RESEARCH ARTICLE

Association of Chest Xray (CXR) findings with outcomes in COVID-19 Patients

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Abstract

Objective: To investigate chest radiography findings in suspected coronavirus disease-2019 patients in a tertiary care setting.

Methods: The retrospective study was conducted at the Aga Khan University Hospital, Karachi, and comprised data of coronavirus disease-2019 cases admitted to the tertiary care centre from March 1 to March 30, 2020. A predesigned proforma was used to gather data, including demographics, like age and gender, co-morbidities, presenting symptoms and chest radiography findings during the admission. Length of stay and mortality were the outcome measures. Data was analysed using SPSS 22.

Results: Of the 154 suspected cases, 46(29.8%) tested positive for coronavirus disease-2019; 29(63%) males and 17(37%) females with a mean age of 50.7±19.1 years. Abnormal chest radiography was noted in 25(54.3%) cases, with bilateral pulmonary infiltrates being the most common finding 19(41.3%). Mortality was the outcome in 7(28%) of these cases, and the mean length of hospital stay was 9.3±7.3 days. Abnormal chest radiography findings were associated with an increased risk of mortality (p=0.009) and a longer hospital stay (p=0.017).

Conclusion: Abnormal chest radiography findings were frequently seen in coronavirus disease-2019 patients and were also associated with increased risk of mortality and prolonged hospital stay.

Keywords: COVID-19, X-ray, Coronavirus, Mortality. (JPMA 72: 1746; 2022) **DOI: https://doi.org/10.47391/JPMA.3628**

Introduction

Coronavirus disease-2019 (COVID-19) was first identified in a patient in December 2019 in Wuhan in the Hubei province of China.[1] The World Health Organisation formerly identified the causative agent as a virus which was named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the disease was declared a pandemic in March 2020.[1,2] SARS-CoV-2, a novel virus, belongs to a family of viruses which can lead to severe acute respiratory distress syndrome (ARDS) and pneumonia.[3] The family has been associated with similar outbreaks in the past, notably the Middle East respiratory syndrome (MERS) and the SARS.[4] As of May 18, 2021, more than 164 million cases have been reported.[5]

Globally, chest computed tomography (CT) has been known to reveal characteristic findings, including ground-glass opacities and multifocal patchy consolidations, in almost all COVID-19 patients even when COVID-19 Reverse transcription polymerase chain reaction (RT-PCR) is negative.[6-9] However, in developing countries, chest CT is not always available due to resource and financial constraints. In such settings, chest radiography (CXR) may be used as a cost-friendly and readily-available alternative. However, the use of CXR as an alternative to CT scan is still inadequately characterised and needs to be studied further. The current study was planned to investigate CXR findings in COVID-19 patients.

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Methods

The retrospective cohort study was conducted at the The Aga Khan University Hospital (AKUH), Karachi after approval from the institutional ethics review committee and comprised data of all patients presenting to the tertiary care centre with suspected COVID-19 infection between March 1 and March 30, 2020. The sample size was calculated using OpenEpi with 95% two-sided significance level (1-alpha) and 80% power.[10]

The cases were identified using the presence of an International Classification of Diseases, 9th Edition, Clinical Modification Code for SARS-associated Coronavirus (079.82).[11] Patients with a positive result on RT-PCR of nasopharyngeal swab were considered as COVID-19-positive. All patients still admitted on March 30, 2020, were excluded as their outcomes were unknown.

A predesigned proforma was used to gather data from the electronic patient record system, which was de-identified before analysis. The collected variables included demographics, like age and gender, co-morbidities, presenting symptoms and CXR findings during the admission. Data related to intensive care unit (ICU) admission and mechanical ventilation was also recorded. Length of stay and mortality were the study outcome measures.

Data was analysed using SPSS 22. Demographic data was presented as simple descriptive statistics with mean and standard deviation, while qualitative variables were presented as frequencies and percentages. Student t-test was used for comparing means between continuous variables. Chi-square test was used to determine associations between different variables. P<0.05 was considered statistically significant.

Results

Of the 154 suspected cases, 46(29.8%) tested positive for COVID-19 (Figure). Of them, 29(63%) were males and 17(37%) were females with an overall mean age of 50.7±19.1 years. Patients requiring ICU care numbered 9(20%) and they were managed with non-invasive ventilation and prone positioning. Those needing mechanical ventilation due to worsening respiratory failure were 6(13%). Abnormal chest radiography was noted in 25(54.3%) cases, with bilateral pulmonary infiltrates being the most common finding 19(41.3%) (Table 1).

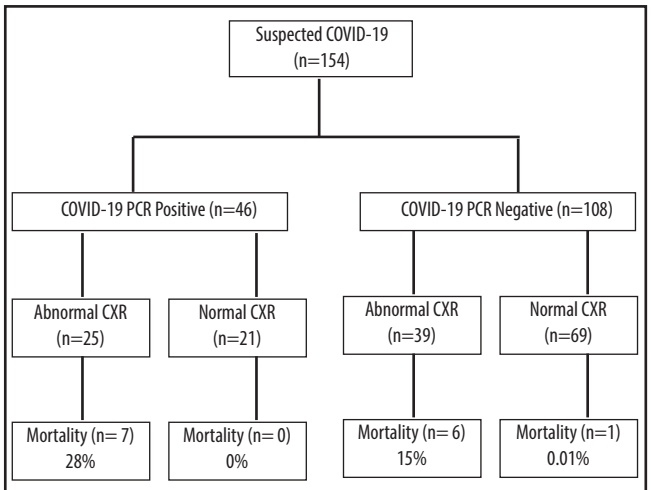

Figure: : Study flowchart (n= 154).

Table-1: Patient characteristics (n = 46).

Characteristics	n (%)
Mean age (years)	50.7±19.1
Gender	
Male	29 (63)
Female	17 (37)
Comorbid conditions	
Diabetes	17 (37)
Hypertension	20 (43)
Ischaemic heart disease	8 (17)
Chronic Kidney Disease	2 (4)
Malignancy	2 (4)
Presenting symptoms	
Fever	29 (63)
Cough	23 (50)
Dyspnoea	14 (30)
Sore throat	6 (13)
Headache	37(80)
Hospitalisation factors	
ICU admission	9 (20)
Mechanical Ventilation	6 (13)
Chest X-ray findings	
Normal	21 (46)
Bilateral infiltrates	19 (41)
Pleural Effusion	2 (4)
Both	4 (9)

ICU: Intensive care unit

Table-2: Association between chest radiography findings and patient outcomes (n = 46).

Characteristics	Abnormal chest radiography (n=25)	Normal chest radiography (n=21)	*p*-value
Mortality	7 (28%)	0 (0%)	0.009
Mean length of stay (days)	9.3±7.3	6.5±4.5	0.017

Table-3: Absolute risk difference (n = 46).

Characteristics	Mortality	No Mortality	Total
Normal Chest X-Ray	0	21	21
Abnormal Chest X-Ray	7	18	25
Total	7	39	46

Absolute Risk Difference: 0.28 – 0 = 0.28

Mortality was the outcome in 7(28%) of the cases with abnormal CXR, and the mean length of hospital stay in that group was 9.3±7.3 days. Abnormal chest radiography findings were associated with an increased risk of mortality (*p*=0.009) and a longer hospital stay (*p*=0.017) (Table 2).

The absolute risk difference was 0.28 (0.28-0) (Table 3).

Discussion

Presentation of COVID-19 can be very variable, ranging from asymptomatic carriers and mild disease to cases with severe pneumonia-like illness which can eventually progress to respiratory failure, and multi-organ dysfunction.[12] The most commonly reported symptoms in the initial group of patients in Wuhan were fever (98%), cough (76%) and dyspnoea (55%).[12] The current study showed comparable results, with the most common symptoms being fever (63%), cough (50%) and dyspnoea (30%) in RT-PCR-positive cases. Patients can also develop ARDS and its incidence has been reported to 17-29%.[13] The currently used standard for diagnosing COVID-19 in patients is RT-PCR.[14] Although it has a high specificity, the sensitivity has been reported to be as low as 60-70%.[6,15] RT-PCR results are affected by many factors, including the source of the sample, performance of testing kit, time period at which the sample was collected, and different sampling operations.[16,17] Due to increased variability in the sensitivity of RT-PCR, patients with a high clinical suspicion who test negative must not be ruled as COVID-19-negative. Hence, in patients with high clinical suspicion in cases of

false negative or non-availability of RT-PCR initially, CXR or chest CT can be used to help diagnose and manage the patients timely.

Globally, CT is used along with RT-PCR due to its high sensitivity (98%), but in our institution during the early days of the pandemic, CXR was used along with RT-PCR as an initial tool in the management of COVID-19.[15] A study conducted in Hong Kong showed baseline sensitivity of CXR to be 69% in COVID-19-positive patients.[18] Moreover, the study also mentioned that all the patients who had abnormal findings on CXR also had similar findings on chest CT.[18] Our results were consistent with the previous study,[18] demonstrating CXR sensitivity of 54% (25/46) in RT-PCR-positive patients and the sensitivity of RT-PCR to be 72% (46/64) in patients with positive CXR findings.

Due to limited resources and financial constraints in a developing country, like Pakistan, chest CT is not used routinely as an option for imaging. Therefore, CXR is used as the first-line option as it is readily available and is cost-effective. As the pandemic progresses, the burden on CT units is going to increase, and, therefore, CXR in cases of high clinical suspicion of SARS-CoV-2 can be used in settings where financial and resource constraints exist, making the use of chest CT difficult, and, hence, can help reduce the burden on already overburdened available CT units in Pakistan.

Previous studies showed the presence of abnormal chest findings in 80% of COVID-19 patients at some point during their illness.[18] The most common CXR and CT findings in patients are ground glass opacities (GGOs) that are often bilateral, peripheral and lower zone in distribution.[13,18] According to literature, bilateral lung involvement is the most common CXR finding (60-79%) with pleural effusion (PE) being relatively less common (3-7%).[18-20] The current study showed consistent results with bilateral infiltrates (41%), PE (4%) and both (9%).

The mortality rate of COVID-19 has varied because of variability in patient factors and has been reported to be as low as 2.9-3.6% to as high as 62% in critically ill patients.[13,21,22] The current study revealed a mortality rate of 28% which could be over-reported as only symptomatic and critically-ill patients generally present to our hospital as it is a tertiary care centre.

The current study has potential limitations. All patients included were admitted to the hospital, therefore, they may have had more severe illness than the patients who did not require hospital admission. Compared to multi-centre studies, the sample size was small as patients from only one centre were included. Collaborative efforts are needed in developing countries for large-scale multi-centre studies to validate the findings of the current study.

We recommend that clinicians should focus on early detection and timely management of suspected COVID-19 patients with abnormal CXR findings irrespective of RT-PCR results to improve patient outcomes and reduce morbidity and associated mortality.

Conclusion

Abnormal CXR findings were frequently seen in COVID-19 patients and were also related to an increased risk of mortality and a significantly prolonged length of stay.

Disclaimer: None.

Conflict of interest: None.

Source of Funding: None.

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