Research Article

Radiological and Clinical Pattern in Severely/Critically ill COVID–19 Positive Patients

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Abstract

Background: Radiological role is not only in the early detection of lung disease, but also to determine its severity, its complications like acute respiratory distress syndrome and superadded bacterial infection.

Objective: To determine the radiological and clinical pattern in severely / critically ill COVID – 19 positive patients admitted in High Dependency Unit / Intensive Care Unit of Mayo Hospital Lahore.

Methodology: This descriptive study was conducted in Institute of Chest Medicine Mayo Hospital Lahore which continued over a period of 6 weeks. 50 patients who were r RT-PCR COVID-19 positive and were hemodynamically unstable admitted in HDU/ICU of Mayo Hospital from 16th April 2020 to 30th May 2020 were included. All these patients had positive X-ray findings.

Results: Study comprised of 50 patients, 34 (68%) males and 16 (32%) females. Presenting complaints were fever 22 (44%), dry cough 10 (20%), dyspnea 10(20%), sore throat 4 (8%), loss of sense of smell 2(4%) and fatigue with body aches 2(4%). Majority of patients i.e 28 (56%) patients had typical X-ray chest findings of COVID-19 pneumonia of L phenotype in which there was peripheral, basal ground glass opacity with or without superadded consolidation bilaterally. Diffuse pattern of disease of H phenotype with peripheral, upper zones, middle zones involvement along with lower zones disease was seen in 7 (14%) patients.

Conclusion: X-ray chest demonstrated a mixed pattern of ground glass opacities / consolidation mainly in peripheral and bilateral lower lung zones with predominantly L phenotype of pneumonia in severely / critically ill COVID-19 patients which was out of proportion to their clinical parameters.

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Key Words: COVID-19, X-ray Chest, Ground glass opacity, Consolidation, HDU, ICU.

Introduction

The COVID-19 crisis is the greatest disaster this world has confronted recently. It is an infectious disease which primarily targets the respiratory system caused by the virus named severe acute respiratory syndrome coronavirus 2 (SARS COV-2). Incubation period is 2-14 days (may change).

This virus is fundamentally spread between individuals during close contact mostly through droplet infection.[1,2] It can cause mild to moderate chest infection but it may lead to severe pneumonia and can be deadly particularly in older individuals or those who have other comorbid diseases like diabetes, cardiovascular disease, cancer or chronic obstructive pulmonary ailment which puts them at higher risk due to their morbids. Co morbidities may intensify with associative COVID infection in immunocompromised patients.[3] Spread of infection is possible before the symptoms appear and even from the asymptomative patients. Common clinical symptoms include fever, dry cough, dyspnea, severe body pains, flu like illness, headache, fatigue and loss of smell or taste. Patients may initially present with diarrhea and nausea preceding to fever and also may present with conjunctivitis. Disease may lead to multiple organ failure (e.g., septic shock, acute respiratory distress syndrome, acute cardiac injury leading to myocarditis, coagulopathy progresssing to disseminated intravascular coagulation and acute renal injury) and eventually death in the severe cases.[4,5] The prompt diagnosis is very crucial for starting treatment and limiting the spread of disease. The standard method of diagnosis of COVID-19 is by real time reverse transcription polymerase chain reaction (rRT-PCR) with sample taken from the nasopharyngeal swab. Sample can be taken from oropharynx too. It is believed to be highly specific along with other laboratory testing. Diagnostic imaging like X-ray chest and HRCT are equally useful to diagnose COVID-19 individuals with high clinical suspicion of disease. Imaging findings are very important for diagnosis as sometimes radiological evidence of disease may appear prior to clinical features. Most commonly performed investigation in COVID-19 suspected cases is X-ray chest.[5] X-ray can be used as a first-line approach because they are easily available and can be easily decontaminated. Patients requiring X-ray chest should have portable X-ray to limit transporting of patients. Machines including any ancillary equipment which were used during examination should be thoroughly cleaned and disinfected afterwards to limit spread of infection. [6,7]

Imaging is very significant in evaluating severity and disease progression in COVID-19 infection. The most common X-ray findings are airspace opacities, described as consolidation (area of increased density due to complete alveolar filling with no underlying visible bronchovasular markings) or, less commonly as ground glass opacity (area of haze with visible underlying bronchovascular markings due to incomplete alveolar filling). Patients may show areas of ground glass opacities admixed with consolidation. The distribution is mostly peripheral with basal predominance and seen bilaterally. However advanced cases may also involve middle and upper zones. Pleural effusion and lymphadenopathy is very rare.[8] The predominant imaging finding of COVID-19 on HRCT are that of atypical pneumonia or organizing pneumonia. Bilateral, multilobar, ill defined GGO with somewhat rounded configuration and with posterior segments involvement at the start of infection. Consolidation with subpleural region involvement, crazy paving pattern, bronchiolar dilation, bronchovascular thickening in the lesion and traction bronchiectasis with architectural distortion may appear as the disease progresses further. Complications include pneumonia and acute respiratory distress syndrome. Rarely findings are unilateral. GGO/consoledation is usually seen in basal segments.[9,10,11] The spectrum of the Covid-19 pneumonia falls into two phenotypes. Type L is described by low elastance, low lung weight and low recruitablity. and Type H is described by high elastance, high lung weight and high recruitability. Treatment protocols is different between the two types.

COVID-19 Pneumonia Type L : Only GGO are seen mainly located sub pleurally and along lung fissures which is due to subpleural interstitial oedema. The change from type L to type H phenotype may be due to the progression of the COVID-19 pneumonia or due to injury induced by high pressure mechanical ventilation.

COVID-19 pnemonia Type H, 20-30% of patients fall into severe ARDS criteria with bilateral diffuse involvement on chest X-ray. CT scan is the investigation of choice in terms of diagnosis of disease and for assessment of its severity but it has its limitations in terms of availability and lengthy decontamination protocols.[12] Another diagnostic modality in

the evaluation of critically ill COVID-19 patients admitted in ICUs is chest ultrasound. It shows multiple B Lines which may be focal or diffuse representing thickening of subpleural interlobular septa, with thickened and irregular pleural line and subpleural consolidations with air bronchogram.[11]

Methods

It was a retrospective and descriptive study which continued over a period of 6 weeks from 15th April 2020 to 30th May 2020. Study was conducted in Institute of TB & Chest Medicine Department Mayo Hospital / KEMU Lahore after approval of Ethical Committee. Study comprised of 50 severely / critically ill rRT-PCR COVID-19 positive patients of either gender and of no age limit admitted in HDU/ICU of Mayo Hospital who were hemodynamically unstable. All these patients had X-ray chest with them with positive X ray findings and were fulfilling the criteria for being admitted in HDU/ICU according to the guidelines of Government of Pakistan Ministry of National Health Service Regulations & Coordination.[13] A severity score i.e Radiographic Assessment of Lung Edema (RALE) for quantification of the extent of lung infection was applied which was proposed by Warren et al.[17] A score of 0-4 was assigned depending on lung involvement (Score 0 = no lung involvement; 1 = <25%; 2 = 25-50%; 3 = 50-75%; 4 = >75% of lung involvement). Patients falling into severe type admitted in HDU presented with clinical manifestations of pneumonia with fever and dry cough mainly and any of the following features i.e had respiratory rate _>30 times/min, SpO2 < 90 at rest, severe respiratory distress, PaO2/FiO2_< 300 mmHg, Chest X-ray showing more than 50 % of lung parenchymal involvement. They had oxygen requirement between 5 to 10 litres / min according to their saturation. Critically ill patients which got admitted in ICU presented with any of the these three manifestations first is ARDS which needed mechanical assistance with oxygen requirement more than 10 litres / min. Their X-ray chest showed bilateral GGO/consolidation not fully explained by cardiac failure or volume overload. ARDS ranged between mild to severe. Mild ARDS showed PaO2/FiO2 > 200 mmHg and <= 300 mmHg. Moderate ARDS patients had PaO2/FiO2 <= 200mmHg and > 100 mmHg and Severe ARDS patients showed PaO2/FiO2 <= 100mmHg. Second is Septic shock with persistent hypotension inspite of volume restoration of the patients. Third manifestation is life threatening Multiple organ failure. Signs of which include: Altered mental level, labored breathing, low SpO2, decreased urine output, hypotension, tachycardia, weak and feeble pulse, cold extremities, mottling of skin, thrombocytopenia, coagulopathy with impending DIC, metabolic acidosis, high lactate level etc. A review of X-ray chest analysis with clinical parameters was done of every patient.

The data was entered in SPSS Version 26. Qualitative variables like gender, co-morbids, signs & symptoms were presented as frequency and percentages while quantitative data like age was expressed as mean ± standard deviation or number. Graphics were performed using Microsoft excel.

Results

Total 50 patients who were COVID-19 positive which fulfilled our criteria reported during the specified time of our study. Out of 50, 34 (68%) patients were admitted in HDU and 16 (32%) patients admitted in ICU. Mean age was 56 +-11 years with age range between 32-80 years. There were 34 (68%) males and 16 (32%) females. Male predilection for this disease was noted. Presenting complaints were fever 22 (44%), dry cough 10 (20%), dyspnea 10 (20%), sore throat 4(8%), loss of sense of smell 2(4%) and fatigue with body aches 2(4%). Travel history was present in 3 patients. 20 patients were hypertensive out of which 6 had history of ischemic heart disease as well, 16 patients were diabetic, Only 4 patients had no co morbid, 2 had respiratory disease and 2 had underlying malignancy so were immune-compromised. Out of 50 patients, 28 (56%) patients had typical X-ray chest

findings of COVID 19 pneumonia of L phenotype in which there was peripheral, basal ground glass haze / consolidation. Diffuse pattern of disease of H phenotype with peripheral, upper zones, middle zones involvement along with lower zones disease was seen in 7 (14%) patients. 7 (14%) patients had X-ray findings of bilateral peripheral and basal consolidation and only 5 (10%) had only peripheral middle zones involvement. Chest X-ray of 3 (6%) patients had unilateral subtle haze or GGO. Our Severity score i.e RALE proposed by Warren et al ranged between 3-7 respectively. Most of the patients had underlying sequelae of chronic disease process with superimposed fresh COVID pneumonia on their X-rays. Costophrenic angle sparing was noted in all of X-rays as there was no pleural effusion. No lymphadenopathy was noted. The predominant imaging pattern noted was air space GGO and consolidation. The distribution was mostly bilateral, peripheral with lower zone predominance.

Table 1: *Demographic and Clinical Characteristics of Patients*

Characteristic	n (%)
Sex	
Male	34 (68)
Female	16 (32)
Age (mean +/- SD)	mean = 56 +/- 11
Comorbidity	
Diabetes	16 (32)
Hypertension	20 (40)
Malignancy	2 (4)
Chronic obstructive pulmonary disease	2 (4)
Ischemic heart disease	6 (12)
No comorbid	4 (8)
Signs and symptoms	
Fever	22 (44)
Dry cough	10 (20)
Shortness of breath	10 (20)
Sore throat	4 (8)
Loss of sense of taste and smell	2 (4)
Fatigue with body ache	2 (4)

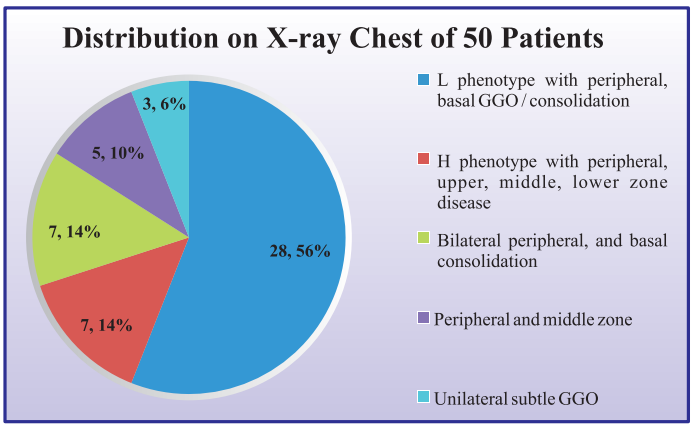

Figure 1: *Distribution of Disease on X-ray Chest*

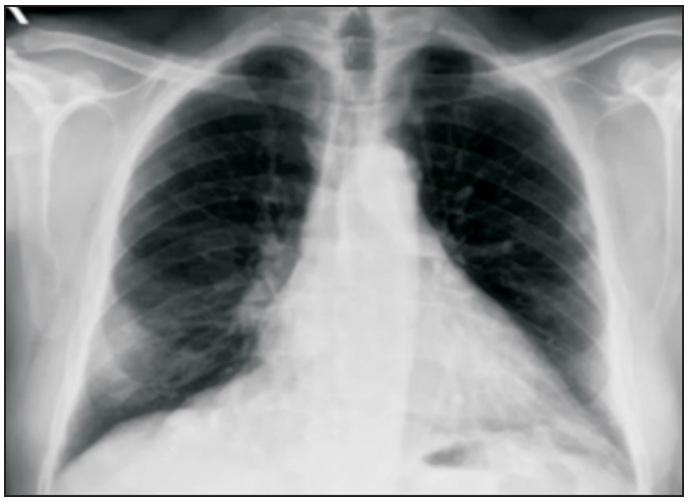

Figure 2: *Area of Opacification in Right Lower Zone and Multifocal Areas on Left Side in the Peripheral Region on X-ray Chest of COVID-19 Patient*

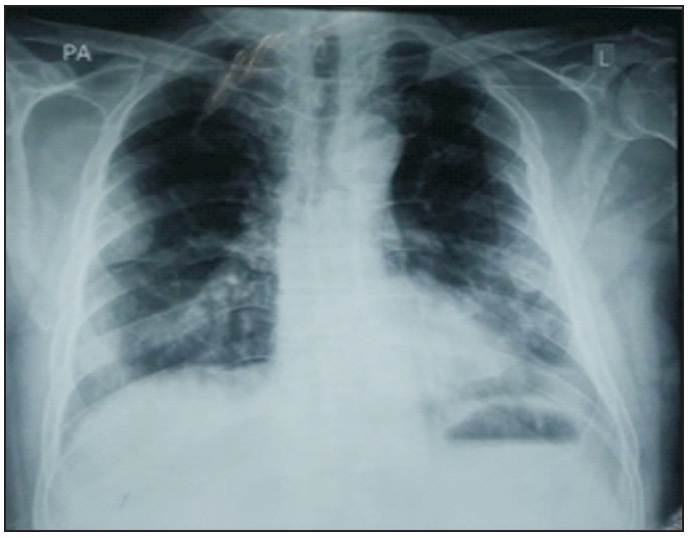

Figure 3: *Opacification Bilaterally in Periphery of Middle and Lower Zone more Pronounced on the Right Side of COVID-19 Positive Patient*

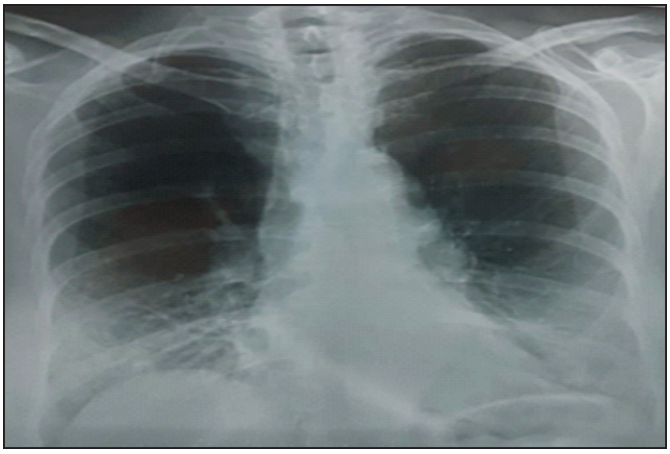

Figure 4: *Bilateral Opacification is Seen in Both Lower Zones More Marked in the Peripheral Region of COVID-19 Patient*

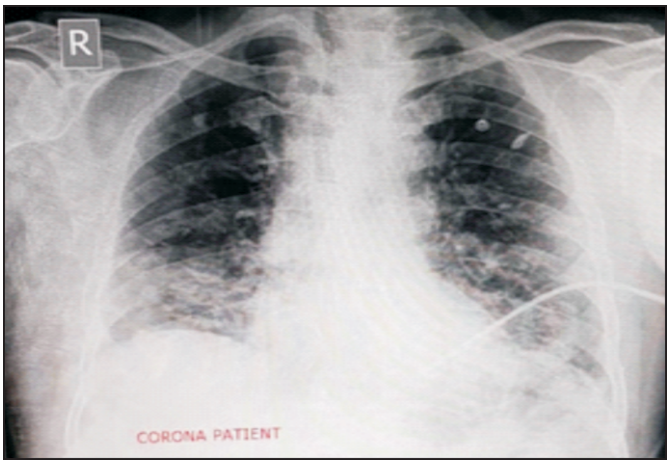

Figure 5: *Ground Glass Haze with Visible Bronchovascular Markings Underneath is Seen in Both Lower Zones with Angle Sparing in COVID-19 Patient*

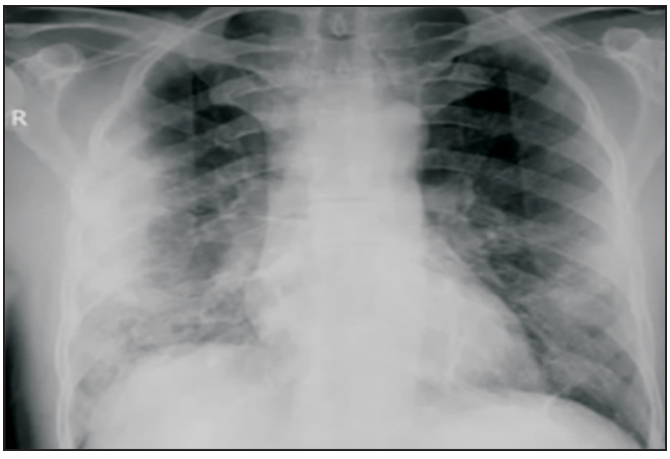

Figure 6: *Consolidation/Ground Glass Haze Seen in Middle and Lower Zones, More on the Right Side with Peripheral Predominance in COVID-19 Patient*

Figure 7: *Dense Peripheral Consolidation in Upper, Middle and Lower Zones Bilaterally in Advanced Intubated Case of COVID-19.*

Discussion:

Radiological findings are very helpful in predicting the clinical outcome of the disease process and its severity. Characteristic manifestations of COVID pneumonia on CT Chest are extremely helpful in early diagnosis and eventual control of this global health emergency. X-ray chest is the first line imaging modality used for suspected COVID-19 patients with portable chest radiography carries minimum risk of cross infection.

We found in our study that majority of patients had peripheral and basal ground glass opacities with or without superimposed consolidation bilaterally as reported in many international studies. In Yoon et al study, 33% of his patients had parenchymal abnormalities detected by chest radiography, and most of the abnormalities were peripheral consolidation which is comparable to our study.[10] In Wong et al study X-ray showed up on 69% of patients (69% sensitivity). Consolidation was the main radiological finding (47% of cases), followed by GGO (33%) and there was more peripheral and lower zone distribution. Pleural effusion was uncommon.[11] Kong W noted an organizing pneumonia pattern characterized by peripheral distribution predominently in his study.[15] Lei J1 showed that multiple chest x rays in 21 patients revealed involvement of multiple lobes and rounded as well as peripheral opacities. The opacities most commonly

were ground glass opacities (57%) and some of mixed attenuation (29%).[18]

In our study HRCT was not done due to logistic issues. X-ray facilities are easily accessible in basic health units of our country and this study will benefit our medical professionals with clear understanding of X-ray chest pattern in suspected COVID-19 patients. As the pandemic is progressing ahead, the medical community will rely more on portable X-ray due to its widespread availability and reduced infection control issues. Now as the number of COVID positive patients are increasing exponenttially all over in Pakistan additional thorough and comprehensive studies should be done to benefit the medical community as a whole.

Conclusion:

Manifestations of COVID-19 infection on chest X-ray demonstrated a mixed pattern of ground glass opacities / consolidation mainly in peripheral and lower lung zones bilaterally. L phenotype of pneumonia was more common in severely / critically ill patients admitted in HDU/ICU of Mayo Hospital Lahore which was out of proportion to their clinical status.

Ethical Approval: Given

Conflict of Interest: The authors declare no conflict of interest

Funding Source: None

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