Original Article

Chest X-ray findings in COVID-19: A Pictorial Review

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Abstract

Introduction: Chest X-ray and Computed tomography(CT) of chest play an important role in the diagnosis and management of the Coronavirus disease (COVID-19). As chest CT may not be readily available in most clinical setups X-ray Chest plays a pivotal role in such clinical scenarios and an irreplaceable initial radiological investigation of these patients.

Objective: The objective of this article is to identify and elaborate the commonest appearances and patterns of lung changes on Chest X rays in COVID-19 positive patients confirmed on RT-PCR COVID testing.

Materials and Methods: Cross-sectional descriptive-analytical study of Chest X-ray findings of 294 RT-PCR confirmed COVID-19 patients admitted across 3 hospitals (Rawalpindi institute of urology (RIU), Benazir Bhutto Hospital (BBH) and Holy Family Hospital (HFH)) from March 30th, 2020 till April 30th, 2020. CXR was analyzed for consolidation patches, ground-glass opacification (GGO), multi-lobe involvement, bilateral distribution, and pleural fluid. The chest X-ray with positive findings was graded into mild, moderate, and severe grades using BSTI (British Society of Thoracic imaging) guidelines.

Results: Mean age of study patients was 45.5 years. Among the study population 230 (78.2 %) were male and 64 (21.8%) female. On baseline chest X rays, consolidations were the commonest finding (n=84, 28.5%), followed by ground-glass opacity (n=17, 5.7 %). The more common locations were peripheral and lower zones, and the majority had bilateral lung involvement (Table 1). Pleural effusions were found in only 5 of the study patients. Among these patients, 187 (63.6%) had an initial normal chest X-ray. Moreover, 35, 34, and 38patients had mild, moderate, and severe diseases respectively.

Conclusion: Chest X-ray is an important initial radiological investigation for COVID 19 patients and plays an important role in the management during the course of the disease.

Keywords: COVID-19, Chest X-ray.

Introduction

The global pandemic of COVID-19 infection is progressing and worsening in various parts of the world, specialists in a wide variety of medical fields are contributing their roles regarding early diagnosis and management of the disease. Regarding diagnostic radiology, most of the published literature to date is mainly focused on the chest CT manifestations of the infection.[1,2] Currently, most of the radiological data being put in use, is provided by Chinese radiologists since in China, some hospitals dedicated specific CT scanners for COVID-19 suspected patients only. This practice is being exercised in the United Kingdom with quite difficulties.[3,4] Keeping in view the high contagiousness of this infection, utilization of CT facility carries many limitations most important being infection control including patient transportation to CT suites, problems in decontamination of CT suites, CT availability issues in various parts of the world, especially in developing countries. Keeping in view these limitations of CT examination for COVID-19, portable chest X rays should be utilized as the initial modality of choice for identification and follow up of COVID-19 patients. American College of Radiology (ACR) recommends that portable chest X rays should be utilized as an imaging modality for COVID-19 patients to reduce the risk of cross-infection since CT suites decontamination required after scanning COVID-19 patients will interfere the availability of CT facility to routine patients and also carries a high risk of cross-infection.[5] Moreover, positive findings on CXR in patients with high clinical suspicion of COVID-19 infection will preclude the need for CT examination. Secondly, the utilization of portable CXR for early diagnosis and follow up of COVID-19 patients will also help in early detection of disease in areas around the world with limited access to CT and real-time COVID reverse transcription-polymerase chain reaction (RT-PCR) testing.

Materials and Methods

Cross-sectional descriptive-analytical study of Chest X-ray findings of RT-PCR confirmed COVID-19 patients admitted across 3 hospitals (Rawalpindi institute of urology (RIU), Benazir Bhutto Hospital (BBH) and Holy Family Hospital (HFH)) from March 30th, 2020 till April 30th, 2020. Two radiologists evaluated each CXR for: consolidation patches, ground-glass opacification (GGO), multilobe involvement, bilateral distribution, and pleural fluid. The chest X-ray with positive findings was graded into mild, moderate, and severe grades using BSTI (British Society of Thoracic imaging) guidelines. Patients undergoing serial radiographs were evaluated for the progression and course of the disease.

Results

A total of 294 confirmed COVID-19 patients (by RT-PCR) were included in the study. Among them 230 (78.2 %) were male and 64 (21.8%) female. The mean age of the study patients was 45.5 years.

Among these patients, 187 (63.6%) had an initial normal chest X-ray.

On baseline chest X rays, consolidations were the commonest finding (n=84, 28.5%), followed by ground glass opacity (n=17, 5.7 %). (Table 1, Figure 1, 2)

The more common locations were peripheral and lower zones, and the majority had bilateral lung involvement (Table 1). Pleural effusions were found in only 5 of the study patients.

Serial X rays of ten patients were performed and analyzed to see the course of the disease (Figure 3, 4, 5). 9 out of these 10 patients were symptomatic at the time of admission with abnormal initial CXR. These patients were followed for 10 days. 8 out of these 10 patients showed radiological worsening on serial X rays while in 2 patients findings were interval static in the initial 5 days. Gradual improvement was seen in 5 patients who had initially mild disease. The rest of 5 patients with severe disease on initial X-ray developed ARDS with eventual demise.

Table 1: Characteristics and the manifestation of Covid-19 on chest X-ray

CHARACTERISTICS	*NUMBER (% of total)*
PULMONARY CHANGES ON INITIAL CXR:	
Ground glass opacity	17(5.7%)
Consolidation/Air space shadowing	84(28.5%)
DISTRIBUTION:	
Peripheral predominance	72(24.4%)
Perihilar predominance	2(0.6%)
Neither peripheral nor perihilar	6(2%)
Upper zone Predominance	11(3.7%)
Lower zone Predominance	80(27.2%)
No zonal predominance	17(5.7%)
UNILATERAL/BILATERAL	
Unilateral	42(14.2%)

Bilateral	65(22.1%)
OTHER FEATURES OF INITIAL CXR	
Pleural effusion	5(1.7%)
Others	2(0.6%)

Table 2: BSTI grading of Covid-19 Pneumonia

Severity of disease	*Number of patients n(%)*
Mild disease	35 (11.9%)
Moderate disease	34(11.5%)
Severe disease	38(12.9%)
Total	107(36.3%)

a)

b)

Figure 1: a) 35 years old male showing air space shadowing in bilateral lower lung zones representing mild disease. b) Chest X-ray of a 48 years old male show areas of ground-glass haze in bilateral lower and left middle lung zones representing moderate disease.

a)

b)

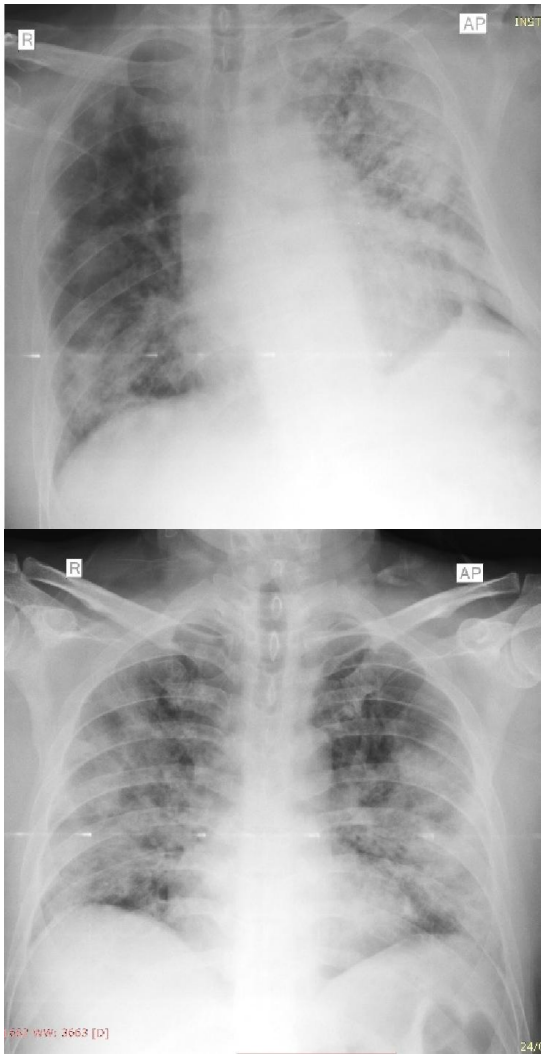


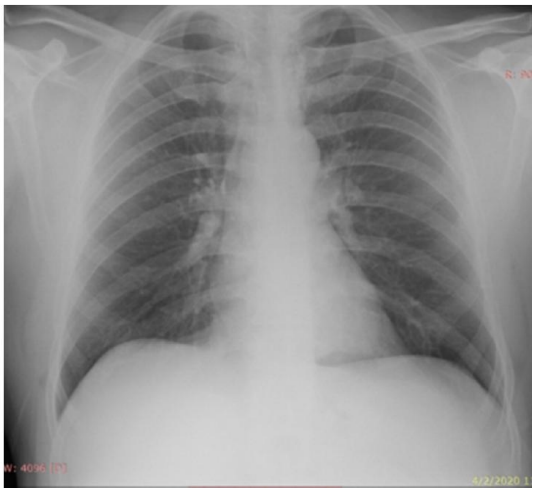
Figure 2: a) Chest X-ray of a 65 years old male show consolidation patches in the entire left lung and right lower lung zone with ground glass opacification in right upper and mid zones. b) Chest x-ray of a 70 years male demonstrating air space shadowing with peripheral patches of consolidation in bilateral lungs representing severe disease process.

a)

b)

Figure 3: a) CXR of 70 years old male showing consolidations seen in bilateral lower and right mid lung zone. b) CXR obtained after 7 hours showed peripheral confluent patches of consolidation in bilateral mid and lower lung zones.

a)



b)

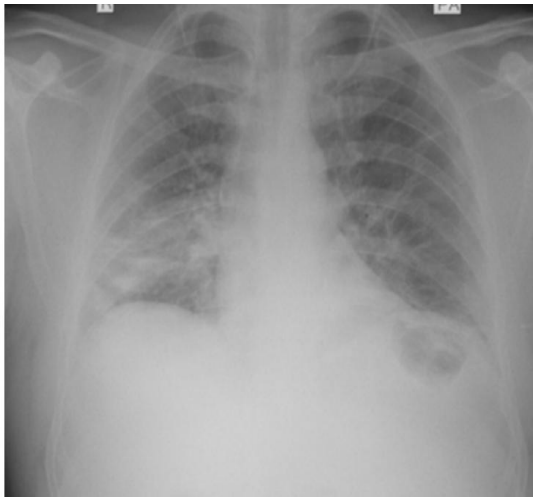


Figure 4: a) 47 years old male tested positive on RT-PCR 2) normal chest x-ray b) Consolidation with ground glass haze in right lower lung zone after 8 days.

a)

b)

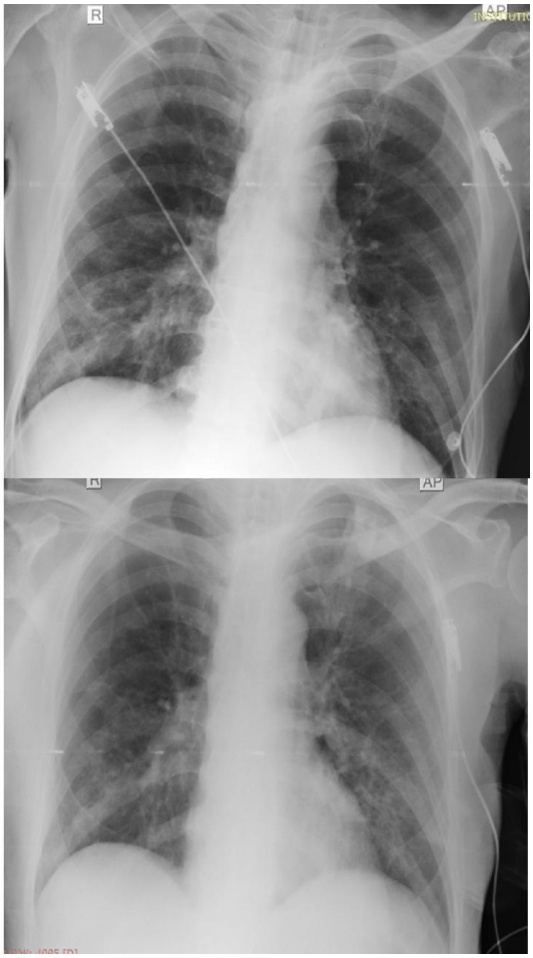


Figure 5: a) CXR o 68 years old male patient at presentation showing bilateral lower zone ground-glass opacification. b) CXR on day 5 shows persisting ground-glass opacities. c, d) Follow up CXR on days 12 and 14 show interval improvement.

Discussion

The recently emerged coronavirus SARS-CoV-2 belongs to the Coronaviradae family of viruses. It is a seventh emerged member of this Coronaviradae family of viruses that previously included six human infecting known RNA viruses.[6] Four members of this group cause only mild respiratory tract symptoms. However, two coronaviruses causing previous epidemics in 2002(SARS) and 2012(MERS) had high mortality rates.[7-10] Although the mortality rates of newly emerged coronavirus labelled as SARS-CoV-2(COVID-19) is much lower than SARS and MERS, but it is highly infectious.

X-ray findings of our study are similar to the early published studies showing that ground glass haze and air space shadowing/ consolidative opacities with bilateral, peripheral and basal predominance are the most commonly observed X-ray appearances in patients with COVID-19 pneumonia. [11, 12, 13] Moreover, findings such as mediastinal lymphadenopathy, lung nodules, pleural effusions, and pulmonary cavities were not notably observed. Of the 294 patients who were positive on COVID-19 RT-PCR, 107 (36.3%) had abnormal lung findings on initial chest x-ray (CXR). Consolidation was the commonest manifestation (84/107, 78.5%), followed by ground-glass opacification (17/107, 15.8%). These lung findings had a peripheral (72/107, 67%) and lower zone predilection (80/107, 74.7%) with bilateral lung involvement (65/107, 61%).

The radiological picture of COVID-19 pneumonia is very comparable and analogous to SARS and MERS infection.[14,15,16] However, radiological picture of COVID-19 pneumonia is less severe than previously emerged SARS and MERS viral pneumonia.[17]

In the present study, the percentage of patients showing abnormal findings on the initial chest radiograph at the time of presentation is 36.3%. This proportion is much less in comparison to previously reported 78.3–82.4% in SARS and 83.6% in MERS.[18,19,20] It is also found that chest radiograph appearances of COVID-19 pneumonia in Pakistani population are quite analogous to COVID-19 viral pneumonia in China.[21]

This study carries a few limitations. First, the sample size of the study was small and accounted for a small proportion of positive cases in comparison to the total number of cases in Pakistan. Second, the analysis was primarily focused on initial X-ray findings at the time of presentation, instead of follow-up X rays. Follow-up X rays were available and evaluated in only a small number of patients. Third, the disease course and outcome of the study patients were not taken into account.

Conclusion

COVID-19 viral infection in Pakistan is largely presented as ground-glass opacification, air space shadowing/ consolidations in the bilateral lungs with peripheral basal predominance. These lung lesions were classically ill-defined, patchy, and primarily distributed in subpleural locations. These appearances are very much comparable to those of COVID-19

infection in China. Clinicians and radiologists must familiarize themselves with X-ray findings of COVID-19 for effective management of this pandemic.

References

1. Zhou S., Wang Y., Zhu T., Xia L. CT features of coronavirus disease 2019 (COVID-19) pneumonia in 62 patients in Wuhan, China. Am J Roentgenol. 2020:1–8.March.
2. Chung M., Bernheim A., Mei X. CT imaging features of 2019 novel coronavirus (2019-nCoV) Radiology. February 2020;200230
3. 13. Zhang H-W, Yu J, Xu H-J et al. Corona Virus International Public Health Emergencies: Implications for Radiology Management. Acad Radiol. February 2020. DOI:10.1016/j.acra.2020.02.003.
4. 14. Lessons from the frontline of the COVID-19 outbreak - The BMJ. https://blogs.bmj.com/bmj/2020/03/20/lessons-from-the-frontline-of-the-covid-19-outbreak/?utm_campaign=shareaholic&utm_medium=twitter&utm_source=socialnetwork. Accessed March 22, 2020.
5. ACR recommendations for the use of chest radiography and computed tomography (CT) for suspected COVID-19 infection American College of Radiology. https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection. Accessed March 22, 2020. Google Scholar 2020.
6. DD Richman, RJ Whitley, FG Hayden (Eds.), Clinical virology (4th edn.), ASM Press, Washington (2016)
7. TG Ksiazek, D Erdman, CS Goldsmith, et al. A novel coronavirus associated with severe acute respiratory syndrome. N Engl J Med, 348 (2003), pp. 1953-1966.
8. T Kuiken, RAM Fouchier, M Schutten, et al. Newly discovered coronavirus as the primary cause of severe acute respiratory syndrome. Lancet, 362 (2003), pp. 263-270
9. RJ de Groot, SC Baker, RS Baric, et al. Middle East respiratory syndrome coronavirus (MERS-CoV): Announcement of the Coronavirus Study Group. J Virol, 87 (2013), pp. 7790-7792
10. AM Zaki, S van Boheemen, TM Bestebroer, AD Osterhaus, RA Fouchier. Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. N Engl J Med, 367 (2012), pp. 1814-1820
11. Chung M, Bernheim A, Mei X, et al. CT Imaging Features of 2019 Novel Coronavirus (2019-nCoV). Radiology. February 2020:200230. DOI:10.1148/radiol.2020200230.
12. Ng M-Y, Lee EY, Yang J et al. Imaging Profile of the COVID-19 Infection: Radiologic Findings and Literature Review. Radiol Cardiothorac Imaging. 2020;2(1):e200034. DOI:10.1148/ryct.2020200034.
13. Salehi S, Abedi A, Balakrishnan S, Gholamrezanezhad A. Coronavirus Disease 2019 (COVID-19): A Systematic Review of Imaging Findings in 919 Patients. Am J Roentgenol. March 2020:1–7. DOI:10.2214/AJR.20.23034.
14. Ajlan AM, Ahyad RA, Jamjoom LG, Alharthy A, Madani TA. Middle East respiratory syndrome Coronavirus (MERS-CoV) infection: chest CT findings. AJR Am J Roentgenol 2014;203:782–787.
15. Das KM, Lee EY, Enani MA, AlJawder SE, Singh R, Bashir S, et al. CT correlation with outcomes in 15 patients with acute Middle East respiratory syndrome coronavirus. AJR Am J Roentgenol 2015;204:736–742.
16. Choi WJ, Lee KN, Kang EJ, Lee H. Middle East respiratory syndrome-Coronavirus infection: a case report of serial computed tomographic findings in a young male patient. Korean J Radiol 2016;17:166–170.
17. Yoon SH, Lee KH, Kim JY, Lee YK, Ko H, Kim KH, Park CM, Kim YH. Chest Radiographic and CT Findings of the 2019 Novel Coronavirus Disease (COVID-19): Analysis of Nine Patients Treated in Korea. Korean J Radiol. 2020 Apr;21(4):494-500. https://doi.org/10.3348/kjr.2020.0132
18. Antonio GE, Ooi CG, Wong KT, Tsui EL, Wong JS, Sy AN, et al. Radiographic-clinical correlation in severe acute respiratory syndrome: study of 1373 patients in Hong Kong. Radiology. 2005;237:1081–1090.
19. Wong KT, Antonio GE, Hui DS, Lee N, Yuen EH, Wu A, et al. Severe acute respiratory syndrome: radiographic appearances and pattern of progression in 138 patients. Radiology. 2003;228:401–406.
20. Das KM, Lee EY, Al Jawder SE, Enani MA, Singh R, Skakni L, et al. Acute Middle East respiratory syndrome Coronavirus: temporal lung changes observed on the chest radiographs of 55 patients. AJR Am J Roentgenol. 2015;205:W267–W274.
21. Yoon SH, Lee KH, Kim JY, Lee YK, Ko H, Kim KH, Park CM, Kim YH. Chest Radiographic and CT Findings of the 2019 Novel Coronavirus Disease (COVID-19): Analysis of Nine Patients Treated in Korea. Korean J Radiol. 2020 Apr;21(4):494-500. https://doi.org/10.3348/kjr.2020.0132.