Radiological Features of COVID-19 Patients in Hodeidah , Yemen

ABSTRACT

Background: The radiological techniques namely chest radiography (chest X – ray) and computerized tomography (CT) scan play a major role not only in the early detection and diagnosis, especially for false negative Real Time –Polymerase Reaction (RT-PCR) tests but in admission criteria, monitoring the clinical course and the disease severity.

Objective: The study aimed to describe the radiological features of chest X – ray and CT scan in COVID – 19 patients , Hodeidah, Yemen.

Methodology : Patients with COVID-19, confirmed by RT-PCR who were admitted in isolation department of COVID-19 , Center of Tropical Medicine and Infectious Diseases (CTMID), AL Thawara Public Hospital Authority, Hodeidah, Yemen who underwent serial chest X – ray and CT scan were retrospectively. 49 cases reports of patients from 3 to 80 years old. Image features and their distribution were analyzed and the COVID-19 Reporting and Data System (CO-RADS) for level of suspicion of COVID-19 infection was applied.

Results: The results showed that 42.85 % of CO-RAD 4 and 57.14 % of CO-RAD 5. The most patterns were 85 % of ground glass opacifications (GGO) ,80 % of bilateral involvement , 83 % of multi-lobar involvement, 75 % of peripheral distribution , 30 % of consolidation pattern and 5 % of crazy paving pattern. On the other hand , in the youngest patients less than 50 year,80 % had GGO, and 20 % had lung consolidations ,while in the patients over 50 year ,GGO were presented in 55 % and consolidations in 45 %. In addition, the lung involvement range of patients was from 40 to 95 % and the median was 60 %. The lung involvement was represented in the patients more than 50 year as 60 – 95 % while in the patients less than 50 years was represented as 40 – 55 %. The lung involvement of death patients was 85 to 95 % of non – chronic diseases and 60 to 70 % of comorbidity and coinfection.

Conclusion: The study concluded that different radiological features were reported in COVID-19 patients according to age, severity and risk factors (comorbidity and coinfection).

Keywords : Radiological , Features , X – ray , CT-scan , COVID – 19 , Hodeidah , Yemen

1. INTRODUCTION

Radiological techniques have an important role to play in the diagnosis and assessment of the coronavirus disease 2019 (COVID-19). Radiological techniques namely radiography and computed

tomography are primarily to assess the severity and/or impact of COVID-19 on patients who have tested positive for the virus and who are experiencing severe and/or problematic symptoms [(1)] .

World Health Organization (WHO) published rapid advice guide examines the evidence and makes recommendations for the use of chest imaging in acute care of adult patients with suspected, probable or confirmed COVID-19. Imaging modalities considered are radiography, computed tomography and ultrasound. This guide addresses the care pathway from presentation of the patient to a health facility to patient discharge. It considers different levels of disease severity, from asymptomatic individuals to critically ill patients [(2)].

According to a Fleischner Society consensus statement published on 7 April 2020, imaging is not indicated in patients with suspected COVID-19 and mild clinical features unless they are at risk for disease progression, imaging is indicated in a patient with COVID-19 and worsening respiratory status, in a resource-constrained environment, imaging is indicated for medical triage of patients with suspected COVID-19 who present with moderate-severe clinical features and a high pretest probability of disease [(3-5)]. The study aimed to describe the radiological patterns of chest X – ray and CT-scan of COVID – 19 patients in Hodeidah, Yemen.

2. METHODOLOGY

2.1. Study area

Hodeidah Governorate is located on the western ,flat and narrow coastal plain between the foothills of the highlands and the red sea. Hodeidah is the fourth largest Governorate in Yemen in the term of population which reaches to about (2157552) .The area is 13500 km2 involves 26 Districts, and a lot of islands in the red sea. The weather is typically hot and humid and the temperatures sometimes exceeding 38 to 40° C. During the rest of the year temperature range between 27-35° C. This region is known to have high conflict area since the 26th of March 2015. Hodeidah also is considered as an endemic zone for numerous infectious diseases [(6-8)].

2.2. Study design

This work was designed in a retrospectively study . The patients who were admitted in the COVID-19 Isolation Department, Center of Tropical Medicine and Infectious Diseases (CTMID), AL Thawara Public Hospital Authority ,Hodeidah, Yemen from 1st June to 31st December 2020.

2.3. CXR and CT Scan protocol

CXRs were performed in the antero-posterior projection. All images were stored in a picture archiving and communication system (AGFA Computed Radiography). Patients with CT were received a non-contrast chest CT (unless iodinated contrast medium is indicated), with reconstructions of the volume at 0.625 mm to 1.5 mm slice thickness (gapless). If iodinated contrast medium is indicated, such as in CT pulmonary angiogram (CTPA), a non-contrast scan should be considered prior to contrast administration, as contrast may impact the interpretation of GGO patterns[3]. Multi-detector CT scan (MDCT) machine with HRCT protocol was applied. The Dutch Association for Radiology (NVvR) proposed a CT scoring system for COVID-19. They called it COVID-19 Reporting and Data System (CO-RADS) to ensure CT reporting is uniform and replicable [(9-11)].

Table 1. CO – RAD level of suspicion of COVID – 19 infection

CO – RAD 1	No	Normal
CO – RAD 2	Low	Abnormalities consistent with infections other than COVID – 19
CO – RAD 3	Indeterminate	Unclear whether COVID -19 is present
CO – RAD 4	High	Abnormalities suspicious for COVID – 19
CO – RAD 5	Very high	Typical COVID -19
CO – RAD 6	PCR +	

3. RESULTS

3.1. Radiological finding according to age and sex

The study in which patients were classified into 2 groups according to their age , patients younger than 50 and patients older than 50 .In the youngest group of patients ,80 % had GGO, and only 20 % had lung consolidations (Figure 2 and 3) ,while in the group of patients over 50 years ,GGO were present in 55 % and consolidations in 45 % (Figure 4 and 5).

Table 2. Sex and Age data of COVID-19 patients in Hodeidah , Yemen (N = 49)

Variables	**Number(n)**	Ratio (%)	X^2	P – value
Gender				
Male	39	79.59		
Female	10	20.41	17.16	0.00
Total	49	100		
Age				
< 50	16	32.65	5.898	0.015
> 50	33	67.34		
Total	49	100		

3.2. Radiological finding according to severity

Lung involvement of COVID – 19 patients was diagnosed in admitted patients using CT scan . The lung involvement was represented in the patients more than 50 years as 60 – 95 % while in the patients less than 50 years was represented as 40 – 55 %. The lung involvement range of COVID-19 patients was from 40 to 95 % and the median was 60 %. The relationship between the lung involvement (%) and mortality

was reported where the lung involvement in death patients was 85 to 95 % of non – chronic diseases and 60 to 70 % of comorbidity and coinfection (Table 3).

Table 3 . Radiological finding according to severity (N: 49)

Comorbidity and Coinfection	Morbidity	Mortality	Lung Involvement of Death Cases
Diabetic	9	3	60 – 70 %
Diabetic and Chronic Diseases	8	4	60 – 70 %
Heart disease and asthma	2	1	66 %
Heart disease and hypertension	6	3	60 – 70 %
Asthma	6	4	60 – 70 %
Renal Failure	2	1	65 %
Tuberculosis	1	0	-
Hepatitis C	1	1	65 %
Non	14	6	85 – 95 %
Total	49	23	60 – 95 %

3.3. Radiological patterns

Firstly , CO – RAD level of suspicion of COVID – 19 infection was summarized in Table 4 . 42.85 % of CO –RAD 4 and 57.14 % of CO –RAD 5 . On the other hand , the radiological features were reported and the most patterns were 85 % of GGO ,80 % of bilateral involvement , 83 % of multi-lobar involvement, and 75 % of peripheral distribution. The least patterns were 30 % of consolidation pattern and 5 % of crazy paving pattern (Figure 1).

Table 4. CO – RAD level of suspicion of COVID – 19 infection (N:49)

CO – RAD 1	No	0
CO – RAD 2	Low	0
CO – RAD 3	Indeterminate	0
CO – RAD 4	High	21 cases
CO – RAD 5	Very high	28 cases
CO – RAD 6	PCR +	NA

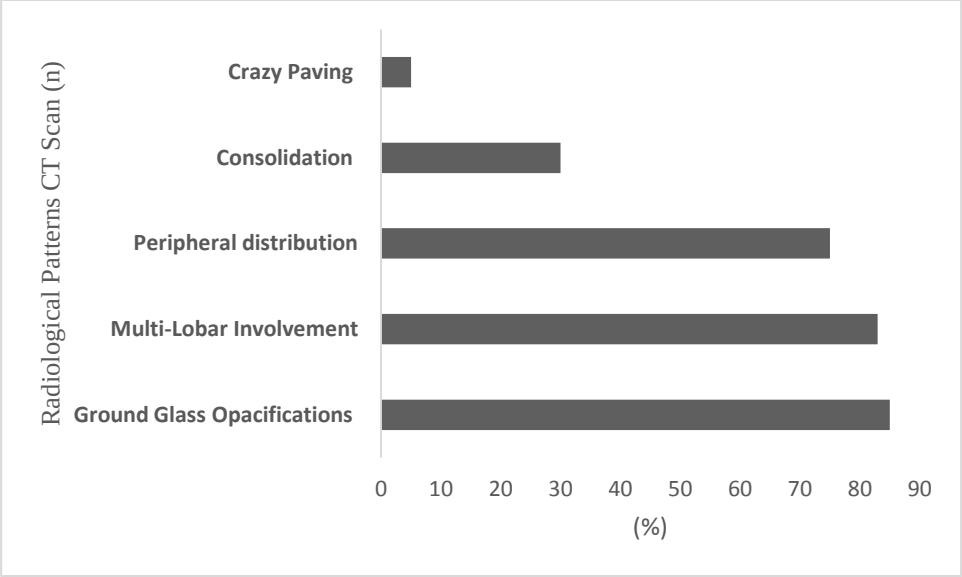

Figure 1. Radiological patterns

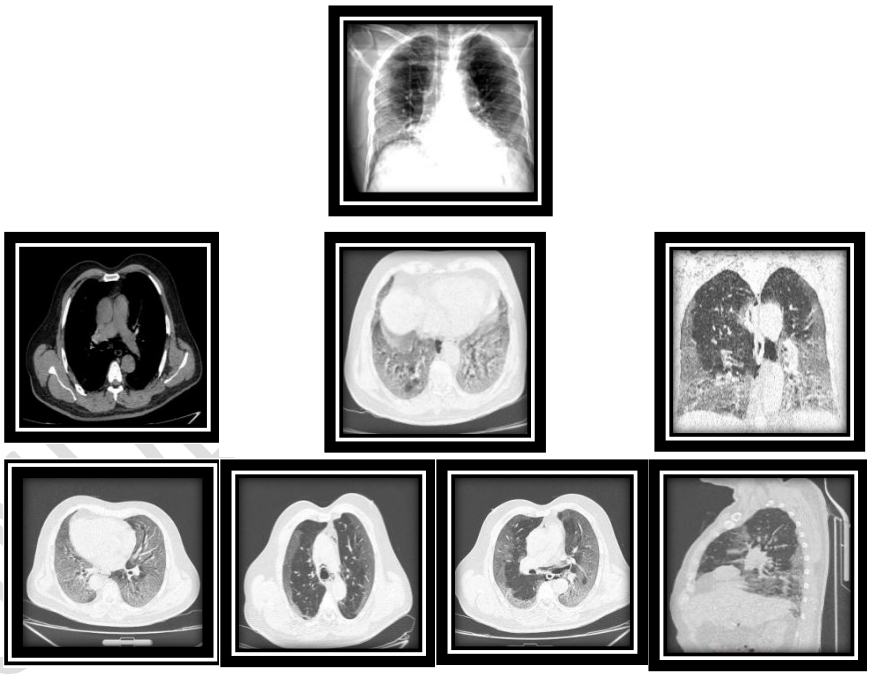

Figure 2 : 40 year old male, who had fever for ten days with progressive coughing and shortness of breath. Saturation at admission was 70%. X – ray finding "posteroanterior (PA) chest x- ray shows bilateral ground-glass opacities with peripheral predominance. CT finding " bilateral multi-lobar symmetrical ground-glass opacities with a posterior and peripheral predominance, no significant enlarged lymph nodes, no pleural effusion. 50% of the lungs are involved. CO-RAD 4 likely COVID-19 and RT – PCR positive .

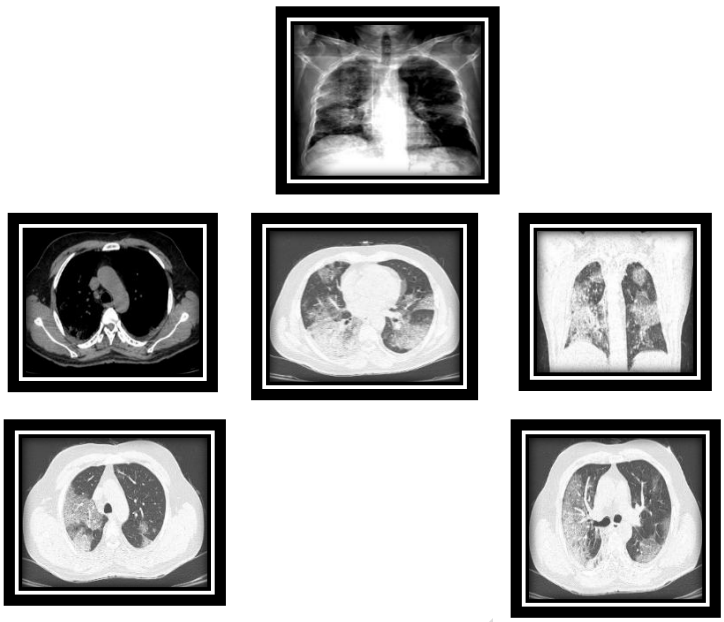

Figure 3 : 45 year old male, who had fever for 15 days with shortness of breath and joint pain. Saturation at admission was 88 %. X – ray finding " PA chest X- ray shows peripheral and lower opacities of both lungs. CT finding "Bilateral GGO with inter-lobar and lobular reticulations consistent with crazy paving appearance, no significant enlarged lymph nodes, no pleural effusion. About 40 % of the lungs are involved. CO-RAD 4 likely COVID-19 with RT PCR positive .

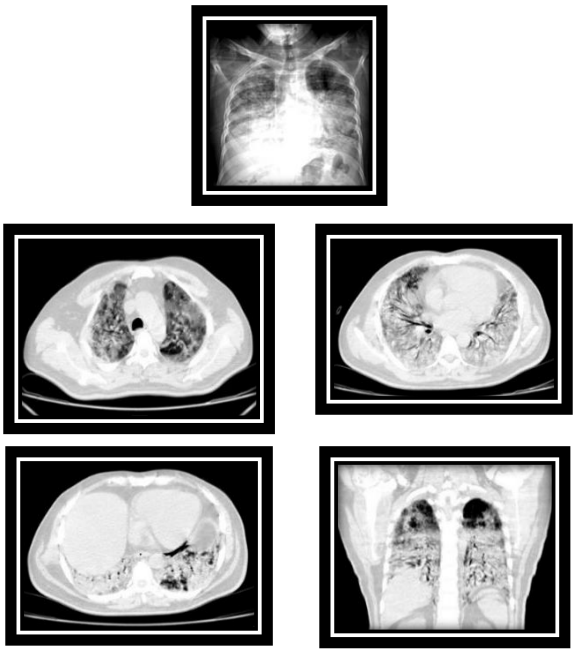

Figure 4 : 58 year old male, who had fever for 20 days with progressive coughing and shortness of breath. Saturation at admission was 50 %. X – ray finding " PA chest x- ray shows bilateral consolidation mainly involving the lower lobes with peripheral predominance in the upper lobes. CT finding "Bilateral consolidations of both lung fields with small areas of GGO mainly seen in the upper lobes the air bronchogram noted, reactive lymph nodes, no pleural effusion.85% of the lungs are involved. CO-RADS 5 high likely COVID-19 with RT – PCR positive .

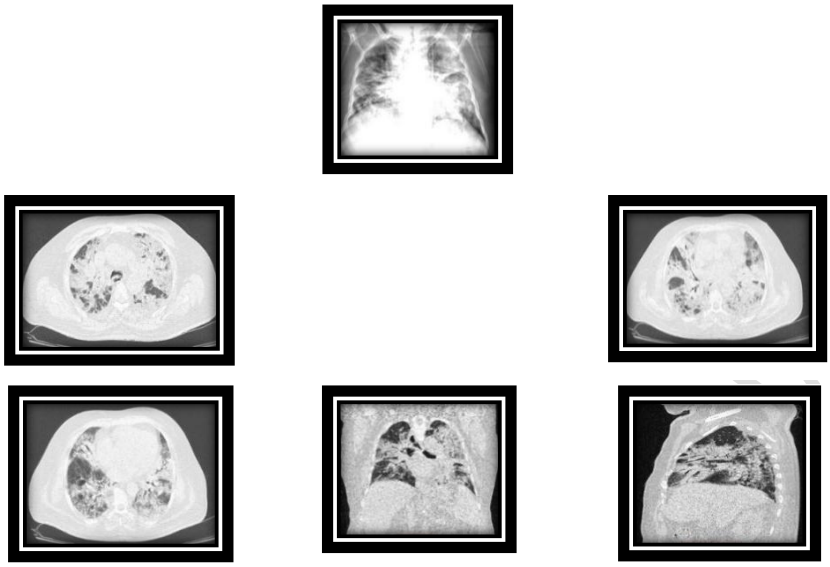

Figure 5 : 80 year old male, who had fever for 30 days with shortness of breath. Saturation at admission was 60 %. X – ray finding " PA chest X- ray shows bilateral consolidation with reticulation" . CT Scan " Bilateral consolidations of both lung fields associated with reticular pattern and traction mild bronchiectasis, reactive lymph nodes, no pleural effusion. > 50 % of the lungs are involved". CO-RAD 5 high likely COVID-19 with RT – PCR positive .

4. DISCUSSION

Plain X-ray , although less sensitive than chest CT, chest radiography is typically the first-line imaging modality used for patients with suspected COVID-19 [9]. For ease of decontamination, use of portable radiography units is preferred [(11)].

Findings are most extensive about 10-12 days after symptom onset [(12)]. The radiological features were reported in Hodeidah, Yemen in different patterns namely GGO pattern, consolidation pattern, consolidation with reticulation and bronchiectasis pattern, and crazy paving pattern. Our patterns similar for many studies in different countries , Rodrigues et al and Wong et al described that the most frequent findings are airspace opacities, whether described as consolidation or, less commonly, GGO. The distribution is most often bilateral, peripheral, and lower zone predominant [(5,12)]. In contrast to parenchymal abnormalities, pleural effusion is rare. Although cardiac manifestations of COVID-19 are well-recognized, there is no published evidence of cardiac disease on diagnostic imaging [(12)]. The British Society of Thoracic Imaging (BSTI) have published a reporting for the plain chest radiographic appearances of potential COVID-19 cases [(5)]. Classic/probable COVID-19 (lower lobe and peripheral predominant multiple opacities that are bilateral > unilateral). Indeterminate for COVID-19 (does not fit classic or non-COVID-19 descriptors). Non-COVID-19 (pneumothorax / lobar pneumonia / pleural effusion(s) / pulmonary edema / other). Normal (COVID-19 not excluded). The primary findings on CT

in adults have been reported as ground-glass opacities (bilateral, subpleural, peripheral, basal distribution), crazy paving appearance (GGOs and inter-/intralobular septal thickening), consolidation, bronchovascular thickening in the lesion, traction bronchiectasis [13 – 19].

Atypical CT findings, these findings only seen in a small minority of patients should raise concern for superadded bacterial pneumonia or other diagnoses as mediastinal lymphadenopathy, pleural effusions: may occur as a complication of COVID-19, multiple tiny pulmonary nodules (unlike many other types of viral pneumonia) , tree-in-bud, pneumothorax and cavitation [5, 20,21]. Temporal CT changes , four stages on CT have been described 1) Early/initial stage (0-4 days): normal CT or GGO only (up to half of patients have normal CT scans within two days of symptom onset); 2) progressive stage (5-8 days): increased GGO and crazy paving appearance ; 3) peak stage (9-13 days): consolidation ; and 4) absorption stage (>14 days): with an improvement in the disease course, "fibrous stripes" appear and the abnormalities resolve at one month and beyond [16, 21-23].

In Italy, the following alterations were more commonly observed: patients with lung consolidations (57.7%), (62.8%) with GGO, (23.5%) with nodules and (66.6%) with reticular–nodular opacities. Patients with consolidations and GGO coexistent in the same radiography were 35.5% of total. Peripheral (57.7%) and lower zone distribution (58.5%) were the most common predominance. Moreover, bilateral involvement (69.2%) was most frequent than unilateral one [24]. Other study in China, the predominant pattern of abnormality observed was bilateral (79% patients), peripheral (54%), ill-defined (81%), and GGO (65%), mainly involving the right lower lobes (27%) of affected segments [25]. Other study in China reported the CT images showed pure GGO in 77% and GGO with reticular and/or interlobular septal thickening in 75% patients. GGO with consolidation was present 59% , and pure consolidation was present in 55% patients. 86% had bilateral lung involvement, while 80% involved the posterior part of the lungs and 86% were peripheral. Patients older than 50 years had more consolidated lung lesions than did those aged 50 years or younger[26] .

In addition , in the youngest group of patients (less than 50 year) , 80 % had GGO, and only 20 % had lung consolidations ,while in the group of patients over 50 years ,GGO were present in 70 % and consolidations in 30 % . Atypical findings were reported also more common in older patients. This results agreed with previous study was reported by Song et al and Raquel et al . 77% had GGO ,and only 23% had lung consolidations ,while in the group of patients over 50 years, GGO were present in 55% and consolidations in 45% [26,27]

5. CONCLUSION

Finally , in our tertiary center, CT examination is usually performed (generally after a CXR) only in specific situations: in case of clinical-radiological discordance (when CXR is negative for infective lung involvement, but there is a high clinical-epidemiological suspect), in case of acute complication (p.e. pulmonary embolism or severe respiratory failure) or after intubation before transporting patient to ICU. The study concluded the different radiological patterns were reported in COVID – 19 patients and this technique is very important in criteria admission of patients. It has good predictive values on severity and mortality. Also can support the clinicians staff in early detection, early triage, and effective management of COVID-19 infection.

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