ORIGINAL ARTICLE

Chest X-Ray in Coronavirus Disease 2019 (COVID-19) Infection: Findings and Correlation with Clinical Outcome at Level-3 Nepalgunj Medical College and Teaching Hospital Kohalpur

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ABSTRACT

Introduction: At the end of 2019 a novel virus, named SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), expanded globally from China. A new coronavirus, severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), was identified as the cause of this outbreak of viral pneumonia that causes coronavirus disease 2019 (COVID-19). **Aim**: The aim of this study is to find out the chest radiological features of corona virus disease patients and correlate them with clinical outcome. **Methods**: This is a Hospital based study involving patients with clinical-epidemiological aspect of all reverse transcription polymerase chain reaction (RT-PCR) corona virus disease (COVID-19) positive patients, who performed Chest X-Rays at the emergency department of Nepalgunj Medical College, Teaching Hospital from March to June, 2020. All patients performed reverse transcription polymerase chain reaction from nasopharyngeal and throat swab, Chest X-Ray at the Emergency Department and clinical-epidemiological data. **Results**: Patients with a reverse transcription polymerase chain reaction positive results for corona virus disease infection were 32 out of these, 22 were females (68.75%) and 10 males (31.25%), with a mean age of 40.78 years (range 20–74 years). Only 2 Chest X-Rays were negative for radiological thoracic involvement (6.25%). The following alterations were more commonly observed among 30 patients: 18 patients with lung consolidations (56.25%), 19 (59.37%) with Ground Glass Opacities, 7 (21.87%) with nodules and 21 (65.6%) with reticular–nodular opacities. Patients with consolidations and Ground Glass Opacities coexisting in the same radiography were 34.37% of total. In reverse transcription polymerase chain reaction positive patients, we found also signs nonspecific for corona virus disease pneumonia as hilar or vascular congestion (37.5%), cardiomegaly (28.12%), pleural effusion (15.6%) and pneumothorax (3.12%). Peripheral (56.25%) and lower zone distribution (56.25%) were the most common predominance. Bilateral involvement (68.75%) was most frequent than unilateral one. Given the results, baseline Chest X-Rays sensitivity in our experience is about 65.62%.**Conclusion**: In this study, COVID-19 CXRs generally manifested a spectrum of pure ground glass, mixed ground glass opacities to consolidation in bilateral peripheral middle and lower lung zones. BSTI CXR reporting classification of COVID-19 is valid and sensitive in our patients with addition of middle zonal involvement in classical COVID-19 criteria as opposed to just lower zone involvement.

Keywords: **British Society of thoracic Imaging classification (BSTI), Chest radiography, Coronavirus, COVID-19, Diagnostic imaging, Infection**

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INTRODUCTION

At the end of 2019 a novel virus, named SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), expanded globally from China with the first Italian cases dating back to February 2020.[1] A new coronavirus, severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), was identified as the cause of this outbreak of viral pneumonia that causes coronavirus disease 2019 (COVID-19). On 24 January, Nepal officially announced its first confirmed COVID-19 in a 32-year old male patient, who had recently returned from Wuhan city, China.[2] Radiological evaluation is one way of looking in the body.[3] This new coronavirus causes a highly infectious disease, commonly called Coronavirus Disease 19 (COVID-19): Lung infection can result in severe pneumonia up to more aggressive acute respiratory distress syndrome (ARDS).[4] Radiological evaluation of patients with clinical–epidemiological suspect of COVID-19 is mandatory, especially in the emergency department (ED) while waiting for RT-PCR results, in order to have a rapid evaluation of thoracic involvement. The recent COVID-19 radiological literature focuses primarily on computed tomography (CT) findings, which is more sensitive and specific than chest X-ray (CXR): In particular, in China CT is used as a first-line diagnostic method for COVID-19. [5, 6.] The pulmonary syndrome was later named coronavirus disease 2019 (COVID-19) by the World Health Organization. Despite the imposition of strict quarantine rules and travel restrictions, the virus transmitted rapidly out of China with a number of confirmed cases reported in Europe, the United Kingdom, and the United States.[7] The clinical features of the initial patients confirmed to be infected with SARS-CoV-2 included lower respiratory tract illness with fever, dry cough, and dyspnoea, a manifestation similar to those of two other diseases caused by coronavirus, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS).[8] In our experience, the imaging features of COVID-19 pneumonia are diverse, ranging from normal

appearance to diffuse changes in the lungs. In addition, different radiological patterns are observed at different times throughout the disease course. Because the time between onset of symptoms and the development of acute respiratory distress syndrome (ARDS) was as short as 9 days among the initial patients with COVID-19 pneumonia, early recognition of the disease is essential for the management of these patients.[9] Radiographic features including consolidation, ground-glass opacities (GGO), pulmonary nodules and reticular–nodular opacities were diagnosed according to the Fleischer Society glossary of terms. [10]

To further our understanding of the radiographic features of COVID-19, our study aims to describe the appearances of COVID-19 at chest radiography, correlate the appearances on chest radiographic images with RT-PCR, compare findings at chest radiography findings and describe the time course of chest radiography appearances relative to symptom onset. The aim of this study was to find out the various radiological findings on CXR in a COVID-19 patients with positive PCR and to correlate with their clinical outcome.

METHODS

CXRs of patients with clinical–epidemiological suspicious of COVID-19 infection presented to Nepalgunj Medical College, Teaching Hospital Kohalpur from March to June, 2020 were reviewed. Approval from the Institutional Review Committee, Nepalgunj Medical College, Kohalpur was obtained before starting the study. Inclusion criteria were: patients' age between 18 and 90 years, RT-PCR positive patients. All patients without RT-PCR negative or negative RT-PCR were excluded, patients below 18 years were excluded. Clinical features like fever, cough, dyspnoea, respiratory impairment, diarrhea, asthenia, myalgia and dysgeusia were noted. RT-PCR results were considered the reference standard. Chest X-rays findings were noted RT-PCR done with nasopharyngeal throat swab. All CXRs were acquired as digital radiographs with the same portable X-ray unit (Simadzu - Fujiflm, Italia) in the isolation wards of our ED. CXRs were performed in the postero-anterior or antero-posterior projection performed by two thoracic radiologists in order to define the number of radiological suspects of COVID-19 infection. Radiographic features including consolidation, ground-glass opacities (GGO), pulmonary nodules and reticular–nodular opacities were diagnosed according to the Fleischer Society glossary of terms. [11] CXRs were also assessed for the presence of a specific distribution of the disease (mostly peripheral or perihilar predominance), monolateral (right or left lung) or bilateral disease, upper or lower or diffuse predominance. Portable CXR findings were classified according to British Society of Thoracic Imaging classification and documented in frequencies and percentages.

Statistical analysis

Statistical analysis was performed with SPSS 19. Mean age of the cohort with age range was calculated. Portable CXR findings were classified according to BSTI classification and documented in frequencies and percentages.

RESULTS

We found 32 patients fulfilling the following selecting criteria: presence of clinical–epidemiological suspect of COVID-19 infection and RT-PCR and CXR performed at the ED admission. Patients with a RT-PCR-positive results for COVID-19 infection were 32 of these, 22 were females (68.75%) and 10 males (31.25%), with a mean age of 40.78 years (range 20–74 years). Only 2 CXRs were negative for radiological thoracic involvement (6.25%). The others showed variable features as described in table I. The following alterations were more commonly observed: 18 patients with lung consolidations

(56.25%), 19 (59.37%) with GGO, 7 (21.87%) with nodules and 21 (65.6%) with reticular–nodular opacities. Patients with consolidations and GGO coexistent in the same radiography were 34.37% of total. In RT-PCR-positive patients, we found also signs nonspecific for COVID-19 pneumonia as hilar or vascular congestion (37.5%), cardiomegaly (28.12%), pleural effusion (15.6%) and pneumothorax (3.12%). Peripheral (56.25%) and lower zone distribution (56.25%) were the most common predominance. Bilateral involvement (68.75%) was most frequent than unilateral one. Given the results, baseline CXR sensitivity in our experience is about 65.62%.

In our population the most affected patients were in the age group of 20–70 years old. Patients older than 70 years (6.25%) often presented more advanced lung involvement. In this study 3 patients (9.3%) were immediately discharged from ED, 20 patients were hospitalized in medicine department and 4 in ICU (Figure 1). A total of 5 (15.62%) patients died in the 30 days

COVID-19 Radiographic Features	Number (%)
Normal Baseline CXR	2 (6.25)
Abnormal Baseline CXR	30 (93.75)
Reticular Nodular Opacities	21 (65.62)
Ground Glass Opacities	19 (59.37)
Consolidation	18 (56.25)
Vascular Congestion Sign	12 (37.5)
Cardiomegaly	9 (28.12)
Nodules	7 (21.87)
Pleural Effusion	5 (15.6)
Pneumothorax	1 (3.12)
Distribution:	
Peripheral Predominance	18 (56.25)
Perihiler Predominance	6 (18.75)
Diffuse	13 (40.62)
Basal Predominance	18 (56.25)
Superior Predominance	10 (31.25)
Right Lung	19 (59.37)
Left Lung	14 (43.75)
Bilateral Lung	22 (68.75)

Table I : Radiographic Findings of COVID-19 patients

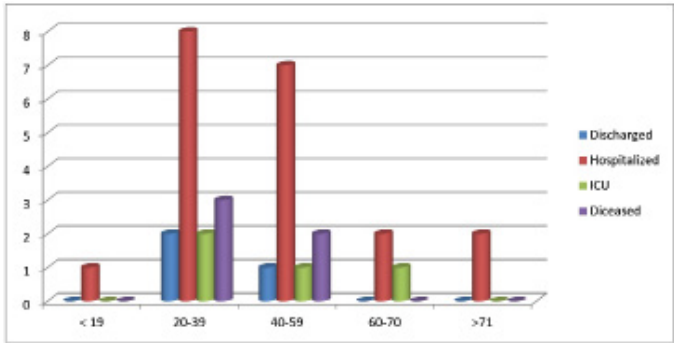

Figure 1 : Age distribution and outcomes of patients with positive RT-PCR

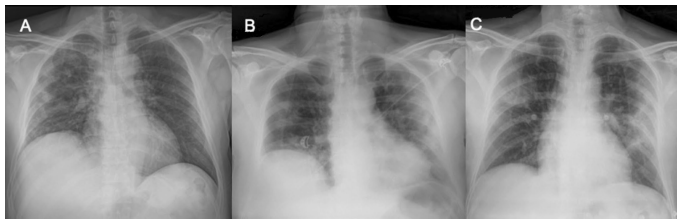

Figure 2 : Peripheral consolidation in COVID-19 pneumonia. Images in A, B and C show three cases of male patients with subpleural consolidations and bilateral involvement

DISCUSSION

In global pandemic situation, the radiological approach should be aimed at a rapid classification of the patient with suspected COVID-19 infection. In our study patients with a RT-PCR-positive results for COVID-19 infection were 32.Out of these, 22 were females (68.75%) and 10 Males (31.25%), with a mean age of 40.78 years (range 20–74 years). The others showed variable features as described in table I.

In our population the most affected patients were in the age group of 20–70 years old. Patients older than 70 years (6.25%) often presented more advanced lung involvement Figure 1. In a study conducted by Diletta Cozzi et al 153 (65.4%) were males and 81 (34.6%) were females, with a mean age of 66.04 years (range 18–97 years). The most affected patients were in the age group of 60–79 years old (43.6%, of which 71.57% males); patients older than 80 years (23.1%) often presented more advanced lung involvement.[12] In our study Only 2 CXRs were negative for radiological thoracic involvement (6.25%). The others showed variable features as described in table I. The following alterations were more commonly observed: 18 patients with lung consolidations (56.25%), 19 (59.37%) with GGO, 7 (21.87%) with nodules and 21 (65.6%) with reticular–nodular opacities. In HY Yoon et al study, 8 (33%) patients had abnormal initial radiographic findings in contrast to 93% abnormal chest findings. In Wong HYF et al study consolidation was found in 47% of cases and this finding is consistent with other studies.[13, 14] In a study conducted by Cozzi D et al, the following alterations were more commonly observed: 135 patients with lung consolidations (57.7%), 147 (62.8%) with

GGO, 55 (23.5%) with nodules and 156 (66.6%) with reticular–nodular opacities.[12]

Ho Yuen Frank et al At baseline chest radiography, consolidation was the most common finding (30 of 64; 47%), followed by ground-glass opacities (21 of 64; 33%). Peripheral distribution (26 of 64; 41%) and lower zone distribution (32 of 64; 50%) were the more common locations, and most had bilateral involvement (32 of 64; 50%). Pleural effusion was found in two patients (3%). [15]

In this study 2 in group of nine patients (4%) were immediately discharged from ED, and the others were hospitalized in medicine department or ICU (Figure 2). A total of 5 (15.62%) patients died in the 30 days (included 2 in group 2 and 3 in group 3). Toussie et al reported, a total of 145/338 (43%) patients were admitted. Of these, 28 (19%) were intubated, 89 (61%) developed sepsis, 29 (20%) had a prolonged stay, and 10 (7%) expired. At the time of writing, 5 (3%) were still intubated in ICUs.[16] In the first cohort of 41 patients with COVID-19 pneumonia from Wuhan, China, 13 patients (31.7%) were admitted to an intensive care unit (ICU) and 6 (14.6%) died . When the cohort size expanded to 99 cases, 11 patients (11.1%) worsened in a short period of time and died of multiple organ failure.[17, 18]

LIMITATION

Low sample size is limiting factor in our study. For better characterization and validation need large sample size and multicenter study. Another limiting factor is CT chest not done for our patient, which is more superior for correlating disease activity in COVID-19 patients.

CONCLUSION

COVID-19 pneumonia generally manifested a spectrum of pure ground glass, mixed ground glass opacities to consolidation in bilateral peripheral lower lung zones in our local population. BSTI chest reporting classification COVID-19 is valid in our patients with addition of middle zonal involvement in classical COVID-19 criteria as opposed to just lower zone involvement. Poor the x- ray chest poorer the outcome. BSTI can be used in emergency department to assist the x-ray chest of covid-19 patients for initial analysis. It can also help to make treatment plan weather patients have to admit in general COVID ward or ICU for betterment. Given the results, baseline CXR sensitivity in our experience is about 65.62%.

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