The Screening utility of HRCT Chest in COVID- 19 Pneumonia by comparing sensitivities of HRCT Chest and rt-PCR in clinically confirmed patients: A study of 689 cases.

Khawaja Muhammad Baqir Hassan[1], Tathir Baqir Hassan[2], Muhammad Imran[3],
Khurram Mansoor[4], Yasser Khan[5], Syed Rehan Asghar Naqvi[6]

ABSTRACT

Objective: To assess the screening utility of HRCT chest in COVID- 19 pneumonia by comparing sensitivities of HRCT Chest and rt-PCR in clinically confirmed patients.

Study Design: Cross sectional validation study

Place and Duration: Department of Radiology and Medicine of Combined Military Hospital Okara from 1st September 2020 to 28th February2021.

Methodology: All clinically confirmed COVID patients were included in the study by using non-probability consecutive sampling. Findings of HRCT chest and results of rt-PCR were assessed by comparing the diagnostic sensitivities of HRCT Chest and rt-PCR for the patients.

Results: a total of 689 patients (80.6% males and 19.4% females) with mean age of 51.45±14.58 years were assessed. They showed sensitivity of HRCT of 91.8% as compared to the PCR sensitivity of 84.7% in highly suspected cases of COVID-19 pneumonia.

Conclusion: HRCT chest has higher sensitivity in detecting COVID-19 pneumonia than PCR and hence proves to be a better, quick and reliable screening tool than rt-PCR for COVID-19 pneumonia.

Keywords: COVID-19; Chest X-Ray, HRCT Chest; rt-PCR; Screening, Sensitivity, Specificity

INTRODUCTION

COVID-19 pandemic has been in the world for more than two

1. Senior Registrar of Radiology,
2. Senior Registrar & Public Health Specialist,
3. Assistant Professor of Pulmonology,
4. Assistant Professor of Nephrology,

   Combined Military Hospital, Malir, Karachi

5. Senior Registrar of Radiology,
   Combined Military Hospital, Multan
6. Health Care Administrator,
   Combined Military Hospital, Malir, Karachi

Correspondence:
Khawaja Muhammad Baqir Hassan
Senior Registrar & Consultant Radiologist,
Combined Military Hospital, Malir, Karachi.
Email: baqar78@hotmail.com

years. Main feature of this pandemic is the rapidity of spread and highly virulent nature of the disease. This requires early and accurate diagnosis to identify and isolate the infected individual. rt-PCR is the gold standard, but it requires 6-8 hours for the results to arrive.[1] Furthermore the sensitivity and specificity of the test is variable from 60-80%.[2,3] This time window can be crucial for isolation and treatment of the infected person. This necessitate the importance of quick and precise diagnosis. Furthermore the symptomology of the Covid-19 is non-specific and overlapping with the common respiratory infections. This advocates rapid and correct diagnosis of Covid-19 infection.

Many symptoms of the COVID-19 have been described in the international studies. Most common of them are fever, cough and shortness of breath.[4] In addition to these flu like symptoms, loss of smell and taste along with diarrhea have also been reported.[5] As respiratory symptoms have been the most common and most severe pathologies, chest radiology has played an important role in screening, diagnosis and management of COVID-19 infections and pneumonia. HRCT chest has been described to have more sensitivity than PCR, especially when Covid-19 pneumonia is suspected.[6] Various HRCT chest findings and their frequencies were also mentioned in the literature.[7] Furthermore to this, various scoring systems, both for Chest X-Rays and HRCT chest have been also described to evaluate, stratify and follow up the disease process.[8] HRCT chest is an expensive and high radiation dose radiological

investigation. But HRCT chest is rapidly conducted and the results are available in minutes. As already mentioned many studies have described better screening utility of the HRCT chest in suspected Covid-19. Unfortunately, this has led to the over prescription of HRCT chest in almost all cases of Covid-19 infection. This has put extra burden on all sort of resources.

In our study we have prospectively studied highly suspected cases of Covid-19 pneumonia and compared the sensitivities of HRCT chest and rt-PCR in such cases. A confident analysis of such suspected individuals can be made on HRCT. Therefore in this prospective study, individuals highly suspicious of COVID-19 pneumonia simultaneously underwent both rt-PCR and HRCT chest at their initial presentation in Covid-19 desks or receptions of the hospital. Both sensitivity and specificity of the investigations were compared. In another study being conducted at the same hospital, diagnostic utility of the HRCT chest and rt-PCR in asymptomatic patients as well.

We believe that the results of this study will help to rationalize the screening utility of HRCT chest in suspected Covid-19 pneumonia cases. Furthermore, it will validate the better screening utility of HRCT chest in Covid-19 pneumonia and can help to formulate a guideline for justified use of HRCT chest in Covid-19 patients. So, this study was conducted with an objective to assess the screening utility of HRCT chest in COVID-19 pneumonia by comparing sensitivities of HRCT Chest and rt-PCR in clinically confirmed patients.

METHODOLOGY

This cross sectional validation study was conducted in department of radiology and medicine of Combined military hospital, Okara after approval Ethical Committee, from 1st March 2021 to 31st August 2021.689 highly suspicious individuals having both exposure and clinical symptoms and also reported at COVID-19 desk underwent rt-PCR and HRCT chest. The sample size was calculated by using cross-sectional study formula having the precision of 5% with 50% prevalence and confidence interval of 95%.

Informed consents were taken from the patients. Individuals who had fever of 100 Celsius or more and dry cough for 3 or more days, shortness of breath on exertion for more than 12 hours, dyspnea on rest for more than 3 hours, positive exposure history were included in the study. Patients who were asymptomatic but were screened due to positive exposure, initially having negative rt-PCR or having milder symptoms were excluded from the study. The rt-PCR was done on samples using Allplex^{TM} SARSCov-2 fast array with extraction and nuclear material carried out in Dmart Lab assist extractor by TANBead^R, amplification on 96-well amplification by Socace biotechnologies, as per international guide lines. The nasopharyngeal swabs were taken for the tests. rt-PCR was taken as gold standard and was repeated for the individuals who had initial negative report and were highly suspicious or positive for COVID-19 pneumonia on HRCT chest. However these results were not included in the statistical analysis. Peripherally placed ground glass opacities, consolidations or mixed opacities on

HRCT were taken as positive scan for COVID-19 pneumonia.[9] HRCT chest was conducted on Siemens 4-slice CT scan. The scan included area in between cervical 7th vertebra and the level including adrenal glands. Both pulmonary and soft tissue windows were analyzed. Negative HRCT chests despite positive rt-PCR were not repeated. The main reasons were the radiation exposure and no human error of sampling is suspected as seen for rt-PCR.

The results including demographic data were recorded on the pre-designed performas. Data was analyzed with SPSS ver. 23.0 for Windows 10.0(SPSS Inc., Chicago, IL, USA). Frequencies, means and ranges for age, specificity and sensitivity were recorded and analyzed.

RESULTS

A total of 689 patients were included in the study. The mean age was 51.45±14.58 years. 80.6 %(555) were male and 19.4(134) were females having mean ages 51.02±14.21 and 53.25±15.95 years respectively. All of them underwent rt-PCR and HRCT chest on clinical suspiciousness of COVID-19 pneumonia.

The table-1 shows that 541(78.5%) patients had positive rt-PCR whereas 638(92.6%) had positive HRCT chest.

Table – I: PCR VS HRCT positive cases

Valid	PCR Result	HRCT Chest
	Frequency (%)	Frequency (%)
Positive	541 (78.5%)	638 (92.6%)
Negative	148 (21.5%)	51 (7.4%)
Total	689 (100.0%)	689 (100.0%)

The sensitivity of the HRCT was calculated on 2 x 2 table in COVID-19 pneumonia patients and was found to be 91.8%. It is shown in table-II. The positive predictive value was calculated as 89.5%. It is worth mentioning that specificity of HRCT chest is 0 as it cannot detect the biological or histo-pathological origin of the COVID-19 virus.

Table – II: Sensitivity and PPV of HRCT chest (N=689)

HRCT Chest		Clinical Suspiciousness		Total
		Yes	No	
Positive	Count	571	67	638
	% within HRCT Chest	89.5%	10.5%	100.0%
	% within Clinical Suspiciousness	91.8%	100.0%	92.6%
Negative	Count	51	0	51
	% within HRCT Chest	100.0%	0.0%	100.0%
	% within Clinical Suspiciousness	8.2%	0.0%	7.4%

The sensitivity of the rt-PCR was also calculated on 2 x 2 table in COVID-19 pneumonia patients and was found to be 84.7%. The PPV was found to be 97.4%. Table-III is depicting the said values. The sensitivities and PPV of both, HRCT chest and rt-PCR were also compared in relation to gender. Table IV shows that HRCT

chest sensitivity and PPV are slightly different when compared on the basis of gender. In females HRCT chest has higher sensitivity (95.7%) than that of males (90.9%).

Similarly the sensitivities and PPV of rt-PCR were also compared among both the genders. Not much if significant difference was noted in both males and females as shown in table-V.

Table – III: Sensitivity, Specificity, PPV and NPV of rt-PCR in COVID-19 Pneumonia (N=689)

PCR Result		Clinical Suspiciousness		Total
		yes	No	
Positive	Count	527	14	541
	% within PCR Result	97.4%	2.6%	100.0%
	% within Clinical Suspiciousness	84.7%	20.9%	78.5%
Negative	Count	95	53	148
	% within PCR Result	64.2%	35.8%	100.0%
	% within Clinical Suspiciousness	15.3%	79.1%	21.5%

Table – IV: Gender based HRCT Chest Sensitivity and PPV (N=689)

HRCT Chest		Clinical Suspiciousness					
		Males			Females		
		Yes	No	Total	Yes	No	Total
Positive	Count	461	48	509	110	19	129
	% within HRCT Chest	90.6%	9.4%	100.0%	85.3%	14.7%	100.0%
	% within Clinical Suspiciousness	90.9%	100.0%	91.7%	95.7%	100.0%	96.3%
Negative	Count	46	0	46	5	0	5
	% within HRCT Chest	100.0%	0.0%	100.0%	100.0%	0.0%	100.0%
	% within Clinical Suspiciousness	9.1%	0.0%	8.3%	4.3%	0.0%	3.7%

Table – V: Frequency of Gender based rt-PCR Sensitivity and PPV (N=689)

PCR Result		Clinical Suspiciousness					
		Males			Males		
		Yes	No	Total	Yes	No	Total
Positive	Count	429	9	438	98	5	103
	% within PCR Result	97.9%	2.1%	100.0%	95.1%	4.9%	100.0%
	% within Clinical Suspiciousness	84.6%	18.8%	78.9%	85.2%	26.3%	76.9%
Negative	Count	78	39	117	17	14	31
	% within PCR Result	66.7%	33.3%	100.0%	54.8%	45.2%	100.0%
	% within Clinical Suspiciousness	15.4%	81.3%	21.1%	14.8%	73.7%	23.1%

DISCUSSION

Covid-19 has become a pandemic and almost five different waves have hit the world so far. Omit (Add reference). COVID-19 infection spreads rapidly and that is why it has led to the pandemic.[10-12] Therefore reliable, efficient and rapid methods are required to screen the patients so that the patient can be isolated to break the chain of infectivity. Pneumonia is one of the commonest and major clinical manifestations of novel corona virus infection.[10] We have utilized this property of the infection in our study to use chest radiology, specifically HRCT chest for early and reliable detection of the infection. We believe that HRCT chest in clinically suspected cases of Covid-19 pneumonia has better sensitivity than rt-PCR. Only clinically confirmed patients of COVID-19 pneumonia having major symptoms such as high grade fever, cough and shortness of breath were included.[13,14] We compared the sensitivities of rt-PCR and HRCT chest in screening of the COVID-19 pneumonia. Our results showed that the sensitivity of the HRCT chest is 91.8%, having positive predictive value of 89.5% against the sensitivity of the rt-PCR which was 84.7%. The specificity of HRCT chest was low (45%). Our results are comparable to the international studies.[15,16] In one of meta-analysis of sixteen studies published in American journal of infection control, the computed tomography showed sensitivity (91.9% [89.8%-93.7%]), but specificity (25.1% [21.0%-29.5%]). For RT-PCR tests, sensitivity of sputum was (97.2% [90.3%-99.7%]) presented higher than our study in detecting the virus.[15] Similarly in the other study published in journal of Academic Emergency Medicine, the sensitivity of both HRCT chest and rt-PCR were recorded between 82-100% respectively, which are comparable to our results.[16]

Most of the patients in our study were male (80.6%). No definite scientific reason for this high gender disparity was found in the study, however a possible explanation could be cultural values as males are more exposed due to their outdoor job related activities. The mean age was 51.44 years, suggesting that the elderly population is more affected than the younger age group. The sensitivity of HRCT chest was calculated to be 91.8%. The positive predictive value is 89.5%. Both these values are comparable to international studies.[15-17] In our study the specificity of HRCT chest was very low. The possible reason could be that HRCT chest can't confirm the biological nature of the disease process. In few studies the sensitivity for HRCT chest has been reported up to 90% for detection of COVID-19 pneumonia. One of the studies was conducted in China and showed 97.2% sensitivity.[6]

Similarly the sensitivity (84.75) and specificity (35.8%) of rt-PCR in our study were also comparable to international studies. Although the sensitivity of rt-PCR is good but still lower than HRCT chest in clinically highly suspicious patients of Covid-19. This information signifies the screening utility of HRCT chest in such cases. This doesn't negate the requirement of the rt-PCR in such cases.

The information gathered in our study is comparable to international studies. An inference can easily be drawn that HRCT chest can effectively and reliably be used in clinically suspected patients of Covid-19 pneumonia for screening. As we know that the clinical symptoms of COVID-19 infections, especially pertaining to respiratory system are non-specific,

HRCT chest can easily identify these patients.[18].But this doesn't obviate the need of rt-PCR as it is the gold standard test due to it's biological relevance.[3] Although it is a time consuming, painful and difficult test to perform and has limited sensitivity, it can be used as an adjuvant to HRCT chest .[19] The duration of the rt-PCR is usually 6-8 hours, enough for the patient to spread the disease further. Many hospitals or clinics devised various methods such as isolation wards, separate waiting areas or admission into dedicated wards. But this caused unnecessary fear, administrative burden and logistic problem for both the hospital administration and patients.[20,21] HRCT chest can be used in this window to screen the Covid-19 patients. Furthermore the HRCT chest scoring system can be used to assess the severity of the disease which rt-PCR cannot do.[22,23] Although HRCT chest has radiation exposure and limited access due to availability, yet it has proved to be a better screening tool than rt-PCR due to speed and ease.[23]

It can reliably deduced from the above discussion that HRCT chest is a better and speedy screening tool than rt-PCR in highly suspected COVID-19 pneumonia patients. The only drawback is radiation exposure which in this pandemic scenario can easily be ignored on the risk versus benefit scale.

CONCLUSION

HRCT chest is better than rt-PCR in screening COVID-19 pneumonia patients due to better sensitivity and being faster, cheaper, and less painful to the patient.

AUTHOR'S CONTRIBUTION

Hassan KMB: Conceived idea, Designed Research Methodology, Data Collection, Data Interpretation, Statistical Analysis, Manuscript Writing
Hassan TB: Literature Review, Data Interpretation, Statistical Analysis.
Imran M: Data collection, Manuscript Writing
Mansoor K: Literature search, Literature Review, Manuscript Writing
Khan Y: Literature Search, Data Collection
Naqvi SRA: Data Collection, Manuscript final reading and approval

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