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Imaging Aspects (Chest Radiographic and CT Scan Findings) of COVID-19 with Clinical Classifications

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Abstract

Chest radiographic (CXR) and chest computed tomography (CT) scans have been used to diagnose coronavirus (COVID-19) disease as an important counterpart to the reverse transcription polymerase chain reaction (RT-PCR) diagnostic protocol. This work explores the application of CXR and CT scans as diagnostic instruments for COVID-19. Numerous databases were searched from 01/01/2020 till 2020 late for COVID-19 articles which documented the clinical features of CXR and CT scans. The documented cases were based on the evaluation of the imaging characteristics. Chest radiographic findings may be confirmed with the most basic CT scans. Peripheral, bilateral and primary ground-glass distortion are the most prominent CT results with COVID-19 infections. In conclusion, unique and ambiguous terms such as pneumonia, blurred opacities, airspace disease, patchy opacities, and infiltrates make it difficult to perceive the different chest radiographic findings.

Keywords: Coronavirus, World respiratory syndrome coronavirus, RT-PCR, Chest X ray, Chest CT.

1. Introduction

In January 2020, the world was shocked by the novel COVID-19 outbreak in Wuhan city (Hubei province, China). Molecular analyses discovered that the COVID-19 virus is closely related to the 2003 severe acute respiratory syndrome coronavirus (SARS-CoV-2) (Al Mutair and Ambani 2020, Kanne, Little et al. 2020, Ludvigsson 2020, Rodriguez-Morales, Cardona-Ospina et al. 2020). COVID-19 is a highly contagious disease that might sometimes lead to critical respiratory disorders requiring dedicated managing and supervision at hospital (Bastola, Sah et al. 2020, Chan, Yuan et al. 2020, Chen, Zhou et al. 2020, Huang, Wang et al. 2020, Lim, Jeon et al. 2020, The 2020, Wu, Liu et al. 2020, Xu, Shi et al. 2020, Zhu, Zhang et al. 2020). • Initially, COVID-19 patients typically have a fever, dry cough, dyspnea, fatigue, and anosmia. Some patients also report gastrointestinal (GI) symptoms(Sahu, Mehta et al. 2021). Moreover, it can cause neurological and enteric diseases, particularly in immunocompromised patients, such as Children, pregnant women, and older adults. Coronaviruses were initially recognized in the 1960s. Before in 2003, these viruses were known to cause flu-like mild symptoms (Bermingham, Chand et al. 2012, Zaki, Van Boheemen et al. 2012, de Groot, Baker et al. 2013, Mailles, Blanckaert et al. 2013, Raj, Farag et al. 2014, Al-Osail and Al-Wazzah 2017).

The COVID-19 pandemic is the third global epidemic caused by a *Betacorovirus* over the last 20 years. In 2003, the world was shocked by the severe acute respiratory syndrome in Asia (Drosten, Günther et al. 2003, Ksiazek, Erdman et al. 2003, Kuiken, Fouchier et al. 2003). Nine years later in Saudi Arabia, a new coronavirus emerged to the known Middle East Respiratory Syndrome coronavirus (MERS-CoV) (Haagmans, van den Brand et al. 2015, de Wit, van Doremalen et al. 2016, Baharoon and Memish 2019). There are many differences and similarities in the clinical feature, epidemiology, and strategies used in managing and controlling Influenza H1N1, SARS, MERS, and COVID-19 (Ratre, Vishvakarma et al. 2020) (Al-Tawfiq, Zumla et al. 2014, Baharoon and Memish 2019, Chen, Zhou et al. 2020, Huang, Wang et al. 2020, Organization 2020, Zhu, Zhang et al. 2020). Coronaviruses are a large group of viruses with a positive-strand RNA (+ssRNA) genome. Most of the studies revealed that these viruses originated in bats and transferred to humans through an intermediate animal host (Plowright, Parrish et al. 2017, Ruiz-Saenz, Bonilla-Aldana et al. 2019, Millán-Oñate, Rodriguez-Morales et al. 2020, Rodriguez-Morales, Bonilla-Aldana et al. 2020). Despite the similarities in the clinical features of SARS, MERS and COVID-19, there are notable differences ever since the initial accounts (Al-

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Tawfiq, Zumla et al. 2014, Yin and Wunderink 2018). Therefore, comprehensive characterizations are required considering the clinical, laboratory as well as imaging features.

Pulmonary embolism is a pathologic condition, whether acute or chronic, causes both partial and complete intraluminal filling defects, which should have a sharp interface with intravascular contrast material. In acute pulmonary embolism that manifests as complete arterial occlusion, the affected artery may be enlarged. Partial filling defects due to acute pulmonary embolism are often centrally located, but when eccentrically located they form acute angles with the vessel wall. However, CT pulmonary angiography is becoming the standard of care at many institutions for the evaluation of patients with suspected pulmonary embolism. Patients with COVID-19 have an increased prevalence of pulmonary embolisms and most have moderate or severe lung involvement on CT studies (Chamorro, Ostolaza et al. 2021).

Typical COVID-19 pneumonia CT results exhibited consolidation and bilateral ground-glass opacities (GGOs) with a posterior and peripheral lung distribution. These findings consistently supported the early radiological studies (Chung, Bernheim et al. 2020, Pan, Ye et al. 2020, Song, Shi et al. 2020). Even though it is merely about three months after the outbreak of COVID-19, many articles have been published in the most reputable international medical and scientific journals, both from China and other international researchers. These published articles include case reports with travel- and non-travel-related circumstances (Ahmad, Khan et al. 2020, Arab-Mazar, Sah et al. 2020, Bastola, Sah et al. 2020, Bernard-Stoecklin, Rolland et al. 2020, Giovanetti, Benvenuto et al. 2020, Holshue, DeBolt et al. 2020, Nishiura, Kobayashi et al. 2020, Organization 2020, Pongpirul, Pongpirul et al. 2020, Reusken, Broberg et al. 2020, Rothe, Schunk et al. 2020). Many studies have begun to proffer solutions to the imaging results; however, there has been no single review to consolidate the knowledge learning from various studies or case reports to understand the authors. In this study, a literature review was conducted to offer the most recent synthesis of the radiographic portrait of the COVID-19 patients. This was achieved with the help of the CXR and CT chest results of several instances at different places. Clinical symptoms, findings, and CT/CXR follow-ups imaging are presented (Oglat 2020, Oglat, Alshipli et al. 2021).

2. Methods

2.1. Criteria of this Study

In the present study, peer-reviewed articles that reported cases with image features were considered. Article language was limited to English and the time span was open to several published during 2020. Furthermore, documents that did not contain the original data were omitted. The data used in the present study were obtained from the Web of Science, Scopus, and the Medline/PubMed. Novel coronavirus, Novel coronavirus 2019, 2019 nCoV, COVID-19, Wuhan coronavirus, Wuhan pneumonia, and SARS-CoV-2 were used as the search terms. The result was assessed by numerous different independent scholars.

2.2. Study Selection

Screenings by title and abstract on the outcomes of the preliminary search were firstly carried out. This was followed by retrieving of the relevant articles considered relevant in the present study. Documents that reported duplicate data were excluded and counted as a single case. Several published articles were incorporated for the study, and their findings were summarized. Data extraction procedures that include information on the publication type, the publication year, date, country, institution, and the amount of cases reported, were studied. Also, demographic information such as age and sex, as well as outcome such as death, complications such as acute respiratory distress syndrome, acute respiratory distress syndrome (ARDS), imaging such as chest X-ray, laboratory findings such as biochemistry, white blood cell counts (WBC), and clinical features such as cough, were studied. The articles list was checked two times to avoid duplication of records.

3. Results

Many patients having a lower pulmonary tract infection caused by COVID-19 were presented with cough, dyspnea, myalgia, and fever. Moreover, 17-29 % of them had ARDS (Chen, Zhou et al. 2020, Huang, Wang et al. 2020). More than 2.3 % fatality rate was estimated. In one retrospective study, the R0 was projected as the average figure of new cases of infection transfer from person to native population as 3.28, as opposed to estimated values of 1.4–2.5 by the World Health Organization (Liu, Gayle et al. 2020). Any value higher than 1.0 indicates the likelihood of the infection's spread instead of being diminished. Because of the improved intervention and awareness, R0 values from later studies were projected to be more dependable.

It was difficult to deduce the desired information from the diverse outcomes on chest radiographs due to the vague and special terms such as hazy opacities, patchy opacities, infiltrates, pneumonia, and airspace disease (Chang, Lin et al. 2020, Huang, Wang et al. 2020, Liu, Gayle et al. 2020). The most detailed reports on CT results can simplify chest radiographic findings. Consolidation, peripheral, basal ground-glass opacity and bilateral were among the predominant CT results of patients infected with COVID-19 (Bernheim, Mei et al. 2020, Pan, Ye et al. 2020). Opacities frequently show extensive geographical distributions. Numerous distinct areas of consolidation, GGO, or both take place in a subcategory of patients who repeatedly have a reversed halo or round morphology or a toll sign. Lymphadenopathy, extensive lung nodules, and pleural effusion, occur in a very small number of cases, suggesting another diagnosis or bacterial superinfection. CXR assessment involves the existence of interstitial involvement (mixed, nodular or reticular form), mediastinal lines, hilar expansion, pleural calcification, pleural effusion, etc.

CT scan estimation has four major categories: 1. GGO and consolidation which is classified as follows: lack of both consolidation and ground glass opacities, occurrence of pure ground glass, existence of ground glass opacities, existence of consolidation, existence of GGO with consolidation, and crazy paving (Huang, Wang et al. 2020); 2. Pleura that includes: existence of focal thicken,

pleural effusion, and existence of calcifications (Organization 2020); 3. Mediastinum which includes: existence of lymphadenopathy (defined as lymph node size of ≥10 mm in short-axis dimensions), existence of pericardial effusion; and ascending thoracic aorta diameter [49]; 4. Pulmonic vessels consisting of: perilesional vessels diameter and diameter of pulmonic artery trunk (Chan, Yuan et al. 2020).

3.1. Case 1.

Pt history: A 50-year-old male patient was admitted to a fever clinic. The patient indicated signs of shortness of breath, fatigue, cough, chills, and fever. The patient was also reported to have travelled to Wuhan city. Furthermore, he showed initial indications of dry cough and mild chills but kept working and only reported to the clinic after 14 days (Xu, Shi et al. 2020).

CXR/CT findings: The CXR exhibited many patchy shadows in both lungs (Figure1). A throat swab sample was collected and on the 22nd of January, the patient was confirmed to have the COVID-19 infection by the Beijing Centre for Disease Control using the RT- PCR assay. Some differences between the right and left lungs and the swift advancement of pneumonia were observed, as evident from the CXR. Also, the liver tissues exhibited mild lobular movement and moderate micro vesicular steatosis; nevertheless, there was no convincing proof to establish that drug-induced liver damage or COVID infections are directly caused. Furthermore, no clear histological alterations were observed in heart tissues, signifying that COVID infection might not be the direct cause of the heart impairment. Even though corticosteroid is not formally endorsed as a treatment for COVID pneumonia, it has been suggested that appropriate and timely use of ventilator support, together with corticosteroids, should be used for the severe patient to avoid the development of ARDS.

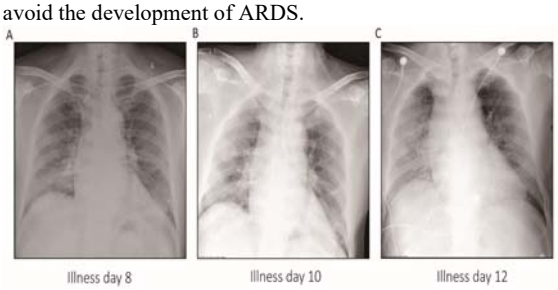

Figure 1. Chest radiographs on day 8, day 10 and day 12 since the onset of illness. (A) The brightness of both lungs was decreased, and multiply patchy shadows were observed. Heart shadow presents in the normal range roughly. The diaphragmatic surface was light and smooth; phrenic rib angle was sharp (illness day 8). (B) Diffuse ground-glass opacity was found in both lungs (illness day 10). (C) Chest radiograph showed progressive infiltrate, diffuse gridding shadow appeared in both lungs. Small area emphysemas were observed in the upper and lower lobes of the left lung (illness day 12) (Xu, Shi et al. 2020).

3.2. Case 2.

Pt history: A 54-year-old man from Korea and living in Wuhan, returned to Korea. The patient sensed the earliest symptom of muscle pain and chills and was isolated (by a negative pressurized room) at Myongji Hospital. After 2 days, the COVID-19 infection test was by RT-PCR and pan-coronavirus conventional PCR assay with a swab taken from the patient throat. The patient had no major ailment and was without any record of drinking or smoking (Lim, Jeon et al. 2020).

CXR/CT findings: Upon admission, the patient did not show any respiratory symptoms and recorded blood pressure of 152/93 mmHg at 73 beats/minute. Moreover, his respiratory rate was 20 breaths per minute, and he recorded a body temperature of 37.0 °C. Clear lung sounds were observed upon physical examinations with clear CXR nor pharyngeal injection. On day 5 and 7 of the illness, the patient developed fever and dry cough respectively. Nevertheless, the patient had no severe respirational symptom such as chest pain, productive sputum, or shortness of breath. Upon high-resolution CT scan, GGOs in both lower lobes and minor consolidation in the right upper lobe were observed (Figure 2).

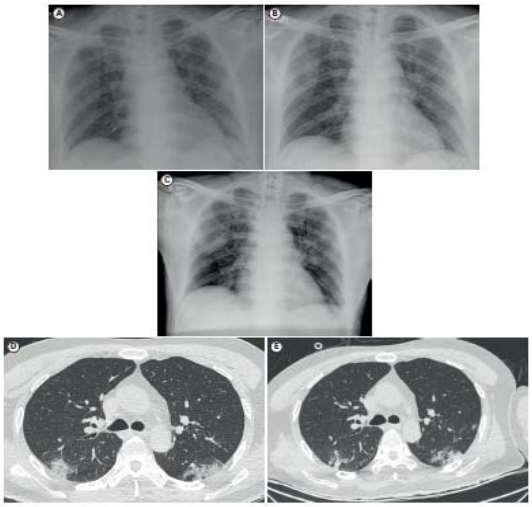

Figure 2. Radiologic findings of the patient. (A) Chest X-ray of illness day 3, hospital day 1. (B) Chest X-ray of illness day 9, hospital day 7. (C) Chest X-ray of illness day 15, hospital day 13. (D) HRCT scan of illness day 9, hospital day 7. (E) HRCT scan of illness day 15, hospital day 13. AP(P) = Anteroposterior (Portable X-ray), HRCT = high-resolution computed tomography (Lim, Jeon et al. 2020).

3.3. Case 3.

Pt history: All registered eighty patients, who were indicated to the Fifth People's Hospital of Wuxi, the Yancheng City was for the second People's Hospital, and the First People's Hospital of Yancheng City were sequentially analysed in retrospect. All the data were collected which include extent of hospitalization and stay at the intensive care unit, medical records, attending doctors, chest CT, laboratory parameters, prognosis from patients' demographic information, and clinical records. The patients were clinically grouped into four subcategories: mild, severe, moderate, and critically ill. At that time, 51% of the patients were female, and their median age was nearly 46.1 years. About thirty-three percent of the patients aged between 25 and 49 years, while about 24 % were between 50 and 64-years-old. Furthermore, about 11% of the patients were above 65 years while 13% below 18 years old, and 19% (15 patients) aged between 18 and 24-years-old (Figure 1). Three patients (3.75 %) were clinically classified as severe type, 49 patients were moderate, while 28 patients mild,

and no one was classified as being critically ill (Wu, Liu et al. 2020).

CXR/CT findings: 55 of the 80 patients (68.75 %), indicated anomalous CT scans. These anomalies consisted of thirty-six (45.0 %) and nineteen (23.75 %) bilateral and unilateral pneumonia respectively. Away from both bilateral and unilateral GGOs (Figure 3A) and (Figure 3B) respectively, bilateral ground glass or sub-segmental consolidation regions, as well as bilateral lobular, sub-segmental consolidation areas, were absent. About 31 % of the cases had normal density shadow in both lungs parenchyma (Figure 3C). Chest imagines are of great importance for diagnoses (Chung, Bernheim et al. 2020). At an early stage, numerous interstitial and mottling changes, particularly in the peripheral part were observed. Lungs consolidations can occur in severe cases; on the other hand, pleural effusions were uncommon. Compared to the cases reported from Wuhan, CT scans in which all the patients were odd with 98% of the patients having bilateral involvement; the abnormal rate of the present study was relatively lower. Total of 55 patients (68.75 %) displayed abnormalities in their chest CT images. 19 out of these abnormal CT images were unilateral pneumonia (23.75 %), while 36 were bilateral pneumonia (45.00 %). The first CT scans of the 25 patients were normal with 23 of them being diagnosed for over four days. It is therefore suggested that during the screening of patient for clinical manifestations, there is a need to combine the laboratory examination with chest imaging with for all-inclusive investigation.

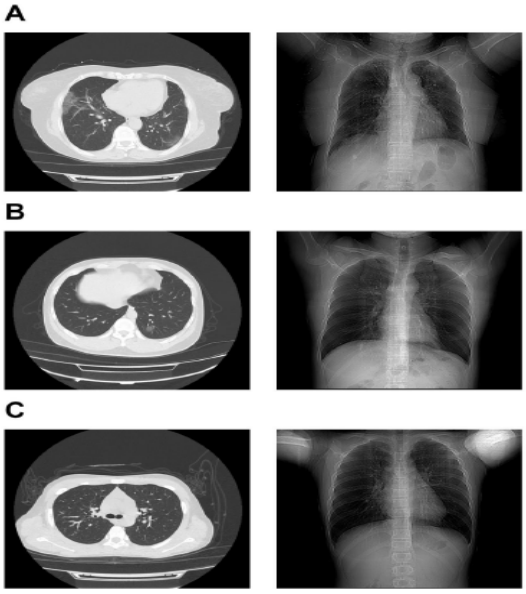

Figure 3. (A) a 71-year-old woman showing that there are scattered high-density shadows with fuzzy patches in the lower lobes of the two lungs, with ground glass, with clear hilar structure, unobstructed trachea, no displacement of mediastinum, no enlarged lymph node shadow (B) a 38-year-old man showing that there is small patchy ground glass like density increasing shadow in the upper and lower lobes of the left lung, with clear hilar structure (C) a 12-year-old boy showing that there was no abnormal density shadow in the parenchyma of both lungs, the structure of pulmonary hilus (Wu, Liu et al. 2020).

3.4. Case 4.

Patient history: A retrospective study of 25 dead persons with the COVID-19 pandemic was done in Renmin Hospital (Wuhan University). **A**ll 25 dead patients (fifteen females and ten males) were tested positive for COVId-19 using RT-PCR on their respiratory tract sample. In conclusion, the age of the patients ranged from 55 to 100-years-old. 100% of the dead persons had diseases, including hypertension (16/25, 64 %), which was the most common. Others include kidney diseases (20 %), cerebral infarction (16 %), Chronic Obstructive Pulmonary Disease (8 %), cancers (8 %), acute pancreatitis (4 %), heart diseases (32 %) and diabetes (40 %) (Li, Wang et al. 2020).

CXR/CT findings: Chest CT scans disclosed that the patients' pulmonic lesions were less well in the later stage than earlier ones (patients 3, 13, and 14) (Figure4).

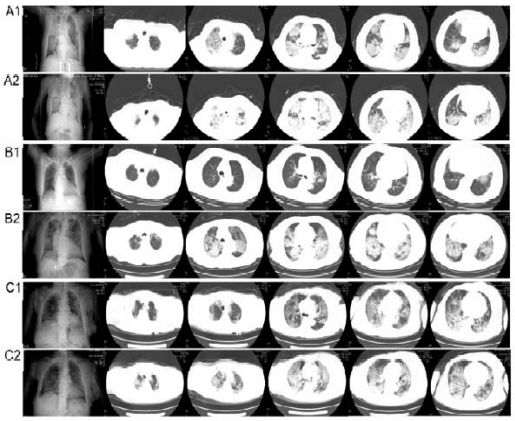

Figure 4. Chest CT scans of patient 3, patient 13 and patient 14. A1: the early stage Chest CT scan of Patient 3; A2: the late stage Chest CT scan of Patient 3; B1: the early stage Chest CT scan of Patient 13; B2: the late stage Chest CT scan of Patient 13; C1: the early stage Chest CT scan of Patient 14; C2: the late stage Chest CT scan of Patient 14 (Li, Wang et al. 2020).

3.5. Case 5.

Patient history: A 40-years-old woman was admitted to the hospital with fever, fatigue, and chest tightness. The patient had no travel history to Wuhan and had no contact with any COVID-19 infected patients. Her body-temperature on admission was elevated to 38.9 °C. The investigations indicated normal lymphocytes (30.9 %), neutrophils (59.6 %), and leukocyte (4170 /μL). There was an increase in the glucose (7.3 mmol/L) and hematocrit (0.456) levels (Wei, Xu et al. 2020).

CXR/CT findings: The Figure 5A indicated that the lungs were normal from the first chest radiograph was that obtained 3-days after the onset of the fever. Moreover, the unenhanced chest CT taken on the same day displayed that the left lung was normal, while GGOs in the sub-pleural zone of the right-lower lobe was observed (Figure 5B). The patient was treated with antibiotics for the obtainable symptoms.

No respiratory symptoms were observed initially; however, the patient begun to cough on day 6 following the commencement of the fever onset. A gained density of GGOs was observed in the right-lower lobe, upon a follow-up chest CT examination. Then this advanced into consolidations with perilobular condensing. Furthermore,

GGO lesions and multi-focal peripheral patchy regions of nodular consolidations were lately established in the sub-pleural zones of both lower lobes (Figure 5C-E). A repeat CT scan at the time of discharge revealed that the earlier GGOs and consolidations in the patient's lungs were virtually absorbed and only a small number of fibrous lesions that may signify lingering consolidating pneumonia were left (Figure 5F).

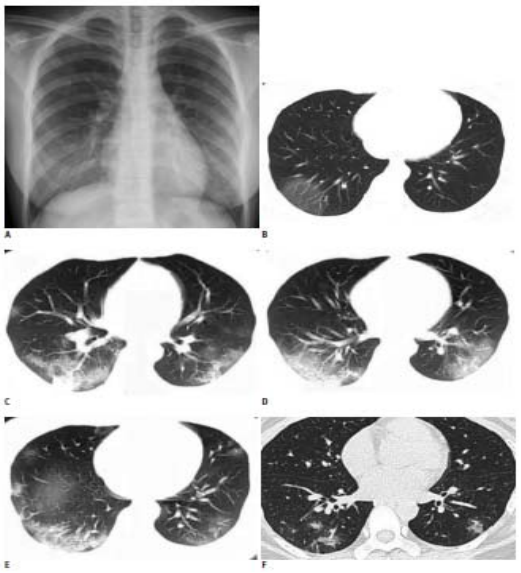

Figure 5. 40-year-old female patient with Coronavirus disease 2019 pneumonia. (A) shows no thoracic abnormalities. Axial CT scan (B) shows GGOs in subpleural area of right lower lobe. Left lung is normal. Multifocal peripheral patchy areas of nodular consolidations and nodular GGO lesions are newly developed in subpleural areas of both lower lobes. F. Progressive resolution of parenchymal lesions is seen in follow-up high-resolution CT scan obtained on day 12. Patchy consolidations and GGOs in both lungs were almost absorbed leaving a few fibrous lesions that may represent pneumonia (Wei, Xu et al. 2020).

The preliminary CT indicated GGOs in the right-lower lobe, the abnormality of which may indicate the formation of hyaline membrane or pulmonary edema (Chung, Bernheim et al. 2020). However, it is difficult to picture the lesions using conventional radiographs due to the subtle nature of their density. Hence, COVID-19 patients are recommended to undergo routine CT scans to lessen missed diagnoses. This patient's CT results contain GGOs in both right lungs and the left lung, particularly in the marginal regions of lower lobes that may signify alveolar damage, fibrous and cellular exudation, several patchy consolidation and the short-term progressions of lesion. After treatment, GGOs and consolidations were virtually absorbed, then leaving the fibrous cord like shades that denote fibrosis.

3.6. Case 6.

Pt history: Two residents of Wuhan a male and a female couple both in their 60s travelled to Italy for vacation. The male patient was seemingly healthy, while the female was taking treatment for oral hypertension. They had fever and respiratory symptoms, and they were received in the advanced isolation unit of the Lazzaro Spallanzani (National Institute of Infectious Diseases), Italy. Their RT-PCR oropharyngeal and nasopharyngeal swabs tested were positive for COVID-19 (Corman, Landt et al. 2020). On their fourth day of admission, they developed progressive respirational failure and clinical proof of ARDS with mechanical ventilator in ICU (Albarello, Pianura et al. 2020).

CXR/CT findings: Chest X-Rays were achieved with conventional plain films with anteroposterior projection at bedsides. On the second day, baseline volumetric CT scans in the horizontal positions at full inspiration were achieved. On the 3rd and 4th day, follow-up scans were carried on these both patients in order to evaluate the level of progressive pulmonary injury. A multiple detector scanner was used for all the earlier and follow-ups CT scans (Albarello, Pianura et al. 2020). The CT images were studied by two skilful radiologists in thorax imaging to assess for any manifestation and spreading of abnormality, and a consensus was reached on the outcomes.

CXR/CT findings: Follow-ups CT scans of the lung were obtained in both abnormal patients; moreover, they were also used to evaluate and measure the residual pulmonic volume in an initial quantitative setting with the help of a thoracic volume by Reading imaging using a specific software (VCAR, GE, Milwaukee, Wis) (Figure 6a, b, c).

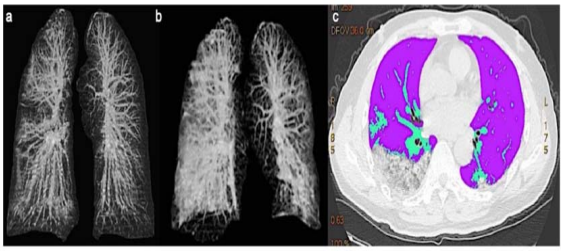

Figure 6. (a and b) Lung VCAR imaging displaying baseline CT and follow-up CT with progressive impairment of the lung parenchyma. (c) lung sparing analysis (Albarello, Pianura et al. 2020).

Two days later, the onset of the symptoms a CXR of the male patient was obtained and found to be inconsistent with lung alteration. However, crazy paving and GGOs were observed in the posterior-basal segment of the right-lower lobe, the lateral piece of the mid lobe, a day following the chest CT scan (Figure 7a and 8a). However, the lesion on the left side involved the posterior segment and superior basal segment of the lower lobes. Likewise, minor unilateral pleural effusions and mediastinal lymphadenopa- were found, and this was the largest with a short-axis of 12 mm (Figure 7b) (Albarello, Pianura et al. 2020).

The initial following-up CT scan was conducted on day 3, and pericardial and bilateral pleural effusions were observed (Figure 8b). The lymph nodes with a linear size ≥10 mm in the short-axis dimensions were found in the 4L, 4R, and 2R levels. Moreover, there was an increase in the diameter of the sub-segmentary vessels as revealed in the first CT scan and also after the third and the 6th day of the follow-ups, 5% and 10% increase in size were observed.

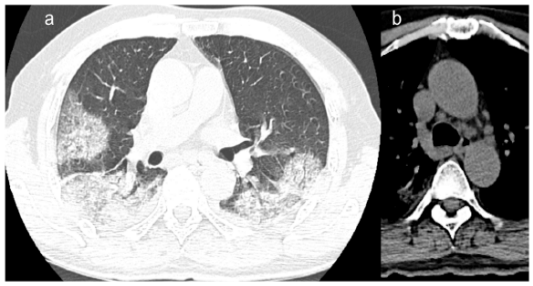

Figure 7. (a) Baseline chest CT images in a 66 years old man displaying multiple patchy ground glass opacities with reticular and interlobular septal thickening: crazy paving. The lesions are mostly distributed in the upper segment of right lower lobe and focal ground glass opacities in the superior segment of left inferior lobe. (b) Mediastinal lymphadenopathies the biggest with short axis of 12 mm (Albarello, Pianura et al. 2020).

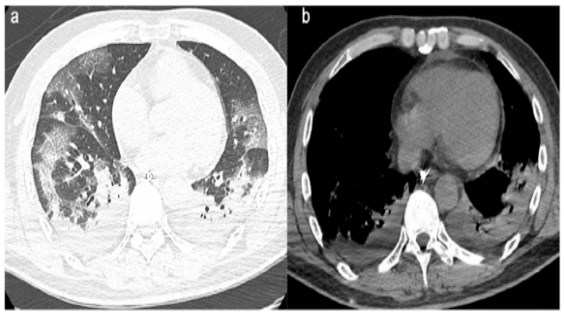

Figure 8. (a) Follow-up CT in a 66 years old man after 5 days, shows severe progression of pneumonia with increased of extension of ground glass opacities and consolidation. (b) Appearance of bilateral pleural effusion (Albarello, Pianura et al. 2020).

Two days later, the onset of the symptoms, a CXR was conducted for the female patient and interstitial lung alteration was evident. Ground glass and crazy pavement in the lateral basal segment of the right lower lobe, the middle-segments of the middle-lobes, the posterior and superior-basal, and the posterior and anterior of the right upper lobes, were observed on the third day following a chest CT scan. The lesions on the left side involved the superior and upper lobes as well as the posterior and lateral-basal sections of the lower-lobe (Figure 9a, 10a).

At third CT scan, pleural effusion at both sides (bilateral) appeared; however, at both 1st and 2nd CT scans, the non-pleural effusion appeared. There was no pericardial involvement (Figure 10b). Nodes having a longitudinal size ≥10 mm in the short-axis dimensions existed in the 10R level, 1R level, as well as the 6R, and level (Figure 9b). The first CT scan revealed an increase in the diameter size of the sub-segmentary vessels. Specifically, there was fourteen percent increase after the third follow-up as well as five percent rise after the 6th day of the following-up (Figure 11 a, b).

Figure 9. (a) Baseline CT images in a 65 years old woman shows patchy ground-glass opacities in the posterior segment of upper right lobe, with pleural contact. (b) Mediastinal lymphadenopathy with short axis of 10 mm (Albarello, Pianura et al. 2020).

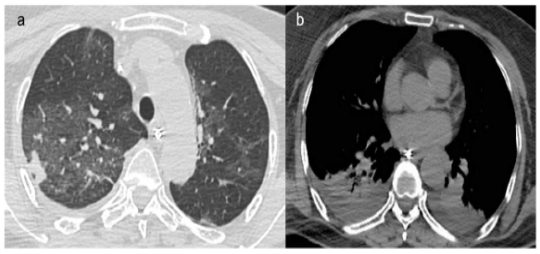

Figure 10. (a) Follow-up CT after 3 days in a 65 years old woman shows increase size and density of the lesions (b) with bilateral pleural effusion (Albarello, Pianura et al. 2020).

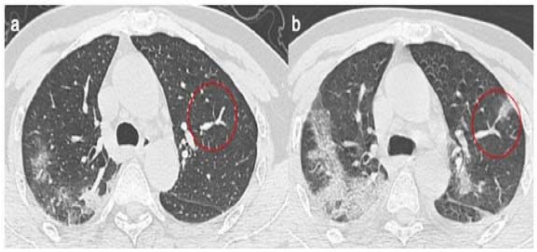

Figure 11. (a) Baseline chest CT shows tubular size increase of segmental vessel with normally ventilated adjacent lung parenchyma, (b) where after 3 days there is a ground-glass opacities (Albarello, Pianura et al. 2020).

Both patients exhibited a rise in the number of lung injury throughout their follow-ups. Enlargement in the lung lesion penetrates as well as an increase in the quantity of lung lesion with a comparative rise in consolidative zones in the posterior segments of the lower-lobes, comparative rise in GGO, and a decrease in interstitial-reticular involvement. The lungs formed of both lung injury patients were hypertrophy of the pulmonic vessels that are enlarged, mainly in areas with further distinct and noticeable interstitial injury. Related to those perceived in the existing severe infectious diseases (Wong, Antonio et al. 2003, Ooi, Khong et al. 2004). The vasoconstriction of the pulmonic vessels was probably connected to the existence of vasoactive elements in the lesions. A changed configuration of lung association was suggested by new radiological evidence [58]. In these 2 patients, the enlarged breadth of the perilesional pulmonic vessels developed by outspreading the pulmonic variations. An enlarged and a tubular look of pulmonic vessels with an unexpected calibre decline was testified throughout the sequel investigations. They were principally established in the dichotomy tracts, where a new insurrectionary pulmonary lesion center was observed (Figure 11a, b).

Case 7.

Pt history: A woman visitor from Wuhan (China) with age of 74-year-old came to the hospital and suffered from losing appetite, malaise, and fever. However, she notified no dependent medical conditions, and there was no diarrhea, abdominal pain, dyspnea, myalgia, rhinorrhea, chest discomfort, sore throat, cough, or chillness. Physical examination disclosed blood pressure (129/68 mm Hg), with a respiratory rate of 18 breaths per min, heart rate of 79 beats per min, as well as a body temperature of 38.1 ˚C. CXR discovered a tiny-raised infiltration over two (bilateral) lower lungs. Peripheral WBC count was 3770 per mL cube (32.1 % lymphocytes and 62.3 % neutrophils). COVID-19 of nasopharyngeal swab was found positive via RT-PCR done at the Centres in Taiwan for Diseases Control (Huang, Teng et al. 2020).

Case 8.

Pt history: A 77-year-old female came to the hospital with poor appetite, malaise, fever, and dry cough. The patient denied diarrhea, abdominal pain, dyspnea, chest discomfort, sore throat, myalgia, rhinorrhea, or chillness. Her blood pressure was 117/47 mm Hg, with respiratory rate of 18 breaths per min, a heart rate of 82 beats per min, as well as body temperature of 38.7 ˚C. CXR investigated non-clear tiny raised infiltration over bilateral lower lung. Peripheral-blood white-cell count was 3420 per cubic millimetre (with 69.3 % neutrophils and 26.9 % lymphocytes).

CXR/CT findings: Following-up CXR discovered rising opacity at right centre and at the lower lung (Figure 12A). On day number 6 in the hospital, the ill person stayed febrile, with malaise and tiny appetite. However, she informed worsening of cough. Following-up chest x ray discovered patchy consolidation over bilateral lower lung (Figure 12B).

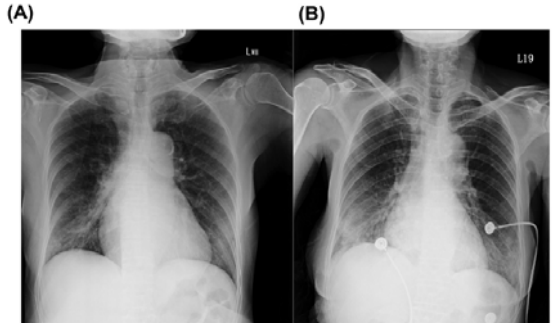

Figure 12. (a) Baseline chest CT shows tubular size increase of segmental vessel with normally ventilated adjacent lung parenchyma, (b) where after 3 days there is a ground-glass opacities (Huang, Teng et al. 2020).

The clinical utility of CXR in the early diagnosis of COVID- 19 is questionable. Similar findings were reported in the first case of COVID-19 in the United States, and pulmonary patch/consolidation was not detected by CXR until day 5 in hospital (day 9 of illness) (Holshue, DeBolt et al. 2020). Equally, in a case series of SARS patients from the Amoy Gardens housing estate, 29.3 % (22/75) cases had normal CXR on admission; however, four of the 22 cases developed acute respiratory distress syndrome (ARDS); afterwards, generally 80% (60/ 75) of the cases experienced radiological worsening at a mean of 7.4 days (Peiris, Chu et al. 2003). Both unifocal and bilateral lung infiltration could be observed. Of 99 COVID-19 cases in China, 25 and 75 % were presented with unilateral and bilateral pneumonia respectively (Chen, Zhou et al. 2020).

4. Discussion

An analysis of the latest work was carried out with the goal of collecting findings in a number of COVID-19 patients (almost 1,200 patients). Pathological and clinical results in a severe case of COVID-19 cannot only help to determine the cause of death but may also provide new insights into the pathogenesis of SARS-CoV-2-related pneumonia. It can allow medical professionals to come up with an effective treatment solution in a similar situation, resulting in a decrease in the death rate. It could be deduced from this event that COVID-19 can cause relatively mild symptoms, and that patient recovery can be accomplished with timely diagnosis of pneumonia. Reduced pathological loads and improved clinical symptoms were reported during treatment with ritonavir / lopinavir. Ritonavir / lopinavir may also be recommended to high-risk patients with COVID-19 at an early stage. However, further research was required to confirm the therapeutic effectiveness of lopinavir / ritonavir based on well-controlled clinical trials. In fact, there is also a need for an in-depth review of COVID-19 cases. Aging and primary conditions, such as diabetes, hypertension, etc., were found to be the most important risk mortality factors for COVID-19 infection. Nevertheless, bacterial infection can play a vital role in raising the death of the patient. In addition, malnutrition was also widespread among serious patients. There was also some multiple organ dysfunction, with the heart being the most affected organ in the lungs, followed by the liver and kidneys. Successive CT results have been recorded for a female COVID-19 patient. The CT scans revealed a fast-emerging number of patchy consolidations and GGOs in both the right and left lungs and were mainly scattered in peripheral areas. In addition, the use of high-resolution CT would make it easier to detect GGOs quickly. Furthermore, since there is potential similarity between the images of COVID-19 and pneumonia caused by other viruses, it is recommended that RT-PCR be adopted for rapid detection and treatment.

Finally, an early marker radiological indicator of lung failure may be identified on the basis of the growth of the expansion of the pulmonary vessel in places where the new lungs permeate as shown by the CT follow-up. As more reports are identified, the full spectrum of imaging findings in SARS-COV2 contaminated patients would be clearer. COVID-19 cannot be consistently differentiated from other causes of pneumonia by surgical, radiological or experimental requirements. There are also a number of cases not listed in this study due to the vast number of reported cases linked to this pandemic around. However, a summary of whole review article with a recap of several cases is shown at Table 1.

Table 1. Review article with summarizing of several cases

Case No.	Study date	Sample size/mean age	Common radiological findings/distributions	Conclusion
1	2020	A 50-year-old male patient	The CXR exhibited many patchy shadows in both lungs Some differences between the right and left lungs and the swift advancement of pneumonia were observed	Use of ventilator support together with corticosteroids should be used for the severe patient to avoid the development of ARDS.
2	2020	A 54-year-old man	Upon high-resolution CT scan, GGOs in both lower lobes and minor consolidation in the right upper lobe were observed	The patient did not show any respiratory symptoms and recorded blood pressure of 152/93 mmHg at 73 beats/minute. Moreover, his respiratory rate was 20 breaths per minute and recorded a body temperature of 37.0 °C. Clear lung sounds were observed upon physical examinations with clear CXR nor pharyngeal injection
3	2020	All registered eighty patients	Bilateral ground glass or sub-segmental consolidation regions, as well as bilateral lobular, sub-segmental consolidation areas, were absent. Total of 55 patients (68.75 %) displayed abnormalities in their chest CT images. Nineteen out of these abnormal CT images were unilateral pneumonia (23.75 %), while 36 were bilateral pneumonia (45.00 %).	It is, therefore, suggested that during the screening of patient for clinical manifestations, there is the need to combine the laboratory examination with chest imaging with for all-inclusive investigation.
4	2020	A retrospective study of 25 dead persons with the COVID-19 pandemic	Chest CT scans disclosed that the patients' pulmonic lesions were less well in the later stage than earlier ones.	In conclusion, the age of the patients ranged from 55 to 100-years-old. 100% of the dead persons had diseases, including hypertension (16/25, 64 %), which was the most common. Others include kidney diseases (20 %), cerebral infarction (16 %), Chronic Obstructive Pulmonary Disease (8 %), cancers (8 %), acute pancreatitis (4 %), heart diseases (32 %) and diabetes (40 %).
5	2020	A 40-years-old woman	The lungs were normal from the first chest radiograph was that obtained 3-days after the onset of the fever. Moreover, the unenhanced chest CT taken on the same day, displayed that the left lung was normal while GGOs in the sub-pleural zone of the right-lower lobe was observed. A gained density of GGOs was observed in the right-lower lobe, upon a follow-up chest CT examination.	It is difficult to picture the lesions using conventional radiographs due to the subtle nature of their density. Hence, COVID-19 patients are recommended to undergo routine CT scans to lessen missed diagnoses.
6	2020	Two residents of Wuhan a male and a female couple both in their 60s	Crazy paving and GGOs were observed in the posterior-basal segment of the right-lower lobe, the lateral piece of the mid lobe, the superior like the right upper lobe, a day afterward the chest CT scan. The lesion on the left side involved the posterior segment and superior basal segment of the lower lobes. Minor unilateral pleural effusions and mediastinal lymphadenopa- were found and this was the largest with a short-axis of 12 mm.	Both patients exhibited a rise in the number of lung injury throughout their follow-ups. Enlargement in the lung lesion penetrates as well as an increase in the quantity of lung lesion with a comparative rise in consolidative zones in the posterior segments of the lower-lobes, comparative rise in GGO, and a decrease in interstitial-reticular involvement.
7	2020	A woman with age of 74-year-old	CXR discovered tiny raised infiltration over two (bilateral) lower lungs.	COVID-19 of nasopharyngeal swab found positive via RT-PCR done at the Centers in Taiwan for Diseases Control
8		A 77-year-old female	Following-up CXR discovered rising opacity at right centre and at the lower lung. Following-up chest x ray discovered patchy consolidation over bilateral lower lung.	The clinical utility of CXR in the early diagnosis of COVID- 19 is questionable. Similar findings were reported in the first case of COVID-19 in the United States, and pulmonary patch/consolidation was not detected by CXR until day 5 in hospital (day 9 of illness).

5. Conclusion

In conclusion, several recent studies have presented descriptions of the results for common chest imaging of respiratory diseases instigated by COVID-19. It is concluded that the image results previously described in patients with SARS and MERS infection appeared similar to those recently reported for COVID-19. The analysis of the various results on chest radiographs proved to be difficult due to the unique and mysterious terms used, such as hazy opacities, patchy opacities, infiltrates, pneumonia, and airborne disease. Health care facilities have a strong responsibility in cases of COVID-19, particularly in situations where the patient suffers from other health problems.

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