International Journal of Early Childhood Special Education (INT-JECSE)
DOI: 10.9756/INT-JECSE/V14I2.556 ISSN:1308-5581 Vol 14, Issue 02, 2022

HRCT evaluation of chest in RT-PCR positive patients of COVID19

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Abstract
Background: Understanding the changes in the lung caused due to the novel corona virus that has been highly contagious and therebydiagnose accurately and plan therapy accordingly. Chest CT has a potential role in the diagnosis, detection of complications, and prognostication of coronavirus disease 2019 (COVID-19). Implementation of appropriate precautionary safety measures, chest CT protocol optimization, and a standardized reporting system based on the pulmonary findings in this disease will enhance the clinical utility of chest CT.
Objectives: In this study we aim to evaluate the patients with HRCT thoraxwho present withpositive RT-PCR COVID19 test,its typical radiological HRCT findings and the diagnostic accuracy of High Resolution CT in identifying Covid 19.
Methodology:A retrospective and observationalstudy will be done at AcharyaVinobaBhave Rural Hospital(AVBRH), Sawangi, involving350 patients who present with clinical symptoms of COVID19 and patients with RT-PCR COVID19 test positive for HRCT thorax. All the patients will beevaluated for the cause based on parameters like presenting symptoms, duration and changes in HRCT thorax like distribution, location, pattern, shape, density and concomitant signs. These dimensions would be compared to evaluate the sensitivity of HRCT thorax in comparison to RT-PCR test for COVID19.
Results: After appropriate statistical analysis, we expect to find the classical HRCT finding in a RT-PCR positive for COVID 19 patients and asses the susceptibility of HRCT as a diagnostic tool.
Conclusion: In this observational study, we expect to precisely understand the lung parenchymal changes in the patients positive of RT-PCR for COVID 19 with the help of HRCT thorax.

Keywords: HRCT THORAX, RT-PCR, COVID19.

INTRODUCTION: In December2019, pneumonia's epidemic with an unidentified aetiology was identified in Hubei Province's of Wuhan (China). A novel corona virus known as the WHO "Corona Virus 2 Severe Acute Respiratory Syndrome (SARS-CoV-2)" was the contagious agent and was referred with "SARS-CoV-2" disease in 2019 as the corona virus disease. The "World Health Organization (WHO)" proclaimed that the most recent corona virus (COVID-19) outburst a worldwide contagion on eleven Mar two thousand twenty.[1]

Due to the lack of new preventive medications for this illness in 2019, recognition of this illness as soon as possible becomes important and separate sick individuals from the healthier population (COVID-19). Nucleic acid amplification testing viz. "RT-PCR" on respirational samples, predominantly nasopharyngeal as well as oropharyngeal swabs has been the ideal way to diagnose the "COVID-19" infection until now. [2]

Medical symptoms, including fever and cough, were present in these patients. Imaging has a critical part to play in the analysis as well as assessment of the illness and severity. Poor correct outcome of "RT-PCR" in the current emergency situation means that not all the subjects having "COVID-19" will get identified and thereby lack insufficient care in a timely manner; subjects like these, and with the highly infectious property of the virus, pose danger of contaminating a greater people. Chest "HRCT" is a routine imaging technique for the diagnosis of pneumonia which is comparatively easy to perform & may offer a quick outcome. In such context, analysis of "COVID-19" with chest CT might be beneficial. It displays classical radiological characteristics among approximately all the infected subjects, comprising "ground-glass opacities", "multifocal patchy consolidation" &/or "interstitial changes" with "peripheral distribution", as stated.[3]

In the patients with clinical symptoms but with negative "RT-PCR" results, these typical characteristics were also observed. According to small-scale trials, recent "RT-PCR" analysis have lead to reduce sensitivity,

whereas chest computed tomography among subjects having original -ve "RT-PCR" findings may show lung anomalies associated with "COVID-19." [4]

The CT can be positive in the early stages, several days after the onset of the first symptom (0–4 days). The CT results change over time in a predictable way. During the progressive stage (5-8 days), the infected areas typically thicken interlobular and intralobular lines emerge inside the Ground glass opacities. It is not typical of other viral pneumonias; however, it may help in differential diagnosis. About the tenth day, the peak time (9-13 days) begins. Consolidation can happen before or after GGO. The most severe health condition is acute respiratory distress syndrome, which is radiologically similar to diffuse alveolar damage. Following that, in the absorption process, the organizing pneumonia pattern emerges, and fibrous streaks can be seen with a reverse halo symbol and minor architectural distortion. [5]

COVID-19 is characterized by sparse "ground glass opacities" (GGOs) which might amalgamate into compact, consolidative lesions having primarily outer spreading beneath the pleura & alongside the bronchovascular packs. The number of lesions will rapidly multiply and migrate to central regions as the disease progresses, with the left lower lobe becoming more commonly affected than the upper/middle and right lobes. Along with GGOs & consolidations, pneumonia might exhibit supplementary CT observations viz. "interstitial thickening," "crazy-paving pattern," "reversed halo sign," "halo sign," as well as “airway and vascular congestion”. It will help in segregating COVID-19 pneumonia from other pneumonia categories. [6]

CT findings in COVID-19

The following are the key CT results in adults: [7,8]:

- ‘Ground-glass opacities (GGO)’: It's an unambiguous hazy opacification of the lung with no bronchial or vascular markings obliterated.Patchy, peripheral, bilateral, and subpleural pneumonia are the most common symptoms of COVID-19 pneumonia.
- “Crazy paving patteren (GGOs and inter-/intra-lobular septal thickening)”: It's GGO with thickened interlobular septa on top of it.It is a mixture of alveolar edema and an inflammatory response in the interstitial space.
- ‘Air space consolidation’: The alveolar spaces are filled with fluid, exudates, transudates, blood, or neoplastic cells, resulting in an area of increased attenuation that obscures the bronchial and vascular marks. It appears “patchy or segmental”, sporadic as well as primarily “subpleural and peripheral” in COVID-19 pneumonia.
- ‘Reticulation’that resembles linear “interlobular or intralobular” density are a comparatively later outcomes among the patients.
- ‘Vascular enlargement: Vascular enlargement is characterised as an increase in the size (> 3 mm) of the sub segmental pulmonary vessels, particularly among areas with more severe interstitial disability.
- ‘Spider web sign’: It reveals GGO sub-pleural three-sided region having web-like condensing of the “interlobular septa” and adjacent pleura retraction.
- ‘Interlobular septal thickening’: SARS-CoV-2 is known to target septal components, which may explain the interlobular septal thickening seen on CT scans.
- ‘Others’

Atypical CT findings [7,8]:

These results should increase questions of bacterial pneumonia or other diagnoses, as they only occur in a limited number of patients.

- “Mediastinal lymphadenopathy”: When the short axis diameter of mediastinal lymph nodes reaches 1 cm, they are considered enlarged.
- “Pleural effusions”: occurs due to COVID-19 problem.
- ‘Multiple tiny pulmonary nodules’: A nodule is a small opacity with a regular or irregular outline that is less than 3 cm in diameter. The presence of nodules is a typical symptom of viral pneumonitis.
- ‘Bronchiectasis’: Inflammation of the bronchial wall, obstruction and fibrosis are all related to it.
- ‘Halo sign’: A halo symbol is the presence of GGO around a nodule or mass.
- ‘Reverse halo sign’: The reverse halo sign signifies a GGO region encircled by a nearly full ring of consolidation. The appearance of this sign and the relatively long onset of symptoms indicate that in COVID-19 pneumonia, organising pneumonia may be the cause of injury to lung.
- ‘Cavitation’: A cavitation, also known as a cavity, is a gas-filled region of the lung visible on chest Computed Topography as a low-density area inside a consolidation, mass, or nodule.
- ‘Fibrosis’: A cavitation, also known as a cavity, is a gas-filled region of the lung that occurs as a low-density area on CT within a consolidation, mass, or nodule.
- ‘Others’

Rationale

Detection of the rapidly evolving global pandemic caused by COVID19 is very important in these current situations. HRCT has been considered as the best diagnostic modality with misdiagnosed rate less than that of a together diagnostic tool.

Aims

To study effectiveness and spectrum of HRCT chest findings in RT-PCR positive COVID19 patients.

Objective

1. To Study the Effectiveness of HRCT in evaluating RT-PCR positive COVID19 patients.
2. To study spectrum of HRCT findings in patients with COVID positive.
3. HRCT chest in grading as per CORAD in positive patients in correlation with CT severity score

Material and Methods:

Study design: Retrospective observationalstudy

Study Area: AcharyaBhave Rural Hospital (AVBRH), Sawangi and Jawaharlal Nehru Medical College (JNMC)

Source of Data: Patients from AVBRH attached to DMIMS. The patients are taken from both IPD and OPD basis.

Subjects: 214 patients presenting to the CT department with clinically suspected of COVID19 and RT-PCR test positive for COVID19

Sampling Procedure: All patients referred to the department of Radiology, AVBRH, Sawangi with hematuria will be subjected for the study.

Sample Size:calculated by formula-

$$\boldsymbol{N = \frac{{Z_{\alpha/2}}^2 \cdot P(1-P)}{d^2}}$$

$Z_{\alpha/2}$ = level of significance at 5% i.e 95% confidence interval = 1.96

P = Prevalence of suspected COVID19 patients and RT-PCR positive patients in Wardhadistrict with a population of 13,989000 = 9.88% = 0.0988

d = Desired error of margin = 4% = 0.04

$$\boldsymbol{N = \frac{1.96^2 \cdot 0.0988(1-0.0988)}{0.04^2}}$$

N = 213.75 = 214 patients needed in the study

(Ref – covid19india.org)

Duration of study: 2020 – 2023

DATA COLLECTION TOOL:

The study will be conducted using SIEMENS 16 Slice CT Scanner.

INCLUSION CRITERION:

1. All RT-PCR COVID19 test positive patients.
2. Patients willing to participate in follow up study.

EXCLUSION CRITERION:

1. Patients with pre-existing lung pathology.
2. Patient who are not willing to participate in the study.

SCOPE AND IMPLICATION:

HRCT is a highly feasible imaging method, which has a major role in screening and also grading of COVID19 patients.

METHODOLOGY:

1. Chest High Resolution CT refers to a CT technique in which thin-slice chest images are collected and post-processed in a reconstruction algorithm of high spatial frequency that helps to obtain images of exquisite lung detail.
2. The patient is sent into the CT scanner in supine position craniocaudal and is asked to hold the breath in full inspiration with scan time of 6.22secs and rotation time of 0.6secs and 1.5mm thin slices are taken.

3. The procedure will be explained to the patients.
4. Images will be obtained and studied for evaluation.
5. The patients are followed up for six months duration and another HRCT thorax is taken in the patients willing to participate.

Bias: Intra-observer variability will be minimized by taking the average of 3 readings of each dimension.

Expected Outcomes:

In this observational study, we expect to understand the typical pattern of changes in an HRCT thorax scan of RT-PCR positive patient of COVID-19 and also understand the complications and changes in the lung parenchyma.

Conclusion:

The data obtained through this study can be used to understand the HRCT lung changes and typical patterns of an RT-PCR positive patient of COVID-19. This dada is also used to assess the sensitivity and specificity of HRCT thorax as a diagnostic tool for RT-PCR positive patient of COVID-19.

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