ORIGINAL ARTICLE

Incidence and Distribution of Findings of Chest Radiographic in Patients Positive for Covid-19

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ABSTRACT

Background: The radiologic parameters of covid-19 (corona virus disease-2019) is displayed mainly by CT but the detail report of chest radiographs in accordance with the time period of the disease is absent.

Purpose: The objective of this study was to analyze the severity of Covid-19 findings on the chest radiographs and to evaluate the disease time course. The aim of the study also included the evaluation of relation between these findings on chest radiograph and RT-PCR(real-time reverse transcription polymerase chain reaction) test for SARS COV-2 nucleic acid.

Methodology: This study was retrospective in which admitted Covid-19 patients (during April-June 2020) inCivil Hospital and Khairpur Medical College, Khairpurwere analyzed through chest radiographs and RT-PCR and was approved by institutional review boards. Consents from all participants included in this study was taken. 74 patients were taken from Civil Hospital Khairpur. The positive covid-19 was evaluated through RT-PCR test done on swabs taken from nasopharynx and throat. 42 patients possessed serial results of RT-PCR. The chest radiography was done on all patients except one. The time course of symptoms was acquired from epidemiological data of public given by the Health department. In a-symptomatic patients (11 out of 74 concluding the date of positive RT-PCR test result was added to analyze onset of symptoms.

The radiologists scored the radiographs of chest on the basis of ground-glass opacity, consolidation, pleural fluid as well as the location. Severity index of each lung was analyzed, and scores were added to obtain the final severity score.

Results: The clinical presentations of 74 patients in which 31 (42%) were males and 43 (58%) were females included in this study. (the mean value of age was 61 years and the range of age was 18 to 80 years). Fever (44 patients; 59.4% as well as cough (30 patients; 41%) were commonly present in the patients. About 11 patients (15%) presented as asymptomatic. The comorbidities like hypertension were present in 16 patients (22%) and diabetes was present in 10 patients (14%). 49 patients displayed abnormal chest radiographs during their course disease. The baseline radiograph of chest reveals consolidation as commonest presentation in about 34 patients (46%), and ground glass opacity in 25 patients (34%). The common locations were peripheral distribution in 30 patients (41%) and lower zone involvement in 36 patients (49%). 36 out of 74 (49%) patients had bilateral involvement of lungs. Only three patients (4%) presented with pleural effusion. All patients were evaluated through baseline chest radiographs in which 25 patients (34%) presented with normal results.

Conclusion: The radiographic examinations of Covid-19 patients revealed bilateral consolidation in lower zones of lungs reaching at peak within 10 to 12 days from the time of onset of the symptoms.

INTRODUCTION

Since CT is more sensitive than other radiographic examinations of chest, the recent studies are focusing more on radiologic parameters of covid-19 (coronavirus disease 2019)[1-2]. CT was the main investigation of choice in China for Covid-19. But this is a great challenge for radiologists in controlling infection in the CT scanroom[3]. In few hospitals of China,particularCT scans were done only in those patientswho are doubtful for the covid infection, which is carried out in England with quite difficulty[4-5]. According to the American College of Radiology, decontamination of CT scan is needed for the examination of covid patients which may lead to disruption of the availability services of radiography. This suggests that to reduce the spread of infection, portable radiography should be considered[6-7].

In the hospitals of Britain and Italy, the first line triage tool is chest radiography due to long and time taking procedure of RT-PCR (real-time reverse transcription polymerase chain reaction) testing in diagnosing SARS COV-2 (severe acute respiratory syndrome coronavirus[8]. Thus, in this pandemic situation, the chest radiography cannot be replaced in some countries by CT[9]. with the increased prevalence of Covid-19, it is important for all health care workers to recognize the covid radiographic features and findings that can be obtained for other purposes as well[10].

The aim of this study was to elucidate the radiographic features of covid-19 and correlate it with the findings of RT-PCR tests. Also, this study evaluated the relation of findings between chest radiographs and CT scans and analyze the disease time course of symptoms appearance on radiographs.

METHODOLOGY

This study was retrospective in which admitted Covid-19 patients (during April-June 2020) in Civil Hospital and Khairpur Medical College, Khairpur were analyzed through chest radiographs and RT-PCR and was approved by institutional review boards. Consents from all participants included in this study was taken.74 patients were taken from Civil Hospital Khairpur. The positive covid-19 was evaluated through RT-PCR test done on swabs taken from nasopharynx and throat.42 patients possessed serial results of RT-PCR. The chest radiography was done on all patients except one. The time course of symptoms was acquired from epidemiological data of public given by the Health Protection. In a-symptomatic patients (11 out of 74 were asymptomatic), the date of positive RT-PCR test result was added to analyze onset of symptoms.

The radiographs of chest were obtained in the form of digital or computed radiographs by following the usual protocols. The radiographs were taken in both AP and PA views. The radiographs in follow ups were taken in AP with the help of portable radiography units in the isolated wards.

Theradiographs of chest were evaluated by the Radiologist.Fleischner Society glossary of terms were followed to diagnose features on radiographs like ground-glass opacity, consolidation, and pulmonary nodules. The lung was distributed according to the changes taking place in covid patient and was categorized into perihilar, peripheral, right, left or bilateral, the upper or lower zones and no zones involvement. The peripheral as well as perihilar distinction was explained as midway within lateral edge of hilum and the lung. The pleural effusion demonstration was analyzed. Non contrast volumetric CT scans of 1–1.25-mm thick section of thorax was done by following the usual protocols.H.Y.S.L. and H.Y.F.W. radiologists evaluate the examination of CT to inspect the absence or the presence of ground-glass opacities as well as consolidation.

Warren et al proposed a severity score to calculate the spread of infection by simplifying the assessment of edematous lungs radiographs. In accordance with the degree of consolidation and the ground-glass opacity, the score 0-4 was allotted to the lungs. 0 score means no involvement, 1 means 25%, 2 means 25%–50%, 3 means 50%–75% and 4 means 75% inclusion. The scores were added to obtain the final scores of severities. FIG 2 shows some examples of it.

The software (IBM, new york, armonk and SPSS Build 1.0.0.1347) was used for statistical analysis. The Kruskal-Wallis test was done to check any difference in severity scores of chest radiographs during various times of disease course. The sensitivity of radiographs was evaluated on the basis of severity scores in which more than 0 was considered positive for covid-19 which was further compared with RT-PCR findings through McNemar x2 test.The Mann-Whitney U test was done to compare the severity score of baseline chest radiograph between initial positive results and negative results of RT-PCR. The radiographic recovery and the virologic recovery, which was defined as the severity score 0 on chest radiographs with negative results at RT-PCR, were correlated through paired-sample t test. The p value of <0.05 was taken which was quite significant.

RESULTS

The Table-I showed clinical presentations of 74 patients in which 31 (42%) were males and 43 (58%) were females included in this study. (the mean value of age was61 years and the range of age was 18 to 80 years).

Table 1	
Parameter	No. of Patients (*n* = 74)
Patient characteristic	
Male sex	31 (42)
Female sex	43 (58)
Age (y)	61 ±8
Travel history	9 (12)
Clinical presentation	
Mild fever*	27 (36)
High fever†	17 (23)
Cough	30 (41)
Sputum	15 (20)
Hemoptysis	0 (0)
Sore throat	11 (15)
Diarrhea	5 (7)
Chest discomfort	8 (11)
Dyspnea	6 (8)
Asymptomatic	11 (15)
Comorbidities	
Diabetes	10 (14)
Hypertension	16 (22)
Chronic obstructive pulmonary disease	0 (0)
Malignancy	0 (0)
Chronic liver disease	2 (3)

Fever (44 patients; 59.4% as well as cough (30 patients; 41%) were commonly present in the patients. About 11 patients (15%) presented as asymptomatic. The comorbidities like hypertension were present in 16 patients (22%) and diabetes was present in 10 patients (14%).49 patients displayed abnormal chest radiographs during their course disease (Table 2).

Table 2	
Characteristic	No. of Findings
No. of normal baseline chest radiographs	25 (34)
No. of abnormal baseline chest radiographs	49 (66)
No. of patients with normal baseline chest radiographs later becoming abnormal	9 (12)
Type of parenchymal opacity at baseline chest radiography	
Consolidation	34 (46)
Ground-glass opacities	25 (34)
Distribution at baseline chest radiography	
Peripheral predominant	30 (41)
Perihilar predominant	8 (11)
Neither peripheral nor perihilar	21 (28)
Right lung	12 (16)
Left lung	11 (15)
Bilateral lungs	36 (49)
Upper zone predominant	0 (0)
Lower zone predominant	36 (49)
No zonal predominance	21 (28)
Other features on baseline chest radiographs	
Pleural effusion	3 (4)
Pulmonary nodules	0 (0)

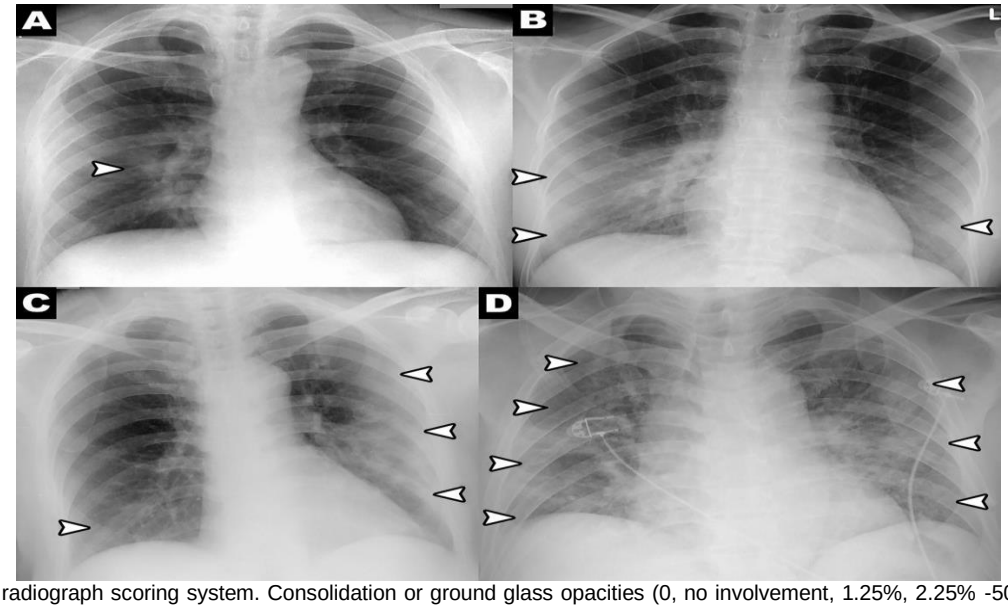
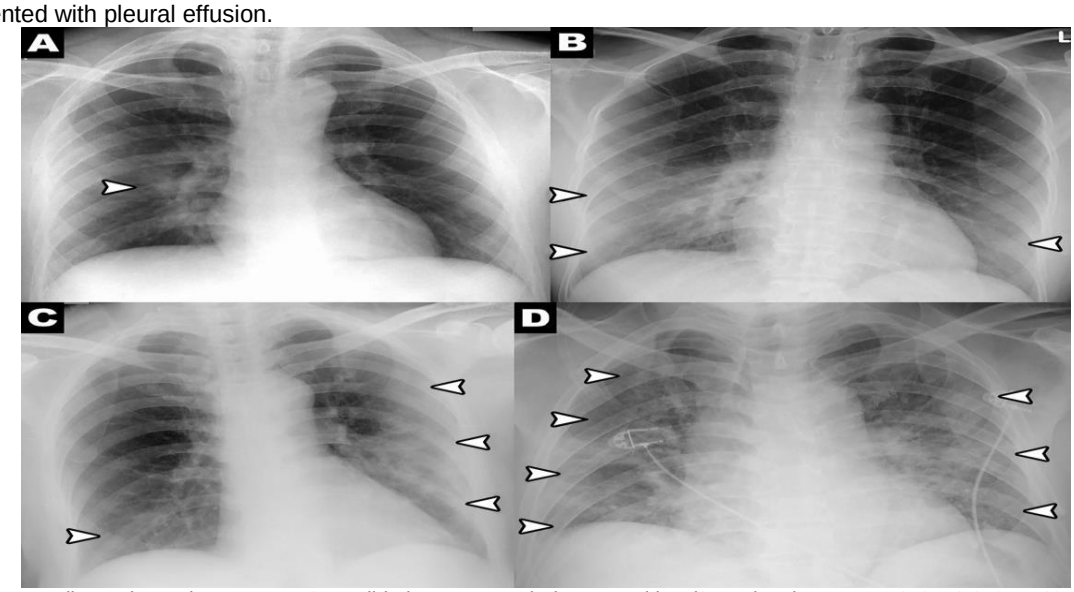


Figure 2: Chest radiograph scoring system. Consolidation or ground glass opacities (0, no involvement, 1.25%, 2.25% -50%, 3.50% -75%; and 4%, 0.75% involvement). Scores for each lung were collected to generate the final severity score. Below are examples of chest X-ray severity score and days from symptom onset in patients with 2019 coronavirus disease (calculation of right lung score + left lung score = total score used): A, day 12 (1 + 0 = 1); B, 5th day (2 + 1 = 3); C, day 3 (1 + 3 = 4); and D, day 10 (4 + 3 = 7). Arrowheads indicate areas of consolidation or ground glass.

The baseline radiograph of chest reveals consolidation as commonest presentation in about 34 patients (46%), and ground glass opacity in 25 patients (34%). The common locations were peripheral distribution in 30 patients (41%) and lower zone involvement in 36 patients (49%). 36 out of 74 (49%) patients had bilateral involvement of lungs. Only three patients (4%) presented with pleural effusion.



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All patients were evaluated through baseline chest radiographs in which 25 patients (34%) presented with normal results.

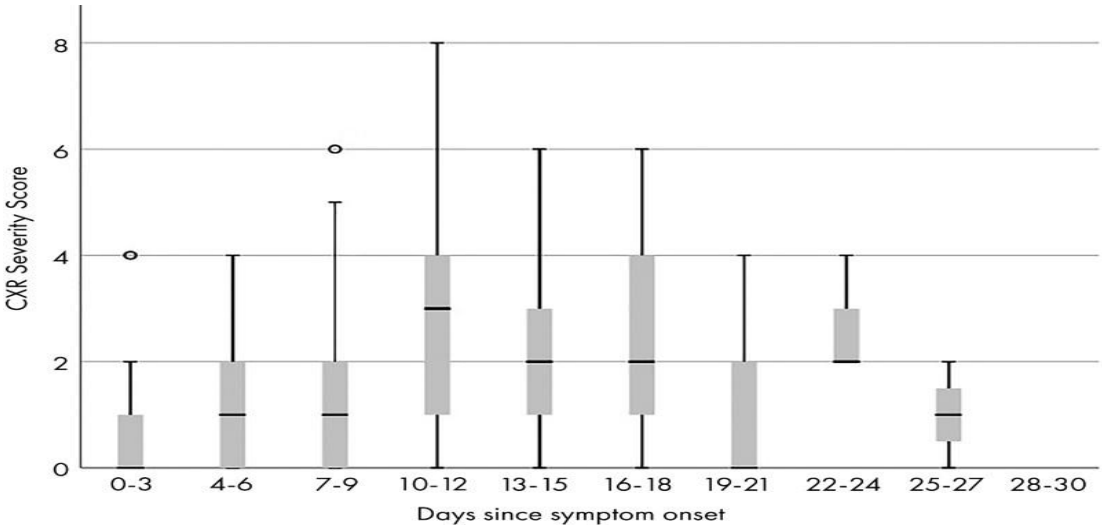
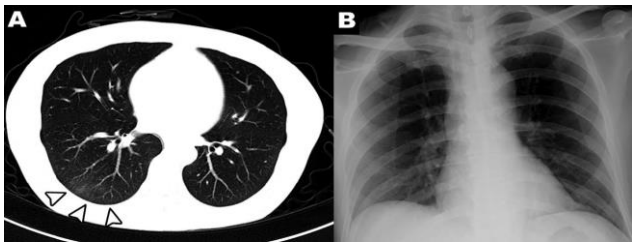


Figure 4 show the severity scores of chest radiographic results from the onset of symptoms. The severity score 8 was the highest to be recorded which is the max possible score. The severity of chest radiograph varies with time (p=0.01). The severity score reaches peak within 10 to 12 days having median chest radiograph severity score of 3.Nine patients that presented with normal radiographs developed abnormalities later during their follow ups.

30 patients out of 74 go through CT in 48 hours of undertaking chest radiography after the onset of symptoms. (mean: 12 daysand range: 0–26 days). 25 out of 30 patients revealed radiographic severity score more than 0 with positive results on CT. only 5 patients showed up with negative results from which 3 of them a revealed negativity even on CT. only 2 patients showed up with ground glass opacity on CT examination as shown in fig: 6.



DISCUSSION

Consolidation as main radiographic feature in covid-19 associated pneumonia is found to be consistent in accordance with formerly published cases.64 out of 74patients who showed up positive as covid-19 patient on RT-PCR, 49 (66%) patients revealed radiographic abnormality of baseline chest radiographs. 49 patients revealed abnormality on baseline radiographyof chest[11].8 patients showed negative result for covid-19 when tested initially with RT-PCR, but they revealed abnormal findings on baseline chest radiographs. The initial analysis through RT-PCR had sensitivity (91%; 95% confidence interval: 83%, 97%) which was more than the baseline radiographic examination of chest radiography (69%; 95% confidence interval: 56%, 80%)[12]. The baseline radiograph of chest reveals consolidation as commonest presentation in about 34 patients (46%), and ground glass opacity in 25 patients (34%). The common locations were peripheral distribution in 30 patients (41%) and lower zone involvement in 36 patients (49%). 36 out of 74 (49%) patients had bilateral involvement of lungs. Only three patients (4%) presented with pleural effusion.

The severity of the disease was found to be at peak within 10 days to 12 days from the onset of the symptoms[13-14].

In this study, all patients that showed positivity on chest radiographs also revealed positive result on CT. only one out of four patients (25%) showed up with false-negative results on chest radiograph when compared with CT. the limitation of this study was that CT was not routinely performed in the patients with positive covid-19. CT examination was done later (average days: 11) during the disease course as compared with chest radiograph.

According to Ai et al, about), 42% patients showed up with improvements on CT examination before getting negative findings on RT-PCR test[15-16]. Others revealed either progression or just improvements on CT after negative RT-PCR test in diagnosing covid-19. The discharged patients revealed positive RT-PCR test for covid-19, so it was concluded that imaging techniques should be included in evaluating clinical manifestations of the disease course till more evidence showed up[17-18].

This study had many limitations. Firstly, the follow up was not done in all patients to get the final result thus the disease course in some patients was not properly analyzed. Secondly, the gap between radiographic results and RT-PCR were not uniform which markedly affected the analysis precision. Thirdly, the subtle radiographic presentations limited the optimal view of the condition[19-20]. Lastly, the control group with no covid-19 was absent and CT availability was for subgroup. This limited the analysis of specificity as well as sensitivity of chest radiographs.

CONCLUSION

Summarizing the whole study, the covid-19 features on chest radiographs were evaluated and described to complement the publications associated with CT.In this study, 70% sensitivity was observed in baseline chest

radiograph. In this pandemic of covid-19, which is quite challenging for all health care workers, including chest radiograph must be considered as a diagnostic tool yet it has sensitivity less than CT.

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