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Original Research Article

Evaluation of Radiological Features in Chest Diseases: A Hospital-Based Study

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Abstract:

Background: Radiological imaging, particularly high-ʿresolution computed tomography (HRCT), plays a pivotal role in diagnosing and managing chest diseases by visualizing structural and pathological changes in the lungs, pleura, and mediastinum.

Aim: To evaluate the spectrum of radiological findings in common chest diseases among adults and correlate patterns with age and gender.

Methodology: This prospective, observational study included 90 patients aged 20–60 years undergoing HRCT at RDJM Medical College and Hospital, Bihar, India. Clinical evaluation was followed by HRCT imaging to identify parenchymal, airway, and pleural abnormalities. Data were analyzed using SPSS 27.0, with categorical variables expressed as frequencies and percentages.

Results: Consolidation was the most common finding (33.3%), followed by ground-glass opacities (27.8%), fibrosis/reticulations (22.2%), nodules/masses (11.1%), and pleural effusions (5.6%). Infectious diseases (38.9%) predominated, followed by interstitial lung disease (22.2%) and COPD (16.7%). Older adults (51–60 years) showed higher rates of fibrosis, while nodules/masses were distributed in middle and older age groups. Females exhibited slightly higher frequencies of parenchymal abnormalities.

Conclusion: HRCT effectively identifies both acute and chronic chest pathologies, highlighting consolidation and ground-glass opacities as predominant patterns, with age and gender influencing disease expression.

Keywords: HRCT, Chest Diseases, Consolidation, Ground-Glass Opacities, Interstitial Lung Disease, COPD, Pneumonia, Tuberculosis.

Introduction

During the last few decades, the function of radiology in diagnosing and treating chest diseases has undergone a radical transformation and imaging has thus become an inescapable tool in clinical practice [1]. Chest diseases comprise a wide spectrum of conditions involving the lungs, pleura, mediastinum, and chest wall; their early detection is crucial for prompt treatment and prognosis. Radiological imaging, mainly chest X-ray and computed tomography (CT), is the most important diagnostic procedure among all and is regarded as non-invasive offering visualization of the structural abnormalities and the changes in physiology and pathology [2]. Although the basic X-ray remains the most commonly conducted examination and it is so because it is easy and fast to get, low-cost and advanced imaging methods like high-resolution CT, MRI and PET have opened up new vistas in terms of identifying subtle or complex lesions with sensitivity and specificity that are considerably higher than that of the conventional methods. It is thus of paramount importance to be well acquainted with the radiological appearance of the common chest diseases not only for precise diagnosis but also for monitoring the progress of the disease, directing interventions, and forecasting results.

Infectious diseases of the lungs, especially pneumonia and tuberculosis, continue to be among the top health problems worldwide and are most often diagnosed with the help of imaging [3]. Pneumonia usually shows up as solid areas in the lungs, which are often in a segment or lobe and characterized by factors like air bronchograms and silhouette sign, all of which help to ascertain the position of the disease. Viral and atypical pneumonia can be a little more

problematic as they may cover larger areas and exhibit interstitial patterns which, in turn, require the radiologist to have good interpretative skills. In places where the disease is common, tuberculosis even shows numerous different forms radiologically from small nodular infiltrates to cavitary lesions in the upper lobes along with lymphadenopathy and pleural effusions [4]. Therefore, the radiologists' ability to identify both the classical and atypical radiographic patterns is extremely important since a delay or errors in the diagnosis can have grave public health consequences owing to the nature of the disease being contagious.

Chronic obstructive pulmonary disease (COPD) and asthma along with other obstructive airway disorders are the main diseases of the chest area that have different radiological signs [5]. COPD usually shows such features as hyperinflation, flattened diaphragms, large retrosternal airspace, and sometimes bullous changes. However, high-resolution computed tomography (HRCT) is able to give the detailed information about the extent of emphysematous destruction, airway wall thickening, and small airway disease. Asthma, although mainly a clinical diagnosis, can show hyperinflation or bronchial wall thickening during acute exacerbations. Interstitial lung diseases (ILDs) comprised of idiopathic pulmonary fibrosis, sarcoidosis, and hypersensitivity pneumonitis, are often difficult to diagnose due to their varied radiological manifestations and may require HRCT for precise assessment [6]. ILDs frequently show a combination of reticulograghical opacities, ground-glass changes, honeycombing, or nodular patterns, and it is very important to understand these subtle variations in order to differentiate among the various causes and to make the right decision about biopsy or therapy.

Pleural and mediastinal disorders are also important contributors to the spectrum of chest diseases. Whether the pleural effusions are transudative or exudative, they can be spotted easily on chest X-rays as the costophrenic angles becoming blunt or layering of opacities, whereas ultrasound and CT are very effective in determining their type and characteristic. Pneumothorax, pneumomediastinum, and hemothorax are other disorders that radiological recognition in time saves life [7]. Mediastinal masses comprising thymomas, lymphomas, and germ cell tumors show different imaging characteristics, and cross-sectional imaging is usually the only way for reliable localization, characterization, and surgical planning. Moreover, cardiac and vascular abnormalities like heart failure and pulmonary embolism are examples that show the usefulness of radiology, as these diseases often reveal secondary lung changes that can be seen on imaging [8].

Radiological findings vary widely and are influenced by factors such as the patient's age and sex, the extent of the disease, the presence of other medical conditions, and the imaging technique used [9]. Therefore, radiologists are required to take into account the clinical situation along with the imaging features to provide the right differential diagnoses. The introduction of advanced imaging technologies like multi-detector CT, MRI, and nuclear medicine has broadened the diagnostic spectrum, making it possible not only to see structural abnormalities but also to monitor physiological and functional changes. Now, artificial intelligence and machine learning applications are being tested for their potential to help in recognizing patterns, measuring disease extent, and predicting the course of the disease, thus promising more precise radiological interpretation.

The wide range of radiological findings related to typical chest diseases is extensive and varied to a great extent, which is the result of the different types of thoracic diseases. Knowing these imaging patterns very well is a prerequisite for the early diagnosis, proper management, and better patient outcomes. A comprehensive knowledge of the radiographic and advanced imaging appearances along with clinical correlation enables the precise identification of infectious, obstructive, interstitial, pleural, mediastinal, and vascular chest diseases. Radiology continues to be a crucial pillar in thoracic medicine with the ongoing development of imaging modalities, it is now the bridge between patient clinical assessment and therapeutic intervention and thus forming the basis for evidence-based patient care.

Methodology

Study Design: This study was designed as a prospective, observational study aimed at evaluating the spectrum of radiological findings in common chest diseases. The primary objective was to identify and categorize different patterns of lung involvement on high-resolution computed tomography (HRCT) and correlate them with clinical presentations.

Study Area: The study was conducted in the Department of Radio-Diagnosis, RDJM Medical College and Hospital, Turki, Muzaffarpur, Bihar, India.

Study Duration: The study was carried out over a period of six months from April 2025 to September 2025.

Study Participants: The study included patients undergoing chest imaging in the radiology department during the study period. Written informed consent was obtained from all participants in a language they could understand.

Inclusion Criteria

- Patients attending the outpatient (OPD) and inpatient (IPD) departments.
- Both male and female patients.
- Age group between 20 to 60 years.

- Patients with known or suspected chest-related diseases undergoing HRCT scans.

Exclusion Criteria

- Patients with traumatic chest injuries.
- Pediatric patients below 20 years of age.
- Uncooperative patients unable to comply with imaging protocols.

Sample Size: A total of 90 patients were included in the study, comprising both male and female patients in equal proportion where possible.

Procedure: All patients included in the study underwent a comprehensive clinical examination and were subsequently subjected to a high-resolution CT (HRCT) scan of their chest using a 16-slice CT scanner. The standard imaging protocols were adhered to, which involved the acquisition of thin-section images at intervals of 1–2 cm. This procedure allowed the detection of abnormalities in both diffuse and localized lung diseases with the least possible radiation exposure to the patient.

The HRCT scans were conducted while the patient was lying on their back, at full lung capacity, and without the use of intravenous contrast unless it was deemed necessary for the clinical assessment. Every scan was done under a great deal of scrutiny and the detection of parenchymal, airway, and pleural abnormalities was very thorough. The common radiological patterns of consolidation, ground-glass opacities, reticulation, nodulation, cavitations, and pleural effusions were then systematically identified and recorded. The resulting pictures were further divided into groups according to the type and extent of lung involvement making it possible to tell apart common chest diseases such as infections, interstitial lung disease, and tumors.

Data that was collected was structured and entered into a database comprising patient demographics, clinical history, and HRCT findings. This made it possible to compare the different radiological patterns and assess their correlation with age, gender, and clinical presentation.

Statistical Analysis: The collected data were analyzed using standard statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Chi-square tests were applied to determine associations between radiological patterns and demographic variables. A p-value of <0.05 was considered statistically significant. The statistical analysis was carried out using SPSS software (version 27.0), ensuring accurate and reliable interpretation of radiological patterns in the study population.

Result

The demographic distribution of the study participants is presented in Table 1, which shows a total of 90 individuals. The age group of 51–60 years had the highest representation with 28 participants (31.2%); then, the age groups of 20–30 and 31–40 years had equal representation, each with 22 participants (24.4%). The 41–50 age group had 18 participants (20%). Regarding sex distribution, females (n = 50) were more numerous than males (n = 40) in the total sample of the study. The results suggest a slight predominance of older participants and also a larger fraction of female participants in the present study cohort.

Table 1: Demographic Distribution of Study Participants (n = 90)

Age Group (years)	Male (n)	Female (n)	Total (n)	Percentage (%)
20–30	10	12	22	24.4
31–40	12	10	22	24.4
41–50	8	10	18	20
51–60	10	18	28	31.2
Total	40	50	90	100

The distribution of chest diseases diagnosed by HRCT is shown in Table 2 for 90 patients. The largest number of patients, 35 (38.9%), had infectious diseases such as pneumonia and tuberculosis, while the second most prevalent disease was interstitial lung disease (ILD), which affected 20 patients (22.2%). Chronic obstructive pulmonary disease (COPD) was found in 15 patients (16.7%), and both pulmonary neoplasms and pleural diseases (effusion and fibrosis) were seen in 10 patients (11.1%) each. This table demonstrates that infectious diseases and ILD were the primary causes of diagnosis in the study population overall.

Table 2: Distribution of Chest Diseases Diagnosed by HRCT (n = 90)		
Chest Disease	**Number of Patients (n)**	**Percentage (%)**
Infectious (Pneumonia, TB)	35	38.9
Interstitial Lung Disease (ILD)	20	22.2
Chronic Obstructive Pulmonary Disease (COPD)	15	16.7
Pulmonary Neoplasms	10	11.1
Pleural Diseases (Effusion, Fibrosis)	10	11.1
Total	90	100

The HRCT findings in the study participants (n = 90) are shown in Table 3. The detection of consolidation was the most frequent abnormality, which was seen in 30 patients and represented 33.3% of the total cases. Following closely were the ground-glass opacities (GGO) which were seen in 25 patients (27.8%) and reticulations or fibrosis in 20 patients (22.2%). Ten patients (11.1%) showed nodules or masses while pleural effusion, with the least frequency, was found in 5 patients (5.6%). To sum up, the table indicates that consolidation and GGO were the main radiological patterns of the participants, thus suggesting that there was a higher prevalence of parenchymal involvement in the population that was studied.

Table 3: HRCT Findings in Study Participants (n = 90)		
HRCT Finding	**Number of Patients (n)**	**Percentage (%)**
Consolidation	30	33.3
Ground-glass Opacities (GGO)	25	27.8
Reticulations / Fibrosis	20	22.2
Nodules / Masses	10	11.1
Pleural Effusion	5	5.6
Total	90	100

The age-related distribution of different radiological patterns is presented in Table 4. The age group of 51–60 years had 10 cases, which was the highest incidence of consolidation, whereas the case distribution of ground-glass opacities (GGO) was relatively uniform, the highest point also being the 51–60 years group with 8 cases. The least frequent radiological pattern in the 41-50 years age group was nodules or masses, which according to the frequency of observation was one case, and the most common was the 51-60 years age group with 3 cases in both the 31-40 and 51-60 age groups. Besides, the pleural effusion was mainly recorded in the younger age groups (20–40 years) and was not observed in anyone over 50. The most common radiological finding in all patients was consolidation, with a total of 30 cases, followed by GGO with 25 cases, fibrosis/reticulations with 20 cases, nodules/masses with 10 cases, and pleural effusion with 5 cases.

Table 4: Distribution of Radiological Patterns According to Age Group					
Age Group (years)	**Consolidation (n)**	**GGO (n)**	**Fibrosis/ Reticulations (n)**	**Nodules/ Masses (n)**	**Pleural Effusion (n)**
20–30	8	6	4	2	2
31–40	7	5	4	3	3
41–50	5	6	5	2	0
51–60	10	8	7	3	0
Total	30	25	20	10	5

Table 5 illustrates how the radiological patterns were distributed among the study participants based on gender. The radiological pattern of consolidation was the one that was most frequently seen and it was present in 33.3% of the cases with 14 males and 16 females having it. Ground-glass opacities (GGO) were made in 27.8% of the participants, these were also slightly more in females (15) than in males (10). Fibrosis or reticulations were identified in 22.2% of cases, again with a higher number of incidences in females (12) compared to males (8). Nodules or masses were responsible for 11.1% of findings which were equally divided among males and females. At the same time, pleural effusion was the least common finding as it was only recorded in 5.6% of participants. In general, most of the radiological abnormalities were slightly more prevalent in females than in males.

Table 5: Distribution of Radiological Patterns According to Gender				
HRCT Finding	**Male (n = 40)**	**Female (n = 50)**	**Total (n = 90)**	**Percentage (%)**
Consolidation	14	16	30	33.3
Ground-glass Opacities (GGO)	10	15	25	27.8
Fibrosis / Reticulations	8	12	20	22.2
Nodules / Masses	5	5	10	11.1
Pleural Effusion	3	2	5	5.6
Total	40	50	90	100

Discussion

The present study analyzed the range of radiological findings in common lung diseases by using high-resolution computed tomography (HRCT) on 90 patients. The data obtained from our study showed that the most common abnormality was consolidation (33.3%), and the second most common was ground-glass opacities (27.8%) followed by reticulations/fibrosis, nodules, masses and pleural effusions. The above findings are generally in agreement with the earlier studies which have pointed out the diagnostic sensitivity of HRCT in identifying both the acute and chronic pulmonary abnormalities.

When we juxtapose our findings with those of earlier studies, the one by Bhat and colleagues (2016) [10] is worth mentioning. They performed a study on interstitial lung diseases (ILDs) involving 50 patients and reported ground-glass opacities in 60% of patients and reticular patterns in 32%, thus indicating the early stage of parenchymal involvement even in patients with normal X-rays or almost normal X-rays. In contrast with our study which ranked consolidation as the foremost pattern, there was still a good proportion of ground-glass opacities 27.8% which matched the range of inflammatory and early fibrotic changes in ILD. On the other hand, Raghuvanshi et al. (2016) [11] similarly reviewed 30 subjects with sputum-negative pulmonary tuberculosis and found among the patients 17% with consolidation, 40% with nodular opacities, and 30% with ground-glass opacities. This distribution of parenchymal abnormalities in our study is in agreement with theirs and at the same time it attests to the superiority of HRCT in the detection of subtle pulmonary lesions.

Age-related trends observed in the current study, with older adults (51–60 years) exhibiting higher frequencies of fibrosis and reticulations, are corroborated by Devakonda et al. (2010) [12], who reported progressive fibrotic changes in chronic airway and parenchymal disorders predominantly in patients over 50 years. This reflects the cumulative effect of environmental exposures, recurrent infections, and age-associated decline in pulmonary compliance, leading to chronic remodeling and fibrotic transformation. In contrast, nodules and masses were more prevalent in middle-aged and older adults, consistent with findings by Webb et al. (2014) [13], who noted that focal lesions such as nodules or masses are more likely to represent neoplastic or localized chronic inflammatory conditions in this demographic.

The gender-based differences observed in this research, where women showed a little higher frequency of consolidation, ground-glass opacities, and fibrosis, are to some extent in agreement with the observations made by Despaux et al. (1998) [14], who mentioned a slight female predominance regarding the autoimmune-related lung involvement and parenchymal nodular abnormalities. Nonetheless, in our group of patients, the presence of nodules and masses was equally common among males and females, which agrees with the findings of Longo et al. (2014) [15] concerning pulmonary tuberculosis and neoplastic conditions, indicating that some focal pathologies might not exhibit pronounced gender preference.

The occurrence of pleural effusions in our research was not very high and it was primarily noted in the younger subjects. This goes against the conclusions drawn by Boehme et al. (2010) [16] who reported a greater prevalence of pleural involvement among the elderly with complicated lung infections or tuberculosis. Differences in the populations studied, severity of diseases, or our group being presented early could be possible reasons for the difference. However, still, the low prevalence overall supports the idea that pleural effusions are usually secondary and not as frequent as parenchymal involvement in the respiratory disease populations based on community surveys.

Comparisons with studies on ILDs and chronic infections further illustrate the diagnostic spectrum. In the study by Naseem et al. (2008) [17], HRCT demonstrated tree-in-bud patterns in 7% of patients, honeycombing in 30%, and reticular opacities in 10%, which resonates with our findings of chronic radiological changes in older adults. Ground-glass opacities were slightly higher in female patients in both our study and the comparative research, suggesting a possible gender-related variation in the inflammatory response or healthcare-seeking behavior. Similarly, Majmudar and Rajput (2017) [18] reported HRCT as a sensitive tool in predicting disease activity in pulmonary tuberculosis, showing that consolidation and nodular opacities remain key diagnostic indicators, supporting our observations.

On the other hand, investigations of lymphangioleiomyomatosis (LAM) and other cystic lung disorders, including the works of Sabri et al. (2016) [19] and Koo and Yoo (2013) [20], showed the prevalence of cystic patterns over consolidation or ground-glass opacities. This indicates that the sensitivity of HRCT is universal, but the range of radiological findings depends a lot on the underlying pathology, thus underlining the need to correlate clinical presentation with imaging features.

In general, the current investigation validates that consolidation and ground-glass opacities are the most common HRCT patterns in a general adult population with chest complaints whereas fibrosis and reticulations are the changes seen in the oldest age group. The differences between genders are slight but can be seen especially in the case of inflammatory lesions. The results indicate that HRCT plays a very important role in detecting both acute infectious processes and chronic interstitial changes thus making it possible to diagnose quickly, decide on treatment, and improve the patient's outcome. It is suggested that future studies should be larger multicenter trials with classification according to the underlying causes in order to further clarify the diagnostic usefulness of HRCT in different lung diseases.

Conclusion

The present study highlights the diverse spectrum of radiological findings in common chest diseases among adults aged 20–60 years, with a total of 90 participants evaluated using HRCT. Consolidation emerged as the most frequent abnormality (33.3%), followed by ground-glass opacities (27.8%), fibrosis/reticulations (22.2%), nodules/masses (11.1%), and pleural effusions (5.6%). Infectious diseases, particularly pneumonia and tuberculosis, were predominant, while interstitial lung diseases and chronic obstructive pulmonary disease contributed significantly to chronic changes. Age influenced the prevalence of fibrosis and reticulations, being more common in older adults, whereas nodules and masses were distributed in middle and older age groups. Gender differences were modest, with females showing slightly higher frequencies of parenchymal abnormalities. Overall, HRCT proved invaluable in detecting both acute and chronic thoracic pathologies, reinforcing its role in accurate diagnosis, clinical management, and prognostic assessment of chest diseases.

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