CHEST COMPUTED TOMOGRAPHY SCAN FINDINGS OF LUNG AND HEART SIZE AFTER COVID-19 PNEUMONIA

DR MADIHA MUSHTAQUE

(06-113202-001)

A thesis submitted in fulfillment of the requirements for the award of the degree of Master of Philosophy (Anatomy)

DEPARTMENT OF ANATOMY

BAHRIA UNIVERSITY ISLAMABAD

PAKISTAN

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BAHRIA UNIVERSITY HEALTH SCIENCES CAMPUS

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AUTHOR'S DECLARATION

I, **Dr. MADIHA MUSHTAQUE** hereby state that my MPhil thesis titled "**CHEST COMPUTED TOMOGRAPHY SCAN FINDINGS OF LUNG AND HEART SIZE AFTER COVID-19 PNEUMONIA**"is my own work and has not been submitted previously by me for taking any degree from this university, **The Bahria University** or anywhere else in the country/world.

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TO MY BELOVED PARENTS, HUSBAND AND KIDS

ACKNOWLEDGEMENTS

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Thank you.

ABSTRACT

Over the past 2 years it has been known that coronaviruses cause respiratory illness in humans and also organ failure depending on what stage the illness is and if the patient is suffering from co-morbid diseases. The family of coronaviruses includes severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and the common cold. The new strain of coronavirus, COVID-19 which is highly contagious was first reported in 42 patients who were working in a sea food market in Wuhan, a city of China in December 2019. Since the 1stcase report of coronavirus disease 2019 (COVID-19) in China December 2019, infection from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have spread promptly, causing a pandemic that has resulted in deaths of millions of people all over the world. Long-term effects of SARS-CoV-2 infection have become increasingly recognized on chest CT scan. Lung radiographic and CT scan changes are seen in convalescent COVID 19 patients which include permanent fibrotic like changes and they experience dry cough and fatigue even after 3 month of recovery.

Objectives were to assess pulmonary sequel and the risk factors for lung fibrosis on chest CT of survivors of severe COVID-19 pneumonia. To assess the difference in lung sizes of COVID-19 survivor and normal individual on CT scan of chest. To assess the difference in heart size of COVID 19 survivor and normal individual on CT scan of chest.To assess the displacement of hilum of lung due to fibrosis on chest CT scan. To assess pulmonary function test of COVID 19 survivors on Spirometery.

Eighty four subjects enrolled in the study; 42 (cases) survivors of COVID 19 and 42 (controls) without COVID 19.

Research was carried out in PNS Shifa hospital radiology department. Eighty four cases and controls underwent chest CT scan. Demographic details were taken and lungs and heart sizes measured using ruler in millimeters. All the data entered on a predefined proforma.

Result showed the significant decrease in diameters of the lungs of survivors of COVID-19 pneumonia as compared to the controls with significant p-value. The diameters of heart were increased on chest CT scan in COVID 19 survivors then the

healthy individuals and significant results found. COVID 19 patients with hypertension or smoking habits require more ICU admission and oxygen support. In conclusion COVID 19 disease causes injury to lungs and heart and fibrosis may persist for longer duration. Follow up of such patients are necessary at 3, 6 and 12 months and other parameter should be investigated like lung function test, cardiac enzymes and echocardiography.

Key Words: COVID 19, CT scan, fibrotic changes, PFT, Spirometry, Cardiac enzymes, Echocardiography

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LIST OF ABBREVIATION

COVID-19	Corona Virus Disease
HRCT	High Resonance Computed Tomography
CT	Computed Tomography
RT-PCR	Real Time Polymerase Chain Reaction
SARS	Severe Acute Respiratory Syndrome
WHO	World Health Organization
GGO	Ground-Glass Opacity
ICU	Intensive care unit
SPO2	Pressure of oxygen
CMR	Cardiovascular Magnetic Resonance

LIST OF ANNEXURES

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

In December 2019, 42 patients reported with cough and dyspnea in the city hospital of Wuhan, China. These patients were declared infected with severe acute respiratory syndrome (SARS) and later this disease was termed as Coronavirus disease COVID 19. It was a very contagious disease and it became a pandemic in 3 months of first case reported and World Health Organization (WHO) declared COVID 19 as global health emergency in March 2020. (Wang et al., 2020) The disease progression of COVID-19 ranges from mild symptoms and signs of acute upper respiratory tract infection, to severe pneumonia and failure of respiration in severe cases along with septic shock. COVID-19 cases are also reported without any illness (Barisione et al., 2020).

Lungs are primarily involved in COVID 19 pneumonia. Some cases were reported with atherosclerosis and heart failure after the infection. Due to the vast COVID-19 clinical spectrum, a lot of challenges faced by the clinical staff on frontline stretched resources prioritization as well as prediction of prognosis. Thus, there is a critical prerequisite of risk analysis for management and treatment. The major risk factors for death are comorbidities and older age. (Zhao et al., 2020)

The Corona virus is diagnosed by the real-time reverse-transcription–polymerase-chain-reaction (RT-PCR) assay through nasopharyngeal and oropharyngeal swab samples. RT-PCR assay is the standard for diagnosis of coronavirus disease. At the period of initial presentation 30-60% was the total positive rate of RT-PCR.

Major draw backs of this test are that false-negative rate are high and availability was also limited during the outbreak of disease. (Cinkooglu et al., 2020)

Molecular biological testing and imaging are currently scientific interest for diagnosis of disease. One of the major queries is about the chest CT in screening and diagnostic process in contrast with real-time polymerase chain reaction (RT-PCR) test that is why we do not do PCR just take CT Scan (Kovacs et al., 2020)

CT scan chest plays a crucial role in the analysis and management of COVID-19 pneumonia. Some studies revealed diverse CT results, with main abnormalities including consolidation and ground glass opacities. Accurate diagnosis and disease staging can be better understood by CT scan findings of patient of coronavirus disease. Infiltration and distribution patterns among lobes of lungs and infiltration are more prominent in CT scan findings that provide information related to diagnosis. Characterization of COVID-19 pneumonia is done by distribution pattern of the lesion. Most of the patients had peripheral, subpleural and bilateral lung involvement (Wang et al., 2020)

1.2 GROSS ANATOMY OF LUNGS

The major organs of the respiratory system are the lungs. The right lung is slightly larger than the left lung and divided into sections, or lobes. The right lung has three lobes and left lung has two lobes. The lungs are situated in the thorax separated by narrow median space called mediastinum, which also includes the heart, trachea, esophagus, and many lymph nodes. The external covering of lungs known as pleura protects the lungs and the muscular diaphragm separate the lungs from abdominal cavity. The lungs are roughly cone shaped with three surfaces and three borders, apex and base. Due to the presence of the heart the left lung is slightly smaller than right lung. The upward projection of lungs above the 1st rib and into the root of the neck is known as apex. The lung's inferior surface which sits on the diaphragm is known as base. (Sinnatamby, 2012)(Figure 1.1)

1.2.1 Lobes

The right lung is divided into three lobes superior, middle and inferior by oblique and horizontal fissures. The left lung divided into two lobes superior and inferior by an oblique fissure. (Wineski, 2012)

1.2.2 Surfaces

There are three surfaces of lungs, which corresponding to the thoracic area. The mediastinal surface of the lung faces the lateral aspect of the middle mediastinum. The lung hilum (where structures enter and leave the lung) is located on this surface. The base of the lung is formed by the diaphragmatic surface. It rests on the dome of the diaphragm, and has a concave shape. This concavity is deeper in the right lung, due to the higher position of the right dome overlying the liver. The costal surface is smooth and convex. It faces the internal surface of the chest wall. It is related to the costal pleura, which separates it from the ribs and innermost intercostal muscles. (Figure 1.2) (Moore, Daley &Agur, 2014)

1.2.3 Borders

The anterior border of the lung is formed by the convergence of the mediastinal and costal surfaces. On the left lung, the anterior border is marked by a deep notch, created by apex of the heart. This t is known as the cardiac notch. The inferior border separates the base of the lung from the costal and mediastinal surfaces. The posterior border is smooth and rounded (in contrast to the anterior and inferior borders, which are sharp). This is formed by the costal and mediastinal surfaces meeting posteriorly (Figure 1.2) (Moore et al., 2014)

1.2.4 Root and Hilum

The lung root is a collection of structures that suspends the lung from the mediastinum. Each root contains a bronchus, pulmonary artery, two pulmonary veins, bronchial vessels, pulmonary plexus of nerves and lymphatic vessels as shown in (Figure 1.3). All these structures enter or leave the lung via the hilum a wedge shaped area on its mediastinal surface. (Fig 1.3) (Moore et al., 2014)

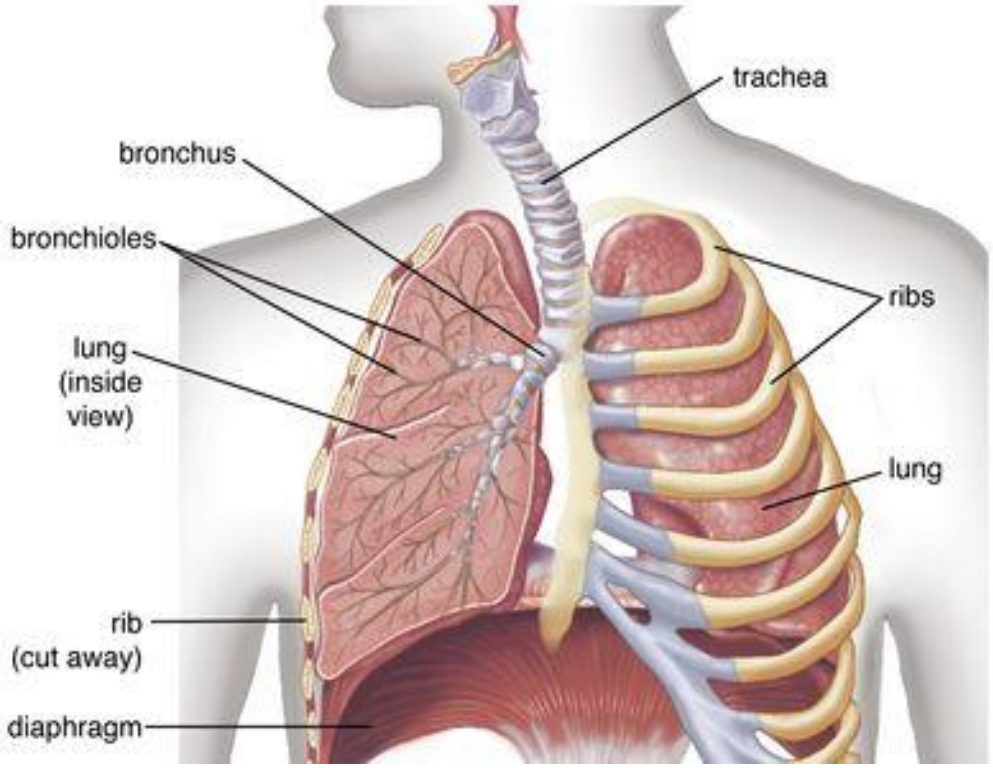

Figure 1.1: Anatomy of lungs (Britannica.com)

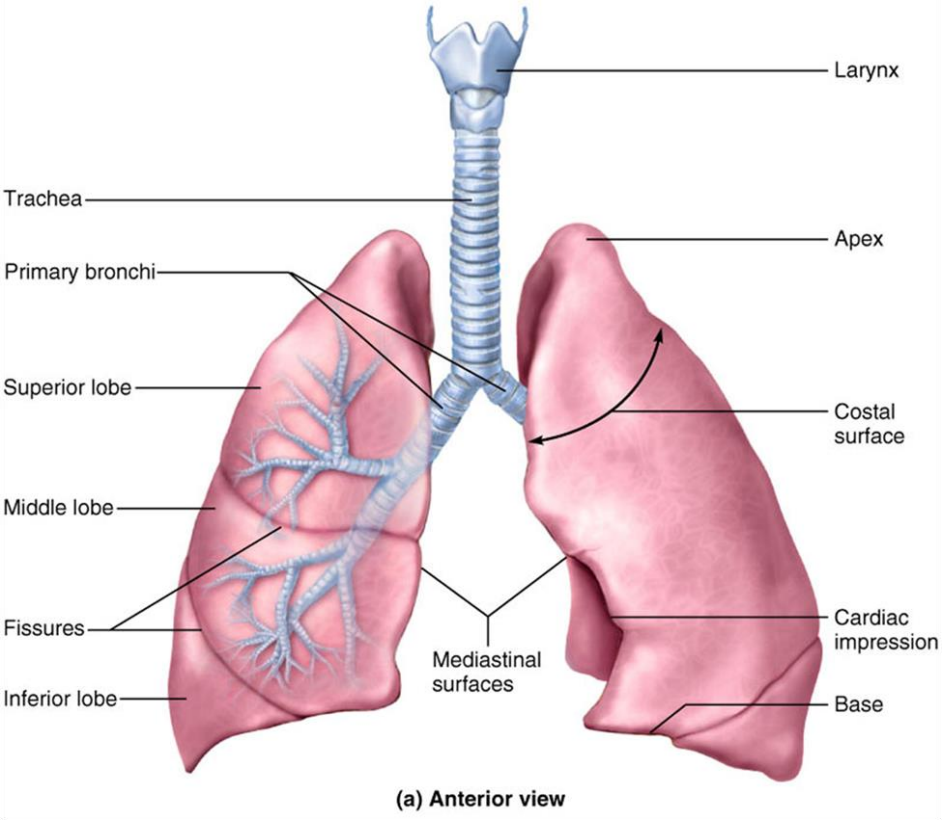

Figure 1. 2: Lobes and surfaces of the lungs (Netters, 2010)

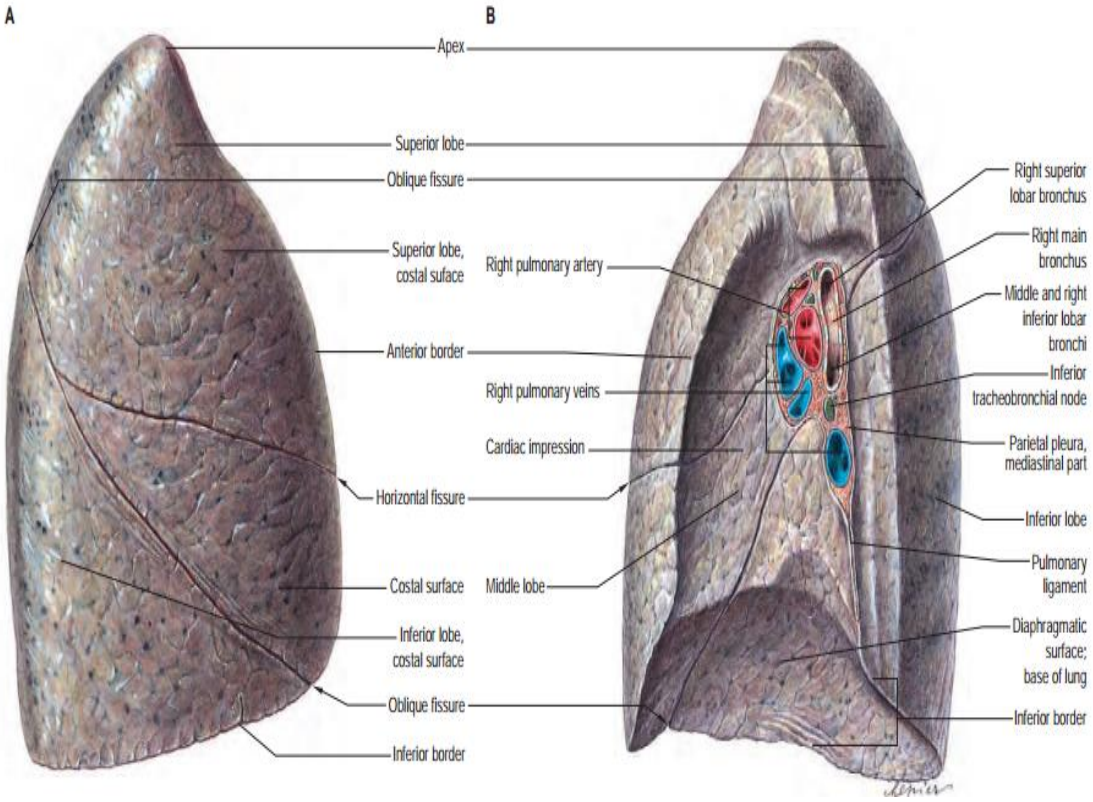

Figure 1.3: Lateral and medial surfaces of Right Lung (Moore et al, 2020)

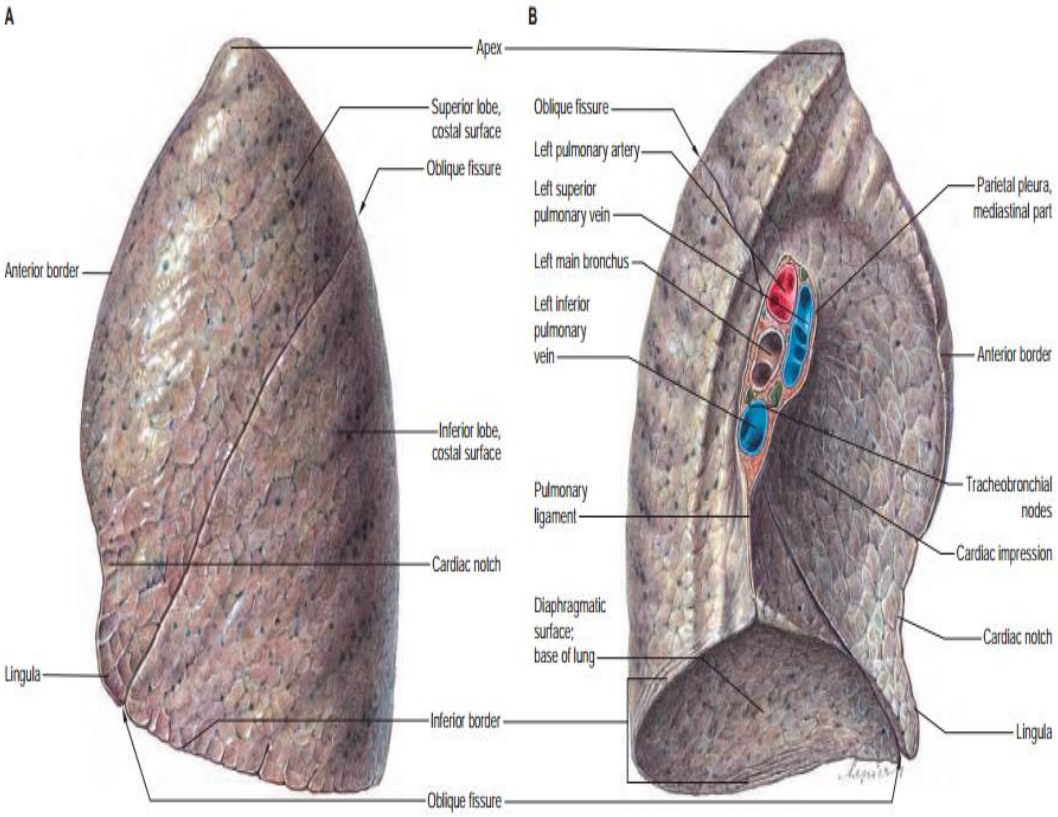

Figure 1.4: Lateral and medial surfaces of Left Lung (Moore et al, 2020)

1.3 BRONCHIAL TREE

The bronchial tree is a series of passages that supplies air to the alveoli of the lungs. It begins with the trachea, which divides into a left and right bronchus (Snell, 2012).

Each bronchus enters the root of the lung, passing through the hilum. Inside the lung, they divide to form lobar bronchi one supplying each lobe. Each lobar bronchus then further divides into several tertiary segmental bronchi. Each segmental bronchus provides air to a bronchopulmonary segment. These are the functional units of the lungs. The segmental bronchi give rise to many conducting bronchioles, which eventually lead into terminal bronchioles (Figure 1.4) each terminal bronchiole gives off respiratory bronchioles, which feature thin walled outpocketings that extend from their lumens. These are the alveoli the site of gaseous exchange. (Snell, 2012)

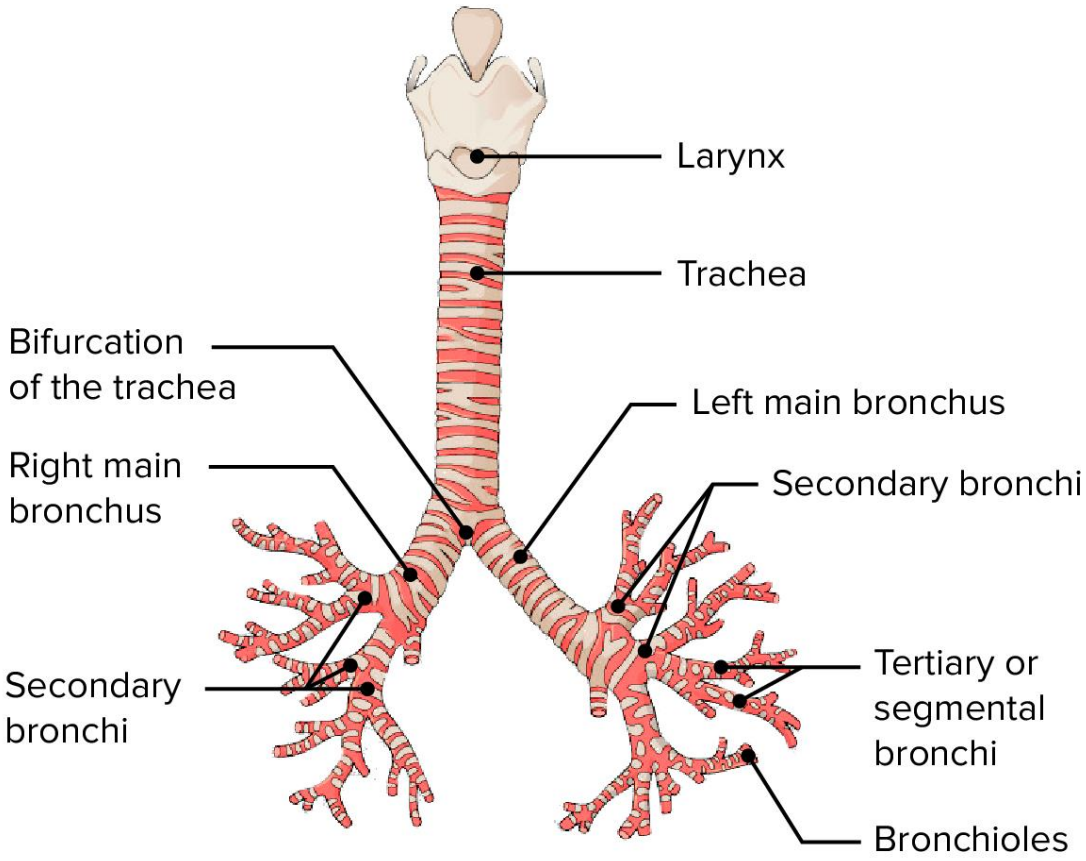

Figure 1.5 Bronchial tree (Snell, 2012)