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Evaluation of the role of HRCT chest in the differentiation of pattern of spectrum in lung diseases

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Abstract---Introduction: - CT is a modality used in imaging of internal structures/ organs by the use of radiation. HRCT is an examination protocol in CT for Lungs and Temporal bone. As HRCT uses thin slices so it provides detailed information which helps in better diagnosis. Aim and Objective:- To evaluate the Role of HRCT Chest in differentiation of pattern of spectrum in lung diseases to find out the different patterns in lung diseases. Methods & Materials:- The study was conducted on a period of 6 months on 30 patients. 16 slice CT machine was used for the scanning and thin sections were acquired by using HRCT protocols. Result:- In out of 30 patients, the common findings are Ground Glass Opacities, Tree In Bud Appearance, Reticular Opacities, Honey Combing, Consolidation Nodular Opacities. Conclusion:- HRCT chest is most important and valuable in diagnosis of lung diseases even when chest X-ray is normal. It is capable of

imaging the lung with excellent spatial resolution and provides good anatomical detail.

Keywords---computed tomography, HRCT, lungs, ground glass opacities.

Introduction

CT is based on the fundamental principle that the density of the tissue passed by the X-Rays beam can be measured from the calculation of the attenuation coefficient.



Figure 1. Siemens 16 slice CT scanner

Principle of Computed Tomography

Computed tomography is the modality used in imaging of internal body structures/organs. X-ray tube is used which revolves around the patient in 360 °, from multiple angles images acquired in axial plain, which further reconstructed to multiple planes by applying multiple recon techniques ^(1,2).

History of Computed tomography

Computed tomography was discovered by Sir Godfrey Hounsfield of EMI laboratories in 1972, England and by South Africa-born physicist Allan Cormack of Tufts University, Massachusetts. Hounsfield and Cormack were later awarded the Nobel Peace Prize for their contributions to medicine and science ⁽³⁾. The first CT scanner was installed between 1974 and 1976. At that time CT scans machine only used to for dedicated head imaging, but "whole body" CT scanner systems were becoming available in 1976. CT became widely available by about 1980. Slip ring technology was discovered in 1989 and this cause a drastic change in the field of computed tomography imaging by which there is no tearing and wearing of wiring in hardware of computed tomography. Generally, slip ring technology principle is that to rotate X-Ray tube on slip metallic ring without any outer wire connection with wire or electricity on X-Ray tube. The X-Ray tube is revolving on a stationery ring and X-Ray tube is connected with stationery ring by the help of brushes and brushes provide two functions to X-Ray tube one is to support to revolve around patient and to pass electricity to X-Ray tube from stationery metallic ring. The electricity is passed into the metallic slip rings. This makes

continuous rotation of X-Ray tube with continuous increment in CT table couch. In 1998, multi slice computed tomography was came in the market of computed tomography by which single breath- hold scans can be possible now ^(4,5).

Helical or spiral Computed Tomography

This is made possible with the help of slip ring technology in which X-RAY tube rotates continuously with continuous increment in CT couch by which X-RAY tube makes an imaginary helical or spiral trajectory around CT patient couch. ^(6,7)

Multi-slice Computed Tomography

The Multi-Slice CT (MSCT) is a CT system equipped with multiple rows of CT detectors to create images of multiple sections. This CT system has different characteristics from conventional CT systems, which have only one row of CT detectors. ⁽⁸⁾ The introduction of this advanced detector system and its combination with helical scanning has markedly improved the performance of CT in terms of imaging range, time for examination, and image resolution. ^(9,10)

HRCT

Is a scanning protocol in which thin section is taken usually (0.625 to 1.25mm) and reconstructed using a sharp algorithm. ⁽¹¹⁾

History of HRCT

“HIGH RESOLUTION COMPUTED TOMMOGRAPHY” (HRCT) term was first used by TODO et.al in 1982. He also described the usefulness of HRCT imaging in pulmonary diseases. ⁽¹²⁾ In 1985, Naidich et.al described the fundamental technique of HRCT and published first report on HRCT ⁽¹³⁾. HRCT is used for:

- Lung imaging
- Temporal bone imaging



Figure 2. Normal HRCT Chest

Lung imaging

Two techniques have been used

- Spaced axial (non-axial)
- Volumetric HRCT
- **Spaced axial**
In this thin section is obtained with an interval of 1-2cm the two set of images .it is sufficient to detect abnormalities in diffuse lung diseases. This technique is most useful when single detector ct is used and in this patient, dose is less as compare to volumetric HRCT.
- **Volumetric HRCT**
In this thin section is obtained continuously using multi detector row, CT Scanner in single breath hold. Volume imaging with thinner slices helps to find greater degree of pathology and also allow reconstruction in any plane. Patient dose is higher compared to axial imaging.^{[1] [2]}

Fundamental Technical Protocols

Slice thickness: 1.0mm - 1.25mm, Scan Time: 0.5 -1 Second, Kv: 120, mAs: 100-200, Collimation: 1.5-3mm, Matrix size: 768*768, Reconstruction Algorithm: High Spatial Frequency, FOV: 240mm, Window: Lung Window, Patient Position: Lies Supine (Routine) Or Prone (If Suspected ILD), Level Of Inspiration: Full Inspiration (Routinely Recommended) Expiratory HRCT Scans at Three Or More Levels In Patients With Obstructive Lung Diseases.

Advantages of HRCT Chest

- Viewing of contiguous slice for better delineation of lung abnormality.
- Complete imaging of lungs.
- Reconstruction of scan data in any plane using MIP/ Min MIP.(maximum intensity projection)
- Whole lung HRCT can be performed in one breath hold.
- Shorter acquisition time.

Disadvantage

Greater radiation dose.

Common HRCT Diagnoses

- Sarcoidosis
- Idiopathic Pulmonary Fibrosis (IPF)
- Tumor
- Aspiration Pneumonia
- Collagen Vascular
- BOOP (Bronchiolitis Obliterans Organizing Pneumonia)
- UIP (Usual interstitial pneumonia)

- Hypersensitivity Pneumonitis (HP)

Need of Study

HRCT is used for diagnosis and assessment of interstitial lung diseases (ILD) such as fibrosis and other lung diseases such as Emphysema and Bronchitis, this study gives detail information about different patterns of lung diseases cause variation in the diagnosis. And after completion of this study, we will know about these because maximum pathology misses due to lackness of HRCT.

Study

Role of HRCT Chest in differentiation of spectrum of lung diseases.

Aim and Objective

The objective of this study was to evaluate the Role of HRCT Chest in differentiation of pattern of spectrum in lung diseases to find out the different patterns in lung diseases.

- Differentiation and evaluation of diagnosis by viewing the pattern of images of HRCT Chest.
- To aware the radiographer the role of HRCT in chest.
- To improve the diagnostic quality.

Methods and Material

A prospective study was conducted out over a period of 6 month on 30 patients in which 15 males and 15 females from 1st October 2018 to 31 March 2019 in radiology department. The patients were subjected to HRCT on 16 slices CT Machine, plain scans obtained and different types of findings were analysis.

Scan protocols

Thin sections are acquired with an interval of 1-2 cm between the two sets of images. It has been considered sufficient to detect abnormalities in diffuse lung disease. This technique is most useful when single detector CT is being used. The patient dose is less as compared to volumetric imaging.

Project and Study Design

The study is carried out for different patterns of lung diseases cause variation in diagnosis patients of SGT hospital healthcare. A database of Role of HRCT in Differentiation of Spectrum of Lung Diseases. The values from each protocol and in every patient were compared to find out the Differentiation of Spectrum of Lung Diseases.

Setting and Resources

The project setting was in SGT hospital located in a rural area of Gurugram district of Haryana. The hospital is equipped with a Siemens Somatom scope 16 slices CT scanner.

Study Population

The population consisted of patient lies between 20-60 age group with known or unknown chest related problems undergoing CT scans of the chest. Sample included random number of subjects admitted in the hospital and outpatient of hospital that underwent HRCT chest protocol between the months of 1st October 2018 and 30th March 2019. Written consent in the language understood by the patient was taken before the test.

Selection Criteria

Inclusion Criteria

- OPD based patients
- IPD based patients
- Both gender of patients
- 20-60 age group

Exclusion Criteria

- Trauma patients
- Pediatric patients
- Uncooperative patients

Case Study & Results



Fig 4.7. (1) Chest X-ray

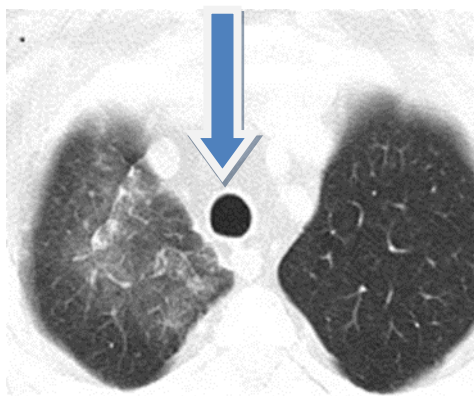


Fig 4.7. (2) HRCT Chest

Fig 4.7(1) is chest x ray of 54-year-old female patient who came with problem of chest pain in the last 1 month. She was advised for chest x ray firstly but her chest x ray was normal as shown in fig4.7 (1) but she was still having problem so she was advised for HRCT Chest, in her report as shown in fig4.7 (2) Ground Glass Opacities was seen in surrounding areas.

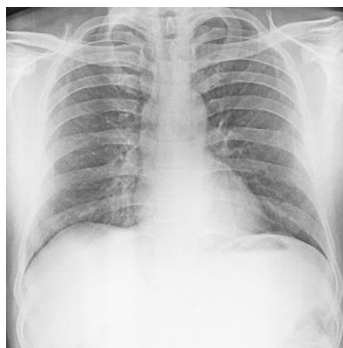


Fig 4.7. (3) Chest X-ray

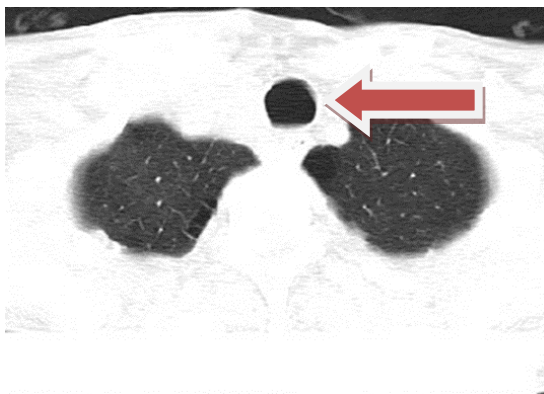


Fig 4.7. (4) HRCT Chest

The fig 4.7 (3) is chest x-ray of 52-year male patient who came with complain of chest pain, he was advised for chest x-ray firstly but his x-ray was normal as

shown in fig4.7(3) but he still had complained of chest pain so he was advised for HRCT Chest. In HRCT Chest Para septal emphysema in bilateral apical segments was noticed in fig4.7(4).

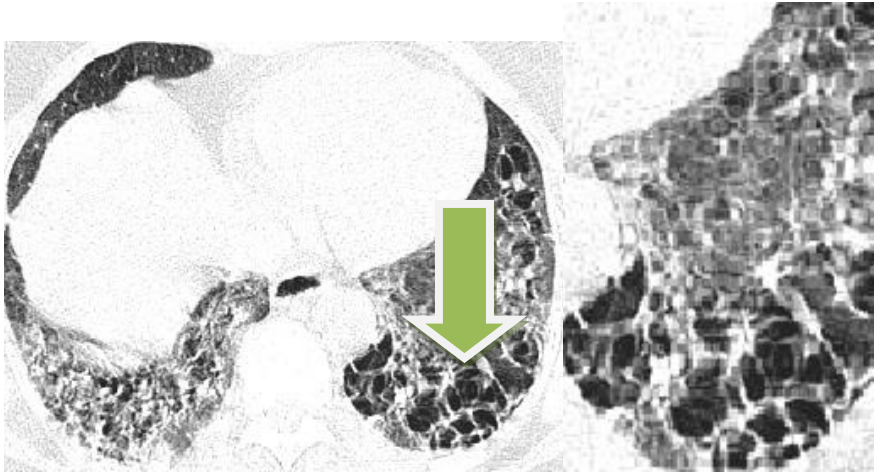


Fig 4.7. (5) HRCT Chest shows honey combing pattern are seen in bilateral lungs involving almost whole of the bilateral lower lobes

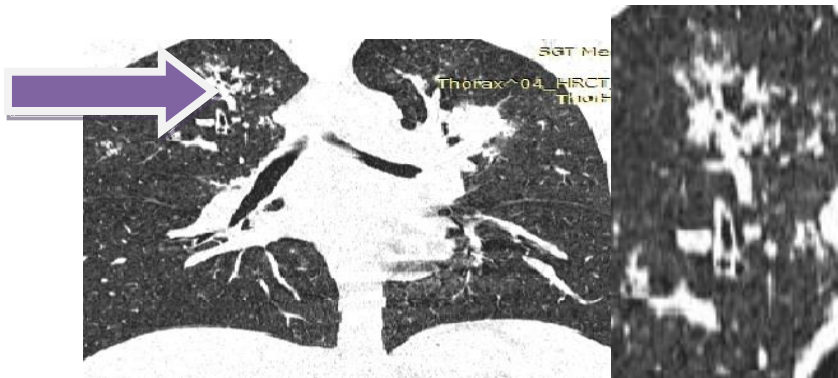


Fig 4.7. (6) High Resolution Computed Tomography shows Tree in bud pattern in bilateral right upper lobe

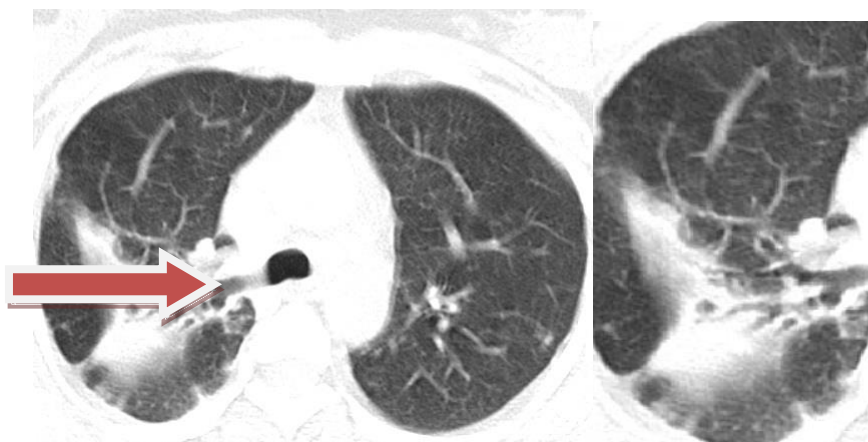


Fig 4.7. (7) HRCT Chest shows consolidation in right middle lobe

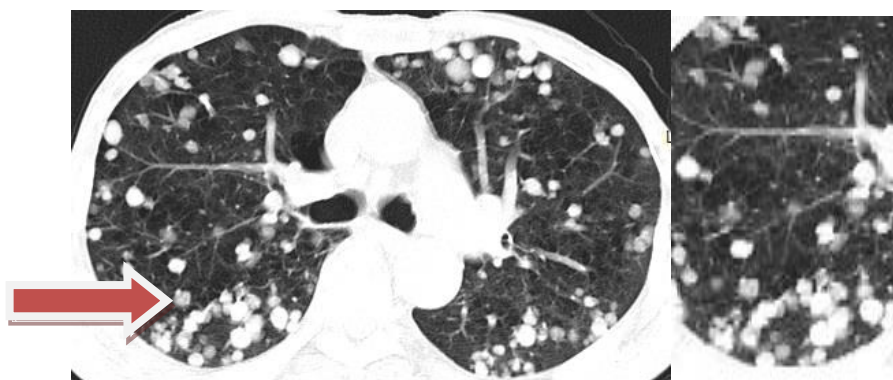


Fig 4.7. (8). High Resolution Computed Tomography Chest shows Nodular Opacities in bilateral lungs involving all the lobes

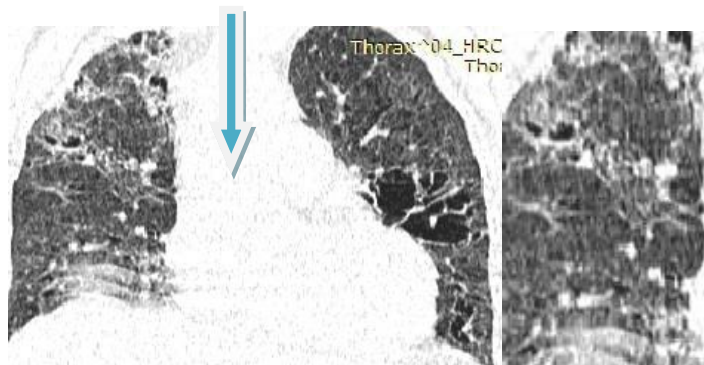


Fig 4.7. (9). High Resolution Computed Tomography Chest shows Reticular Opacities seen in bilateral lungs

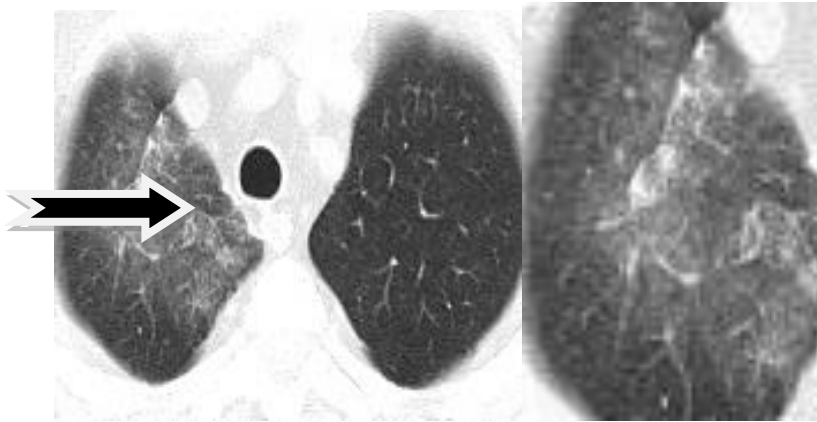
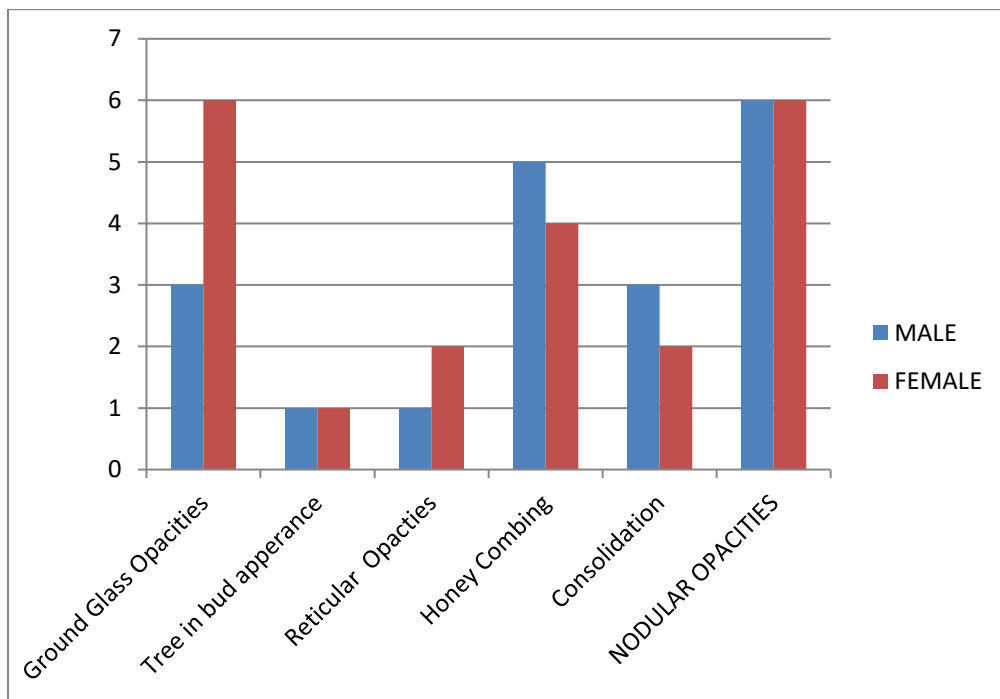


Fig 4.7. (10) High Resolution Computed Tomography shows Ground Glass Opacities are seen in right middle and bilateral lower lobes



Graph 5.1. The graphical representation shows percentage of CT findings compared between male and female

30 patients were taken for this study in which 15 male and 15 females. All findings were comparing between male and female. In which out of 30 patients Ground Glass Opacities were seen in 3 male and 6 female patient, In 2nd finding Tree In Bud Appearance were seen equally in both patients in 1 male and in 1 female, In 3rd finding Reticular Opacities were seen in 1 male and 2 female patient, and 3 female patient, In 4th finding Honey Combing were seen in 5 male and 4 female patient, In 5th finding Consolidation were seen in 3 male and 2

female patient, , In 6th finding Nodular Opacities were seen in 6 male and 6 female patient.

Discussion and Conclusion

Discussion

Many researchers worldwide have published their research related to role of HRCT in Chest & lung diseases in many disciplines. A literature which has been conducted in the year of 2016 concluded that HRCT is valuable technique for evaluation of the extent of lung involvement in various ILDs even when chest X-ray is normal. The study was done on 50 patients with suspected ILD diagnosis. The result so concluded was the most common presenting clinical feature was Dyspnea on exertion present in 64% of patients followed by cough which was present in 60% of cases. In one another article from ELSEVIER, concluded that HRCT findings shows signs of ILD and air way diseases in 9cases (45%) and both entities in 2 cases (10%) showing clearly the importance of HRCT. The research has conducted among 20 patients ^(17,18).

In this research study a case study of 30 patients has been carried out. The gender discrimination was equal with 15male and 15 females. Patient's selection criteria were random. The age group was 20-60 years. The chest X-ray reports of the above patients are normal in minority of cases and abnormal in majority of patients. The result so concluded that Glass ground opacities is shown in 9 patients (30%), Tree in bud appearance is shown in 2 patients (7%), Reticular Opacities is shown in 3 patients (10%), Honey Combing is seen in 9 patients (30%), Consolidation is seen in 5 patients (17%) and Nodular Opacities is seen in 12 patients (40%). 30 patients were taken for this study in which 15 male and 15 females. All findings were comparing between male and female. In which out of 30 patients Ground Glass Opacities were seen in 3 male and 6 female patient, In 2nd finding Tree In Bud Appearance were seen equally in both patients in 1 male and in 1 female, In 3rd finding Reticular Opacities were seen in 1 male and 2 female patient, and 3 female patient, In 4th finding Honey Combing were seen in 5 male and 4 female patient, , In 5th finding Consolidation were seen in 3 male and 2 female patient, , In 6th finding Nodular Opacities were seen in 6 male and 6 female patient.

Conclusion

Although chest radiography is the foremost imaging technique in the evaluation of lung diseases but HRCT chest is most important and valuable in diagnosis of lung diseases even when chest X-ray is normal. It is capable of imaging the lung with excellent spatial resolution and provides good anatomical detail.

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