

**STUDENT WORKBOOK  
IN RADIOLOGY**

**Department of Medicine  
Faculty of Medicine  
Sabaragamuwa University of Sri Lanka**

First Edition 2021

*2021 Department of Medicine  
Faculty of Medicine  
Sabaragamuwa University of Sri Lanka*

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**ISBN 978-624-97939-4-1**

## CLINICAL APPOINTMENT IN RADIOLOGY

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1. Name of the student

.....

2. Year passed GCE Advanced level Examination

.....

3. Duration of the appointment

From: ...../...../..... To: ...../...../.....

4. Name of the consultant

.....

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## **PREFACE**

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Students of the Faculty of Medicine, Sabaragamuwa University of Sri Lanka, study Radiology as a separate appointment of 2 weeks at the Teaching Hospital Ratnapura. During this period, they will be attached to the Radiology unit under the consultant radiologists appointed by the Ministry of Health.

This workbook in Radiology is compiled to help students achieve essential knowledge indications, patient preparation and interpretation of common radiological investigations, expected from an undergraduate when they qualify to work in medical wards as intern house officers. Thus, the workbook will guide the student during their radiology short appointment.

This workbook is a joint effort between academic staff of the Department of Medicine, SUSL and the current consultant radiologists of the Teaching Hospital Ratnapura. Students are expected to organize their classes and do self-studies in order to complete the tasks set out in the workbook.

We value your feedback to improve the workbook.

Dr Champika Gamakaranage

Dr Udayangani Ramadasa

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### **Contribution**

CG – Wrote the investigations and exercises sections and updated and edited all the sections

UR – Wrote the initial draft and updated all the sections

DG – Updated all the sections and contributed with providing images and new questions

JK and SV – Accepted and approved the contents

SJ – Conceptualized the production of this book and updated all the sections

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## CHAPTER 1

### INTRODUON

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Dear Students,

We have prepared a series of workbooks to guide you during your medical appointments. These include 3<sup>rd</sup> year workbook, 4<sup>th</sup> year workbook and workbook for each short appointment and a workbook for the professorial appointment.

The appointments in finer specialties are organized based on the University Grants Commission guidelines and according to the needs of the Ministry of Health.

The short appointment in Radiology will give you the opportunity to study Radiology with exposure to specific case scenarios in more detail. This workbook is prepared to provide guidance to the students during the Radiology appointment to cover the essential areas expected from an undergraduate. You are expected to learn the management plans in further detail. This includes the investigation, treatment of common medical conditions, management of common emergencies, which are essential clinical topics for an intern medical officer. This knowledge, skills and experience you gather during the short appointments will help you to understand patient problems in greater depth.

Your continuous assessments will be based on these workbooks.

## Learning Outcomes in Radiology

On completion of the appointment, students should be able to,

1. Know the basic technical aspects and safety issues related to radiological investigations.
2. Interpret findings of common radiological investigations such as chest radiograph, radiographs of the abdominal region and skeletal X-rays using the knowledge of anatomy and pathophysiology of different disorders.
3. Describe the indications, limitations and be able to interpret simple findings and outline abnormalities commonly seen in,
  - Ultrasonography (mainly abdomen and pelvis)**
  - Non-contrast CT scan (specially brain and urinary tract)**
  - Contrast CT scan (chest, abdomen, pelvis and brain)**
  - High resolution CT (chest - HRCT)**
  - MRI imaging (specially brain and spine)**
  - Barium studies of the GIT (Gastrointestinal tract)**
  - Fluoroscopy**
  - Other radiological investigations**
4. Describe the necessary preparations for the patient preparations and manage complications of the following procedures,
  - a. Ultrasound guided aspirations and biopsies of thyroid, lymph nodes, pleural, renal, **breast, knee joint** and liver
  - b. CT Guided biopsies in chest and abdomen
  - c. Chest drains



## CHAPTER 2

### CORE CLINICAL KNOWLEDGE AND SKILLS

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At the end of the radiology appointment, you should be competent in the patient preparation, obtaining consent, describing the procedure, interpretation of commonly seen abnormal images in relation to a clinical diagnosis at a level of a student about to enter the final year.

#### STEPS IN OBTAINING THE CONSENT FOR RADIOLOGICAL INVESTIGATIONS AND PROCEDURES

The procedure could be diagnostic or interventional. Patient should understand the procedure and the risks and benefits of it and the patient should actively involve in consenting. In Sri Lanka, often families get involved in the process.

Firstly, greet the patient and briefly introduce yourself. It is important to initially talk to the patient and understand the background of the patient (e.g., level of education, culture, beliefs and preferences). Find out whether the patient can understand the language you use or whether he or she needs an interpreter. See whether the patient is competent enough to understand the procedure you are going to explain and to give the consent.

When you obtain the consent, include the following.

1. Details of the procedure, basically what exactly would follow
2. The person who will do the procedure
3. Details of other options available
4. The benefits the patient gains by doing the procedure
5. Whether it is an emergency procedure or elective procedure
6. Whether it is an invasive procedure or whether it is painful
7. The possible short term and long-term complications and contraindications
8. The expected outcome if this is not done
9. The financial cost if procedure is going to be done in the private sector
10. Whether this is a part of a clinical trial.
11. Once you explain all these, review again to make sure that the patient has understood what you explained.

#### INTERPRETATION OF A CHEST RADIOGRAPH

Confirm the identity of the X-ray, look at the detail of the patient and check the name age sex and clinic or bed head ticket number and essential information regarding the background of the patient's condition. **Always** use an illuminator. Check for the correct side (Left and right).

### Radiological abnormalities in the lung

Condition	Possible radiological features
Cardiac failure	<i>Upper lobe pulmonary venous diversion (cephalization), pulmonary interstitial oedema (peri bronchial cuffing, septal thickening/Kerly B lines), pulmonary alveolar shadows (batwing pattern), cardiomegaly, pleural effusion</i>
Consolidation	<i>Air space opacification, air bronchogram</i>
Calcifications	<i>Generally, more dense than bones, there are a number of causes. The interpreter should identify the structure involved (Eg: lymph nodes, lung parenchymal, mediastinal, pleural)</i>
Bullae	<i>Localized regions of emphysema with no discernible walls (best seen in the CT scans)</i>
Abscess	<i>Cavity with air-fluid level</i>
Fibrosis	<i>Architectural distortion, reticulations, honey combing and associated bronchiectasis</i>
Pulmonary tuberculosis	<i>Primary pulmonary TB – lobar consolidation, hilar /mediastinal lymphadenopathy (specially in children)</i>
	<i>Post primary pulmonary TB – usually in the upper lobes and in the superior segment of the lower lobes cavitations, consolidations, nodal enlargement</i>
	<i>Miliary TB- small nodules of 1-3 mm with uniform distribution</i>
Bronchial carcinoma	<i>Appearance depends on the location- rounded or speculated mass with or without cavitation, associated lobar collapse, consolidation, pleural effusion, lymphadenopathy, metastatic pulmonary lesions, soft tissue mass in the chest wall and rib erosions in case of peripherally located carcinoma</i>

Secondary malignant deposits	<i>Usually multiple, one or both lungs, appear as peripheral, rounded nodules of variable size,</i>
Lung collapse	<i>Volume loss in the affected lobe, absence of air bronchogram</i>
Bronchiectasis	<i>Tram-track opacities, ring shadows, fluid levels</i>
Emphysema	<i>Hyperinflation of the lungs (flattened hemidiaphragms, increased radiolucency in the lung fields, increased retrosternal airspace in lateral CXR, saber-sheath trachea</i>
Pulmonary embolism	<i>CXR is not sensitive, Signs are; enlarged pulmonary artery (Fleischner sign), peripheral wedge of air space opacity (Hampton hump), regional oligemia (Westermark sign)</i>

### **Diseases in the pleura and pleural cavities**

Pleura is not usually visible in chest x rays. Borders of each lung markings extend to the edges of the lung fields in normal healthy individuals.

Pleural abnormality	Description	Radiological features in chest x ray
Pleural effusion	<i>Accumulation of fluid in the pleural space Usually more than 250 ml of fluid should fill the pleural space to become evident in the frontal chest radiograph. Lateral decubitus projection can detect smaller volumes of effusion.</i>	<i>Blunting of the costophrenic angle, fluid in the fissures, meniscal appearance (not seen with hydropneumothorax)</i>
Haemothorax		<i>Similar appearance to the pleural effusion, there can be associated features in case of trauma (e.g.; rib fractures, soft tissue oedema)</i>

Pneumothorax	<i>Accumulation of gas in the pleural space</i>	<i>Visible pleural edge with no lung markings peripheral to that, associated collapse</i>
Tension Pneumothorax	<i>Air accumulation in the pleural space leading to haemodynamic compromise</i>	<i>Features of pneumothorax with mediastinal shift to the contra lateral side.</i>
Pleural thickening	<i>Thickening of either visceral or parietal pleura</i>	<i>Thickening of the lung edge</i>

### Cardiac abnormalities

<b>Abnormality</b>	<b>Description</b>	<b>Cause/causes</b>
Cardiomegaly	<i>Enlargement of the heart</i>	<i>Congestive cardiac failure, hypertension, aortic regurgitation, cardiomyopathy, congenital heart diseases, cor pulmonale</i>
Reduced definition of right heart border	<i>The right heart border is difficult to demarcate from adjacent lung</i>	<i>Right paratracheal stripe definition loss is seen with right upper lobe pathology.</i>

		<i>Right heart border is ill defined in the right middle lobe or medial segment of the right lower lobe pathology.</i>
Reduced definition of the left heart border	<i>Left heart border is ill defined or hazy</i>	<i>Definition of aortic knuckle is lost in left upper lobe pathology. Left heart border is ill defined in the lingular segment of the left upper lobe pathology. Posterior border of the heart in a lateral X ray is ill defined in left lower lobe pathology.</i>

### Diaphragm

Right side hemidiaphragm is usually higher than the left diaphragm due to the underlying liver. The stomach air bubble is seen under the left hemidiaphragm. List the causes for air bubbles under the right hemidiaphragm.

- 1.
- 2.
- 3.

Costophrenic angle, which is formed by the dome of the hemidiaphragm, and the lateral wall of the pleural cavity is clearly seen as an acute angle in a chest radiograph of a healthy individual. Write causes for blunted costophrenic angle.

- 1.
- 2.
- 3.

## Mediastinum

Condition	Radiological features
Aortic aneurysm	<i>Smooth enlargement of the thoracic aorta with mass effect. Wall calcifications may be present</i>
Mediastinal lymphadenopathy	<i>Widening of the mediastinum, widening of the para tracheal stripe</i>
Pneumomediastinum	<i>Linear or curvilinear lucencies outlining the mediastinum.</i>

Look for,

- Bony abnormalities such as fractures, lytic lesions or cervical rib
- Soft tissue abnormalities such as subcutaneous emphysema and large hematoma
- Tubes (e.g., nasogastric tube, endotracheal tube), Artificial cardiac valves, or pacemakers and defibrillators.

## Interpretation of an X-ray abdomen

- Confirm the name, age, date and the Bed Head Ticket or clinic number.
- Check whether the projection is supine or erect x ray abdomen.
- Ensure the correct exposure and adequate area is visible.
- Differentiation of small and large bowel.

Radiological appearance	Small bowel	Large bowel
Position of the bowels in in the x-ray	<i>Tends to be central and seen when gas is filled</i>	<i>Peripheral, fixed positions of the ascending and descending colon whereas transverse and sigmoid colon show variable position Mottled appearance due to faecal matter</i>

Mucosal folds	<i>Traverses the lumen (valvulae conniventes) and closely spaced</i>	<i>Do not traverse the whole lumen (haustral folds)</i>
Bowel diameter	<i>Less the 3 cm</i>	<i>Less than 6 cm wide (ascending, transverse and descending colon) Caecum and sigmoid colon up to 9 cm</i>

Mottled appearance seen in large bowels due to the gas trapped within solid faeces.

#### Compare radiological findings of following conditions

<b>Small bowel obstruction</b>	<b>Large bowel obstruction</b>	<b>Inflammatory bowel disease</b>
<b>Dilated (&gt;3cm) loops proximal to the obstruction</b>	<b>&gt; 6 cm of the colon &gt; 9 cm caecum and sigmoid</b>	<b>Usually no place in routine practice, however, important to evaluate the complications; Dilated colon in toxic mega colon, bowel obstruction, pneumoperitoneum</b>
<b>Predominantly central</b>	<b>Tends to be in the periphery, may be variable</b>	
<b>Valvulae conniventes</b>	<b>Haustral folds</b>	
<b>Air fluid levels in erect X ray</b>	<b>Collapsed colon distal to the obstruction</b>	
	<b>Little or no air in the rectum</b>	
	<b>Dilated small bowel in case of incompetent ileocaecal valve</b>	

Identify the relevant pathologies in the lung base, liver, gall bladder spleen, kidneys, stomach, bladder and psoas muscle.

Look for bony abnormalities (e.g., osteoarthritis, fractures, bone secondaries)

Look for gall bladder calculi, renal, ureteric or bladder calculi, pancreatic calcification, or any other calcifications or calcified masses, surgical clips, foreign bodies, stents, contrast material.

#### INTERPRETATION OF PLAIN CT BRAIN

Condition	Pathophysiology	Appearance in the CT brain
Extradural haemorrhage (EDH)	Collection of blood between the inner surface of the skull and the outer layer of the dura (Located in the sub periosteum)	Hyperdense, sharply demarcated and biconvex in shape. Usually do not cross the sutures. Frequently seen beneath the temporal bone with associated fracture. Features of mass effect (midline shift, subfalcine, uncal herniation)
	Usually seen with head trauma and associated skull fracture	
	Most commonly the middle meningeal artery is injured	
Subdural haemorrhage (SDH)	Blood accumulation in the subdural space, the potential space between the dura and the arachnoid mater.	Crescent shaped, more extensive than the EDH. Density depends on the age of the haematoma. Limited by dural reflections, but not limited by the sutures.
	Usually due to trauma.	
Intracranial haemorrhage (ICH)	Accumulation of blood within the cerebral parenchyma.	Acute blood is hyperdense. The location depends on the underlying etiology . Can lead to intra ventricular haemorrhage, hydrocephalus.



	Can be primary or secondary (trauma, hypertension, vascular malformation, tumours, etc.)	
Subarachnoid haemorrhage (SAH)	Blood in the subarachnoid space	The sensitivity depends on the amount of blood present and the time since haemorrhage. Hyperdense material filling the subarachnoid space commonly seen around the Circle of Willis
	Can be traumatic or spontaneous	
Brain tumors	Arises from different cell types found in the central nervous system. Eg; Schwannomas are arising from Schwann cells Type of tumor varies with age. Metastasis is a common tumor in the elderly.	Intra or extra axial space occupying lesions with variable density and enhancement patterns depending on the tumor type. Some contain calcifications. Aggressive tumors show significant perilesional oedema.
Hydrocephalus	Refers to dilatation of the ventricular system due to increased CSF volume. Two types: communicating and non-communicating. Aetiology can be congenital or acquired.	Dilatation of the ventricles. Appearance depends on the site of obstruction. Eg; Obstruction at the aqueduct results in dilated third and lateral ventricles.
Cerebral infarction	Results from acute cut off of cerebral blood flow. Blockage of the arterial supply could be secondary to thrombosis or embolism.	A hypodense area can be identified in the brain that represents the corresponding vascular territory.

## CHAPTER 3

### EXERCISES

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#### Interpretation of Chest x ray

1. A 55-year-old patient who has a past history of myocardial infarction 2 years back with defaulted follow-up, presented with shortness of breath, chest pain and severe sweating. Blood pressure was 140/90 Hg mm, SpO<sub>2</sub> detected in the pulse oximeter was 92%. ECG shows ischemic changes with tachycardia. This is the chest x-ray,

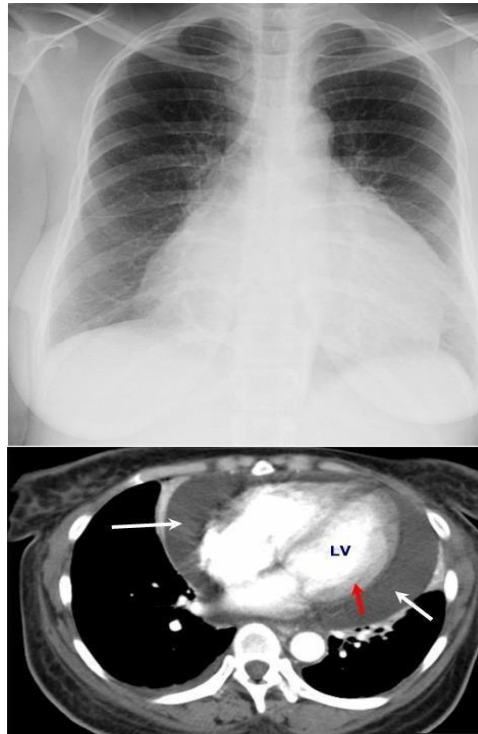


a. Describe the chest x ray

b. What is your diagnosis?

2. A 68-year-old patient who has a past history of pulmonary tuberculosis, presented with bilateral ankle oedema, abdominal discomfort and shortness of breath on mild exertion. On examination, jugular venous pressure was elevated and apex beat is not clearly heard.

This is the chest x ray taken on admission



- Describe this chest radiograph
- What is the diagnosis?
- Give two causes.

3. Following is a chest radiograph of a patient with a mixed mitral valve disease.



- a. Describe this chest radiograph
- b. What are the clinical signs you expect in this patient?

4. Following is a chest radiograph of a 76-year-old patient with cough and wheezing for 10 years. He had been on inhalers from time to time and there had been several hospital admissions over the past 3 years with exacerbation of symptoms. He had been an ex-smoker for 25 pack years. Following is his chest x-ray.



- a. Describe this chest radiograph
- b. What abnormalities do you expect in the Respiratory system and the cardiovascular system examination of this patient?

5. This 62-year-old patient was presented with a chronic cough, significant weight loss and low-grade fever for 1 month. The house officer has taken a chest radiograph.



- a. Describe this radiograph
- b. What is your most probable diagnosis?

6. This patient was presented with a shortness of breath and on examination there was absent breath sounds in the right-side of the chest and on percussion the right lower zone was stony dull. This is the chest x ray.



- a. Describe this chest radiograph.
- b. Give two possible causes for this presentation.

7. A 19 years old tall boy was presented with sudden severe chest pain associated with mild shortness of breath. This is the chest radiograph taken in the emergency department.



- a. Describe the abnormalities you see
  
  
  
  
  
  
  
  
  
  
- b. What is your immediate step in the management of this patient?



8. This 23-year-old patient was presented with a pleuritic type of chest pain, fever and mild shortness of breath. Following chest radiograph was taken by the house officer.



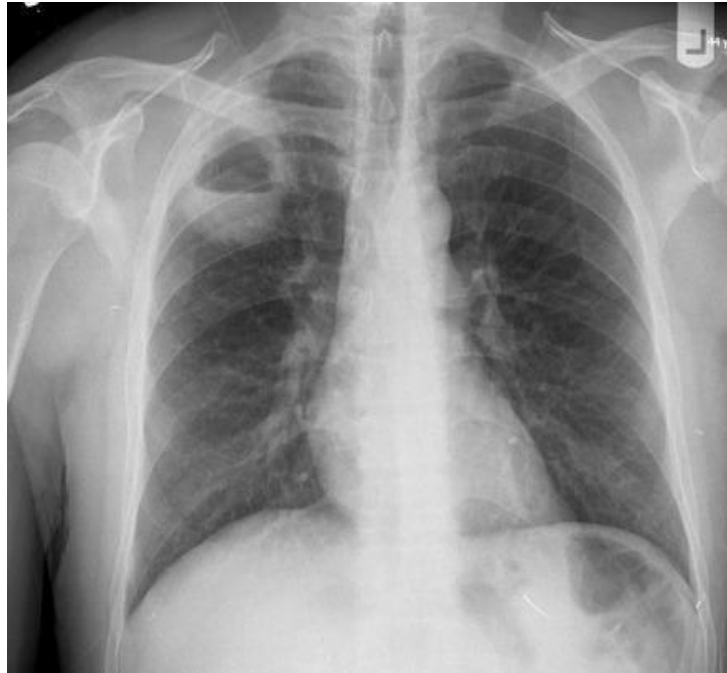
- a. Describe the findings
  
  
  
  
  
  
  
  
  
  
- b. What is the diagnosis?
  
  
  
  
  
  
  
  
  
  
- c. Give 2 important steps in the management of this patient.

9. Following is a chest x - ray of a patient who was presented with severe chest pain for 2 weeks, mainly at night and recently noted hemoptysis. He had been a smoker with 24 pack years.



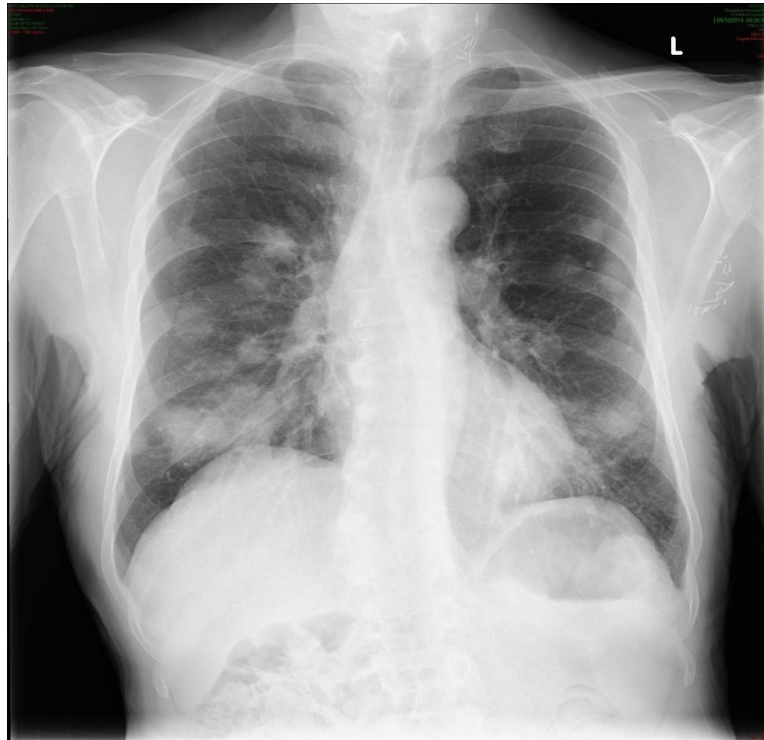
- a. Describe this chest radiograph
  
  
  
  
  
  
  
  
  
  
- b. What is your most probable diagnosis?
  
  
  
  
  
  
  
  
  
  
- c. List the next line of investigations you order.

10. This patient was treated with IV antibiotics in the medical ward for lower respiratory tract infection. However, he did not respond as expected and now he is having very high fever spikes. See the repeat chest radiograph of this patient.



- a. Describe radiological abnormalities
  
  
  
  
  
  
  
  
  
  
- b. What is the pathology?
  
  
  
  
  
  
  
  
  
  
- c. What is your next management plan?

11. A 57 years old patient who had renal cell carcinoma took a chest radiograph before nephrectomy. This is the chest x-ray.



- a. Describe your findings
- b. What would you expect to see a year after the surgery?

### Interpretation of abdominal radiograph

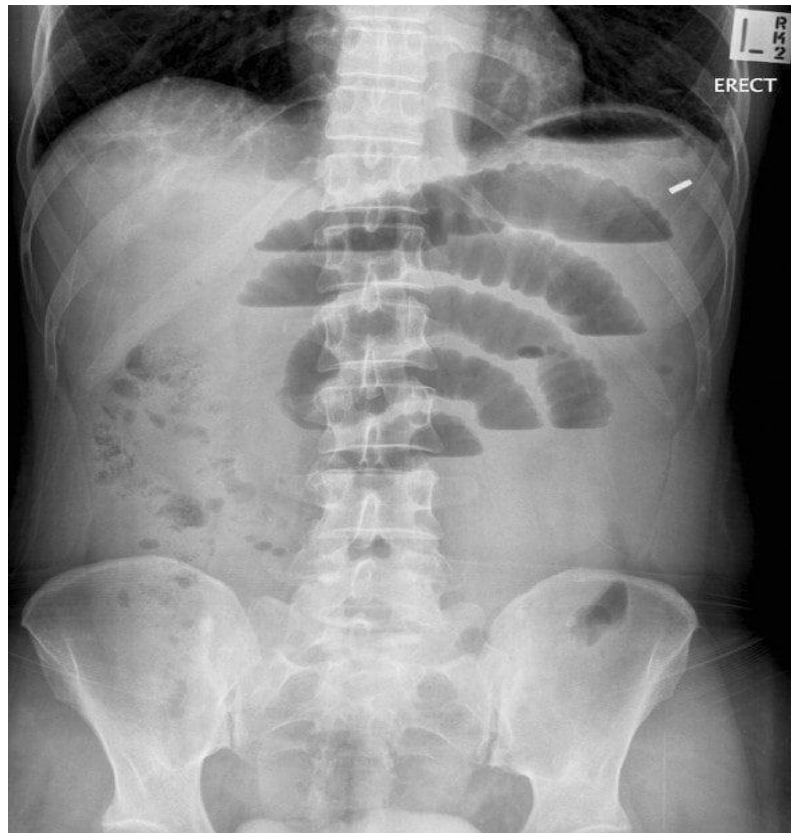
1. This chronic alcoholic patient was presented with chronic abdominal pain. He prefers to be in a forward bent posture as this posture gives him some relief. Below is his x-ray abdomen.



a. What are the abnormalities you see in this?

b. What is your diagnosis?

2. This patient complains of abdominal pain. He has not passed stools for the last two days and not even flatus passes today. Medical officer in the emergency department has requested an erect - ray abdomen. This is the radiograph.



a. What radiological abnormalities do you see?

b. What is the tentative diagnosis?

3. What abnormalities you see in this x ray  
Give 2 reasons for this presentation.



### Interpretation of x rays of the skeletal system

1. A 45 years old female patient was presented with multiple joint pain with swelling. Pain becomes worse in the morning. Investigations show ESR of 92mm 1<sup>st</sup> hour. This is the x-ray of both hands.



- a. Describe the findings
- b. What deformities do you expect in this patient if untreated?



2. This is a skull x-ray of a 79-year-old patient who was presented with back pain.



- a. What radiological abnormalities do you see in this radiograph?
  
  
  
  
  
  
  
  
  
  
- b. List other investigations you order to come to a diagnosis.

3. This 58-year-old patient has pain in both knees for 10 years. She has been on “Pain killers” for several years and now complains that even “pain killers” shows limited relief of pain.



- a. Describe this x-ray
  
  
  
  
  
  
  
  
  
  
- b. What is your probable diagnosis?

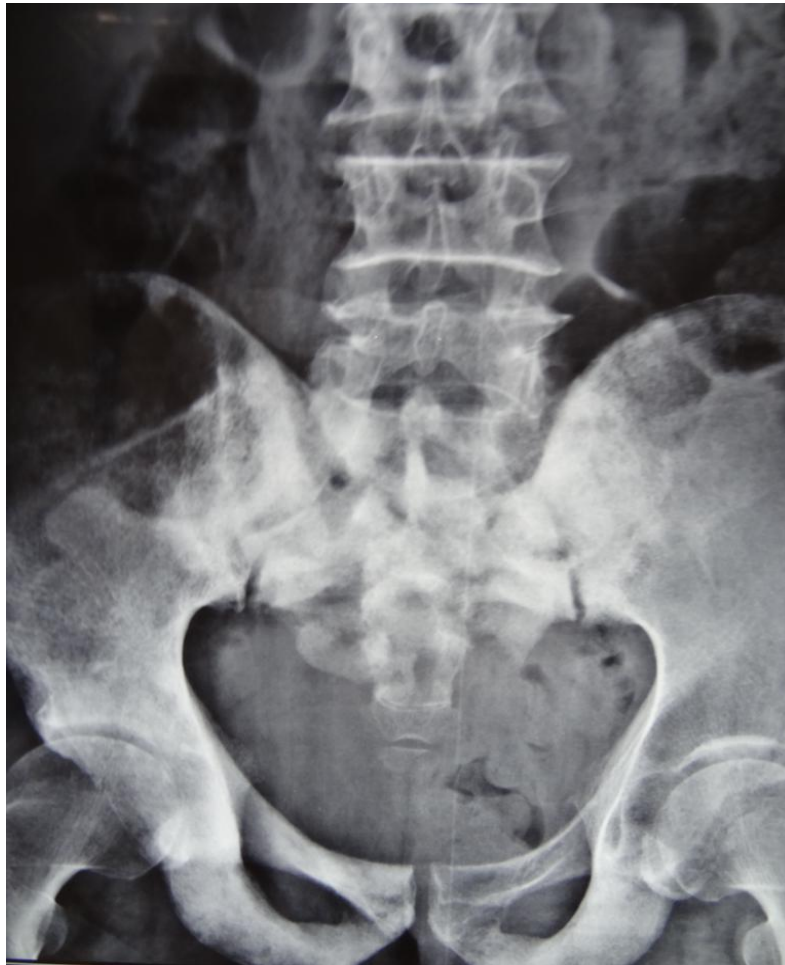
4. This is an x ray of a 25 years old girl who complains of pain and tingling sensation of neck radiating to the arm.



a. What do you find abnormal?

b. What is the diagnosis?

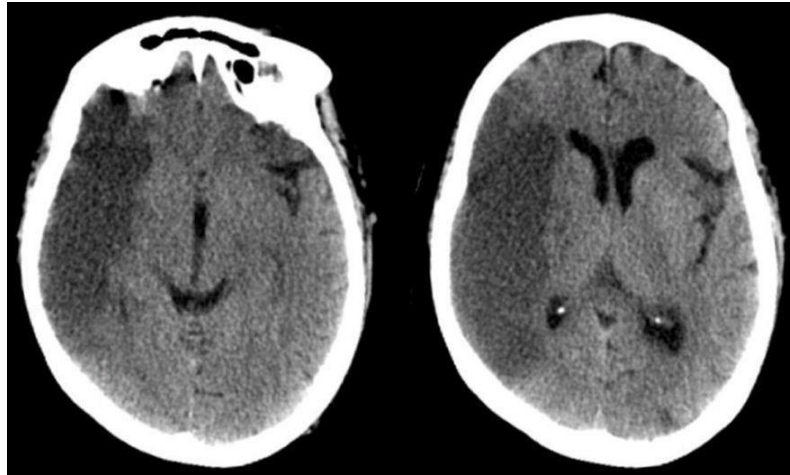
5. This is an x-ray of the lumbosacral spine of an 80 years old man who came with back pain. On direct questioning, he has some difficulties in passing urine for several years and recently noted severe loss of appetite.



- a. What abnormalities do you see in this x-ray?
- b. What physical examination do you like to perform in this patient?
- c. What is your probable diagnosis?

**Computerized tomography scans**

1. A 75 years old patient was presented with a sudden onset weakness of the left side of the body. CT scan performed in the ED is given below.



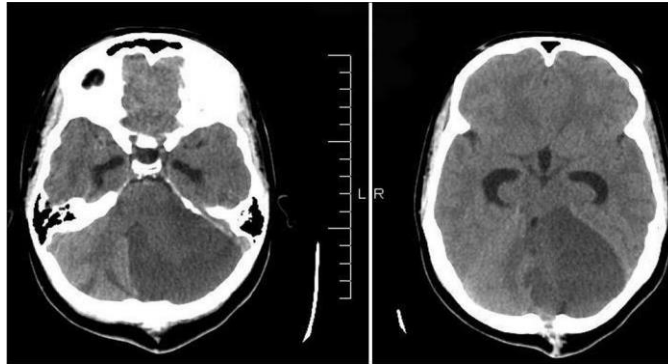
- a. What are the radiological abnormalities you see?
- b. Describe the pathophysiology of this condition
- c. Other than weakness, what other neurological deficits do you expect to elicit in this patient?

2. This 62-year-old patient who was on treatment for hypertension from the medical clinic, was presented with a sudden onset loss of consciousness. Following is the non-contrast CT brain of the patient.



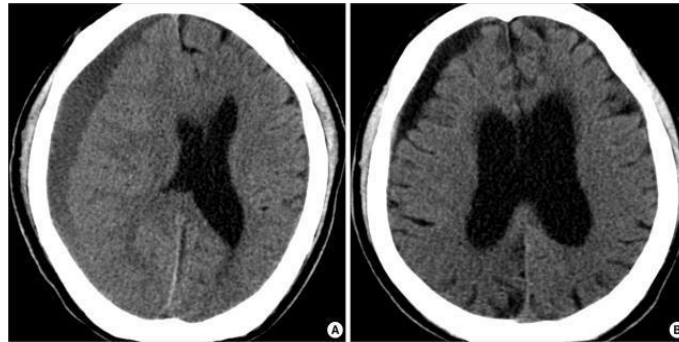
- a. Describe the CT scan findings
  
  
  
  
  
  
  
  
  
  
- b. Comment about the prognosis of this patient.

3. This is a CT film of a patient who was presented with a sudden onset vertigo and unsteadiness of the gait.



- a. What is your diagnosis?
- b. Describe the pathophysiology?
- c. Three days later, the patient deteriorated. Consultant Neurologist ordered a repeat CT brain. What has happened?

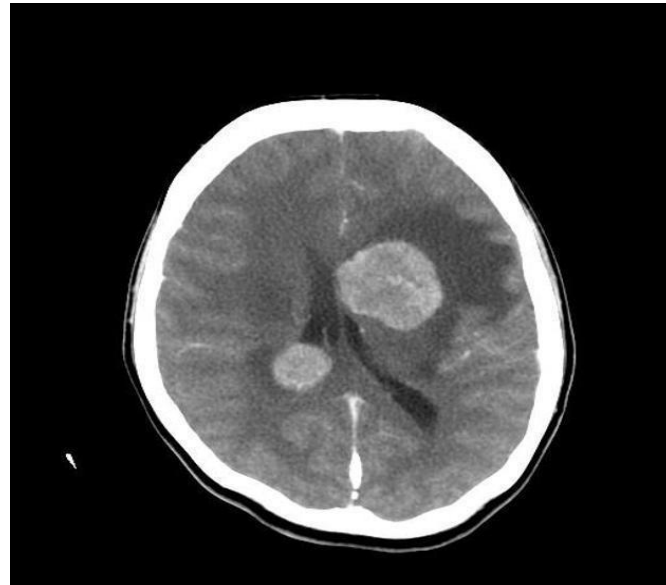
4. This is a CT film of a patient who consumes alcohol daily and was presented with convulsions.



- a. What is your diagnosis?
- b. List three other causes for this patient to present with convulsions.



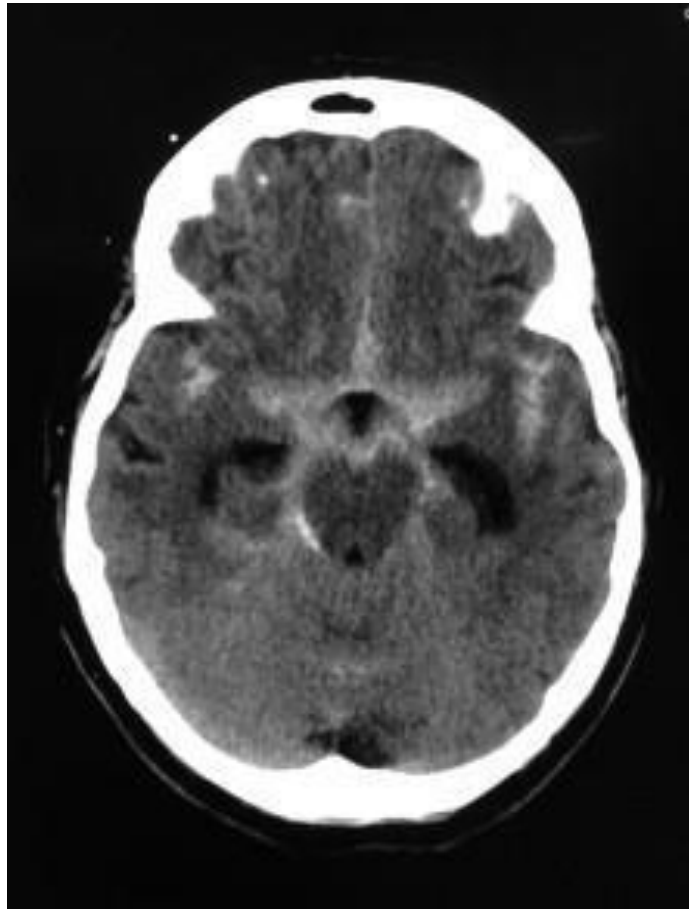
5. This is a contrast CT brain of a patient who has a past history of breast cancer presented with two episodes of tonic clonic seizure.



a. Describe the CT scan report

b. What is the most likely diagnosis?

6. This patient was presented with a sudden severe headache.



- a. What is the radiological diagnosis?
- b. What is the next step of management?

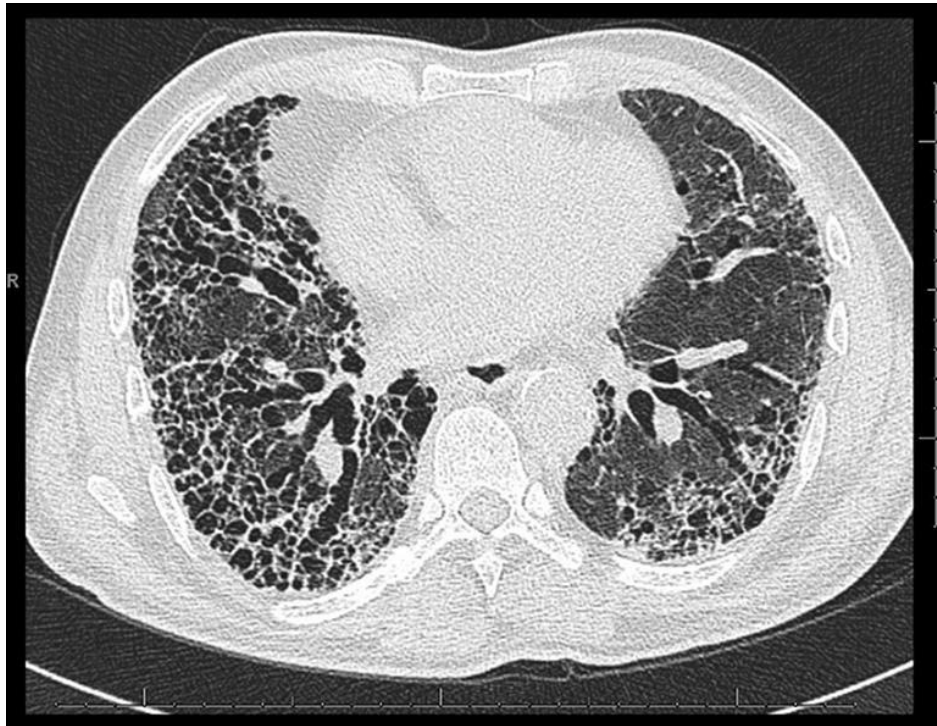
7. This is a NCCT brain of a patient who accidentally fell in the kitchen and had lost consciousness for few minutes.



a. Describe the radiological abnormality

b. Outline the management?

8. This is the HRCT chest of a patient who was presented with shortness of breath on exertion.



a. Describe your findings

b. List causes for this condition.

9. Perform an USS of a patient with dengue haemorrhagic fever. Appreciate the presence of the following sonographic evidence of fluid leakage. Your consultant will guide you to perform this.
  - i. Pericholecystic fluid collection
  - ii. Pleural effusion
  - iii. Ascites

**This book is peer reviewed and recommended as a teaching and learning material for the Department of Medicine, Faculty of Medicine Sabaragamuwa University of Sri Lanka, by the following experts,**

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