INTRODUCTION

Chronic obstructive pulmonary diseases (COPD), cause significant high mortality and morbidity rate. The World Health Organization estimates that chronic obstructicve pulmonay diseases are the fourth leading cause of death world wide *(**David et al., 2005**)*.

Chronic obstructive pulmonary diseases (COPD), are characterized Pathologic changes occur in the large (central) airways, the small (peripheral) bronchioles, and the lung parenchyma. Most cases of COPD are the result of exposure to noxious stimuli, most often cigarette smoke ***(*Andersen, *et al*., 2011)***.

High resolution CT is the recommended imaging technique for assessing the airway. Quantitative computed tomography (CT) is a promising technique, because current CT technology is able to quantify emphysema, air trapping, and large airway wall dimensions **(Mets *et al*., 2010).**

High Resolution CT is the modality of choice for imaging and diagnosis of chronic obstructive pulmonary disease and asthma, its role in phenotyping these diseases, and the measurement of disease severity and functional compromise **(Kauczor *et al*., 2011)**.

High Resolution CT of the lung (HRCT) is a widely used technique which has proved to be of great value in the

assessment of pulmonary diseases. It is used as a supplement of plain chest radiography and clinical studies in problematic patients with suspected chronic lung diseases **(Dubois *et al*., 2004).**

AIM OF THE WORK

The aim of this study is to assess the value of high resolution CT in the assessment of chronic obstructive pulmonary diseases.

ANATOMY OF THE LUNG

The Airway

The airways can be divided into central airways, extending from the trachea to the segmental bronchi, and peripheral airways, extending from the sub segmental bronchi to the bronchioles ***(Susan et al., 2005)***.

The Center Airway

Trachea

The trachea is a mobile tube 5 inches (13cm) long and 1 inches (2.5cm) in diameter. It has a fibroelastic wall in which are embedded a series of U- shaped bars of hyaline cartilage that keep the lumen patent. The posterior free ends of the cartilage are connected by smooth muscle, the trachealis muscle. The trachea commences in the neck below the cricoid cartilage of the larynx at the level of the body of the sixth cervical vertebra. ends below in the thorax at the level of the sternal angle (lower border of the fourth thoracic vertebra) by dividing into the right and left principale (main) bronchi. The bifurcation is called the carina. In deep inspiration the carina descends to the level of the sixth thoracic vertebra ***(Snell, 2011)***.

Principal bronchus:

The right principal bronchus is wider, shorter and more vertical than the left, being about 2.5cm long. It gives rise to its first branch, the superior lobar bronchus, then enters the right

lung opposite the fifth thoracic vertebra ***(Susan, et al., 2005)***.

The left principal bronchus is narrower and less vertical than the right**,** is nearly 5cm long**,** and enters the hilum of the left lung level with the sixth thoracic vertebra ***(Susan et al., 2005)***.

The Bronchopulmonary segments:

The segments of a lung supplied by segmental bronchi are called bronchopulmonary segments. Within each segment there is further branching of the bronchi. Each segment is pyramidal in shape with its apex facing the root of the lung and its base on the pleural surface. Each segment is named according to the segmental bronchus that supplies it (Fig. 1) ***(Moore et al., 2007)***.

The right upper lobe bronchus is found about 2cm from the origin of the right mainstem bronchus and turns superolaterally at a sharp angle. It divides**,** in turn**,** into the apical**,** anterior and posterior segmental bronchi. The right mainstem bronchus continues on past the takeoff of the right upper lobe bronchus and is often called the bronchus intermedius at this point ***(Moore et al., 2007)***.

The middle lobe bronchus: It starts about 2cm below the superior**,** from the front of the mian bronchus**,** descends antrolaterally and soon divides into a lateral and a medial segmental bronchus passing to the lateral and medial parts of the middle lobe**,** respectively ***(Susan et al., 2005)***.

The Right Inferior Lobar Bronchus: It is the continuation of the principal bronchus beyond the origin of the middle lobar bronchus. At or a little below its origin from the principal bronchus**,** it gives off posteriorly a large superior (apical) segmental bronchus**,** then it descends posterolaterally and medial basal segmental bronchus branches from its anteromedial aspect**,** then the inferior lobar bronchus continues downwards and divides into an anterior basal segmental bronchus**,** and a trunk which soon divides into a lateral basal segmental bronchus and a posterior basal segmental bronchus ***(Susan et al., 2005)*.**

The left upper lobe bronchus arises about 4 to 5cm distal to the origin of the left mainstem bronchus. It turns superolaterally at a sharp angle and soon divides into its segmental branches the apical-posterior (sometimes recognized as two separate bronchi)**,** the anterior**,** the superior lingular**,** and the inferior lingular ***(Mathers et al., 1996)***.

The left lower lobe bronchus continues inferolaterally past the origin of the left upper lobe bronchus**,** for a total length of 4 to 5cm. About mid- way along its course**,** the superior segmental bronchus arises from the medial surface of the left lower lobe bronchus. The bronchus then travels the remaining 2 to 3cm of its total length before terminating as the medial basal**,** the anterior basal**,** the lateral basal**,** and the posterior basal segmental bronchi ***(Craggs, 1995)*.**

The segmental bronchi divide into smaller and smaller divisions until after 6 to 20 divisions they become bronchioles

and no longer contain cartilage in their walls. Normal bronchi are not visualized in the peripheral lung fields. The walls of segmental bronchi are invisible on the chest radiograph unless seen end-on**,** when they may cause ring shadows. The entire airway down to the terminal bronchiole can**,** however**,** be identified on a well filled bronchogram ***(Armstrong, 2010)***.

The Peripheral Airways

The bronchioles divide and the last purely conducting airways are known as the terminal bronchioles (measuring 0.2 mm in diameter)**,** beyond which lie the alveoli which represent the gas exchange unit of the lung ***(Armstrong, 2010)***.

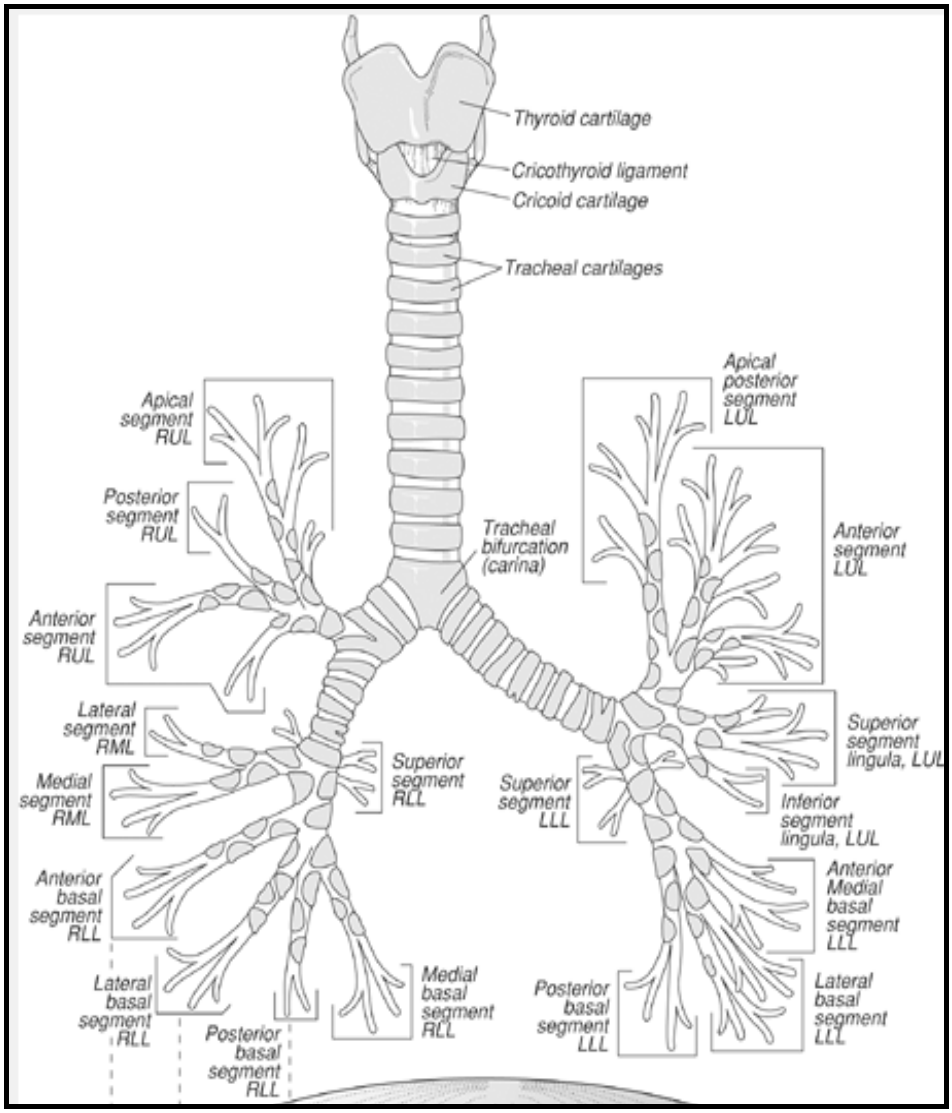


Fig. (1): Diagram of normal airway anatomy**,** frontal view. Note how the basilar segmental bronchi are oriented from lateral to medial. The anterior basilar segmental bronchus is most lateral**,** and the posterior basilar segmental bronchus is medial**,** just lateral to the right medial basilar segmental bronchus. Climbing the diaphragm from lateral to medial can be thought of as climbing the ALPs (Anterior**,** Lateral**,** and Posterior basilar segmental bronchi)**,** as a way to remember this orientation. RUL**,** right upper lobe; RML**,** right medial lobe; RLL**,** right lower lobe; LUL**,** left upper lobe**,** LLL**,** left lower lobe ***(Collins et al., 2008)***.

Lungs:

The lungs are soft**,** spongy and very elastic organs situated on each side of the mediastinum. Each lung is conical in shape and is covered with visceral pleura. It is suspended free in its own pleural cavity**,** being attached to the mediastinum only by its root ***(Snell, 2011)***.

Each lung has an apex, three surfaces, and three borders.

An apex, the blunt superior end of the lung ascending above the level of the 1st ribe into the root of the neck that is covered by cervical pleura ***(Moore et al., 2007)***.

The mediastinal surface. This has two parts: a posterior vertebral and anterior mediastinal part. The vertebral part lies in contact with the sides of the thoracic vertebrae and intervertebral discs**,** the posterior intercostal vessels and the splanchnic nerves. The mediastinal area is deeply concave**,** as it is adapted to the heart at the cardiac impression**,** which is much larger and deeper on the left lung as the heart projects more to the left of the median plane. Posterosuperior to this concavity is the somewhat triangular hilum**,** where various structures enter and leave the lung**,** collectively surrounded by a sleeve of pleura which also extends below the hilum and behind the cardiac impression as the pulmonary ligament ***(Susan et al., 2005)***.

The costal surface of the lung is large**,** smooth**,** and convex. It is related to the costal pleura that separates it from the ribs**,** costal cartilages**,** and the innermost intercostal muscles.

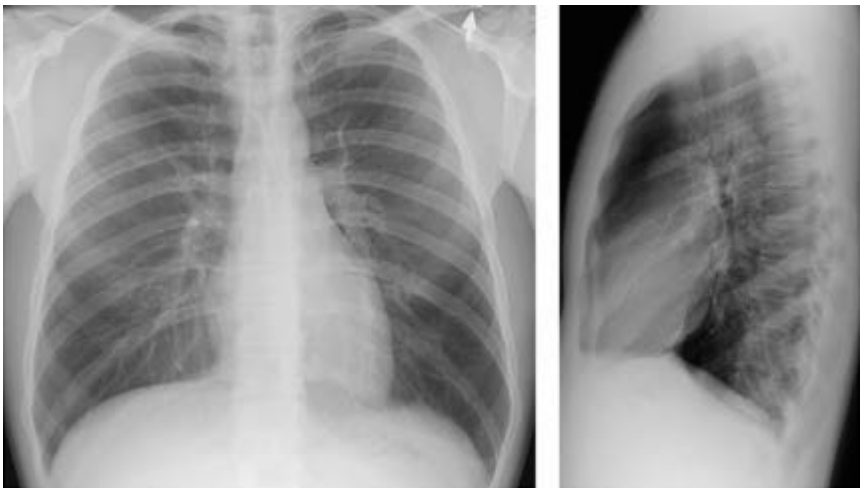
The posterior part of this surface is related to the bodies of the thoracic vertebrae and is sometimes referred to as the vertebral part of the costal surface ***(Moore et al., 2007)***.

The diaghragmatic surface of the lung: This is semilunar and concave**,** resting upon the superior surface of the diaghragm**,** which separates the right lung from the right lobe of the liver and the left lung from the left lobe of the liver**,** the gastric fundus and spleen. Since the diaghragm extends higher on the right than on the left the concavity is deeper on the base of the right lung. Posterolaterally**,** the base has a sharp margin which projects a little into the costodiaghragmatic recess ***(Susan et al., 2005)***.

Anterior border: where the costal and mediastinal surfaces meet anteriorly and overlap the heart**,** the cardiac notch indents this border of the left lung.

Inferior border**:** which circumscribes the diaghragmatic surface of the lung and separates this surface from the costal and mediastinal surfaces.

Posterior border**:** where the costal and mediastinal surfaces meet posteriorly**,** it is broad and rounded and lies in the cavity at the side of the thoracic region of the vertebral column (Fig. 2) ***(Moore et al., 2007)*****.**



(A) (B)

Fig. (2): Normal PA (A) and lateral (B) chest radiographs *(**Collins et al., 2008)***.

Fissure of the lung

Horizontal fissure: separates the right upper lobe from the right middle lobe**,** and thus represents the visceral pleural surfaces of both of these lobes.The minor fissure is oriented horizontally**,** extending ventrally from the chest wall**,** and extending posteriorly to meet the major fissure. Generally**,** the location of the minor fissure is approximately at the level of the fourth vertebral body and crosses the right sixth rib in the midaxillary line (Fig. 3) ***(Thompson, 2003)*.**

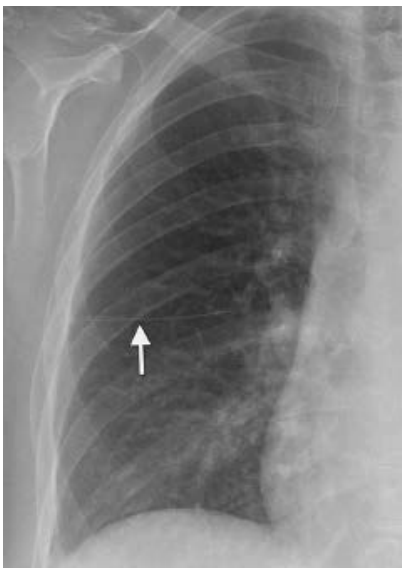


Fig. (3): Minor fissure on PA chest radiograph. The minor fissure has a horizontal course from the right hilum to the periphery of the right lung (arrow) ***(Collins et al. 2008)***.

The major fissures: The major fissures have similar anatomy on the two sides. They run obliquely forwards and downwards from approximately the fifth thoracic vertebra to pass through the hilum and contact the diaphragm 0-3cm behind the anterior costophrenic angle (Fig. 4) ***(Grainger et al., 2008)***.

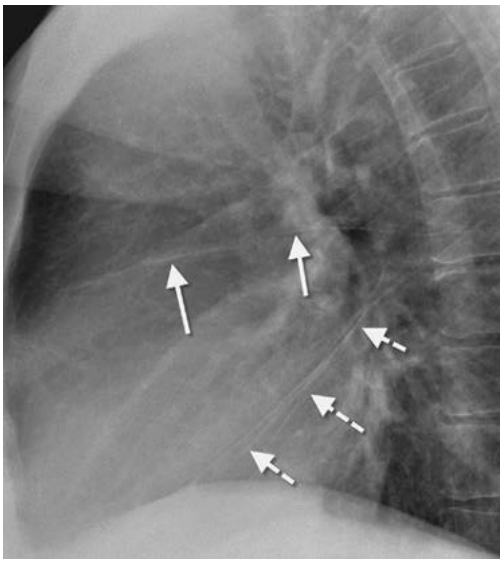


Fig. (4): Major and minor fissures on lateral chest radiograph. The inferior portions of the major fissures (dashed white arrows) and the right minor fissure (solid white arrows) are shown. They outline the location of the right middle lobe. The superior portions of the major fissures are not well seen. It is not uncommon that portions of the fissures are not visualized on normal chest radiographs ***(Collins et al. 2008)***.

Accessory fissures

The azygous fissure*:** This is a downward invagination of the azygous vein through the apical portion of the right upper lobe. It therefore has four pleural layers**,** two visceral and two parietal layers. The term azygous lobe is inappropriate as there no corresponding change in lober architecture (Fig. 5) ***(Ryan et al., 2011).

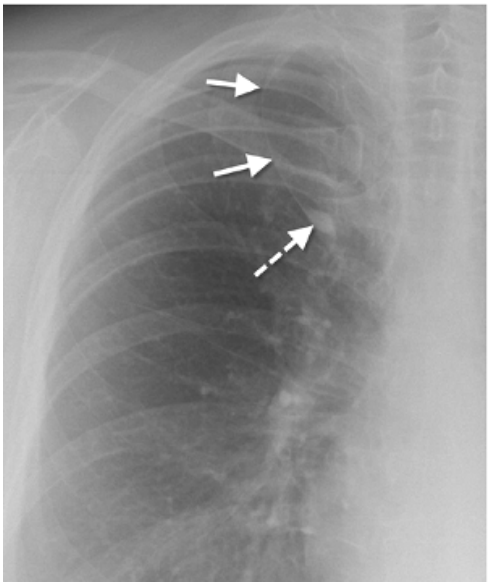


Fig. (5): Accessory azygos fissure. The accessory azygos fissure (solid arrows) creates an accessory azygos lobe. The fissure contains the azygos vein (dashed arrow)**,** which is higher than its usual location in the tracheobronchial angle ***(Collins et al., 2008)***.

The superior accessory fissure*:** This separates the apical segment of the right lower lobe from other basal segments. It lies parallel and inferior to the transverse fissure and passes posteriorly from the right oblique fissure to the posterior surface of the lung. It seen in (5‰) of PA chest radiographs ***(Ryan et al., 2011).

The inferior accessory fissure*:** this separate the medial basal from the other right lower lobe segments. Called Twining's line**,** it is seen in 45 ‰ of post-mortem examinations but in only 8‰ of PA chest radiographs ***(Ryan et al., 2011).

The Secondary pulmonary lobule

The secondary pulmonary lobule is a polyhedral structure measures approximately 1-2.5cm and is supplied by 3-5 terminal bronchioles. As small airways enter the center of the lobule**,** they begin to branch at short intervals (1-3mm). The pulmonary arteriole accompanies the terminal bronchioles into the center of the lobule**,** where it distributes blood to the capillary bed that surrounds the alveoli. The pulmonary venules then drain toward the periphery of the lobule and form pulmonary veins that travel in the interlobular septa ***(Galvin et al., 2004)***.

These septa form the boundaries of the secondary lobule. They are well developed in the apex and periphery of the lung and rather poorly developed in the posterior aspects of both upper and lower lobes. In the lower lung fields**,** these septa are oriented perpendicular to the pleura ***(Galvin et al., 2004)***.

Pulmonary lymphatics are found within the interlobular septa and along the bronchovascular bundles (pulmonary arteries and airways) as they drain from the pleural surface to the hila ***(Galvin et al., 2004)***.

The secondary lobule is divided into core and septal structures. The core structures include the pulmonary arteriole, terminal bronchiole, and accompanying lymphatics. The septal structures include the pulmonary veins, lymphatics and the fibrous septum. The alveoli and pulmonary capillary bed fill the space between them (Fig. 6)**(D.Karthikeyan., 2004)**.

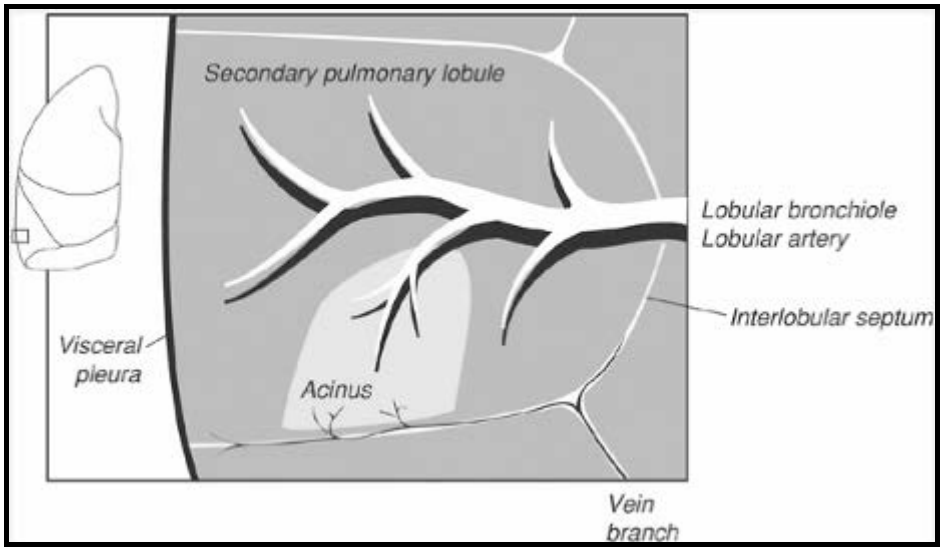


Fig. (6): Secondary pulmonary lobule ***(Collins et al., 2008)***.

Pulmonary Hilum

Is usually located opposite the bodies of vertebrae T5 to T7. At the hilum, the pulmonary artery and its branches are most superior, the bronchi and its branches are intermediate and posterior, and the pulmonary veins are inferior. The hilum also contains autonomic nerves, lymphatics, tracheo-bronchial lymph nodes, and the bronchial vessels ***(*Karthikeyan., 2004).**

Pulmonary veins