Different Patterns of HRCT Chest in Patients with 2019 Novel Coronavirus SARS-CoV-2

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MAM SAN conceived idea, MAM RS MWA drafted the study, ANJ SA RS collected data, MAM SAN ANJ did statistical analysis and interpretation of data, MAM MWA SAN critical review manuscript, All approved final version to be published.

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The authors declare that there is no conflict of interest.

Abstract

Background: COVID-19 commonly known as Coronavirus disease is a sensitive type of pneumonia caused by the β-coronavirus (SARS-CoV-2). Up till now six different species of coronavirus have been recognized which cause disease. Four of them can cause common cold while remaining two are foundations of svere acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) resulting into fatal sickness.

Methodology: Sampling consists of 100 patients which was collected between April 2020 to November 2020 in Nishter University Hospital Multan. Sample included 64 Males and 36 Females having age ranging from 28 to 92 years. Analysis was based on irrefutable characteristics of the patients and morphology, distribution pattern and accompanying manifestations of lung lesions with number of lobes involved on HRCT chest.

Results: The mainstream of the impure patients were having common pattern of Ground Glass Opacities (84%). Different other patterns included Consolidation (41%), Infiltrates (28%), Reverse halo (4%), Crazy Paving (4%), Vessel wall widening (30%), Spider web sign (4%), Septal thickening (38%). Combination of different pattern include GGO with consolidation (33%), GGO with infiltrates (28%), GGO with reverse halo sign (4%). Distribution of pattern was symmetrical (16%) and asymmetrical (84%), Peripheral (100%) and central (0%), sub pleural (20%) and basal (100%), both basal and sub pleural (20%). Number of lobes affected by COVID were: one lobe (0%), two lobes (8%), three lobes (42%), four lobes (25%) and five lobes (25%) Almost 50 cases out of 100 had four or five lobes affected.

Conclusion: Our study included those patients who were having respiratory Or gastrointestinal symptoms and all were PCR positive. We observed that most common pattern on HRCT was Ground glass (84%). Other patterns observed were Consolidation, Infiltrates, septal wall thickening, GGO with consolidation, GGO with infiltrates. Less common patterns were Reverse halo, crazy paving and GGO with reverse halo 4% each. Most common distribution pattern was basal, peripheral, sub pleural and asymmetrical. We observed that COVID involved multiple lobes.

Key words: HRCT Chest; SARS-COV-2; GGO; Crazy Paving; Consolidation

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Introduction

COVID-19 which is known to be Coronavirus is an acute type of pneumonia caused by the β-coronavirus (SARS-CoV-2). Shape of this virus is varies as it exists in spherical, oval, polymorphic or can be in enveloped one having a diameter of almost 60–140 nm.[1] Heritably, it is very much different from MERS-CoV and SARS-CoV. Main source of infection in this virus is through respiratory secretions and it is very dangerous as in this virus asymptomatica patients can also be the source of spread of virus. Close contact is also another spreading cause. Where persons are open to the elements of elevated concentrations of aerosols in a closed environment the chances of spread of this deadly virus enhances while fecal-oral transmission remains to be inveterate uptil now.[2-4] SARS-CoV-2 is a beta coronavirus that is linked to the family of Coronaviridae and the other Nidovirales.[5] The clinical signs of infection include fever, dry cough, and dyspnea.

A positive test result for the SARS-CoV-2 nucleic acid is essential for labelling the case as Confirmed.[6]

By the end of this time six coronavirus varieties have been acknowledged to contaminate persons and cause disease. 229E, OC43, NL63, and HKU1 infections are mild and mostly caused common cold symptoms. Remaining two types of Coronavirus are severe acute respiratory syndrome and the other one is Middle East respiratory syndrome coronavirus which are known to cause fatal respiratory illness.[7,8] For definitive diagnosis test for nucleic acid is mandatory which should be positive.[9] However the specificity of nucleic acid testing is high but the sensitivity is relatively low so chances of false negative results are high. Diagnosis with chest High Resolution Computed Tomography (HRCT) is more accurate and faster, chest CT is therefore the main method used for screening and diagnosis.[10,11]

In this study, we retrospectively analyzed HRCT imaging data from 100 patients who tested positive for COVID-19 in our hospital in order to examine the CT characteristics of infection. We hope our findings will provide useful information for medical imagers to identify the different patterns and characteristics of COVID-19 pneumonia and assess its evolution.

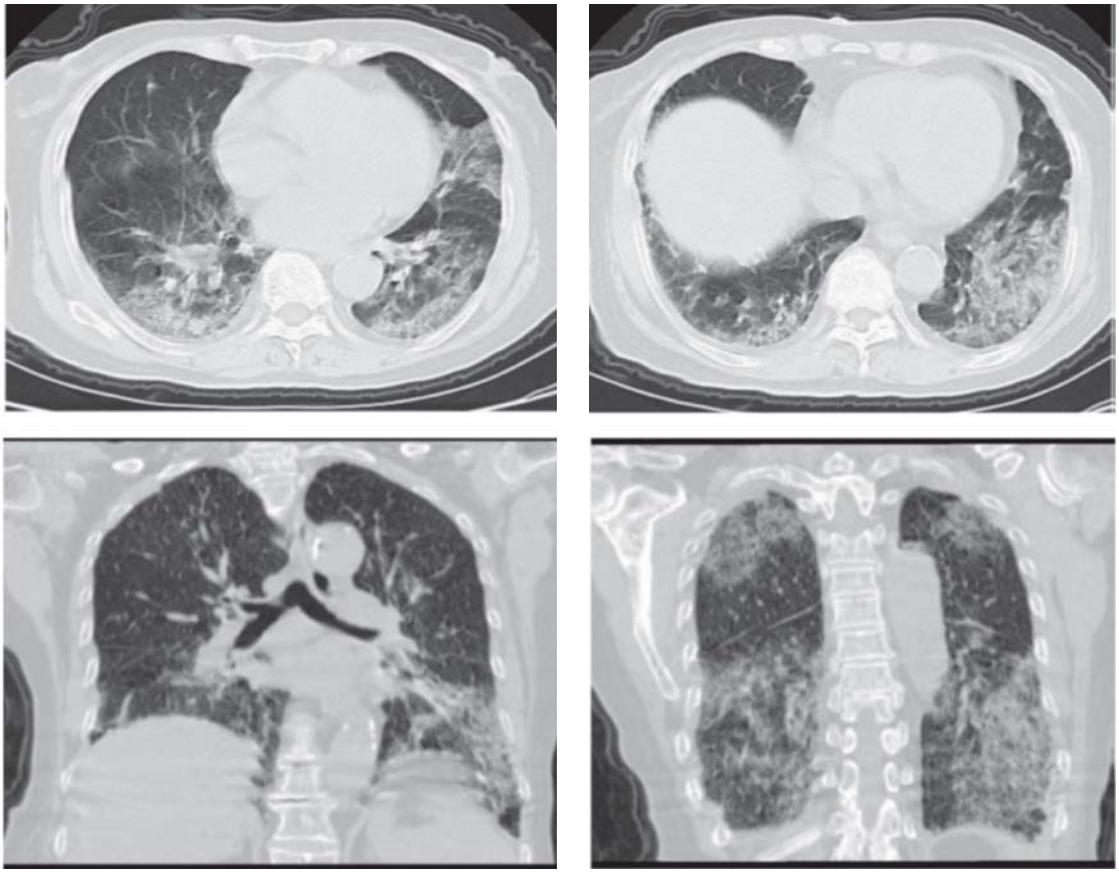

Fig. 1: Areas of consolidated bilaterally in the lung periphery and sub pleural areas (arrow) and extensive ground-glass opacities are more prominent in the lower lungs.

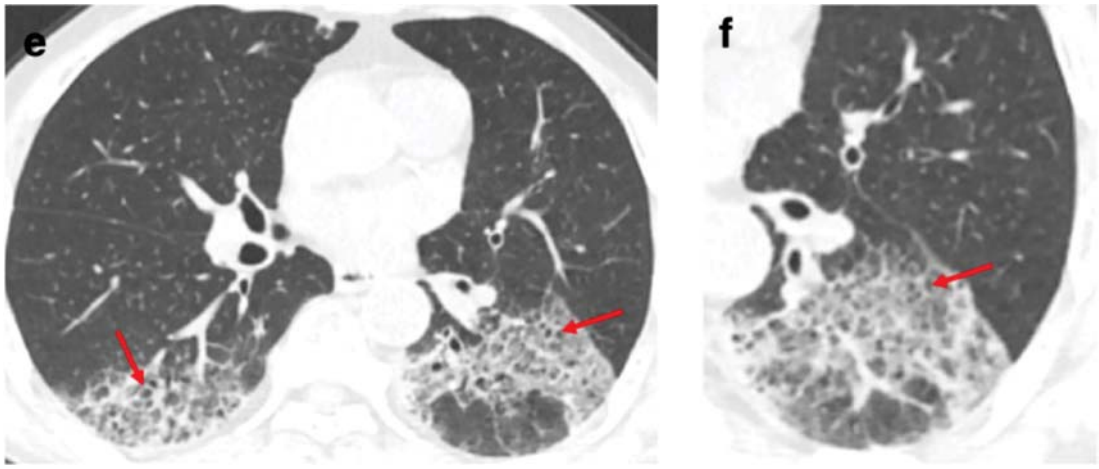

Fig 2: Thickening of the adjacent pleura and multiple ground glass opacities in the both lower lobes. (Red Arrows) are showing crazy paving pattern.

Methodology

It was a retrospective analysis of data. In the premises of our hospital , 100 patients underwent HRCT scans who were positive for SARS-CoV-2 by Nasoph-aryngeal swab during July and August 2020. Patients included in study were meeting in one of the following two sets of criterion:

1: Patients having history of heightened dyspnea, positive SARS-CoV-2 nucleic acid test results and radiological evidence of pneumonia.

2: Patients having history of sore throat, fever, diarrhea, cough and other gastrointestinal and respiratory symptoms, and positive SARS-CoV-2 nucleic acid test results.

Following patients were excluded from this study

1: Patients with preexisting respiratory diseases such as tuberculosis, malignancy etc.

2: Patients with gastrointestinal issues leading to loss of appetite.

3: Trauma and patients with bleeding.

Study included 36 female and 64 male patients aged from 28 to 92 years, all of them were COVID positive by PCR. These patients fulfilled inclusion criteria 1 or 2 as mentioned above. HRCT chest was performed in all the patients at booking

Then patients were shifted to isolation ward, HDU or ICU according to their clinical condition and oxygen demand.

In context with the "COVID-19 Imaging Examination and Diagnosis, Quality Control Protocol (interim 3rd edition)", N95 masks or surgical masks should be used by the suspected COVID-19 patients. Their hands should be disinfected before entering the imaging room. In isolation zone it was made clear that the radiology technician will wear protective gear and no one will be present in that room. Adoption of supine position by patients was ensured and breath was being held. The scan parameters of CT machine were set as follows: tube current 120 mA, tube voltage 120 kV, scanning duration <5s, slice interval 01 mm, standard lung window level 600 HU, and window width 1600 HU.

Two leading radiologists having experience in chest radiology interpreted the images. Analysis of the

Table 1. Distribution of different HRCT patternsin COVID-19 at presentation

Distribution of Different Patterns	n = 100
Symmetrical	16 %
Asymmetrical	84 %
Peripheral	100 %
Central	0 %
Sub pleural	20 %
Basal	100 %
Basal plus sub Pleural	20 %

Table 2. Different patterns seen in SARS-CoV-2 at presentation

Different Patterns	N = 100
Ground glass	84 %
Consolidation	41 %
Infiltrates	28 %
Reverse Halo	4 %
Crazy Paving	4 %
Vessel wall thickening	30 %
Spider web sign	4 %
Septal wall thickening	38 %
GGO + Consolidation	33 %
GGO + Infiltrates	28 %
GGO + Reverse Halo	4 %

imaging data was done in the dearth of laboratory or clinical results. By the help of discussion discrepancies were resolved after independent appraisal.

Different patterns of CT scan were seen that includes: Ground glass opacities, consolidations, infiltrates, reverse halo sign, crazy paving pattern, vessel wall widening, spider web sign and septal thickening. Moreover, combinations of different pattern were also observed namely ground glass with consolidation, ground glass with infiltrates and ground glass with reverse halo sign.

Data was analyzed by SPSS version 22. Quantitative variables like age and number of lobes were statistically analyzed in mean and standard deviation. Qualitative variables like gender, pattern distribution, types of lesions were statistically analyzed in frequency and percentage.

Results

This study included 100 patients (64 males and 36 females) ranging from 28 to 92 years. Median age was 66.56. Tables 1,2 and 3 summarizes different pattern seen on HRCT as well as their distribution and number of lobes involved. Most common pattern seen was Ground Glass Opacities (84%). Different other patterns include Consolidation (41%), Infiltrates (28%), Reverse halo (4%), Crazy Paving (4%), Vessel wall widening (30%), Spider web sign (4%), Septal thickening (38%). Combination of different pattern include GGO with consolidation (33%), GGO with infiltrates (28%), GGO with reverse halo sign (4%)

Distribution of pattern was symmetrical (16%) and asymmetrical (84%), Peripheral (100%) and central (0%), sub pleural (20%) and basal (100%), both basal and sub pleural (20%).

Number of lobes affected by COVID were, (0%) one lobe, (8%) two lobes, (42%) three lobes, (25%) four lobes and (25%) five lobes .

Discussion

Irrefutable presentation of a typical COVID-19 is fatigue, fever, dry cough and shortness of breath and such appearance is unswerving with lower respiratory tract infection. Runny nose, nasal congestion and other upper respiratory tract symptoms are also seen. Dyspnea may crop up during start of 2nd week of illness, and sternly affected patients rapidly advances to refractory metabolic acidosis, septic shock, acute respiratory distress syndrome , multi organ failure and coagulation disorders.[12-13]

Our study included those patients who were having respiratory

Or gastrointestinal symptoms and all were PCR positive. We observed that most common pattern on HRCT was Ground glass (84%). Other patterns observed were

Table 3. Number of Lobes involved in SARS-CoV-2 at presentation

No. of Lobes	N = 100
1 lobe	None
2 lobes	8 %
3 lobes	42 %
4 lobes	25 %
5 lobes	25 %

Consolidation (41%), Infiltrates (28%), septal wall thickening (38%), GGO with consolidation (33%), GGO with infiltrates (28%). Less common patterns were Reverse halo, crazy paving and GGO with reverse halo 4% each. Most common distribution pattern was basal, peripheral, sub pleural and asymmetrical. We observed that COVID involved multiple lobes. Almost 50 cases out of 100 had four or five lobes affected.

Similar studies were done in other countries. In the Department of Interventional Radiology same study was conducted by Xugong Zou, Ning Cui in Zhongshan Guangdong, China. In this study almost similar observations were noted like peripheral subpleural GGO was seen in 41.5% patients, Septal thickening 35.8%, GGO with consolidation 30.5%. Multiple lobes involvement were seen in 60 % patients.[14] Another study was conducted by Jing Qu, Chengcheng Yu , Xi Xu et all in China and results were seen similar. Almost 50% of the patients taken in this study had peripheral distribution and bilateral 'multifocal lung lesions' while more than two lobes were involved in 59% patients. In all selected patients, COVID-19 pneumonia presented with crazy paving pattern in 12%, consolidation in 13%, interlobular thickening in 37%, adjacent pleura thickening in 56%, and linear opacities combined in 61% and GGO in 72%.[15]

Both the above studies showed Ground glass pattern as the dominant CT finding. 1st study showed 41.5 % and 2nd study showed 72 % GGO while our study showed 84 % GGO pattern which is higher as compare to those two studies.

This depicts that we also had the same pattern of disease as in China with more frequent cases of ground glass pattern. One reason for this could be early trend of HRCT chest done in our hospital while it was done at different timings in other studies. However, more studies are needed to establish relationship of COVID 19 and different patterns on HRCT.

Conclusion

Our study included those patients who were having respiratory Or gastrointestinal symptoms and all were PCR positive. We observed that most common pattern on HRCT was Ground glass (84%). Other patterns observed were Consolidation, Infiltrates, septal wall thickening, GGO with consolidation, GGO with infiltrates. Less common patterns were Reverse halo, crazy paving and GGO with reverse halo 4% each. Most common distribution pattern was basal, peripheral, sub pleural and asymmetrical. We observed that COVID involved multiple lobes.

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