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Chest HRCT versus RT-PCR for the Detection of COVID-19 in Bangladesh

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ABSTRACT

The coronavirus disease 2019 (COVID-19) pandemic is a crisis of a completely different magnitude, and it is a challenge to life in the whole world, including Bangladesh. The real-time reverse transcription polymerase chain reaction (RT-PCR) tests are currently the gold standard diagnostic tool for COVID-19. This observational study was done to evaluate the diagnostic assessment of high-resolution computed tomography (HRCT) of the chest as compared to a RT-PCR test in COVID-19 patients attending the Radiology and Imaging department of Jalalabad Ragib-Rabeya Medical College Hospital, Sylhet, from 1st July 2020 to 31st December 2021. This study included 387 patients admitted to the ICU and suspected of having COVID-19 who went to the radiology and imaging department for HRCT of the chest for the diagnosis of COVID-19 pneumonia. Simultaneously, nasal swabs from the same number of patients were tested by RT-PCR in the government-approved centre to diagnose COVID-19. Demographic and clinical data were collected by a structured questionnaire, and analysis was done with the help of the Statistical Package for Social Science (SPSS) version 23. Abnormal HRCT was discovered in 317 patients, 309 of whom were positive and 8 of whom were negative by RT-PCR. The difference between the two groups was statistically significant ($p<0.05$). These outcomes showed that the HRCT evaluation for prediction of COVID-19 sensitivity was 94.8%, specificity was 86.9%, accuracy was 93.5%, positive predictive value (PPV) was 97.5%, and negative predictive value (NPV) was 75.7%. RT-PCR is the gold-standard test for identifying COVID-19; HRCT can be useful in situations where RT-PCR is expected but COVID-19 isolation is a concern. HRCT evaluation for prediction of COVID-19 has more sensitivity and accuracy.

Keywords: *Chest HRCT, RT-PCR, COVID-19.*

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INTRODUCTION

The coronavirus disease-19 (COVID-19) pandemic is a crisis of a completely different magnitude, and it is a challenge to the life threads of the whole world, including Bangladesh. The novel coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) began in December 2019 in Wuhan, China, and has since spread globally[1]. The coronavirus pandemic has infected 40,251,950 confirmed cases of COVID-19, including 1,116,131 deaths, reported to WHO. The outbreak spread from the Chinese city of Wuhan to more than 180 countries and territories, affecting every continent except Antarctica[2]. Coronaviruses are enveloped positive-sense single-stranded RNA viruses belonging to the family Corona viridae, that are broadly distributed in humans and other vertebrates, eventually causing damage in respiratory, digestive and even multiple systems[3].

Around 80% of COVID-19 infections present as a mild respiratory illness in a patient who is ambulatory and can generally be managed outside the hospital. Around

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15% typically need hospital care (usually for moderate to severe pneumonia), and another 5% have critical illness requiring more intensive supports[4]. Studies have shown that COVID-19 could induce fever, dry cough, dyspnoea, and fatigue in infected patients. In more severe cases, infections caused viral pneumonia and could lead to severe acute respiratory distress syndrome (ARDS) and even death[5]. Pharyngodynia, nasal congestion, and rhinorrhoea have been reported in patients with COVID-19[6].

Currently, the COVID-19 infection is diagnosed with the aid of detection of viral nucleic acids using real-time reverse transcription polymerase chain reaction (RT-PCR) or gene sequencing for respiratory or blood specimens[7]. However, there are some challenges associated with these diagnostic modalities. For instance, sample collection and transportation are restricted by limited workforce and unavailability of PCR kit. The total positive rate of RT-PCR for COVID-19 nasal or throat swab is reported to be somewhere between 30% and 60%[8]. On the other hand, a recent study by Qureshi et al.[9] reported that high-resolution computed tomography (HRCT) chest is a substantially useful modality in establishing the diagnosis of COVID-19 pneumonia. Furthermore, HRCT is less time-consuming and may reveal abnormalities in the lung parenchyma consistent with features of COVID-19 pneumonia in individuals with negative PCR of nasal or throat swab results[10]. Few studies have compared RT-PCR and HRCT chest in the ICU population in our country. So we were conducting the study to evaluate the diagnostic value and utility of HRCT chest as compared to RT-PCR in the diagnosis of COVID pneumonia in the ICU population.

MATERIALS AND METHODS

This observational study was conducted in the radiology and imaging department of Jalalabad Ragib-Rabeya Medical College Hospital, Sylhet, from July 1st 2020 to December 31st 2021. Ethical permission was duly obtained. Prior to commencing the study, informed consent was obtained from each participant. A total of 387 patients were enrolled for the study by consecutive sampling method. The study included patients admitted to the ICU of Jalalabad Ragib-Rabeya Medical College Hospital and suspected of having COVID-19 who went to the radiology and imaging department for HRCT of the chest for the diagnosis of COVID-19 pneumonia. Simultaneously, nasal swabs from the same number of patients were tested by RT-PCR within an interval of 3 days or less in the government-approved centre to diagnose COVID-19. Normal and abnormal chest HRCT findings were recorded by following the CT features for COVID-19[11]. The detection rate of COVID-19 infection based on the initial chest CT and RT-PCR findings was compared. Demographic and clinical data were collected by a structured questionnaire and analysis was done with the help of Statistical Package for Social Science (SPSS) version 23. Continuous data were presented as mean and standard deviation and categorical data were presented as number and percentage. Statistical analysis was performed using the McNemar chi square test, with a p value of <0.05 indicative of a statistically significant difference. Sensitivity, specificity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) of the HRCT evaluation for prediction of COVID-19 were measured. The summarised data were presented in the table and chart.

RESULTS

The results showed that male patients were predominant (72.6%) and the mean age of the patients was 53.32±13.48 years (Table-I). The commonest signs and symptoms were fever 347 (89.6%) followed by shortness of breath 251 (64.9%), cough 241 (62.3%), ache 171 (44.2%), fatigue 96 (24.7%), loss of taste 75 (19.5%), sore throat 65 (16.9%) and anorexia 65 (16.9%) (Table-II). Table-III showed that abnormal HRCT chest was 317 (81.91%), whereas Table-IV showed that consolidation was found in 92 (29%), ground glass opacities (GGOs) 184 (58.1%) and crazy paving appearance 41 (12.9%). Table-V showed that abnormal HRCT was found in 317 patients, out of whom 309 were positive and 8 were negative as evaluated by RT-PCR. The difference was statistically significant ($p<0.05$) between two groups. The sensitivity, specificity, accuracy, PPV, and NPV of the HRCT examination for the prediction of COVID-19 pneumonia were 94.8%, 86.9%, 93.5%, 97.5%, and 75.7%, respectively (Table-VI).

Table-I: *Demographic characteristics of the study patients (N=387)*

Characteristics		Number	Percentage
Gender	Male	281	72.6
	Female	106	27.4
Mean Age (Years±SD)		53.32±13.48	

Table-II: *Signs and symptoms of the study patients (N=387)*

Signs and Symptoms	Number	Percentage
Fever	347	89.6
Shortness of breath	251	64.9
Cough	241	62.3
Ache	171	44.2
Fatigue	96	24.7
Loss of taste	75	19.5
Sore throat	65	16.9
Anorexia	65	16.9
Diarrhoea	30	7.8
Headache	30	7.8
Palpitation	25	6.5
Sputum	25	6.5
Smell loss	25	6.5
Sweating	25	6.5
Rhinorrhoea	20	5.2
Nausea	20	5.2
Vomiting	20	5.2
Confusion	15	3.9

*One respondent considered more than one reason.

Table-III: *HRCT chest findings of the study patients (N=387).*

HRCT Chest	Number	Percentage
Abnormal	317	81.9
Normal	70	18.1
Total	387	100

Table-IV: *Abnormalities of HRCT chest findings of the study patients (N=317)*

Abnormalities	Number	Percentage
Consolidation	92	29
Ground glass opacities	184	58.1
Crazy paving appearance	41	12.9
Total	317	100

Table-V: *Association between HRCT with RT PCR findings (N=387)*

	RT-PCR			
HRCT	**Positive**	**Negative**	**Total**	**p value**
Abnormal	17	53	70	<0.001
Normal	309	08	317	
Total	326	61	387	

Table-VI: *Sensitivity, specificity, accuracy, PPV and NPV of the HRCT evaluation for prediction of COVID-19 (n=387)*

	Sensitivity, %	**Specificity, %**	**Accuracy, %**	**PPV, %**	**NPV, %**
HRCT	94.8	86.9	93.5	97.5	75.7

*PPV- Positive predictive value, NPV- Negative predictive value

DISCUSSION

In the present study, the mean age was found 53.32±13.48 years with male preponderance (72.6%). A study by Seyhan et al.[12] reported that the age range of the patients was 18-91 years where 130 (50.6%) were female and 127 (49.4%) were male. Murtaza et al.[13] reported that the majority of their study population consisted of males (62.8%) as compared to females (37.2%). The mean age in their study was 60 years. According to Mowla et al.[14], the average age was 41.7±16.3 years, and 63% of the participants were male. Hasan et al.[15] also observed similar findings. They showed the mean age of participants was 63 years and the number of male patients was more than twice the number of female patients (67.3% vs. 32.7%). These findings were similar to our study's findings. Due to decreased immunity and increased frequency of exposure to this contagious disease, vulnerability in older patients and male predominance were expected.

In the current study, the most common symptoms was fever (347; 89.6%), followed by shortness of breath (251; 64.9%), cough (241; 62.3%), ache (171; 44.2%), fatigue (96; 24.7%), taste loss (75; 19.5%), sore throat (65; 16.9%), and anorexia (65; 16.9%). Mowla et al.[14] revealed that, patients were admitted predominantly with fever (69%), cough (54%), breathlessness (41%), fatigue (40%), anorexia (26%) and diarrhoea (19%). Less frequent symptoms included chest pain, sore throat, headache, body ache, nasal congestion, anosmia, and nausea or vomiting. The earliest reports from China described fever, dry cough, breathing difficulties (dyspnoea), headache, and pneumonia as the typical clinical symptoms of COVID-19[16-18]. With an incidence of 3% (1/41)-79% (159/201), globally gastrointestinal symptoms of COVID-19 included anorexia 39.9% (55/138)-50.2% (101/201), diarrhoea 2% (2/99)-49.5% (146/295), vomiting 3.6% (5/138)-66.7% (4/6), nausea 1% (1/99)-29.4% (59/201), abdominal pain 2.2% (3/138)-6.0% (12/201) and gastrointestinal bleeding 4% (2/52)-13.7% (10/73)[19]. Paul et al.[20] also reported that, fever (91%), dyspnoea (41%), cough (33%) were the most frequent symptoms. Other symptoms were sore throat (12%), diarrhoea (12%), myalgia (12%), rectal bleeding (2%) and convulsion (1%). Guan et al.[21] discovered that the most common symptoms on or after hospitalization were fever (88%), followed by a dry cough (70.2%), fatigue (42.8%) and productive cough (36%).

Our study showed that in HRCT chest, consolidation was found in 92 (29%), GGOs in 184 (58.1%) and crazy paving appearance in 41 (12.9%). According to Caruso et al.[22] ground glass opacities (100%) with multi-lobe (93%) and posterior lobe (93%) involvement and bilateral distribution (91.4%) were the most frequent signs in COVID-19 cases that were confirmed by PCR. Similarly, Çinkoo lu et al.[23] (n=185) highlighted pure ground glass opacities (82.3%) to be present in most patients, followed by ground glass opacities with consolidation (32.7%) and the crazy paving pattern (21.8%). Similarly, Long et al.[24] (n=87) found the most common CT pattern in their cohort of COVID-19 cases was ground-glass opacities with consolidations (52.7%) in the lower lobes. Ma et al.[25] (n=158) also reported that the most common manifestation was ground-glass opacities (58%). However, Ai et al.[26] (n=1014) found that, consolidation and ground-glass opacities were reported in 50% and 46% of cases, respectively. Guan et al.[21] reported that at least one abnormal chest CT manifestation (Including ground-glass opacities,

pulmonary infiltrates and interstitial disorders) was identified in >70% of patients.

The current study observed that abnormal HRCT was found in 317 patients, out of whom 309 were positive and 8 were negative as evaluated by RT-PCR. The difference between the two groups was statistically significant ($p<0.05$). Seyhan et al.[12] revealed that 184 (71.6%) of the 257 patients got positive results from the RT-PCR test, while 73 (28.4%) had negative results. Out of 73 patients who had negative results from the first RT-PCR test, 56 (76.7%) had positive test results and 17 (23.3%) had negative test results after the second RT-PCR. According to Ai et al.[26], positive chest CT findings were found in 75% of patients with negative RT-PCR results and 97% of those with positive results.

This study showed that the sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV) of the HRCT examination for the prediction of COVID-19 pneumonia were 94.8%, 86.9%, 93.5%, 97.5%, and 75.7%, respectively. Based on a prospective analysis of 1014 patients, it was reported that the sensitivity of CT in detecting COVID-19 was 97%, and the sensitivity of RT-PCR ranged from 60% to 70%. In countries with a low COVID prevalence (<10%), the positive predictive value of RT-PCR has been reported to be ten times that of chest CT[26]. Recently, in a meta-analysis covering a wide prevalence range, RT-PCR sensitivity was reported to be 94% and specificity 37%[27]. As seen in the literature, for COVID-19, the sensitivity and specificity of RT-PCR and chest CT are controversial. Karam et al.[28] demonstrated that the sensitivity of CT for the identification of COVID-19 patients was practically equal to that of RT-PCR, with mean sensitivity values of 0.90 and 0.91, respectively. Specificity in identifying COVID-19 was reported in 10 studies enrolling 3689 patients. The specificity for chest CT was lower than that of RT-PCR in the identification of COVID-19 cases, with mean specificity values of 0.74 and 1, respectively. Kim et al.[27] reported pooled sensitivity to be higher in CT scan (Sensitivity=94%, 95% CI=91% to 96%, I2=95%) than RT-PCR (Sensitivity=89%, 95% CI=81% to 94%, I2=83%). Their study showed the sensitivity of RT-PCR to be slightly higher. Murtaza et al.[13] reported that, the sensitivity and specificity of typical and atypical HRCT in comparison with RT-PCR results were 91% and 76%, respectively and the positive predictive and negative predictive values were 83.4% and 86.3%, respectively. In another study by Qureshi et al.[9] reported that the sensitivity and specificity of HRCT were 97.41% and 80%, respectively, with a positive predictive value of 99.12% and a negative predictive value of 57.14%. Furthermore, they reported the diagnostic accuracy of HRCT for COVID-19 to be 96.69%[9]. Long et al.[24] revealed that the sensitivity of the CT scan was 97.2%, whereas the PCR sensitivity was 83.3%. The study authors recommend that it is better to isolate patients with typical findings of COVID-19 on chest CT even when PCR is negative for COVID-19 nucleic acids[24].

CONCLUSION

RT-PCR is the gold-standard test for identifying COVID-19. When RT-PCR is anticipated and COVID-19 case isolation is a concern, HRCT may be beneficial. Occasionally, there is high clinical suspicion of COVID-19, but RT-PCR may be falsely negative. Moreover, resources for RT-PCR may run short in light of the rising number of cases at some centres. In such circumstances, HRCT findings can be another possible option.

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