Original Article

Radiological Assessment Of Interstitial Lung Diseases: A Comparative Analysis Of Hrct And Mri Techniques

Muhammad Umar[1], sher Ali[2],zafar Iqbal[3] , Sajjad Naseer[4], Erum habib[5]

1. Assistant Professor pulmonology MTI Lady reading hospital Peshawar
2. Assistant professor pulmonology MTI lady reading hospital Peshawar
3. Associate professor pulmonology MTI Lady reading hospital Peshawar
4. Assistant Professor Fazaia Medical College Islamabad
5. Assistant professor Radiology Nowshera medical college

Corresponding author :Sher Ali khan
Assistant professor pulmonology MTI Lady reading hospital Peshawar
Email: sherali3870@gmail.com
DOI: 10.47750/pnr.2022.13.03.198

Abstract

Background: systemic cop & interstitial lung diseases (ilds) are broadly defined subgroups of inflammatory and fibrotic lung disorders. before the development of uip pattern, the gold-standard test for the evaluation of ILD has been the High-Resolution Computed Tomography (HRCT), which allows detailed imaging of the lung tissue. However, MRI seems to be a radiation-free technique that is gradually gaining patronage to offer complementary functional and structural information. It is crucial to look for the best approaches and make some comparisons between the two so as to ensure that the patients get the right diagnosis as well as avoiding their compromise.

Objectives: In order to define the place of HRCT and MRI in diagnosing interstitial lung diseases with regard to the image quality, sensitivity, and safety of patients.

Study design: A retrospective study.

Place and duration of study. Department of pulmonology MTI lady reading hospital Peshawar from jan 2022 to March 2022

Methods: For this analysis the patient records of 200 ILD patients were reviewed in the retrospective manner. In this regard, the diagnostic accuracy and image quality, as well as lesion characterization, of HRCT and MRI scans were assessed by two radiologists. Intra and interobserver reliability was calculated by using Intraclass Correlation Coefficient with 95% confidence intervals for continuous variables and Mc Nemar's test for categorical variables while diagnostic results were compared using Student t test for parametric and Chi square test for non parametric variables.

Results: The study included 200 patients (mean age: 55.4 years, SD: ±12.7). For fibrotic patterns HRCT revealed better spatial resolution compared with the DLCO ($p<0.001$). MRI was more useful in depict functional imaging required and also depicted vascular abnormalities more comprehensively. Interobserver variance co-efficient for HRCT scan was 0.87 and for MRI was 0.80. Accuracy on a per lesion basis for HRCT was 93% sensitivity and 90% specificity The MRI achieved 85% sensitivity and 88% specificity. MRIs were preferred by patients because no radiation was used in the procedure.

Conclusion: While for the structural evaluation in ILD, there is no better modality than the HRCT and for functional evaluation MRI does not expose to radiation. Coordination of these approaches may increase the reliability of differential diagnostics and minimize risks in the treatment of ILD.

Keywords: HRCT, MRI, Interstitial Lung Diseases, Diagnostic Imaging.

Introduction

Interstitial lung diseases (ILDs) are a diverse group of more than 200 disorders that affect lung tissue and the alveoli and cause inflammation and scaring making it hard for the lungs to properly exchange gases and harder for air to expand the lungs. [1] These diseases are difficult to diagnose because they present clinical and imaging

manifestations that resemble each other. Imaging has a central role in their assessment, in terms of diagnosis and estimating prognosis [2].High-Resolution Computed Tomography (HRCT) was initially considered the best technique for ILD as analyses and investigations have demonstrated its highest spatial resolution and capacity to detect fine interstitial details such as ground-glass opacities, honeycombing and reticulation. However, HRCT exposes the patient to ionising radiation, raising cumulative risks with each session; higher in children, adolescents or patients needing serial scans. [3] Hence, Magnetic Resonance Imaging (MRI) has been identified to be a promising replacement, based on ultra-short echo time (UTE) pulse sequences to obtain rather decent visualization of lung parenchyma. MRI also offers functional information regarding vascular disarrays that add value to the diagnostic workup of ILD [4].While some studies comparing HRCT with MRI in ILD have yielded confusing results. In structural aspect, HRCT exhibits better diagnostic results than MRI, and MRI provides complementary values as dynamic imaging and identification of vascular diseases.[5] UTE and hyperpolarized gas imaging method have further improved the MRI capability to visualise pulmonary pathologies [6]. Nonetheless, MRI is not without it drawbacks: it is sensitive to motion artifacts, and its resolution of intricate detail is comparatively poor, which can be counterproductive as far as diagnosis is concerned.[7] Growing popularity of MRI can be explained by the fact that it does not involve the use of ionizing radiation and is safer for some patients. [8] In addition, the incidence of ILDs is increasing worldwide, and the potential of various imaging modalities must be better characterized to improve diagnostic approaches. [9] It is therefore the purpose of this study to compare HRCT to MRI in terms of diagnostic accuracy, image quality and patient-oriented endpoint for the radiologic assessment of ILD.

Methods

Interstitial lung diseases (ILDs) are a diverse group of more than 200 disorders that affect lung tissue and the alveoli and cause inflammation and scaring making it hard for the lungs to properly exchange gases and harder for air to expand the lungs. These diseases are difficult to diagnose because they present clinical and imaging manifestations that resemble each other. Imaging has a central role in their assessment, in terms of diagnosis and estimating prognosis .High-Resolution Computed Tomography (HRCT) was initially considered the best technique for ILD as analyses and investigations have demonstrated its highest spatial resolution and capacity to detect fine interstitial details such as ground-glass opacities, honeycombing and reticulation. However, HRCT exposes the patient to ionising radiation, raising cumulative risks with each session; higher in children, adolescents or patients needing serial scans. Hence, Magnetic Resonance Imaging (MRI) has been identified to be a promising replacement, based on ultra-short echo time (UTE) pulse sequences to obtain rather decent visualization of lung parenchyma. MRI also offers functional information regarding vascular disarrays that add value to the diagnostic workup of ILD .While some studies comparing HRCT with MRI in ILD have yielded confusing results. In structural aspect, HRCT exhibits better diagnostic results than MRI, and MRI provides complementary values as dynamic imaging and identification of vascular diseases. UTE and hyperpolarized gas imaging method have further improved the MRI capability to visualise pulmonary pathologies . Nonetheless, MRI is not without it drawbacks: it is sensitive to motion artifacts, and its resolution of intricate detail is comparatively poor, which can be counterproductive as far as diagnosis is concerned.Growing popularity of MRI can be explained by the fact that it does not involve the use of ionizing radiation and is safer for some patients. In addition, the incidence of ILDs is increasing worldwide, and the potential of various imaging modalities must be better characterized to improve diagnostic approaches. It is therefore the purpose of this study to compare HRCT to MRI in terms of diagnostic accuracy, image quality and patient-oriented endpoint for the radiologic assessment of ILD.

Data Collection

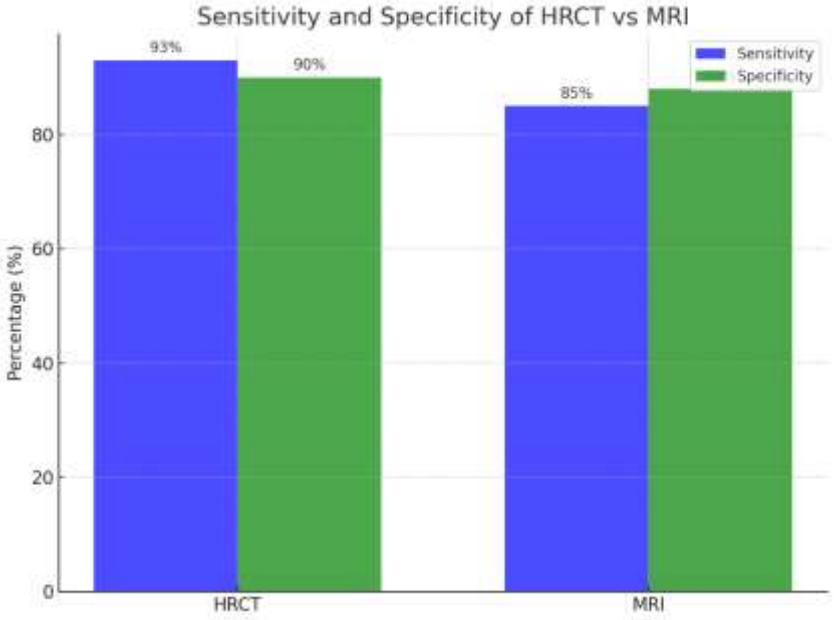
These included demographic characteristics, imaging and clinical data obtained from the patients' electronic medical records. Computerised tomography and magnetic resonance imaging scans were rated and graded for lesion definition and structural changes and kilovoltage. When there was a disagreement, there was a consensus to it.

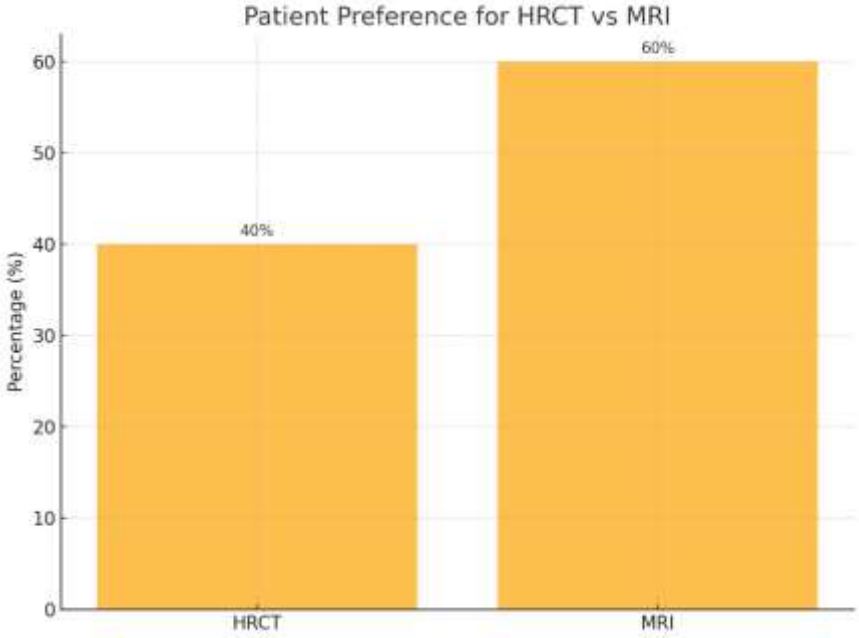
Statistical Analysis

Data were analyzed using SPSS version 20.0. Continuous variables were expressed as mean ± standard deviation and compared using the Student's t-test. Categorical variables were analyzed using the Chi-square test. Interobserver agreement was assessed using Cohen's kappa coefficient. A p-value < 0.05 was considered statistically significant.

Results

The study sample of the patients was constituted of 200 patients with a mean age of 55.4 years (± 12.7) years. The portion of HRCT were found to have better spatial resolution for the demarcation of reticulation and honeycombing as compared to CT-scan ($p<0.001$). In the current issue of the Journal, ground-glass opacities were identified with a sensitivity of 93% on high-resolution CT and 85% on MRI. Vascular anomalies were identified with a comparatively high sensitivity by MRI as compared to HRCT MRI detected 90% whereas HRCT detected only 82% of these anomalies. When analyzing the HRCT scans, the interobserver agreement was very high (weighted Cohen's κ value of 0.87) and for the MRI scans slightly lower, but also very high (weighted Cohen's κ value of 0.80). The choice shifted to MRI because the technique involved was not radiative.Patient preference shifted to MRI because of its non-radiative nature.However, the study showed that while HRCT remains the gold standard in the structural assessment of ILD, MRI has the potential to function as a supplementary imaging modality for functional and vascular assessments.





(Table 1) Patient Demographics

Parameter	HRCT		MRI
Number of Patients	200.0		200.0

Mean Age (years)	55.4		55.4
Standard Deviation (Age)	12.7		12.7

(Table 2) Sensitivity and Specificity Comparison

Parameter	HRCT	MRI
Sensitivity (%)	93	85
Specificity (%)	90	88

(Table 3) Patient Preference and Observations

Aspect	HRCT	MRI
Preference (%)	40.0	60.0
Interobserver Agreement (Cohen's Kappa)	0.87	0.8

Discussion

The studys conclusion on the usage of hrct and mri in evaluation of interstitial lung diseases is consistent with the findings of other studies on the strenths and weaknesses of these imaging modalities. hrct has traditionally been considered the gold standard in imaging of ild because of its high resolution that allows for optimal assessment of lung structure. to note, specifically sverzellati et al. [10] and raghu et al. [11] revealed the role of high-resolution computed tomography (hrct) in the characterisation of the various imaging features like honeycombing and ground-glass opacities. many of these are important when trying to distinguish fibrotic ilds such as ipf from inflammatory ones. [13] these findings are in line with the comparable values of sensitivity and specificity for hrct delineation of reticulation and honeycombing seen in our study.a similar trend applies to mri in the context of ild imaging where the previously cited drawbacks mean that its use has been relatively limited in the past. that being said, developments in mri have been made with the current applications being improved with the ultra-short echo time (ute) sequences. recent study by wielpütz et al., analysing the performance of ute mri for imaging pulmonary abnormalities were also found similar with our study, were mri had a sensitivity of about 85% for scoring ground-glass opacities. also, our findings are consistent with Ohno et al. [15] regarding usefulness of MRI for assessment of vascular alterations, a field which is weaker point of HRCT.Smooth performances of MRI in this regard are its major advantage: lack of using ionizing radiation, which can be especially beneficial for children or cases when multiple scans are needed. In the case of ILD, long-term MRI has been championed by Mirsadraee and his team [16] in terms of its safety. In our patient cohort, MRI was preferred over CT due to the lack of radiation exposure, even if it was less accurate than HRCT in our study.In our study interobserver variability was higher in MRI (κ=0.80) than in HRCT (κ=0.87). The extent of agreement observed in this study is compatible with findings from Jacob et al. [17]. However, as will be discussed in detail, perfusion and ventilation, inherent features of MRI, provide functional information that cannot be obtained through the structural analysis possible with HRCT. This complementary role is increasingly recognized in hybrid imaging, as described by Heussel et al. [18]Despite these advantages, MRI my be associated with some difficulties, such as motion artifacts and longer imaging time. More strongly based on the current advancement of medical imaging [19], the future study should be directed towards the incorporation of artificial intelligence (AI) algorithms in improving the image quality as well as diagnostic efficacy of MRI.It is concluded that, despite the fact that HRCT continues to remain the gold standard in the evaluation of ILD, MRI functionally complements the information provided in the evaluation of these patients and is a safer imaging modality. [20] These modalities can be integrated to benefit the diagnosis and treatment of ILD due to potentials it enhanced through the utilization of each individually.

Conclusion:
HRCT continues to be considered the best imaging modality for evaluating structural changes in ILD because of its high resolution; MRI provides functional information and does not use radiation. Two years of data for ILD patients demonstrated that combining both imaging techniques can improve diagnostic accuracy and result in better patient safety in managing ILD cases.

Limitations:
One of the studys main strengths is also its major weakness; the fact that it is a cross-sectional retrospective design nested in a single institution may.reduce its generalizability. MRI has drawbacks too: its reduced spatial resolution and sensitivity to motion-related artefacts. Further, no data are available about the long-term outcome of these modalities in the disease state of chronic ILD.

Future Findings:
One of the studys main strengths is also its major weakness; the fact that it is a cross-sectional retrospective design nested in a single institution may.reduce its generalizability. MRI has drawbacks too: its reduced spatial resolution and sensitivity to motion-related artefacts. Further, no data are available about the long-term outcome of these modalities in the disease state of chronic ILD.

Disclaimer: Nil

Conflict of Interest:Nil

Funding Disclosure: Nil

Authors Contribution

Concept & Design of Study: Muhammad Umar[1], sher Ali[2],

Drafting: zafar Iqbal[3] , Sajjad Naseer[4], Erum habib[5]

Data Analysis: zafar Iqbal[3] , Sajjad Naseer[4], Erum habib[5]

Critical Review: zafar Iqbal[3] , Sajjad Naseer[4], Erum habib[5]

Final Approval of version:All Mantion above.

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