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High-Resolution Computed Tomography in the Detection of Lung Abnormalities

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ABSTRACT

Lung disease is a major global issue. High-resolution computed tomography is the best modality for detecting lung abnormalities. **Objective:** To evaluate lung abnormalities on high-resolution computed tomography (HRCT) and assess the progression of fibrosis. **Methods:** It was a retrospective analysis of HRCT Findings in Lung Abnormalities at a tertiary Care Centre in Sargodha. A sample size of 50 was collected, reviewed retrospectively. The convenient sampling technique was used. This research included patients who visited the CT department for the diagnosis of lung disease. The study included emphysema, bronchiectasis, chronic obstructive disease, interstitial lung disease, and fibrosis, and the study excluded pneumonia, sarcoidosis, bronchitis, pulmonary hypertension respiratory tract infections. **Results**: A statistical analysis using SPSS version 23.0 was conducted to examine the relationshipsbetween these variables and the occurrence of lung abnormalities. The majority were 50 patients, of whom 54% were males and 46% were females. In the current study, interstitial fluid was 14%, Bronchiectasis and pneumonia were 22%, and fibrosis and pulmonary nodules were 14%. A significant relationship was noted between bronchiectasis and the patient according to age. **Conclusions:** The study concluded that the lung cancer that affects the lungs and alters the tissues and airways of the respiratory system is bronchiectasis. High-resolution computed tomography provides an accurate diagnosis of lung diseases.

INTRODUCTION

Unhealthy disease is a condition that affects the lungs and prevents them from functioning normally [1]. The airways are the tubes that transport oxygen and other gases into and out of the lungs. Hence, diseases of the airways impact these tubes. Asthma, chronic obstructive pulmonary disease (COPD), bronchitis, and bronchiectasis are among the diseases of the airways, which are also the main disorders for persons with cystic fibrosis [2]. Lung tissue diseases have an impact on the tissue's structure. Scarring or tissue inflammation prevents the lungs from expanding completely. Lung circulation disorders influence the blood vessels in the lungs. They appear as a result of inflammation, scarring, or blood vessel clotting. The lungs' ability to take in oxygen and expel carbon dioxide is impaired by them [3]. A CT scan is diagnostic imaging that captures pictures of the interior of the body using X-ray technology. CT has many different views of the same organ or structure and provides much greater detail [4]. High-resolution computed tomography, or HRCT, is a form of CT that uses certain methods to improve picture resolution. HRCT imaging parameters are chosen to maximize spatial resolution, and a narrow slice width is used (typically 1-2 mm) at intervals of 10mm to 20mm throughout the lungs [5]. For the identification of diffuse lung illness, high-resolution CT (HRCT) scans taken with patient's supine are frequently sufficient. Nevertheless, to identify or rule out mild illness in the posterior region of the lung, further scans taken while the patient is prone may be required. The scan could be carried out during both inspiration and expiration, depending on the probable diagnosis [6]. The scan for an

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expiratory HRCT is performed while lying flat. An HRCT of the lungs is used for the evaluation of clinically suspected diffuse lung disease and suspected small airway disease [7]. The HRCT of the lungs has no definite limitations. Lung infection is obliterating millions of families around the world. Many people are enduring lung diseases [8]. CT is used to diagnose the most frequent lung disease by assessing the lung parenchyma. Interstitial lung illnesses, including pulmonary fibrosis, interstitial pneumonitis, and other generalized lung diseases like emphysema, are diagnosed on HRCT. Emphysema damages the air sacs in the lungs. Bronchiectasis is a condition where the airways of the lungs become widened, leading to a buildup of excess mucus that can make the lungs infected. Chronic obstructive pulmonary disease is caused by obstructed airflow from the lungs. Lung abnormalities are diagnosed and evaluated by using HRCT [9]. HRCT uses thin-section CT images (1.5-mm slice thickness) with a high spatial frequency reconstruction algorithm used to determine the diseases that involve the pulmonary parenchyma and narrow airways [10]. The advancement of multi-detector CT is used by machines that can gather near-isotropic data across the complete thorax in a single breath-hold [11]. HRCT is done by using MDCT scanners that can image at full resolution while maintaining extremely quick coverage, overcoming this dependency. High-Resolution Computed Tomography (HRCT) is an important diagnostic tool for lung abnormalities because it can generate high-quality, high-resolution images of the lung parenchyma. HRCT has the advantage of being able to identify subtle alterations in the structure of the lungs, unlike conventional chest X-rays, and is thus exceedingly useful in the early diagnosis and description of interstitial lung diseases (ILDs), emphysema, bronchiectasis, and small airway disease [12]. Its accuracy enables clinicians to recognize the type, degree, and pattern of abnormalities, which is important for proper diagnosis, tracking disease progression, and assessing treatment response. HRCT also plays a vital role in discriminating among a range of lung pathologies that can present with similar symptoms, thus influencing proper clinical management. Being non-invasive and comparatively expeditious, HRCT markedly increases diagnostic accuracy and aids in more informed clinical decision-making in respiratory medicine [13]. HRCT gives meticulous visualization of lung parenchyma, alveoli, bronchioles, and interstitial tissues and is therefore uniquely capable of assessing conditions like ILD, pulmonary fibrosis, sarcoidosis, emphysema, and bronchiectasis. HRCT is also very important in guiding clinical management by enabling clinicians to decide on the nature and extent of lung abnormalities, choose further investigative procedures such as biopsy, follow disease progression or response to therapy, and determine prognosis. Being non-invasive and a rapid imaging modality, HRCT provides a patient-friendly experience while providing accurate diagnostic information. Additionally, it helps in differential diagnosis by differentiating among lung diseases with almost identical clinical presentation, thereby enhancing overall diagnostic accuracy and leading to better outcomes for the patients [14].

The study aims to identify and evaluate diseases using HRCT that affect lung function, parenchyma, airways, and other abnormalities. The study will help the radiologist identify and treat them and prevent other conditions. It can also help raise awareness about lung abnormalities in people who are not familiar with this issue.

METHODS

It was a retrospective study conducted at Sargodha, Pakistan. A sample size of 50 was considered from the relevant published studies [15]. In this study, the convenience sampling method was used. This research comprised the patients who visited the CT department for the diagnosis of lung disease. Data were gathered over six months, from November 2022 to March 2023, under approval of the University Research Committee's Ethical guidelines. Patients registered their age, gender, and type of examination, and procedure details were to be recorded. The study included emphysema, bronchiectasis, chronic obstructive disease, interstitial lung disease, and fibrosis, and the study excluded sarcoidosis, bronchitis, pulmonary hypertension respiratory tract infections. A Toshiba Alexion 16 CT Scanner was used. Data were analyzed using SPSS version 23.0. Graphs and tables were used for data summarization.

RESULTS

In the present investigation, CT was used to analyze 50 individuals with lung abnormalities to look for other illnesses that were present. Utilizing SPSS, the associations between these traits and the incidence of lung abnormalities were examined using statistical analysis. There are 50 patients in this research, of whom are men and of whom are women. The gender of the patients (46%) was female, and (53%) were male (Figure 1).

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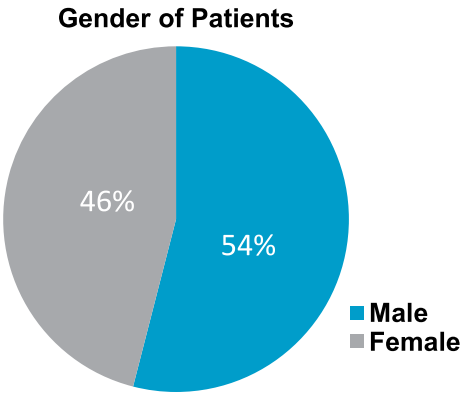

Figure 1: Gender of Patients

The Frequency distribution of the patients indicates that most are middle-aged, particularly the age group of 35–55 years (26%). Both the age groups 25–35 and 55–70 account for 22% each. There are fewer patients in the youngest (16%) and oldest (14%) age groups (Table 1).

Table 1: Frequency Distribution of Age of Patients

Age of Patients	Frequency (%)
Less Than 25	8 (16.0%)
25-35	11 (22.0%)
35-55	13 (26.0%)
55-70	11 (22.0%)
More Than 70	7 (14.0%)
Total	50 (100.0%)

Frequency distribution of indications in which 14 patients (28% of patients) which affected by chest pain, 5 patients (10 patients) which affected by shortness of breath, 10 patients (20% of all patients) which affected by cough, and 5 patients (10 patients) which affected by fever (Figure 2).

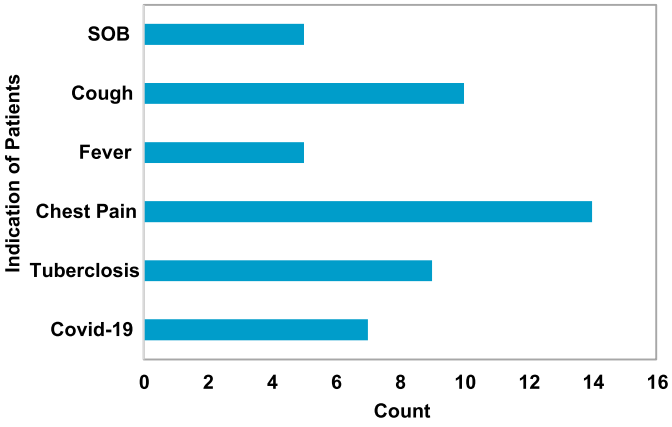

Figure 2: Frequency Distribution of Indications of the Patient

14% had intestinal fluid, 22% had bronchiectasis and pneumonia, and 14% had fibrosis and pulmonary nodules 14%. A significant relationship was noted between bronchiectasis and the patient's age (Table 2).

Table 2: Frequency Distribution of Diseases of the Patient

Diseases	Frequency (%)
Fibrosis	7 (14.0%)
Interstitial Fluid	7 (14.0%)
Bronchiectasis	11 (22.0%)
Pulmonary Nodules	7 (14.0%)
Pneumonia	11 (22.0%)
Perihilar Brachial Wall Thickening	7 (14.0%)
Total	50 (100.0%)

The age group was descriptive analysis of bronchiectasis, 11 out of 50 patients had bronchiectasis, with the majority in the age group 55–70 (5 cases) and 35–55 (4 cases). Single 1-case appearance was in the "less than 25" and "over 70" groups, and none in the 25–35. This speaks of increased prevalence among middle-aged and elderly adults (Table 3).

Table 3: The Age Group with Bronchiectasis

Age of Patients	The Age Group with Bronchiectasis		Total
	Yes	No	
Less Than 25	1	7	8
25-35	0	11	11
35-55	4	9	13
55-70	5	6	11
More Than 70	1	6	7
Total	11	39	50

DISCUSSION

Lung illnesses are affecting millions of people worldwide. There are various kinds of lung diseases, but the most common diseases are Asthma, chronic obstructive pulmonary disease (COPD), bronchitis, and bronchiectasis. Interstitial lung illnesses, including pulmonary fibrosis, interstitial pneumonitis, and other generalized lung diseases like emphysema [15]. High-resolution CT is carried out with standard CT scanning. The choice of imaging settings, however, maximizes spatial accuracy. CT with high clarity is called high-resolution computed tomography, or HRCT. Although most frequently used to diagnose pulmonary illnesses, it is also used to diagnose several other health issues. It entails evaluating the lung tissue using specialized computed tomography scanning methods [16]. The investigation revealed that computed tomography was advantageous in evaluating lung diseases, structure, and anatomy due to its accessibility, lack of need for a contrast agent, and high clarity. Radiology techs also benefit from focusing on skills and understanding the differences between pathological and typical lung characteristics [17]. The researcher will go into more detail about the results of this study, which was conducted to measure the accuracy of CT in the diagnosis and classification of lung abnormalities. Table 1 and Figure 1 exhibit the subject and gender according to the age of the group. Similar findings indicate that the most common

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high-resolution lung CT findings are bronchiectasis (22%), fibrosis (14%), pneumothorax (22%), and pneumonia (22%). 27 male (54%) and 23 female (46%) make up the distribution [18]. The present study shows that the majority of patients, 11(22%), suffer from bronchiectasis as compared to the pulmonary nodules. In the current study, 14 patients (28% of patients) which affected by chest pain, 5 patients (10 patients) which affected by shortness of breath, 10 patients (20% of all patients) which affected by cough, 5 patients (10 patients) which affected by fever, and 19 patients (14% of all patients) which affected by covid-19 are the signs and symptoms of the study [19]. As shown in the table, bronchiectasis is more common in age groups greater than 55 years in high-resolution chest CT [5]. According to earlier investigations, axial and coronal HRCT were used to diagnose lung abnormalities, and the findings demonstrated that these scans were quite clear and offered a great deal of information. The most common lung disorders are more likely to occur between the ages of 25 and 70, as shown in the table. This pneumonia is large in terms of percentage. In our study, bronchiectasis (22%) is significant owing to a variety of environmental factor [20].

CONCLUSIONS

In conclusion, computed tomography is reliable for the detection of lung abnormalities. The current investigation, done on patients in Sargodha, Pakistan, discovered that bronchiectasis is the main disease that affects the lungs and changes the tissues and airways of the respiratory system.

Authors Contribution

Conceptualization: MA
Methodology: MA
Formal analysis: AAA
Writing review and editing: MJ, MA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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