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CASE REPORT

To diagnose histopathological alterations in respiratory system through radiological analysis.

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ABSTRACT… Histopathological alteration in the respiratory system of COVID-19 patient is mainly caused due to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). HRCT is a highly diagnostic tool to detect COVID-19, as chest computerized tomography (CT) describes pre and post effect of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on the respiratory system by radiological findings such as Ground-glass opacity, Pleural effusion, bilateral consolidation, and Interlobular septal thickening.

Key words: COVID-19, HRCT, SARS-CoV-2.

INTRODUCTION

A novel Coronavirus disease 2019 (COVID-19) is an acute respiratory disease that is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). In December 2019 the first human case of COVID-19 was identified in Wuhan, China, and then rapidly spread throughout the world. There were approximately 8 million confirmed cases and more than 425 000 confirmed deaths due to COVID-19 worldwide On June 13, 2020. On March 12, 2020 COVID-19 was announced as a pandemic by the World Health Organization (WHO).[1] Pakistan was reported between the top 20 of the most affected countries, where the first case was described in February 2020 in Karachi[2] and the first death was reported on March 18, 2020, at District Headquarter Hospital Mardan.[3] Since then COVID-19 has been spreading throughout the country. Till 2nd July 2020, there were 221,896 confirmed cases with 4,551 deaths according to the COVID-19 Health Advisory Platform by the Ministry of National Health Pakistan.[4] Many COVID-19 patients cannot be identified at an early stage and are at risk of infecting large populations due to the highly contagious nature of coronavirus. The COVID-19 is an acute respiratory syndrome that harms the morphology of the lungs. Radiological analysis including chest X-Ray and CT imaging is the only diagnostic alternative of Reverse transcriptase-polymerase chain reaction (RT-PCR) that gives a detailed picture of lungs morphology. A chest computerized tomography (CT) scan aids a faster diagnosis of COVID-19 by radiological findings such as multiple ground-glass opacities, patchy pulmonary consolidations, and crazy-paving pattern, typically involving peripheral, sub-pleural, and basal areas of the lung in COVID-19 patients.[5] Thus chest computerized tomography (CT) scan plays an important role in the management of patients with suspected SARS-CoV-2 infection by providing accurate diagnosis of viral pneumonia, particularly when there are no exactly proven therapies to cure COVID-19.[6]

We all are aware of the diagnostic importance of Reverse transcriptase-polymerase chain reaction (RT-PCR), but still, need a diagnostic tool that describes the presence of COVID-19 as well as its severity on the respiratory system so

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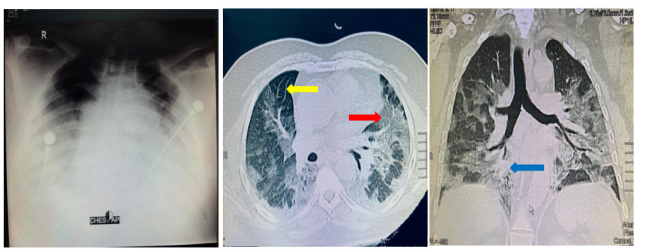
that the disease can be treated in a systematic manner. Our study aims to describe the effect of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on lobes of lungs, clues to understanding the histopathological alteration in the respiratory system through clinical observations and radiological analysis. Radiographic studies of the respiratory system of patients will reveal Ground-glass opacity, Pleural effusion, bilateral consolidation, and Interlobular septal thickening in both lung fields suggestive of the viral inflammatory process most likely COVID-19.

CASE REPORT

The first patient is a 56-year-old male that came into the emergency unit of a private hospital in Faisalabad, Pakistan, with a seven-day history of subjective fever, cough, headache, and one-day history of shortness of breathing. The patient was alright 1 week back then he develops a fever, cough and now followed by shortness of breathing. The patient disclosed that he met a person who tested positive for COVID-19. The patient had limited his contact with other people after the symptoms of the disease appeared. The physical evaluation showed stable vital signs. Saturation measured using pulse oximetry was 90% in the room atmosphere. Chest X-ray (CXR) and Non-contrast chest computerized tomography (CT) images were fields suggestive of the viral inflammatory process most likely COVID-19 (Figure-1). The first patient was discharged after 8 days of hospitalization with a mortality outcome.

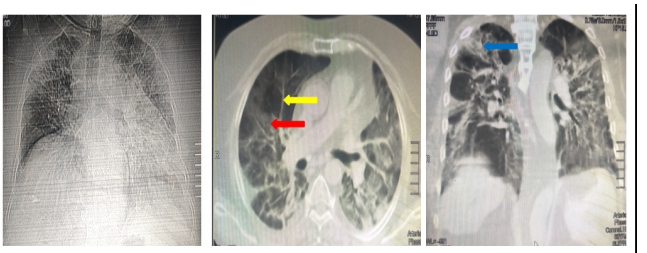


(a) (b) (c)

Figure-1. A 56-year-old male; (a) CXR, AP view (b) Chest CT, Axial view (c) Chest CT, coronal view

High-resolution chest computed tomography scan revealed Ground glass opacities (red arrow), consolidation (blue arrow), Interlobular septal thickening (yellow arrow).

The second patient is a 63-year-old male that came into the emergency unit of a private hospital in Faisalabad, Pakistan, with a two-day history of shortness of breathing and one-week history of continuous high-grade fever along with rigors and chills and coughs in bouts throughout the day. The presence of headaches, comorbidities, and nausea was denied by the patient. Partially relief was gained by taking antipyretic but no diurnal variations occur, however, the patient's condition worsened over time. The patient disclosed that he had no contact with suspected or confirmed COVID-19 patients in the month before the onset of illness. The patient had limited his contact with other people after the symptoms of the disease appeared. The patient had a history of hepatitis C, controlled by the consumption of medicine. On general physical examination, blood pressure was 140/100, a fever of 37°C, Heartbeat 84 per minute, and Saturation was 77% without oxygen, and 94% with 10-liter oxygen. Chest X-ray (CXR) and Non-contrast chest computerized tomography (CT) images were fields suggestive of the viral inflammatory process most likely COVID-19 (Figure-2). The second patient was discharged after 3 days of hospitalization with a mortality outcome.



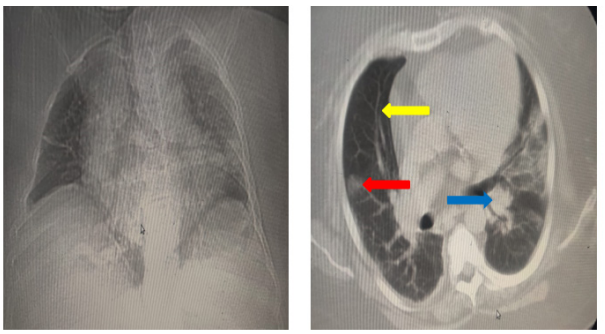
(a) (b) (c)

Figure-2. A 63-year-old male; (a) CXR, AP view (b) Chest CT, Axial view (c) Chest CT, coronal view

High-resolution chest computed tomography scan revealed Ground glass opacities (red arrow), consolidation (blue arrow), Interlobular septal thickening (yellow arrow).

The third patient is a 70-year-old female that came into the emergency unit of a private hospital in Faisalabad, Pakistan, with one-week history of fever, dry cough, and wild shortness of breathing

initially (from day 1st to 5th) which increased in severity from day 7th to onward. The presence of headache, expectoration, and nausea was denied by the patient. The patient disclosed that three other people in her family have also been infected with SARS-CoV-2. The patient had limited her contact with other people after the symptoms of the disease appeared. The patient had a history of body aches, controlled by the consumption of Deltacortril, hypertension, allergy to penicillin intake, and diabetes mellitus. Physical evaluation by the physician showed respiratory distress on movement, a fever of 37°C, blood pressure was 100/60, Heartbeat 76 per minute, and Saturation was 90% with 3-liter oxygen. Chest X-ray (CXR) and Non-contrast chest computerized tomography (CT) images were fields suggestive of COVID-19 (Figure-3). The third patient was recovered and discharged after 8 days of hospitalization.



(a) (b)

Figure-3. A 70-year-old female; (a) CXR, AP view (b) Chest CT, Axial view

High-resolution chest computed tomography scan revealed Ground glass opacities (red arrow), consolidation (blue arrow), Interlobular septal thickening (yellow arrow).

X-RAY AND CT SCAN

The x-ray machine used in this case series study was Ge-AMX IV portable (General Electric, American). Chest X-ray images were taken on AP supine position factors of 100 kVp and 4-8 mAs. The CT scan machine used in this case series study was Toshiba's Activion 16 Multislice (Toshiba, Japan) with parameters of 120 kVp, 124 mAs, and 1.25 mm image thickness continued with mediastinum and lung window reconstruction and images were sent to the PACS to be read by the radiologists. Chief radiologists with field experience of 30 years provided reports for each patient's chest X-ray and chest CT scan images.

The patients in this case series were two males and one female with an age range of 56-70 years old. All three had mild to severe symptoms with the most common symptom being fever, cough, and dyspnea. One male and one female out of the three patients had lymphocytosis, a significant increase in neutrophils, and a decrease in lymphocytes. All three patients had a significantly high level of CRP with a range of approximately 28-45 times over the normal range. Chest X-ray (CXR) of the first two patients showed bilateral infiltrates and of third patients showed unilateral infiltrates, suggestive of an infective lung disease process. Non-contrast chest computerized tomography (CT) of all three patients showed bilateral ground-glass opacifications fields suggestive of the viral inflammatory process most likely COVID-19. RT-PCR of all three patients was confirmed positive for SARS-CoV-2.

CRP: C-reactive protein; HCV: Hepatitis C virus; WBCs: White blood cells; RBCs: Red blood cells; RT-PCR: Reverse transcriptase-polymerase chain reaction

DISCUSSION

This case series study highlights the fundamental importance of chest computerized tomography (CT) in diagnosing COVID-19. The mean age in this study was 63 years old, which is older than 42.64 years old[7] and 30.55 years old.[8] In this study, the most common clinical symptoms were fever, cough, and dyspnea while comorbidities symptoms like body aches, Hypertension, and allergy to penicillin consumption appeared in the third patient. The third patient was also shifted to ICU at second day of hospitalization with physical examination, blood pressure 90/40, a fever of 98°F, Heartbeat 73 per minute, and O_2 Saturation measured using pulse oximetry 90% with 15 liter oxygen in the room atmosphere.

Variants	Patient 1	Patient 2	Patient 3	Reference Range
Age (Years)	56	63	70	
Sex	Male	Male	Female	
Lab results				
CRP (mg/L)	224.7	184.40	141.0	<5
HCV	Negative	Positive	Negative	Negative
WBCs (10^3/uL)	No data	11.4	16	4.0-11.0
RBCs (10^6/uL)	No data	5.84	4.37	M : 4.5-5.5 F : 3.8-4.8
Platelets (10^3/uL)	No data	195	203	150-450
Hemoglobin (g/dL)	No data	15	12.4	M : 13-17 F : 12-15
D-dimer (mg/L)	No data	2.8	< 0.20	< 0.20
RT-PCR	Positive	Positive	Positive	Negative
Urea (Blood) /Ureum (mg/dL)	No data	17	54	16.6-48.5

Table-I. Baseline characteristics of COVID-19 patients

Findings	Patient 1	Patient 2	Patient 3
Chest X-ray Findings			
Unilateral infiltrate	No	No	Yes
Bilateral infiltrate	Yes	Yes	No
Chest CT Findings			
Ground-glass opacity	Yes	Yes	Yes
Pleural effusion	No	No	No
Bilateral consolidation	Yes	Yes	Yes
Interlobular septal thickening	Yes	Yes	Yes
Severity	30/40	32/40	12/40

Table-II. Chest X-ray and chest CT findings of COVID-19 patients

After four days in ICU, she was shifted back to the isolation room with physical examination, blood pressure 139/90, a fever of 98°F, Heartbeat 89 per minute, and O_2 Saturation measured using pulse oximetry 91% in the room atmosphere. All three patients had mild to severe symptoms. Following recent studies, older patients have moderate to severe symptoms, while younger patients have mild to moderate symptoms.[9] The mean duration of hospitalization was 6.3 days that is lesser than 12.3 days.[10] A variety of tools are used to diagnose coronavirus, including clinical study, RT-PCR, X-rays, and HRCT. Clinical studies are also somewhat useful, but different test findings vary according to the medical condition of different patients that are not exactly suggestive of COVID-19. Reverse transcriptase-polymerase chain reaction (RT-PCR) confirms the presence of COVID-19 either it is positive or negative. According to other studies, the diagnosis of COVID-19 currently relies mostly on RT-PCR testing of samples collected from the oropharyngeal and nasopharyngeal swabs because it offers benefits in terms of low cost, safety, and ease of collection.[11] Chest CT provides a quick result as compare to RT-PCR which requires at least a whole day for confirmation. We know, many patients have missed the chance of timely isolation and treatment because they have not been diagnosed in an appropriate manner. Due to numerous variables that could render the results of RTPCR invalid, chest CT is a more reliable alternative to RT-PCR that diagnoses COVID-19 accurately[12], as for the sensitivity of chest CT for COVID-19 pneumonia. Ai et al., reports the high sensitivity of CT (97%, 580/601) in RT-PCR positive patients.[13] Bernheim et al., reported that CT showed sensitivity of 44% (16/36) in the early period within two days from clinical onset.[14]

Chest CT examination is much unblemished in

the initial screening, differential diagnosis, and disease severity valuation of COVID-19. So, it should be performed as soon as possible for patients with the first symptom most likely fever and with a history of exposure to COVID-19. Even if the RT-PCR result for the detection of SARS-CoV-2 is negative or unavailable and chest CT imaging shows the presence of the virus, it is still needed to take isolation measurements. It is compulsory to avoid the prevalence of the disease.[15] For the progress of the detection rate of the SARS-CoV-2, it was asked by an academician of the American Society for Radiation Oncology to establish a CT-based diagnostic method for COVID-19 immediately.[16] Antipyretics, Antibiotic e.g. azithromycin and multivitamins are given every four hours and O_2 saturation is maintained to treat a COVID-19 patient, as no specific drug has yet been developed for treatment, only corona vaccines have been developed. The recovered patient was discharged based on physical examination, laboratory results, RT-PCR, and radiological improvements. Not everyone can afford these entire tests or sometimes the number of patients in the hospital is very high. In such a situation the patient is discharged only based on necessary tests including physical examination, and COVID-PCR. Since two of our three patients under observation died during this study, to our knowledge, older people with severe COVID-19 and the people who have a weakened immune system due to other diseases, have a high mortality rate.

We know that chest computerized tomography (CT) images are important for the diagnosis of the disease, but also the safety of healthcare workers, radiographers, radiologists, and patients. For this purpose, appropriate safety measures should be taken while performing CT scans. The radiographer is urged to wear a PPE Kit and the patient is required to wear an N95 face mask and gloves. After the CT scan, the machine is sanitized so that later patients are protected from the effects of the virus. We are also aware that this study still has some limitations because we have kept its sample size very small. We know that the larger the sample size, the better the results will be. To a large extent, a more comprehensive picture of the importance of Non-contrast chest computerized tomography (CT) scans in diagnosing the COVID-19 is clear.

CONCLUSION

In conclusion, HRCT is a highly diagnostic tool to detect the pre- and post-effect of SARS CoV-2 on the respiratory system that defines the onset and the severity of the disease. This timely diagnose also helps prevent the further spread of the disease. So, it's a precious diagnostic tool to detect histopathological alterations in respiratory system.

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2	Ali Arslan	Acquisition of data.	
3	Almas Safdar	Compiling of data.	
4	Mahrukh Mazhar	Compiling of data.	
5	Ali Raza Ishaq	Critical revision for important intellectual content.	
6	Maleeha Manzoor	Concept or design.	