

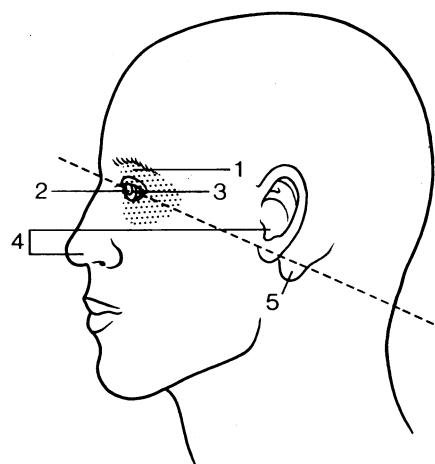
## INITIAL ASSESSMENT AND MANAGEMENT—II: SECONDARY SURVEY

Peter Driscoll, David Skinner



The following scheme describes how to perform a detailed head to toe examination of the patient. In addition, it should be standard practice to perform lateral cervical spine, chest, and pelvic radiography in patients with blunt trauma. Protective lead aprons should be worn by staff who continue to manage the patient. One doctor, who may be the team leader, should be responsible for the secondary survey; the examination should be orderly and complete.

### Head and neck



- 1—Raccoon eyes (bilateral periorbital haematoma)
- 2—Subhyaloid haemorrhage
- 3—Scleral haemorrhage without a posterior margin
- 4—Cerebrospinal fluid rhinorrhoea and otorrhoea
- 5—Battle's sign (bruising over the mastoid process)

#### Scalp

Palpate from posterior to anterior. Check for lacerations, swellings, and depressions. Palpate for fractures at the base of lacerations. Profuse bleeding of the scalp must be stopped.

#### Neurological state

The patient's level of consciousness must be monitored regularly and recorded according to the Glasgow coma scale. **Deterioration may not be due to the primary injury to the brain but may reflect hypoxia or hypoperfusion.**

#### Base of skull

Externally the base of the skull runs from the mastoid process to the orbit. Consequently, fractures of the basal skull may produce signs along this line.

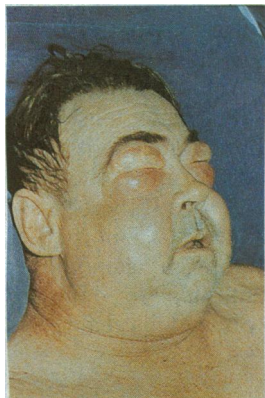
When there is cerebrospinal fluid rhinorrhoea or otorrhoea the fluid is invariably mixed with blood, and this will delay the clotting of the blood and produce a double ring pattern if dropped on to a sheet. Examination with an auroscope may precipitate meningitis in patients with such problems.

#### Eyes

Examine the eyes early, before orbital swelling makes this impossible. Look for haemorrhages inside or outside, foreign bodies under the lids, and any signs of penetrating injuries. Visual acuity can be tested rapidly by asking the patient to read a label. If the patient is unconscious test the pupillary response and the corneal reflex.

#### Face

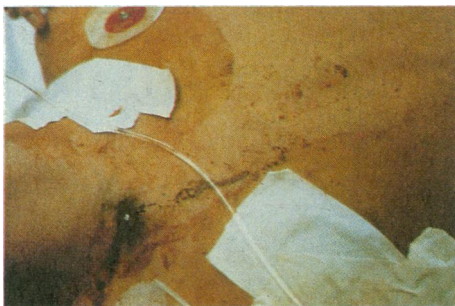
The face should be palpated symmetrically for deformities and tenderness. Check for loose or lost teeth. Grasp the upper incisors and determine whether there is any instability of the maxilla, which would suggest a middle third fracture. These fractures may be associated with fractures of the basal skull. Only those fractures compromising the airway need to be treated immediately. This may entail pulling the fractured facial skeleton segment forwards to clear the airway.



Extreme facial and periorbital oedema.



Facial injury likely to obstruct the airway.



Gunshot wound in the neck.

## Neck

With the head held firmly by an assistant undo the cervical collar and examine the neck. Look for any deformity, bruising, or lacerations. Palpate each of the cervical spinous processes to detect tenderness and "step off" deformities. Palpate the posterior cervical neck muscles for spasm and tenderness. Conscious patients will also assist by telling you if there is any pain in the neck and, if so, its location. Inspect lacerations of the neck, and if the wound penetrates the platysma it needs to be explored under general anaesthesia in the operating theatre. A lateral cervical spine radiograph showing all seven cervical vertebrae is essential in patients with multiple injuries. The patient's arms should be pulled towards the feet while the radiograph is being taken. Remember that this radiograph can miss fractures of C1 and C2 and the low cervical vertebrae. An anteroposterior radiograph of the cervical spine and odontoid peg is required for full evaluation of the cervical spine, but this can be delayed until the secondary survey has been completed.

## Thorax

### Immediately life threatening thoracic injuries

Obstruction of the airway  
Open chest wound  
Tension pneumothorax  
Massive haemopneumothorax  
Cardiac tamponade

The priority at this stage is to identify conditions that are immediately life threatening.

Inspect the chest for bruising, wounds, signs of respiratory obstruction, and asymmetry of movement. Forces of acceleration and deceleration can produce extensive thoracic injuries, but they often leave marks on the chest wall. Certain patterns may be associated with particular types of injury. The bruise resulting from pressure exerted by a diagonal seat belt may overlay a fractured clavicle, a tear in the thoracic aorta, pulmonary contusion, and a lacerated pancreas. The mark caused by impact with the central steering wheel suggests a sternal fracture with cardiac contusion.



Open sucking chest wound.

### Lung and chest wall

A flail segment is diagnosed when paradoxical movement of a segment of the chest wall is observed. Small flail segments are difficult to diagnose and require careful inspection of the chest wall. Immediate treatment of this condition may be necessary, depending on the degree of underlying contusion of the lung. If analysis of the blood gases shows a low  $PO_2$  or if the patient is becoming exhausted intubation and intermittent positive pressure ventilation are necessary.

An open chest wound must be covered with an occlusive dressing. A chest drain must then be inserted into the affected side of the chest to prevent the development of a tension pneumothorax.

Palpate the chest by feeling the ribs in the apices of both axillae. Feel for crepitus and tenderness in conscious patients. Continue in a caudal manner. Palpate the anterior aspect of the chest by pressing on both clavicles, each rib, and the sternum. Note the presence of surgical emphysema. Squeeze the chest in a lateral and anteroposterior plane to detect the presence of multiple rib fractures.

Auscultation detects differences in air entry between the two sides of the chest. Even in the presence of a pneumothorax air entry can sometimes be heard over the anterior aspect of the chest, especially if the patient is being ventilated. Always listen peripherally for a difference in air entry; a significant difference suggests a pneumothorax, which, if under tension, needs immediate drainage. To do this insert a large bore intravenous cannula in the second intercostal space in the mid-clavicular line on the affected side. A sudden release of air confirms the diagnosis. If there is no release of air perform radiography of the chest immediately to confirm the diagnosis before inserting the chest drain. A pneumothorax or haemothorax should be treated by inserting a chest drain with a gauge of 32 to 34 in the fifth intercostal space just anterior to the mid-axillary line. This enables air and fluid to be drained.



Needle aspiration of a potential pneumothorax.



Chest drain in situ.



### Signs of pericardial tamponade

#### Beck's triad

- 1 Jugular venous pressure raised
- 2 Muffled heart sounds
- 3 Blood pressure reduced

#### Pulsus paradoxus

Pulse rate raised

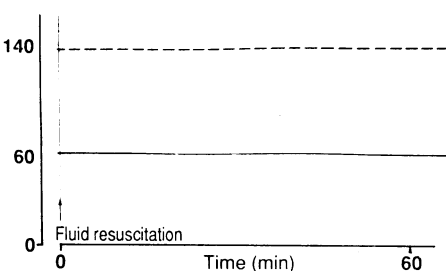
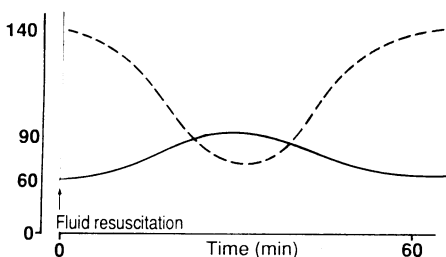
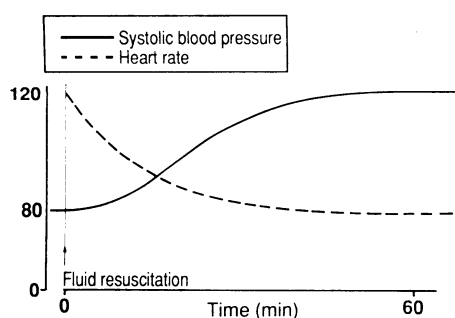
### Hypovolaemic shock

Skin colour

Pulse

Pulse volume

Blood pressure



### Heart

The mechanism of injury will often indicate the possibility of damage to the cardiac or thoracic aorta. Invariably the signs will be subtle. Patients with extreme physical signs usually die at the scene of the accident. Cardiac contusion should be suspected if the chest has been subjected to a decelerating force, such as a fall from a height or road traffic accident. This may produce sternal bruising and tenderness. Cardiac arrhythmias or an infarction pattern seen on the cardiac monitor may reflect cardiac contusion. Rapid deceleration forces may also produce a tear in the thoracic aorta.

Penetrating thoracic injuries may damage the heart and produce pericardial tamponade. The classic features of this condition may not be present in a patient with multiple injuries. In view of the diagnostic difficulty doctors should have a low threshold for performing a percutaneous pericardial aspiration. This will also relieve the problem temporarily.

### Circulation

The degree of hypovolaemic shock is estimated by noting the patient's skin colour, pulse, pulse volume, and blood pressure. Up to a 30% loss of blood volume will produce a tachycardia and decreased pulse pressure, but the blood pressure may remain within normal limits. A consistent fall in the systolic blood pressure will occur only when more than 30% of the blood volume has been lost. A urine output of less than 50 ml/h in an adult indicates poor renal perfusion, suggesting poor perfusion of the tissues in general.

The adequacy of fluid resuscitation is measured by the same variables. One of three responses may be seen:

(1) The vital signs return to normal after infusion of less than 2 litres of colloid solution. In such cases patients have lost less than 30% of their blood volume and are not actively bleeding.

(2) The vital signs initially improve with the infusion but then deteriorate. In such cases patients are actively bleeding and have usually lost more than 30% of their blood volume. They need to be transfused with typed blood, and the source of bleeding must be controlled; this may require an operation.

(3) The vital signs do not improve at all. This suggests that either the shock has not been caused by hypovolaemia or the patient is actively bleeding faster than fluid is being infused. History, mechanism of injury, and physical findings (including the central venous pressure) will help to distinguish between these two possibilities. Blood can be crossmatched urgently in 15 minutes or less in most laboratories. Transfusion of group O negative blood is justified only when crossmatching is not available.

Patients with hypovolaemia whose vital signs do not improve at all have usually lost over 40% of their blood volume. The source of bleeding is invariably in the thorax, abdomen, or pelvis and requires an operation to correct it.

### Abdomen



Evisceration of the bowel after an abdominal wound.

Inspect the abdomen for bruising, movement, and wounds. Cover any exposed bowel with a sterile pack soaked in warm saline. Explore any laceration; if it extends into muscle the wound must be formally explored at laparotomy.

### Signs of urethral injury

Blood at external urethral meatus  
Bruising of scrotum  
High riding prostate

### Per-rectal examination

- (1) Sphincter tone reduced (possible spinal injury)
- (2) Rectal damage
- (3) Pelvic fractures
- (4) Position of prostate
- (5) Test faecal residue for blood

### Indications of positive diagnostic peritoneal lavage

>100 000 red blood cells/mm<sup>3</sup>  
>5000 white blood cells/mm<sup>3</sup>  
Bile  
Food products  
Bacteria



Patient undergoing peritoneal lavage.

## Extremities



Compound fracture and dislocation of the right ankle.

## Spinal column

### Signs of spinal injury

- Priapism
- Hypotension with relative bradycardia
- Decreased motor power and sensation below lesion
- Decreased anal sphincter tone

Palpate for tenderness and note any signs of urethral injury in men. Squeezing the pelvis in two planes will detect only severe abnormalities. Every patient with multiple injuries must undergo pelvic radiography and rectal examination. The importance of bowel sounds is controversial; decisions on abdominal management should never rely solely on the presence or absence of bowel sounds.

Intra-abdominal bleeding should be suspected if there are fractures of ribs 5-11, which lie over the liver and spleen, or if there are marks caused by seat belts or tyres over the abdomen.

A catheter must be inserted so that the patient's rate of urine output can be measured. A per-urethral approach is used if there is no evidence of urethral injury. If urethral damage is suspected a suprapubic catheter should be inserted, and subsequently a retrograde urethrogram will be required. The urine must be tested for blood. If the result is positive a one shot intravenous pyelogram can be taken in the resuscitation room. This will show whether both kidneys are present, functioning, and with or without major disruption. This rapid investigation is usually performed on a patient going for an urgent operation, when the presence of any major renal disease needs to be excluded. If there is no urgency a definitive intravenous pyelogram and cystogram can be performed at the end of the examination. Urine should be saved for possible future microscopic examination and analysis of drug concentrations.

Occasionally there is pronounced gastric distension. A nasogastric tube decompresses the stomach and facilitates the examination of the abdomen.

Abdominal palpation may be unreliable, particularly in a patient with a head injury or one who is drunk. A diagnostic peritoneal lavage will rule out intraperitoneal injury in such a patient. The general surgeon who will be looking after the patient must be present while this procedure is undertaken.

Inspect the arms and legs for bruising, wounds, and deformities. In all patients check distal pulses and sensation. The viability of the skin overlying a fracture or dislocation must be assessed. Correct limb deformities and recheck peripheral pulses and sensation. Do all of this before performing radiography on the area as delays can result in loss of tissue. Palpate and rotate all long bones, noting any crepitus and instability. Test for active movement if the patient is conscious. Swabs should be taken for microbiological analysis from sites of compound fracture and wounds then covered with a sterile dressing. Splint all fractures: this will inhibit movement, reducing further damage to soft tissues and possible production of fat emboli as well as reducing pain. A polaroid picture taken before covering a compound fracture will prevent repeated inspection and decrease the risk of infection.

Spinal injuries can be partial or complete. Test for sensory and motor defects and note any degree of priapism; the penis does not have to be fully erect for this condition to be diagnosed. The results of these tests indicate the level and extent of damage. If the cord has been transected above the level of the sympathetic outflow hypotension without tachycardia results. The degree of vasodilatation producing spinal shock depends on how much sympathetic tone remains. Transection of the cervical spinal cord removes all vasoconstrictor tone and consequently produces profound hypotension.

**If you suspect a spinal injury do not move the patient**

If there is evidence of a spinal injury the patient should not be moved. Do not turn the patient to examine the back as this can increase the degree of neurological damage if the vertebral column is unstable. Radiographs of the affected sites are required initially so that management can be planned. The exceptions to the rule of not turning patients are those with penetrating injuries in whom the exit wound is not visible.

## Back



Log rolling a patient to enable examination of the back.

If there is no damage to the spinal cord the patient can be log rolled and the whole of the back examined. The patient should be turned away from the team leader so that the debris under the patient can be cleared away and the back inspected. Look for bruising and open wounds and auscultate the back of the chest. Inspect between the buttocks for the exit or entry site of a penetrating injury. "Walk" down the vertebral column with your fingers, feeling for boggyness, malalignment, and step off deformities. Sites of tenderness in conscious patients must be recorded. Finally, palpate the longitudinal spinal muscles for spasm and tenderness. The patient is then log rolled back into the supine position.

## Medical history

### Assessment of patient

- A Allergies
- M Medicines
- P Past medical history
- L Last meal
- E Events leading to the injury

This should now be assessed. Information may be available from the patient, relatives, and the ambulance crew. A useful mnemonic is given in the box.

Further x ray films may now be taken. Clearly, this should not precede or interfere with management of life threatening conditions—a ruptured spleen should be operated on before radiological confirmation of a fractured metacarpal.

## Reassessment

PRIMARY SURVEY	ON ARRIVAL	RESUSCITATION	INVESTIGATIONS
<b>AIRWAY</b> Clear <input type="checkbox"/> Compromised <input type="checkbox"/> CERVICAL SPINE Normal <input type="checkbox"/> Suspect injury <input type="checkbox"/> Rigid collar <input type="checkbox"/> In line traction <input type="checkbox"/>		Oxygen sat. % <input type="checkbox"/> Oropharyngeal airway <input type="checkbox"/> Nasopharyngeal airway <input type="checkbox"/> Endotracheal tube <input type="checkbox"/> Other (specify) <input type="checkbox"/> Gag reflex <input type="checkbox"/> N/G tube <input type="checkbox"/>	Blood gases Time <input type="checkbox"/> pH <input type="checkbox"/> pO <sub>2</sub> <input type="checkbox"/> pCO <sub>2</sub> <input type="checkbox"/> BE <input type="checkbox"/> O <sub>2</sub> Sat <input type="checkbox"/>
<b>BREATHING</b> Respiratory rate-breaths 10-20 (3) TS 6-8 (2) (4) 5-6 (1) (5) Bag and mask <input type="checkbox"/> Inhaled <input type="checkbox"/>		Full segment <input type="checkbox"/> Compensatory chest injury <input type="checkbox"/> Tension pneumothorax <input type="checkbox"/> Pneumothorax <input type="checkbox"/> Haemothorax <input type="checkbox"/> Intercostal drain site <input type="checkbox"/> Cardiac tamponade <input type="checkbox"/> Normal <input type="checkbox"/>	Urine Catheterised Yes <input type="checkbox"/> No <input type="checkbox"/> Protein <input type="checkbox"/> Blood <input type="checkbox"/> Sugar <input type="checkbox"/> Ketones <input type="checkbox"/> BM sticks <input type="checkbox"/> mmol HB NA BS WBC X Alcohol Platelet Count U Toxicology Crossmatch <input type="checkbox"/> No of units <input type="checkbox"/>
<b>CIRCULATION</b> Systolic BP 89 (3) TS 76-89 (2) (4) 50-75 (1) (5) 1-49 (1) (6) No carotid pulse <input type="checkbox"/>		External haemorrhage site <input type="checkbox"/> Internal haemorrhage <input type="checkbox"/> Thorax <input type="checkbox"/> Abdomen <input type="checkbox"/> Pelvis <input type="checkbox"/> External cardiac massage <input type="checkbox"/> None of above <input type="checkbox"/> Intravenous access <input type="checkbox"/> Central <input type="checkbox"/> Peripheral <input type="checkbox"/>	Peritoneal lavage MACRO MICRO Result Pink <input type="checkbox"/> Red <input type="checkbox"/> Clear <input type="checkbox"/> RBC count <input type="checkbox"/> WBC count <input type="checkbox"/> Amylase <input type="checkbox"/> Performed by <input type="checkbox"/> (Signature)
<b>DISABILITY</b> Alert <input type="checkbox"/> Responds to verbal commands <input type="checkbox"/> Responds to pain <input type="checkbox"/> Unresponsive <input type="checkbox"/>		<b>X RAYS</b> C-Spine <input type="checkbox"/> CXR <input type="checkbox"/> Pelvis <input type="checkbox"/> Skull <input type="checkbox"/> Other X rays <input type="checkbox"/>	
<b>EXPOSURE</b> Completely undress patient. Ensure genital and back are examined. SECONDARY SURVEY: SOFT TISSUE INJURY 		CT scan result <input type="checkbox"/> Summary of injuries <input type="checkbox"/> ALCOHOLIC INTOXICATION SUSPECTED <input type="checkbox"/> Disposal of patient <input type="checkbox"/> ITU <input type="checkbox"/> Theatre <input type="checkbox"/> Ward <input type="checkbox"/> CT scan Transfer <input type="checkbox"/> Mortuary <input type="checkbox"/>	

Pages two and three of the trauma sheet.

The ABC of Major Trauma has been edited by Mr David Skinner, FRCS; Mr Peter Driscoll, FRCS; and Mr Richard Earlam, FRCS, who is consultant general surgeon at The London Hospital.

The team leader must constantly evaluate the response to resuscitation:

(1) Is the patient improving, deteriorating, or unchanged since resuscitation started? If the patient is not improving then recheck the results of the Airway, Breathing, and Circulation investigations of the primary survey. The patient's condition can change rapidly: repeated examination and constant monitoring are essential.

(2) What is the extent of the injuries and what are the priorities for treatment?

(3) Has an injury been missed? If you have not found an injury in a body cavity between two injured sites you have probably missed it. Re-examine the patient.

(4) What is the patient's tetanus state, and are antibiotics required?

(5) Patients with multiple injuries require pain relief. A mixture of 50% nitrous oxide and 50% oxygen (Entonox) should be given until the baseline observations are recorded. Morphine can then be given intravenously, the dose being determined by titration against the patient's response.

The team leader is responsible for all documentation, which must be accurate and complete, and should write up the case notes. If a criminal cause of injury is suspected all clothes, loose debris, bullets, etc, should be bagged, labelled, and signed.

Responsibility for continuing care should be formally handed over, usually to the senior duty general surgeon, when the patient leaves the accident and emergency department.

The photographs depicting periorbital oedema, facial injury, and a penetrating neck injury have been reproduced by kind permission of the American College of Surgeons' working party on advanced trauma life support. The line drawing of the head was prepared by the department of education and medical illustration services, St Bartholomew's Hospital, who also supplied the photograph of a trauma team at work.

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