgical technique, meticulous attention to bleeding points, appropriate use of diathermy, if available, and the use of hemostatic, e.g. collagen, felt, or warmed packs, cannot be overstated.

### Posture

Positioning the patient to encourage free unobstructed venous drainage at the operative site can not only reduce venous blood loss, but will also improve the operating conditions. The level of the operative site should be a little above the level of the heart. The Trendelenburg position (head down) is the most appropriate for lower limb, pelvic and abdominal procedures. For head and neck surgery, the head-up posture should be adopted.

### Vasoconstrictors

Infiltration of the skin at the site of surgery with a vasoconstrictor can help to minimize skin bleeding once an incision is made. In addition, if the vasoconstrictor also contains local anesthetic, some contribution to postoperative analgesia can be expected from this technique.

Bleeding from skin graft donor sites, desloughed areas and tangential excisions can also be reduced by direct application of swabs soaked in a saline solution containing a vasoconstrictor.

One of the most widely-used and effective vasoconstrictors is the catecholamine adrenaline (epinephrine), although several other preparations are available. *It should not be necessary to exceed a total dose of 0.1 mg of adrenaline in an adult, equivalent to 20 ml of 1 in 200 000 strength or 40 ml of 1 in 400 000 strength.* Because of the profound systemic actions of both vasoconstrictors and local anesthetics, do not exceed the recommended dose levels and ensure that these drugs remain at the site of incision and are not injected into the circulation. *Of all the anesthetic inhalational agents, halothane is the most likely to cause cardiac dysrhythmias when a vasoconstrictor is being used.* Vasoconstrictors should not be used in areas where there are end arteries, such as fingers, toes and penis.

### Tourniquets

When operating on extremities, blood loss can be reduced considerably by the application of a limb tourniquet. To take full advantage of this effect and to provide a bloodless operative field, the limb should first be exsanguinated using a bandage or elevation prior

to inflation of a suitable sized, well-fitting tourniquet. Towards the end of the procedure, it is good practice to deflate the tourniquet temporarily to identify missed bleeding points and ensure complete hemostasis before finally closing the wound. Tourniquets should not be used on patients with sickle cell disease or trait (HbSS, HbAS, HbSC) because of the risk of precipitating sickling, or in patients where the blood supply to the limb is already tenuous: for example, severe atherosclerosis.

### Anesthetic Techniques

The anesthetic technique can make an important contribution to reducing operative blood loss. Episodes of hypertension and tachycardia due to sympathetic overactivity should be prevented by ensuring adequate levels of anesthesia and analgesia. Similarly, coughing, straining and patient manoeuvres which increase venous blood pressure should be avoided. Excessive carbon dioxide retention, or hypercarbia, can cause widespread vasodilatation which will increase operative blood loss. It should therefore be avoided, if necessary by controlling ventilation. The appropriate use of regional anesthesia, particularly epidural and subarachnoid anesthetic techniques, can significantly reduce operative blood loss in a variety of surgical procedures.

The use of hypotensive anesthesia can undoubtedly reduce operative blood loss. However, because of the risks associated with this technique, it is not recommended for the inexperienced anesthetist or where comprehensive monitoring facilities are unavailable.

### Antifibrinolytic and Other Drugs

Several drugs, including aprotinin and tranexamic acid, which inhibit the fibrinolytic system of blood and encourage clot stability, have been used in an attempt to reduce operative blood loss. The indications and benefits of these drugs in surgery are not yet clearly defined.

Desmopressin (DDAVP) has been shown to be of value in preventing excessive bleeding when used in hemophiliacs and some acquired bleeding disorders, such as cirrhosis of the liver. It acts by increasing the production of Factor VIII.

### ESTIMATING BLOOD LOSS

In order to maintain blood volume accurately, it is essential to continually assess surgical blood loss throughout the procedure. An adult weighing 60 kg would have a blood volume equal to  $70 \times 60$ , which is 4200 ml.

#### Calculating blood volume

<i>Blood volume</i>	
Neonates	85–90 ml/kg body weight
Children	80 ml/kg body weight
Adults	70 ml/kg body weight

Accurate measurement of blood loss is especially important in neonatal and infant surgery where only a very small amount lost can represent a significant proportion of blood volume. However, whatever methods are used there is always a tendency to underestimate blood loss.

Guessing how much blood is on a swab is a very inaccurate method of estimating blood loss. It is important to weigh swabs while still in their dry state and in their sterile packs and then to weigh the blood-soaked swabs as soon as they are discarded. Subtract the dry weight of any unused swabs from the total dry weight. Then subtract the weight of the blood soaked swabs to estimate the blood loss (1 ml of blood weighs approximately 1 g).

It is straightforward to assess the amount of blood lost into graduated drains or suction bottles. However if the bottles are ungraduated, the loss can again be calculated by weighing, provided that you know the empty weight of the bottle.

It is also important to estimate blood loss into surgical drapes, together with that pooling beneath the patient and onto the floor. Remember to note the volume of any irrigation or washout fluids that are used during surgery and which have contaminated swabs or suction bottles. This volume needs to be subtracted from the measured blood loss to arrive at a final estimate.

### MONITORING FOR SIGNS OF HYPOVOLEMIA

Many of the autonomic and central nervous system signs of significant hypovolemia can be masked by the effects

of general anesthesia. The classic picture of the restless or confused patient who is hyperventilating (air-hunger), in a cold sweat and complaining of thirst is not a presentation under a general anesthetic. However, many of these signs will still be apparent in the patient undergoing local or regional anesthesia and in those recovering from general anesthesia. Patients under a general anesthetic may show only very few signs that hypovolemia is developing. *Pallor of the mucous membranes, a reduced pulse volume and tachycardia may be the only initial signs.* As volume depletion progresses, a fall in blood pressure will occur and the capillary refill time will be delayed; more than 2 seconds for color to return to finger pad or nail-bed after it has been briefly compressed is abnormal. In addition, desaturation detected by oximetry or the development of cyanosis, ischemic or rhythm changes on an ECG, and a falling urine output, may also occur.

If capnography is used, hypovolemia may be manifested by a reduction in end-tidal carbon dioxide as pulmonary perfusion falls. Central venous pressure will fall in hypovolemia and, if temperature monitoring is used, there will be a increase in the difference between the core and peripheral temperature as vasoconstriction occurs.

#### *Monitoring for hypovolemia*

- Color of mucous membranes
- Respiratory rate
- Level of consciousness
- Urine output
- ECG
- CVP, if available and appropriate
- Heart rate
- Capillary refill time
- Blood pressure
- Peripheral temperature
- Saturation of hemoglobin

#### *Replacement of blood loss*

Different methods have been suggested to calculate the amount of blood loss. These calculations are merely guides to fluid replacement. During surgery, the decision to transfuse will ultimately need to be based on the careful assessment of other factors, in addition to the volume of blood loss. These include:

- Rate of blood loss (actual and anticipated)
- Patient's clinical response to blood loss and fluid replacement therapy
- Signs indicating inadequate tissue oxygenation.

One must therefore be prepared to move away from any calculation/guidelines and transfuse at an earlier stage if the situation warrants it. The ability of a patient to compensate for a reduction in oxygen supply will be limited by:

- Evidence of cardiorespiratory disease
- Treatment with drugs such as beta-blockers
- Pre-existing anemia
- Increasing age.

A healthy adult may be able to sustain losses of up to 30 percent of blood volume, or a hemoglobin of approximately 9 g/dl, without requiring a blood transfusion, provided that blood volume is maintained. However, an anemic patient with a history of ischemic heart disease losing 20 percent of blood volume, or haemodiluted below 10 g/dl, may decompensate despite maintaining normovolemia.

#### *Maintaining Normovolemia*

It is essential that blood volume is maintained at all times. Even if the allowable blood loss is exceeded and no blood for transfusion is readily available, one should continue to infuse crystalloid replacement fluids or colloids to ensure normovolemia.

## FLUID REPLACEMENT AND TRANSFUSION

*Choice of replacement fluid-* As discussed earlier there is some debate about the choice of fluid used for the initial replacement of blood loss in order to maintain blood volume. Crystalloid replacement fluids, such as normal saline or Ringer's lactate solution, leave the circulation more rapidly than colloids. For this reason, at least three times the volume of blood lost should be used: that is, 3 ml of crystalloid to every 1 ml of blood loss. If colloid fluids are used, the amount infused should be equal to the volume of blood lost.

Provided that surgical blood loss is replaced with crystalloid or colloid fluids to maintain normovolemia, a significant degree of loss can often safely be incurred

before a blood transfusion becomes necessary. This practice is well-tolerated in the majority of patients, despite the reduction in oxygen carrying capacity that occurs. The reasons for this are as follows:

1. The supply of oxygen in a healthy, resting adult with a normal hemoglobin concentration is 3 to 4 times greater than that required by the tissues for metabolism. A safety margin therefore exists between oxygen supply and demand, and this allows some reduction in hemoglobin to occur without serious consequences.
2. When significant blood loss occurs, the fall in the oxygen-carrying capacity of blood together with the reduction in blood volume invoke several compensatory responses which help to maintain the supply of oxygen to the tissues.
3. These compensatory mechanisms are facilitated and tissue oxygenation is even better preserved if the normal blood volume is maintained with fluid replacement therapy as blood loss occurs. In particular, ensuring normovolemia allows the cardiac output to increase, thereby sustaining the oxygen supply in the face of a falling hemoglobin.
4. The replacement of blood loss with crystalloid or colloid fluids also results in dilution of the blood components, or hemodilution. This reduces the viscosity of blood which improves capillary blood flow and cardiac output, enhancing the supply of oxygen to the tissues.

#### *Avoiding Hypothermia*

A fall in body temperature of a patient can cause several unwanted effects. These include:

- Impairment of the normal compensatory responses to hypovolemia
- Increase in operative bleeding
- Increase in oxygen demand postoperatively as normothermia become re-established. This may lead to hypoxia
- Increase in wound infection.

For these reasons, every effort should be made to maintain a normal body temperature in the perioperative period, including the warming of intravenous fluids remember that heat loss occurs more readily in children.

<b>Measures to avoid hypothermia</b>	
<i>Patient</i>	<i>Fluids</i>
• Cover with blankets	• Store fluids in warming cabinet
• Use warming mattress (37°C)	• Immerse fluid bags in warm water
• Humidify anesthetic gases	• Use heat exchangers on infusion set

#### **Autologous Blood Transfusion**

Autologous transfusion involves the collection and subsequent reinfusion of the patient's own blood or blood products. It can avoid some of the immunological and disease-transmission problems associated with donor, or homologous blood and, in some circumstances, may also be the only readily available source of blood for transfusion. Autologous transfusion is an effective technique in both elective and emergency surgery, but one should consider it only in a patient if one anticipate that the surgery will result in sufficient blood loss to require homologous transfusion.

All autologous transfusion methods require careful preparation and planning and it is vital to seek the advice and cooperation of the blood bank or transfusion centre before they are introduced into a hospital.

The principal methods of autologous transfusion are:

1. Preoperative blood donation.
2. Acute normovolemic hemodilution.
3. Blood salvage.

These techniques can be used alone or in combination to reduce or eliminate the need for homologous blood. Out of three methods only preoperative blood donation will be discussed.

#### *Preoperative Blood Donation*

Preoperative blood donation involves the collection and storage of the patient's own blood prior to elective surgery. Firstly, it must be established that the surgical procedure is likely to result in sufficient blood loss to require transfusion. A unit of the patient's own blood is then collected every five or more days in the period leading up to surgery. The blood is tested, labelled and stored to the same standard as homologous blood and the patient is prescribed oral iron supplements. On the

date of operation, up to 4–5 units of stored blood are then available if transfusion becomes necessary during the procedure.

This technique requires considerable planning and organization to be effective and experience shows that the initial costs can be higher than those of homologous transfusion. Thought must also be given to the criteria for patient eligibility since not all patients are either fit enough or live close enough to the hospital to make repeated donations.

This method of autologous transfusion does not avoid the risk of bacterial contamination as a result of collection or storage problems and does not reduce the risk of procedural errors that can cause incompatibility of blood.

#### *Postoperative Transfusion*

Staff caring for patients postoperatively should be aware that some degree of hemodilution can be expected in patients who have lost blood during a procedure. For this reason, a hemoglobin level performed postoperatively is very likely to be lower than the preoperative level. This alone is not an indication for a blood transfusion, and the decision to transfuse should only be made following a careful assessment of the patient.

Consideration should be given to the general condition of the patient and, in particular, to coexisting cardiopulmonary disease, signs of inadequate tissue oxygenation and continued blood loss.

# 13

# Intravenous Fluids and Post-operative Fluid Management

**R Dayananda Babu**

Fluid balance is the relationship between fluid output and fluid intake. Under normal circumstances fluid balance is maintained quite precisely, but in the surgical patient it has to be monitored carefully.

Fluid loss occurs in the following ways:

Urinary excretion	1500 ml (0.5- 2ml/kg/hr)
Insensible loss	900 ml (0.35 ml/kg/hr)
Feces	100 ml
Total	2500 ml/day

Normal daily requirement for an adult is as follows:

Water	2500 ml (30-40 ml/kg/day)
Sodium	100-180 mEq/24 hr (1-2 mEq/kg/day)
Potassium	40-60 mEq/24 hr (0.5-1 meq/kg/day)
Glucose	100 gm (min. required to ward off ketosis)

## **POSTOPERATIVE FLUID MANAGEMENT**

### **Practical Fluid Balance for the Operated Patient**

The calculation is based on:

1. The initial estimated loss (ie. the perioperative fluid loss)
2. The maintenance requirement
3. The on-going loss

Usually 50 percent of the calculated loss is corrected in the initial 24 hours.

### **The Initial Estimated Loss**

- All peri-operative losses are isotonic and should be replaced by isotonic fluids, and all such losses must be rectified.
- Blood loss in excess of 15 percent of the blood volume in the adult is replaced by infusion of stored blood.
- Smaller blood losses may be replaced by crystalloid solutions.

### **Maintenance Requirement**

- This is estimated after all the operative losses have been calculated and dealt with
- This is based on the estimated NORMAL requirements of the patient. For example, a normothermic 60 kg. adult with a normal metabolic rate would require about 2000 ml. of water, 100 mEq of sodium and about 50 mEq of potassium per day. Thus, this patient requires a daily fluid maintenance, *under uncomplicated circumstances*, consisting of:
  - 1500 ml. of isotonic water as 5 percent Dextrose
  - 500 ml. of 0.9 percent Normal Saline
  - 60 mEq of Potassium (K)

But, certain modifications have to be made in the first 24 hours when the stress response to surgery is the maximum, as:

- Stress—induced release of ADH, aldosterone and cortisol causes retention of sodium and water and increased renal excretion of potassium.

- Endogenous release of potassium from traumatized tissues and catabolism warrants restriction of potassium.

Therefore, in the first 24 hours, the patient requires no salt and less of water than normal.

2000 ml of 5 percent Dextrose is sufficient (*when all the operative losses have been replaced*)

- By the second 24 hours metabolic response diminishes:

Patient requires 2000 ml of 5 percent Dextrose and 1000 ml of isotonic saline in 24 hours.

- From the third post-operative day and thereafter:  
20 mEq of Potassium is added to each 500 ml of intravenous fluid to give a total of 60 mEq in 24 hours.

### On-going Losses

Additional fluid may be required in the following circumstances:

- If blood or serum is lost through drains
- If GIT losses continue; e.g. Nasogastric aspiration or fistula
- Continuing third-space losses in the first 24 to 48 hours after major surgery
- During rewarming, if the patient has become hypothermic during surgery
- These losses are replaced as Isotonic Saline(0.9% NS)  
In lower intestinal losses, ringer lactate is preferred (but this is best avoided in patients with hepatic disease as lactate is not converted to bicarbonate)
- For every 1000 ml of fluid loss, 20 mEq of potassium is added.

For example, a post-operative patient has a Ryle's tube aspirate of 1000 ml., a biliary fistula of 1000 ml. and a urinary output of 1000ml. If the patient is not dehydrated, fluid calculation would be thus:  
Total fluid requirement is:  $1000 + 1000 + 1000 + 500$  (insensible losses) = **3500 ml.**

(of this, Ryle's tube aspirate and biliary loss is replaced as 0.9% NS; 2000ml.)

Potassium requirement is: 40 mEq.(for each 1000 ml of bile and gastric aspirate 20 mEq of Potassium is required).

To calculate the total fluid required for this patient in a day (*including maintenance*):

### Saline Required

- On-going losses of bile and gastric aspirate is replaced as NS  
2000 ml of 0.9 percent Normal Saline
- Maintenance requirement of saline = 1000ml.  
**Total = 3000 ml**

### Potassium Required

- For on-going losses = 40 mEq
- For maintenance = 60 mEq  
Total = 100 mEq

### Glucose Required

- A minimum of 100 gm (500 ml of 5 percent Dextrose contains 25 gm of glucose)  
Hence, this patient's **total requirement of 3500 ml** can be administered as:  
1500 ml of 0.9% NS  
1500 ml of DNS  
500 ml of 5 percent Dextrose  
100 mEq of K (5 ampoules)

## **ASSESSMENT OF ADEQUACY OF FLUID AND ELECTROLYTE REPLACEMENT**

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1. Clinical and biochemical parameters
  - General condition and sensorium
  - Signs of dehydration
  - Hemodynamic stability; vital signs: pulse, blood pressure etc.
  - Hematocrit, serum electrolytes, BUN, urine osmolality
2. Urine output
  - A very sensitive index
  - The ultimate goal of hydration is to obtain a minimum urine output of 0.5 ml/ kg/hr.
3. CVP
  - Normal level is 4 to 8 cm of water
  - Provides realistic information about fluid volume  
Low CVP >> decreased blood volume  
High CVP >> increased blood volume

- Should be monitored half-hourly
- Should be evaluated in the background of other data like pulse, blood pressure, respiration etc. For example, an increase in CVP parallels an increase in systolic BP indicating adequate fluid volume replacement.

After major surgery assessment of fluid and electrolytes is best achieved by the measurement of urine output, CVP and serum electrolyte concentration.

Judicious and appropriate administration of fluids in the postoperative period will reduce morbidity and mortality.

**The following points should be always borne in mind with regard to intravenous fluid therapy:**

1. Replacement fluids are used to replace abnormal losses of blood, plasma or other extracellular fluids in:
  - Treatment of patients with established hypovolemia: e.g. hemorrhagic shock
  - Maintenance of normovolemia in patients with ongoing fluid losses: e.g. surgical blood loss.
2. Intravenous replacement fluids are the first-line treatment for hypovolemia. Initial treatment with these fluids may be life-saving and provide some time to control bleeding and obtain blood for transfusion if it becomes necessary.
3. Crystalloid maintenance fluids, which contain dextrose, are not suitable for use as replacement fluids. Only crystalloid solutions with a similar concentration of sodium to plasma (normal saline or balanced salt solutions) are effective as replacement fluids. These should be available in all hospitals where intravenous replacement fluids are used.
4. Crystalloid replacement fluids should be infused in a volume at least three times the volume lost in order to correct hypovolemia.
5. All colloid solutions (albumin, dextrans, gelatines and hydroxyethyl starch solutions) are replacement fluids. However, they have not been shown to be superior to crystalloids in resuscitation.
6. Colloid solutions should be infused in a volume equal to the blood volume deficit.
7. Plasma should never be used as a replacement fluid.

8. Plain water should never be infused intravenously. It will cause hemolysis and will probably be fatal.
9. In addition to the intravenous route, the intraosseous, oral, rectal or subcutaneous routes can be used for the administration of fluids.

## **REPLACEMENT FLUIDS**

Replacement fluids are used to replace abnormal losses of blood or other extracellular fluids by increasing the volume of compartment. They are sometimes also called plasma substitutes.

*Replacement fluids are used principally in:*

- Treatment of patients with established hypovolemia: hemorrhagic shock
- Maintenance of normovolemia in patients with ongoing fluid losses: e.g. surgical blood loss.

All colloid solutions are replacement fluids. However, only crystalloid solutions that contain a sodium concentration similar to plasma are suitable as replacement fluids. Some of these crystalloids have a composition resembling extracellular fluid and are known as balanced salt solutions: e.g. Ringer's lactate or Hartmann's solution.

Examples of replacement fluids are:

- Crystalloids with a similar concentration of sodium to plasma:
  - Normal saline (sodium chloride 0.9%)
  - Ringer's lactate
  - Hartmann's solution
- All colloid solutions.

## **Intravenous Replacement Therapy**

In hypovolemia, the primary goal of treatment is to restore the circulating blood volume in order to maintain tissue perfusion and oxygenation. The administration of replacement fluids achieves this by increasing the volume of the vascular compartment. A blood transfusion may also become necessary if there is extensive blood loss. However, even in cases of severe hemorrhage, initial treatment with intravenous replacement fluids may be life-saving and will allow time to obtain blood for transfusion. Intravenous replacement fluids are the first-line treatment for hypovolemia.

Intravenous replacement fluids are the first-line treatment for hypovolemia.

## Intravenous Replacement Fluids

### Crystalloids

Crystalloids are composed of crystalline substances such as dextrose or sodium chloride which, when dissolved in water, form a clear solution of electrolytes or sugars. These are aqueous solution of small molecules which easily pass through capillary membranes: e.g. normal saline, balanced salt solutions.

Crystalloid replacement fluids contain a similar concentration of sodium to that of plasma. This ensures that they are excluded from the intracellular compartment since the cell membrane is generally impermeable to sodium. However, they readily cross the capillary membrane from the vascular compartment to the interstitial compartment to become rapidly distributed throughout the whole extracellular compartment.

Normally, only a quarter of the crystalloid solution remains in the vascular compartment. For this reason, crystalloids should be infused in a volume at least three times the deficit in order to restore circulating blood volume (intravascular volume).

Crystalloids should be infused in a volume at least three times the blood volume deficit in order to correct hypovolemia

When large volumes of crystalloid fluid are administered, edema develop as a result of the fluid that passes (or ‘leaks’) from the circulation into the interstitial compartment. Careful monitoring of the patient’s clinical condition is therefore essential. Crystalloid maintenance fluids, which contain mainly dextrose, are not recommended for use as replacement fluids (Table 13.1).

The dextrose rapidly becomes metabolized leaving only water, which readily crosses the capillary and cell wall membranes to become distributed throughout the extracellular and intracellular compartments. Only a small fraction remains in the vascular compartment, as shown in Figure 13.1.

Dextrose (glucose) solutions do not contain sodium and are poor replacement fluids. Do not use them to treat hypovolemia unless there is no other alternative

### Colloids

Colloid solutions are composed of a suspension of particles that have a much larger molecular weight than crystalloids. These particles are generally too big to pass through the capillary membrane and initially tend to remain within the vascular compartment. They are used as a replacement fluid: e.g., gelatines, dextrans, hydroxy-

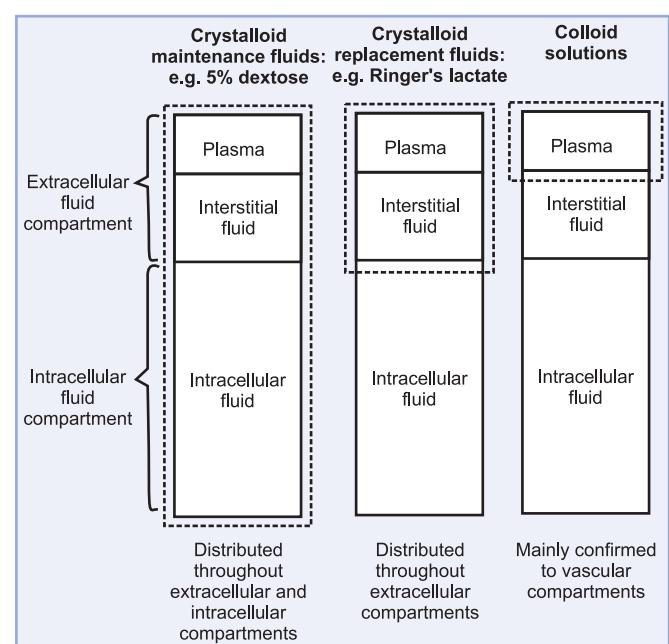


FIGURE 13.1: Distribution of intravenous fluids

Table 13.1: Suitability of intravenous fluids as either maintenance or replacement fluids.

Fluid	Crystalloids composed mainly of dextrose	Crystalloids with high sodium content and balanced salt solutions	Colloids
Maintenance fluids	✓	✗	✗
Replacement fluids	✗	✓	✓

ethyl starch. The effect of these particles in the circulation is to mimic plasma proteins, thereby maintaining or raising the colloid osmotic pressure of blood.

The molecular weight and number of particles in a colloid solution is important in determining its properties. The larger the particle sizes, the longer the duration of action of the solution in the vascular compartment. Also, the higher the number of particles in the solution, the greater the osmotic effect.

Solutions with an oncotic pressure greater than that of plasma have the capacity to draw water from the interstitial compartment into the blood. The increase in blood volume may thus exceed the infused volume.

Colloids can be classified as:

1. Plasma-derived (natural): prepared from donated human blood or plasma (e.g. albumin). These should not be used simply as replacement fluids.
2. Synthetic: prepared from another source (e.g. bovine cartilage).
  - Gelatines (Hemaccel, Gelofusine)
  - Dextran 60 and Dextran 70
  - Hydroxyethyl starch (Hetastarch or hes)
  - Pentastarch

Colloids require smaller infusion volumes than crystalloids. They are usually given in a volume equal to the blood volume deficit.

However, in many conditions where the capillary permeability is increased, they may leak out of the circulation and produce only a short-lived volume expansion. Supplementary infusions will be necessary to maintain blood volume in conditions such as:

- Trauma
- Acute and chronic sepsis
- Burns
- Snake bite (hemotoxic and cytotoxic).

#### *Properties of an Ideal Intravenous Replacement Fluid*

The most important property of an intravenous replacement fluid is simply to occupy volume in the vascular compartment. An ideal replacement fluid should do this for a sufficient length of time and without interfering with the normal functions of the blood. Furthermore, it should be:

- Easily available and inexpensive
  - Non-toxic
  - Free of allergic reactions and risk of infection
  - Totally metabolized or eliminated from the body.
- Unfortunately, no fluid yet satisfies all these requirements. It is important, therefore, to be familiar with the properties and characteristics of the replacement fluids used in the hospital and to be able to use them safely.

#### **The Crystalloids or Colloids Controversy**

Much has been written about the crystalloids or colloids controversy, but it can be summarized as follows. Most clinicians agree that, in hypovolemic patients, it is essential to restore blood volume with replacement fluids. However, they disagree on the type of fluid that should be used. Both crystalloids and colloids have advantages and disadvantages, as shown in the Table 13.2.

However, ensuring that an adequate volume of replacement fluid (of whatever type) is administered to a hypovolemic patient is more important than the choice of fluid.

There is no evidence that colloid solutions are superior to normal saline or balanced salt solutions in resuscitation.

If the supply of infusion fluids is limited, it is recommended that, wherever possible, the crystalloid normal saline (sodium chloride 0.9%) or a balanced salt solution such as Ringer's lactate or Hartmann's solution should be available in all hospitals where intravenous replacement fluids are used.

**Table 13.2: Advantages and disadvantages of crystalloids and colloids**

	<i>Advantages</i>	<i>Disadvantages</i>
Crystalloids	Few side-effects Low cost Wide availability	Short duration of action May cause edema
Colloids	Longer duration of action Less fluid required to correct hypovolemia	No evidence that they are more clinically effective Higher cost May cause volume overload May interfere with clotting Risk of anaphylactic reactions

Before giving any intravenous infusion:

1. Check that the seal of the infusion fluid bottle or bag is not broken.
  2. Check the expiry date.
  3. Check that the solution is clear and free from visible particles.

## Plasma-derived Colloids

These are prepared from donated blood or plasma. They include:

- Plasma
  - Fresh frozen plasma
  - Liquid plasma
  - Freeze-dried plasma
  - Albumin

These products should not be used simply as replacement fluids. They can carry a similar risk of transmitting infection such as HIV and hepatitis, as whole blood. They are also generally more expensive than crystalloid or synthetic colloid fluids.

Table 13.3 shows the composition of replacement fluids and plasma

## Factors Affected by Acid-base Imbalance

As a result of acid-base imbalance, the following four clinical entities can occur.

1. *Respiratory acidosis* may be produced by any condition or combination of conditions that result in inadequate ventilation (atelectasis, pneumonia, airway obstruction). The clinical signs of restlessness, hypertension, and tachycardia in the post-operative patient may indicate the presence of, hypercapnia. Treatment consists of providing adequate ventilation and correcting the pulmonary problem when possible.
  2. *Respiratory alkalosis* in the surgical patient is caused, usually by hyperventilation secondary to apprehension, pain, brain injury, or overventilation by mechanical respirators. If the condition is mild, no therapy is required. When the cause of hyperventilation can be determined and corrected, the problem is eliminated.
  3. *Metabolic acidosis* may occur as a result of acute circulatory failure or renal damage, chloride excess, loss of lower gastrointestinal fluids, administration of unbalanced salt solutions, and uncontrolled diabetes

**Table 13.3:** Composition of replacement fluids and plasma

Fluid	Na <sup>+</sup> nmol/L	K <sup>+</sup> nmol/L	Ca <sup>2+</sup> nmol/L	Cl <sup>-</sup> nmol/L	Base mEq/L	Colloid osmotic pressure mmHg
<b>Crystalloids</b>						
Normal saline (sodium chloride 0.9%)	154	0	0	154	0	0
Balanced salt solutions (Ringer's lactate/Hartmann's solution)	130-140	4-5	2 -3	109-110	28-30	0
<b>Colloids</b>						
Gelatine (urea linked): e.g. Hemaccel	145	5.1	6.25	145	Trace amounts	27
Gelatine (succinylated): e.g. Gelfusine	154	< 0.4	< 0.4	125	Trace amounts	34
Dextran 70 (6%)	154	0	0	154	0	58
Dextran 60 (3%)	130	4	2	110	30	22
Hydroxyethyl starch 450/0.7 (6%)	154	0	0	154	0	28
Albumin 5%	130-160	< 1	V	V	V	27
Ionic composition of normal plasma	135-145	3.5-5.5	2.2-2.6	97-110	38-44	27
V=varies between different brands						

mellitus., Correction of protracted metabolic acidosis may require the use of sodium bicarbonate. When cardiopulmonary arrest occurs, restoration of blood flow, pulmonary ventilation, and administration of sodium bicarbonate is required.

4. *Metabolic alkalosis* usually occurs when some degree of hypokalemia exists. It occurs when there is an uncomplicated loss of acids (H ion) or retention of bases. Because of the associated hypokalemia, cardiac arrhythmias, paralytic ileus, digitalis intoxication, and tetany may develop. Dangerous

hyperkalemia (greater than 6 mEq per liter) is unusual if kidney function is normal. Generally, it is unwise to administer potassium during the first 24 hours postoperatively unless there is a definite hypokalemia. These deficits should be replaced after an adequate urine output is obtained. The daily replacement of potassium for renal excretion is 40 mEq plus 20 mEq for gastrointestinal loss if indicated; it should not be administered parenterally in concentrations of more than 40 mEq per liter as potassium chloride.

# 14

# Transfusion of Blood and Blood Products

**K George Varghese**

The following key points should be always borne in mind when transfusion of blood and blood products is planned:

1. Safe blood products, used correctly, can be life-saving. However, even where quality standards are very high, transfusion carries some risks. If standards are poor or inconsistent, transfusion may be extremely risky.
2. No blood or blood product should be administered unless all nationally required tests are shown to be negative.
3. Each unit should be tested and labelled to show its ABO group and its RhD group.
4. Whole blood can be transfused to replace red cells in acute bleeding when there is also a need to correct hypovolemia.
5. The preparation of blood components allows a single blood donation to provide treatment for two or three patients and also avoids the transfusion of elements of the whole blood that the patient may not require. Blood components can also be collected by apheresis.
6. Plasma can transmit most of the infections present in whole blood and there are very few indications for its transfusion.
7. Plasma derivatives are made by a pharmaceutical manufacturing process from large volumes of plasma comprising many individual blood donations. They must be tested to minimize the risks of transmitting infection.
8. Factors VIII and IX and immunoglobulins are also made by recombinant DNA technology and are often favored because there would be no risk of transmitting infectious agents to the patient. However, the costs are high and there have been some reported cases of complications.

## **DEFINITIONS**

**Whole blood:** Unseparated blood collected into an approved container containing an anticoagulant-preservative solution.

**Blood product:** Any therapeutic substance prepared from human blood

**Blood component:**

1. A constituent of blood, separated from whole blood, such as:
  - Red cell concentrate
  - Red cell suspension
  - Plasma
  - Platelet concentrates
2. Plasma or platelets collected by apheresis
3. Cryoprecipitate, prepared from fresh frozen plasma, which is rich in Factor VIII and fibrinogen

**Plasma derivative:** Human plasma proteins prepared under pharmaceutical manufacturing conditions, such as:

- Albumin

- Coagulation factor concentrates
- Immunoglobulins
- \* *Apheresis: a method of collecting plasma or platelets directly from the donor, usually by a mechanical method.*

## WHOLE BLOOD

Whole blood is obtained from human blood donors by venesection. During donation, blood is collected into a sterile, disposable, plastic pack which contains an anticoagulant-preserved solution. This solution usually contains citrate, phosphate, dextrose and often adenine (CPDA). Their functions are summarized in Table 14.1.

**Table 14.1:** Functions of anticoagulant-preserved solution in blood collection pack

Solutions	Functions
C Sodium citrate	Binds with calcium ions in blood in exchange for the sodium salt so the blood does not clot
P Phosphate	Supports metabolism of the red cells during storage to ensure they release oxygen readily at tissue level
D Dextrose	Maintains the red cell membrane to increase storage life
A Adenine	Provides energy source

There are variations in the volume of blood collected and the type of anticoagulant-preserved solution used in different hospitals.

During storage, metabolism continues in the red cells and platelets, while some plasma proteins lose their biological activity. The biochemical and metabolic effects of storage are as follows:

- Reduction in the pH (blood becomes more acidic)
- Rise in plasma potassium concentration (extracellular K+)
- Progressive reduction in the red cell content of 2,3 diphosphoglycerate (2,3 DPG) which may reduce the release of oxygen at tissue level until 2,3 DPG is restored
- Loss of all platelet function in whole blood within 48 hours of donation
- Reduction in Factor VIII to 10 to 20 percent of normal within 48 hours of donation. Coagulation factors such as VII and IX are relatively stable in storage

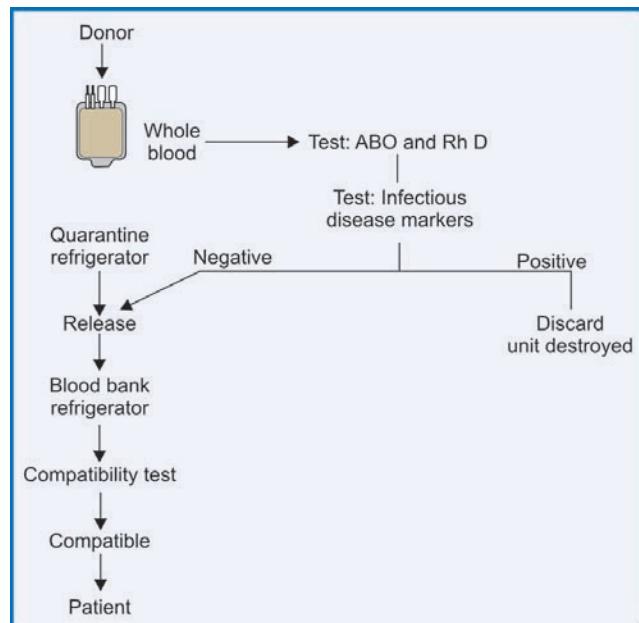
## Advantages of Whole Blood

- Requires only simple and inexpensive single collection packs
- No special equipment is needed for processing
- For patients with hemorrhage, whole blood supplies red cells, volume and stable coagulation factors.

## Disadvantages Whole Blood

- For patients at risk of circulatory overload, whole blood contains a higher volume than red cell concentrate.

Whole blood must be collected, tested and processed to high safety standards (Fig. 14.1).



**FIGURE 14.1:** Collection of Whole Blood

## BLOOD COMPONENTS / BLOOD PRODUCTS

Whole blood may be suitable for transfusion in many clinical situations, such as red cell replacement in acute blood loss where there is also hypovolemia. However, the separation of whole blood into its constituent components—red cells, platelets and plasma—is widely practiced for use when these specific components only are required.

These components may be processed further by, for example:

- Leukocyte (white cell) removal
- 'Pooling' (combining platelets separated from 4 to 6 donations to produce a therapeutic dose for an adult patient), as shown in the Figure 14.2.

The process of separation requires specialized plastic bags, more equipment, a higher level of expertise and more work to ensure the quality of the components produced.

An infectious agent present in the donated blood may be transmitted to all recipients of the components prepared from a single donation.

When the plasma is removed from whole blood, the red cells can be used as a red cell concentrate or can be formed into a red cell suspension by the addition of an additive diluent solution (Fig. 14.2).

## CLINICAL TRANSFUSION PROCEDURES

The following are the steps in the clinical transfusion procedures:

1. Assess the patient's clinical need for blood and when it is required.
2. Inform the patient and/or relatives about the proposed transfusion treatment and record in the patient's notes that you have done so.
3. Record the indications for transfusion in the patient's notes.
4. Select the blood product and quantity required. Use a blood ordering schedule as a guide to transfusion requirements for common surgical procedures.
5. Complete the blood request form accurately and legibly.
  - The products that are being requested

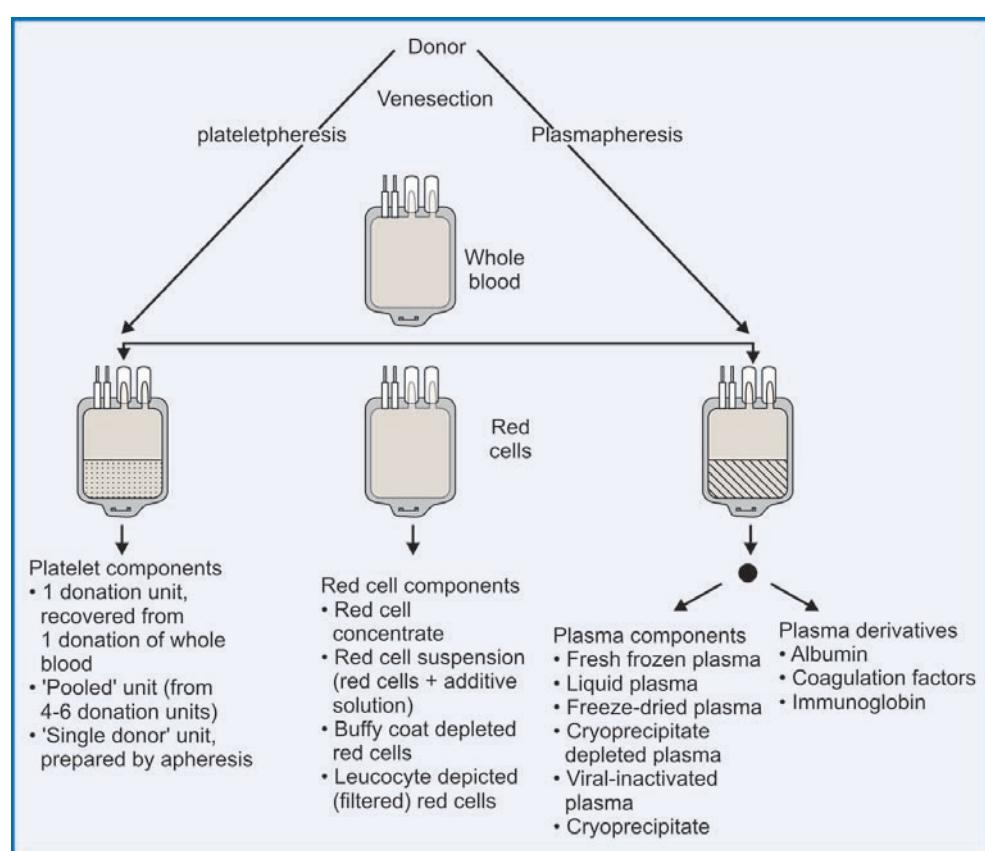


FIGURE 14.2: Blood products

- The number of units required
  - The reason for transfusion
  - The urgency of the patient's requirement for transfusion
  - When and where the blood is required
  - Who will deliver or collect the blood.
6. If blood is needed urgently, contact the blood bank by telephone immediately.
  7. Obtain and correctly label a blood sample for compatibility testing.
  8. Send the blood request form and blood sample to the blood bank.
  9. Laboratory performs pre-transfusion antibody screening and compatibility tests and selects compatible units.
  10. Delivery of blood products by blood bank or collection by clinical staff.
  11. Store blood products in correct storage conditions if not immediately required for transfusion.
  12. Check identity on:
    - Patient
    - Blood product
    - Patient's documentation.
  13. Administer blood/blood product.
  14. Record in the patient's notes:
    - Type and volume of each product transfused
    - Unique donation number of each unit transfused
    - Blood group of each unit transfused
    - Time at which the transfusion of each unit commenced
    - Signature of the person administering the blood.
  15. Monitor the patient before, during and on completion of the transfusion.
  16. Record the completion of the transfusion.
  17. Identify and respond immediately to any adverse effect. Record any transfusion reactions in the patient's notes.

### Communication between Clinicians and the Blood Bank

The safety of the patient requiring transfusion depends on effective communication between clinical and blood

bank staff. Blood bank staff, for example, may not always recognize the problems faced by medical and nursing staff in an emergency when blood may be needed very urgently. On the other hand, clinicians may not fully understand the problems faced by blood bank staff if they order blood or blood products without completing a blood request form or allow insufficient time for laboratory technicians to prepare them safely for transfusion. It is essential that there is clear understanding by both clinicians and blood bank staff of each other's role in the transfusion process.

### Urgent Requests for Blood

It is particularly important to ensure that there is common agreement and understanding about the language used by both clinical and blood bank staff in order to avoid any misinterpretation of words such as 'immediate', 'urgent' or 'as soon as possible'. It is preferable to agree on categories of urgency, such as:

- Extremely urgent: within 10 to 15 minutes
- Very urgent: within 1 hour
- Urgent: within 3 hours
- Same day
- Or date and time required.

### Informing the Patient

Once the decision has been made that transfusion is necessary, it is important to explain the proposed transfusion treatment to the patient or relatives, wherever possible. Record in the patient's notes that you have done so.

Patients or their relatives may be worried about the risks of transfusion and wish to know more about them, as well as the need for transfusion and possible alternatives, such as autologous transfusion or drugs such as erythropoietin (a stimulant for red cell production). Patients of the Jehovah's Witness faith are not allowed by their religious beliefs to receive blood components, but may be prepared to accept plasma fractions or alternative treatments. In some cases, people of other religions or cultural groups may have their own special concerns about giving or receiving blood, and these should be handled sensitively, to the benefit of the patient.

In many countries, the law defines it as a serious assault to transfuse a patient who has clearly indicated that this is against his or her will, even if you believe the patient's life can only be saved by transfusion.

### Ordering Blood for Elective Surgery

Since many operations very rarely need blood transfusion, it is unnecessary for a compatibility test (crossmatch) to be performed routinely for every surgical procedure. Considerable time and expense can be saved by avoiding the obligation of units of blood that are unlikely to be used, while still ensuring that blood is readily available for all patients who need it.

### The Blood Request Form

When blood is required for a transfusion, the prescribing clinician should complete and sign a standard blood request form and enter his/her name in legible capitals.

**All the details requested on the form must be completed accurately and legibly.** If blood is needed urgently, also contact the blood bank by telephone. **A sample blood request form is included in the appendix**

### Blood Samples for Compatibility Testing

It is vital that the patient's blood sample is placed in a sample tube that is correctly labelled and is uniquely identifiable with the patient. The following is the steps involved in taking a blood sample for compatibility testing:

1. If the patient is conscious at the time of taking the sample, ask him or her to identify themselves by given name, family name, date of birth and any other appropriate information.
2. Check the patient's name against:
  - Patient's identity wristband or label
  - Patient's medical notes
  - Completed blood request form.
3. If the patient is unconscious, ask a relative or a second member of staff to verify the patient's identity.
4. Take the blood sample into the type of sample tube required by the blood bank. **For adults, this is usually 10 ml, with no anticoagulant.**
5. Label the sample tube clearly and accurately at the patient's bedside at the time the blood sample is being

taken. The following information should be included on the blood sample tube label:

- Patient's given name and family name
- Patient's date of birth
- Patient's hospital reference number
- Patient's ward
- Date
- Signature of person taking the sample.

Ensure that the patient's name is spelt correctly. Do not label tubes before obtaining the specimen because of the risk of putting the patient's blood into the wrong tube.

6. If the patient needs further red cell transfusion, send a new blood sample for cross matching. This is particularly important if the patient has had a recent red cell transfusion that was completed more than 24 hours earlier. Antibodies to red cells may appear very rapidly as a result of the immunological stimulus given by the transfused donor red cells. **A fresh blood sample is essential to ensure that the patient does not receive blood which is now incompatible.**

### Red Cell Compatibility Testing (Cross Matching)

It is essential that all blood is tested before transfusion in order to:

- Ensure that the transfused red cells are compatible with antibodies in the patient's plasma
- Avoid stimulating the production of new red cell antibodies in the recipient, particularly anti-Rh D.

All pre-transfusion test procedures should provide the following information about both the patient and the units of blood:

- ABO group and antibodies
- Rh D type
- Presence of other red cell antibodies that could cause hemolysis in the patient.

The blood bank plays a central part in ensuring that patients receive compatible blood.

### ABO Blood Group Antigens and Antibodies

In clinical transfusion practice, the ABO blood groups are by far the most important and can never be ignored

in red cell transfusion. Red cells comprise four main ABO types: O, A, B and AB. Individuals who (genetically) lack antigen A or antigen B have antibodies (IgM class) against the red cell type(s) that they have not inherited.

- A person of group A has antibody to group B
- A person of group B has antibody to group A
- A person of group O has antibody to group A and group B
- A person of group AB does not have antibody to group A or B

These antibodies can destroy red cells rapidly in the circulation. Anti-A + anti-B antibodies occur 'naturally' and are not developed as a result of prior sensitization to the corresponding antigen. However, Rhesus antibodies (anti-Rh D) only appear after a Rhesus negative individual is sensitized by Rh D positive red cells.

### **ABO Incompatibility: Hemolytic Reactions**

Safe blood transfusion depends on avoiding incompatibility between the donor's red cells and the antibodies in the patient's plasma. Anti-A or anti-B recipient antibodies are almost always capable of causing rapid destruction (hemolysis) of incompatible transfused red cells as soon as they enter the circulation. A red cell transfusion that is not crossmatched carries a high risk of causing an acute hemolytic reaction. Similarly, if blood is given to the wrong patient, it may be incompatible. The exact risk depends on the mix of ABO groups in the population. In populations where 30 percent of unmatched transfusions will be ABO incompatible, at least 10 percent of these will lead to severe or fatal reactions. In some circumstances, it is also important that the donor's antibodies are compatible with the patient's red cells. It is not always essential, however, to give blood of the same ABO group. The following is the summary of the basic transfusion rules for red cells and plasma in the ABO system:

In red cell transfusion, there must be ABO and Rh compatibility between the donor's red cells and the recipient's plasma.

- Group O individuals can receive blood from group O donors only.
- Group A individuals can receive blood from group A and O donors.
- Group B individuals can receive blood from group B and O donors.

- Group AB individuals can receive blood from AB donors, and also from group A, B and O donors.

### **Transfusion Rules for Plasma in ABO System**

In plasma transfusion, group AB plasma can be given to a patient of any ABO group because it contains neither anti-A nor anti-B antibody.

- Group AB plasma (no antibodies) can be given to any ABO group.
- Group A plasma (anti-B) can be given to group O and A patients.
- Group B plasma (anti-A) can be given to group O and B patients.
- Group O plasma (anti-A + anti-B) can be given to group O patients only.

- Severe acute hemolytic transfusion reactions are nearly always caused by transfusing red cells that are incompatible with the patient's ABO type. These reactions can be fatal.
- They most often result from errors made in identifying the patient when blood samples are being taken or when blood is being administered.

### **Rhesus D Antigens and Antibodies**

Red cells have other antigens and those carried by any individual are mainly determined by their genetic make-up. In contrast to the ABO system, individuals rarely make antibodies against these other antigens, unless they have been exposed to them by previous transfusion or during pregnancy and childbirth. The most important of these is the Rhesus D antigen. Even a single transfusion of Rh D positive red cells to a Rh D negative person will usually provoke production of anti-Rh D antibody. This can cause:

- Hemolytic disease of the newborn in a subsequent pregnancy
- Rapid destruction of a later transfusion of Rh D positive red cells.

### **Other Red Cell Antigens and Antibodies**

There are many other minor antigens on the human red cell which may, like the Rhesus D antigen, lead to the development of antibodies if the person lacking the antigen is sensitized by a transfusion of these antigens.

These antibodies, which can also cause severe reactions to transfusion, include:

- Rhesus: C, c, E, e
- Kell
- Duffy
- Lewis.

### Collecting Blood Products Prior to Transfusion

A common cause of transfusion reactions is the transfusion of a unit of blood that was intended for a different patient. This is often due to mistakes when collecting blood from the blood bank.

It is therefore essential that one should follow the hospital's standard procedure for the collection of blood from the blood bank and its storage in the clinical area prior to transfusion.

**Check that the following details** on the compatibility label attached to the blood pack exactly match the details on the patient's documentation:

- Patient's family name and given name
- Patient's ABO and RhD group
- Patient's hospital reference number
- Patient's ward, operating room or clinic

The following is a standard compatibility label to be affixed to blood pack:

THIS BLOOD IS COMPATIBLE WITH:

Blood pack no.

Patient's name:

Age/Date of birth:

Patient's hospital reference number:

Patient's ward:

Patient's blood group:

Blood group of the blood pack:

Expiry date:

Date of compatibility test:

**RETURN BLOOD PROMPTLY TO BLOOD BANK IF NOT USED**

When blood is issued from the blood bank, the time of issue must always be recorded. The person responsible for the blood bank should make sure that blood does not leave the refrigerator until it is issued for transfusion. It only takes about 30 minutes for a unit of blood to reach

10°C and it is rarely necessary to warm blood before transfusing it.

The blood bank will sometimes supply blood that is of a different ABO group from the patient's, but that may still be compatible; for example, red cells of group A are safe for a patient of group AB. In this event, usually due to shortage of a particular group, the blood bank should inform the clinician responsible and also record the fact on the documentation that accompanies the blood units.

### Storing Blood Products Prior to Transfusion

The 'blood cold chain' is the system for storing and transporting blood and blood products so that they are kept at the correct temperature at all times from collection from the donor to administration to the patient. Any breaks in the blood cold chain increase the dangers for the recipients of blood products and are wasteful of a scarce, valuable resource. The efficiency and effectiveness of the blood cold chain depend on:

1. Well-maintained, regularly monitored equipment to store and transport blood at controlled temperatures, including blood transport boxes, refrigerators, freezers and platelet agitators.
2. Correct use of this equipment by all staff involved in handling blood products.

Clinical staff are responsible for ensuring that blood products issued by the blood bank for transfusion are kept at the correct temperature until their infusion into the patient.

### Storage Conditions: Red Cells and Whole Blood

Red cells and whole blood must always be stored at a temperature between +2°C and +6°C. They must never be allowed to freeze. The upper limit of 6°C is essential to minimize the growth of any bacterial contamination in the unit of blood. The lower limit of 2°C is essential because red cells that are allowed to freeze become hemolysed. If they are transfused, the presence of cell membrane fragments and free hemoglobin can cause fatal bleeding problems or renal failure.

Red cells and whole blood must always be stored at a temperature between +2°C and +6°C. They must never be allowed to freeze

The solution in the blood bag contains both anticoagulant (sodium citrate) to stop the blood from clotting and dextrose (glucose) to ‘feed’ the red cells during storage. Storage at a temperature between 2°C and 6°C is essential to make sure the dextrose is not used too quickly.

Whole blood and red cells should be issued from the blood bank in a blood transport box or insulated carrier that will keep the temperature under 10°C if the ambient (room) temperature is greater than 25°C or there is a possibility that the blood will not be transfused within 30 minutes. Unless required for immediate transfusion, the packs should be stored in the ward or operating theatre blood refrigerator at a temperature between 2°C and 6°C.

**Red cells and whole blood should be infused within 30 minutes of removal from refrigeration.**

Red cells and whole blood that have been out of the correct storage conditions for more than 30 minutes should never be returned to the refrigerator for later use because of the potential for bacterial contamination and the loss of cell function.

### Platelet Concentrates

Platelet concentrates must be kept at a temperature of 20°C to 24°C on a platelet agitator to maintain platelet function. Since there is a risk of bacterial proliferation, the storage life is restricted to 3 or 5 days, depending on the type of blood bag used. Platelets that are held at lower temperatures lose their blood clotting capability. Platelet concentrates should be issued from the blood bank in a blood transport box or insulated carrier that will keep the temperature at about 20°C to 24°C. Platelet concentrates should be transfused as soon as possible. They should never be placed in a refrigerator.

### Fresh Frozen Plasma

Fresh frozen plasma (FFP) must be stored in the blood bank at a temperature of -25°C or colder until it is thawed before transfusion. As with whole blood or red cells, bacteria can proliferate in plasma that is held at ambient (room) temperature. Most of the clotting factors are stable at refrigerator temperatures, except for Factor V and Factor VIII. If plasma is not stored frozen at -25°C or colder, Factor VIII falls rapidly over 24 hours. Plasma with a reduced Factor VIII level is of no use for the

treatment of hemophilia, although it can be used in other clotting problems. Factor V declines more slowly. Fresh frozen plasma should be thawed in the blood bank in a waterbath between +30°C and +37°C and issued in a blood transport box in which the temperature is maintained between +2°C and +6°C. FFP should be infused within 30 minutes of thawing. If not required for immediate use, it should be stored in a refrigerator at a temperature of 2°C to 6°C and transfused within 24 hours.

### The Blood Refrigerator

Once issued by the blood bank, the transfusion of whole blood, red cells and thawed fresh frozen plasma should be commenced within 30 minutes of their removal from refrigeration. If the transfusion cannot be started within this period, they must be stored in a refrigerator at a temperature of 2°C to 6°C. The temperature inside every refrigerator used for blood storage in wards, operating rooms and other clinical areas should be monitored and recorded every four hours to ensure that the temperature remains within this range. *All blood refrigerators should be specifically designed for blood storage.* If the ward does not have a refrigerator that is appropriate for storing blood, the blood should not be released from the blood bank until immediately before transfusion.

- Once issued by the blood bank, the transfusion of whole blood, red cells and thawed fresh frozen plasma should be commenced within 30 minutes of their removal from refrigeration.
- Once out of correct storage conditions for more than 30 minutes these should never be returned to the refrigerator for later use because of the potential for bacterial contamination and the loss of cell function

## ADMINISTERING BLOOD PRODUCTS

### Checking the Blood Pack

Before administering the blood products the compatibility label attached to the blood pack is verified. The blood pack should always be inspected for signs of deterioration:

- Before it is issued from the blood bank
- On arrival in the ward or operating theatre
- Before transfusion, if it is not used immediately.

If time allows, mix the blood and let it settle until you can see the color of the plasma layer before checking for each of the following signs of deterioration.

1. Any sign of hemolysis in the plasma indicating that the blood has been contaminated, allowed to freeze or become too warm.
2. Any sign of hemolysis on the line between the red cells and plasma. If you suspect this, gently mix the unit and allow it to 'settle out' before being issued.
3. Any sign of contamination, such as a change of color in the red cells, which often look darker or purple/black when contaminated.
4. Any clots, which may mean that the blood was not mixed properly with the anticoagulant when it was collected.
5. Any signs that there is any damage or leak in the blood pack or that it has already been opened.

If any discrepancies are found or the pack appears abnormal in any way, the unit must not be transfused and the blood bank must be informed immediately.

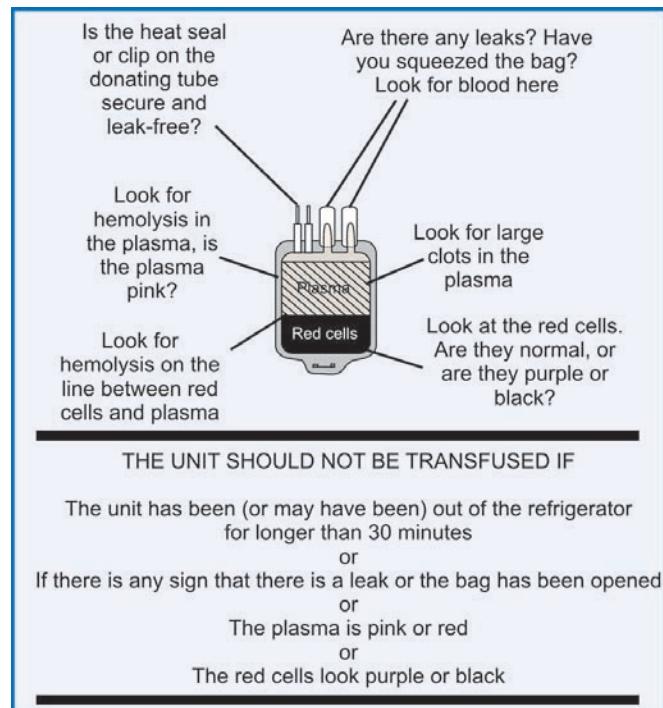
Discoloration or signs of any leakage may be the only warning that the blood contains bacterial contamination and could cause a severe or fatal reaction when transfused.

Figure 14.3 shows signs of deterioration in blood or plasma.

### Checking the Patient's Identity and the Blood Product Before Transfusion

Before starting the infusion, it is vital to make the final identity check in accordance with the hospital's standard procedure with regard to *Blood pack, Compatibility label and Patient's notes*. The final identity check should be undertaken at the patient's bedside immediately before commencing the administration of the blood component. It should be undertaken by two people, at least one of whom should be a registered nurse or doctor.

The final identity check at the patient's bedside is the last opportunity to detect an identification error and prevent a potentially incompatible transfusion, which may be fatal.



**FIGURE 14.3:** Signs of deterioration in blood or plasma

This is the last opportunity to detect an identification error and prevent a potentially incompatible transfusion, which may be fatal.

### Time Limits for Infusion

Table 14.2 shows the time limits of starting and completion of infusion.

**Table 14.2:** Starting and completing time limit of infusion

	<i>Start infusion</i>	<i>Complete infusion</i>
Whole blood/red cells	Within 30 minutes of removing pack from refrigerator	Within 4 hours (or less in high ambient temperature)
Platelet concentrates	Immediately	Within 20 minutes
Fresh frozen plasma	Within 30 minutes	Within 20 minutes

### Warming Blood

There is no evidence that warming blood is beneficial to the patient when infusion is slow. Cold blood can cause

spasm in the vein used for infusion. Dry warm towels applied locally may help, but take care not to burn the skin. Case reports suggest that, at infusion rates greater than 100 ml/ minute, cold blood could be a contributing factor in cardiac arrest. However, keeping the patient warm is probably more important than warming the infused blood.

Warmed blood is most commonly required in:

- Large volume rapid transfusions:
  - Adults: greater than 50 ml/kg/hour
  - Children: greater than 15 ml/kg/hour
- Exchange transfusion in infants
- Patients with clinically significant cold agglutinins.  
Blood should only be warmed in a blood warmer. Blood warmers should have a visible thermometer and an audible warning alarm and should be properly maintained. Older types of blood warmer may slow the infusion rate of fluids. Blood should never be warmed in a bowl of hot water as this could lead to the hemolysis of the red cells and liberation of K<sup>+</sup> which could be life threatening.

### Pharmaceuticals and Blood Products

No medicines and no infusion solutions other than normal saline (sodium chloride 0.9%) should be added to any blood component. These may contain additives such as calcium which can cause citrated blood to clot. Dextrose solution (5%) can lyse red cells. If there is an adverse reaction during the transfusion, it may be impossible to determine whether this is due to the blood, to the added drug or to an interaction of the two. If an intravenous fluid other than normal saline, or a colloid solution, has to be given at the same time as blood components, it should preferably be given through a separate IV line to avoid any risk of these problems.

No medicines and no infusion solutions other than normal saline (sodium chloride 0.9%) should be added to any blood component.

### Recording the Transfusion

The following information should be recorded in the patient's notes.

1. Whether the patient and/or relatives have been informed about the proposed transfusion.
2. The reason for transfusion.
3. Signature of the prescribing clinician.
4. Pre-transfusion checks of:
  - Patient's identity
  - Blood pack
  - Compatibility label
  - Signature of the person performing the pre-transfusion check.
5. The transfusion:
  - Type and volume of each component transfused
  - Unique donation number of each unit transfused
  - Blood group of each unit transfused
  - Time at which the transfusion commenced
  - Signature of the person administering the blood component.
6. Any transfusion reactions.

### Rate of Infusion

The rate of infusion is begun generally at 2 to 3 ml. per minute and increased as follows:

1. For an elective transfusion into a normal circulatory system, infuse 8 to 10 ml per minute with 60 to 80 minutes per transfusion.
2. In the embarrassed cardiovascular system, especially in the elderly, infuse at 4 to 5 milliliter per minute, 130 minutes per transfusion.
3. In acute hypovolemia, infuse at maximum possible rates until systolic blood pressure of 100 mm Hg is attained.

### Monitoring the Transfused Patient

Ensuring the patient's safety is the most important aspect of caring for a patient during transfusion. It is essential to take baseline observations and to ensure that the patient is being monitored during and after the transfusion in order to detect any adverse event as early as possible. This will ensure that potentially life-saving action can be taken quickly and efficiently. *Adverse reactions can occur with all blood components so it is equally important to monitor patients receiving FFP, cryoprecipitate or platelet concentrates as those receiving whole blood or red cells.*

Severe reactions most commonly present during the first 15 minutes of a transfusion. It is therefore very important that all patients and, in particular, unconscious patients should be monitored during this period and for the first 15 minutes of each subsequent unit.

Before commencing the transfusion, it is essential to:

- Explain the procedure to the patient and check for understanding of the explanation
- Encourage the patient to notify a nurse or doctor immediately if he or she becomes aware of any reactions such as shivering, flushing, pain or shortness of breath or begins to feel anxious.
- Ensure that the patient is in a setting where he or she can be directly observed.

If the patient appears to be experiencing an adverse reaction, stop the transfusion and seek urgent medical assistance. Record vital signs regularly until the medical officer has assessed the patient.

*The transfusion of each unit of the blood or blood component should be completed within four hours of the pack being punctured.* If a unit is not completed within four hours, discontinue its use and dispose of the remainder through the clinical waste system. In the case of a suspected transfusion reaction, do not discard the blood pack and blood administration set, but return them to the blood bank for investigation.

Change the blood administration set after 12 hours if the patient requires ongoing transfusion support.

The following is the summary of the observations that should be made and recorded before, during and after the transfusion of *each unit of blood*:

1. For each unit of blood transfused, monitor the patient at the following stages:
  - Before starting the transfusion
  - As soon as the transfusion is started
  - 15 minutes after starting transfusion
  - At least every hour during transfusion
  - On completion of the transfusion
  - 4 hours after completing the transfusion.
2. At each of these stages, record the following information on the patient's chart:
  - Patient's general appearance
  - Temperature
  - Pulse

- Blood pressure
- Respiratory rate
- Fluid balance:
- Oral and IV fluid intake
- Urinary output.

### 3. Record:

- Time the transfusion is started
- Time the transfusion is completed
- Volume and type of all products transfused
- Unique donation numbers of all products transfused
- Any adverse effects.

*Monitor the patient particularly carefully during the first 15 minutes of the transfusion to detect early signs and symptoms of adverse effects.*

## **ADVERSE EFFECTS OF TRANSFUSION**

Blood transfusion can be associated with various adverse effects. Some of these reactions are acute and arise during or shortly after the transfusion, but the clinical effects of others are delayed, sometimes by months or years. The safety of blood and blood products varies widely in different areas of the world. However, even with the highest standards of donor selection, blood collection, screening, processing and storage, there remains a risk of transfusion-transmitted infection and other adverse effects. Consequently, the decision to transfuse must be based on a careful assessment of the risks and benefits to the patient, and with the knowledge and skills to recognize and treat any adverse reactions or complications that may arise (Table 14.3).

### **Initial Management and Investigation**

When an acute reaction first occurs, it may be difficult to decide on its type and severity as the signs and symptoms may not initially be specific or diagnostic. However, with the exception of allergic urticarial and febrile nonhemolytic reactions, all are potentially fatal and require urgent treatment.

In an unconscious or anesthetized patient, hypotension and uncontrolled bleeding may be the only signs of an incompatible transfusion. In a conscious patient undergoing a severe hemolytic transfusion reaction, signs and symptoms may appear within minutes of infusing only 5–10 ml of blood. Close observation at the start of the infusion of each unit is essential.

**Table 14.3:** Categories of adverse reactions of transfusion**Category 1: Mild reactions**

- Mild hypersensitivity: allergic, urticarial reactions

**Category 2: Moderately severe reactions**

- Moderate–severe hypersensitivity (severe urticarial reactions)
- Febrile non-hemolytic reactions:
- Antibodies to white cells, platelets
- Antibodies to proteins, including IgA
- Possible bacterial contamination (early signs)
- Pyrogens

**Category 3: Life-threatening reactions**

- Acute intravascular hemolysis
- Bacterial contamination and septic shock
- Fluid overload
- Anaphylactic reactions
- Transfusion-associated lung injury

**Delayed complications of transfusion**

Delayed complications of transfusion essentially fall into two categories.

**A. Transfusion-transmitted infections**

- HIV-1 and HIV-2
- HTLV-I and II
- Viral hepatitis B and C
- Syphilis
- Chagas disease
- Malaria
- Cytomegalovirus
- Other rare infections: e.g. human parvovirus B19 and hepatitis A

**B. Other delayed complications of transfusion**

Other delayed complications of transfusion which occur days, months or even years after the transfusion has been completed, include:

- Delayed hemolytic reaction
- Post-transfusion purpura
- Graft-vs-host disease
- Iron overload (in patients who receive repeated transfusions)

If an acute transfusion reaction occurs, first check the blood pack labels and the patient's identity. If there is any discrepancy, stop the transfusion immediately and consult the blood bank.

Table 14.4 shows the guidelines for the recognition of acute transfusion reactions.

**Immediate Management****CATEGORY 1: MILD**

- Slow the transfusion.
- Administer antihistamine IM (e.g. chlorpheniramine 0.1 mg/kg or equivalent).
- If no clinical improvement within 30 minutes or if signs and symptoms worsen, treat as Category 2.

**CATEGORY 2: MODERATELY SEVERE**

- Stop the transfusion. Replace the infusion set and keep IV line open with normal saline.
- Notify the doctor responsible for the patient and the blood bank immediately.
- Send blood unit with infusion set, freshly collected urine and new blood samples (1 clotted and 1 anticoagulated) from vein opposite infusion site with appropriate request form to blood bank and laboratory for investigations.
- Administer antihistamine IM (e.g. chlorpheniramine 0.1 mg/kg or equivalent) and oral or rectal antipyretic (e.g. paracetamol 10 mg/kg: 500 mg—1 g in adults). Avoid aspirin in thrombocytopenic patients.
- Give IV corticosteroids and bronchodilators if there are anaphylactoid features (e.g. bronchospasm, stridor).
- Collect urine for next 24 hours for evidence of hemolysis and send to laboratory.
- If clinical improvement occurs restart transfusion slowly with new blood unit and observe carefully.
- If no clinical improvement within 15 minutes or if signs and symptoms worsen, treat as Category 3.

**CATEGORY 3: LIFE-THREATENING**

- Stop the transfusion. Replace the infusion set and keep IV line open with normal saline.
- Infuse normal saline (initially 20–30 ml/kg) to maintain systolic BP. If hypotensive, give over 5 minutes and elevate patient's legs.
- Maintain airway and give high flow oxygen by mask.
- Give adrenaline (as 1:1000 solution) 0.01 mg/kg body weight by slow intramuscular injection.
- Give IV corticosteroids and bronchodilators if there are anaphylactoid features (e.g. bronchospasm, stridor).

**Table 14.4:** Guidelines for the recognition of acute transfusion reactions

Category	Signs	Symptoms	Possible cause
Category 1 Mild	Localised cutaneous reactions: • Urticaria • Rash	Pruritis (itching)	Hypersensitivity (mild)
Category 2 Moderately Severe	• Flushing • Urticaria • Rigor • Fever • Restlessness • Tachycardia	• Anxiety • Pruritus • Palpitations • Mild dyspnea • Headache	• Hypersensitivity (moderate–severe) • Febrile non-hemolytic transfusion reactions: – Antibodies to white blood cells, platelets – Antibodies to proteins, including IgA • Possible contamination with pyrogens and/or bacteria
Category 3 Life threatening	• Rigor • Fever • Restlessness • Hypotension (fall of > 20% in systolic BP) • Tachycardia (rise of >20% in heart rate) • Hemoglobinuria (red urine) • Unexplained bleeding (DIC)	• Anxiety • Chest pain • Pain near infusion site • Respiratory distress/shortness of breath • Loin/back pain • Headache • Dyspnea	• Acute intravascular hemolysis • Bacterial contamination and septic shock • Fluid overload • Anaphylaxis • Transfusion-associated lung injury

6. Give diuretic: e.g. frusemide 1 mg/kg IV or equivalent
  7. Notify the doctor responsible for the patient and the blood bank immediately.
  8. Send blood unit with infusion set, fresh urine sample and new blood samples (1 clotted and 1 anticoagulated) from vein opposite infusion site with appropriate request form to blood bank and laboratory for investigations.
  9. Check a fresh urine specimen visually for signs of hemoglobinuria (red or pink urine).
  10. Start a 24-hour urine collection and fluid balance chart and record all intake and output. Maintain fluid balance.
  11. Assess for bleeding from puncture sites or wounds. If there is clinical or laboratory evidence of DIC give platelets (adult: 5 to 6 units) and either cryoprecipitate (adult: 12 units) or fresh frozen plasma (adult: 3 units). Use virally-inactivated plasma coagulation products, wherever possible.
  12. Reassess. If hypotensive:  
• Give further saline 20–30 ml/kg over 5 minutes  
• Give inotrope, if available.
  13. If urine output falling or laboratory evidence of acute renal failure (rising K<sup>+</sup>, urea, creatinine):  
• Maintain fluid balance accurately  
• Give further frusemide  
• Consider dopamine infusion, if available  
• Seek expert help: the patient may need renal dialysis.
  14. If bacteremia is suspected (rigors, fever, collapse, no evidence of a hemolytic reaction), start broad-spectrum antibiotics IV, to cover pseudomonas and gram positives.
- Table 14.5 gives information about the drugs that may be required in the management of acute transfusion reaction.
- #### Investigating Transfusion Reactions
- Immediately report all acute transfusion reactions, with the exception of mild hypersensitivity (Category 1), to

**Table 14.5:** Drugs that may be required in the management of acute transfusion reaction

Drug	Relevant effects	Examples		Notes
		Name	Route and Dosage	
I/V replacement fluid	Expand blood volume	Normal saline	If the patient is hypotensive, 20-30 ml/kg over 5 minutes	Avoid colloid solutions
Antipyretic	Reduce fever and inflammatory response	Paracetamol	Oral or rectal 10 mg/kg	Avoid aspirin containing products if the patient has low platelet count
Antihistamine	Inhibits histamine mediated responses	Chlorpheniramine	Intramuscular	
Bronchodilator	Inhibits immune mediated bronchospasm	Adrenalin	0.01 mg/kg (as 1:1000 solution) by slow IM Inj.	Dose may be repeated every 10 minutes according to B.P. and pulse until improvement occurs
		Consider salbutamol	By nebuliser	
Ionotrope	Increases myocardial contractility	Aminophylline Dopamine	5 mg/kg IV infusion, 1 micro gm /kg/ minute	Dopamine in low doses induces vasodilation and improves renal perfusion
		Dobutamine	IV infusion 1-10 micro gm /kg/minute	Doses above 5 micro gm /kg /minute causes vasoconstriction and worsen heart failure
Diuretic	Inhibits fluid reabsorption from ascending loop of Henle	Furosemide	Slow IV injection 1mg/kg	

the doctor responsible for the patient and to the blood bank that supplied the blood. Take the following samples and send them to the blood bank for laboratory investigations:

1. Immediate post-transfusion blood samples (1 clotted and 1 anticoagulated: EDTA/Sequestrene) from the vein opposite the infusion site for:
  - Full blood count
  - Coagulation screen
  - Direct antiglobulin test
  - Urea
  - Creatinine
  - Electrolytes
2. Blood culture in a special blood culture bottle

3. Blood unit and giving-set containing red cell and plasma residues from the transfused donor blood
4. First specimen of the patient's urine following the reaction.

*Complete a transfusion reaction report form.*

1. After the initial investigation of the reaction, send the following to the blood bank for laboratory investigations:
  - Blood samples (1 clotted and 1 anticoagulated: EDTA/Sequestrene) taken from the vein opposite the infusion site 12 hours and 24 hours after the start of the reaction
  - Patient's 24-hour urine sample.

- Record the results of the investigations in the patient's records for future follow-up, if required.

### *Acute Intravascular Hemolysis*

Acute intravascular hemolytic reactions are caused by infusing incompatible red cells. Antibodies in the patient's plasma hemolyse the incompatible transfused red cells. Even a small volume (5-10 ml) of incompatible blood can cause a severe reaction and larger volumes increase the risk. For this reason, it is essential to monitor the patient at the start of the transfusion of each unit of blood. The most common cause of an acute intravascular hemolytic reaction is an ABO incompatible transfusion. The antibodies concerned are either IgM or IgG directed against the A or B antigens on the transfused red cells, causing acute intravascular hemolysis. The infusion of ABO-incompatible blood almost always arises from:

- Errors in the blood request form
- Taking blood from the wrong patient into a pre-labelled sample tube
- Incorrect labelling of the sample tube sent to the blood bank
- Inadequate checks of the blood against the identity of the patient before starting a transfusion.

Antibodies in the patient's plasma against other blood group antigens of the transfused blood, such as Kidd, Kell or Duffy systems, can also cause acute intravascular hemolysis.

### *Signs*

- Fever
- Rigor
- Tachycardia, hypotension
- Breathlessness
- Hemoglobinuria, oliguria
- Signs of an increased bleeding tendency due to disseminated intravascular coagulation (DIC)

In the conscious patient undergoing a severe hemolytic reaction, signs and symptoms usually appear within minutes of commencing the transfusion, sometimes when less than 10 ml have been given. In an unconscious or anesthetized patient, hypotension and uncontrollable bleeding due to DIC may be the only signs of an incompatible transfusion.

### *Symptoms:*

- Pain or heat in limb where infusion cannula is sited
- Apprehension
- Loin or back pain.

### *Management*

- Stop the transfusion, replace the giving set and keep the IV line open with normal saline.
- Maintain the airway and give high concentrations of oxygen.
- Support the circulation:
  - Give intravenous replacement fluids to maintain blood volume and blood pressure
  - Inotropic support of the circulation may be required: e.g. dopamine, dobutamine or adrenaline 1:1000 by intramuscular injection, 0.01 ml/kg body weight.
- Prevent renal failure by inducing a diuresis:
  - Maintain blood volume and blood pressure
  - Give a diuretic, such as frusemide 1 to 2 mg/kg
  - Give a dopamine infusion at 1 microgram/kg/minute.
- If DIC occurs:
  - Give blood components, as guided by clinical state and coagulation tests
  - Regularly monitor the coagulation status of the patient.
- Investigations:
  - Recheck the labelling of the blood unit against the patient
  - Send patient blood sample for:
    - Full blood count
    - Coagulation screen
    - Direct antiglobulin test
    - Urea
    - Creatinine
    - Electrolytes

*The direct antiglobulin test will be positive and serum bilirubin raised:*

- Examine the patient's urine sample and send to the laboratory for testing for hemoglobinuria
- Return the blood unit and infusion set for checking of group and compatibility testing

- Repeat electrolytes and coagulation screening 12-hourly until the patient is stable.

#### *Bacterial Contamination and Septic Shock*

It is estimated that bacterial contamination affects up to 0.4 per cent of red cells and 1-2 per cent of platelet concentrates.

*Blood may become contaminated by:*

- Bacteria from the donor's skin during blood collection (usually skin staphylococci)
- Bacteremia present in the blood of a donor at the time the blood is collected (e.g. Yersinia)
- Errors or poor handling in blood processing
- Manufacturing defects or damage to the plastic blood pack
- Thawing frozen plasma or cryoprecipitate in a waterbath (often contaminated).

Some contaminants, particularly *Pseudomonas* species, grow at 2°C to 6°C and so can survive or multiply in refrigerated red cell units. Rapid growth in contaminants can occur when the unit is allowed to warm. The risk therefore increases with the time out of refrigeration. Staphylococci grow in warmer conditions and proliferate in platelet concentrates at 20°C to 24°C, limiting their storage life.

Signs usually appear rapidly after starting infusion, but may be delayed for a few hours. A severe reaction may be characterized by sudden onset of high fever, rigors and hypotension. Urgent supportive care and high-dose intravenous antibiotics are required.

#### *Fluid Overload*

When too much fluid is transfused, the transfusion is too rapid or renal function is impaired, fluid overload can occur resulting in heart failure and pulmonary edema. This is particularly likely to happen in patients with chronic severe anemia, and also in patients with underlying cardiovascular disease, for example ischemic heart disease.

#### *Anaphylactic Reactions*

Anaphylactic-type reactions are a rare complication of transfusion of blood components or plasma derivatives. The risk of anaphylaxis is increased by rapid infusion, typically when fresh frozen plasma is used as an exchange

fluid in therapeutic plasma exchange. Cytokines in the plasma may be one cause of bronchoconstriction and vasoconstriction in occasional recipients. A rare cause of very severe anaphylaxis is IgA deficiency in the recipient. This can be caused by any blood product since most contain traces of IgA. Anaphylaxis occurs within minutes of starting the transfusion and is characterized by cardiovascular collapse and respiratory distress, without fever. It is likely to be fatal if it is not managed rapidly and aggressively.

#### *Transfusion-associated Acute Lung Injury*

Transfusion-associated acute lung injury (TRALI) is usually caused by donor plasma that contains antibodies against the patient's leucocytes. Donors are almost always multiparous women. In a clear-cut case of TRALI, which usually presents within 1 to 4 hours of starting transfusion, there is rapid failure of pulmonary function with diffuse opacity on the chest X-ray. There is no specific therapy. Intensive respiratory and general support in an intensive care unit is required.

#### *Delayed Complications of Transfusion: Transfusion-transmitted Infections*

Blood donors may carry infectious agents in their blood, sometimes over prolonged periods and without necessarily demonstrating any clinical symptoms or signs of disease. The following infections may be transmitted by transfusion:

- HIV-1 and HIV-2
- HTLV-I and HTLV-II
- Hepatitis B and C
- Syphilis (*Treponema pallidum*)
- Chagas disease (*Trypanosoma cruzi*)
- Malaria
- Cytomegalovirus (CMV).

#### *Screening for Transfusion-transmissible Infections*

Because of the risk of transfusion-transmitted infection, blood should be collected only from donors who have been selected in accordance with national screening criteria. Every unit of blood should be screened for:

- HIV-1 and HIV-2 (anti-HIV-1, anti-HIV-2) antibody
- Hepatitis B (HBsAg) surface antigen
- *Treponema pallidum* antibody (syphilis).

No blood or blood product should be released for transfusion until these and all other nationally required tests are shown to be negative. Screening for other infectious agents should comply with national policies that should reflect the prevalence of the infection in the potential blood donor population. Where possible, these should include screening for:

- Hepatitis C
- Chagas disease, in countries where the seroprevalence is significant
- Malaria, in low-prevalence countries. This only applies to donors who have traveled to malarial areas. Malaria screening tests are being evaluated but are not yet sufficiently specific for use in the routine screening of blood donations.

#### *Other Delayed Complications of Transfusion*

Apart from transfusion-transmitted infections, other delayed transfusion complications may not present immediately but only become apparent days or sometimes months after transfusion. These include (Table 14.6):

- Delayed hemolytic transfusion reaction
- Post-transfusion purpura
- Graft-versus-host disease (GvHD)

- Iron overload
- Immunosuppression.

#### *Massive or Large Volume Blood Transfusions*

The term 'massive transfusion' can be defined as the replacement of blood loss equivalent to or greater than the patient's total blood volume with stored blood in less than 24 hours (70 ml/kg in adults, 80-90 ml/kg in children or infants). Massive (or large volume) transfusions generally arise as a result of acute hemorrhage in obstetric, surgical and trauma patients.

The initial management of major hemorrhage and hypovolemia is to restore the blood volume as rapidly as possible in order to maintain tissue perfusion and oxygenation. This requires infusing the patient with large volumes of replacement fluids and blood until control of the hemorrhage can be achieved. Morbidity and mortality tend to be high among such patients, not because of the large volumes infused but, in many cases, because of the initial trauma and the tissue and organ damage secondary to hemorrhage and hypovolemia.

It is often the underlying cause and consequences of major hemorrhage that result in complications rather than the transfusion itself. However, the administration of large volumes of blood and intravenous fluids may itself give rise to a number of problems. Complications of massive or large volume transfusion are:

**Table 14.6:** Details about delayed complications of transfusion

Complication	Presentation	Treatment
Delayed hemolytic reactions	5–10 days post transfusion: • Fever • Anemia • Jaundice	• Usually no treatment • If hypotension and oliguria, treat as acute intravascular hemolysis
Post-transfusion purpura	5–10 days post transfusion: • Increased bleeding tendency • Thrombocytopenia	• High dose steroids • High dose intravenous immunoglobulin • Plasma exchange
Graft-vs-host disease	• 10–12 days post transfusion: • Fever • Skin rash and desquamation • Diarrhoea • Hepatitis • Pancytopenia	• Supportive care • No specific treatment
Iron overload	Cardiac and liver failure in transfusion-dependent patients	• Prevent with ironbinding agents: eg.desferrioxamine

- Acidosis
- Hyperkalemia
- Citrate toxicity and hypocalcemia
- Depletion of fibrinogen and coagulation factors
- Depletion of platelets
- Disseminated intravascular coagulation (DIC)
- Hypothermia

- Reduced 2,3 diphosphoglycerate (2,3 DPG)
- Microaggregates

**SUGGESTED READING**

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1. The Clinical use of blood in medicine, obstetrics, paediatrics, surgery, anaesthesia, trauma and burns, World Health Organization (Geneva) Guidelines on Blood Transfusion Safety.

# 15

## Surgical Site Infection

**R Dayananda Babu**

Wound infection is a term that has caused a lot of confusion among surgeons worldwide. As a result of this confusion there has been a lot of disparity in the collection and comparison of data regarding wound infection in postoperative patients. To tide over this problem the Centre for Disease Control (CDC), came up with certain definitions and protocols (1992) that could be used world over.

### **CDC DEFINITION**

As per the CDC classification there are three types of Surgical Site Infection (SSI)

1. Superficial Incisional SSI.
2. Deep Incisional SSI.
3. Organ/Space SSI.

### **Superficial Surgical Site Infection**

To call an infection a superficial SSI it should meet the following criteria:

- Infection should occur within 30 days of the surgery
- Infection should involve the skin and subcutaneous tissue
- Incision must meet one of the following criteria
  1. Purulent drainage from the superficial incision
  2. Organism isolated from an aseptically obtained culture of fluid or tissue
- Incision must show at least one of the following signs or symptoms
  1. Pain or tenderness

2. Localized tenderness
3. Redness or heat
4. Superficial incision is deliberately opened by a surgeon unless the incision is culture negative or diagnosis of superficial incisional surgical site infection is made by the surgeon

The earliest sign of such an infection is induration accompanied by erythema and increasing pain.

Immediate therapy consists of opening the wound and evacuating the pus.

**Antibiotics are not usually required.**

### **Deep Incisional Surgical Site Infection**

Involves fascia and muscles. Associated with infection in one of the body cavities, bone or joint. Drainage, control of any source of continuing infection and antibiotic therapy are indicated.

### **Organ-Space Surgical Site Infection**

These infections usually occur in the organ that was operated upon. Postoperative peritonitis is one such infection. These are very difficult problems to manage and have got a very high mortality. In most of the cases one need an operative intervention.

### **ANTIBIOTIC PROPHYLAXIS**

A surgical incision exposes sterile tissues to non sterile environment. So invariably some contamination occurs

during all surgeries. This contamination flares up and goes on to become a frank infection depending on the several host and bacteriological factors. The rationale of giving antibiotic prophylactically is to attain a tissue concentration of the antimicrobial which will prevent the colonization of the wound by the microbes. The scientific basis of prophylactic antibiotics were laid down by Miles and Burke in 1950.

### Principles of Antibiotic Prophylaxis

1. Use an antibiotic with efficacy against the bacteria likely to contaminate the wound.
2. Use full dose of the chosen antibiotic.
3. Administer the antibiotic preoperatively at a time such that effective tissue concentration will be achieved when intraoperative contamination occurs.
4. If operation is prolonged for more than 3 hours give another dose.
5. Employ antibiotic prophylaxis whenever the risk of wound infection is increased.

#### *Single Dose versus Multiple Dose*

Several prospective randomized control trials have proved over and again that single dose antibiotic is superior to multiple dose antibiotics. If the cost factor and antibiotic resistance factor is also taken into consideration, it can be said without doubt that the order of the day is **Single Dose Antibiotic Prophylaxis**.

## THE RISK OF WOUND INFECTION

There are three major factors that determine the risk of infection in a surgical wound. They are:

- Class of the wound
- Host defense-as depicted by the ASA score
- Duration of the surgery (Table 15.1).

### Classification of Wounds

- Clean
- Clean contaminated
- Contaminated
- Dirty
- Any patient exhibiting one or more of these risk factor is given prophylactic antibiotics

**Table 15.1:** Critical values for duration of operations

Hours	Typical operations
1	Appendectomy, cesarean, amputations
2	Hernia, cholecystectomy, mastectomy
3	GI surgeries
4	Hepatobiliary surgeries
5	Cardiac surgeries
7	Transplant surgeries

- Any patient in whom a prosthesis is to be inserted should be given antibiotic prophylaxis

#### *Clean Operations*

The CDC guidelines does not recommend antibiotic for clean operations unless a prosthetic is being inserted or the immune system of the patient is altered. But if the objectively assessed risk of SSI in a particular institute for clean operations is more than 4 percent antibiotic prophylaxis is to be used.

#### *Prophylactic use of Antibiotics in Oral Surgery*

For antibiotic prophylaxis in medically compromised patient, see chapter 4 on management of medically compromised patients. Indiscriminate use of prophylactic antibiotics for surgical procedures in healthy patients has favored the survival and increase of drug-resistant bacteria and should therefore be avoided. Minor oral surgery has a low infection rate in healthy individuals and studies have found no convincing evidence of any benefit from prophylactic antibiotics except where there is overt infection preoperatively. Prophylactic use of antibiotics should therefore comply with the following important principles:

1. The surgical procedure should harbour a significant risk for infection, for example:
  - Long procedure ( $> 30$  minutes) or difficult surgery involving significant tissue trauma.
  - Where there is existing infection in and around the surgical site.
2. Administration of the antibiotic must be immediately prior to or within 3 hours after the start of surgery:
  - The ability of systemic antibiotics to prevent the development of a primary bacterial lesion is

- confined to the first 3 hours after inoculation of the wound.
- Commencing prophylactic antibiotic cover the day before surgery only leads to the development of resistant organisms.
  - Continuing antibiotics for days after surgery has not been shown to decrease the incidence of wound infection.
3. Prophylactic antibiotics should be given at twice the usual dose over the shortest effective time so as to minimize the potential side-effects of long term use (e.g. diarrhoea) and prevent the growth of resistant strains of bacteria.
4. There are many antibiotic prophylactic regimens currently used. The following are just a few that may be considered.
- Amoxycillin 3 gm orally, 45 minutes before surgery under local anaesthesia.
  - Clindamycin 600 mg. orally, 30 minutes before surgery under local anaesthesia for patients allergic to penicillin.
  - Benzyl Penicillin 600 mg. IV/IM on induction for procedures under general anaesthesia.
  - Erythromycin lactobionate 500 mg. IV on induction for surgery under general anaesthesia for patients allergic to penicillin
- The above dose may be followed with an additional oral dose 6 hours after the initial dose.

# 16

## Prevention and Management of Oral Problems of Cancer Therapy

**K George Varghese**

Increased public awareness and advances in cancer therapy have resulted in earlier detection and subsequently , greater survival rates. In the past , the expectation of an average cancer patient was extension of life – life free from disease. They were not much bothered about the morbidity of the treatment. But now the situation has changed. There has been a concomitant increase in the demands and expectations of the cancer patients. The patients are now more concerned about the quality of life after radiotherapy (RT) and chemotherapy (CT). To site an example is the successful use of osseointegrated implants and implant supported prosthesis in patients who have undergone RT in western countries. Even though our patients may not be that much demanding, the dental surgeon will be called upon to address the oral problems related to cancer therapy.

Most patients with head and neck carcinomas/ tumor are treated with curative dose of 50 to 70 Gy. This dose is usually given over five to seven week period, once a day, five days a week, 2 Gy per fraction. The total dose for pre-operative RT or RT for malignant lymphoma is usually lower. Unlike other parts of body, head and neck region is unique and complex area composed of several dissimilar structures that respond differently to radiation: mucosal lining, skin, subcutaneous tissue, salivary gland, teeth, bone and cartilage. In addition to the beneficial anti-tumor effects, ionizing irradiation causes damage to normal tissues located in the field of radiation. These radiation induced changes in healthy oral tissues results

in oral problems of RT. Similarly, patient's receiving CT also develops a number of complications. This chapter is intended to highlight the importance of a coordinated team approach of the head and neck cancer care team, the general dental practitioner and the patient in the prevention of oral problems by promoting consistent high standards of oral care.

The undesirable side effects of RT and CT affect the patient in the following manner:-

1. Affect the quality of life
2. Affect the ability to tolerate therapy
3. Oral complications contribute to systemic infection

### **Incidence of Oral Complication**

- Virtually all patients treated for head and neck tumors develop local problems. (RT of head and neck tumors has direct, immediate, and late effects and complications.)
- Approx. 40 percent of patients being treated for other cancers with CT develop mouth problems. A study conducted in US shows that out of 7, 85, 000 patients receiving CT 2, 50,000 cases of oral problems have been reported.
- Studies conducted in UK have shown that up to 90 percent of pediatric oncology patients may suffer from oral complications with implications both for longevity and quality of life during and after therapy.

Frequently in the past, oral complications were considered inevitable, often recognized late and were

treated retrospectively rather than in a prospective or preventive manner. Fortunately, a more scientifically based approach to the analysis of oral complications has produced much information relative to prospective determination of risk, intervention technique, pathophysiology of hard and soft tissue changes and appropriate therapy that can be instituted.

The prevention of oral complication is achieved in various levels or steps. The first step is the pretreatment assessment.

### **PRETREATMENT ASSESSMENT**

Many of the oral problems associated with cancer therapy can be prevented or minimized if intervention occurs before the onset of treatment with drugs or radiation. Thus a protocol which includes pretreatment assessment is recommended.

Objectives of pretreatment assessment:-

- A. Identification and elimination of—
  - 1. Asymptomatic oral infection
  - 2. Potential oral infection
  - 3. Sources and sites of chronic irritation
- B. Pre surgical assessment for prosthetic rehabilitation and
- C. Initiation of regimens for prevention of radiation caries.

### **How Effective is the Pretreatment Screening?**

A study conducted by Woods et al (1989) showed that 72 per cent of patients screened prior to bone marrow transplantation revealed positive findings of latent infection of oral cavity, irritating prosthesis or restoration. Studies by Sonis and colleagues (1987) have further demonstrated that pre CT intervention had a significant favorable impact on morbidity especially related to local infection and sepsis.

### **When to do Pretreatment Assessment?**

Patients for RT—3 weeks should be allowed between the time of dental intervention esp. extraction and start of RT.

Patients for CT—sufficient time between dental treatment and the patient's anticipated granulocyte nadir ( $< 500/\text{mm}^3$ ) period is required.

The above protocol is not applicable in all the cases. Because of the acute onset of some of the hematologic neoplasms and the need for immediate therapy, optimal timing for oral screening and intervention may not be feasible. If the radiation oncologist considers the tumor growth to be such that any further delay will adversely affect the outcome, then pre irradiation extraction will not be possible. All parties involved in the management of the patient must accept the risks associated with this compromise since control of tumor is obviously the most important consideration. Nevertheless, an oral assessment should be made as this evaluation will provide a baseline data. More importantly, the presence of active oral infections might necessitate intervention despite the patient's myelosuppressed status.

The ideal components of a Pretreatment assessment are:

1. Medical and Dental history
2. Laboratory data such as A/B status relative to Herpes Simplex Type I virus (HSV)
3. Examination of head and neck
4. Intra oral soft tissue examination
5. Periodontal screening
6. Dental evaluation
7. Radiographs for the diagnosis of dental caries, periapical pathology

### **Pre Irradiation Dental Treatment**

Literature regarding management of dental disease in RT patient has been filled with disagreement. However, the following issues should be taken into consideration while planning dental treatment to prevent radiation complication.

1. Condition of Dentition: - Placing the patient in optimal dental health is important to prevent high risk procedures in the post irradiation period. All teeth with a questionable prognosis should be removed. Teeth with advanced carious lesions, periapical infection, and significant periodontal disease should be carefully evaluated. The patient's periodontal status is probably the important consideration; in particular molar teeth with furcation involvement in the radiation field should be removed. Mandibular teeth are more commonly indicated for removal than maxillary teeth.

Removal of asymptomatic, complete bony impacted teeth with no associated pathological features is not advised. These procedures create large defects requiring prolonged time for healing. Partially impacted third molars with associated periodontal defects, pericoronal inflammation or difficult access for hygiene should be carefully considered for removal before radiation.

Large tori or exostosis (Fig. 16.1 and Fig. 16.2), sharp or extremely irregular ridges, inflamed hypertrophic soft tissues in the radiation field in the edentulous and dentulous patient should be considered for removal. Because, these areas can become traumatized and denuded and the thin covering mucosa can atrophy, ulcerate and expose the underlying bone.



**FIGURE 16.1:** Bilateral mandibular torus



**FIGURE 16.2:** Mandibular exostosis

### Guidelines for Pre-irradiation Surgery

- When teeth are removed radical alveolectomy should be performed and primary closure obtained. Residual alveolar ridges should be smooth as possible. Sharp mylohyoid ridges and exostosis should be removed. Atraumatic surgical technique with meticulous care of soft tissue flaps should be exercised so as not to impair the healing process.
- Consideration should be given to the removal of groups of teeth in the radiation field because it is easier to properly contour the alveolar bone and provide a tension-free closure of soft tissue flaps.
- It has been suggested that three weeks (21 days) is required for healing that is sufficient enough to minimize the risk of osteoradionecrosis. But the final decision regarding this should be arrived after discussion with the radiation oncologist and the patient, weighing the risks and benefits involved.

### Motivation of the Patient and Oral Hygiene Instruction

Without the patient's co-operation and willingness to maintain good oral hygiene, the risk of complication is increased. The less motivated the patient with poor oral hygiene is, the more aggressive one should be in the removal of teeth before radiation therapy. For others pretreatment counseling regarding the implication and sequelae of RT and the need for frequent and continuous maintenance of dentition is important. The four basic elements of oral hygiene instruction are assessment, brushing, rinsing and flossing. Teaching and reinforcing these oral hygiene practices is important prior to, during and after therapy. Table 16.1 shows the protocol for dental management before, during and after RT.

### Effects of Radiotherapy

The oral tissues affected directly by radiation include the epithelium, salivary glands, bone and muscle. The teeth may be secondarily affected as a consequence of radiation induced xerostomia.

### Radiation injury

- Direct**—Damages susceptible cells causing loss of tissue function (eg. salivary glands, mucosa, skin, and taste buds).

**Table 16.1:** Showing protocol for dental management before, during and after RT

<i>Pre- irradiation phase</i>	<i>Irradiation phase (6-7 wks)</i>	<i>Post-irradiation phase(life long)</i>	
Pre-treatment assessment	<b>1. Mucositis prevention</b>		
1. A. Extraction B. Removal of foci	A. Oral rinses/spraying B. Selective elimination of oral flora C. Discourage denture wearing D. Pain relief		
2. Oral prophylaxis	<b>2. Relief of oral dryness</b>		
3. Restorative procedures	A. Oral rinses B. Saliva substitutes	A. Oral rinses	C. Sialogogues
4. Initiation of preventive programme		B. Saliva substitutes	D. Mucin lozenges
	<b>3. Prevention of caries and periodontal disease</b>		
	A. Oral hygiene B. Topical fluoride	A. Oral hygiene B. Topical fluoride	
	<b>4. Trismus prevention</b>		
	A. Monitoring mouth opening B. Exercises C. Physiotherapy	A. Monitoring mouth opening B. Exercises C. Physiotherapy	
	<b>5. Nutritional counseling</b>		
	A. Advices B. Monitoring body weight C. Artificial feeding	A. Return to regular diet B. Adjustment to individual needs C. Non-cariogenic diet	

**B. Indirect**—Results from decreased vascularity and subsequent tissue changes. Hypoxic, hypocellular, hypovascular response (Marx, 1983). These include changes in saliva, increase in caries rate, microbial shifts and hard and soft tissue necrosis.

## ORAL PROBLEMS RELATED TO RADIATION THERAPY

The following are the oral problems related to radiation therapy:-

1. Mucositis
2. Xerostomia
3. Radiation Caries
4. Loss of Taste
5. Trismus
6. Osteoradionecrosis

### Mucositis

This results from mucosal atrophy as a result of decreased cell renewal in the basal layer. Usually starts two to three weeks after RT and is self limiting, resolving two to three

weeks after termination of treatment. The movable mucosa of the cheek, lips, soft palate and ventral surface of the tongue are most often affected (Fig. 16.3). Patients complain of burning sensation and their ability to tolerate hot and spicy foods decreases. Mucositis can be extremely uncomfortable and debilitating causing decrease in oral intake.

**FIGURE 16.3:** Radiation mucositis

### *Prevention and Management*

Since the traumatized area easily ulcerate, elimination of sources of local irritation like removal of dentures, grinding of sharp edges of teeth, extraction of fractured teeth and root stumps are done prior to start of radiotherapy. Children undergoing orthodontic therapy should have their orthodontic appliance removed and treatment discontinued until 1 year after completion of cancer therapy. Use of tobacco, alcohol, and spicy and acidic foods should also be discouraged. Good oral hygiene although uncomfortable to maintain is very important to avoid super added infection of these wounds.

Relief from mucositis is unpredictable. Very few therapies have been tested in randomized prospective trials. Because of the high carriage rate of Gram-negative bacilli in many high-dose RT patients, it has been postulated that selective elimination of these bacilli has a prophylactic or ameliorating effect on the development of radiation mucositis. Antibiotic lozenges containing polymyxin E/tobramycin/amphotericin B (PTA) lozenges have shown to be of use in the reduction of the severity of radiation mucositis. Recent evidence would suggest the use of antibiotic lozenge reduces the most severe symptoms of mucositis. However, the evidence does not yet appear to be sufficiently compelling to recommend this treatment as part of standard practice. Symptomatic relief can be achieved by the following drugs:

Aspirin—Mucaine mouthwash (aluminum hydroxide + magnesium hydroxide + oxethazine) will help to combat dysphagia when used prior to meals. This should not be used for children under 12 years of age. Rinses with Xylocaine viscous 2 %, Dyclone 0.5% (dyclonine HCl), Kaopectate or milk of magnesia and Benadryl (diphenhydramine HCl) in equal parts are helpful to aid adequate oral intake. Newer drugs like Difflam (benzydamine hydrochloride) a non steroidial rinse with anti inflammatory, analgesic and anesthetic properties have been suggested. Sucralfate—used in the treatment of gastric ulcers has been reported to be effective as a rinse by a number of investigators. Prostaglandin (P.G.E.2 tablets 0.5mgs 4 times daily)—can help alleviate mucositis. However, it should not be used following bone marrow transplantation since it increases the risk of herpes

infections. Steroid lozenges should not be used since they encourage the development of candidal infections. Acidic and spicy foods should be avoided. Cold foods such as ice chips or ice cream may be soothening.

Aqueous chlorhexidine rinses are beneficial in controlling chemotherapy associated oral mucositis. But they are unable to control radiation mucositis. Allopurinol is particularly valuable for chemotherapy induced mucositis; particularly that induced by 5-Fluorouracil and provides some protection for methotrexate induced mucositis.

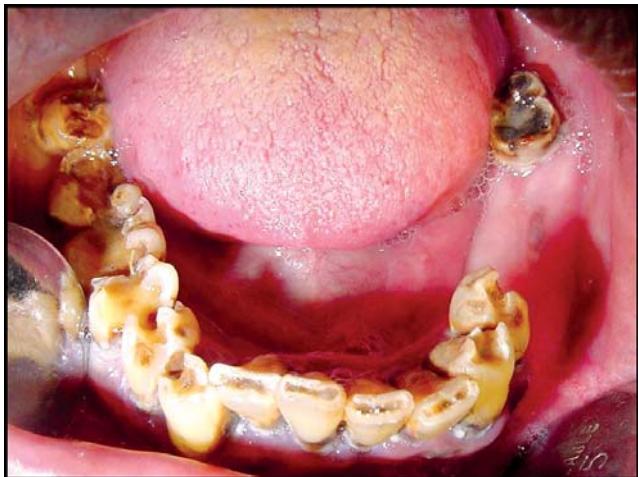
When the mouth is too painful for cleaning and a mouthwash cannot be used the oral tissues should be swabbed with Polygon oral swabs (Rochaille Medical Limited, Cambridge, U.K) or a gauze soaked in chlorhexidine 3 to 4 times daily. Polygon swabs are softer than cotton buds and cause less bleeding and pain when applied to the already inflamed mucosa.

## **XEROSTOMIA AND RADIATION CARIES**

Xerostomia is one of the most consistent and bothersome side effects of RT. It is caused by the effects of radiation on acinar cells, especially of serous glands (parotid gland). Consequently, inflammation, degeneration, and fibrosis of the glandular parenchyma occur. Xerostomia is noted one week after the start of RT in which the salivary glands especially the parotid are exposed. Spontaneous recovery is unlikely for patients with xerostomia persisting for 12 months or more.

### **Effects of Xerostomia**

The saliva turns thick, ropey and acidic as serous function is diminished. Therefore its effect as a cleaning, diluting, mineralizing and buffering agent in the oral cavity is greatly diminished. Decreased output and increased viscosity of saliva can be an important factor in the use of removable prostheses. In addition to the functional changes such as difficulty in swallowing and alteration of taste, loss of saliva is associated with reduction in pH (5.5 to 6), shift in the oral microbial flora to highly cariogenic bacteria and diminished oral IgA. Consequently, patients with xerostomia are susceptible to local oral infection particularly dental caries (Figs 16.4 and 16.5).



**FIGURE 16.4:** Radiation caries affecting the incisal edges and necks of the teeth



**FIGURE 16.5:** Extensive radiation caries with associated Trismus making oral hygiene measures difficult

The most effective intervention for reduced salivary gland function is its prevention. Because once chronic hyposalivation occurs, treatment essentially relies upon stimulation of the residual secretory capacity of the salivary glands

#### *Prevention and Management of Xerostomia*

1. Amount of salivary tissue exposed to radiation to be minimized
2. Stimulation of salivary flow should start simultaneously with RT
3. Drug therapy
4. Replacement of saliva as need arises
5. Anticaries regimen to protect dentition

1. *Amount of salivary tissue exposed to radiation to be minimised:* Selective fields of radiation which maximize tumor exposure, but minimize involvement of normal tissue are desirable. Meticulous treatment planning and beam arrangement designed to spare as much of the parotid and submandibular glands are done. Another option is to attempt to spare one of the parotid glands by three-dimensional treatment planning and conformal dose delivery techniques. This has been shown to reduce radiation induced impairment of salivary gland function.
2. *Stimulation of Salivary flow (Gustatory and tactile sialogogues):* This can be achieved by local or systemic measures. Sucrose free lemon drops, lemon slices, vitamin C tablets, or sugarless chewing gum may be used. Avoid cinnamon or mint flavored mints or gum as these may irritate the mucosa
3. *Drug Therapy (Pharmacological sialogogues):* Salivary stimulants can cause unwanted side effects that are often more distressing than the xerostomia. The following have been used:
  - A. Pilocarpine stimulates parotid function, but not submandibular or sublingual. Dosage: Pilocarpine-ophthalmic drops - 5 to 10 mgs. 3 times daily. A more persistent effect of pilocarpine has been observed when its administration is started before RT, continued during RT and then stopped three months post-RT.
  - B. Anetholetrithione (Sialor-sulfarlem, latema) 1 to 2 tablets 3 times daily.
  - C. Combination of Pilocarpine and Anetholetrithione
  - D. Other agents such as bromhexine, bethanechol HCl, potassium iodide, neostigmine and reserpine have been used with variable results.
4. *Replacement of saliva:* Accomplished by the use of salivary substitutes (Fig. 16.6). Most of these are based on either carboxymethyl cellulose(CMC) or mucin. Mucin containing saliva substitutes are preferred over CMC containing substitutes, by patients with both Sjogren's syndrome and radiation induced xerostomia. Moreover, mucin based artificial saliva is also more effective in restoring normal oral flora. When compared with the CMC substitutes, mucin containing saliva substitutes have superior rheological and wetting properties.



**FIGURE 16.6:** Saliva substitute

There is a great variation in the toleration to artificial saliva among patients. Hence, it is worthwhile to use different types of saliva substitutes in a particular patient and select the most effective one for the patient. Salivary substitutes are best used before meals and at bed time to help with the difficulties in swallowing or dryness of mucosa.

The simplest technique in managing xerostomia is frequent moistening of mouth with sips of cold water, milk, tea, saline, or solutions containing sodium bicarbonate and sodium chloride soda (mix  $\frac{1}{2}$  teaspoon salt and  $\frac{1}{2}$  teaspoon baking soda in 1 cup of warm water). Use of Emser salt or diluted milk of magnesia is also effective. Mouth washes containing irritating substances (sharp tastes, alcohol) must be avoided because of their effect on the thin, dry and atrophic mucosa. An important disadvantage of these mouth washes is the necessity of frequent applications because of poor retention properties. Hence many clinicians treat xerostomia with more viscous glycerin-containing mouth washes, which require less frequent application. Ripe bananas are a good lubricant; however, they should be avoided for dentate patients because of their high refined sugar content. Flavourless salad oil or dietary fat at night time lubricates the lips and tongue.

5. **Anticaries regimen:** Patients treated with radiation in fields involving the major salivary glands are at extreme risk for radiation caries. This is secondary to the reduced production and chemical change in the composition of saliva. This causes rampant caries of incisal, cusps and cervical areas (which are considered to be resistant to caries) even in three months time. Incidence of caries is as high as 46 percent. Most patients complain of hypersensitivity of teeth to heat and cold. This can be managed with desensitizing tooth pastes. Proper pretreatment evaluation, aggressive use of topical fluoride and patient education can minimize or eliminate this in a properly motivated patient. The patient should be well educated on the importance of excellent oral hygiene and avoidance of cariogenic diet. Patients should be seen by the dentist at about eight weeks intervals. Caries noted should be treated quickly. Currently there are a number of filling materials with cariostatic property.



**FIGURE 16.7:** Fluoride foam and tray

Fluorides for dental use are provided in three forms—rinses, gels applied by brushing and drops used in trays moulded to fit over teeth. The use of tray (Fig. 16.7)—borne drops can be supplemented with rinses. Generally the use of rinses in the day time and trays before sleep is more effective.

Acidulated fluorides tend to be most effective, although neutral fluorides are available for patients with mucositis in whom acidulated material may be irritating or for patients with porcelain prosthesis in which pitting of restoration may occur.

For patients who cannot tolerate trays due to gagging fluoride gels may be applied with a tooth brush either as 1.1 per cent sodium fluoride or 0.4 per cent stannous fluoride.

Although, Chlorhexidine 0.12 to 0.2 percent mouth rinses may help in reducing oral micro flora and plaque control; it has not been effective in the management of xerostomia. This is explained by the fact that salivary glycoproteins are necessary co factors for mucosal cell protection by chlorhexidine

### **LOSS OF TASTE (AGEUSIA/HYPOGEUSIA)**

It is a transient but bothersome sequelae of RT. This is due to the alteration of the function and architecture of the taste buds. Usually reported during the second week and may continue up to four months after cessation of therapy. Total recovery may take up to 12 months. Some patient's may be left with residual hypogeusia after RT. Zinc supplements are reported to be helpful in increasing taste acuity in such patients.

Since taste loss can result in weight loss, the importance of dietary counseling should be stressed during and after therapy. Food with pleasing taste, colour and smell/aroma may improve food intake. Choose foods high in calories and protein. Take supplements that provide vitamins, minerals, and calories. Attention also has to be paid to the level of hyposalivation , since insufficient moistening and lubrication of oral tissues and food have a major negative impact on food intake and ability of a patient to eat.

### **TRISMUS**

This occurs secondary to direct radiation to the temporomandibular joint and muscles of mastication leading to fibrosis and scarring (Fig.16.8). The most decisive factor in the development of trismus is probably the inclusion of the medial pterygoid muscle in the treatment portals. Prevention of trismus, rather than its

treatment, is the most desirable objective. Mouth opening should be measured before and also frequently during RT. Trismus leads to severe nutritional and hygiene problems.



**FIGURE 16.8:** Trismus secondary to radiation therapy

#### *Management*

When symptoms start to occur aggressive physiotherapy can minimize the limited range of motion. Patient compliance and perseverance are critical for success because dramatic results are not achieved immediately. Patients at risk of developing trismus should be put on home exercise to maintain maximum mouth opening. Use of tongue blades, rubber stops, or dynamic mouth openers is recommended.

### **OSTEORADIONECROSIS**

Of all the oral complications of RT, the most significant is osteoradionecrosis (ORN). Incidence range from four percent to 40 percent. Clinical manifestations of ORN may include pain, orocutaneous fistula (Fig.16.9), exposed necrotic bone (Fig.16.10), pathologic fracture (Fig.16.11), and suppuration. Radiographically it has a classic "moth-eaten" appearance which gradually spreads through the adjacent mandible. Because of severely compromised blood supply sequestra and involucra occur late or not at all. ORN is more commonly seen in the mandible than in the maxilla due to the relatively

decreased vascularity and increased bone density of the mandible. In addition, the mandible often receives a greater dose of radiation than the maxilla.



**FIGURE 16.9:** Orocutaneous fistula associated with ORN



**FIGURE 16.10:** Exposure of bone intra orally in ORN



**FIGURE 16.11:** Pathologic fracture associated with osteoradionecrosis

Clinically there are 3 types of ORN. Type I is trauma-induced ORN which occurs when radiation or surgical wounding are coupled closely together. The most common is Type II, also trauma-induced ORN, which occurs years after radiation therapy. Type III or spontaneous ORN can occur anytime after radiotherapy but commonly occurs six months to two years following radiotherapy, without any obvious preceding surgical or traumatic event.

ORN was historically attributed to the triad of trauma (tooth extraction), radiation and infection. It represents a defect of wound healing rather than true osteomyelitis. Microorganisms play only a concomitant role. The changes in the bone after radiation therapy are obliteration of fine vasculature, progressive fibrosis, loss of normal marrow cellular elements, fibrosis and fatty degeneration of marrow. The pathophysiology of ORN is best illustrated by the “3 H” principle which describes the effect of radiation on tissue as presented in the landmark article by Marx (1983). Radiation leads to progressively hypocellular, hypovascular and hypoxic tissues. This impedes the replacement of connective tissues and cells as part of tissue turnover in normal homeostasis and in wound healing. Breakdown of tissues can thus ensue with or without trauma. ORN is therefore a problem of impaired and inadequate tissue turnover and wound healing.

#### *Predisposing Factors*

It can be divided into

- A. Radiotherapy
- B. Dental factors
- C. General factors

A. *Radiotherapy factors:* Modes of therapy, total dose exceeds 60 Gy, dose fraction with high number of fractions, volume of mandible exposure, and anatomic site of the tumor.

B. *Dental factors:* Condition of the dentition, motivation of the patient, pre and post radiation extraction

C. *General factors:* Patient is immuno deficient or malnourished

The most important dental disease factor predisposing the tissue to bone exposure and necrosis is periodontal

defects in the dentition retained in the treatment field. Even carious exposure of the dental pulp appears to be less important. Patients who are edentulous at the time of radiation exposure are at a relatively lower risk compared with dentulous patients. But trauma from prosthesis can occur, especially as xerostomia worsens and saliva loses its ability to lubricate the denture mucosal surface. Also, the edentulous ridge prepared before radiation should be inspected thoroughly before a denture is placed because hypocellular- hypovascular bone loses its ability to remodel and bony irregularities or projections may cause an ulceration and exposure with denture function.

#### *Post Radiation Extraction*

The concept of revascularization of bone within the radiation field does not occur or is not clinically significant. Therefore it appears that there is not a safe time to electively insult or expose the tissue after the radiation dose greater than 65 Gy.

Obviously, conservative non-surgical means of managing dental disease in the irradiated patient to prevent exposure of bone is preferred. Endodontic procedures can be successfully performed. The risk of procedure itself in the radiation field is unclear. Dental extractions and osseous surgery should be avoided during active RT and in the early post irradiation period. A protocol reported by Marcini (1986) requires a nine month interval between RT and dentoalveolar surgery. When post irradiation extractions and osseous surgery must be performed, these procedures should be undertaken with great caution to avoid traumatizing the soft tissue envelope of bone. Careful thought should be given to the placement of incisions and wounds should be closed without tension with ample soft tissue. Extractions if unavoidable they should be undertaken in a hospital environment with an appropriate antibiotic prophylaxis. Chlorhexidine gluconate 0.2 percent mouthwash should be used prior to surgery. Systemic antibiotics should be used until healing has taken place. Where multiple extractions are required hyperbaric oxygen (HBO) therapy is recommended both before and after tooth removal.

Removal of tooth or osseous surgery causes a metabolic burden on the tissues to initiate protein

synthesis and vascular network capable of providing a nutrient supply to the area. Neither of these demands can be met in the hypocellular, hypovascular, hypoxic milieu of the irradiated tissue. Various authors have reported the prophylactic use of HBO to prevent osteoradionecrosis when teeth must be removed in the region of irradiated bone. Unfortunately, the limited access to oxygen chambers and significant expenses are the obstacles in the widespread use of this modality.

Due to the potential for irritation of underlying mucosa and development of ORN, denture-wearing should be kept to the minimum. For patients who had teeth extracted immediately before RT it is recommended that at least one year should elapse before beginning wearing the dentures. Poor oral hygiene and continued use of alcohol and tobacco may lead to rapid onset of ORN

#### *Management of Osteoradionecrosis*

The management of ORN still remains controversial and there is no universally accepted treatment. In general the following treatment modalities are practiced:

1. Control of infection with antibiotics when there is acute exacerbation. Since the necrotic bone is devoid of circulation antibiotics do not penetrate it.
2. *Analgesics*—Narcotic and non narcotic analgesics can be used. If pain is severe alcohol nerve blocks, or nerve avulsion is to be considered.
3. Surgical debridement is kept to the minimum possible. When small pieces of bone become loose it can be removed easily.
4. *Supportive treatment*—Adequate hydration, high calorie diet with vitamin supplements.
5. *Oral hygiene measures*—Chlorhexidine mouth wash or irrigation used frequently
6. *Sequestrectomy*—When required it is preferably done intra orally. This is because damage to skin and vascular structures as a result of radiation retards or prevents wound healing when performed extra orally.
7. *Pathologic fractures*—Even though not common , may occur from minor trauma. The fractures do not heal readily and pose great difficulty for successful treatment. Excision of necrotic ends of both fragments and replacement with large grafts has given promising results. Major soft tissue flap support also may have to be combined.

8. **Resection**—Bone resection is performed if there is persistent pain , infection or pathologic fracture. If possible it should be performed intra orally to avoid development of orocutaneous fistula in radiation compromised extra oral soft tissue.
9. **Hyperbaric oxygen therapy**—This is a useful adjuvant in the successful management of ORN and has revolutionarized its treatment. It can be used alone or combined with surgery.
10. Recent evidence suggests that ultra sound may be helpful. There have been promising results with ultra sound at frequencies of 3mhz pulsed 1 in 4 at an intensity of 1w/cms sq. applied to the mandible for 10 minutes daily for 50 days

Rationale for the use of HBO in association with surgery is to increase the tissue oxygen gradient in irradiated tissue. This promotes fibroplasia and capillary budding in wounds. This hastens neovascularization. Thus the amount of necrotic bone to be removed surgically is also minimized. Post operative wound healing is hastened.

Varying protocols have been suggested by investigators. A typical regime is to keep the patient in a chamber (Fig. 16.12 and Fig.16.13) and oxygen is supplied in 2.4 atmospheric pressure for one hour daily over a four week period. The number of HBO treatment recommended is the minimum and more are given if the response is slow. Most authors now recommend to relay on clinical observation of the resolution of the condition rather than strictly follow a fixed protocol. Due to the paucity of HBO chambers this facility is currently available only in certain major centers in India.

### **ORAL PROBLEMS RELATED TO CHEMOTHERAPY (CT)**

Oral problems of cancer chemotherapy are the result of:-

1. The direct action of chemotherapeutic agent on the basal epithelium(Primary stomatotoxicity)
2. Patient's inability to contain local minor oral disease due to myelosuppression (Secondary stomatotoxicity)
3. Combination of the above.

Due to the disturbance in the activity of basal epithelium, epithelial renewal is diminished and atrophic changes are noticed. Mucosa becomes erythematous and



**FIGURE 16.12:** Monoplace HBO chamber where a single patient is placed in one chamber



**FIGURE 16.13:** Multiplace HBO chamber where multiple patients are placed in one chamber

the patient will have sensitivity to spicy foods. Later on ulceration develops. These lesions tend to be confined to the movable non keratinized mucosa of the mouth like buccal and labial mucosa, ventral surface of the tongue, soft palate and oropharynx.

The oral complications are dependant on various factors. They can be broadly grouped as :-

- A. Patient related factors
- B. Nature of chemotherapy
- A. *Patient Related Factors*
  - a. *Type of tumor:* Patients with hematologic neoplasm (leukemia and lymphoma) are at a greater risk of

- developing oral complications than patients with solid tumors, except for tumors of head and neck.
- b. *Age of the patient:* Young patients develop oral soft tissue problems like mucositis more often than older patients. This is due to the increased mitotic activity of oral mucosal cells in the younger individuals than in older age group. The former however recover much faster than from ulcerative mucositis compared to the latter.
  - c. *Preexisting oral condition:* Patients whose pre-treatment oral condition is poor are at a greater risk. Chronic irritation from poorly fitting dentures or faulty restorations predispose to ulcerative mucositis. Patients with advanced periodontal disease , pulpal disease, partially erupted third molars are at a greater risk to develop oral sepsis once they become myelosuppressed.
  - d. *Oral care during chemotherapy:* The level of oral care during therapy markedly influences the development of oral complications and infections. Proper oral hygiene measures markedly reduce the oral flora.

#### B. Nature of Chemotherapy

- a. *Stomatotoxicity of the drug:* Stomatotoxicity of chemotherapeutic drugs varies. Drugs such as methotrexate and adriamycin are markedly stomatotoxic and causes mucosal breakdown. However drugs like cyclophosphamide and phenylanine mustard do not. Combinations of drugs enhance stomatotoxicity.
- b. *Schedule of administration:* Drugs given in repetitive low doses tend be less stomatotoxic than do bolus doses of the same.
- c. *Total dosage of drug:* Patients who receive multiple course of drug therapy are more likely to develop complications.
- d. *Concomitant therapy:* Patients receiving both radiation and chemotherapy are at a greater risk for developing oral complications. This is particularly true of patients receiving radiation to the head and neck region. But this has been noted in patients receiving radiation to other areas also.

The following oral problems are noted in patients receiving oral chemotherapy:-

1. Mucositis                    19%

2. Infections                    33%
3. Hemorrhage                15%
4. Others                        33%

## MUCOSITIS

Mucositis with ulceration usually occurs five to eight days following the administration of chemotherapy and lasts for seven to 14 days. Lesions heal spontaneously without scar formation. Patients who receive repeated regimes of chemotherapy , lesions tend to reappear in the same site with each dose. Management of mucositis is by use of topical medicaments similar to those used in the management of radiation induced mucositis.

Concomitant with the breakdown of oral epithelium the patient's ability to deal effectively with the oral microbial flora diminishes as myelosuppression occurs. The lack of an intact epithelial barrier permits influx of organisms and secondary infections develop.

## INFECTIONS

Local oral infections in myelosuppressed patients are attributable to fungal, viral and bacterial microorganisms.

### Fungal Infections

Candidiasis is the most common oral infection and appears as white curdy form or as erythematous macular lesions. It frequently occurs on the palate, tongue and corners of the mouth. Although candida albicans is a normal inhabitant of oral flora in 50 percent of the population, changes in the salivary flow, granulocytopenia and shift in the oral microbial flora predispose the cancer patient to the development of clinical candidiasis (Fig. 16.14). Oral candidiasis, when it is poorly controlled increases the risk of aspiration and the development of candidal esophagitis or fungemia.

Systemic candidiasis is the cause of death in as many as one-third of patients with immunosuppression. Hence topical antifungal prophylaxis should be considered in all patients in whom granulocytopenia is anticipated. The polyene antibiotics (e.g. nystatin) are probably the most extensively used form of topical antifungal therapy although their efficacy in markedly neutropenic patients is not clear. Among the imidazole agents clotrimazole is



**FIGURE 16.14:** Oral candidiasis

delivered as troches and patient compliance with this drug is better than nystatin especially in those with nausea. When compared with nystatin, clotrimazole is less expensive. The other two imidazoles available viz. miconazole (oral gel 25 mg. per 5 ml: four times daily) and fluconazole (fluconazole suspension-50mg per 5ml: up to four times daily) have been found to be effective for prophylaxis as well as treatment of existing disease. If candidal infection has been diagnosed, a miconazole oral gel or varnish should be applied to the fit surface of denture prior to re-insertion. Miconazole must be avoided if the patient is on warfarin medication.

The efficacy of chlorhexidine gluconate rinses as topical antifungal agents is unclear. It has been observed that chlorhexidine reduces the activity of nystatin. Hence its concomitant use with nystatin is not advisable.

Aspergillosis and muromycosis are also not uncommon in myelosuppressed patients. These appear as invasive oral ulcerations which are painful and may involve bone.

### Viral Infections

Herpes simplex type I( HSV) is the most common oral viral infection in patients receiving chemotherapy or radiation therapy for head and neck tumors. It can be the result of a primary infection with the virus or the reactivation of latent virus in a previously exposed host, the latter being the most common. The most common manifestation of HSV infection is oral ulceration which clinically resembles other forms of mucositis. Extra oral or perioral vesiculations may occur. Hence, determination

of antibody status is an important component of risk assessment for oral HSV infection.

The timing of HSV infection in patients receiving chemotherapy or bone marrow transplantation is fairly consistent. Lesions generally appear 18 days following the initiation of therapy. This time gap helps to differentiate HSV lesions from the lesions due to stomatotoxicity which appears after five to seven days and those from secondary infection due to myelosuppression which occurs around 12 to 14 days. Viral culture is the most definitive way to diagnose HSV infection. For treatment and prophylaxis of HSV infection systemic acyclovir is the drug of choice.

Herpes zoster infection may also appear. They begin as vesicular lesions which rupture and form painful small ulcerations. The vesicles appear in crops. Unlike HSV infection , these lesions are usually linear , often following one branch of trigeminal nerve.

### Bacterial Infections

Bacterial infections may be of soft tissue, gingival or odontogenic origin. Due to poor oral hygiene and xerostomia in cancer patients , there is subsequent increase in the oral microorganisms. In addition to this, there is shift in the oral flora from one in which gram positive organisms predominate to a state in which there is a preponderance of gram negative organisms following cancer therapy.

Odontogenic infection most often occurs as a result of advanced caries process when infection and degeneration of pulp occurs. Because of patient's inability to evoke an inflammatory response, conventional signs of dental infection such as swelling and abscess are absent and patient complain of localized tooth ache. Clinical or radiographic evidence of pulp involvement by caries are diagnostic. Infection due to anaerobic bacteria is more common. Extraction of the involved tooth under antibiotic cover is the treatment of choice. This is done after assessing the general condition of the patient . Platelet transfusion is given when the count is less than 50,000 cells/mm<sup>3</sup>. Attention to details such as gentle handling of soft tissues, good closure and continuing antibiotic therapy till the wound is epithelialized are mandatory to avoid complications. Use of gelfoam to control bleeding from extraction socket is best avoided, since it can act as focus of infection.

Gingival infections are relatively common in patients receiving chemotherapy. It can be either localized as pericoronitis or it can be generalized as gingivitis or periodontitis. All these generally occur when there is a preexisting gingival or periodontal disease. The clinical appearance of acute gingival infection resembles that of acute necrotizing ulcerative gingivitis. Pain, loss of gingival architecture especially necrosis of interdental papillae are characteristic. Treatment includes irrigation, gentle local debridement and systemic antibiotic therapy. Empiric treatment is advised regardless of culture results.

Mucosal infections in myelosuppressed patients are often superimposed on ulcerated areas. Ulcers have rounded borders with yellowish-white necrotic center. Due to the lack of inflammatory response, characteristic erythematous borders are usually absent. If the ulcerations are precipitated by trauma, secondary hematoma formation may occur in the thrombocytopenic patient. Treatment includes gentle debridement, palliation, and antibiotics.

#### **Measures for prevention of oral infection**

1. Elimination of sources of mucosal irritation: Sharp areas of teeth or restorations should be made smooth. Patients with removable prosthesis should be instructed to remove them during the period of myelosuppression.
2. Reduction in the oral microbial flora by various oral hygiene measures and oral rinses (mechanical and/or chemical means): Conventional tooth brushing with soft brush is advised. Brushing should be discontinued if there is significant bleeding. Alternatively, cotton swabs may be used. Dental floss is an excellent adjuvant if the patient is not severely thrombocytopenic. Oral rinses are of great help in maintaining the oral hygiene. Rinses containing alcohol as their active agent cause burning of the atrophic mucosa and hence not recommended. Chlorhexidine gluconate rinses markedly reduces oral microbial flora.
3. Treatment of low grade asymptomatic oral infection prior to start of chemotherapy

#### **HEMORRHAGE**

Most often, bleeding that occurs during the periods of myelosuppression is of gingival origin. Spontaneous gingival bleeding is a rare occurrence when platelet count exceeds 20,000 cells/mm<sup>3</sup>. Slow oozing may be noted, especially in areas with preexisting periodontal or gingival disease. Local treatment of gingival bleeding includes initial debridement, not disturbing the clots already formed, and topical application of thrombin under pressure.

Hematoma formation often occurs in areas of trauma especially the buccal mucosa, the alveolar mucosa, or edentulous areas. Areas of submucosal hemorrhage form bluish blister-like areas which then form a yellowish/white tumor like mass of fibrin. Epithelialization occurs beneath the mass. If bleeding occurs before healing is complete, topical therapy includes thrombin, microfibrillar collagen, or other hemostatic gel. Before healing is complete the clot may serve as a focus of microbial growth. It should be checked daily and removed as soon as epithelialization is complete. Unchecked sublingual bleeding may cause respiratory embarrassment by elevating the tongue.

#### **SUMMARY OF PREVENTION AND MANAGEMENT OF ORAL PROBLEMS**

##### **Prior to Cancer Therapy**

1. A comprehensive oral assessment is undertaken.
2. Detailed oral hygiene instruction with reinforcement and elaboration of diet advice is provided in cooperation with the dietician.
3. Oral hygiene practices are supplemented with the use of a chlorhexidine mouthwash or dental gel, if there is gingival disease diagnosed.
4. Impressions of the mouth are taken for study casts to construct applicator trays and where appropriate for obturator planning.
5. Carious teeth that can be restored are stabilized with appropriate restorations.
6. All sharp teeth and restorations are suitably adjusted and polished.

7. The patient is counseled about denture wear during therapy.
8. Wherever possible, teeth with a dubious prognosis are removed no less than ten days prior to therapy
9. Orthodontic treatment is discontinued.

### **During Cancer Therapy**

1. The patient receives appropriate support from a dental hygienist.
2. A high standard of oral hygiene is encouraged (to include denture hygiene).
3. The use of a chlorhexidine mouthwash, or dental gel, is continued.
4. Those patients receiving radiotherapy, or total body irradiation prior to bone marrow transplantation, receive a daily fluoride mouthwash to prevent dental caries and promote enamel remineralisation.
5. Children and adults receiving bone marrow transplants often receive Acyclovir as a prophylaxis if there is a high risk of viral infections. This is usually prescribed by the oncology team.
6. Antifungal medication is used following detection of oral candida. For children this should be used routinely as a prophylaxis.
7. Every effort should be made to reduce the severity of the mucositis.
8. Every effort is made to reduce the effect of the xerostomia.
9. Patients are advised that removable prostheses may be left out of the mouth if there is any evidence of ulceration. They should be examined by a member of the dental team.
10. When the mouth is too painful for cleaning, the tissues are swabbed with oral sponges.
11. Foods, drinks and mouthwashes, which irritate the oral mucosa should be avoided to maintain oral comfort.
12. Dental treatment is avoided wherever possible during therapy.

### **Following Cancer Therapy**

#### *Prevention and Monitoring*

1. Growth and development should be closely monitored for children.

2. Three months oral hygiene review for as long as the xerostomia continues.
3. Regular and appropriate oral healthcare monitoring is provided by the designated member of dental staff.
4. Strategies for dealing with xerostomia continue.
5. A remineralising solution, such as a fluoride mouthwash continues to be used regularly with confirmation of compliance.
6. Chlorhexidine gel is applied with applicators.
7. In the event of trismus, jaw exercises are implemented.

#### *Restorative Dental Care*

1. In the event of uncontrolled periodontal disease, vigorous treatment is initiated. This may involve identification of atypical pathogens.
2. Herpes labialis can be a chronic problem. Topical acyclovir is effective.
3. Restorations are kept simple ensuring acceptable aesthetics and function.
4. Dental extractions if essential, must be performed with appropriate precautions.
5. Dentures should be avoided wherever possible.
6. Implant stabilization of prostheses and obturators may be feasible in some patients.

#### *Requirements for Denture Wearers*

1. Removable prostheses are left out at night.
2. Glandsane saliva substitute should be used for edentate patients only.
3. Antifungals are used if a candidal infection is diagnosed.
4. Appliance wear is discontinued if the mouth becomes painful.
5. Obturators are reviewed regularly. They may require frequent attention with adjustment or remake.

### **Conclusion**

When presented with a diagnosis of cancer a patient will be unlikely to consider the oral implications of cancer treatment as a high priority. Hence, before subjecting the patient to therapy careful consideration should be given to the possibility of development of oral complications and the patient should be well informed. It is the responsibility of the dental surgeon to perform a pre-treatment assessment and institute the necessary dental

treatment after consultation with the radiation oncologist. During the time of cancer therapy oral care must be seen as an integral part of patient care. The necessity of maintaining a meticulous oral hygiene during and in the posttreatment period should be stressed to the patient. Oral examination should be at least biannual. In the absence of recurrent disease oral health monitoring should at least be equivalent to the period of monitoring by the

oncology team. Patients with unstable oral health will require more frequent monitoring because susceptibility to dental disease following cancer treatment can be lifelong.

A summary of oral problems during treatment (acute changes) and following treatment (chronic changes) is given in the Table 16.2 and Table 16.3. Practical oral care is given in Table 16.4.

**Table 16.2:** Summary of oral problems during treatment (acute changes)

Acute Change	Explanatory Notes	Radiotherapy	Chemotherapy
1. Mucositis	<ul style="list-style-type: none"> <li>• Acute inflammation of the mucosa</li> <li>• White/yellow fibrinous slough, often with ulceration</li> <li>• Painful to speak/eat/swallow</li> <li>• Portal for microbial entry</li> <li>• Healing complete 2-3 week after completion of cancer therapy</li> </ul>	<ul style="list-style-type: none"> <li>• Onset 2 to 3 weeks after commencing treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Onset usually one week after treatment commencement</li> <li>• Ulceration often severe</li> </ul>
2. Blood Changes	<ul style="list-style-type: none"> <li>• Anemia</li> <li>• Neutropenia</li> <li>• Thrombocytopenia</li> <li>• Present from commencement of cancer therapy until up to 4 weeks post therapy</li> </ul>		<ul style="list-style-type: none"> <li>• Spontaneous gingival/mucosal bleeding</li> <li>• Crusting of lips</li> </ul>
3. Immuno-suppression	<ul style="list-style-type: none"> <li>• Increases susceptibility to bacterial/fungal/viral disease</li> <li>• Exacerbates preexisting periodontal disease</li> </ul>		<ul style="list-style-type: none"> <li>• Periapically involved primary teeth can become a medical emergency</li> <li>• Acute herpetic gingivo stomatitis and candidiasis with systemic involvement in children</li> </ul>
4. Changes in Salivary Flow/Composition	<ul style="list-style-type: none"> <li>• Saliva becomes thick, viscous, acidic</li> <li>• Xerostomia is less common in children</li> <li>• Onset within 14 hours to one week of cancer therapy</li> </ul>	<ul style="list-style-type: none"> <li>• Xerostomia can be prolonged</li> <li>• Can last up to 2 years post therapy</li> <li>• Often permanent</li> </ul>	<ul style="list-style-type: none"> <li>• Salivary flow usually returns to normal within 2 months</li> </ul>
5. Acute Ascending Sialadenitis	<ul style="list-style-type: none"> <li>• Can occur in children as a complication of xerostomia</li> </ul>		
6. Loss of Taste	<ul style="list-style-type: none"> <li>• Onset usually during the second week</li> <li>• Related to xerostomia and direct damage to taste buds</li> <li>• Sense of taste often returns with an unpleasant interim period of altered taste</li> </ul>	<ul style="list-style-type: none"> <li>• May continue up to 4 months</li> <li>• Total recovery up to 12 months</li> </ul>	
7. Dysphagia	<ul style="list-style-type: none"> <li>• As a result of mucositis and xerostomia</li> </ul>		

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## 210 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY

Acute Change	Explanatory Notes	Radiotherapy	Chemotherapy
8. Changes in Oral Flora	<ul style="list-style-type: none"> <li>Due to reduced buffering action and antibacterial action of saliva</li> <li>Increase in cariogenic organisms within 2 weeks of cancer therapy</li> <li>Increased susceptibility to candidal/viral infections</li> </ul>	<ul style="list-style-type: none"> <li>Oral candidiasis more likely</li> <li>Implications for increased dental caries.</li> </ul>	<ul style="list-style-type: none"> <li><i>Oral Candidiasis:</i> pseudo membranous candidiasis with ulceration and perioral inflammation</li> </ul>
9. Periodontal/ Gingival Disease	<ul style="list-style-type: none"> <li>Can be exacerbated by oral flora changes, mucositis, xerostomia and immunosuppression</li> </ul>	<ul style="list-style-type: none"> <li>Acute gingivitis</li> </ul>	<ul style="list-style-type: none"> <li>Acute gingivitis</li> <li>Pericoronitis in children</li> <li>Gingival hyperplasia in acute myeloblastic leukemia</li> </ul>
10. Tooth Sensitivity	<ul style="list-style-type: none"> <li>Increased risk of tooth wear and/or gingival recession present prior to cancer therapy</li> </ul>		
11. Dental Pain	<ul style="list-style-type: none"> <li>Related to leukemic infiltration of dental pulp tissue and direct jaw infiltration</li> </ul>		
12. Trismus	<ul style="list-style-type: none"> <li>Must exclude posterior invasion of carcinoma into pterygomasseteric muscles as a cause</li> <li>Inclusion of medial pterygoid muscle in the treatment portals</li> </ul>	<ul style="list-style-type: none"> <li>Prevention rather than the treatment is desirable</li> <li>Mouth opening measured before and during RT</li> </ul>	<ul style="list-style-type: none"> <li>Can occur in children</li> <li>Jaw Pain related to Vincristine administration</li> </ul>

**Table 16.3: Summary of oral problems after treatment (chronic changes)**

Chronic Change	Explanatory Notes	Radiotherapy	Chemotherapy
1. Progressive endarteritis	<ul style="list-style-type: none"> <li>Occurs in irradiated bone, especially the mandible</li> <li>Can occur in muscle and cause trismus 3 to 6 months post therapy</li> <li>Uncommon in children</li> </ul>	<ul style="list-style-type: none"> <li>Implications for dental extractions/ surgery (see management guidelines)</li> </ul>	
2. Blood Changes	<ul style="list-style-type: none"> <li>Anemia</li> <li>Neutropenia</li> <li>Thrombocytopenia</li> <li>Prolonged by maintenance chemotherapy</li> </ul>		<ul style="list-style-type: none"> <li>Implications for dental treatment</li> </ul>
3. Trismus	<ul style="list-style-type: none"> <li>Must exclude posterior invasion of carcinoma into pterygomasseteric muscles as a cause</li> <li>Predominantly due to fibrosis as a direct effect of radiotherapy, but also related to endarteritis</li> </ul>		
4. Prolonged Oral Flora Changes	<ul style="list-style-type: none"> <li>Increase in cariogenic organisms and candida</li> </ul>	<ul style="list-style-type: none"> <li>Increased susceptibility to dental caries</li> </ul>	

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Chronic Change	Explanatory Notes	Radiotherapy	Chemotherapy
		<ul style="list-style-type: none"> <li>Candidiasis more likely especially in denture wearers</li> </ul>	
5. Xerostomia	<ul style="list-style-type: none"> <li>May last up to 2 years post therapy</li> <li>It is often considered permanent although this can be subjective</li> <li>Predisposes to dental caries</li> </ul>	<ul style="list-style-type: none"> <li>More prolonged if parotid glands are in the irradiation field.</li> <li>Salivary output can be maintained by ipsilateral parotid sparing during RT</li> </ul>	
6. Tooth Erosion	<ul style="list-style-type: none"> <li>Due to prolonged xerostomia</li> <li>Loss of protective action of saliva</li> </ul>		
7. Periodontal/ Gingival Disease	<ul style="list-style-type: none"> <li>Can continue to be exacerbated by xerostomia and oral flora changes</li> <li>Gingival recession</li> </ul>	<ul style="list-style-type: none"> <li>Rapid progression of periodontal disease</li> </ul>	
8. Growth and Development	<ul style="list-style-type: none"> <li>In children general growth and development including facial growth and dental development should be closely monitored</li> </ul>	<ul style="list-style-type: none"> <li>Damage to developing teeth is frequent</li> </ul>	<ul style="list-style-type: none"> <li>Appears to have little permanent effect on oral health</li> <li>May result in an increased incidence of dental developmental disturbances</li> </ul>

**Table 16.4:** Practical oral care (Care of the edentulous patient should start at step 5)

Oral Care	Notes
1. Tooth brushing	<ul style="list-style-type: none"> <li>Use a soft toothbrush and brush 2 to 3 times a day for 2 to 3 minutes.</li> <li>Rinse the toothbrush in hot water every 15 to 30 seconds to soften the bristles, if needed</li> <li>Encourage or assist with gentle thorough brushing of teeth and gums at least twice daily</li> <li>Use a fluoride toothpaste</li> <li>Use a mild-tasting toothpaste; flavoring may irritate the mouth</li> <li>Rinse properly after tooth brushing to remove excess toothpaste</li> <li>If tooth brushing has to be discontinued it should be resumed at the earliest opportunity</li> </ul>
2. Aqueous Chlorhexidine Gluconate Mouthwash	<ul style="list-style-type: none"> <li>Use twice daily following tooth brushing</li> <li>If tooth brushing is discontinued, use mouth wash three to four times daily</li> </ul> <p><b>N.B.</b> Stagger use of chlorhexidine mouthwash and nystatin antifungal agent-separate administration by at least one hour.</p> <p>Mouthwashes may need to be diluted for comfort, i.e. 10ml mouthwash to 10ml water, ensuring the whole diluted volume is used</p>
3. Fluoride mouthwash	<ul style="list-style-type: none"> <li>Fluoride should be used both during and after cancer therapy</li> </ul>

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Oral Care	Notes
	<ul style="list-style-type: none"> <li>• Use a fluoride toothpaste when tooth brushing</li> <li>• Use a fluoride mouthwash daily as directed</li> <li>• Fluoride gel may be used for children between three and six years of age</li> </ul>
4. Dietary advice	<ul style="list-style-type: none"> <li>• Preventive advice to reduce the risk of dental decay should be given in liaison with a Dietician.</li> <li>• Emphasis should be placed on adequate hydration.</li> <li>• Assist with healthy meal choices</li> </ul>
5. Gentle Swabbing of the oral tissues	<ul style="list-style-type: none"> <li>• Polygon/gauze swabs soaked in chlorhexidine mouthwash may be used to gently clean the oral tissues</li> <li>• If the above cannot be tolerated, the swabs may be soaked in 0.9% saline (N.B. no antibacterial effect)</li> </ul>
6. Moisten mouth and lips frequently	<ul style="list-style-type: none"> <li>• Advise regular sips of water</li> <li>• KY jelly may be frequently applied to the lips, but should be removed when in the radiation field</li> <li>• Lubricate lips and tongue at night with flavourless salad oil</li> <li>• Use recommended artificial saliva substitutes</li> </ul>
7. Swabs for candidal superinfection	<ul style="list-style-type: none"> <li>• Regular swabs should be taken for detection of candida</li> <li>• Topical / systemic antifungal agents should be prescribed following the diagnosis of candida</li> </ul>
8. Care of appliances	<ul style="list-style-type: none"> <li>• After each meal / at least twice daily, dentures and obturators should be removed and meticulously cleaned with a tooth or denture brush</li> <li>• It is advisable to do this over a basin of water to prevent damage if the appliance is dropped</li> <li>• Use unperfumed household soap</li> <li>• Rinse well before replacing in cleaned mouth</li> <li>• Antifungal agents, as prescribed may be applied to the fit surface of the denture prior to reinsertion</li> <li>• Remove all dentures at night and clean; soak in an appropriate sodium hypochlorite cleanser for 30 minutes following removal and store dry overnight</li> <li>• Leave dentures dry at night except for when they are left out for &gt;24hrs, when they should be stored damp. If stored away from the patient they should be appropriately labelled</li> </ul>
9. Appliance wear	<ul style="list-style-type: none"> <li>• Removable prostheses should be left out of the mouth if there is any evidence of ulceration</li> <li>• Dentures should be removed at night</li> <li>• Denture should be moistened with water or an appropriate saliva substitute before reinsertion</li> <li>• Obturators should not be left out at night. A specialist opinion should be sought if there is evidence of ulceration.</li> </ul>

## SUGGESTED READING

1. Dental Complications of head and neck radiotherapy: Part 1; Nectarios Andrews, Chris Griffiths; Australian Dental Journal 2001:46(2):88-94.
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3. Oral sequelae of Head and Neck Radiotherapy; Vissink A. et al; Crit Rev Oral Biol Med 2003;14(3):199-212.
4. Prevention and treatment of the consequences of head and neck radiotherapy; Vissink A, et al; Crit Rev Oral Biol Med 2003:14(3):213-25.
5. Protocol for the Prevention and Treatment of Oral Sequelae Resulting from Head and Neck Radiation Therapy; Jansam Johan et al; Cancer Vol 7 No.8: 1992:2171-80.
6. Text Book of Radiotherapy, Fletcher Gilbert H, Lea and Febiger, Philadelphia 1980:229-37.

# 17

## Dental Jurisprudence

**Tomy Mappalakkayil, K George Varghese**

Dental Jurisprudence is used to denote that branch of dentistry which deals with application of the principles and knowledge of dentistry to the purpose of the law. There is always an element of anxiety and apprehension on the part of dental surgeons regarding the management of medico legal cases. Once the procedures involved in the management of these cases are known, they can be managed with relative ease.

Dental surgeons working in hospitals (government/private) or in private practice may have to attend medico legal cases and later summoned to the court of law as witness to give material evidence regarding the case they have attended. The most common type of medico legal cases, where Dental/ Oral and Maxillofacial Surgeons are involved, are:

- Road traffic accidents (RTA)
- Assault
- Accidents in work site/industrial accidents

Dental surgeons should have sufficient knowledge of courts and legal procedures before managing such cases. The proof of guilt or innocence depends in many cases upon medical evidences.

### **WOUND CERTIFICATE AND POLICE INFORMATION/INTIMATION**

Generally all medico legal cases are attended first by medical officers on duty, i.e. physician or general surgeon. If the patient has sustained dental or faciomaxillary injury,

the duty medical officer should refer the case to the dental specialist/dental surgeon. In such cases the preparation of wound certificate and police intimation should be done by the duty medical officer before referring the case to dental surgeon.

All Dental Surgeons attending medico legal cases are bound to keep proper record of cases which one is attending. When a patient presents with injuries of medico legal importance, like road traffic accidents or assault the doctor who is first attending the patient should record the details of the patient and the injuries carefully in the wound register in duplicate (i.e. with a carbon copy). A wound certificate should contain the preliminary data, examination findings including the history and opinion as to cause of injury. The injuries should be described in detail, i.e. the nature, size, shape, exact location, depth, etc. The format of wound certificate is included in the appendix. The original of this wound certificate have to be later handed over to the police. Similarly the doctor who is first attending the patient also has to intimate the police at the earliest. This police intimation has to be recorded in duplicate in the police intimation register; the format of which is also included in the appendix. If the patient reports for expert treatment to the doctor, (e.g. one or two days after the initial treatment in some other hospital) enquire whether he/ she has been previously treated in any other hospital or doctor and whether the wound register entry and the intimation of the police has already been done. If in doubt either the full details of

the injuries has to be noted in the case record or enquire with the hospital or the doctor who has attended the patient initially. It is important to note that it is based on this intimation that the police takes further action in the case like recording of FIR (first information report) etc. Otherwise the case may go unregistered in the police station and such instances are considered a breach of duty on the part of doctor who has first seen the patient. *In teaching hospitals, the wound register entry and the police intimation has to be done by an officer not below the rank of a Lecturer/Tutor. In hospitals under Government Health Services this has to be done by the Dental Surgeon attending the case.* **Postgraduate students and house surgeons are not permitted to do these entries usually.** Officers who examines the case and write the wound register and later the case record should take utmost care to ensure that the full details of the case are recorded properly without mistakes and signed with the name and designation of the doctor. This is because all these documents may have to be produced later in the court and the attending doctor will be called as witness to give material evidence.

Out patient records can be given to the patient with proper instructions to keep it safely; while in patient records has to be kept in safe custody in the hospital record section/library.

### Discharge Certificate

If medico legal cases are admitted at the time of discharge a discharge certificate has to be written in the proper format in duplicate with carbon copy. This is in addition to the discharge summary that is given to the patient. The discharge certificate also has to be written by a responsible officer as stated before and later handed over to the police. Discharge summary can be written by a postgraduate student or an house surgeon and signed by the medical officer after careful scrutiny. Format of the Discharge Certificate and Discharge Summary is included in the appendix.

### Treatment Certificate

In addition to the above certificates, the medical officer also may have to issue a treatment certificate to the patient especially in road traffic accident cases for producing

before Motor Accidents Claims Tribunal. In such cases while issuing such certificates the nature of injuries sustained and the details of the treatment given has to be mentioned. Very often, the patient may request for a disability certificate along with the treatment certificate for producing before the court. In such instances a lot of judiciousness on the part of the medical officer is required because there are no nationally or internationally accepted criteria/scale to award the disability encompassing the various combination of dental and maxillofacial injuries. A valuable guide in such cases is the one put forth by Dr. George Paul after extensive research and accepted by the Association of Oral and Maxillofacial Surgeons of India. Hence, the medical officer must be careful while issuing a disability certificate and should be competent enough to substantiate the certificate one has issued.

Each hospital may have its own protocol for the management of medico legal cases. But the essential element is that the medical officer who makes the entries in the above relevant records and signs the certificates, should be readily available when summoned by the court (Fig. 17.1) as witness to give evidence regarding the case.

## CRIMINAL COURTS OF INDIA

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The following is a brief description of **Criminal Courts of India:**

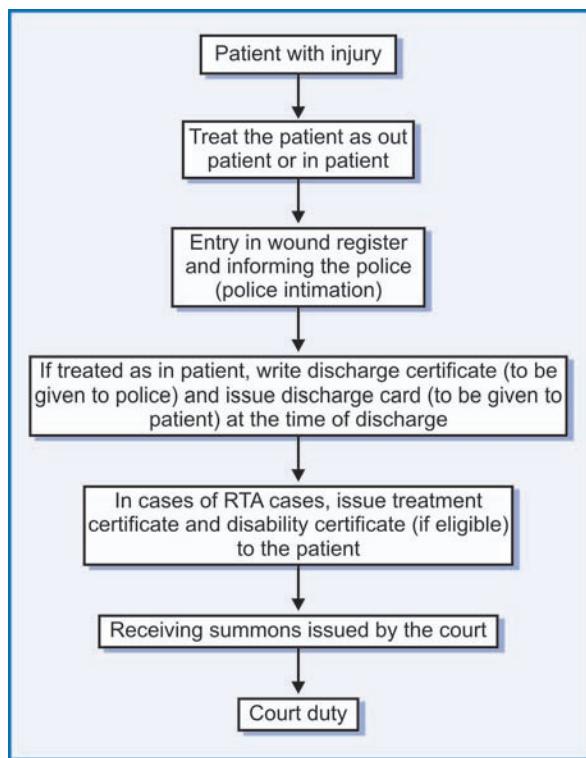
**Supreme court:** Is the highest tribunal in India. Situated in India's capital. Law declared by this is binding on all other courts.

**High court:** These are highest tribunals of states. They can try any offences and pass any sentence authorized by law.

**Sessions court:** Every state is divided into various sessions comprising of one or more districts. A sessions court can try any offence and pass any sentence. However a sentence of death passed by this court should be subjected to confirmations by the High Court.

**Additional sessions court:** Same as sessions court. But cannot pass a sentence of death, life imprisonment, or imprisonment exceeding 10 years.

**Court of Magistrates 1, Chief Judicial Magistrates:** In every district, the High Court appoints a Judicial



**FIGURE 17.1:** Flow chart showing management of medicolegal cases

Magistrate of first class as Chief Judicial Magistrate. He can pass a sentence of imprisonment up to seven years.

**Judicial Magistrate of first class:** Can pass a sentence of imprisonment up to three years and fine up to Rs.5000/- . Similarly Metropolitan Magistrate and Chief Metropolitan Magistrate exists in Metro town.

Dental Surgeons are usually summoned to first class Judicial Magistrate court and rarely to the Sessions court. They may also be summoned to give expert opinion in **Motor Accidents Claims Tribunal** and in **Consumer Disputes Redressal Forum**.

### Subpoena or Summons

Is a writ compelling the attendance of a witness in a court of law at a specified place and time and for a specified purpose under a penalty.

In civil cases it is customary to offer a fee termed conduct money to cover necessary travelling expenses.

When a subpoena is served, ignoring of it in criminal cases is liable to punishment under section 174 of IPC.

When summoned to attend two courts on the same day, one criminal court and the other civil one should attend the criminal court first and inform the civil court. If both summons are from criminal court one should attend the higher court first and inform the lower court. If summoned by courts of same status attend the court from which early reception of the summons. The oral evidence of a witness will be valid only when given on oath or affirmation.

### WITNESSES

A witness is a person who testifies to a fact seen, heard or perceived in any other manner.

#### Types of witness:

- Common witness: is one who testifies to the facts observed by himself.
- Expert witness: is one who on account of his professional training is capable of deducing opinions and inferences from the facts observed by himself or noticed by others.
- Hostile witness is a person one who gives evidence contrary to what he has disposed earlier or against the interest of the party that has cited him. Both expert and common witness may turn out to be hostile.

### RECORDING OF EVIDENCE IN A COURT

1. Examination in chief: The details should be enquired by the public prosecutor or the party who cited the witness. No leading questions at this stage.
2. Cross examination: The defense lawyer or the adverse party examines the witness. Leading questions are allowed.
3. Re-examination: Repeated examination is chief after the cross examination. At this stage no new matter can be introduced by the witness without the permission of the judge or the opposing counsel.
4. Questions by the judge: He can ask relevant questions at any stage of examination.

If a doctor is going to a court for giving evidence, certain pre trial preparations, personnel appearance in

the court and good behavior in the witness box enhance the credibility of the witness.

**Oath:** The bench clerk administer the oath. *The evidence which I shall give to the court shall be the truth, the whole truth and nothing but the truth, so help me God.*

If a witness gives false evidence after taking the oath or affirmation, he is liable to be prosecuted for perjury. (IPC-193)

### Documentary Evidence

**Medical certificates:** This refers to ill health, death, age or insanity and consists of statements of facts. The certificate should bear the signature of both medical officer and the patient.

**Medico legal reports:** These are reports prepared by medical officers at the instance of the magistrates or any other investigating authority, e.g. Post mortem certificate. These reports are open to scrutiny by the defense counsel and hence great care should be observed while preparing such reports.

**Dying declaration:** This is a verbal or written statement made by a person since diseased regarding the cause and circumstances leading to his present state. The medical officer should inform the respective magistrate for taking the dying declaration. If immediate death expects, in the presence of two witness he should take the declaration by himself. The medical officer should certify the mental status of the person at the time of the dying declaration (compos mentis or not).

**Dying deposition:** Dying deposition is a dying declaration made on oath in the presence of the accused or his legal representative who has the opportunity to cross examine the dying man. This is recorded only by Magistrate. So this have more weight than dying declaration.

**Printed opinions of experts** is also a medico legal report.

**Deposition of a medical officer** in the lower court.

**Reports of certain scientific experts of government** e.g. Chemical examiner, Director Haffkine institute, Director of Forensic Science Laboratory (FSL), etc.

### Oral Evidence

According to Indian Evidence Act (IEA) -60, oral evidence must in all cases be direct. The oral evidence carries more weight than documentary evidence as the person can be cross examined.

The following documentary evidences are exempted from oral evidences

1. Dying declaration
2. An expert opinion expressed in a treatise
3. Deposition of a witness in a lower court
4. Reports of certain Government scientific experts
5. Evidence given by a witness in previous judicial proceedings
6. Statements by persons who cannot be called as witness.

### Absenting from Court

Once a summons has been accepted by the officer, absenting from the court should not be done without strong and valid reasons. In such cases the court has to be intimated well in advance by registered post or telegram regarding the inability to attend. If not it can result in issuing of an arrest warrant. Failure to appear in court without valid reasons after warrant has been issued can invite contempt of court.

Exaggeration or false statements given under oath is not only unethical, but can invite punishment under sec.181, sec.193.

## RECORDING INJURY IN WOUND CERTIFICATE

The wound certificate as already stated should carry the full details of the injury sustained by the patient. The injuries should be described in detail, i.e. the nature, size, shape, exact location, etc. Hence it is essential that the Dental Surgeon should be fully conversant regarding the different class, types and nature of injury.

### INJURY

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**Injury is any harm, whatever illegally caused to any person in body, mind, reputation or property.** (**Section 44 IPC**). This is different from the medical definition of wound.

The medical definition of a wound or injury is the break of the natural continuity of any of the tissues of the living body (skin or mucous membrane).

### **Classification of Injuries**

**I Mechanical injuries:** These are produced by physical violence.

A. Due to blunt force

Abrasions

Contusion

Laceration

Fractures and dislocations

B. Due to sharp edged weapons

Incised wound

Chop wounds

C. Pointed sharp edged weapons

Stab wounds

**II Thermal injuries:**

A. Due to cold

Frost bite

Trench foot

Immersion foot

B. Due to heat

Burns

Scalds

**III Chemical injuries:**

A. Corrosive acids

B. Corrosive alkalies

**IV. Injuries due to electricity:**

Lightning, X-rays, radioactive substances, etc.

The nature of an injury caused by a mechanical force is depend upon:

1. The type and shape of the weapon.
2. Amount of energy in the weapon or instrument when it strikes the body.
3. Whether it is inflicted upon a moving or a fixed body.
4. The nature of the tissues involved

### **Legal Injuries**

**Legal injuries are classified into simple and grievous.**

**Simple hurt:** Has not been defined in Indian law. However, an injury which is neither serious nor extensive but heals rapidly without leaving permanent deformity or disfigurement is a simple hurt.

**Grievous hurt:** Is defined in IPC Sec. 320 as the one which results in any of the following:

1. Emasculation meaning depriving a male of masculine vigour, rendering him impotent.
2. Permanent deprivation of the sight of either eye. An injury as a result of which there is only temporary loss of vision is not grievous.
3. Permanent deprivation of the hearing of either ear.
4. Deprivation of any member or joint.
5. Deprivation or permanent impairing of the powers of any member or joint, e.g. muscles or tendons are cut.
6. Permanent disfigurement of head or face. Disfigurement means marring the beauty of the person by means of an injury. Such disfigurement must be permanent. Face is taken as the front of head from forehead to the chin. Then an injury which leaves a visible scar on the face is grievous.
7. Fracture or dislocation of a bone or tooth. A fracture is defined as break through bone or cartilage. It includes a green stick fracture. If a fracture or dislocation is suspected it is to be supported by the medical officer's opinion by a diagram.
8. Any hurt which endangers life or which causes the victim to be in severe bodily pain or inability to follow his ordinary pursuits for a period of 20 days.

Examples of grievous injuries with regard to oral and maxillofacial region are:

1. Loss of teeth.
2. Fracture of teeth.
3. Avulsion of teeth.
4. Non-vitality of teeth.
5. Fracture of any facial bone.
6. Loss of soft tissue and severe scarring.
7. Neurological deficit (motor or sensory).

### **Fatal Injury**

It is one that causes death immediately or within a short time after its infliction. Death may take place inspite of surgical aid. These are the wounds involving the heart, large blood vessels, the brain, the upper part of the spinal cord, the lungs, the liver, the stomach, the spleen and the intestines.

The doctor who is performing the wound register entry should ensure that the full details of each wound/ injury

is made including the **nature of wound** (e.g. abrasion, laceration), **size** of the wound (e.g. length, width and depth in case of a laceration, or length and width in case of a superficial wound) and **age** of the wound if possible.

The following are the common types of wounds resulting from road traffic accidents or assault:

**Abrasions or gravel rash:** It is defined as injuries involving the superficial layers of the skin. In this case healing does not result in a permanent scar unless the dermis is also involved. The abrasions are caused by a lateral rubbing action by a blow, a fall on a rough surface, by being dragged in a vehicular accident, finger nails, thorns or teeth bite.

**Scratches:** Are caused by a sharp or pointed object passing across the skin, such as finger nails, pin or thorn. The surface layers of the skin are collected in front of the object which leaves a clean area at the start and tags at the end.

**Grazes:** Are the most common type of abrasion. They occur when there is horizontal or near horizontal movement between skin and a rough surface in contact with it. They show uneven longitudinal parallel lines, i.e. grooves and furrows with the epithelium heaped up at the end of these lines.

### **Age of abrasions:**

- |               |   |
|---------------|---|
| Fresh:        | bright red.   |
| 12-24 hours:  | lymph and blood dries up leaving a bright scab.               |
| 2-3 days:     | reddish brown scab.   |
| 4-7 days:     | epithelium grows and covers the defect under the scab.        |
| After 7 days: | scab dries shrinks and falls off, leaving a depigmented area. |

### **Medico legal importance of abrasion:**

1. They give an idea about the site of impact and direction of the force.
2. Abrasions can be the only external sign of serious internal injuries.
3. Patterned abrasions connect with the weapon used.
4. Age of the abrasion relates the time of occurrence.
5. The character and manner of injury may be known from its distribution, e.g. in throttling crescentric nail marks and in smothering abrasions around mouth and nostrils.

### **Contusions (Bruises)**

Contusion is an effusion of blood into the tissues due to rupture of blood vessels caused by blunt trauma. Bruises may be seen in association with abrasions and are called as abraded contusions. Children bruise more easily because of softer tissues and delicate skin and old persons bruise easily because of loss of flesh and more fragility of vessels.

**Ectopic bruises or migratory contusions:** The blood will track along least resistance and may appear where the tissue layers become superficial, e.g. black eye. The site of bruise does not always indicate the site of violence.

### **Age of Contusion(bruise):**

At first:	red in color.
Within a few hours to 3 days:	it turns to blue.
4th day:	bluish black to brown due to hemosiderin.
5 to 6th day:	greenish due to hematoidin.
7 to 12 days:	yellow due to bilirubin.
After two weeks:	become normal in color.

In antemortem bruise there is swelling, damage to epithelium, extravasations, coagulation and infiltration of tissues with blood and thereby color changes.

**Complications:** A contusion may contain 20 to 30 ml or even more blood, multiple contusions can cause death from shock and internal hemorrhage. Gangrene and death of tissues can result. The pooled blood can serve as a good site for bacterial growth especially by clostridia group.

**Artificial bruises:** Some irritant substances when applied to skin produce injuries which simulate bruises, they are produced to make false charges of assault, e.g. marking nut, juice of mango peduncle, or papaya peduncle, calotropis, etc.

## **INCISED WOUNDS**

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Incised wounds are clean cut wounds without loss of tissues caused by sharp cutting instruments such as razor, knife or dagger. The edges are clean cut, regular and everted. Unlike laceration bleeding will be minimal due to retraction of blood vessels; unless major vessels are cut. Healing will be faster. Incised wounds can be suicidal, accidental or homicidal.

## Stab Wounds (Punctured Wounds)

Stab wounds are caused by the thrusting in of sharp pointed objects such as a knife, arrow, scissors, etc. into the body. The edges are cleanly cut and regular if caused by a sharp cutting weapon called as incised punctured wound. Those injuries caused by a pointed or conical instrument have lacerated edges and the wound appears stellate (lacerated punctured wounds). The shape of the external wound depends upon the nature of the weapon. A single edged weapon produce a wedge shaped wound of which one end is sharply cut and the other end rounded or flat. A double edged weapon produces a spindle shaped wound-both ends may be sharply cut. A single edged weapon rarely produce a spindle shaped wound especially thin blade of the knife is used. A pointed cylindrical or conical instrument produces a stellate injury with lacerated margins. A rubber taper's knife may produce boat shaped injury.

Sometimes small abrasions and associated contusions may be seen on the skin beyond one or both ends of the wound. This is caused by the hilt of the weapon (hilt mark) and therefore indicates the type of the weapon or the depth of penetration of the weapon.

A punctured wound that penetrates the body cavity is called a **penetrating wound**

## Lacerated Wounds

Resulting from tearing or splitting of tissues. Forces such as stretching, tearing, splitting, compressing and grinding of the skin can result in lacerations. The margins of the wound are irregular and ragged and may show shelving. Hair bulbs and fat cells are seen crushed along the margins of the wound. Small bridges of connective tissues are seen stretching across the gap. Various degrees of bruises are at the margins of the wound. Incised looking lacerations may be seen on scalp and other bony prominences. Wound caused by a blunt, heavy cutting weapon such as an axe are often lacerated rather than incised wounds.

## Age of Wounds

The age can be assessed from the process of repair of a wound. The speed of repair depends on the type of wound and whether it is infected or not.

**The repair of a clean incised wound (healing by primary intention):** During the first 24 hours a mild inflammatory reaction and edema of the edges seen. The inflammatory cells are initially polymorphs and later monocytic macrophages and lymphocytes appears. Macrophages loaded with hemosiderin can be recognized in 12 to 24 hours.

**Healing by granulation tissue formation (Healing by secondary intention):** Healing of an open or infected wound occurs by the formation of granulation tissue. The gap is filled with coagulated blood fibrin and inflammatory exudates. Fibroblast and capillary buds grow into it and form the granulation tissue.

**Healing of fracture:** External callus (primary callus) forms at the end of first week. Intermediate callus and internal callus may be formed by two to three weeks time. A period of two to three months is required for complete healing.

## Cause of Death from Wounds

Primary or immediate cause of death

1. Hemorrhage
2. Gross injury to vital organs
3. Primary or neurogenic shock
4. Air embolism.

Secondary or remote cause of death.

1. Infection
2. Gangrene
3. Renal shut down
4. Thrombosis and embolism
5. Fat embolism
6. Exacerbation of the pre existing diseases, e.g. tuberculosis.

## WOUND CERTIFICATE

Literally the term wound means a bodily injury caused by physical means with disruption of the normal continuity of the structures. After the examination of the wounded patient a wound certificate should be issued containing the preliminary data, examination findings including the history and opinion as to cause of injury. The injuries should be described in detail, i.e. the nature, the size, shape, exact location, depth, etc.

Description of injury recorded in the wound certificate must be precise and the following points must be noted:

1. Number.
2. Nature, type of injury, i.e. abrasion, contusion, laceration, punctured, incised or stab wounds, firearm wounds or fractures mentioning the types.
3. Exact dimension(length,width,depth), shape and location.  
(Do not probe a deep wound in the casualty)
4. Condition of edges—i.e. regular, contused, ragged, inverted or everted.
5. Direction of wound (e.g. bevelling in incised wounds).
6. Presence of foreign bodies of any kind (e.g. fragments of glass or metals or broken part of weapon/ material causing the injury, paint flakes, grease sand, mud, etc.)
7. Extent of bleeding if any
8. Age of the injury by noting inflammatory /repair changes, color changes in contusions, etc.
9. Mechanism of production—kind of weapon, dimensions of weapon and any other feature to establish identity of the weapon if present.
10. Manner of infliction—self infliction or otherwise. Whether consistent with the alleged cause of injury by studying all data observable from injuries.

## DENTAL/ORAL AND MAXILLOFACIAL SURGEONS AS EXPERT WITNESSES

(Adapted with kind permission of Dr George Paul)

Dental/Oral and Maxillofacial surgeons are often called upon to give evidence in civil or criminal cases. When a Dental Surgeon is called upon to give evidence as part of forensic evidence he needs to have a grasp of the subject of Forensic odontology. Forensic odontology has been used extensively in many sensational cases in India.

Dental/Oral and Maxillofacial surgeons are often summoned to court in situations like:

1. To testify the veracity of the injury recorded in the wound certificate or authenticity of other certificates issued by the Dental/Maxillofacial surgeon in case of an alleged assault or road traffic accident.
2. Evaluation of disability after dental or maxillofacial injuries.(Motor Accidents Claims Tribunal)

3. For opinion regarding the procedures adopted by other doctors/dentists in cases of alleged negligence. (Consumer Disputes Redressal Forum.)
4. To give expert opinion in matters related to Forensic odontology.

Expert witnesses are issued summons. When summoned, the dentist is obliged to present himself before the court at the appointed date and time. He may be questioned by the lawyers of the prosecution, defence or the insurance company, as to the nature of injury and the quantum of disability. The dentist is to clearly state his opinion without ambiguity and should remain non-committal about subjects that he is not sure about. If the dentist has issued a wound certificate, the copy of the same will be given to him for reference at the time of testifying. The witness is to merely state the facts. He is not expected to involve himself with law on the subject. For example, loss of teeth, fracture of teeth, etc. He may answer truthfully any other question pertaining to the same.

Today, there does not exist any quantified disability criteria for dental and maxillofacial impairment in India. The Association of Oral and Maxillofacial Surgeons is in the process of evolving criteria for dental and maxillofacial disabilities and deformities. Until such time dentist can use the rather incomplete reference from 'The Manual for Permanent Disability' brought out by the CGHS, WHO and AIIMS in 1981. Other references can be obtained from McBrides disability criteria or the criteria established the American Association of Oral and Maxillofacial Surgeons (which may not be very relevant to our population). However a dentist may state if the injury is grievous or not. He may also elaborate on the actual disability that the defect might cause. Examples of grievous injuries with regard to oral and maxillofacial region has already been mentioned in this chapter.

### *Quantification of Dentofacial Disability/Deformity (after Dr George Paul)*

Form and function are the quintessence of human life. Disability and deformity are interruptions to this harmony. Disability/deformity may be congenital or acquired. Governments have a social responsibility to mitigate such afflictions by creating an environment for re-integrating them into normal social life. Most welfare states provide benefits for persons with disability.

Disability can also be caused by accidents, interpersonal violence and iatrogenic causes. These situations have legal overtones and often require compensation in some form. Benefits and compensation can only be calculated if the disability is quantified. Orthopedic disabilities in civil and military life have been calibrated and quantified. Similarly, other disabilities involving locomotor, neurological, visual and hearing deficit have also been quantified. Unfortunately, the maxillofacial region has not been adequately addressed in any of these quantification charts.

Quantification of the maxillofacial region is unique on account of the fact that there are two criteria to be evaluated—disability and deformity. While disability is more readily calculated, deformity is highly subjective and therefore any award for the latter is bound to be arbitrary. However, it is not possible to ignore the importance of deformity to the face, and an attempt is made to establish a broad parameter in which it can be assessed.

### *Review of Quantification Criteria*

Quantification of orthopedic disability is well established and has been in use for social benefits, rehabilitation, assistance and percentage reservations in labor market placement of disabled people. It has also been in use for legal and insurance compensations due to accidents, interpersonal violence and occupational diseases. The Phulhems profile by the Canadian Army was established as early as 1943. The McBrides criteria was the established reference in India till 1980. It did cover some aspects of the maxillofacial region and was generally accepted for dental injuries and dental loss. The McBrides criteria (1955) was replaced in India by the "Manual for Doctors to Evaluate Permanent Physical Impairment" (1981). Unfortunately, the impairment and disability of the face is covered rather incomprehensively and inadequately, relegating the whole area of the face to one half of a chapter, with hardly 30 points being allocated to the face. Not one maxillofacial surgeon sat on the expert committee of 45 advisors. In the realm of physical rehabilitation and orthopedics, numerous references are available. Kessler (1970) covered various aspects of upper and lower extremity disabilities. The American Academy of Orthopedic Surgeon's Manual (1966) discusses the concept of permanent impairment through a serious of

questions that reveal the permanency of the deficit. The Government of India notification (1986) covers visual disabilities, locomotor disabilities and hearing, and speech disabilities. It recommends that Kessler's formula can be taken as a general guide line.

Significantly, the only other Indian guideline for maxillofacial region comes through a Government of Tamil Nadu notification (1974) where complete facial disfigurement is dealt with. It simply awards a 50 percent for total facial disfigurement. No break up figures is given for type or severity of disfigurement.

The American Association of Oral and Maxillofacial Surgeons and American Medical Association have given guidelines for assessment of maxillofacial injuries and disabilities. They however need modification to suit our population and needs.

Dr Paul has depended on two major sources while making the evaluation.

1. Objective evaluation of impairment and ability in locomotor handicapped by Sabapathyvinayagam Ramar, an excellent reference book on Physical Medicine and Rehabilitation.
2. Guidelines to the Evaluation of Impairment of The Oral and Maxillofacial Region—issued by the American Association of Oral and Maxillofacial Surgeons.

Dr Paul has modified the guidelines of the above sources to arrive at the following recommendations.

The general aim of the exercise was to evolve quantification criteria for disabilities and deformities of the maxillofacial region taking into account the special features of the problems encountered in India. It also endeavours to simplify the percentages awarded by eliminating complex variables. The evaluation adopts a position of awarding a 100 percent to the face to be divided between deformity (50%) and disability (50%). It does not try to evaluate facial impairment as a part of the total body as it would significantly reduce the quantum of impairment and thus defeat the purpose of this exercise. Consider a situation where 100 percent has to be divided between cardiovascular, alimentary, central nervous and locomotor systems in addition to sexual dysfunction, liver dysfunction, renal, endocrine and metabolic dysfunctions. Further distribution amongst visual, hearing, etc. will certainly minimize any help of giving value to the face.

## **222 A PRACTICAL GUIDE TO HOSPITAL DENTISTRY**

The evaluation has also eliminated the need to go into variables like age, sex and occupation, which will modify the award percentages. These will rest within the realm of the government agencies, judiciary or insurance agents.

The criteria formulated shall simply make a statement of disability/deformity based on standards established within the purview of the 100 percent for the face—equally divided amongst the various structures and functions. The total of these shall remain within hundred utilizing the formula

$$A + \frac{B(100 - A)}{100}$$

where, A = higher value and  
B = lower value.

### **Definitions**

Based on Government of India Gazette Part I section 1 No. 4-2/83—HW III Ministry of Welfare, 1986.

*Impairment* is defined as any loss (or) abnormality of psychological, physiological (or) anatomical structure (or) function.

*Disability*: WHO defines disability in the context of health experience as any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner (or) within the range considered normal for a human being.

*Deformity*: Facial disfigurement involving soft and hard tissues arising from multiple genetic factors, environment influences, acquired defects, neoplastic processes and trauma.

### **Recommended Quantification for the Dentofacial Region**

#### **Areas of deformity evaluation—Hard Tissues.**

##### **A. Loss of teeth:**

Anteriors	Deformity/Disability
All anteriors (upper and lower)	: 25%
Between 8 and 11	: 20%
Between 4 and 7	: 15%
Between 2 and 3	: 10%
One tooth	: 05%

Though these are disabilities and deformities that can be replaced, it deserves the above percentile as the strength and function of false teeth are not considered

equal to natural teeth. Orthopedic deformities are evaluated even if prosthesis is given.

Posteriors	Disability
Excluding third molars and including premolars.	
All posteriors (16)	: 25%
Between 10 and 14	: 20%
Between 6 and 9	: 15%
Between 2 and 5	: 10%
Occlusal discrepancy	: 10-20%
One tooth	: 05%

Loss of teeth due to progressive dental pathology (e.g. Periodontitis, Caries) are not considered. The dental surgeon will have to make an assessment based on the condition of remaining teeth or preexisting records.

B. Loss of bone	Disability
Significant loss of bone causing	
Deformity/Disability	: 10-25%
Small bony fragment	: 5%

C. Malunited facial bones	(depending on extent of disability/deformity)
Malunited facial bones	: 10-20%
Occlusion to be combined whenever affected.	

This is an incomplete quantification and will have to be assessed by the surgeon on the basis of the degree of disability/deformity caused by the malunion.

D. Orbital Deformity (excluding visual field assessment)	
Subjective evaluation based on:	
Bony orbit:	: 5-10%
Soft tissue, e.g. ectropian, scar etc:	: 5-10%
Composite deformities including	
Telecanthus etc:	: 15-25%

#### **Areas of Deformity Evaluation—Soft Tissue**

A. Soft Tissue—Non-reversible	
Single linear scar	: 5%
Multiple or deforming scars	
Including Keloids	: 10-30%
Significant loss of soft tissue, e.g. Loss of nose, ear, lips, etc.	: 20-50%

B. Facial sensory impairment (Ramar)	
Face has 34 percent sensory innervations of whole body.	

Ophthalmic	: 8%
Maxillary	: 8%
Mandibular	: 8%
Tongue	: 10%
<b>C. Impairment rate for mouth opening (Ramar)</b>	
Impairment rate for interincisor distance of 4 cm	: 0%
Impairment rate for interincisor distance of 3 cm	: 10%
Impairment rate for interincisor distance of 2 cm	: 20%
Impairment rate for interincisor distance of 1 cm	: 30%
Impairment rate for interincisor distance of 0 cm	: 50%
<b>D. Motor disability (Ramar)</b>	
Jaw muscles (masticatory)	: 5% right side, : 5% left side.
Tongue muscles	: 15% either side.

**E. Facial nerve impairment**

Single branch	: 5%
Five branches	: 25%
Zygomaticotemporal	: 10%
Bilateral problems are not addressed.	

**F. Disfigurement criteria (AAOMS and AMA guidelines 1997 and 2002)**

Class 1—(0-5%) Disorder of cutaneous structure, e.g. visible scars.

Class 2—(5-10%) Loss of supporting structure with or without cutaneous disorder, e.g. depressed cheek and nose.

Class 3—(10-15%) Absence of normal anatomical area of face. For example, loss of eye or part of nose. Visual or hearing loss will have to be separately evaluated.

Class 4—(15-35%) Impairment of whole person. Facial disfigurement is so severe that it precludes social acceptance.

This criteria appears logical and it significantly simplifies an otherwise complex quantification of facial disfigurement. However, we would encourage its use with the other mentioned parameters. The multiple percentages can be resolved with the Kessler's formula.

In multiple disabilities and deformities or when there is a combination of the two the Kessler's Formula

$$A + \frac{B(100 - A)}{100}$$

can be used, where

A = the higher and

B = lower value.

Another formula has also been used by Ramar as per the Government of India notification:

$$A + \frac{B(90 - A)}{100} \quad \begin{matrix} \text{again A being the} \\ \text{higher value and B} \\ \text{being the lower value} \end{matrix}$$

The formula can be used in a few mock situations.

1. X has an injury resulting in the fracture of the mandible and loss of four incisors. He also develops a paresis of the marginal mandibular nerve following surgery. His total percentage may be calculated thus: A=15% and B = 5%.

$$15 + \frac{5(100 - 15)}{100} = 19.25, \quad \begin{matrix} \text{whereas the sum of} \\ \text{both would have} \\ \text{been 20\%.} \end{matrix}$$

2. Y has an injury resulting in the fracture of both condyles causing subsequent total bony ankylosis. He also has a large scar with keloid on his right cheek. His percentage is calculated thus:

$$50 + \frac{20(100 - 50)}{100} = 60 \quad \begin{matrix} \text{whereas the sum of two} \\ \text{injuries would have} \\ \text{been 70\%.} \end{matrix}$$

Please note that the value adjusts itself as the percentiles go up.

Quantifying all kinds of disabilities/deformities is an enormous task. The above quantification deal with only those disabilities resulting from accidents. Congenital disabilities/deformities such as those found in cleft-craniofacial anomalies will require a more extensive analysis. Similarly, disabilities and deformities caused by aggressive tumors and cancers of the head and neck comprise a wide range of problems, which are not necessarily regional. Cancer in particular may have numerous associated problems ranging from donor site morbidity to psychological impact affecting quality of life and mental depression.

Dental injuries and their resultant disability/deformity are closely linked to aesthetics and mastication. For the

purpose of awarding percentiles, the anterior teeth were considered for aesthetics and the posterior teeth for masticatory function. The awards are arbitrary and are based on the relative dysfunction caused by the absence of teeth in the masticatory apparatus. The American Association of Oral and Maxillofacial Surgeons (AAOMS) guidelines award percentages for the complete masticatory apparatus. It awards 24 percent for a person who is restricted to liquid diet (40-60% if tube feeding is necessary) and 5 to 19 percent if person is restricted to semisolids (includes those with ability to wear dentures). In the quantification described above, points were given for individual teeth. However, if the whole masticatory apparatus is to be evaluated, one may separately evaluate absence of teeth, occlusal disharmony, TMJ movement (craniomandibular articulation), muscle power, etc. and arrive at a figure by using the Kessler's formula of

$$A + \frac{B(100 - A)}{100}$$

This appears as a reasonable formula, which accounts for individual disabilities within the framework of the masticatory apparatus.

Further, the AAOMS guidelines classifies the percentiles into two categories.

1. Percentage of normal.
2. Percentage impairment of whole person.

The dichotomy does not seem reasonable and is likely to cause further confusion. Finer details such as lateral

excursion etc which, have been dealt with in the AAOMS guidelines have been ignored.

Similarly, the concept of deformity and disfigurement has been dealt with differently in the AAOMS and the AMA guidelines. The matter of disfigurement is complicated by issues such as personality crisis and the impact of social acceptance. As suggested earlier this criteria can be incorporated into Kessler's formula, thus resolving the issue of multiple disabilities and deformities.

Finally, the question is who can give a disability certificate. The Indian sources are silent in the matter of maxillofacial injuries. However, the law in many American states clearly provides for the role of a board qualified oral surgeon or maxillofacial surgeon to issue disability certification for the maxillofacial region.

Contrary to general perception, it is not necessary that these criteria need to be made by statutory bodies. General usage can give legal legitimacy. It would of course be in the best interest of the surgeon, patient and the public if these suggestions can be scrutinized, amended and enlarged to accommodate a larger spectrum of disabilities and deformities.

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## SUGGESTED READINGS

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# 18

## Medical Negligence

**George F Moolayil**

With the advent of Consumer Protection Act and awareness of the patients regarding their rights, a lot of litigations have arisen against the medical professionals. In the olden times, the medical professionals were considered like gods and were unquestioned in whatever they used to do. Now in the age of enlightenment regarding the rights of the patients, things have changed and it is imperative on the part of the doctor to be careful and knowledge of what constitute medical negligence is necessary on his part.

### MEDICAL NEGLIGENCE

Negligence is not susceptible of any precise definition. Various meanings can be attributed to negligence. It can be said that negligence is a careless conduct without reference to any duty to take care. Lord Wright in *Lochgelly Iron and Coal Co. V M Mullan* [1934] AC 1, 77 Sol Jo 539 has pointed out that negligence means more than heedless or careless conduct, whether in omission or commission; it properly connotes the complex concept of duty, breach and damage thereby suffered by the person to whom the duty was owing. Negligence is a tort which involves a person's breach of duty that is imposed upon him to take care, resulting in damage to the complainant. The essential components of the modern tort of negligence propounded by Percy and Charlesworth [*Charlesworth and Percy on Negligence*, 9th Ed, p. 16 (1.25)] are as follows:

- a. The existence of a duty to take care, which is owed by the defendant to the complainant;
- b. The failure to attain that standard of care, prescribed by the law, thereby committing a breach of such duty, And
- c. Damage, which is both causally connected with such breach and recognized by the law, has been suffered by the complainant.

If the plaintiff proves that the doctor was negligent, but fails to establish that any loss or injury was caused thereby, then he will not be entitled to claim any compensation [*Sidhraj Dhadda vs State of Rajasthan* AIR 1994 Raj 68; 1993(1) Raj LW 532]. The general test for causation required the plaintiff to establish that the injury would not have occurred, but for the negligence of the defendant.

Negligence can be fixed under law of tort where tortious liability arises from the breach of a duty primarily fixed by law; this duty is towards persons generally and its breach is redressible by an action for unliquidated damages. The negligence can also be fixed under contractual liability, liability of retainer, criminal liability and under consumer law.

Negligence occurs only when there is a failure to attain the standard of care prescribed law. It has been laid down by the Supreme Court in *Dr LB Joshi v. Dr TB Godbole* (AIR 1969 SC 128) that the doctor must bring to his task

a reasonable degree of skill and must exercise a reasonable degree of care. Neither the highest nor the lowest degree of care is expected. It is well established law that it is sufficient if he exercise the ordinary skill of an ordinary competent man exercising that particular art. A person who holds himself out ready to give medical advice and treatment impliedly undertakes that he is possessed of skill and knowledge for the purpose. Such a person when consulted by a patient owes him certain duties, viz. a duty of care in deciding whether to undertake the case, a duty of care in deciding what treatment to give, or a duty of care in the administration of that treatment. A breach of any of those duties gives a right of action for negligence to the patient. The practitioner must bring to his task a reasonable degree of skill and knowledge and must exercise a reasonable degree of care. Neither the very highest, nor a very low degree of care and competence judged in the light of the particular circumstances of each case is what the law requires. So in a case of dental surgeon, he will be assessed for negligence on the basis of the standard prevailing in similar situations and not on the basis of high standard available in advanced countries.

#### *Common Allegation of Negligence Against Dental Surgeons*

Patients attend the dental surgeons for pain or discomfort in teeth, gums, jaws, face or temporomandibular joints. Pain may be caused due to damaged pulp of tooth, dental caries, trauma, loss of protective enamel or inflammation or abscess formation. Failure to recognize obvious lesions and to treat the patient is considered negligence. Similarly, failure to identify the causes of pain amounts to negligence if appropriate investigation is not prescribed.

The extraction of wrong tooth by the dental surgeon is always considered negligence. Omission to obtain satisfactory medical history and record of drug therapy before commencing treatment may be considered negligence, if complications due to treatment, which would have been evaded had precautions been taken in time, occur subsequently.

The duty of the dental surgeon is to examine carefully ulcers, swellings or other lesions of the soft tissues of the mouth and to refer to consultant for assessment of any

condition or symptom which persists despite diagnosis and treatment or for which no diagnosis can be made. The prime duty of the dental surgeon is to avoid damage to the pulp during cavity preparation. The dental surgeon may invite potential litigation by cementing permanently the bridges or crowns on teeth displaying symptoms of pulp damage. The object of treatment during root canal therapy is to remove the pulp from within the tooth and eliminate infection and to seal the canal to prevent any further risk of infection. Failure to place and adequate root filing which seals the cavity of the root canal can lead to periapical infection or cyst formation which is considered negligence when it results in failure of crowns and bridges placed on a tooth with defective root filing. Precaution has to be taken to see that implements like needle etc. are not dislodged and swallowed by the patient.

#### *Few Judgments Regarding Negligence*

Failure to warn of alteration in sensation—The patient suffered permanent damage of lingual nerve during surgery to remove three wisdom teeth. This resulted in pain and loss of taste. A case was filed against the Surgeon alleging that he was negligent in conducting the surgery and not explaining the possibility of alteration in sensation. It was held by the Queen's Bench in UK [Health Vs Berkshire Health Authority (1991)8 BMLR 1998] that damage to the nerve was due to lack of care and skill on the part of the Surgeon who allowed the drill to cut into the lingual nerve. However, the negligence on the part of the Surgeon in not issuing the warning was not established because a responsible body of professional opinion was in favor of not issuing warning of the risk of the symptoms involving partial loss of taste and unpleasant sensation in the mouth. Similarly, an Orthodontist was held to be negligent during extraction of a wisdom tooth when the burr of the drill severed the lingual nerve of the patient [Tomkins v Bexley Health Authority (1993)4 Med LR 235].

In a case where the needle got detached from the syringe and slipped into the throat of the patient, the State Commission of Karnataka [Amblappa v Sriman D. Veeendra Hegde 1999(3) CPR 72 (Bangalore)] held the doctor negligent for not exercising due care and skill

at the time of irrigating the mouth of the patient by applying the principle of *res ipsa loquitur* (the fact speaks for itself), as the doctor could not explain as to why the needle was detached from the syringe while irrigating the mouth of the patient.

**Sufferings for defective dentures**—The complainant got prepared dentures for himself and for his wife from a doctor. Both the sets of dentures did not fit properly to the respective recipients who suffered from pain and injury in the mouth. The National Commission reversed the order of State Commission and upheld the order of District Forum which held the doctor negligent and awarded compensation of Rs. 1000 against the doctor [Ishwar Das v Vinay Kumar Gupta II (1992) CPJ 118 (NC)].

## Consent

### Introduction

Informed consent is the legal embodiment of the concept that the right of a person over his own person is inviolable except under certain conditions. Section 13 of Indian Contract Act defines consent as “the two or more persons are said to consent when they agree upon the same thing in the same sense”. The law protects the individual’s right to give informed consent by requiring the disclosure of information by the party to whom consent is given. In the case of doctor-patient relationship the onus of disclosure of information lies with the doctor and the right to decide the manner in which his/her body will be treated lies with the patient. So the doctor is duty bound to disclose information as to the risks, which can arise from the treatment of the patient. Risk may be defined as “exposure to a chance of an injury or loss.” Medical informed consent law requires the disclosure of risks of and alternatives to suggested medical procedures to enable patients to make knowledgeable decisions about the course of their medical case.

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Currently the courts nearly unanimously treat lack of informed consent as a matter of negligence of the physician to disclose necessary information to patients. As in all other substantive areas of **tort** law, there must be a causal link between the defendant’s failure to disclose the risk and the injury suffered by the plaintiff/patient.

Consent is an act of reason accompanied with deliberations, the mind weighing as in a balance, the good and bad on each side. The consent that is given must be intelligent and informed and should be given after understanding what is given for and the risks involved. None is allowed to give consent to anything intended to cause his/her death.

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### General Principle

There is more to consent than getting a patient’s signature on a consent form. The principles forming the corner stone of informed consent is enunciated by Lord Scarman in the case of Sidaway V Board of Governors of Bethlehem Royal Hospital.

- It is a basic concept that an individual of adult years and sound mind has a right to choose what shall happen to his/her body.
- The consent is the informed exercise of a choice and that entails an opportunity to evaluate knowledgeably the options available and the risks attendant on each.
- The doctor must therefore disclose all material risks. What risks are material is determined by the prudent patient test, which determines what a reasonable patient in the position of the patient would attach significance to in coming to a decision on the treatment advice given.

There is however a therapeutic privilege for the doctor to withhold information, which is considered to be to

the “psychological detriment” of the patient. It will be advisable not to emotionally disturb or rather upset the patient by explaining all sorts of risks and complications involved. It is advisable to enjoin the close relatives if needed, and the consent has to be obtained from them also in such situations. There is no requirement in law that every possible complications and side effects should be informed to the patients. However recent court cases show a trend by the judges to require more detailed explanations to be given than earlier.

### **Standard of Disclosure of Information**

There are two dominant approaches to defining the standard of disclosure of information by which the physician's duty to their patient is measured. A majority of courts require the physician to disclose information that other physician possessed of the same skills and practicing in the same or similar community would disclose in the same situations. A large minority of courts apply the materiality of “prudent patient” approach allowing them to decide whether risk or other information would have been considered significant by the reasonable patient in making a decision. Even when therapeutic privilege for the doctor to withhold information which is considered to be to the ‘psychological detriment’ of the patient, is taken as a defense for not making the disclosure, it has to be supported by other physicians possessed of the same skill and practicing in the same or similar community. A case was filed against the Surgeon alleging that he was negligent in conducting the surgery and not explained the possibility of alteration in sensation. It was held by the Queen's Bench in UK [Health Vs Berkshire Health Authority (1991)8 BMLR 1998] that damage to the nerve was due to lack of care and skill on the part of the Surgeon who allowed the drill to cut into the lingual nerve. **However, the negligence on the part of the Surgeon in not issuing the warning was not established because a responsible body of professional opinion was in favor of not issuing warning of the risk of the symptoms involving partial loss of taste and unpleasant sensation in the mouth.**

The duty of the Dental Surgeon is to warn the patient of the possible damage to the sensory nerve supply to

soft tissues of lip, tongue and cheek due to difficult extraction of teeth. Omission to inform the patient of the accidental fracture of teeth, or jaw, or breaking of root during extraction of teeth is negligence on the part of the dental surgeon. It is obligatory on the part of the Dental Surgeon to remove the broken root of teeth if it is considered necessary, or to explain the patient about the risk of complications if the removal of broken root is considered to be of greater risk of damage to the patient.

Prior consultation with the patient about the matching of color and shape of the restored teeth is mandatory, where crowns, veneers, or bridges are to be constructed. Failure to warn the patient of the stark reality that replacement by dentures of natural teeth can never recreate the chewing and masticating ability of the patient's natural teeth, may be considered negligence. Omission to advise the patient adequately of the scope of treatment—the likely outcome and risks of failure may also amount to negligence.

### **Types of Consent**

#### *Implied Consent*

It is a situation where a patient by virtue of his action gives consent. When a patient approaches a dental doctor for tooth extraction, it implies his willingness to get his tooth extracted by the doctor. However, it is always safer to get a written consent showing the position of the tooth to be extracted.

#### *Express Consent*

Express consent is given when a patient states agreement in clear terms, orally or in writing to a request. A perfectly valid consent may be given orally. However a written consent is preferable as it provides documentary evidence of the agreement. Legal action regarding consent may take place years after the consent was given and it will be difficult to remember the terms of the consent. It is always better to get a written informed consent where any treatment or procedures carry some risk of injury. It also would be advisable to seek written consent in the case of those whom the physician regards as troublesome patient.

#### *Blanket Consent*

Some hospitals when admitting the patients obtain consents to the effect that they are willing to undergo

any type of treatment including surgeries without mentioning any particular procedure. These are known as blanket consents. However these consents have no legal validity as they do not mention any specific procedures or their complications.

### *Proxy Consent*

It is a situation when some other person is responsible for giving a consent for a patient who is unable to give the consent. This is so in the case of a legal guardian who is giving the consent on behalf a minor or a near relative of an unconscious patient. Proxy consent is not legally valid if the patient is a major and of sound mind and is in a position to give the consent himself/herself.

### *Informed Consent*

In medical practice anything beyond the routine would require this type of consent. Here the doctor explains to the patient relevant details regarding the nature of his disease, the diagnostic procedures involved, the course and alternatives to the treatment proposed, risks involved and the prognosis. The relative chance of success or failure is explained so that the patient can take an intelligent decision after attaining a comprehensive view of the situation. Yet in practice things are not that simple. The patient may be in dire need of treatment, but revealing the risks involved—the law of “full disclosure” may frighten him to a refusal. This situation calls for the common sense and discretion of the doctor. What should not be revealed may at times be a problem. In such situation “Therapeutic privilege” is an exception to the rule of “full disclosure”. The doctor may in confidence, consult his colleagues to establish that the patient is emotionally disturbed. Apart from this, it is good for the doctor to reveal all risks involved, in confidence to one of the close relatives and involve them in decision-making. Informed consent has now become a must in all operation, anesthetic procedures, complicated therapeutic procedures and any procedures, which carry some risk. In the years to come, with the great advances in science and awareness of people regarding their rights with respect to treatment and consent, the importance of informed consent will increase only.

Informed consent has now become a must in all operation, anesthetic procedures, complicated therapeutic procedures and any procedures, which carry some risk. In the years to come, with the great advances in science and awareness of people regarding their rights with respect to treatment and consent, the importance of informed consent will increase only.

### *Emergencies and Consent*

A doctor can lawfully operate or give other treatment to adult patient who are incapable of consent to his doing so, provided that the operation or treatment is in the best interest of such patients. The operation or treatment will be in their best interest only if it is carried out in order either to save their lives or to ensure improvement or prevent deterioration in their physical or mental health. It is clear that in cases of emergency or unconsciousness all considerations regarding consent will be set aside and doctor will do whatever is necessary to save the life of a patient, child or adult, to save him from permanent disability or from unnecessary pain and sufferings. Accordingly in life threatening situations, doctors would not be required to consult with parents of minor patients, though in normal course of events they would be required to make consultation and consider any reasonable alternative to the proposed treatment.

Medical and not legal consideration are of greater importance in life threatening situations and the courts are most unlikely to censure a practitioner for proceeding to provide essential treatment in an emergency.

However the doctor should do only that which is immediately necessary for the patient's well being, if during an emergency procedure, some coincidental and nonurgent problem is encountered it should not be dealt with until later, after consent has been obtained. The principle to guide the practitioner is to act in good faith and in the immediate interest of the patient's health and safety. If there is any element of doubt there should be no hesitation in seeking the advice and opinion of one or more colleagues. If the emergency arises in an unconscious patient, the practitioner should, if time permits, endeavor to obtain the consent of the next of kin. But if urgent treatment or investigation is essential

the doctor should have no hesitation in proceeding to do what is necessary. The next of kin's consent is not legally necessary nor will it justify a practitioner in treating an unconscious patient unless he is otherwise justified because it is a situation of urgent necessity. If no relative or responsible person is available, permission of Superintendent of hospital, police or judicial officer can be obtained. It is also advisable to get a written statement from a professional colleagues that an emergency surgery or procedure was indicated.

### **Consent and Treatment of Children**

Section 3 of Indian Majority Act 1875 speaks of attainment of majority on completion of the age of eighteen years. A person who has not completed the age of 18 years is a minor. Any person of sound mind who has attained the age of 18 years may give a legally valid consent to surgical, medical or dental treatment or procedures. Section 90 of the Indian Penal Code specifically excludes consent given by a child under 12 years of age as invalid. What has been less clear is the validity of consent given by patients who are above 12 years of age and under 18 years of age. As a matter of law, the parental right to determine whether or not a patient of such an age will have medical treatment, terminate if and when the child achieves a sufficient understanding and intelligence to enable him or her to understand fully what is proposed. A patient belonging to this age group of between 12 and 18 years and who is capable of appreciating fully the nature and consequences of a particular operation or treatment can give an effective consent thereto and in such cases the consent of the parent or guardian is not necessary. This capacity to understand is a question of fact to be determined by the court on the basis of evidence adduced during trial. A case in point would be a decision of Madras High Court where a minor refused to terminate her pregnancy caused outside marriage, and that court accepted her choice and overruled the prayer of her father for termination of pregnancy. However in India the pregnancy of minor woman cannot be terminated except with the consent in writing of her guardian.

Under the common law the natural guardian has power to do all acts, which are necessary or reasonable

and also proper for the benefit of the minor. In the absence of the natural guardian, the District Court is authorised to appoint the guardian for the welfare of the minor in accordance with the law to which the minor is subject and such guardian must look after the health of the minor. The natural guardian and in his absence, the guardian appointed by the court has the legal authority to give consent for medical or surgical treatment on behalf of the minor child. The judge exercising wardship jurisdiction can give consent to a particular treatment or procedure. The paramount consideration for the exercise of wardship jurisdiction is the welfare and best interest of the ward in question. The court under wardship jurisdiction can authorise to carry out the treatment by overriding the decision of the parents. A classical example is a case where a 15 years old boy suffering from leukemia required blood transfusion as life saving measure and the parents of the boy being devout Jehovah's witnesses refused consent for the blood transfusion. The court under wardship jurisdiction granted permission to the hospital authority to carry out the treatment overriding the decision of the parents.

### **Obtaining Consent**

Whichever consent is obtained, whether express or implied, oral or written, the paramount consideration is that care should be taken to explain the intention, nature and purpose of what is proposed so that the party signing it truly comprehends what is involved when his/her agreement is sought. It would not be realistic to insist upon a written request for all examination and procedures and common sense is required in deciding whether the consent should be evidenced in writing. It is prudent to seek written consent for procedures involving general anesthesia and surgeries and for more complex and hazardous procedures and in any procedures, which carry some risk. It is advisable to make the person who is giving the consent to write in his own handwriting so that the validity of the consent cannot be questioned later on. In many cases consent is really too important a topic to be delegated to junior staffs or others since it often calls for careful clinical judgment and explanation.

It is necessary to obtain appropriate consent. Where two or more procedures are planned it is necessary to

have consent for each. Sometimes when the procedures which was envisaged was amended, some hospital staff have the habit of crossing the original description and adding the amended procedure without getting it re-signed by the person giving the consent. This consent has no validity. If a change is made to a planned procedure, it must be explained to the patient and a new form should be completed, signed and witnessed. Never get blanket consents from the patient.

### **Validity of the Consent**

To be valid the consent must be real. The following situation will make the consent invalid—

- If it was obtained by fraud
- If it was obtained by misrepresentation as to the nature of the procedure
- If it was obtained by undue influence or threat of violence
- A consent obtained when the patient was under sedation
- When there is failure in giving proper information and sufficient disclosure regarding the procedure
- Consent given by a minor who is not competent to give it
- Consent given by a person of unsound mind
- When the doctor performs a substantially different procedure than the one for which consent was given
- When the procedure performed exceeds the scope of consent
- When a different physician than the one to whom consent was given, carries out the procedure.

### **Refusal of Treatment**

The patient has a right to control his own body. The tort of battery protects the interests in bodily security from unwanted physical interferences. A competent adult is entitled to reject a specific treatment or all treatment or to select an alternative form of treatment even if the decision may entail risks as serious as even death. The doctor cannot disregard a patient's advance instructions, though in an emergency the doctrine of necessity may protect the physician who acts without consent. The interest of the state in protecting and preserving the lives

and health of its citizen may override the individual's right to self-determination in order to eliminate a health threat to the community. However it does not prevent a competent adult from refusing life-preserving medical treatment. So an adult of sound mind who went on hunger strike could refuse to receive nutrition and hydration whether by artificial means or otherwise as long as he retains the capacity to refuse the same and the medical personals will have to abide by his decision.

Consent is implied in the case of patient who submits to the doctor, and the person who takes the defense that consent was not given must make out the absence of consent. When a surgeon or medical man advances a plea that the patient did not give his consent of the treatment suggested by them, the burden is on them to prove that nonadministration of the treatment was on account of the refusal of the patient to give consent thereto. If the refusal involves the welfare of a minor or an unborn baby the court can override the objection of parents.

In situations where there is refusal of treatment the consequences should be explained to the patients in form of a witness and it is better to get the refusal signed by them. The doctor has also got the freedom to refer the patient elsewhere if he/she refuses treatment.

### **Exception to Requirement of Consent**

The courts recognise certain situations where a physician's nondisclosure will be excused—

1. If a patient is incompetent to make a reasoned decision, then disclosure to the patient may not be required.
2. Under the therapeutic privilege, the physician may withhold information if disclosure would be upsetting or otherwise would interfere with treatment or adversely affect the condition or recovery of the patient.
3. The emergency exception applies in situations where attempting to secure consent could detrimentally delay proper treatment. Moreover generally, physicians need not disclose risks of which the patient is already aware of, risks which are commonly known.
4. Consents by minors, lunatic, intoxicated persons and persons in coma are invalid. In such cases, the guardian's consent holds validity.

5. In cases of operations where the patient is not in a position to give valid consent and delay can result in loss of life, a doctor may go ahead on his own. In emergency cases involving a child, an accident victim, an insane person, or a person who is unconscious or delirious, consent is not necessary.

### Situation where Consent may not be Obtained

- Medical emergencies
- In case of person suffering from notifiable disease
- Immigrants
- Members of armed forces
- Handlers of food and dairy milk
- New admission to prisons
- In case of a person where a court may order for a psychiatric examination or treatment
- Under S.53(1) of the CrPC, a person can be examined at request of the police by use of force. S53(2) lays down that whenever a female is to be examined it shall be made only by or under the supervision of a female doctor.

### Legal Provision Regarding Informed Consent

The prototypical informed consent case can arise when a patient suffers an injurious nonnegligently caused outcome of a diagnostic or therapeutic medical procedure. An outcome that is nonnegligently caused is one which arises in a certain percentage of cases regardless of the care of physician due to physiological differences from the norm or particular susceptibilities of a patient and where there is no fall in standard medical care. However the problems arises when

1. The physician had a duty to disclose a particular information to the patient
2. Disclosure did not occur
3. a. But for the non disclosure, the tendered procedure would have been refused and  
b. That the tendered procedure was the cause in fact of patient's injury and
4. The patient suffered a compensable injury

The issue will be decided against the doctor as in other medical negligence cases.

### *Penal Provision Regarding Informed Consent*

The Indian Penal Code makes the offense punishable with a fine or imprisonment depending on the circumstances of the case.

### Conclusion

A proper informed consent is a must for every procedure which carries some risk. Many cases have been lost by the doctors in various judicial forums due to failure to get a proper informed consent even though there is no fall in the professional standard of care given by them. The courts in UK, US and India have failed to enunciate clear limits as to the level of disclosure of information that would constitute informed consent. It can be concluded that no physician can absolutely avoid liability under the informed consent laws unless he or she discloses every known risks and alternatives to every patient.

## **DOCUMENTATION**

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### Introduction

The importance of documentation in medical practice cannot be stressed enough. It is the most important evidence to support the medical practitioner in litigations. It also helps in the treatment of the patient. It is the evidence, which justifies the diagnosis, warrants the treatment and follows the end result of all patients treated in a hospital. It is said that "the patient forgets but records remember". To ensure that this remembrance is obtained at the right time, documentation and the ability to retrieve is very important for proper treatment of a patient. In many indemnity cases it is taken up by any judicial forum years after the occurrence of the treatment. It is not possible for the doctor to remember what happened months earlier. So it is very important to have proper documentation. In situations where there is theft of the records by the patients or the relatives, it is advisable to inform the police about the same so that a record of the theft will be officially there.

## Things to be Documented

### *The Out Patient Record*

1. OP master sheet containing Registration No., Name, Age, Religion and Address of the patient.
2. Clinical examination chart and continuation sheets showing Time, Date, Month and Year of each examination. All relevant history including details of previous illness along with any history of drug allergy should be noted. If there is no history of drug allergy, it has to be noted. If the patient develops allergy to a drug subsequently, the date has to be noted. The case sheet should contain the complete examination details including the positive and relevant negative findings. A provisional diagnosis and a working diagnosis should be there before starting a particular line of management.
3. All investigations reports should be there.
4. All the medicines prescribed and advice given should be written legibly.

Many doctors have the habit of giving the OP sheets to the patients. So before giving it, all the above details should be there and if it is feasible, they can keep a copy. Computerization is an answer for this problem. It is advisable to number the pages and write "continued" on the next page number so that if a patient or relative purposely remove certain sheets for litigation purpose, it could be proved.

### *The in Patient Record*

1. Admission record with No., Name, Age, Religion and Address of the patient.
2. The In Patient record with complete examination details including the positive and relevant negative findings. A provisional diagnosis and a working diagnosis should be there before starting a particular line of management. Daily progress note should be maintained. This is the proof that doctor has seen

the patient daily. Request for investigation and the report should be attached. All the medicines prescribed and advice given should be written legibly. Doctor's Order sheet, Nurse's Record, TPR and Graphic chart and any other monitoring requested should be in separate sheets.

3. In any procedure involving some risk, informed consent should be obtained and kept.
4. Any procedure like surgery, anesthesia, etc. should have separate record.
5. If intensive care is given, it has to be documented.
6. At the time of discharge, a proper discharge summary including discharge advice and showing all the details should be given to the patient and a copy has to be kept in the records.
7. If the patient is referred, a reference letter showing all the details of the diagnosis, investigation and treatment should be given and a copy has to be kept in the records.
8. In case of death, a death summary has to be given with a copy kept in the records.

## Retention Period of Records

There is no clear-cut guidelines regarding the retention period of records and it varies from state to state. However the Medical Council of India has specified that all IP Records should be kept for a period of three years. However it is advisable to keep the records of Pediatric patients for a period of three years after they attain majority. This is because a person can file a case once he attains majority and the limitation period starts from then and will be up to three more years.

## SUGGESTED READING

1. Law of medical negligence and compensation by RK Bag, Second Edn, Published by Eastern Law House, Calcutta 2001.

# 19

## Consumer Protection Act and its Relevance to Dental Practice

***George F Moolayil***

The modernization of the society and the unprecedent development in the international trade and commerce has led to a huge volume of consumer goods unloaded on the consumers and a host of various types of services have been made available to the consumers. The presence of advertisements of products and services with exaggerated benefits have resulted in many consumers being mislead on their quality. For the welfare of the public the flooding of market with adulterated and substandard articles had to be prevented and also the quality of the services had to be ensured. Inspite of various provisions providing protection to the consumer being there, very little could be achieved in the field of consumer protection. In order to provide better protection of the interest of the consumer, the Consumer Protection Bill 1986 was introduced in the Lok Sabha on 5th December, 1986. The Act has been amended by The Consumer Protection (Amendment) Act, 1991 (34 of 1991), The Consumer Protection (Amendment) Act, 1993 (50 of 1993) and The Consumer Protection (Amendment) Act, 2002 (62 of 2002). To provide speedy and simple redressal to consumer disputes, quasi-judicial bodies were set up at the district, state and central levels under the Act. These quasi-judicial bodies are expected to observe the principles of natural justice and have been empowered to give relief of a specific nature and to award, wherever appropriate compensation to consumers. They have been also given the power to award penalties for noncompliance of their orders. The reproduction of the entire Act is quite voluminous and hence only things which

are relevant to practicing dental surgeons are dealt with in this chapter.

There is a difference between the Consumer Protection Act and the law of tort. Under law of tort, for compensation to be paid, there should be a breach of a duty enforced by law. Payment for service is not necessary. Hence those who are providing free service as Government servants will come under law of tort. In Consumer Protection Act there has to be deficiency of service for which payment has been made partially or fully or there is a promise of payment partly or fully.

### **DEFINITIONS**

- a. **Consumer** means any person who—
- i. Buys any goods for a consideration which has been paid or promised or partly paid and partly promised, or under any system of deferred payment and includes any user of such goods other than the person who buys such goods for consideration paid or promised or partly paid or partly promised, or under any system of deferred payment when such use is made with the approval of such person, but does not include a person who obtains such goods for resale or for any commercial purpose. Or
  - ii. Hires or avails of any services for consideration which has been paid or promised or partly paid and partly promised, or under any system of deferred payment and includes any beneficiary of such services other than the person who hires or

avails of the services for consideration paid or promised or partly paid and partly promised, or under any system of deferred payment, when such services availed of with the approval of the first mentioned person but does not include a person who avails of such services for any commercial purpose;

**Explanation**—For the purposes of this clause, “commercial purpose” does not include use by a person of goods bought and used by him and services availed by him exclusively for the purposes of earning his livelihood by means of self-employment. It is also clear from the definition that the patient treated by a doctor is a consumer even though somebody else has paid for his treatment. In IMA v. V P Shantha, Supreme Court has, on the basis of this, included those patients treated free in a hospital where some patients are treated free and some are charged fees, stating that those paying patients are bearing the treatment expenses of those free patients.

It has been held by the Supreme Court that when a young child was taken to a private hospital by parents and treated by a doctor, not only the child but his parents were also “consumer” [Spring Meadows Hospital v. Harjol Ahluwalia, 1998 (4) ACC 39: AIR 1998 SC 1801: 1998 (92) Comp Cases 797].

b. **Complainant** means—

- i. A consumer; Or
- ii. Any voluntary consumer association registered under the Companies Act, 1956 (1 of 1956) or under any other law for the time being in force; Or
- iii. The Central Government or any State Government, who or which makes a complaint;
- iv. One or more consumers, where there are numerous consumers having the same interest;
- v. The Consumer Protection (Amendment) Act, 2002 (62 of 2002) has made provision for substitution of legal heir or representative as a party in the event of death of the opposite party;

c. **Complaint** means any allegation in writing made by a complainant that—

- i. An unfair trade practice or a restrictive trade practice has been adopted by any trader or service provider;

- ii. The goods bought by him or agreed to be bought by him is defective.
- iii. The services hired or availed of or agreed to be hired or availed of by him suffer from deficiency in any respect.
- iv. A trader or the service provider, as the case may be, has charged for the goods or for the services mentioned in the complaint, a price in excess of the price fixed by or under any law for the time being in force.

Note: In the case of service provided by a medical professional, charging of excess fees does not come under Consumer Protection Act as no fees have been fixed by any law. Regarding the allegation that excess amount is charged from the complainant, it will be seen from the definition of deficiency that the consideration for the “Service” does not fall within that clause “deficiency” (Ramlal v. Vice Chairman, II (1995) CPJ 121 N. Co). Excess consideration is not a deficiency in service. Dispute over the mode of payment is not a deficiency in service (B S Hegde v. Dr S Bhattacharya, 111 (1993) CPJ 388 N Co). Regarding the allegation that excess amount is charged from the complainant, it may be noted in the decisions 1993 (3) CPR page 415 the National Commission held that demand and acceptance of an exorbitant bill can not be deemed to be deficiency of service and it is not a consumer dispute.

d. **Deficiency** means—

Any fault, imperfection, shortcoming or inadequacy in the quality, nature and manner of performance which is required to be maintained by or under any law for the time being in force or has been undertaken to be performed by a person in pursuance of a contract or otherwise in relation to any service.

e. **Opposite party** means—

The person against whom the complaint has been filed in respect to defect in goods supplied by him or in respect to the deficiency in the services provided by him.

Note: The Consumer Protection (Amendment) Act, 2002 (62 of 2002) has made provision for substitution of legal heir or representative as a party in the event of death of the opposite party.

f. **District Forum** means—

A Consumer Disputes Redressal Forum established under clause (a) of Section 9 with jurisdiction over the complaints in that district.

g. **State Commission** means—

Consumer Disputes Redressal Commission established under clause (a) of Section 9 with jurisdiction over the complaints in that state.

h. **National Commission** means—

Consumer Disputes Redressal Commission established under clause (a) of Section 9 with jurisdiction over the complaints in the country.

### District Forum

*Composition:* Each District Forum shall consist of—

- a. A person who is, or has been, or qualified to be a District Judge, who shall be its President.
- b. Two other members, one of whom shall be a woman, who shall have the following qualifications, namely:
  - i. Be not less than thirty-five years of age.
  - ii. Possess a bachelor's degree from a recognised university.
  - iii. Be persons of ability, integrity and standing, and have adequate knowledge and experience of at least ten years in dealing with problems relating to economics, law, commerce, accountancy, industry, public affairs or administration.

Provided that a person shall be disqualified for appointment as a member if he—

- a. Has been convicted and sentenced to imprisonment for an offence which, in the opinion of the State Government, involves moral turpitude. Or
- b. Is an undischarged insolvent. Or
- c. Is of unsound mind and stands so declared by a competent Court. Or
- d. Has been removed or dismissed from the service of the Government or a body corporate owned or controlled by the Government. Or
- e. Has, in the opinion of the State Government, such financial or other interest as is likely to affect prejudicially the discharge by him of his functions as a member. Or
- f. Has such other disqualifications as may be prescribed by the state Government.

### Jurisdiction

1. Subject to the other provisions of this Act, the District Forum shall have jurisdiction to entertain complaints where the value of the goods or services and the compensation, if any, claimed does not exceed rupees twenty lakhs (enhanced from five lakhs by 2002 amendments).
2. A complaint shall be instituted in a District Forum within the local limits of whose jurisdiction—
  - a. The opposite party or each of the opposite parties, where there are more than one, at the time of the institution of the complaint, actually and voluntarily resides or carries on business or has a branch office or personally works for gain. Or
  - b. Any of the opposite parties, where there are more than one, at the time of the institution of the complaint, actually and voluntarily resided, or carries on business or has a branch office, or personally works for gain, provided that in such case either the permission of the District Forum is given, or the opposite parties who do not reside, or carry on business or have a branch office, or personally work for gain, as the case may be, acquiesce in such institution. Or
  - c. The cause of action, wholly or in part, arises.

### State Commission

*Composition:* Each State Commission shall consist of—

1. A person who is or has been Judge of a High Court, appointed by the State Government, who shall be its President.  
Provided that no appointment under this clause shall be made except after consultation with the Chief Justice of High Court.
2. Not less than two, and not more than such number of members, as may be prescribed, and one of whom shall be a woman, who shall have the following qualifications, namely:
  - i. Be not less than thirty-five years of age;
  - ii. Possesses a bachelor's degree from a recognised university.
  - iii. Be persons of ability, integrity and standing, and have adequate knowledge and experience of at least ten years in dealing with problems relating to

economics, law, commerce, accountancy, industry, public affairs or administration.

Provided that not more than fifty percent of the members shall be from amongst persons having a judicial background.

**Explanation:** For the purposes of this clause, the expression "persons having a judicial background" shall mean persons having knowledge and experience for at least a period of ten years as a Presiding Officer at the district level Court or any Tribunal at equivalent level:

Provided further that a person shall be disqualified for appointment as a member if he—

- a. Has been convicted and sentenced to imprisonment for an offence which, in the opinion of the State Government, involves moral turpitude. Or
- b. Is an undischarged insolvent. Or
- c. Is of unsound mind and stands so declared by a competent Court. Or
- d. Has been removed or dismissed from the service of the Government or a body corporate owned or controlled by the Government. Or
- e. Has, in opinion of the State Government, such financial or other interest as is likely to affect prejudicially the discharge by him of his functions as a member. Or
- f. Has such other disqualifications as may be prescribed by the State Government.

#### *Jurisdiction*

1. Subject to the other provisions of this Act, the State Commission shall have jurisdiction;
  - a. To entertain—
    - i. complaints where the value of goods or services and compensation, if any, claimed exceeds rupees twenty but does not exceed one crore (enhanced by 2002 amendments).
    - ii. appeals against the orders of any District Forum within the State. And
  - b. To call for the records and pass appropriate orders in any consumer dispute which is pending before or has been decided by any District Forum within the State, where it appears to the State Commission that such District Forum has exercised

a jurisdiction not vested in it by law, or has failed to exercise a jurisdiction so vested or has acted in exercise of its jurisdiction illegally or with material irregularity.

2. A complaint shall be instituted in State Commission within the limits of whose jurisdiction—
  - a. the opposite party or each of the opposite parties, where there are more than one, at the time of the institution of the complaint, actually and voluntarily resides or carries on business or has a branch office or personally works for gain. Or
  - b. any of the opposite parties, where there are more than one, at the time of the institution of the complaint, actually and voluntarily resided, or carries on business or has a branch office, or personally works for gain, provided that in such case either the permission of the State Commission is given, or the opposite parties who do not reside, or carry on business or have a branch office, or personally work for gain, as the case may be, acquiesce in such institution. Or
  - c. the cause of action, wholly or in part, arises.

#### **National Commission**

*Composition:* National Commission shall consist of—

- a. A person who is or has been Judge of a Supreme Court, appointed by the Central Government, who shall be its President.  
Provided that no appointment under this clause shall be made except after consultation with the Chief Justice of India.
- b. Not less than four, and not more than such number of members, as may be prescribed, and one of whom shall be a woman, who shall have the following qualifications, namely:
  - i. Be not less than thirty-five years of age.
  - ii. Possesses a bachelor's degree from a recognised university. And
  - iii. Be persons of ability, integrity and standing, and have adequate knowledge and experience of at least ten years in dealing with problems relating to economics, law, commerce, accountancy, industry, public affairs or administration.

Provided that not more than fifty percent of the members shall be from amongst persons having a judicial background.

**Explanation:** For the purposes of this clause, the expression "persons having a judicial background" shall mean persons having knowledge and experience for at least a period of ten years as a Presiding Officer at the district level Court or any Tribunal at equivalent level.

Provided further that a person shall be disqualified for appointment as a member if he—

- a. Has been convicted and sentenced to imprisonment for an offence which, in the opinion of the Central Government, involves moral turpitude. Or
- b. Is an undischarged insolvent. Or
- c. Is of unsound mind and stands so declared by a competent Court. Or
- d. Has been removed or dismissed from the service of the Government or a body corporate owned or controlled by the Government. Or
- e. Has, in opinion of the Central Government, such financial or other interest as is likely to affect prejudicially the discharge by him of his functions as a member. Or
- f. Has such other disqualifications as may be prescribed by the Central Government.

#### **Jurisdiction**

1. Subject to the other provisions of this Act, the National Commission shall have jurisdiction;
  - a. To entertain—
    - i. complaints where the value of goods or services and compensation, if any, claimed exceeds rupees one crore (enhanced from twenty lakhs by 2002 amendments).
    - ii. appeals against the orders of any State Commission. And
  - b. To call for the records and pass appropriate orders in any consumer dispute which is pending before or has been decided by any State Commission, where it appears to the National Commission that such State Commission has exercised a jurisdiction not vested in it by law, or has failed to exercise a jurisdiction so vested or has acted in exercise of its jurisdiction illegally or with material irregularity.

#### **Power of the District Forum**

The District Forum shall have the same powers as are vested in a civil court under the Code of Civil Procedure, 1908 (5 of 1908), while trying a suit in respect of the following matters, namely:

1. The summoning and enforcing attendance of any defendant or witness and examining the witness on oath.
2. The discovery and production of any document or other material object producible as evidence.
3. The reception of evidence on affidavits.
4. The requisitioning of the report of the concerned analysis or test from the appropriate laboratory or from any other relevant source.
5. Issuing of any commission for the examination of any witness.
6. Any other matter which may be prescribed.

#### **Limitation Period**

1. The District Forum, the State Commission or the National Commission shall not admit a complaint unless it is filed within two years from the date on which the cause of action has arisen.
2. Notwithstanding anything contained in Sub-section (1), a complaint may be entertained after the period specified in Sub-Section (1), if the complainant satisfies the District Forum, the State Commission or the National Commission, as the case may be, that he had sufficient cause for not filing the complaint with such period.

Provided that no such complaint shall be entertained unless the National Commission, the State Commission or the District Forum, as the case may be, records its reasons for condoning such delay.

*Note:* It is to be noted that complaint cannot be made if a civil suit is pending in respect of the same matter (*Thotakara Sabha Rao v. Sudhakar*, 1993 (3) CPJ 1470).

#### **Procedure**

A complaint in relation to any goods sold or delivered or agreed to be sold or delivered or any service provided or agreed to be provided may be filed with a District Forum by the complainant under Sub-Section (1). Every complaint filed under Sub-Section (1) shall be

accompanied with such amount of fee and payable in such manner as may be prescribed.

On receipt of the complaint, the District Forum may by order allow the complaint to be proceeded with or rejected. If the complaint is rejected, it shall be done only after giving an opportunity to the complainant to be heard. The admissibility of the complaint shall ordinarily be decided within twenty one days from the date on which the complaint was received.

The District Forum shall on admission of a complaint shall refer a copy of the admitted complaint within twenty one days from the date of its admission to the opposite party mentioned in the complaint directing him to give his version of the case within a period of thirty days or such extended period not exceeding fifteen days as may be granted by the District Forum.

Where the opposite party, on receipt of a copy of the complaint, referred to him under clause (a) denied or disputes the allegations contained in the complaint, or omits or fails to take any action to represent his case within the time given by the District Forum, the District Forum shall proceed to settle the consumer dispute—

- i. On the basis of evidence brought to its notice by the complainant and the opposite party, where the opposite party denied or disputes the allegations contained in the complaint, or
- ii. Ex parte on the basis of evidence brought to its notice by the complainant where the opposite party omits or fails to take any action to represent his case within the time given by the Forum.

Where the complainant fails to appear on the date of hearing before the District Forum, the District Forum may either dismiss the complaint for default or decide it on merits.

Every complaint shall be heard as expeditiously as possible and endeavor shall be made to decide the complaint within a period of three months from the date of receipt of notice by opposite party. No adjournment shall be ordinarily granted by the District Forum unless sufficient cause is shown and the reasons for grant of adjournment have been recorded in writing by the Forum.

After the proceeding conducted under Section 13, the District Forum is satisfied that any of the allegations contained in the complaint about the services are proved, it shall issue an order to the opposite party directing him to do one or more of the following things, namely:

- a. To return to the complainant the price, or, as the case may be, the charges paid by the complainant.
- b. To pay such amount as may be awarded by it as compensation to the consumer for any loss or injury suffered by the consumer due to the negligence of the opposite party.
- c. To remove the defects in goods or deficiencies in the services in question.

Every proceeding referred in Sub-Section (1) shall be conducted by the President of the District Forum and at least one member thereof sitting together. Every order made by the District Forum under Sub-Section (1) shall be signed by its President and the member or members who conducted the proceeding. Where the proceeding is conducted by the President and one member and they differ on any point or points, they shall state the point or points on which they differ and refer the same to the other member for hearing on such point or points and the opinion of the majority shall be the order of the District Forum.

### **Appeal**

Any person aggrieved by an order made by the District Forum may prefer an appeal against such order to the State Commission within a period of thirty days from the date of the order, in such form and manner as may be prescribed. The State Commission may entertain an appeal after the expiry of the said period of thirty days if it is satisfied that there was sufficient cause for not filing it within that period.

Any person aggrieved by an order made by the State Commission may prefer an appeal against such order to the National Commission within a period of thirty days from the date of the order, in such form and manner as may be prescribed. The National Commission may entertain an appeal after the expiry of the said period of thirty days if it is satisfied that there was sufficient cause for not filing it within that period.

In the 2002 amendments, provision has been made for depositing, either fifty percent of the amount of compensation or fine or the amounts mentioned below whichever are less, before the admission of appeal, namely:

- a. Rs. 25,000/- in case of appeal to a State Commission from the District Forum.

- b. Rs. 35,000/- in case of appeal the National Commission from a State Commission.
- c. Rs. 50,000/- in case of appeal to the Supreme Court from the National Commission.

### Dental/Medical Professionals and the Consumer Protection Act

The Supreme Court in Indian Medical Association v. V P Shantha [AIR 1996 SC 550; (1995)6 SCC 651; III (1995) CPJ 1 (SC); 1995(3) CPR 412 (SC); (1995)3 CTJ 969 (SC) (CP); 1996 CCJ 1 (SC)] has clarified the liability of the medical professionals under the C P Act—

- 1. Those hospitals and doctors who treat all the patients without charging any fees do not come under C P Act.
- 2. Those hospitals and doctors who treat all the patients charging fees come under C P Act.

- 3. Those hospitals and doctors who treat some of the patients without charging any fees and rest of the patients charging fees come under C P Act. It has been held that those patients who are treated free are also consumers as the paying patients are indirectly meeting the expenditure of those free patients.
- 4. The services rendered by the Medical Professionals to their employers do not come under C P Act as the employers have control over their employees.
- 5. In a situation where the payment is made by the insurance company, the beneficiary of the service is a consumer.

### SUGGESTED READING

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The Consumer Protection Act, 1986 [As Amended by the Consumer Protection (Amendment) Act, 2002] 5th Edn. 2003, (Edited by George Johnson and Dominic Johnson, distributed by Law Book Centre, Ernakulam).

# Appendices

**APPENDIX 1**  
**(This form to be written in duplicate)**

1. Serial No.....
  2. Date and Hour of Examination.....
  3. Name.....
  4. Age.....
  5. Sex.....
  6. Address.....
  7. Marks of identification: (1) .....
  - (2) .....
  8. By whom brought and the requisition brought by him .....
  9. History and alleged cause of injury .....
  10. Details of injuries/ clinical features:
  
  11. Number of additional sheets, if any .....
  12. If dying declaration required .....
  13. If yes, whether Police/Magistrate is informed .....
  14. Investigation results, if any .....
  
  15. Date of admission as IP and IP No .....
  16. Date of discharge .....
  17. Condition on discharge .....
  18. Opinion as to cause of injury .....

*Signature of Medical Officer*

Name of Institution.....  
Station.....  
Date.....

Name of Medical Officer.....  
Designation.....

Issued to.....as per his requisition  
no.....dated.....

*Signature and Name of Issuing Medical Officer*

**APPENDIX 2**  
**(This form to be written in duplicate)**

**POLICE INFORMATION**

No .....

Date .....

From

.....  
.....

To

.....of Police  
.....  
(Through the Superintendent of Hospital)

Sir

I write to inform you that a patient by name .....aged .....son/daughter/wife \* of .....inhabitant of .....has been brought to the casualty department/out patient \* at .....AM/PM \* on .....alleged to have been# .....at .....AM/PM on .....at (place).....He /she is being treated as out patient/in patient in ward no.....

Please do the needful.

Yours faithfully

Medical officer(Name and signature)

\*Cross out item which are not relevant

# Write the cause of injury

**APPENDIX 3**  
**(This form to be written in duplicate)**

**DISCHARGE CERTIFICATE FOR POLICE CASES**

No.....

Dated.....

From

Name of Medical Officer .....

Designation .....

Name of Institution .....

Station .....

To

The.....Inspector of Police

Sir

In continuation of the Wound certificate No.....dated ..... I have to inform you that Sri/Smt ..... aged.....and admitted on ..... as I.P. No ..... was discharged/cured/relieved\* on ..... Given below are further remarks on the case.

a. X-ray and other special investigation showed .....

.....  
.....  
.....

b. The following surgeons and specialists were concerned in the treatment of the case .....

.....

c. Other relevant information .....

.....

Yours faithfully

\* Cross out items which are not relevant

**APPENDIX 4**

**DISCHARGE SUMMARY**

Name.....IP No.....Age.....Sex.....

Date of admission.....Date of Operation.....Date of Discharge.....

Referred from.....

Medicolegal case/Nonmedicolegal case

Diagnosis

Chief complaint

History

Investigations

Referral to other units

Operation/ Procedure

Postoperative course

Drugs given

Discharge advice and Drugs

Signature and Name of the Doctor

**APPENDIX 5****CONSENT FORM FOR DENTAL INVESTIGATION, TREATMENT OR OPERATION**

Patient's Name : \_\_\_\_\_  
 Parent's/ Guardians Name : \_\_\_\_\_  
 Date of Birth : \_\_\_\_\_  
 Sex : \_\_\_\_\_  
 Identification Marks : 1 \_\_\_\_\_  
                           2 \_\_\_\_\_  
 Type of Investigation/Treatment/Operation \_\_\_\_\_  
 \_\_\_\_\_

**DOCTOR**

I confirm that I have explained the operation/investigation/treatment and such appropriate options as are available and the type of anesthetic to the patient in terms which in my judgement are suited to the understanding of the patient and/or to one of the parents or guardians of the patient.

Siganture \_\_\_\_\_ Date \_\_\_\_\_ Time \_\_\_\_\_  
 Name of the Doctor \_\_\_\_\_

**PATIENT/PARENT/GUARDIAN**

1. Please read this form very carefully.
2. If there is anything that you don't understand about the explanation, or if you want more information, you should ask the doctor.
3. Please check that all the information on the form is correct. If it is, and you understand the explanation, then sign the form.

**I am the Patient/Parent /Guardian (delete as necessary)**

**I agree** : to what is proposed which has been explained to me by the doctor named on this form.  
**I understand** : that any procedure in addition to the investigation or treatment described on this form will be carried out, if it is necessary in my best interests and can be justified for medical reasons

Signature \_\_\_\_\_  
 Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 Date \_\_\_\_\_ Time \_\_\_\_\_

Witnesses	Name and Address	Signature	Date and Time
1.			
2.			

## APPENDIX 6

### BLOOD REQUEST FORM

Hospital \_\_\_\_\_

Date of request \_\_\_\_\_

**PATIENT DETAILS**

Family name \_\_\_\_\_

Date of birth \_\_\_\_\_ Gender \_\_\_\_\_

Given name \_\_\_\_\_

Ward \_\_\_\_\_

Hospital reference no. \_\_\_\_\_

Blood group (if known including Rh) \_\_\_\_\_

**HISTORY**

Diagnosis \_\_\_\_\_

Antibodies Yes/No \_\_\_\_\_

Reason for transfusion \_\_\_\_\_

Previous transfusion Yes/No \_\_\_\_\_

Hemoglobin \_\_\_\_\_

Any reactions Yes/No \_\_\_\_\_

Relevant medical history \_\_\_\_\_

Previous pregnancies Yes/No \_\_\_\_\_

**REQUEST** Group, screen and hold patient's serum

Whole blood \_\_\_\_\_ units

 Provide product

Red cells \_\_\_\_\_ units

Date required \_\_\_\_\_

Plasma \_\_\_\_\_ units

Time required \_\_\_\_\_

Other \_\_\_\_\_ units

Deliver to \_\_\_\_\_

Name of Doctor \_\_\_\_\_

Signature \_\_\_\_\_

**IMPORTANT:** This blood request form will not be accepted if it not signed or any section is left blank**LABORATORY USE ONLY**

Patient ABO \_\_\_\_\_

Rh.D \_\_\_\_\_

	Donor typing		Compatibility testing				Date of issue	Time of issue
	ABO	Rh	AHG	Date of match	Time of match			

Signature of tester \_\_\_\_\_

# Index

## A

- Administering blood products 180
  - checking the blood pack 180
  - checking the patient's identity and the blood product before transfusion 181
- monitoring the transfused patient 182
- pharmaceuticals and blood products 182
  - recording the transfusion 182
  - time limits for infusion 181
  - warning blood 181
- Admission process 4
  - elective admission 4
  - nonelective admissions 4
- Adverse effects of transfusion 183
  - immediate management 184
  - initial management and investigation 183
    - acute intravascular hemolysis 187
    - anaphylactic reactions 188
    - delayed complications of transfusion: transfusion-transmitted infections 188
    - fluid overload 188
    - massive or large volume blood transfusions 189
    - other delayed complications of transfusion 189
    - screening for transfusion: transfusion-transmissible infections 188
    - transfusion-associated acute and lung injury 188
- AIDS and HIV infection 47
  - dental management of HIV infected/ AIDS patients 49
  - diagnosis of HIV infection 49
  - identifying high-risk patients 48
  - transmission of HIV 48

- accidental exposure and post exposure prophylaxis 50
- oral lesions 49
- special precautions 49
- surgery 49

- Airway management in sedation 105
  - artificial airways 107
  - Head-tilt/chin-lift 106
  - jaw-thrust 106
  - oropharyngeal airway 107
  - oxygen delivery 107
    - endotracheal intubation 108
    - legal aspects 109
    - oxygen mask 108
  - protection 110
  - research 110
  - responsibilities 109
- Antibiotic prophylaxis 191
  - principles 192
- Assessment of adequacy of fluid and electrolyte replacement 167

## B

- Biopsy 88
  - excision biopsy 88
  - incision biopsy 88
  - instruments required 89
- Bleeding disorders 36
  - adrenal insufficiency 35
  - dental management 35
  - causes of bleeding disorders 37
  - causes of bleeding disorders 37
    - coagulation defects 38
    - platelet disorders 37
    - vascular defects 37
  - dental management of the patient with a serious bleeding disorder 39
    - general consideration 39
    - special consideration 40
- Blood components/blood products 174
- Blood transfusion in surgical patients 160

- preoperative hemoglobin level and surgery 160
- techniques to reduce operative blood loss 161
- anesthetic techniques 162
- antifibrinolytic and other drugs 162
- surgical technique 161
- tourniquets 161
- vasoconstrictors 161

## C

- Cardiovascular diseases 28
  - hypertension 28
  - infective endocarditis 29
  - ischemic heart disease 30
  - dental management consideration for patient with angina pectoris or history of myocardial infarction 31
  - thromboembolic disorders 31
- Care of tracheostomy 84
  - care of the tracheostomy tube 84
  - indications 84
  - procedure 85
  - surgical procedure of tracheostomy 84
  - venous cutdown 85
- Casualty service 9
- Categories of surgery 127
- Changing room, semi sterile and sterile areas 139
  - eye protection 140
  - foot wear 140
  - hair cover 140
  - masks 140
- Clinical transfusion procedures 175
  - ABO blood group antigens and antibodies 177
  - ABO incompatibility: hemolytic reactions 178
  - blood refrigerator 180

blood request form 177  
blood samples for compatibility testing 177  
collecting blood products prior to transfusion 179  
communication between clinicians and the blood bank 176  
fresh frozen plasma 180  
informing the patient 176  
ordering blood for elective surgery 177  
other red cell antigens and antibodies 178  
platelet concentrates 180  
red cell compatibility testing (cross matching) 177  
rhesus D antigens and antibodies 178  
storage conditions: red cells and whole blood 179  
storing blood products prior to transfusion 179  
transfusion rules for plasma in ABO system 178  
urgent requests for blood 176  
Complications of odontogenic infection 65  
brain abscess 66  
cavernous sinus thrombosis 66  
Ludwig's angina 65  
meningitis 67  
necrotizing fasciitis 67  
Conscious sedation 92  
types of sedation administration 93  
enteral 93  
inhalation 93  
intravenous conscious sedation 94  
parenteral 93  
transdermal/transmucosal 93  
Consent 227  
consent and treatment of children 230  
exception of requirement of consent 231  
general principle 227  
legal provision regarding informed consent 232  
obtaining consent 230  
standard of disclosure of information 228  
types of consent 228  
blanket consent 228

emergencies and consent 229  
express consent 228  
implied consent 228  
informed consent 229  
proxy consent 229  
validity of the consent 231  
Consumer protection Act and its relevance to dental practice 234  
Criminal courts of India 214

## D

Dental/oral and maxillofacial surgeons as expert witnesses 220  
quantification of dentofacial disability/deformity 220  
recommended quantification for the dentofacial region 222  
review of quantification criteria 221  
Documentation 232  
retention period of records 233

## E

Elderly undergoing surgery 137  
cardiovascular system 138  
hepatobiliary system 138  
integumentary system 138  
nervous system 138  
respiratory system 138  
urinary system 138  
Endocrine diseases 33  
diabetes mellitus 33  
classification 33  
dental management 33  
hyperthyroidism 34  
hypothyroidism 34  
Estimating blood loss 162  
Exposure prevention method in dental practice 114

## F

Factors influencing the spread of infections 58  
general 58  
local 58  
Fluid replacement and transfusion 163  
autologous blood transfusion 164  
preoperative blood donation 164

## G

General management of odontogenic infection 68  
obtaining specimen/pus for microbiological examination 69  
medical treatment 71  
supportive care 71  
surgical 69

## H

Handling of sterile instruments 142  
induction of anesthesia and intubation 143  
patient positioning on operating table 142

## I

Immediate preoperative care in surgery 132  
Impact of surgery on the patient and family 128  
Incidence of oral complications 194  
Incised wounds 218  
lacerated wounds 219  
stab wounds (punctured wounds) 219  
age of wounds 219  
Informed consent 7  
Injections 73  
locating the sites for injection 73  
purposes of injection 73  
deltoid site 73  
dorsogluteal site 74  
intramuscular injection 73  
vastus lateralis site 73  
ventrogluteal site 73  
subcutaneous injections 74  
intramuscular injection 75  
intravenous injection 77  
Injuries of the maxillofacial region 10  
clinical examination of the maxillofacial region 14  
general examination 14  
history of injury 14  
local examination 15  
definitive treatment of maxillofacial fractures 19  
principles of treatment of bony injuries 19  
facial lacerations 19

- definitive management of middle third fractures 20
- fractures of the mandible 15 classification 15, 16
- fracture of the middle third of the face 16
- golden hour 10
- primary care in maxillofacial injuries 11 hemorrhage 12 management of airway obstruction 12 preliminary examination and care respiratory obstruction 11 principles of treatment 13 shock 13
- protocol for the management of faciomaxillary injuries 21 radiology of the facial injuries 17
- I**njury 216 classification 217 chemical injuries 217 injuries due to electricity 217 mechanical injuries 217 thermal injuries 217 legal injuries 217 fetal injury 217
- I**nsertion of oral airway 84 indications 84 procedure 84
- I**ntubation 82 material required 83 procedure 83 purposes 82
- L**
- L**iver disease 44 chronic alcoholism and liver cirrhosis 44 dental management 44 management of an acute asthmatic attack 43 chronic obstructive pulmonary disease 43 viral hepatitis 45 dental management of patients with hepatitis 46 patients with active hepatitis 46
- M**
- Maintaining the sterility of the operation theater 139
- Major service units of the dental department 1 admitting service 1 casualty service 2 consultation service 2 outpatient service 1 cardiology 2 dermatology 2 ENT 2 general medicine 2 intensive care unit 2 Oncology department 2 plastic surgery 2 sleep apnea syndrome laboratory 2
- Making corrections in the medical record 7
- M**anagement of head injury 21 assessment of head injuries 22 assessment of vital signs 22 history 22 mini-neurological examination 22
- emergency management of head injury 23
- M**anagement of shock in trauma 155 classes of hemorrhage based on percentage of blood loss 157 evaluation of fluid correction 158 blood replacement 159
- hemorrhagic shock in the injured patient 155
- initial management of hemorrhage shock 157
- trimodal distribution of trauma deaths 155 adjuncts to venous cannulation 157
- pitfalls in the diagnosis and treatment of shock 159 fluid overload and CVP monitoring 159
- M**edical conditions of significance in dental practice 28
- M**edical negligence 225 common allegation of negligence against dental surgeons 226 few judgments regarding negligence 226
- M**edical record 5 admission note 4 consultations 6 discharge summary 7 laboratory results 5 nursing notes 6 preoperative and postoperative notes 5
- operative notes 6 preoperative notes 5
- M**edications that affect surgical experience 129
- Monitoring for signs of hypovolemia 162 maintaining normovolemia 163
- N**
- N**asogastric tube (Ryle's tube) insertion 81 materials required 81 purposes 81
- N**ebulization 79
- N**eurological disorders 51 epilepsy 51 clinical manifestation 51 dental management 51
- Parkinson's disease 53 stroke 52 dental management of stroke patient 52
- O**
- O**perating notes 148 Operating room to recovery room 148
- O**ral hygiene 80 oral hygiene for an unconscious client 81 equipment 81 procedure 81
- Oral problems related to chemotherapy (CT) 204 hemorrhage 207 infections 205 mucositis 205 bacterial infections 206 fungal infections 205 viral infections 206
- Oral problems related to radiation therapy 197 loss of taste (ageusia/hypogesia) 201 mucositis 197 prevention and management 198 osteoradionecrosis 201 trismus 201 management of osteoradionecrosis 203 post radiation extraction 203 predisposing factors 202 xerostomia and radiation caries 198

- effects of xerostomia 198  
prevention and management of xerostomia 199
- Oxygen therapy 77  
equipment 78  
methods of oxygen delivery 77  
nasal cannula 77  
oxygen masks 78  
procedure 78
- P**
- Patients with organ transplantation 53  
chronic renal failure 55  
dental management of patients with chronic renal failure 56
- dental management 53  
post-transplant period 54  
pretransplant period 54
- nephritic syndrome 57  
dental management of patients with nephritic syndrome 57
- Personnel health elements of an infection-control program 112  
education and training 112  
exposure prevention and postexposure management 112
- immunization programs 112  
dental surgeons to patients 113  
preventing transmission of blood-borne pathogens 112
- Personnel in sedation 102  
complication: prevention and management 105  
patient management and monitoring 102  
during the procedure 103  
following the procedure 104  
prior to procedure 103
- risk management 104
- Pharmacology in sedation 99  
benzodiazepines 100  
chloral hydrate 102  
diazepam 101  
droperidol 102  
fentanyl 100  
flumazenil 101  
haloperidol 102  
ketorolac 102  
meperidine 100  
midazolam 101  
morphine 100
- naloxone 101  
opioids 99  
reversal agents 101
- Physical examination in dental surgery 130
- Postexposure management and prophylaxis in dental practice 115  
hand hygiene 116  
fingernails and jewelry 117  
personal protective equipment (PPE) 118  
gloves and gloving 119  
masks, protective eyewear, face shields 119
- postexposure prophylaxis (PEO) following occupational exposure 115  
contact with known HIV/HBV infected material resulting 115
- protective clothing 119
- sterilization and disinfection of patient-care items 119  
sterilization 120
- Postoperative fluid management 166  
initial estimated loss 166  
maintenance requirement 166  
on-going losses 167  
practical fluid balance for the operated patient 166  
glucose required 167  
potassium required 167  
saline required 167
- Postoperative instructions and postoperative orders/drug 149
- postoperative care 149
- postoperative complications 150  
acute ventilatory failure 150  
aspiration of gastric contents or blood 151  
cardiorespiratory arrest 154  
convulsions 154  
deep venous thrombosis and pulmonary embolism 154  
edema 152  
epistaxis 151  
fat embolism 153  
hypertension 153  
hypotension 153  
postoperative fever 152  
postoperative nausea and vomiting 151  
shock 153
- sore throat or pharyngitis 151  
transient emotional upsets 153
- postoperative drugs 149  
postoperative instructions 149 during the first 24 hours 149
- Preanesthetic medication 136  
commonly used premedications 137
- Pregnancy 46  
spine hypotensive syndrome 46  
dental management during pregnancy 46  
drug administration during pregnancy 47
- Preoperative period in dental surgery 129
- Preoperative preparations in dental surgery 127
- Preoperative teaching of surgical patients 133  
coughing exercise 133  
diaphragmatic breathing 133  
informed consent 134  
leg, ankle and foot exercises 133
- Preparation of operation list 134
- Preparing the patient on the day of surgery 135
- Pretreatment assessment of cancer therapy 195  
effects of radiotherapy 196  
guidelines for pre-irradiation surgery 196  
motivation of the patient and oral hygiene instruction 196  
preirradiation dental treatment 195  
radiation injury 196
- Prevention and management of oral problems of cancer therapy 194
- R**
- Recording injury in wound certificate 216
- Recording of evidence in a court 215  
absenting from court 216  
documentary evidence 216  
oral evidence 216
- Replacement fluid 168  
crystalloids or colloids controversy 170  
factors affected by acid-base imbalance 171

intravenous replacement fluids 169  
intravenous replacement therapy 168  
    colloids 169  
    crystalloids 169  
properties of an ideal intravenous replacement fluid 170  
plasma-derived colloids 171  
    metabolic acidosis 171  
    respiratory acidosis 171  
    respiratory alkalosis 171  
Respiratory diseases 42  
Risk of wound infection 192  
classification of wounds 192

**S**

Scrubbing and Donning sterile gown and gloves 140  
Shock in trauma victims 155  
    cardiogenic 155  
    distributive 155  
    hypovolemic 155  
    obstructive 155  
Significance of medical evaluation 26  
Sites of localization of dental infection 58  
    primary sites of localization of dental infections 58  
        buccal space  
        canine space 61  
        oral vestibule and palate 60

sublingual space 62  
submandibular space 62  
submasseteric space 63  
submental space 61  
secondary sites of spread of odontogenic infections 63  
infratemporal space 64  
parotid space 63  
pharyngeal space infection 64  
temporal space infection 64  
Special considerations in dentistry 122  
    aseptic technique for parenteral medications 123  
    dental handpieces and other devices attached to air and waterlines 122  
    dental laboratory 124  
    dental radiology 123  
    discharging blood or other body fluids to sanitary sewers or septic tanks 125  
    general waste and biomedical waste 125  
    handling of extracted teeth 125  
    oral surgical procedures 124  
    saliva ejectors 123  
    single-use or disposable devices 124  
Specific microorganism related issues 113  
    hepatitis B virus (HBV) 113  
    hepatitis C virus 114  
    hepatitis D virus 113  
    human immunodeficiency virus 114

Surgical site preparation and draping the patient 144

**U**

Urinary catheterization 79  
    equipment 79  
    indications 79  
    procedure 79  
    types of catheterization 79  
        indwelling retention catheterization 79  
        intermittent catheterization 79

**V**

von Willebrand's disease 42

**W**

Ward rounds 8  
Whole blood 174  
    advantages 174  
    disadvantages 174  
Wound certificate 219  
Wound certificate and police information/intimation 213  
    discharge certificate 214  
    treatment certificate 214  
Wound dressing 87  
    procedure 87  
    purposes 87