Original Research Article

Role of HRCT chest as primary investigation to screen symptomatic primary contacts of COVID-19

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Received: 05-09-2021 / Revised: 21-10-2021 / Accepted: 13-11-2021

Abstract

Chest CT had higher sensitivity for the diagnosis of COVID-19. Chest CT may be considered as a primary tool for screening of symptomatic contacts of COVID 19 in epidemic areas, particularly where access to reverse transcriptase-polymerase chain reaction (RT PCR) testing is difficult. The positive rates of RT-PCR assay and chest CT imaging in our cohort were 61.4% (43/70), and 85.7 % (60/70) for the diagnosis of suspected patients with COVID-19, respectively. With RT-PCR as a reference, the sensitivity of chest CT imaging for COVID-19 was 93% (40/43).

Keywords: COVID-19, reverse transcriptase-polymerase chain reaction, chest CT, dry cough

Introduction

The diagnosis of COVID-19 currently relies on RT-PCR testing of samples collected from the respiratory tract, through oro- or nasopharyngeal swabs. But the sensitivity of RT-PCR testing ranges from 93% for samples collected at broncho-alveolar lavage to 63% for sputum and just 32% for throat swabs[1]. Sensitivity may be lower if samples are collected sub-optimally or in patients with a low viral load. As a result, there are a significant number of false-negative results, creating diagnostic uncertainty and the need for additional diagnostic tools to accurately differentiate between patients with and without COVID-19[2]. The Royal College of Radiologists highlights that cases will arise where early CT imaging in patients with suspected COVID-19 will be clinically appropriate[3].

Our primary objective was to evaluate the diagnostic accuracy of HRCT chest for the as primary investigation to screen symptomatic primary contacts of covid-19. Our secondary objectives were to identify the most common radiographic changes on chest CT among patients with COVID-19 and the distribution pattern of these changes within the lungs.

Materials and Methods

Patients and data sources of RT-PCR results

The institutional review board of our hospital (Mahatma Gandhi memorial hospital, Warangal) approved this retrospective study. From July 26 to August 2020, a total of 70 symptomatic primary contacts of COVID 19 patients (mean age, 51 ± 15 years; 46% male) who were suspected of novel coronavirus infection, underwent both chest CT imaging and laboratory virus nucleic acid test (RT-PCR assay with Nasopharyngeal swab samples) were retrospectively enrolled.

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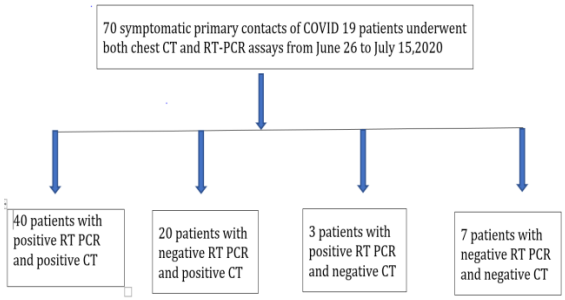
The RT-PCR results were extracted from the patient's electronic medical records in our hospital information system (HIS).



Chest CT protocols

All images were obtained on one CT system (GE Bright speed 16 Slice CT Unit) with patients in the supine position. All images were obtained with a slice thickness = 10 mm. All images were then reconstructed with a slice thickness of 0.625 - 1.250 mm with the same increment.

Image analysis

Radiologists were blinded to RT-PCR results, reviewed all chest CT images, and decided on positive or negative CT findings by consensus. The epidemiological history and clinical symptoms (fever and/ dry cough) were available for the reader. The radiologists classified the chest CT as positive or negative for COVID-19. The radiologists also described main CT features (ground-glass opacity, consolidation, reticulation/thickened interlobular septa, nodules), and lesion distribution (left, right, or bilateral lungs).

Statistical analysis

The statistical analysis was performed using SPSS trial version 21.0. Continuous variables were displayed as mean ± standard deviation and categorical variables were reported as counts and percentages.

Using RT-PCR results as a reference, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and

accuracy of chest CT imaging were calculated. A 95% confidence interval was provided by the Wilson score method.

Results

General description

70 patients (mean age, 48±13 years; 74% [52/70] men) were available for analysis. Of seventy patients, 43 had positive and 27 had negative RT-PCR results with a positive rate of 61.4% (43/70) (95% confidence interval [CI]. Of forty-three patients with positive RT-PCR results, 93% (40/43) had positive chest CT scans. Of 27 patients with negative RT-PCR results, 74% (20/27) had positive chest CT scans [Table 1] [Table 2].

The median time interval between the paired chest CT exams and RT-PCR assays was 2 days (range of 0-7 days). Eighty-six percent (60/70) (95% CI) of patients had positive chest CT findings. The main chest CT findings were ground-glass opacity (63% [38/60]) consolidations (38% [23/60] and Reticular/Thickened interlobular septa (31% [19/60]) [Figure 1][Table 3].

Table 1. Patient characteristics at presentation

	Freq	Percentage	Valid		Freq	Percentage	Valid
Cough				Hypertension			
Absent	12	17.1	17.1	Absent	52	74.3	74.3
Present	58	82.9	82.9	Present	18	25.7	25.7
Breathlessness				Oxygen dependency			
Absent	47	67.1	67.1	Not dep	54	77.1	77.1
Present	23	32.9	32.9	Depend	16	22.9	22.9
Sore throat				Diabetes mellitus			
Absent	61	72.9	72.9	Absent	56	60	60
Present	19	27.1	27.1	Present	14	20	20
Fever				Bronchial asthma			
Absent	24	34.3	34.3	Absent	69	98.6	98.6
Present	46	65.7	65.7	Present	1	1.4	1.4
Diarrhoea				Risk factors			
Absent	66	94.3	94.3	CAD	2	2.9	-
Present	4	5.7	5.7	DVT	1	1.4	-
CT severity score				HIV	1	1.4	-
Mild (0-8)	26	43.4	-	Tongue CA	1	1.4	-
Moderate (9-15)	13	21.6	-	Absent	65	92.9	-
Severe (16-25)	21	35					

Table 2. Characteristics of seventy patients

Characteristic	**Results**
Age(years)	
Mean age	48±13, Range 25-73
20-39	18 (26%)
40-59	31 (44%)
>60	21 (30%)
Median Time Interval between	**2** Range (0 to 5)
Chest CT scan and RT PCR assay (days)	
Results of RT PCR assay (days)	
Positive forty-three	
Negative twenty-seven	
Findings and manifestations of chest CT	
Consistent with viral pneumonia (positive)	60
Predominant CT finding	
Ground glass opacity	thirty-eight
Consolidation	23
Reticulation/thickened interlobular septa	12
No CT findings of viral pneumonia	10

Performance of chest CT in diagnosing COVID-19

There were 60 patients with positive chest CT findings. With RT-PCR results as reference, the sensitivity, specificity, accuracy of chest CT in indicating COVID-19 infection were 93% (95% CI 95-98%, 40/43 patients), 25% (95% CI 22-30%, 7/27 patients) and 67.14% (95%CI 65-70%, 47/70 patients), respectively.

Table 3. Performance of Chest CT for COVID-19 infection with RTPCR result as the reference

	Results				Test performance				
	TP	TN	FP	FN	Sensitivity [95% CI]	Specificity [95% CI]	PPV [95% CI]	NPV [95% CI]	Accuracy [95% CI]
Over all	40	7	20	3	93[40/53]	26[7/27]	67[40/60]	70[7/10]	67 [47/70]
Age									
<60 years	30	5	12	2	94[30/32]	29[5/17]	71[30/42]	71[5/7]	71[35/49]
≥ 60 years	10	2	8	1	90[10/11]	20[2/10]	56[10/18]	67[2/3]	57[12/21]
Sex									
Male	34	5	14	1	97[34/35]	26[5/19]	71[34/48]	83[5/6]	72[39/54]
Female	6	2	6	2	75[6/8]	25[2/8]	50[6/12]	50[2/4]	50[8/16]

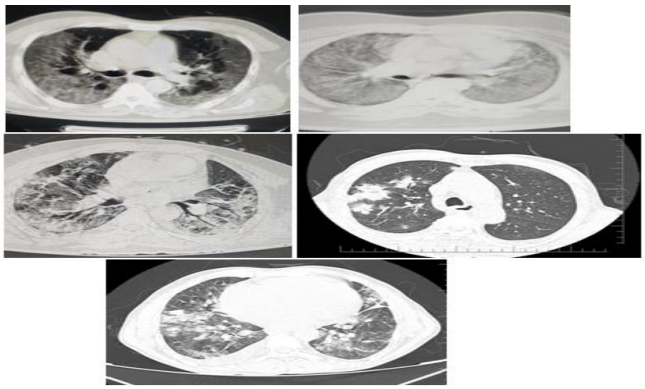


Fig 1. HRCT Chest in Symptomatic Primary Contacts of Covid-19

Discussion

Early diagnosis of 2019 novel coronavirus disease (COVID-19) is crucial for disease treatment and control. With RT-PCR results as a reference, the sensitivity, specificity, accuracy of chest CT in indicating COVID-19 infection were (93%, 40/43 patients), (25%,7/27 patients) and (67.14%, 47/70 patients), respectively. The positive predictive value and negative predictive values were 67% (40/60) and 70% (7/10), respectively.According to the current diagnostic criterion, the viral nucleic acid test by RT-PCR assay plays a vital role in determining hospitalization and isolation for individual patients. However, its lack of sensitivity, insufficient stability, and long processing time was detrimental to the control of the disease epidemic. In our study, the sensitivity of RT-PCR assay for nasopharyngeal swab samples was 61.4% (95%CI) which was consistent with wenling wang et al[4]. (63%), Yicheng Fang et al[5]. (70%). In addition, a number of external factors may affect RT-PCR testing results including sampling operations, specimens' source (upper or lower respiratory tract), sampling timing (different periods of the disease development), and performance of detection kits. As such, the results of RT-PCR tests must be cautiously interpreted.

Chest CT is a conventional, non-invasive imaging modality with high accuracy and speed. From our study sensitivity of chest CT in suggesting COVID-19 was (93 %) which was consistent with Chunqin Long et al[6]. (97.2%), Tao Ai et al[7]. (97%). This indicates that CT imaging can be very useful in the early detection of suspected cases.In this study, 97% of patients confirmed by RT-PCR assays showed positive findings on chest CT, which was higher than that reported by Zheng Zhong et al[8]. (76.4%).

For patients with negative RT-PCR tests, 74% had typical CT manifestations. On the one hand, due to the overlap of CT imaging features between COVID-19 and other viral pneumonia, false-positive cases of COVID-19 can be identified on chest CT. Nevertheless, considering the rapidly spreading epidemic of COVID-19, the priority was to identify any suspicious CT case to isolate the patients and administer appropriate treatment as per our hospital protocol. In patients with negative RT-PCR tests, a combination of exposure history, clinical symptoms, typical CT imaging features, and dynamic changes should be used to identify COVID-19 with higher sensitivity[9,10,11].

Limitations

The results cannot be generalized as it involves an only small number of samples

Conclusion

Chest CT imaging has a high sensitivity for diagnosis of COVID-19. Our data and analysis suggest that chest CT should be considered for the COVID-19 screening, symptomatic primary contacts of COVID 19 in epidemic areas particularly where access to RT PCR testing is difficult.

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Conflict of Interest: Nil Source of support: Nil