ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

THE VALUE OF HRCT CHEST IN DIAGNOSIS OF COVID 19AND ITS CORRELATION WITH RT-PCR

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ABSRACT

Objective: Aim of the study is to correlate CT findings of pulmonary involvement in COVID-19 positive patients with clinical findings and to investigate the role of CT Score in predicting result of patients.

Study Design: Single-centered retrospective analysis

Place and Duration of Study: The study has been conducted from June to November, 2020. Research has been carried out in District Headquarter Teaching Hospital, Sargodha.

Methodology: From June to November 2020, 138 COVID-19 patients who appeared positive for reverse transcriptase polymerase chain reaction were registered for chest CT analysis and clinical examination. Based on the range of lobular involvement quantitative CT scores were considered. Data was correlated with clinical findings.

Results: Among the patients 106(76.8%) were males and 32(23.18%) were females. Among 138 positive patients, 51(36.9%) cases were categorized as severe while 87(63.04%) were placed in mild group. Normal chest CT is shown by 89 (64.4%) patients while 49 (35.5%) patients show parenchymal abnormalities. Among the patients with abnormal CT findings bilateral 39/51 (76.5 %), multilobar (88.2 %) lung involvement with a predominant peripheral and posterior distribution is commonly observed. Ground glass opacity is the dominant abnormality which we observe in all 48 (97.9 %) cases. Pure Ground glass opacity is detected in 13 (27.08 %) and Ground glass opacity with mixed consolidation is noted in 17(35.4 %).

Conclusion: Chest CT findings have potential role in predicting consequence of COVID-19 positive patients. It can be beneficial for speeding up diagnostic workflow as CT findings are correlated with disease severity and clinical findings.

Keywords: COVID-19, High –resolution computed tomography, Chest X-ray (CXR) and RT-PCR.

INTRODUCTION

The recent outburst of novel coronavirus SARS-CoV-2 in Wuhan city, of Hubei Province of China has become pandemic. A global health emergency has been declared by WHO Emergency Committee in response of emerging cases in china and other countries of the world as well[1]. More than one million deaths have been instigated by coronavirus which denotes an alarming number[2]. Owing to surfeit of environmental, socioeconomic and ecological factors human diseases outbreaks have become diverse since 1980's. Prior to the emergence of severe acute respiratory syndrome in 2003 in China and 2012 in Saudi Arabia, coronaviruses were not considered extremely pathologic[3].

In literature the emphasis of radiological findings about corona virus is on High-resolution computed tomography (HRCT) that is a kind of CT (computed tomography) as it is more delicate than chest radiography. For COVID-19 first line of investigation was CT in China[4]. The reason behind using this technique for COVID-19 patients is that HRCT poses high sensitivity[5]. The sensitivity of pharyngeal and nasal swabs taken at the same time is inadequate which also depends on the technique of specimen gathering and technical individualities of test. COVID-19 patients would not be diagnosed quickly because of extensive turnaround time (TAT) for viral testing along with shallow sensitivity of RT-PCR (real-time reverse-transcriptase polymerase-chain reaction) for pharyngeal and nasal swab specimens[6]. In this scenario, chest diagnostic imaging has a primary relevance in the diagnosis and severity assessment of COVID-19 together with clinical manifestations, epidemiological history and laboratory tests.

Chest CT imaging has been demonstrated more sensitive than chest radiography (CR) to identify some of the manifestations of COVID-19. The aim of this study was to assess the potential role of chest CT in the early detection of COVID-19 and to explore its role in patient management in Pakistani population.

METHODOLOGY

The present study retrospectively evaluated data from symptomatic 352 patients (females, males; mean age 58 ± 12 years) from June to October 2020, presented with clinically suspected COVID-19. Ethical committee of DHQ Teaching Hospital Sargodha approved the study and informed consent forms were

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

duly filled by candidates. Patients with negative reports of RT-PCR were excluded from the study. Out of 352 patients RT-PCR results of 138 patients were positive for SARS-Cov-2 so, they underwent Chest CT imaging. Chest CT examinations were performed with a 64-slice scanner (Siemens SOMATOM Sensation, Siemens Medical Solutions, Forchheim, Germany) in a specific COVID-19-dedicated CT scan room of our Emergency Radiology Unit. To obtain high-resolution images, all data were reconstructed with a slice thickness of 1.0 mm. Depending upon the criteria set by Center of Disease Control (CDC) severity of disease was evaluated.

Nine CT findings were considered as ground-glass opacities (GGOs), consolidation, mixed GGO and consolidation, single or multiple solid nodules surrounded by ground-glass opacities (halo sign), bronchial wall thickening, air bronchogram, interlobular septal thickening, pleural effusion and mediastinal lymph node enlargement. Ground-glass attenuation was defined as a hazy increased opacity of lung, with preservation of bronchial and vascular margins. Consolidation was defined as a homogeneous increase in pulmonary parenchymal attenuation that obscures the margins of vessels and airway walls. Bronchial wall thickening was defined in areas not close to areas of ground-glass attenuation and/or consolidation. Air bronchogram was defined as a pattern of air-filled bronchi on a background of high-attenuation airless lung. Interlobular septal thickening was defined when a septum became thicker and was clearly visible than in normal conditions. Mediastinal lymphadenopathy was judged to be present when the minimal diameter of a lymph node was larger than 10 mm. The abnormalities were characterized as unilateral or bilateral. The distribution was categorized as peripheral, centrolobular, both peripheral and centrolobular, focal, multifocal and diffuse. Focal was defined as a single abnormality, multifocal as more than one abnormality and diffuse as a widespread involvement of most of the volume of one lung. Craniocaudal distribution was classified as upper lung predominant and lower lung predominant. Chest CT was classified into four categories (typical CT pattern, possible CT pattern, inconsistent CT pattern and negative for pneumonia) and subsequently into CT negative (inconsistent CT pattern and negative for pneumonia) and CT positive (typical and possible CT pattern) for COVID-19 pneumonia. This classification helped clinicians and anesthesiologist to rapidly address patients to the intensive care unit, having all information about lung parenchyma involvement.

Statistical analyses were run by using SPSS (v. 25). Mean values of continuous variables were expressed as ± standard deviation (SD). For single comparisons Mann-Whitney test was used, while for multiple comparisons Kruskal-Wallis test was applied. Percentages of demographic characteristics were expressed and were then compared with Fisher exact test. A statistical significant p-value was <0.05.

RESULTS

Among 138 positive patients, 51(36.9%) cases were categorized as severe while 87(63.04%) were placed in mild group. Among the patients 106(76.8%) were males and 32(23.18%) were females. The mean age was 45 years. As compared to the mild patients the patients with severe condition were older, median age 55 years vs 40 years. They were having more core comorbidities i.e Cardiovascular disease (8[5.7%] vs 0), malignancy (5[3.6%] vs 2[1.4%]), diabetes (13[9.4%] vs 4[2.8%]) and hypertension (6[4.3%] vs 12[8.6%]). Most of the patients had traveling history from epidemic area.

Table 1: Demographic Characteristics of COVID-19 Patients. (Significant p-value <0.05)

Characteristics	All patients (n=138)	Severe cases (n= 51)	Mild Cases (n= 87)	p-value
Living or traveling from epidemic area	82 (59.4%)	29 (56.8%)	53 (60.9%)	0.0203
Contact with positive patients	34 (24.6%)	13 (25.4%)	21 (24.13%)	0.409
No contact history	18 (13.04%)	8 (15.6%)	10 (11.4%)	0.125
Comorbidities	54 (39.13%)	21 (41.7%)	33 (37.9%)	0.003
Hypertension	18 (13.04%)	6 (11.7%)	12 (13.7%)	…
Malignancy	6 (4.34%)	2 (3.9%)	3 (3.44%)	…
Smoking history	14 (10.1%)	5 (9.8%)	9 (10.3%)	…
Cardiovascular disease	8 (5.79)	8 (15.6%)	0	…

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

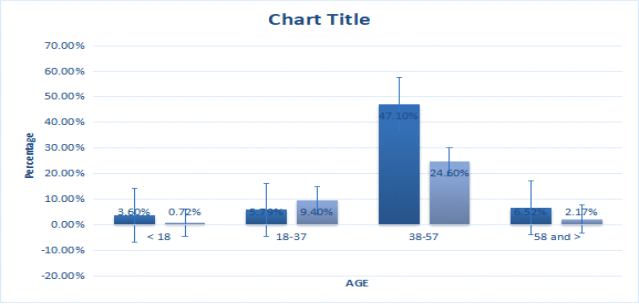

Figure 1: Percentages of COVID-19 patients within different age groups.

Chest CT observations

Abnormalities in lung parenchyma were observed in 49 (35.5%) patients, whereas 89 (64.4%) patients had normal chest RT results. Among 49 Patients with abnormal CT findings 35 (71.4%) showed bilateral lung involvement. 5 lobe involvement was showed by 28 (57.1%) patients while single lobe and two lobe involvement was showed by 9(18.3%) patients. Posterior distribution was observed in 49 (100%) patients from them 24 (48.9%) had posterior distribution while 26 (53.06%) had both posterior and anterior distribution. But none of the patients showed solitarily anterior distribution.

Purely central distribution was not seen in any of the patients. Peripheral distribution was observed in 47 (95%) patients, of them 14 (8.16%) had peripheral and central distribution while 33 (67.3%) had peripheral distribution. The dominant abnormality, Ground Glass Opacity (GGO) was observed in 48 (97.9%) patients. GGO mixed consolidation was observed in 17(35.41%) patients, 19(39.5%) patients showed GGO with intralobular lines and interlobular septal thickening and 13(27.08%) patients were noted with pure GGO.

Table 2: Chest CT findings.

CT findings of Lung abnormalities	No. of patients	%
Absent	89	64.4%
Present	49	35.5%
Lung Involvement		
Right lung	5	10.2%
Left lung	7	14.2%
Bilateral	35	71.4%
Lobular involvement		
Left upper lobe	39	79.5%
Left middle lobe	41	83.6%
Left lower lobe	28	57.14%
Right lower lobe	43	87.7%
Right middle lobe	36	73.46%
Right upper lobe	46	93.87
1 lobe	5	10.2%
2 lobes	4	8.16%
3 lobes	1	1.6%
4 lobes	11	22.4%
5 lobes	28	57.1%
Opacity location		
Central	0	0
Peripheral	33	67.3%
Central and peripheral	14	8.16%

Significant difference was witnessed while comparing clinical findings and CT score (<0.002). In critical category the CT mark was higher significantly while making multiple comparisons (mean value ± SD: 23.6 ± 3, 15-24) as compared to mild category (7.6 ± 5; range 1-18) ($p<0.002$). In severe category CT score was significantly higher (20.4 ± 2.9; range 15-30) than in mild cases (9.3 ± 4; range 0-15) ($p<0.002$). Between critical and severe categories no significant value have been observed ($p=0.7921$).

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

Discussion

The presence of bilateral GGOs is COVID-19 pneumonia whether or not the consolidative areas are present as this study confirms[7]. It has been reported that in early phase the presence of GGOs represented the correlation of imaging of acute-phase diffuses alveolar damage with bronchiolar fibrin, airspace edema and interstitial thickening[8]. Activation of virus mediated T and B cells occurs in the late progression of disease which triggers an autoimmune response by causing an intense production of inflammatory cytokines[9]. Due to the heterogeneity of disease manifestations including subclinical forms and asymptomatic to critical disease along with ARDS clinical course is unpredictable.

Ferritin is a key mediator of immune dysregulation and contributes a lot to cytokine storms which may cause disease severity. An increase in ferritin level may cause severe complications from Covid-198. One study reported an increased ratio of serum ferritin levels in patients with very severe COVID-199. Another study reported a great association of increased ferritin level with death. They observed that the median ferritin level exceeded the normal range of 9 within 16 days of hospitalization which enhances the risk of death10.

For identifying patients who need instant medical consideration or for estimation of the mortality rate there is no accessible predictive biomarker[10]. Correlation of disease progression CT prediction and clinical findings may be helpful for clinical staff for establishing early treatment for the patient, even though therapy against COVID-19 is based on empirical decisions instead to evidence. The assumption has been verified by using validated CT score stated by Pan et al. centered on lobular extent[11].

Comparison of CT scoring with the independent risk factors that were associated with ARDS categorized as age, presence of comorbidities and dyspnea[12]. Prognostic age importance has been confirmed by the mortality data, as the mortality rate was higher in patients with age 70 or above. We have observed negative CT in large proportion of patients with positive RT-PCR result. While the results been reported by Korea, China and Europe shows 61%-100% patients with lung-parenchymal abnormalities of RT-PCR confirmed COVID-19 patients[13]. A study reported 71.8% CT positive results in COVID-19 confirmed cases along with clinical symptoms. The percentage of critical cases was 10.2%, common 59% and 30.5% mild cases reported in the study[14]. Caruso D et al. stated that on CT 96.6% of pulmonary findings were observed in symptomatic patients. The common symptom was fever (61%) while 56% patients had cough and 33% had duspnea[15]. A study reported 100% CT positivity rate in which mild symptoms were shown by 2/3 of the cases with dyspnea 10% and fever 86%[16]. The CT findings have confirmed the symptomatic COVID-19 patients in the population in comparison with the data from different countries. CT scans are only performed for the RT-PCR positive patients but not for all symptomatic patients that's why the prevalence rate of CT Is low in our country. Increased severity rate has been associated with comorbid illnesses[17]. Patients who showed abnormalities in lung parenchymal on chest CT were also having multilobar and bilateral distribution of pulmonary opacities. The distribution and type of pulmonary opacities observed in COVID-19 patients are in line with our findings. Pure GGO (13) and GGO (17) with mixed consolidation was the dominant abnormality observed in all cases. The findings are in accordance with many studies stated by Salehi et al. in the review[18].

CONCLUSION

CT findings can help in predicting temporary outcome of COVID-19 positive patients. A high proportion (64.4 %) of normal chest CTs was witnessed in mildly symptomatic RT-PCR positive COVID-19 patients. Same CT features have been observed in CT positive patients as reported by many studies with a majority of GGOs in a bilateral and multilobar dissemination with peripheral and posterior predilection. This study strongly recommends chest CT for COVID-19 positive patients which proved to be effective an swift gatekeeper to preclude patients with low probability of disease.

CONFLICT OF INTEREST

Author declares no conflict of interest by any author with this study.

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