International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Comparative Role of HRCT and Pulmonay MRI in Lung Diseases

Sehyr Rajpal[1], Ashish Kumar shukla[2], Mohit Gaur[3], Aditya Dwivedi[4], Rachit Thavanani[3], Prajwal C S[4]

[1]Junior Resident, Department of Radiodiagnosis, SMC, Santosh Deemed to be university, Ghaziabad Uttar Pradesh, India.
[2]Professor, Department of Radiodiagnosis, SMC, Santosh Deemed to be university, Ghaziabad Uttar Pradesh, India.
[3]Assistant Professor, Department of Radiodiagnosis, SMC, Santosh Deemed to be university, Ghaziabad Uttar Pradesh, India.
[4]Senior Resident, Department of Radiodiagnosis, SMC, Santosh Deemed to be university, Ghaziabad Uttar Pradesh, India.

OPEN ACCESS

Corresponding Author:

Dr. Sehyr Rajpal
Junior Resident, Department of Radiodiagnosis, SMC, Santosh Deemed to be university, Ghaziabad Uttar Pradesh, India.
Email dr.sehyrrajpal@gmail.com

Received: 04-06-2026
Accepted: 25-06-2026
Available online: 08-07-2026

ABSTRACT

Background: Imaging is vital for diagnosing pulmonary infections and tuberculosis. While HRCT is the traditional choice, the radiation dose is a concern. This study evaluates if MRI can serve as a safe, radiation-free alternative by comparing it directly against HRCT.
Objectives: The study aims to evaluate and document the role of pulmonary magnetic resonance imaging (MRI) in the assessment of various lung disorders, while also undertaking a comparative analysis of its diagnostic accuracy with that of computed tomography (CT) in the evaluation of pulmonary diseases.
Methods: This prospective observational study was conducted in the Department of Radiodiagnosis at Santosh Medical College Hospital, Ghaziabad, over 18 months. A total of 45 patients presenting with suspected pulmonary disease were included. Each patient underwent both a non-contrast high resolution computed tomography (HRCT) and a specialized lung pulmonary magnetic resonance imaging (MRI). We compared specific radiological signs, including consolidation, ground-glass opacities, honeycombing, and pleural effusion, to determine the accuracy of MRI.
Results: The findings demonstrate a distinct divergence in modality performance. HRCT proved clearly superior for evaluation of pulmonary parenchymal details, identifying 10 cases of honeycombing and 9 cases of ground-glass opacities that were not detected on MRI, reflecting 0% sensitivity for these features. This corresponds to an approximate 24% diagnostic information gap, indicating that MRI remains limited in resolving fine air-space architecture.In contrast, MRI showed complete concordance with HRCT in the detection of pleural effusion (11 cases) and lung collapse. Importantly, MRI demonstrated added value in the assessment of soft tissues, identifying additional cases of hilar lymphadenopathy and chest wall edema that were not appreciable on CT.
Conclusion: HRCT remains the reference standard for the evaluation of pulmonary parenchymal and interstitial lung diseases owing to its superior sensitivity for detecting subtle abnormalities, including ground-glass opacities and early fibrotic changes. Although pulmonary MRI demonstrated limited sensitivity for these findings and cannot replace HRCT as the primary imaging modality, it serves as a valuable complementary tool, particularly in radiation-sensitive populations such as pediatric and pregnant patients. MRI reliably detects larger pathological abnormalities, including consolidation, pleural effusion, and pulmonary abscesses, making it well suited for selected clinical indications and follow-up imaging. A complementary imaging strategy integrating HRCT for initial diagnosis and MRI for appropriate follow-up may optimize diagnostic accuracy while minimizing radiation exposure.

Keywords: *HRCT, Lung MRI, Tuberculosis, Radiation Safety, Pleural Effusion, GGO.*

INTRODUCTION

Advances in thoracic imaging have significantly transformed the diagnostic evaluation of pulmonary diseases, evolving from conventional radiography to high-resolution cross-sectional imaging. High-resolution computed tomography (HRCT) has emerged as the gold standard for evaluating lung parenchymal and airway abnormalities owing to its superior spatial resolution and ability to detect subtle structural changes. Modern multidetector CT scanners enable volumetric image acquisition with submillimeter resolution, allowing detailed visualization of diffuse and focal pulmonary pathologies.

HRCT plays a central role in the diagnosis and follow-up of a wide spectrum of pulmonary diseases, including interstitial lung diseases (ILDs), pneumoconiosis, acute inflammatory conditions, and tuberculosis. It is particularly indispensable in identifying characteristic patterns such as usual interstitial pneumonia (UIP), which is critical for the diagnosis of idiopathic pulmonary fibrosis.

Despite its excellent diagnostic accuracy, HRCT is associated with exposure to ionizing radiation, raising concerns regarding cumulative radiation dose, particularly in patients requiring repeated imaging. This has prompted the search for alternative imaging modalities capable of providing comparable diagnostic information without radiation exposure. In this context, magnetic resonance imaging (MRI) has emerged as a promising radiation-free modality, particularly for pediatric patients, pregnant women, and individuals requiring serial follow-up examinations.

However, the application of MRI in pulmonary imaging has historically been limited by several technical challenges. The lung parenchyma is characterized by low proton density and high air content, resulting in reduced signal intensity and rapid signal decay, which make conventional MRI less effective.

Furthermore, the lack of standardized imaging protocols has limited its widespread clinical application. Recent technological advances, including ultrashort echo time (UTE) and zero echo time (ZTE) sequences, have significantly improved the feasibility of pulmonary MRI by enabling earlier signal acquisition and enhanced visualization of lung structures.

In addition to structural assessment, MRI offers unique advantages in functional and tissue characterization by enabling differentiation between active inflammation and fibrosis in ILDs. This provides complementary biological information beyond the morphological assessment obtained with HRCT and may aid in disease evaluation and follow-up.

Although pulmonary MRI has demonstrated encouraging results in the assessment of selected thoracic abnormalities, its diagnostic accuracy in detecting subtle pulmonary parenchymal abnormalities remains to be fully established. In particular, the detection of ground-glass opacities, honeycombing, and other fine structural changes continues to represent a challenge for MRI compared with HRCT. Consequently, the precise role of pulmonary MRI as a complementary imaging modality in routine clinical practice remains under investigation.

Therefore, the present study was undertaken to compare the diagnostic performance of pulmonary MRI with HRCT across a spectrum of pulmonary diseases, including tuberculosis, chronic obstructive pulmonary disease, and interstitial lung diseases, and to evaluate the potential role of MRI as a complementary radiation-free imaging modality without compromising diagnostic accuracy.

MATERIALS

Study Design: This prospective comparative cross-sectional study was conducted in the Department of Radiodiagnosis at Santosh Medical College Hospital, a tertiary-care hospital in Ghaziabad, India, over an 18-month period. A total of 45 patients presenting with clinical features suggestive of pulmonary disease and meeting the eligibility criteria were enrolled during the study period.

Participants: All patients presenting with respiratory symptoms who fulfilled the inclusion criteria, including suspected or confirmed pulmonary disease, those undergoing follow-up for known pulmonary conditions, and those who provided written informed consent, were included in the study. Patients with contraindications to MRI, including ferromagnetic implants, pacemakers, metallic intraocular foreign bodies, or severe claustrophobia, were excluded to ensure patient safety.

Machines used Imaging Protocol

All HRCT examinations were performed using a Siemens Healthineers SOMATOM go.now 32-slice multidetector computed tomography (MDCT) scanner. HRCT of the chest was performed using thin-section imaging for detailed evaluation of the lung parenchyma. Image acquisition was performed using a helical technique with thin collimation. The detector configuration was 32 × 0.7–1.0 mm, with a slice collimation of 0.5–1.0 mm. Tube voltage ranged from 100–130 kVp, depending on the patient. Automatic tube current modulation (CARE Dose4D) was used with a reference tube current of approximately 120–180 mAs. Images were acquired with a slice thickness of 1.0–1.5 mm and reconstructed at 0.7–1.0 mm intervals using thin-section reconstruction for high-resolution evaluation of the lung parenchyma.

Pulmonary MRI was performed on a 1.5-T UNITED MRI system using a dedicated lung imaging protocol. The protocol included T2-SPAIR and T2-FSE sequences in the coronal plane for anatomical assessment, and T2-weighted fat-suppressed (T2WFS) and short tau inversion recovery (STIR) sequences in the axial and sagittal planes for the evaluation of pulmonary parenchyma, fluid, and inflammatory changes.

RESULTS

The study enrolled 45 patients, with a clear male predominance of 75.6 percent and a male to female ratio of approximately 3.1:1. The majority of participants were in the productive age groups, with 40 percent between 21 and 40 years and 33.3 percent between 41 and 60 years. Clinically, cough was the most common symptom, reported in 91.1 percent of patients, followed by fever in 84.4 percent and expectoration in 66.7 percent. Loss of appetite was present in 53.3 percent, while dyspnea was noted in 40 percent and chest pain in only 20 percent. This distribution reflects the predominance of infectious and inflammatory lung diseases in the study population, particularly tuberculosis and pneumonia.

When comparing parenchymal abnormalities, HRCT consistently demonstrated superior performance. It identified ten cases each of tree in bud and honeycombing, and nine cases of ground-glass opacities, whereas MRI failed to detect any of these subtle findings. MRI showed moderate sensitivity for fibrotic changes, detecting five of seven cases, and was reliable for larger lesions such as consolidation, where it detected twelve of fourteen cases, and collapse, where it matched HRCT perfectly. In mediastinal and pleural evaluation, MRI demonstrated strengths in soft tissue characterization, detecting one additional hilar lymph node, two extra cases of pleural thickening, and chest wall edema in two patients that HRCT did not reveal. Both modalities showed perfect agreement in detecting pleural effusion and pneumothorax, while HRCT was clearly superior in identifying calcified lymph nodes.

Agreement analysis showed perfect concordance for collapse and pleural effusion, almost perfect agreement for consolidation, and substantial agreement for fibrotic changes. MRI showed no agreement for ground glass opacities or honeycombing. Sensitivity and specificity analysis reinforced these results: MRI was highly sensitive for pleural effusion and consolidation but sensitivity dropped sharply for tree in bud, honeycombing, and ground glass opacities.

DISCUSSION

The demographic profile of the study population reflects the typical burden of pulmonary disease in the region, with a strong male predominance and concentration in the working age group. This pattern is clinically significant because individuals in this age bracket are at higher risk of occupational and environmental exposures, and rapid diagnosis is essential to prevent community spread, particularly in tuberculosis. The clinical symptoms, dominated by cough and fever, correlated well with radiological findings such as consolidation and tree in bud patterns, reinforcing the clinical-radiological link that underpins the comparative evaluation of HRCT and MRI.

The comparative analysis of parenchymal abnormalities revealed the critical limitations of MRI. While MRI was dependable for large, dense lesions such as consolidation and collapse, it failed to detect any cases of ground glass opacities or honeycombing. These subtle findings are essential for diagnosing early interstitial lung disease and tuberculosis, and their absence on MRI highlights the technical challenges of imaging fine airspace architecture. Statistical analysis confirmed that these differences were not random, with poor or absent agreement for tree in bud, GGO, and honeycombing. The detection gap of nearly one in four findings emphasizes that MRI cannot be relied upon as a primary diagnostic tool for early disease, as false negatives could lead to missed or delayed treatment.

Despite these limitations, MRI demonstrated clear advantages in soft tissue characterization. It detected additional hilar nodes, pleural thickening, and chest wall edema, findings that HRCT either missed or underrepresented. MRI is particularly valuable in situations where radiation exposure must be avoided, such as in children, pregnant women, or patients requiring repeated followup imaging. Taken together, the study confirms HRCT as the gold standard for fine parenchymal detail and early disease detection, while MRI serves as a safe and effective adjunct for evaluating pleural disease, mediastinal involvement, and soft tissue extension.

Funding

No funding was received for this Study.

Conflicts of interest

No conflicts of interest were declared.

Table 1: Demographic Distribution of Study Subjects N=45

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	34	75.60%
	Female	11	24.40%
Age (Years)	10–20	4	8.90%

	21–40	18	40.00%
	41–60	15	33.30%
	>60	8	17.80%
Total		45	100%

Table 2. Clinical Symptoms and Mediastinal/Pleural Findings

Finding	HRCT (n)	MRI (n)	Interpretation
Cough	41	–	Most common symptom (91.1%)
Fever	38	–	Present in 84.4%
Expectoration	30	–	66.7%, correlated with consolidation
Loss of Appetite	24	–	53.3%, systemic impact
Dyspnea	18	–	40%, subacute progression
Chest Pain	9	–	20%, less frequent
Enlarged Lymph Nodes	7	8	MRI detected one extra hilar node
Necrotic Nodes	2	2	Perfect agreement
Calcified Nodes	4	1	HRCT superior
Pleural Effusion	11	11	Perfect agreement
Pleural Thickening	5	7	MRI detected two extra cases
Pneumothorax	1	1	Perfect agreement
Chest Wall Edema	0	2	MRI detected additional cases

Table 3. Comparative Detection of Parenchymal Abnormalities

Finding	HRCT (n)	MRI (n)	MRI Detection (%)	Detection Gap (n)
Consolidation	14	12	85.7	2
Collapse	5	5	100	0
TreeinBud	10	3	30	7
Honeycombing	10	0	0	10
Ground Glass Opacities	9	0	0	9
Fibrotic Changes	7	5	71.4	2

Table 4. Diagnostic Yield, Agreement, and Performance Metrics (Objectives 5–10)

Feature	Sensitivit y (%)	Specificit y (%)	PPV (%)	NPV (%)	Kappa Value	Strength of Agreement
Consolidation	85.7	100	100	93.9	0.82	Almost Perfect
Pleural Effusion	100	100	100	100	1	Perfect
Collapse	100	100	100	100	1	Perfect
Fibrotic Changes	71.4	100	100	95	0.68	Substantial
Ground Glass Opacities	0	100	100	81.8	0	None
Honeycombing	0	100	100	77.7	0	None
TreeinBud	30	100	100	83.3	0.21	Poor

REFERENCES

1. Biederer, J., et al. (2012). MRI of the lung (2/3). Why, when and how? Insights into Imaging, 3(4), 355–371.
2. Khadadah, M., et al. (2012). The role of High Resolution Computed Tomography in Asthma. Medical Principles and Practice, 21(5), 444-449.
3. Raghuvanshi, V., et al. (2016). Use of High Resolution Computed Tomography (HRCT) in Diagnosis of Sputum Negative Pulmonary Tuberculosis. Journal of Clinical and Diagnostic Research, 10(6), TC01–TC04.
4. Eliker, B. E. M., et al. (2017). High-resolution computed tomography in the follow-up of diffuse lung disease. Radiologic Clinics of North America, 55(3), 575-592.
5. Lauri, H., et al. (2017). Indications for HRCT of lungs in chronic and acute diffuse diseases. Duodecim, 133(1), 45-53.
6. Romei, C., et al. (2018). Chest magnetic resonance imaging in interstitial lung disease: Current role and future perspectives. European Respiratory Review, 27(150), 180062.

7. Lonzetti, L., et al. (2019). Magnetic resonance imaging in interstitial lung diseases: A state-of-the-art review. Jornal Brasileiro de Pneumologia, 45(3), e20180315.
8. Hatabu, H., et al. (2020). Pulmonary MRI in clinical practice: A Fleischner Society position paper. Radiology, 297(2), 286-301.
9. Douren, M., et al. (2021). Clinical use of lung MRI in cystic fibrosis: Recent developments and perspectives. Magnetic Resonance Materials in Physics, Biology and Medicine, 34(4), 481-495.
10. Geiger, J., et al. (2021). Clinical application of ultrashort echo-time MRI for lung pathologies in children. Pediatric Radiology, 51(5), 784-793.
11. Torres, P. P. T. S., et al. (2021). Importance of chest HRCT in the diagnostic evaluation of fibrosing interstitial lung diseases. Radiologia Brasileira, 54(3), 189-195.
12. Azour, L., Ohno, Y., et al. (2025). Contemporary Capabilities of Lung MRI: AJR Expert Panel Narrative Review. American Journal of Roentgenology, 224(1), 1-15.