

# **RADIO-DIAGNOSIS — M D**

## **GOAL**

Goal of the course is to orient and train the students on different aspects of diagnostic and interventional radiology in the diseases of various organ systems of the human body. They should be able to apply this training at secondary and tertiary level of medical care.

## **OBJECTIVES**

In order to achieve the goal of this course, following objectives are to be accomplished by the time the candidate completes the 3 years course.

**Three broad domains of the objectives are:**

1. Cognitive domain (Knowledge)
2. Psychomotor domain (Skills)
3. Attitudinal domain (Human values, ethical practice etc.)

### ***Cognitive Domain (Knowledge)***

1. Describe aetiology, pathophysiology, and principles of diagnosis and management of common problems including emergencies, in adults and children.
2. Demonstrate understanding of basic sciences relevant to this specialty.
3. Identify important determinants in a case (e.g. social, economic, environmental) and take them into account for planning therapeutic measures.
4. Recognize conditions that may be outside the area of specialty/competence and to refer them to proper specialist or ask for help.
5. Advise regarding the management (including interventional radiology) of the case and to carry out the management effectively.
6. Update oneself by self-study and by attending courses, seminars, conferences and workshop which are relevant to the field of radio-Diagnosis.
7. Carry out guided research with the aim of publishing his/her work and presenting work at various scientific fora.

***Psychomotor Domain (Skills)***

1. Take a proper clinical history, examine the patient, perform essential diagnostic/interventional procedures and interpret the results to come to a reasonable diagnosis or differential diagnosis in the condition.
2. Provide basic life saving support service in emergency situations.
3. Undertake complete patient monitoring including the care of the patient.

***Attitudinal Domain***

1. Adopt ethical principles in all aspects of his/her practice. Professional honesty and integrity to be fostered.
2. Develop communication skills in order to explain the various options available in management and to obtain a true informed consent from the patient.
3. Be humble and accept the limitations of his knowledge and skills and to ask for help from colleagues/seniors when needed.
4. Respect patient rights and privileges including patient's right to information and right to seek a second opinion.

**COURSE CONTENT****1. BASIC SCIENCES RELATED TO RADIO-DIAGNOSIS**

- (a) Radiation physics and Radio-Biology,
- (b) Radiological anatomy and pathology of various organ systems
- (c) Imaging Techniques,
- (d) Radiography.

**Includes all aspects of:** Fundamentals of electromagnetic radiation, X-Ray production, characteristic properties of X-Rays, units of radiation, radiation measurement, X-ray equipments, X-Ray films, intensifying screens, other X-Ray appliances, dark room equipments and procedures, II TV, cine fluorography, tomography.

- Quality assurance.
- Radiation hazards and principle and methods of radiation protection.
- Contrast media : types, chemistry, mechanisms of action, dose schedule, routes of administration, their potential adverse reactions and management.
- Clinical applications of important isotopes and instrumentation in Nuclear medicine with advances in both.
- Physics and applications of advanced imaging i.e., Ultrasound, CT, MRI, Angiography (DSA), PET etc.
- Practical experiments in physics : A list of experiments, which a resident should be able to do and interpret the results, is available in the department.

## **2. RESPIRATORY SYSTEM**

### ***Goal***

At the completion of the course the resident should be able to interpret conventional and advanced (CT, MRI) chest examinations, differentiating normal from abnormal cases and be able to recognize specific imaging pattern of different diseases.

### ***Content Coverage***

Diseases of the chest wall, diaphragm, pleura and airways; pulmonary infections; pulmonary vasculature; pulmonary neoplasms; diffuse lung disease; mediastinal disease; chest trauma; post- operative lung and X-Rays in intensive care.

### ***Essential Objectives***

1. Should be able to localize the chest pathology into one of the following compartments: pulmonary, pleural, mediastinal, extra-pleural, extra-thoracic, diaphragmatic, infradiaphragmatic.
2. Recognize chest pathology that requires urgent or emergency treatment and describe this in an adequate manner: Pneumothorax, traumatic aortic rupture, esophageal rupture, acute pulmonary embolism, CHF and tracheo-bronchial foreign bodies.
3. Recognize acute and chronic patterns of bacterial and viral pneumonia's, occupational diseases, allergic states.
4. Recognize acute and chronic cardiac failure patterns and non-cardiogenic edemas.
5. Understand the radiographic features and precipitating causes of adult and infant respiratory distress syndrome.
6. Recognize and describe appropriately the various manifestations of benign and malignant neoplasm's of the lung.

### ***Evaluation***

- Resident's progress through daily observation of work
- At the end of the rotation an assessment by a small group of faculty.
- Maintain a log book showing techniques learnt during the rotation – to be supervised.

## **3. GASTROINTESTINAL (GIT) AND HEPATO-BILIARY-PANCREATIC SYSTEM**

### ***Goal***

At the completion of this course the resident should be able to interpret both the conventional and other newer (ultrasound, CT, MRI, angiography) examinations. This includes examination of GIT i.e., esophagus, upper gastrointestinal study, follow through for small bowel (including small bowel enterolysis) and enema (both conventional and double contrast) for colon. It also includes examination of liver, biliary system and pancreas using all the imaging modalities available to a radiologist including specialized investigations like ERCP, PTC and interventional procedures like abscess drainage, Percutaneous Transhepatic biliary drainage (PTBD, internal and external), tumor embolization, Radiofrequency (RF) ablation etc.

During this posting resident also performs other investigations done using fluoroscopic guidance e.g; hysterosalpingography (HSG); fistulogram, sinogram, T-Tube cholangiography, sialography etc. and he/she should be able to perform and interpret studies using these modalities.

### **Content Coverage**

Diseases and disorders of mouth, pharynx, salivary glands, esophagus, stomach, small intestine, large intestine, diseases of omentum, peritoneum and mesentery, acute abdomen, abdominal trauma using conventional and newer imaging methods like CT, MRI, DSA, isotope studies.

Diseases and disorders of hepato-biliary-pancreatic system using conventional & newer imaging methods.

### **Essential Objectives**

1. Learn to evaluate the clinical condition & needs of a patient and to decide the appropriate studies and approach for examining the GIT or hepato-biliary-pancreatic system of a patient.
2. Learn a proper approach to fluoroscopy: this includes developing proficiency in GIT fluoroscopy, mastering the equipment and using proper radiation protection measures (both for the patient and the operator).
3. Learn the basic pathology and patho-physiology of GIT/hepato-biliary-pancreatic diseases.
4. Learn to communicate the findings both at fluoroscopy and in films, in an accurate, succinct and meaningful way.

### **Evaluation:**

- Day to day observation of residents work including documentation and interpretation
- Assessment by a group of faculty at the end of the rotation.
- Log book will be maintained of the procedures learnt.

## **4. GENITO-URINARY SYSTEM**

### **Goal**

At the completion of this course resident should be able to perform, direct the radiography and interpret the conventional radiological examinations of the urinary tract. These includes: excretory urography (intravenous pyelography); cystograms, micturating cystourethrography (MCU) and retrograde urethrography (RGU).

[HSG is included under GIT rotation].

In addition the resident should be able to perform and interpret other diagnostic imaging modalities and procedures which are used to evaluate urinary tract pathology i.e., ultrasound, CT, MRI, angiography, as well as various interventional procedures like percutaneous nephrostomy, kidney biopsy, stent placement, antegrade pyelography, tumor embolization etc.

Obstetrics and gynaecology ultrasound : separate posting in III year.

Hysterosalpingography : already included with GIT posting.

### **Content Coverage**

Imaging : conventional, ultrasound, CT, MRI, angiography; of various diseases and disorders of genito-urinary system. These includes : congenital, inflammatory, traumatic, neoplastic, calculus and miscellaneous conditions.

### **Essential Objectives**

1. Recognize and evaluate emergency conditions involving the urinary tract including trauma, infection, vascular compromise and obstruction.

2. Recognize and understand the patho-physiology of stone disease.
3. Recognize patterns of infectious diseases and the modalities necessary for diagnostic evaluation.
4. Understand the complete evaluation of renal mass lesions and the evaluation of other urinary tract neoplasms, including the detection and staging of the tumor.
5. Recognize the difference between the pattern of diseases affecting the genito-urinary tract of adults and that of children and understand and identify the common conditions affecting the paediatric genito-urinary system on imaging.

***Evaluation:***

- day to day, based on daily work assessment
- by a group of faculty at the end of the posting.
- Maintain a log book

**5. MUSCULOSKELETAL SYSTEM*****Goal***

At the end of the course the resident should be able to correctly interpret all the common abnormalities of the bones and joints. He/She should have a good understanding of the common congenital abnormalities, arthritis, bone and joint trauma, neoplastic conditions, metabolic bone disease and inflammatory diseases. He/She should also have an understanding of the role of CT/MRI in all these conditions and should be able to perform and interpret CT/MRI in diseases of musculo-skeletal system.

***Content Coverage***

Imaging (Conventional, ultrasound, CT, MRI, angiography, Radio-isotope studies) and interpretation of diseases of muscles, soft tissue, bones and joints including congenital, inflammatory, traumatic, neoplastic and miscellaneous conditions.

***Essential Objectives***

1. Communicate precisely and cogently radiographic descriptions of bone and joint trauma.
2. Differentiate various forms of arthritis and know correlative laboratory and clinical findings.
3. Enumerate the radiographic features that differentiate benign and malignant bone tumors with a basic familiarity of more common tumors.
4. Know radiographic features of acute and chronic osteomyelitis and discitis (including tuberculosis).
5. Recognize differential features of osteoporosis ( including Bone Mineral Density or BMD assessment techniques e.g; US,CT,Dexa) including various endocrine and metabolic diseases e.g; osteomalacia, hyperparathyroidism etc.
6. Know the application and interpretation of ultrasound/CT/MRI/angiography in one or more of the above situations.

***Evaluation***

- through daily sessions assessment
- by a small group of faculty at the end of the posting
- Will maintain a log book

## 6. CARDIOVASCULAR RADIOLOGY/ECHO CARDIOGRAPHY

### **Goal**

Goal is to provide experience in the role of imaging in cardiovascular diseases by different techniques including cardiac catheterization and cardiac angiography, Digital subtraction angiography (DSA) and interventional procedures in non cardiac arterial and venous diseases.

### **Content Coverage**

Diseases and disorders of cardiovascular system including congenital conditions and the role of imaging by conventional, ultrasound, Echo, color-Doppler, CT, MRI, angiography (including DSA) and radionuclide studies. It also includes interventional procedures e.g; balloon angioplasty, embolization etc.

### **Essential Objectives**

1. Understand the anatomy and common pathology of congenital and acquired cardiac conditions.
2. Correlate plain film findings of common congenital abnormalities with those shown by angiography and explain the pathophysiology including abnormal pressure measurements.
3. Correlate plain film findings and the echocardiographic studies of patients with acquired valvular diseases and other common pathologic conditions including pericardial pathology.
4. Understand the role of newer modalities like CT/MRI, in aortic diseases e.g., aorto-arteritis, aortic dissection and aortic aneurysm.
5. Should be able to perform fluoroscopy on patients before and after valve replacement and identify those with complications after valve replacement.
6. Understand the principle and logic behind various interventional procedures carried out in the cardiovascular labs e.g; PTCA, balloon dilatation of valvular lesions, septostomy etc.

### **Evaluation**

- day to day assessment
- by a small group of faculty
- Maintain a log book to be checked by faculty in charge

## 7. NEURORADIOLOGY

### **Goal**

At the end of the course the resident should be able to demonstrate reasonable proficiency in the assistance during performance as well as in the interpretation of all neuro-radiological studies. This includes angiograms, both cerebral and non-cerebral studies, transluminal angioplasties, embolization procedures and myelography. They should also be able to perform and interpret CT and MRI of head and spine.

### **Content Coverage**

Includes imaging (using conventional and newer methods) and interpretation of various diseases and disorders of the head, neck and spine covering congenital lesions, infective lesions, vascular lesions, traumatic conditions and neoplasia. It also includes a number of interventional procedures carried out in the department of neuroradiology.

### **Essential Objectives**

1. Know detailed normal neuro-imaging anatomy on different imaging modalities.

2. Identify pathologic conditions (listed under the content) on images acquired using different techniques and communicate the report in a concise manner.
3. Participate in daily neuroradiology conferences held with the neurosurgery or neurology units.

**Evaluation**

- day to day based on reporting and procedures performed.
- by a small group of faculty.
- Will maintain a log book to be checked by faculty in neuroradiology.

**8. GENERAL RADIOLOGY****Goal**

In this rotation the resident learns to evaluate conventional radiographs. This includes radiographs of : chest, abdomen, pelvis, skull, spine, musculo-skeleton and soft tissues. Resident is posted in OPD and indoor radiography rooms for this purpose.

During indoor posting, he/she will also have the additional responsibility of directing, evaluating and reporting mammographic procedures including related interventional procedures.

**Essential objectives**

1. Learns to direct and perform radiography on patients.
2. He/she should be able to decide on further imaging views based on the clinical suspicion and the initial imaging.
3. Write reports on the radiographs obtained in a methodical, concise and precise way and communicate it to the referring unit.
4. Present interesting cases in the departmental meets.

**9. ULTRASOUND (INCLUDING GYNAE/OBSTETRICS)****Goal**

At the completion of this rotation the resident should be able to perform and interpret all ultrasound studies. These studies include : abdomen, pelvis, small parts, neonatal head, color-duplex imaging (including peripheral i.e; extremity arterial and venous studies), obstetrics/gynaecology (in the dept of Gyn/Obstet) and interventional procedures using ultrasound guidance. The resident should have a thorough knowledge of the common abnormalities of the abdominal/pelvic organs, retroperitoneal structures, neck, chest, extremities and small parts (thyroid/parathyroid, scrotum, orbit, breast).

**Essential Objectives**

1. Determine or select the appropriate diagnostic procedure for the clinical problem.
2. Demonstrate proficiency in patient scanning using appropriate techniques and instrumentation.
3. Modify the procedure, if required, based upon the observed abnormalities (pathology).
4. Analyze the results of the diagnostic procedure, make diagnosis and record the findings.
5. Communicate findings, diagnosis and other relevant information to the referring physician.
6. Present interesting ultrasound cases in the departmental conferences/meetings.

**Evaluation**

- ongoing basis using day to day work

- presentations in departmental meets
- maintain a log book
- by a group of faculty at end of the rotation

## 10. CT

### **Goal/Objectives**

The goals/objectives to be achieved by the end of this rotation are:

1. Select CT protocol according to the clinical diagnosis. He/she should be able to direct and modify (if required) the performance of the CT examination
2. Demonstrate knowledge of the CT findings of the common pathologic conditions occurring in the head, neck, chest, abdomen, pelvis, and in the soft tissues and musculo-skeletal system.
3. Resident should be familiar with both the conventional and different modified CT techniques (High resolution, Dual phase, CT angio, BMD, multislice CT etc.)
4. Interpret conventional and modified body CT examinations (including HRCT, dual/triple phase CT, CT portography, virtual CT etc.) with a reasonable degree of accuracy.
5. Demonstrate proficiency in verbal and written reporting of CT findings and differential diagnosis.
6. Demonstrate knowledge of the limitations (and potential fallacies) of CT imaging of various pathologic conditions and be able to perform correlations with other imaging modalities including formulations of recommendations for additional appropriate imaging procedures.
7. Perform CT guided biopsy procedures under guidance of seniors.
8. Present interesting cases of CT in the departmental meetings.

### **Essential Objectives**

1. The resident will review the daily body CT schedule and based upon the known clinical information and review of other radiologic studies of the same patient done earlier, select the most appropriate CT imaging protocol for the each patient. This may include altering an existing CT protocol to provide the most appropriate examination for an individual patient.
2. Develop a working knowledge of the actual performance of the CT examinations. This includes starting intravenous lines, amount and timing of injecting i.v. contrast, and actual operation of CT machine.
3. Review and report all the completed body CT examinations. Initially this will be under the supervision of the seniors but later independently – but all reports will be signed by the faculty incharge.
4. Participate and present CT cases in departmental and inter departmental meets.

### **Evaluation**

- on daily basis after observing reporting and working in the CT room
- by a group of faculty
- Maintain a log book under the supervision of faculty incharge.

## 11. ANGIOGRAPHY AND INTERVENTIONAL RADIOLOGY

### **Goal**

At the completion, the resident should be able to perform the most common non-cerebral angiographic studies. He/she should have a good basic understanding of both; the vascular interventional radiologic



procedures such as angioplasty, embolization using various embolizing agents; as well as the various non-vascular interventional procedures such as percutaneous nephrostomy, stenting, abscess drainage, PTC/PTBD, percutaneous biopsy, balloon dilatation of the esophagus etc. He/she should have a good understanding of the various equipment and available catheters and guidewires and other technical aspects of special procedures. In addition he/she should know all the potential risks and complications of these procedures and their management.

### ***Essential Objectives***

1. Evaluate the requisition for appropriate clinical information to determine if additional information is needed.
2. Determine or select appropriate diagnostic procedure for the clinical problem.
3. Assist and perform appropriate procedures under supervision and modify procedures based on observed abnormalities (pathology).
4. Know the potential risks and complications of procedures performed.
5. Know normal vascular anatomy applicable to angiographic procedures performed and know normal anatomy and landmarks to perform other non-vascular procedures.
6. Present interesting cases in the departmental meets.

### ***Evaluation***

- day to day evaluation
- by a group of faculty
- Will maintain a log book

## **12. PAEDIATRIC RADIOLOGY**

### ***Goal***

Intention is to train residents to perform common radiologic procedures and to be able to interpret paediatric studies in order that they can appropriately deal with examinations of children in a non paediatric hospital environment.

At the completion the resident should be able to interpret most of the conventional and newer paediatric examinations which includes: upper airways, chest, genito-urinary, gastro-intestinal and musculo-skeletal systems. Resident should be familiar with many of the neurologic conditions encountered in neonates and children. Resident should also be able to perform transfontanelle cranial ultrasound.

### ***Content Coverage:***

Common diseases and disorders of different organ systems covering congenital, inflammatory, traumatic, neoplastic and other miscellaneous conditions, using both conventional and newer imaging methods.

### ***Essential Objectives***

1. Understand the appropriate indications for various imaging procedures and determine that the patient has been properly prepared for the procedure.
2. Know the standard radiographic views for paediatric examinations.
3. Learn to recognize and evaluate imaging manifestations (on conventional and newer methods) of common paediatric conditions occurring in the head/neck, chest, abdomen/pelvis and in the musculo-skeleton.

4. Perform paediatric fluoroscopic examinations with skill and accuracy.
5. Understand and apply the knowledge and principle of radiation protection, both for the child and the operator.

### **13. RADIOLOGY IN EMERGENCY MEDICINE**

#### ***Goal***

At the end of the course, resident should be able to give an evaluation of the emergency radiographic examinations. He/she should also be familiar with medicolegal cases (MLC) procedures.

#### ***Essential Objectives***

1. Determine and direct radiography in emergency patients and review and interpret the radiographs.
2. If study is incomplete then determine additional views or repeat views.
3. Know indications for and limitations of the common emergency imaging procedures.
4. Communicate findings, diagnosis and other relevant information to the emergency room physician.
5. He/she should be able to perform (some under supervision) and interpret special imaging procedures needed in emergency room e.g; barium studies, excretory urography, CT, ultrasound, Doppler and angiography.

### **14. ONCOLOGIC RADIOLOGY**

#### ***Goal***

At the end of the rotation the resident should be able to interpret radiological investigations in patients with neoplastic diseases (both benign and malignant). He/she should be able to perform, interpret and diagnose these patients.

#### ***Essential objectives***

1. Understand pathology and patho-physiology of common neoplasms.
2. Learn the algorithmic approach to image these patients based on the suspected disease, its biological behaviour and potential and limitations of various imaging modalities.
3. Perform appropriate investigation(both conventional and newer methods), interpret the results and reach at a reasonable diagnosis/ differential diagnosis based on the clinical and biochemical results.
4. Learn to communicate the results in a precise way in a written report to the concerned unit.
5. Present interesting cases in the departmental meets.

### **15. NUCLEAR MEDICINE**

#### ***Goal***

At the completion of this rotation the resident should be able to interpret common nuclear medicine examinations (including cardiac cases). He /she should be able to evaluate the examinations for completion and determine what further images (including non nuclear medicine) need to be done. He/she should have a good understanding of the physical and biological properties of the commonly used radiopharmaceuticals and become familiar with safe handling of isotopes and basic radiation safety measures while dealing with isotopes.

***Essential objectives***

1. Review all cases performed each day.
2. Interpret the results of the procedures and give an appropriate diagnosis.
3. Observe and help in some common procedures performed in the department ( e.g; thyroid, kidney, bone, cardiac scans), understand the principle underlying the procedure and the basis for using a particular isotope in an investigation.

***Evaluation***

- Day to day by the nuclear medicine staff.

**DISSERTATION****Thesis**

1. Every candidate pursuing MD degree course is required to carry out work on a selected research project under the guidance of a recognised post graduate teacher. The results of such a work shall be submitted in the form of a dissertation.
2. The dissertation is aimed to train a post graduate student in research methods and techniques. It includes identification of a problem, formulation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, comparison of results and drawing conclusions.
3. Chief guide will be from the department of Radio-diagnosis while co-guides will be from either the department of Radio-diagnosis or other disciplines related to the dissertation topic.
4. Every candidate shall submit a thesis protocol to the Dean of the Institute in the prescribed proforma containing particulars of proposed dissertation work four months from the date of commencement of the course. The thesis protocol shall be sent through the proper channel.

Protocol in essence should consist of:-

- (a) Introduction and objectives of the research project.
  - (b) Brief review of literature
  - (c) Suggested material and methods
  - (d) Bibliography
5. Such thesis protocol will be reviewed and the dissertation topic will be registered by the Institute. No change in the dissertation topic or guide shall be made without prior approval of the Dean of the Institute.
  6. Submission of thesis.

Thesis will be submitted at the end of two and a half (2.5) years.

Thesis should consist of

- (e) Introduction
- (f) Review of literature
- (g) Aims and objectives
- (h) Material and methods

- (i) Results
  - (j) Discussion
  - (k) Summary and Conclusions
  - (l) Tables
  - (m) Annexures
  - (n) Bibliography
7. Two copies of dissertation thus prepared shall be submitted to the Dean AIIMS, six months before the final examination.
8. The dissertation shall be valued by two external examiners appointed by the Institute. Approval of dissertation work is an essential precondition for a candidate to appear in the final MD examination.

Dissertation is graded as follows :

- Highly commendable
- Commendable
- Satisfactory
- Rejected

### MD (Radodiagnosis), Posting Schedule

Total Duration : 3 years

#### Applied Physics and Basic Sciences

First Year	Second Year	Third Year
Conventional Radiology (OPD) — 3 months	Ultrasound (with interventions) — 2 months	Emergency Radiology (Casualty) — 2 months
Genitourinary-3 months	CT (with interventions) — 2 months	Oncologic Radiology (IRCH) — 2 months
Conventional Radiology, including Paediatric Radiology (Indoor) — 3 months	Angiography (with interventions) — 2 months	Nuclear Medicine — 1 month
Observer Postings:		
1. GIT - 1 month	MRI – 2 months	Obstet/Gyn (US)- 15 days
2. Ultrasound-1 month		
3. CT –1 month	Cardiac Radiology- 2 months	Echocardiography – 15 days
	Neuroradiology – 2 months	Ultrasound – 1 Month
		CT — 1 month
		MRI — 1 month
		Angiography — 1 month
		Elective – 2 months
<b>Dissertation submission at the end of 2 ½ years</b>		

**Classes on Statistics :** A series of lectures held for every one

## STRUCTURE

### 1. Basic Sciences

- (a) Anatomy
- (b) Pathology
  - General Pathology
  - Systemic Pathology
- (c) Radiotherapeutic physics
- (d) Clinical Radiobiology
- (e) Statistical basis for planning & interpretation of clinical trials.

### 2. Clinical Radiotherapy

### 3. Clinical Chemotherapy

### 4. Other disciplines allied to Radiotherapy and Oncology

### 5. Palliative care

### 6. Research, Training & Administration

## 1. BASIC SCIENCES

### 1.1. Anatomy

- 1.1.1. Knowledge of surface anatomy pertaining to Oncology
- 1.1.2. Detailed knowledge of the anatomy of all organs.
- 1.1.3. Detailed knowledge of the lymphatic system of all regions
- 1.1.4. Practical familiarity with the radiographic appearance of important regions
- 1.1.5. Cross sectional anatomy

### 1.2. Pathology

- 1.2.1 General Pathology
  - 1.2.1.1. Definitions of & distinction between different types of growth disorders (i.e. distinction between hyperplasia, hypertrophy, regeneration, malformation & neoplasia)
  - 1.2.1.2. Malignant transformation -
    - Initiation & promotion stages of carcinogenesis
    - Mode of origin - monoclonal, polyclonal, unifocal, multifocal
    - Structural & functional changes in the cellular components.
    - Etiology, mechanisms of carcinogenesis, known types of carcinogens & their effects upon the cell. The relative importance of different factors in the causation of human cancer.
  - 1.2.1.3. Rate of growth, methods of measurement
    - Factors affecting growth rate
    - Mechanisms of spread
    - Local effects of tumors