



بسم الله الرحمن الرحيم

**Sudan university for science and  
technology**



**college of graduate studies**

## **Accuracy of Chest X-Ray in Diagnosing Pulmonary Tuberculosis**

**دقة الأشعة السينية للصدر في تشخيص مرض السل الرئوي**

A Thesis submitted for partial Fulfillment of the  
requirement of M.SC degree in Diagnostic Radiology

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## الآية

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

قال تعالى: (اللَّهُ نُورُ السَّمَاوَاتِ وَالْأَرْضِ مِثْلُ نُورِهِ كَمِشْكَاةٍ  
فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ الزُّجَاجَةُ كَأَنَّهَا كَوْكَبٌ  
دُرِّيٌّ يُوقَدُ مِنْ شَجَرَةٍ مُّبَارَكَةٍ زَيْتُونَةٍ لَا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ  
يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُورٌ عَلَى نُورٍ يَهْدِي  
اللَّهُ لِنُورِهِ مَنْ يَشَاءُ وَيَضْرِبُ اللَّهُ الْأَمْثَالَ لِلنَّاسِ وَاللَّهُ بِكُلِّ  
شَيْءٍ عَلِيمٌ) ﴿٣٥﴾

صدق الله العظيم

سورة النور الآية (٣٥)

**Dedication**

**.....To**

**My parents**

**My supervisor**

**My sisters**

**My colleagues**

## **Acknowledgement**

First of all, I thank Allah the Almighty for helping me  
.complete this project

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## Abstract

Chest x-ray is important radiographic procedures during the management of lungs disorders and diagnosis tuberculosis

**aimed** :to evaluate diagnostic Accuracy of chest x-ray in diagnosing tuberculosis .The problem of study was chest radiography demonstrated most of chest pathology, but the main problem arise when there on overlapped of pathology with dense structures and Bing late on discovering the patient affected with pulmonary tuberculosis threaten disease spread .**Methods:** Observational, cross sectional study, Descriptive , 75 patients come to x-ray department for check up chest x-ray suspected pulmonary Tuberculosis , males and females. were examined in Alshab teaching hospital and Alshahed Khalid public health center , during the period from (November 2015-march 2016). The variable collected from patient include gender, age, clinical sign and symptom, lab investigation sputum ,finding chest x-ray, the Data collection according include all above variable data. **Result:** the majority of samples were males greater than females, males 49(65%) and females 26 (34%). In this study peak incidence was among the age between (less than 30) years of age presenting (42%). The cough is most sign & symptomwith35patient(46%) . and lab investigations for sputum exam , positive sputum (60%), and negative (40%). Finding chest x-ray examination showed normal chest x-ray appearance (56%), and abnormal appearance tuberculosis (44%) ,sensitivity(70 %) ,specificity (42%) .The study recommended to use other modality on detecting tuberculosis with association of sign and symptoms for conformation. Finally the study showed that chest x-ray .was not enough for tuberculosis diagnosing



## المستخلص

تعتبر أشعه الصدر السينية من أهم الفحوصات لدراسة أمراض الرئة ومرض السل . هدفت هذه الدراسة لتقييم الدقة التشخيصية لأشعة الصدر في تشخيص مرض السل الرئوي. تمثلت مشكلة الدراسة بان صورة الأشعة السينية للصدر تشخيص معظم أمراض الرئة والأمراض الاخرى و لكن المشكلة أن بعض الأحيان يحصل تداخل بين- المرض والتركيبية التشريحية للصدر كذلك التأخر في اكتشاف المريض المصاب بمرض السل الرئوي يهدد بانتشار المرض. تصميم الدراسة:دراسة وصفية (رقابية) , ذات المقطع المستعرض. تم إجراء فحص صورة أشعة للصدر علي 75 مريض من النساء والرجال, المتوقع إصابتهم بمرض السل الرئوي في كل من مستشفى الشعب التعليمي ومركز الشهيد خالد عبد الله بجزره في الفترة من نوفمبر 2015-ألي مارس 2016. والبيانات التي استخدمت في هذه الدراسة هي :العمر, النوع, الأعراض والعلامات السريرية , وفحص التفاف سالب أو موجب , ظهور تشخيص صورة الاشعه للصدر طبيعية أو غير طبيعية , وتم جمعها وتحليلها. أظهرت النتائج أن عدد الرجال أكثر من النساء ,الرجال 49(65%), النساء 26(34%) وجدت الدراسة أن أكثر الفئة العمرية المصاب هي (اقل من 30)وهي(40%) , والكحة هي أكثر الأعراض والعلامات السريرية بالنسبة لي الأعراض الاخرى 35 ( 46%). واطهر فحص التفاف موجب ( 60% ) والسالب ( 40%). وكانت نسبة تشخيص صورة أشعه الصدر طبيعية الظهور (56% ) و تشخيص أشعه الصدر بمرض السل (44%) ,الحساسية( 70% )والخصوصية(42%). أوصلت الدراسة باستخدام أجهزه أخرى في تشخيص مرض السل الرئوي بالإضافة الأعراض والعلامات السريرية للمزيد من التأكيد. وأخيرا أظهرت هذه الدراسة أن صورة أشعة الصدر لوحدها غير- كافية لتشخيص مرض السل .



## **Abbreviation**

TB: Tuberculosis

CXR :Chest x-ray

PA: Posterior-anterior

CR: Computed radiography

MA: Milliamp

MM: Millimeter

CM: Centimeter

F.F.D :Focal Film distance

S.O.B :Short of breathing

KVP: Kilo applied voltage

O<sub>2</sub>: Oxygen

CO<sub>2</sub> :Carbon dioxide

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# Chapter one

## Introduction



## **:Introduction 1.1**

Imaging studies that use ionizing radiation are tool for the evaluation of many disorder .ionizing radiation is used in radiography, fluoroscopy, angiography, and computed tomography scanning .X-ray imaging is a well-know imaging modality that has been used for over100 years since roentgen discovered. X-ray imaging is based on through transmission and analysis of the resulting x-ray .(absorption data.(Pizzutillo ,et al 1996

Plain film x-ray an important tool for the diagnosis of many disorder. In radiography, a beam of x-rays ,produced by an x-ray generator, is transmitted through an object the x-rays are absorbed by the material they pass through in differing amounts depending on the density and composition of the material x-rays that are not absorbed pass through the object and are recorded on x-ray .(sensitive film.(www.medical radiation

A chest x-ray is typically the first imaging test used to help diagnose symptoms and therefore physicians use the examination to help diagnose or monitor treatment for conditions such as :tuberculosis ,pneumonia, and other medical conditions. Tuberculosis is caused by mycobacterium tuberculosis which is an aerobic bacillus ;rising incidence due to increasing susceptible groups include immune compromised ,alcoholics and immigrants .(from third world countries(Rakesh et al ,2007

Some pervious study, Pulmonary tuberculosis remains a common worldwide infection that produces high mortality and morbidity, especially in developing countries. Latent tuberculosis( TB) infection is defined as a state of persistent infection, in the absence of clinical symptoms of active disease. When clinically manifest illness is present, the term tuberculosis (TB), without further qualifications, is used to designate the disease. Given these definitions, both and tuberculosis( TB) may be considered different

moments in a continual pathological process, and both conditions are usually distinguished on the basis of the presence tuberculosis or absence of clinical, laboratory, and chest radiography findings. Control of TB infection relies on the identification and preventive treatment of individuals who are latently infected by *Mycobacterium tuberculosis*. The diagnostic tests used to identify individuals with are the *in vivo* tuberculin skin test and the *ex vivo* interferon-g release assays both are designed to identify an adaptive immune response against (but not necessarily a latent). The problem of screening has become more and more relevant in recent years because of the introduction of immunomodulatory biologic drugs in clinical practice especially in the field of rheumatic diseases. In fact, tumor necrosis factor antagonists can be the cause of either *de novo* TB infection or reactivation of. Therefore, different surveillance agencies for disease control and prevention have issued recommendations to ensure the detection and treatment of before antagonist initiation. This systematic review focuses on the role and value of CXR in TB diagnosis and screening for detection in patients who undergo medical treatment with biological drugs. The main objective of this work was to give evidence-based answers to relevant clinical issues regarding the value of diagnostic imaging in the screening (for TB. ([www.ncbi.nlm.nih.gov/pubmed](http://www.ncbi.nlm.nih.gov/pubmed))

Tuberculosis is spread through inhalation of infected material from someone who already has the disease. The tubercle dose not grow very easily in a patient who is not immunocopromised unless there is constant or repeated contact with sputum-positive patient. General symptom include fever, loss of weight ,and weakness. Coughing and sputum production depend on the type on the Tuberculosis the patient has. Until cavities are formed, very little sputum is coughed up .The patient may also experience pain in the side from tuberculosis pleurisy. Patient who are more likely to contract tuberculosis include homeless; alcoholic; immigrants from Mexico ,philipines Indochina .Although it generally affects the lungs, other areas of the body such as the spine may also be affected. The type of pulmonary tuberculosis determines the site of infection .Primary tuberculosis ,also known as childhood

tuberculosis, occurs in someone who has never had the disease before. It used to occur almost exclusively in childhood when tuberculosis was common, hence the second name. However, primary tuberculosis is now common in adults that fit the profile listed above. Reactivation (secondary tuberculosis) usually develops in adults and is almost always found in the apical and posterior segments of the upper lobe bilaterally. The right lung is attacked first more often than the left because of the right bronchus being more vertical and larger. The radiographic signs of this type of tuberculosis are bilateral infiltrates, which are mottled, and calcification, which are streaked. As reactivation heals, the hilar region retracts and the lung shrinks in size fibrous tissue surrounds and invades the lesion, leaving only a scar with calcification. (Wason et al, 1980)

### **:Problem of study 1.2**

Chest radiography demonstrated most of chest pathology, but the main problem arises when there is an overlap of pathology with dense structures and being late on detection the patient affected with pulmonary tuberculosis threatens disease spread.

## **:Objective 1.3**

### **:General objective 1.3.1**

The main objectives of this study is to evaluate the role of x-ray chest in diagnosing tuberculosis

### **:Specific objective 1.3.2**

:This study intended to

To show percentages of all variables and chest x-ray finding •

To find whether there is a relationship between the variables and chest x-ray finding •

To determine the sensitivity and specificity of the pulmonary tuberculosis •

## **:1.4Thesis out line**

This study consists of five chapter: Chapter one, which is an introduction ,deals with theoretical frame work of the study. It presents the statement of the study problems, objectives of the study. Chapter two is divided into two sections, section one deal with theoretical background (anatomy ,physiology and pathology).and section two deals with literature review(previous studies).Chapter three discusses the materials and method. Chapter four includes result presentations. finally Chapter five include the discussion, conclusion, recommendations and .appendix



# Chapter Two

## Literature Review

## Chapter Two

### Theoretical back ground

#### :Anatomy 2.1

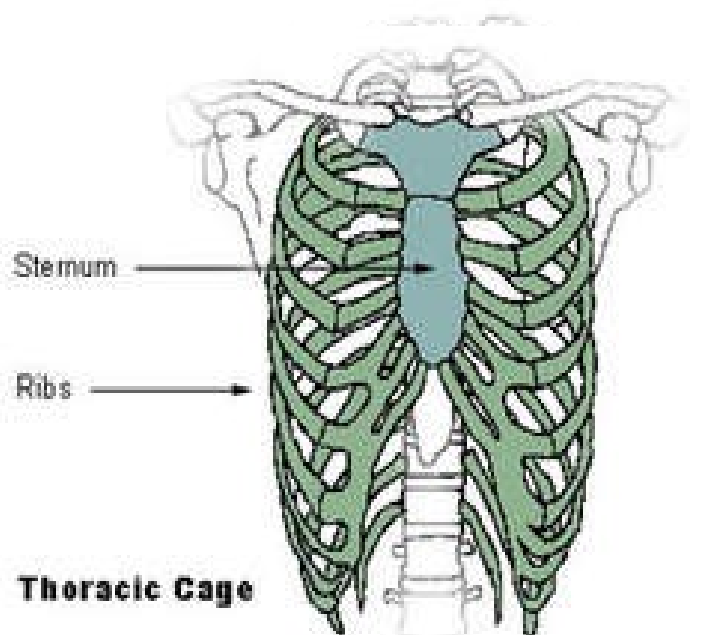
#### The External Anatomy of the chest thoracic cage 2.1.1

It is a frame work bony structure which is composed of the ribs (anterior ,posterior and lateral)sternum and dorsal spine it acts as protective frame work for the lungs ,heart and great blood vessels .it protects these organs from damage .the ribs are flexible thin long bones (helps in respiration mechanism.(Martini et al ,2006

#### The Internal Anatomy of the chest 2.1.2

The chest or thorax is the upper part of the trunk between the neck and the abdomen .Contain:-Trachea, Right and Left bronchi, Pleura , Lungs, Mediastinum.

((Martini et al 2006



(Figure 2:1 the thoracic cage(sternum , ribs

(Martini et al 2006)

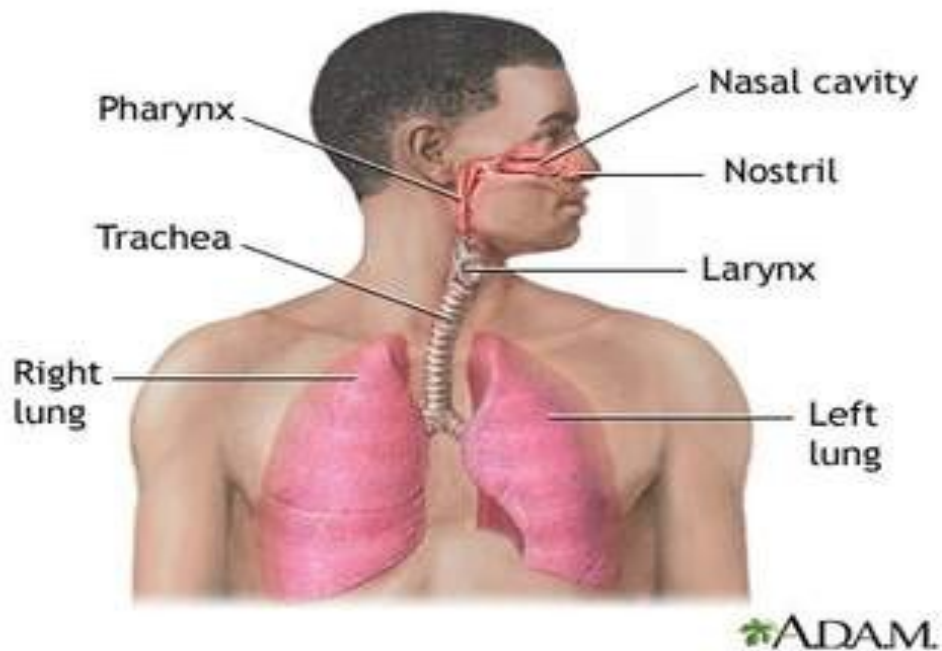


Figure 2:2 anatomy of chest ,Nasal cavity ,Nostril  
.,Larynx ,Pharynx, Trachea

(Martini et al 2006)

### **:The Trachea 2.1.3**

The trachea is the tube about 10cm long extends downwards from lower part of the larynx .it commences at the level of the 6<sup>th</sup> cervical vertebra and ends, at the level of the upper border of the 5<sup>th</sup> thoracic vertebra, by dividing in to the right and left main bronchi. The portion of the trachea in the neck lies in the midline but in the



thoracic cavity it is displaced slightly to the right by the  
(arch of the aorta.(Martini et al 2006

### **:The Bronchi(Right and Left 2.1.4**

The right and left main bronchi commence at the bifurcation of the trachea at the upper border of the 5<sup>th</sup> thoracic vertebra .The right main bronchus is under and shorter than the left and run more vertically down wards, it is about 2.5cm in length and enter the right lungs opposite the 5<sup>th</sup> thoracic vertebra The left main bronchus is narrower than the right and it runs more horizontally .it is about 5cm in length ,and it is enter the left lung at the level of the 6<sup>th</sup> thoracic vertebra within the lung the two main bronchi divide and subdivide to form smaller and  
(smaller branches.(Martini et al 2006

### **:The Lung 2.1.5**

The right and the left lungs lie freely in the right and left pleural cavities attached only at the hila where the bronchi and pulmonary vessels enter and cave the lungs .Each lung is roughly conical in shape having an apex which lies superiorly .Abase or diaphragmatic surface  
..a costal surface and mediastinal surface

The right lung is slightly larger than the left •

At birth the lungs are pink in color but with •  
advancing years they become increasingly grey  
on black due to deposits of inhaled particles of  
.carbon from the atmosphere

The apices of the lungs extend up words and the base of each lung is concave and rested on the .diaphragm •

.The right lungs is shorter than left one •

The costal surface of each lung related to the chest wall and the medical surface of each lung related posteriorlly to the thoracic vertebra and .anterior to the mediastinum •

.The right lung related to the superior vena cava •

The left lung is related to the arch of aorta. •  
(Martini et al 2006

### -:2.1.5.1The Lobes of the Lungs

The right lung is divided into the lobes by an oblique fissure and a transverse fissure the .three lobes are

The upper lobe .i

The meddle lobe .ii

The lower lobe .iii

The left lung is divided into two lobes by an oblique fissure the two lobes are called the (upper and the lower lobes.((Martini et al 2006

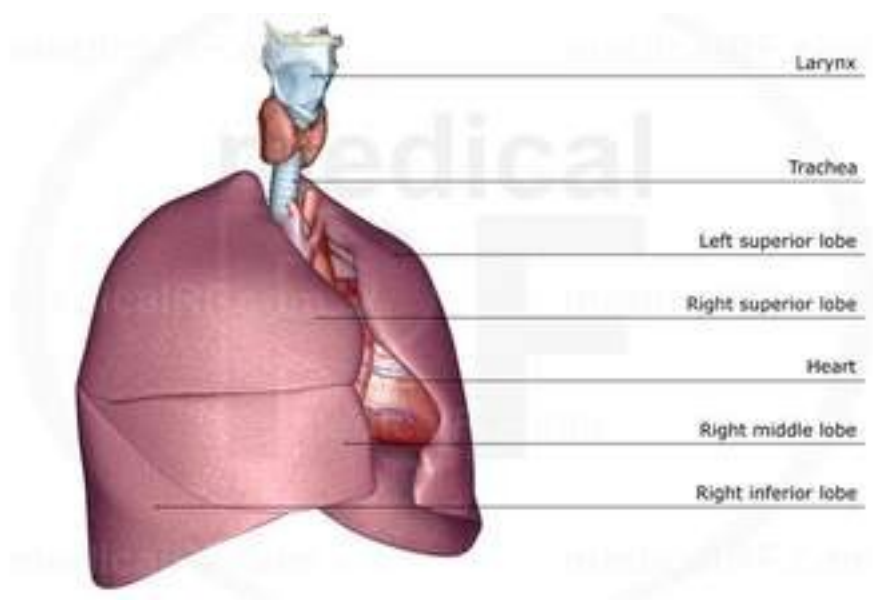
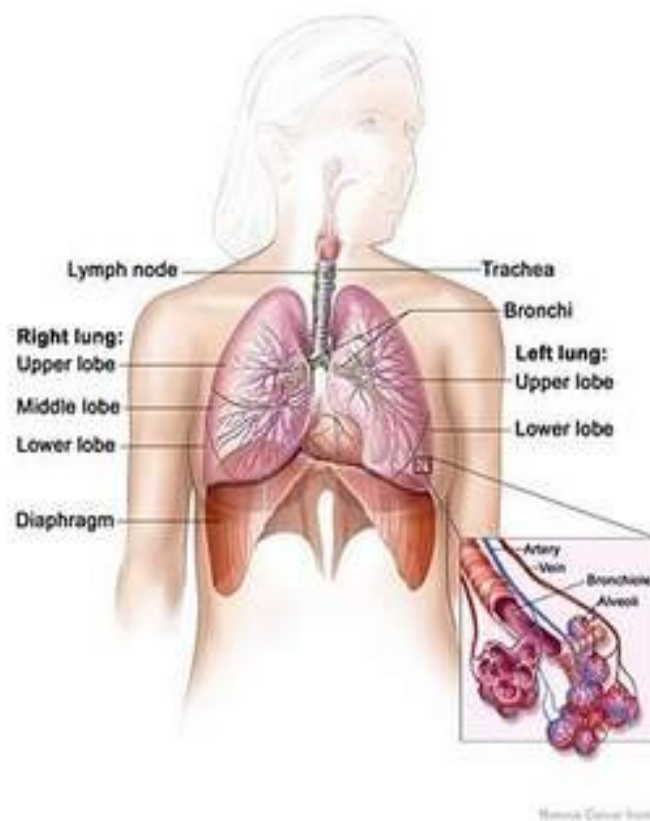


Figure 2:3 the lung(right and left superior lobe, heart ,right middle lobe, right inferior lobe (Martini et al 2006).



.Figure 2:4 Trachea ,bronchi, bronchioles, alveolar

(Martini et al 2006)

### **:The Blood Supply of the lungs 2.1.6**

The right and the left pulmonary arteries carry deoxygenated blood from the right ventricle to the right and left lung .The lungs are supplied with oxygenated blood by the bronchial arteries which arise from .(descending aorta(Martini et al 2006

### **:Nerve supply to the lungs 2.1.7**

The lungs are supplied by branches of the vague nerve .(and the sympathetic nervous system.(Martini et al 2006

### **:Mediastinum 2.1.8**

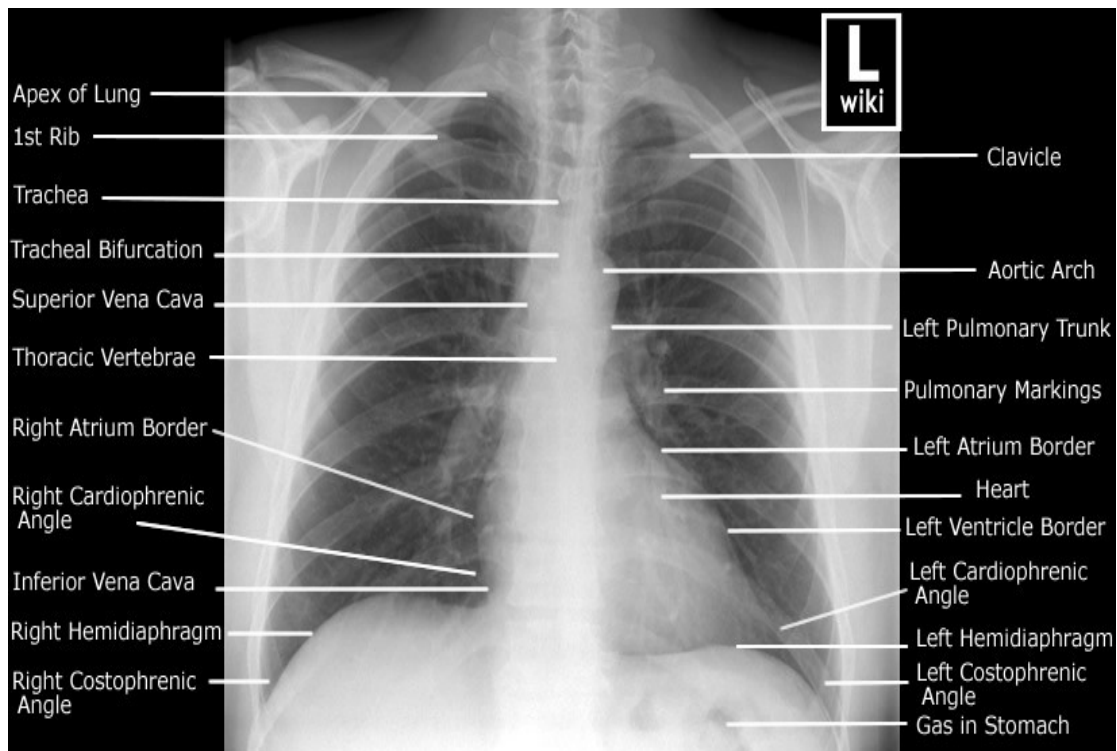
The medical portion of the thoracic cavity between the lungs is called the mediastinum .The important structures .in mediastinum

- The heart ▪
- Great vessels ▪
- The trachea and esophagus ▪
- (The thymus gland (Martini et al 2006 ▪

### **:Radiographic Anatomy 2.1.9**

Plain chest The PA show the soft tissue shadows of the pectoral's major, axillary folds and show of female breast, the companion shadows of the clavicle and ribs, the

relative position of the diaphragmatic cupola, and the gastric gas bubble. It also shows the manubrium overshadowing the arch of the aorta. The parts of the sternum are seen best in lateral views The ribs may be counted from above following each behind forwards. Their direction and cortical margins may be examined for notching and fractures. Calcification in costal cartilage is normal but its anatomic features have to be differentiated from pulmonary calcification which are abnormal .The radiographic appearance of the normal pulmonary parenchyma and vessels are learned by experience, understanding the anatomic borders helps a great deal in identifying the images of the transverse, oblique and accessory fissures, lung lobes and costophrenic angles .It may be helpful to compare with examples of (abnormalities.(Lothar Wicke,1995



.Figure 2:5 Postero anterior radiograph of the chest x-ray

## Physiology:2-2

### Physiology of the respiratory system

#### -:Respiration 2-2-1

Respiration as a term is generally used includes two processes: External respiration, the absorption of O<sub>2</sub> and removal of CO<sub>2</sub> from the body as a whole, and Internal respiration, the utilization of O<sub>2</sub> and production of CO<sub>2</sub> by cells and gaseous exchanges between the cells and their fluid medium. The respiratory system is made up of a gas-exchanging organ (the lungs) and a pump that ventilates the lungs. The pump consists of the chest wall, the respiratory muscles which increase and decrease the size of the thoracic cavity, the areas in the brain that control the muscles, and the tracts and nerves that connect the brain to the muscles. (William & Ganong, 2003)

Pulmonary ventilation is the process of getting air into and out of the lungs during breathing. It occurs by:- Inspiration, Expiration

**2.2.1.1 Mechanism of inspiration:** is occurs by the following steps

.Contraction of inspiratory muscles

.Expansion of the chest

.Reduction of intra-pleural pressure

.Expansion of the lungs

.Reduction of intra-pulmonary

.Air moves into the lungs

-:Inspiratory muscles that share in inspiration are

Diaphragm and external intercostals muscles at rest.  
Accessory muscles at exercise. The diaphragm increase  
the vertical diameter of the chest The external intercostals  
muscles runs obliquely downward and forward from rib to  
rib and increases the antero-posterior and the transverse  
(diameter.(William &.Ganong,2003

**2.2.1.2Mechanism of expiration** :is occurs by  
-:the following steps

.Relaxation of inspiratory muscles

.Increased intrapleural pressure

.Recoil of the lungs to the expiratory position

.Increased intra-alveolar pressure

.Air moves out of the lungs

-:Expiratory muscles that share in expiration are

.Expiration is due to passive recoil of the lungs at rest

Internal intercostals muscles and abdominal muscles at  
(exercise.(William&.Ganong,2003

## **:Function of respiratory system 2-2-2**

The primary functions of the respiratory system are to supply the body tissue with oxygen and remove the carbon dioxide product by cellular activities. Other :function includes

providing a large area for gas exchange between air and .circulation blood

Moving air to and from the gas-exchange surfaces of the . lungs

Protecting the respiratory surfaces from dehydration and temperature changes and defending against invading .pathogens

Producing sounding permitting speech, singing, and .nonverbal auditory communication

providing olfactory sensations to the central nervous .(system for the sense of smell.(William &.Ganong,2003

## **:Pulmonary circulation 2-2-3**

Almost all the blood in the body passes via the pulmonary artery to the pulmonary capillary bed, where it is oxygenated and returned to the left atrium via the pulmonary veins. These separate and much smaller bronchial arteries come from systemic arteries. They from capillaries , which drain into bronchial veins or a nastomose with pulmonary capillaries or veins. The bronchial veins drain into the azygos vein(William .(&.Ganong,2003



## **Pathology:2-3**

### **-.:Pathology of the respiratory system**

#### **:pulmonary tuberculosis:2-3-1**

Pulmonary tuberculosis, caused by the acid-fast mycobacterium tuberculosis. Most pulmonary tuberculosis is caused by the human strain, but in countries in which .bovine tuberculosis is common

#### **-.:Primary pulmonary Tuberculosis 2-3-2**

The lung is a common site for primary tuberculosis infection. It is the form of disease that develops in a previously unexposed and therefore no sensitized individual Ghon focus: It is area of gray-white inflammatory consolidation in the distal air spaces of the lower part of the upper lobe, or upper part of the lower lobe, close to the pleura caused by implantation of inhaled tubercle bacilli. In most cases the center of this focus under goes caseation necrosis. Ghon complex: The tubercle bacilli from Ghon focus drain to regional lymph node to form foci of consolidation there the combination of the parenchyma lesion(Ghon focus) and this nodal .(involvement is called Ghon complex.(Watson et al ,1980

#### **:Military tuberculosis 2-3-1-2**

Military tuberculosis is the result of acute diffuse dissemination of tubercle bacilli via the lymphatics into the lymphatic ducts, which empty into the venous return to the pulmonary arteries .it mostly occurs in the children and young adults as a complication of primary tuberculosis however it may

also occur in old patient. Military lesions may expand and coalesce to involve almost total consolidation of large regions or even whole lobes of the lung (Watson et al, 1980).

### **-Secondary pulmonary Tuberculosis 2-3-3**

This condition is thought to occur as a result of reactivation of a dormant tuberculosis infection or less commonly a re-infection, with tubercle bacilli, in individual who has previously had primary tuberculosis in lung, or in (some other site. (Mohamed et al, 2010)

It almost always localized to apices of one or both upper lobes because of high oxygen tension in the apices (military tuberculosis grows rapidly in a crobic (environment

Hypersensitivity reaction tends to wall off the focus and as result of this localization the regional lymph nodes are less prominently involved as compared to (primary tuberculosis. (Mohamed et al, 2010)

### **Pulmonary tuberculosis appearance in 3-3-4**

#### **:chest x-ray**

Primary pulmonary tuberculosis show in chest x-ray :abnormalities

Nonspecific consolidation, Cavity nodule and masses, Small military nodules, Necrotizing a denopathy .Military, Pleural effusion

Military pulmonary tuberculosis radiographic appearance, fine discrete nodules uniformly throughout

both lungs, sarcoidosis and staphylococcal or . mycoplasma pneumoniae can mimic

Secondary pulmonary tuberculosis radiographic appearance, fibronodular consolidation, cavitations and adenopathy, fibrosis and scarring with volume loss, shift (of fissures and vessels.) (Mohamed et al, 2010)

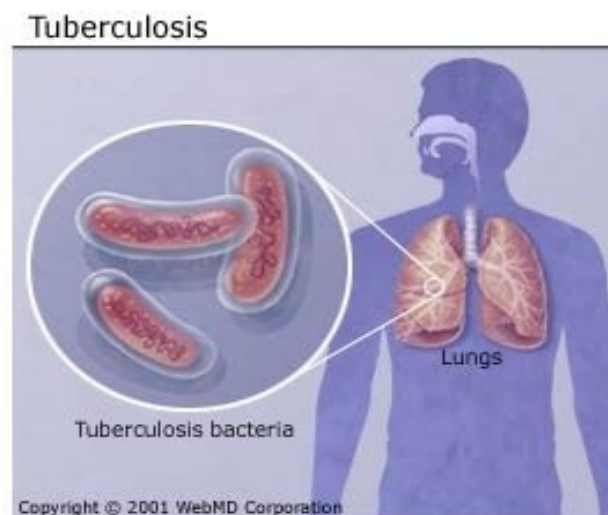


Figure 2:6 Tuberculosis bacteria

(Watson et al, 1980)

### **:The x-ray machine-2-4**

This study is an accuracy study, carried out to evaluate the accuracy of the plain chest x-ray in diagnosing tuberculosis, as well as to show the benefit of this x-ray and whether it is better to be taken a day before diagnosing. The chest x-ray images were taken by the x-ray unit Frequency, Generator, Max.

Voltage 150KV, Focal Spot 2.0/1.0mm. The machine is a major unit, it consists of the following parts

.The floating-top Bucky table

.The vertical (stand) Bucky

.The x-ray tube

.The control panel

### **-.Floating-top bucky table 2-4-1**

:It consists of the following parts

### **-.Tabletop 2-4-2**

The tabletop is a flat type and is made of transparent brown acrylic resin. This tabletop can be moved in the longitudinal and lateral directions simultaneously. Since the tabletop is flat, it is easy to transfer the patient to /from the table, and since the tabletop is transparent, the operator can easily confirm the position of the bucky (device, simplifying positioning. (Jerry Williams, 2008

### **-.Bucky devices 2-4-3**

The bucky device holds the cassette, and moves the x-ray grid using the oscillating method. Movement of the x-ray grid starts when an x-ray exposure signal is received from the x-ray control unit. There is a cassette tray which holds the cassette by the centering method, ensuring easy positioning. The cassette ranging in size from (18x24)cm to (35x43)cm. Also there is a knob for moving and fixing the bucky device, to move the bucky device turn to the

left ,and turn it fully to the right to engage the lock(Jerry  
.(wiliams,2008

#### **:-Foot -switch 2-4-4**

This switch is used to release locking of tabletop lateral and longitudinal movement and set the radiographic position for the patient. When this switch is pressed, the magnetic lock is released and the tabletop can be moved manually. And when this switch is released, tabletop movement is locked and the radiographic position can be  
.(set for the patient.( Jerry wiliams,2008

## **:-The vertical stand Bucky 2-4-5**

The Bucky with grid is a very important part of the x-ray unit, it used to increase the image quality, and it called otter bucky. The potter bucky is positioned behind the patient either in the table or the vertical chest stand comprising the cassette holder, the grid and the detectors for the automatic exposure control system, The stand bucky is installed perpendicularly to the parallel to the wall with wheels and counterweight and break handle to adjust the Bucky up and down according to the height of the patient. The front is covered with a symmetric lines (vertical and cross) in order to center the x-ray beam to the cassette. The grid is composed of lead strips. Moving grid is holed by frame which is fixed on the Bucky by four springs, the frame is moving by electrical coil spindle during exposure time to disappear the grid lines and to confirm the main aim of using the grid (to absorb the scattered radiation). It has cassette tray which can be and pulled smoothly ,all sizes of cassette can be loaded into .(the unit from the right side(Jerry wiliams,2008

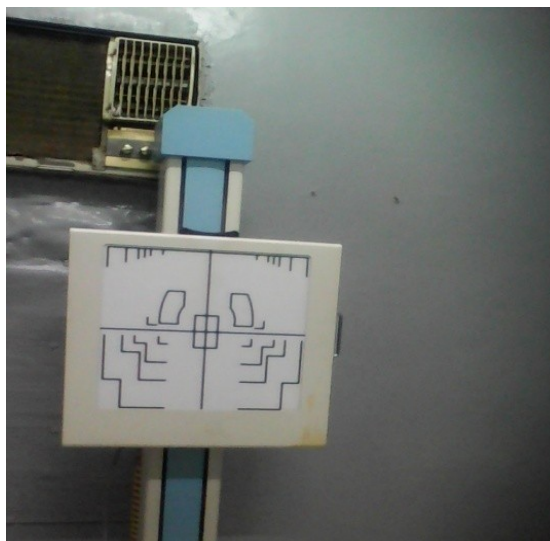


Figure 2:7Stand bucky

(ALshahed Khalid pubic health center.2016)

### **-:The x-ray tube 2-4-6**

The x-ray tube consists of two diodes, the cathode(filament) and the anode (target).The x-ray will be emitted from the tube during the time it is energized with high voltage .The x-ray tube is surrounded by an envelope which is made of glass .The tube is supported on a column which is fixed with the ceiling rail above and the floor rail below, it has a power supply box which supply the electromagnetic brakes, the variable aperture beam limiting device the movement of the x-ray tube by .(switches of lock and free(Jerry wiliams,2008



Figure 2:8 Floating table top &x-ray tube

(ALshahed Khalid pubic health center.2016)

### **-:The control panel 2-4-7**

The control unit exists in an isolated and protective area where the technologist prepares and controls the exposure parameters according to the required exam .It includes the on /off switch, keys for selection of technique, keys for selection of exposure factors(KV, MA ,Second).

.(Jerry wiliams ,2008



Control Unit

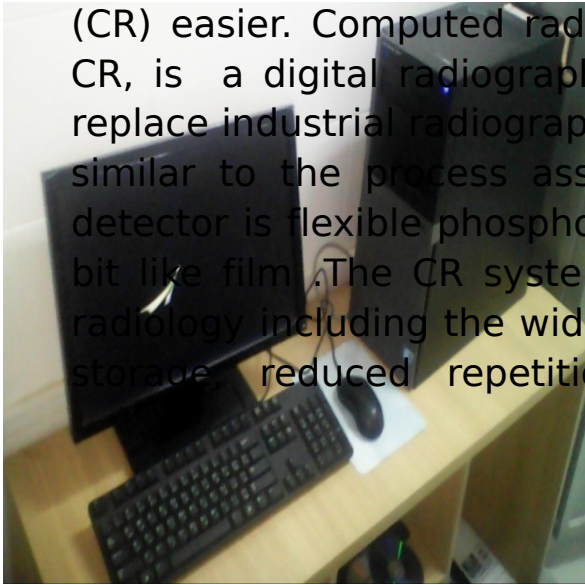
Figure 2:9 X-ray unit

(ALshahed Khalid pubic health center.2016)

### **-(The computed radiography(CR:2-5**

Computed radiography in first appearance, similar to the used of film/screen systems are still used in the radiology because of the good image quality ,high spatial resolution and low cost, The CR plate is in a cassette, which will fit the table and vertical Bucky trays and can be used with mobile equipment. The plate is then scanned in a reading system, this make the change to computed radiography





(CR) easier. Computed radiography, commonly known as CR, is a digital radiography process that is designed to replace industrial radiographic film. The CR process is very similar to the process associated with film. Like digital detector is flexible phosphor screen that looks and feels a bit like film. The CR systems have advantages of digital radiology including the wide dynamic range, digital image storage, reduced repetition and image manipulation.

.(Sonoda et al1983



(Figure 2:10 Computed radiography(CR

ALshahed Khalid pubic health center.2016)

**:The basic projection-2-6**

The basic projection of the chest is postero-anterior(PA) in .erect position

### **:2-6-1Preparation of the x-ray**

The radiographic examining room should be as scrupulously clean as any other room used for medical purposes. The radiographic room should be prepared for the examination before the patient is brought into the room. fresh linen should be put on the table and pillow, and everything should be in place so that the room will look clean and fresh ,not disarranged from the previous examination. The accessories to be used with the examination should be selected and placed nearby. These duties require only a few minutes, but they create a lasting impression on the patient. Prepare the suitable cassette, marker and gown. check the x-ray machine and select the exposure factors if there is no automatic .(exposure control.(Philip W. Ballinger,1986

### **:2-6-2Preparation of the patient**

Patient preparation for chest radiography includes the removal of all opaque objects from the chest and neck region, or any objects that can be visualized on the .(radiograph(Philip W. Ballinger,1986

### **:Film 2-6-3**

.x17 inches(35 x 43cm)lengthwise or 14 x14 inches 14

### **:-Positioning 2-6-4**

**Body position:** If possible, examine the patient in the erect position, either standing or seated, so the diaphragm will be at its lowest position and so engorgement of the pulmonary vessels is avoided, before a vertical grid device. Adjust the height of the cassette so that the upper border of the film is about 1.5 inches above the ..(shoulders(Philip W. Ballinger, 1986

**Part position:** Center the midsagittal plane of the body to the midline of the cassette and have the patient straight, with weight of the body equally distributed on the feet. Extend the chin over the top of the grid device and adjust the head so that the midsagittal plane is vertical, With the palms of the hands facing up ward to rotate the scapulae laterally, place the hands low on the hips so that they will not be superimposed on the costophrenic angles. Adjust the shoulders to lie in the same transverse plane, depress them to carry the clavicles below the apices, and then rotate them forward. Instruct the patient to keep the shoulder in contact with ..(the grid device(KC Whitley, CLARK, 1990

### **:Centering point-central ray and F.F.D 2-7**

center point: adjust the collimator and direct the central-ray in the midsagittal plane to the center of the film at the level of the six thoracic vertebra.(KC Whitley, CLARK, ..(1990

### **:Central ray is perpendicular 2-8**

..(F.F.D:72inches(180cm

### **:Collimation 2-9**

Collimate on four sides to area of lung fields. Top border of illuminated field should be to level of vertebra prominens, and lateral borders to outer skin margins(KC Whitley, CLARK, 1990)

### **:Shielding 2-10**

Secure lead shields around waist to shield gonads.(KC Whitley, CLARK, 1990)

### **:Breathing Instruction 2-11**

Breathing instructions are very important in chest radiography because any chest or lung movement occurring during the exposure will result in blurring of the radiographic image .Chest radiographs must be taken on full inspiration to demonstrate the lungs as they appear .(fully expanded(KC Whitley, CLARK, 1990)

### **:After care of the patient 2-12**

Make the patient comfortable, and alleviate his fears if he is apprehensive about the examination

Explain the procedure calmly because his full co-operation is needed

In moving and adjusting a patient into position, handle him gently but firmly. Instruct the patient in breathing, and practice with him until he understands exactly what he is to do. After he is in position and before leaving him to make

the exposure, practice the breathing once more. This procedure requires a few minutes, but it saves much time, .(radiation, and many films.(KC Whitley, CLARK, 1990

## **:Previous studies**

**Piccazzo** , et al(2014) Blantyre, Malawi, International study, the Study Accuracy of chest radiography for the diagnosis of tuberculosis(TB) and relevance. the conclusion of this study is the chest x-ray must be performed after positive TST. The diagnostic performance of CXR ,reaching an overall sensitivity and specificity of 96% and 46% .and inconclusive CXR findings .the role of CXR in the detection of T.B can be summarized as follows: Chest radiography for the diagnosis of pulmonary T.B has good sensitivity but poor specificity. Radiographic diagnosis of active disease can be evolution of pulmonary , and radiographic diagnosis of T.B can be elusive, and symptomatic culture-positive pulmonary T.B with a normal .(CXR is not uncommon.([www.ncbi.nlm.nih.gov>pubmed](http://www.ncbi.nlm.nih.gov/pubmed)

**Kwong** et al,( 1996) Canada, International, The study to assess the efficacy patient of the chest radiography in identifying patients with tuberculosis. population-based sample, including all proved cases of tuberculosis diagnosed in the province of British Columbia, Canada, one 100 case of tuberculosis were identified,44normal chest and 20chest radiography of patients with localized pulmonary tuberculosis is conclusion. The chest radiograph allowed identification of 59 to 69% of case of tuberculosis with high specificity and good interobserver . .([www.ncbi.nlm.nih.gov>pubmed](http://www.ncbi.nlm.nih.gov/pubmed)

**JMGIMS** et al ,( 2012)India, Institute of medical sciences, International study, This study diagnostic efficacy of x-ray chest in the diagnosis of pulmonary tuberculosis in symptomatic. The current study in undertaken to evaluate chest x-ray as a tool to active tubercular lesion in symptomatic .first blind and then clinic-radiological diagnosis was committed as tubercular, non-tubercular or

suspect in door patients with chronic respiratory symptoms (cough, fever ,weight loss) on CXR diagnosis of tubercular cases was confirmed by either mycobacterium in sputum 67% of tubercular,33% in patient clinic-radiological diagnosis had 99% sensitivity and 98% specificity for active TB . Accuracy of detecting active pulmonary TB remained excellent(sensitivity 100%,and specificity(100%) conclusion :A significant proportion of tubercular patients are missed by sputum examination .and radiology patterns are reliably helpful in determining activity of tuberculosis ,hence simultaneous CXR with sputum examination should find its priority place in case (detect ion of tuberculosis.(www.medind-nic.in>jar

**A**nother study conducted from ,**A** .H. Van, Hoog et al (2013) Kenya , international study ,is A Systemic review of sensitivity and specificity of symptom- and chest - radiography screening for active pulmonary tuberculosis. This study examined with a screening tool to identify people with suspected active TB ,questioning patients for symptoms and chest radiography are screening tools most widely available . show screening with CXR and symptoms, the prolonged to CXR in creased sensitivity by0-9% and decreased specificity by 2-5%or screen after symptom screening, reported in one study, sensitivity was 0.90%{0.81,0.96} and specificity0.56{0.54,0.58} ,the conclusion chest x-ray screening had greater accuracy compared to symptoms screening .of the symptom screens, prolonged cough had low sensitivity and high specificity .the sensitivity of any TB symptom was higher (...but specificity low.(www.who.int>tb>publication>final

**T**he last study carried out by to ,**E**ur Radiol et al(2013) Malawi -clinical research program ,international, study of tuberculosis chest x-ray image reference set non-expert reader performance .the doctors and clinical officers

pulmonary tuberculosis, used the CXR reading and recording system. Correct decisions were assessed against of mycobacterium culture and expert performance .Results tuberculosis image reference set significantly .clinical officers sensitivity from68.0% to77.4% but decreased in specificity from 55.0% to 40.8, tuberculosis image reference set 62.7%.Conclusion use of a CXR image reference set correct intervention improving non-expert performance ,further evaluation is warranted.(www.ncbi.nlm.nih.gov/pub med



# Chapter Three

## Material & Methodology

## **Chapter Three**

### **Material and method**

#### **:Study designs 3-1**

.Descriptive, cross sectional ,observational study

#### **:Place and time of study 3-2**

This study is performed in Department of Radiology of Alshab Teaching Hospital and ALSshahed Khalid public health center, in period of four month(November2015-(march2016

#### **:3-2-1Sampling**

This study included 75patient come to x-ray department .for check up chest x-ray ,males and females

#### **:Study variable 3-2-2**

The variable that collected from patient include gender, age, clinical sign and symptom, lab investigation sputum .,finding chest x-ray

#### **:Methods of data collection 3-2-3**

Data collection according to work sheet (appendix) in cluded all above variables data

#### **:Technique used 3-4**

Chest is poster-anterior (PA) in erect position

#### **:3-5X-ray machines**

The chest x-ray images were taken by the x-ray unit model DRX-1603B, TOSHIBA/ROTANO DETM, High Frequency Generator, max .Voltage 150KV, Focal Spot 2.1/1.0mm

### **:Evaluation of the Image 3-8**

The image were interpreted and confirmed by radiologist and evaluated by the doctor to determine the pathological findings seen or not

### **:Inclusion criteria 3-6**

Study includes 75 patient come to department for check up the chest x-ray with symptomatic (fever, loss of weight, and weakness, cough, and sputum)suspected .diagnosing as tuberculosis

### **:Exclusion criteria 3-7**

Exclusion criteria patient whom normal and other chest x-ray pathology

### **:Data analysis 3-8**

The data were first summarized into master data sheet and then analyzed, by using SPSS(Statistical Package for Social Science) Program that in clued frequency and table .percentage and chi-square tests

### **:Ethical consolidation 3-9**

.No identification or individual details were published

No information or patient details will be disclosed or used .for reasons



# Chapter Four

## Results

## Chapter four

### The Results

Result this study was 75 patients with suspected pulmonary TB the following this table and figure frequency shows summary of the results including distractions ,gender ,age, sign &symptom, lab investigations sputum .exam, finding chest x-ray

#### Frequency Table

Table No.4. 1 Shows gender frequency distribution among the sample

Percent		Freque ncy	Gender
65.3	49	Male	
34.7	26	female	
100.0	75	Total	

Figure 4-1. Shows gender distribution among the sample

Table No 4 .2 Shows age frequency distribution among the sample

Percent		Frequency	Age
42.7	32	Less than 30	
30.7	23	and 30 less than 40	
6.7	5	and 40 less than 50	
20.0	15	and 50 more	
100.0	75	Total	

(Age group (years

Figure 4-2 Shows age distribution

Table No 4.3 Shows sign & symptom frequency distribution among the sample

Percent	Frequency	Sign & symptom
---------	-----------	----------------



46.7	35	Cough
1.3	1	Weight loss +cough
4.0	3	Cough+ fever
4.0	3	SOB+ cough
16.0	12	Chest pain
4.0	3	Fever
6.7	5	Weight loss
2.7	2	Cough+ sputum
2.7	2	SOB +fever
12.0	9	SOB
100.0	75	Total

Figure 4-3. Shows clinical data distribution

Table No 4.4 Shows lab investigations sputum Exam  
.frequency distribution among the sample

Percent	Frequency	Lab investigation sputum exam
60.0	45	positive
40.0	30	negative
100.0	75	Total

Figure 4-4 Shows lab investigation sputum Exam distribution

Table No 4. 5 -Shows finding chest x-ray frequency distribution among the sample

Percent	Frequency	Finding chest x-ray
44.0	33	TB
56.0	42	Normal
100.0	75	Total

Figure 4-5.Shows finding chest x-ray distribution

Table No 4.6 (gender and finding chest x-ray)distribution

Total	Finding Chest x-ray		Gender
	normal	TB	

49	30	19	male
26	12	14	female
75	42	33	Total

### Chi-Square Tests

Asymp. Sig. (2-sided)	df	Value	
.211 <sup>a</sup>	1	1.566	Pearson Chi-Square
.314 <sup>b</sup>	1	1.014	Continuity Correction <sup>b</sup>
.211	1	1.562	Likelihood Ratio
			Fisher's Exact Test
.214	1	1.545	Linear-by-Linear Association
		75	N of Valid Cases

a. 0 cells (.0%) have expected count less than 0.5. The minimum expected count is 11.44

In table gender and finding chest x-ray the null hypothesis there is no relationship between the gender and finding chest x-ray

Alternative hypothesis there is relationship between the gender and finding chest x-ray

And significant value is .211 which is bigger than .05 so we Accept the null hypothesis

That is mean there is no relationship between the gender and finding chest x-ray

Table No.4.7 sign &symptom with finding chest x-ray distribution

Count

Total	Finding Chest x-ray		Signs& Symptom
	TB	normal	
35	15	20	Cough
1	0	1	Weight loss+ cough
3	2	1	Cough +fever
3	2	1	SOB+ cough
12	5	7	Chest pain
3	2	1	Fever
5	1	4	Weight loss
2	2	0	Cough+ sputum
2	1	1	SOB+ fever
9	3	6	SOB
75	33	42	Total

### Chi-Square Tests

Asymp. Sig. (2-sided)	Df	Value	
651.	9	6.866 <sup>a</sup>	Pearson Chi-Square
525.	9	8.094	Likelihood Ratio
		75	N of Valid Cases

a. 15 cells (75.0%) have expected count less than 0,5. The minimum expected count is .,44

In table sign& symptom and finding chest x-ray the null hypothesis there is no relation ship between the sign& symptom and finding chest x-ray

The Alternative hypothesis there is relation ship between the sign &symptom and finding chest x-ray

And significant value is .651 which is high significant, so we reject the null hypothesis

That is mean there is no relationship between the sign & .symptom and finding chest x-ray

**Table No 4.9 (The Sensitivity and Specificity of Plain Chest X-Ray)**

**:LAB INVESTIGATIONS SPUTUM \* FINDING CHEST X-RAY**

Total	Finding Chest x-ray		Lab investigation on sputum	
	TB	Normal	Count	Positive
45	33	12	Count	Positive
54.7%	70%	57.4%	within FINDING CHEST XRAY	%
30	14	16	Count	Negative
45.3%	37.8%	42.6%	within FINDING CHEST XRAY	%
75	47	28	Count	Total
100.0%	100.0%	100.0%	within FINDING CHEST XRAY	%

**Sensitivity** is the ability of a test to correctly classify an individual as diseased, i.e. comparison of what the test indicated and the real fact and counted as a proportion of true positives that are correctly identified by the test

.(70%

**Specificity** is the ability of a test to correctly classify an individual as disease free, and defined as a proportion of true negatives that are correctly identified by the test

.(42.6%



Hence Plain Chest X-Ray correctly identifies 70% of all TB cases (the sensitivity) and correctly identifies 42.6% of those who TB (the specificity), are less than 70% (Poor). And the Plain Chest X-Ray is good sensitivity ,and poor .specificity of the diagnose Tuberculosis

Chapter Five

Discussion, Conclusion

&

Recommendations

## Chapter Five

### Discussion, Conclusion and Recommendation

#### :Discussion.5.1

On this study of 75 patient came to x-ray department for chest x-ray were suspected of tuberculosis (TB). The study found that the number of male (49) which was (65%) than female 26 which was (34%) that was because the sample was small table(4.1) also this same as. Age less than 30 years (42%) and less than 50 years patient which was (6%) table(4.2). On studying the signs and symptom (cough) was the greater one 35 patient which was (46%) but with weight loss there was only one patient ,table(4.3). agree with the previous studies( Jmgims et al,2012 and ,Hoog et al.) Lab investigation sputum positive was 45 patient (60%) and negative 30 patient (40%). Table(4.4). agree with the previous (studies(Piccazzo, et al 2014

The study found also in chest x-ray diagnosing tuberculosis (TB) 33 patient (44%) ,and normal chest x-ray 42 patient (56%).table(4.5) ). agree with the previous .(studies(Kwong, et al,1992

The study found the correlation between gender and finding chest x-ray Alternative hypothesis there is relationship between the gender and finding chest x-ray. And significant value is .211 which is bigger than ,0.5 so we Accept the null hypothesis. That is mean there is no relationship between the gender and finding chest x-ray.table (4.6

The study found the correlation between sign & symptom and finding chest x-ray The Alternative hypothesis there is relationship between the sign & symptom and finding

chest x-ray. And significant value is .651 which is high significant, so reject the null hypothesis. That is mean there is no relation ship between the sign & symptom and finding chest x-ray .table(4.7) The study found the correlation between lab investigation sputum and finding chest x-ray was negative from 30(45%) patient 16(42.6%) with chest x-ray finding is normal and 14(37) is not normal and the positive count 45(54%) patient . 12(47%) is normal chest x-ray and 33 (70%) is show TB

Sensitivity is the ability of a test to correctly classify an individual as diseased, i.e. comparison of what the test indicated and the real fact and counted as a proportion of true positives that are correctly identified by the test (70%). Specificity is the ability of a test to correctly classify an individual as disease free, and defined as a proportion of true negatives that are correctly identified by the test (42.6%). Hence Plain Chest X-Ray correctly identifies 70% of all TB cases (the sensitivity) and correctly identifies 42.6% of those who TB (the specificity), are less than 70% (Poor). And the Plain Chest X-Ray is good sensitivity ,and poor specificity of the diagnose Tuberculosis .table(4.8). According to above analysis can say that chest x-ray is poor of the diagnosing of TB. Disagree with Kwong et al,1992 only previous studies, .agree of all other previous studies

## **:conclusion 5:2**

The result concluded that there Accuracy of plain chest x-ray in diagnosing tuberculosis, must be performed after positive sputum, inconclusive CXR finding in the detection :of T.B can be summarized as follows

Radiographic for the diagnosis of pulmonary TB in symptomatic (cough) is high clinical signs & symptom

Radiographic diagnosis of active disease can be evaluated of pulmonary and radiographic culture-positive pulmonary .TB with a normal CXR is not uncommon

Hence simultaneous CXR with sputum examination should .go the priority in detection TB

Chest x-ray radiography for the diagnosis of pulmonary TB .has good sensitivity but poor specific its



### **:Recommendation 5:3**

Continues education is important for improving in this  
.study

Chest x-ray radiograph when patient got symptoms he  
must to doctors and to department for checkup a normal  
.or not chest x-ray radiograph

Further studies are needed in this to detect or evaluate  
specific problems or diagnosis, such military tuberculosis,  
secondary pulmonary tuberculosis

Use other modality on detecting Tuberculosis with  
.association of sign and symptoms for conformation

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# Appendices

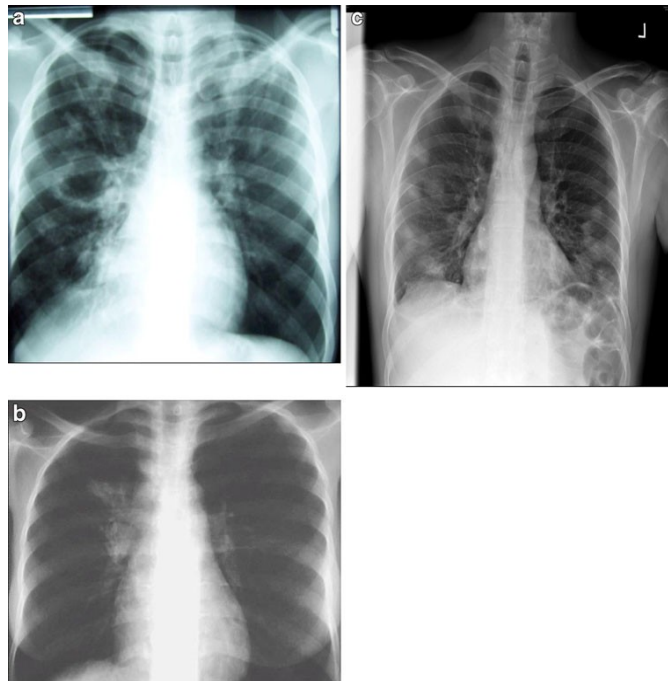
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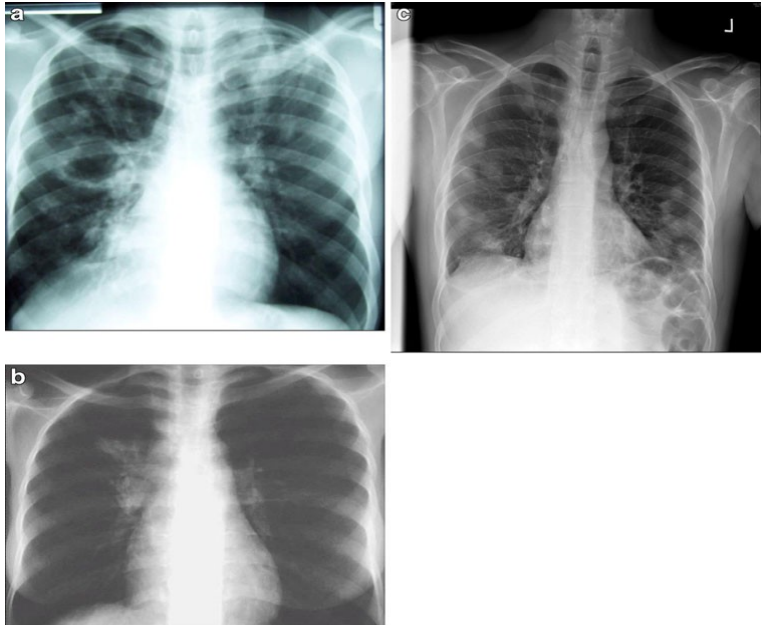
**Image:(1)A 29-years old man with symptom cough,  
(PA C X R Erect Show reveals left lower lobe(left LL**



**Image(2) A-37 years old female with the S.OB, PA upper lobe CXR ,Erect show right .infiltrative**

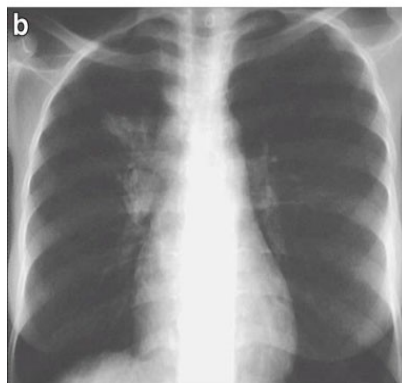


**Image(3) A-27years old male with cough PA CXR .(Erect show right lower lobe cavitations (active TB**



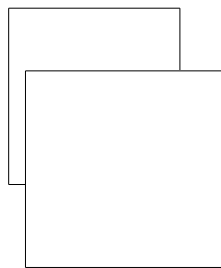
**Image(4)A-22 years old male with chest pain PA  
CXR Erect, show right upper lobe  
.(bronchopneumonia,(active TB**

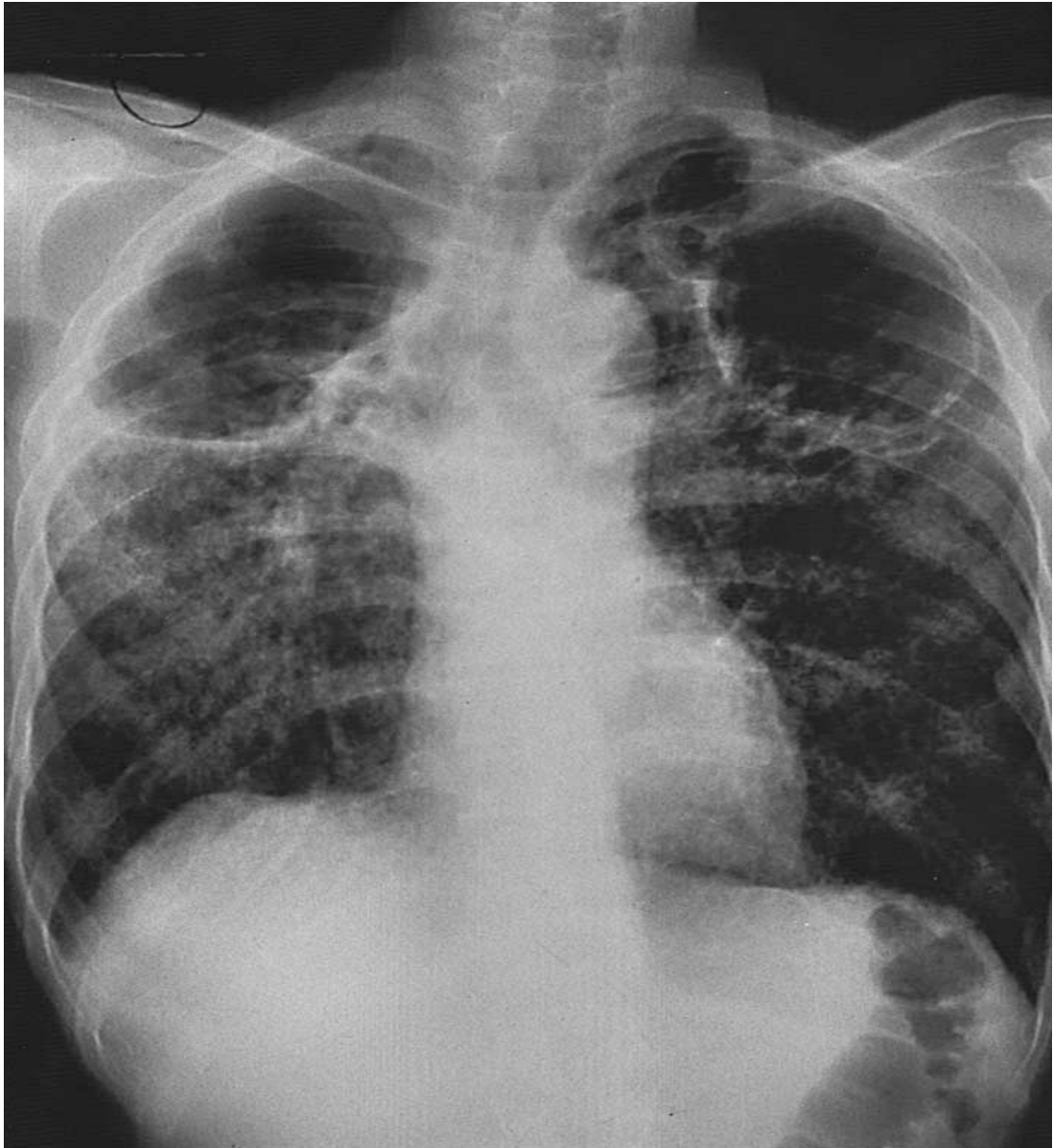




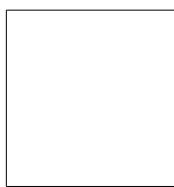
C

**Image(5)A-35 years old ,female symptom S.O.B ,and  
.(cough PACXR Erect, show(TB**





**Image (6) A 30 years old male ,weight loss and fever and positive sputum .PA C X R, Erect show active pulmonary bilateral upper lobe infiltrative' with cavities**



## Data sheet

Finding	Lab Investigations	Sign&	Age	Gend	No
Chest x- ray	Sputum	symptom		er	



