Efficacy of HRCT Chest and RT-PCR in Covid-19 Patients

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Abstract

Aims: To observe diagnostic efficacy of HRCT Chest and RT-PCR swab and their utility for the better management of covid 19 patients.

Settings and Design: This is a prospective study from March 2020 to September 2020.

Methods and Material: A Prospective Study of adults with clinical features and radiological findings suggestive of COVID 19 attended to the Department of Pulmonary Medicine Government Fever Hospital, Guntur, Andhra Pradesh

Statistical analysis used: The data was entered into MS Excel software 2010 and analyzed using the SPSS Software version.. The degree of agreement between the two investigational procedures is analyzed using Kappa statistic and graded and expressed accordingly

Results: Out of 115 patients in the study, 75 were males, and 40 were females. Of the 115 patients 44 had positive RT PCR results and 71 had negative RT PCR results, with 38% positive rate for RT-PCR. Of the 44 patients with positive RT PCR results, 91%(40) had typical features of covid-19 in chest CT. Of the 71 patients with negative RT PCR results 80%(57) had typical features of covid-19 in chest CT .The time between CT chest examination and RT PCR assay was 0-3 days. Of the 115 patients, 97 (84%) had typical covid-19 chest CT findings (97/115).

Conclusions: Chest CT has a high sensitivity for the diagnosis of COVID-19. This study suggests that chest CT should be considered for COVID-19 screening, comprehensive evaluation, and follow-up, especially in epidemic areas with a high pre-test probability for disease.

Keywords: HRCT chest, RT-PCR, COVID-19

Introduction

The outbreak of coronavirus disease 2019 (COVID-19) began in Wuhan, China, in December 2019, and rapidly spread to neighboring Asian and Western countries. In the month of January 30, 2020, the World Health Organization (WHO) declared COVID-19 a public health emergency of international concern, and on March 12, the WHO declared COVID-19 to be a pandemic[1]. As of Dec 2020, a total of 67,454,385 infected patients were reported globally, with 1,542,894 deaths, and COVID-19 cases had been reported in 218 countries or areas[2]. COVID-19 pneumonia is mainly diagnosed using real-time PCR to detect SARS-CoV-2 nucleic acid [3]. Due to the limited supply of real-time PCR kits and the emergence of false-negative nucleic acid cases, many experts have proposed using time-saving chest computed tomography (CT) to diagnose suspected cases rather than real-time PCR[3]. CT is considered the first-line imaging modality in highly suspected cases of covid-19 and is helpful for monitoring imaging changes during treatment. It can identify people with negative results of RT-PCR assay, but in whom COVID-19 is highly suspected. The purpose of the current study was to compare chest CT's sensitivity with that of nasopharyngeal swab Reverse Transcription Polymerase Chain Reaction at initial patient presentation.

Materials and Methods

A. Study Design: This is a prospective study conducted in the Department of Pulmonary Medicine Government Fever Hospital, Guntur, from March 2020 to September 2020. The study included 125 patients above the age of 18yrs with clinical features, and radiological findings suggestive of COVID 19 attended to the department. Informed consent from all the patients in the study was taken.

B. Case Definition: Covid 19 pneumonia was defined as acute onset of any three or more of the following signs or symptoms; such as fever, cough, general weakness/fatigue, headache, myalgia, sore throat, coryza, dyspnea, anorexia/nausea/vomiting, diarrhea, altered mental status[9] irrespective of contact history and/or imaging findings suggestive of Covid 19with or without laboratory confirmation and must have responded to Covid -19 treatment protocol according to MOHFW, India[4]

C. Inclusion Criteria

- Age> 18 years
- Clinical features and/or radiological findings suggestive of Covid 19(ground-glass opacity, consolidation, reticulation and/or thickened interlobular septa, nodules with peripheral distribution)
- Who has given consent to this study.
- Who responded to Covid 19 treatment protocol according to MOHFW guidelines, India

D. Exclusion Criteria

- Age < 18yrs
- Diseases with Chest CT imaging findings that can mask the radiological diagnosis of covid 19 pneumonia such as other viral pneumonia (H1N1), PLHIV with radiological PCP pneumonia, Acute decompensated congestive heart failure, Chronic

Kidney Disease& who is having bilateral interstitial lung disease, and bilateral extensive fibrotic lung disease.

- Who did not give consent
- Who did not respond to Covid 19 treatment protocol and subsequently found with an alternate diagnosis.

E. Study Protocol: Symptomatic patients suggestive of Covid 19 pneumonia irrespective of exposure history attended to the Out-Patient department were subjected to imaging and RT- PCR and were managed according to Covid 19 treatment protocol, MOHFW. Permission from the ethical committee with IEC No application no GMC/IEC -349/2020 was approved.

For Chest CT protocol, we also followed CO-RADS staging [16] wherever it is applicable statistically.

| CO-RADS*		
Level of suspicion COVID-19 infection		
		CT findings
CO-RADS 1	No	normal or non-infectious abnormalities
CO-RADS 2	Low	abnormalities consistent with infections other than COVID-19
CO-RADS 3	Indeterminate	unclear whether COVID-19 is present
CO-RADS 4	High	abnormalities suspicious for COVID-19
CO-RADS 5	Very high	typical COVID-19
CO-RADS 6	PCR +	

The current study considered Corads 4 & 5 are Chest CT findings typical of covid-19, as both stages have a high and very high suspicion for Covid-19 infection, respectively, and all those patients were responded with covid-19 treatment protocols as per MOHFW.

F. Outcome: All patients were cured with Covid 19 treatment protocol according to MOHFW in our study.

G. Statistical Analysis: The data was entered into MS Excel software 2010 and analyzed using the SPSS Software version. The categorical variables are expressed in the form of frequencies and percentages. The differences between the proportions are tested using the Chi-Square test. In the case of small numbers, the proportions are tested using Fischers Exact P-value test. The evaluation of CT compared to the RT-PCR is expressed in the form of Sensitivity, Specificity, Predictive values, and accuracy. The degree of agreement between the two investigational procedures is analyzed using Kappa statistic and graded and expressed accordingly. In every case, a p-value of less than 0.05 is considered statistically significant.

H. Study Flowchart
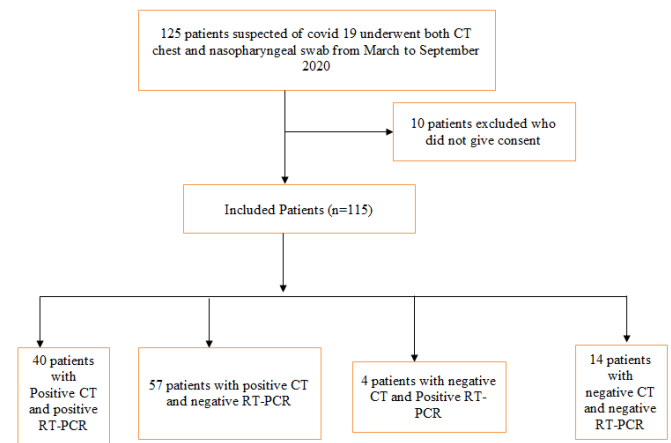
Results

Generalised Description: A total of 115 patients were included in the present study. The mean age in the study was 53.5 years.40-59 years age group is the most commonly affected age group in this study. Out of 115 patients in the study, 75 were males, and 40 were females. Of the 115 patients, 44 had positive RT PCR results, and 71 had negative RT PCR results, with a 38% positive RT-PCR rate. Of the 44 patients with positive RT PCR results, 91 %(40) had typical features of covid-19 in chest CT. Of the 71 patients with negative RT PCR results, 80 %(57) had typical features of covid-19 in chest CT.

The time between CT chest examination and RT PCR assay was 0-3 days. Of the 115 patients, 97 (84%) had positive chest CT findings (97/115).

Table1: Summary of Patient Characteristics

characteristic	Value
No of patients	115
Age	mean age 53.5 years
<40	38(33%)
41-59	49(42%)
>/=60	28(25%)
Gender	
Males	75(65%)
Females	40(35%)
Range of time between RT PCR and CT chest	0-3 days
Results of nasopharyngeal swab	
Positive	44(38%)
Negative	71(62%)
Findings and manifestations of CT Chest	
Consistent with Covid 19 pneumonia	97(84%)
Normal/ Not consistent with covid19	18(16%)

B. Comparision of CT Chest and RT-PCR Results

41-59 years age is the most commonly affected age group in the study. Swab Positivity is more in this group when compared to CT-chest findings suggestive of covid-19.

Table 2: Comparison of CT and RT-PCR Results

Parameter	CT Chest s/o Covid 19 with negative RTPCR result	Positive RT-PCR result irrespective of CT Chest s/o Covid 19	Both RTPCR and CT negative	Chi-Square and P-value
No. of Patients	57	44	14	----
Age(mean)	53.5 years			
Age group 1.</=40 2.41-59 3.>/=60	25(44%) 20(35%) 12(21%)	16(36%) 20(46%) 8(18%)	1(7%) 7(50%) 6(43%)	χ^2= 8.11; P=0.08; NS
Sex distribution				

Male	41	30	5	χ^2=5.47; P=0.06; NS
Female	16	14	9	
Predominant(most common)symptom	Dyspnea	Fever	Fever	
Imaging findings*(number)				
CORAD 1	0	0	2	χ^2=20.71; P<0.001; S
CORAD 2	0	1	3	
CORAD 3	0	3	9	
CORAD 4	20	12	0	
CORAD 5	37	28	0	

*CO-RADS 6 indicate proven Covid 19 as signified by positive RTPCR results. So we are not comparing CORAD 6 imaging findings between the variables in the table.

Table 3: Table showing duration of illness with respect of CT chest and SWAB (RT-PCR)

Duration of Illness from symptom onset in days	Total number of patients	CT typical	RT-PCR positive irrespective of CT chest s/o Covid 19	Chi-Square and P-Value
<5	31	21(67.7%)	12(38.7%)	χ^2=0.77; P=0.86; NS
5-8	62	55(88.7%)	24(38%)	
9-10	18	17(94.4%)	7(38.8%)	
>10	04	4(100%)	1(25%)	

In this study, most CT chest and RT-PCR numbers were done within 5-8 days from the symptom onset. In patients with less than five days of illness, patients with typical CT findings and RT-PCR positivity irrespective of CT chest findings were 67.7% and 38.7%, respectively. In patients between 5-8 days of illness, patients with typical CT findings and RT-PCR positivity irrespective of CT chest findings were 88.7% and 38%, respectively. In between 9-10 days duration of illness, typical CT findings and RT-PCR positivity irrespective of CT chest findings were 94.4% and 38.8%, respectively. More than ten days duration of illness typical CT findings and RT-PCR positivity irrespective CT chest findings were 100% and 25% respectively. In this study, with the increase in the duration of illness typical CT features suggestive of Covid 19 pneumonia is also increasing from 67.7% to 100 %.

C. Performance of CT in Diagnosing In Covid-19

With RT PCR results as the reference standard, the sensitivity, specificity, and accuracy of Chest CT in indicating Covid 19 infection were 91%(40/44), 20% (14/71), 47%(54/115), respectively.

Table 4: Performance of CT Chest in Diagnosis of COVID 19

Parameter	Test performance parameters (%)				
	Sensitivity	Specificity	Accuracy	Kappa Statistic	Degree of Agreement
Overall	91	20	47	0.09	Slight
Age less than 60 years	89	15	45	0.04	Slight
Age 60 & above	100	32	52	0.21	Fair[*]
Male	97	11	45	0.06	Slight
Female	80	35	51	0.12	Slight

*Fair Degree of Agreement

D. Clinical Features

Most common symptoms in the study are fever, followed by dyspnea and cough. The least common symptom in the study is vomiting.

Table 5: Table Showing Clinical Features

Symptoms	CTs/o covid-19 with RT-PCR negative (57)	RT-PCR positive with/without CTs/o covid-19 (44)	Both CT and RT-PCR negative (14)
Fever	34(60%)	33(75%)	09(64%)
Dyspnea	39(68%)	20(45%)	06(43%)
Cough	29(51%)	27(61%)	08(57%)
Myalgia	22(38%)	17(39%)	01 (7%)
Headache	04(7%)	05(11.3%)	02(14%)
Diarrhoea	03(5%)	01(2.2%)	00
Anosmia	01(2%)	01(2.2%)	01(7%)
Vomiting	02(3%)	00	00

Table 6: Table Showing Comorbidities

Comorbidities	CT positive RT-PCR negative 57	RT-PCR positive with/without CT positivity 44	Both CT and RT- PCR negative 14
Diabetes	15(26%)	16(36%)	05(36%)
HTN	08(14%)	07(16%)	02(14%)
COPD	08(14%)	01(2%)	01(7%)
Asthma	00	01(2%)	00
Obesity	00	01(2%)	00

The most common comorbidity in the present study is diabetes mellitus, followed by hypertension.

Discussion

Early diagnosis of coronavirus disease 2019 (COVID-19) pneumonia is crucial for disease treatment and control. Compared with RT, PCR chest CT may be more reliable, practical, and rapid to diagnose and

assess Covid 19, especially in the area affected by the epidemic. With RT PCR results as the reference standard, the sensitivity, specificity, and accuracy of Chest CT in indicating Covid 19 infection were 91%(40/44), 20% (14/71), 47%(54/115), respectively. The positive predictive value (PPV) and negative predictive values (NPV) were 41 % (40/97) and 78% (14/18) respectively.

There is no significant association between age groups, gender, and type of diagnostic method

Most number of CT chest and RT-PCR were done within the duration of 5-8 days from the day of symptom onset. In all groups of the duration of illness, CT is a sensitive tool when compared to RT-PCR to diagnose Covid 19 pneumonia. With the increase in illness duration, typical CT features suggestive of covid 19 pneumonia are also increased. There is a significant association between CORADS score and type of diagnostic method.(p<0.001)

According to current diagnostic guidelines, viral nucleic acid tests play a vital role in determining the approach for individual patients, but its lack of sensitivity, insufficient stability, sampling errors, and relatively long processing time were obstacles to the control of the disease epidemic[5]. In the present study, the positive rate of RT PCR assay for throat swab samples was 38%(44/115) lower than that described by Tao et al. study(59%) [3]. The nasopharyngeal swab's low positive rate is that some patients with covid 19 do not have high levels of virus detectable in the upper respiratory tract. This may be because of suboptimal sampling technique, because a patient is incubating an infection or is already clearing the virus or because viral replication is predominantly occurring at other sites, such as the lower respiratory tract. Several external factors may also affect swab antigen testing

results, including sampling operations and detection kits.[6]

Chest CT is a conventional, non-invasive imaging modality with high accuracy and speed. Based on available data published in recent literature, almost all patients with Covid-19 had typical CT features in the disease process, such as different degrees of ground-glass opacities and/or crazy-paving pattern, organizing pneumonia, and architectural distortion in a peripheral distribution. In the present study, about 84% (97/115) had typical CT features, which is similar to Guan et al. study (86%).

For patients with negative RT PCR tests, more than 80% had typical CT findings, which is higher than Tao Ai et al. study[3]. Considering the rapid spread of covid19 infection in India from March, False positive cases identified by CT were acceptable as the priority was to isolate Covid 19 infections and administer appropriate treatment. In patients with negative RT PCR results, a combination of exposure history clinical symptoms, typical CT imaging features should be used to identify Covid 19 with higher sensitivity.[3]

The present study has few limitations. First, RT-PCR as the reference standard with a relatively low positive rate, CT chest sensitivity for COVID-19 could have been overestimated, and the specificity underestimated. In the epidemic affected area, negative RT-PCR findings but positive CT features can still be highly suggestive of COVID-19. This has significant societal and clinical implications; rapid detection with high sensitivity of viral infection may better control viral spread. A second limitation is that serial RTPCR was not done as repeat RT PCR assays were not permitted within 14 days as per the guidelines of local governing body. Another limitation is that the date of symptom

onset was mainly based on the history of the patient and their attendants.

In conclusion, chest CT has a high sensitivity for the diagnosis of Covid-19. Our data and analysis suggest that CT chest should be considered for Covid-19 screening, comprehensive evaluation, and follow-up, especially in epidemic areas with a high pre-test probability for disease.

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