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Review Article

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COVID 19 –X-RAYS, CT, ULTRASOUND AND PET/CT – A REVIEW

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INTRODUCTION

COVID-19 or Coronavirus disease 2019 is a pandemic that has now spread across the world. It has infected millions of people with 25 million cases tested positive and 855, 000 deaths worldwide as of September 1, 2020.[1] This virus was first brought to attention when a cluster of pneumonias of unknown etiology started popping up in Wuhan, Hubei Province, China towards the end of 2019.[2] A new coronavirus was identified and named severe acute respiratory coronavirus 2 (SARS – COV- 2) by the International Committee on Taxonomy of Viruses (ICTV) in February 2020. (2) The World Health Organization declared COVID-19 a Public Health Emergency of International Concern on January 31, 2020 and a Pandemic on March 11, 2020.[3] As of September 1, 2020, COVID-19 has spread to 212 countries and territories spanning 6 continents.[4]

KEYWORDS: COVID-19, Coronavirus, Pandemic, X rays, CT, Ultrasound, PET/CT, Pneumonia.

CLINICAL PRESENTATION

COVID-19 has a very wide range of clinical presentation, ranging from asymptomatic or pauci-symptomatic patients to patients requiring ventilator support.[5] Most common symptoms are cough, shortness of breath, fever, hypoxia and hypotension.[6] Pauci-symptomatic patients can also present with ageusia or anosmia in as much as 1/5 of cases.[7] COVID-19 has been shown to cause a high inflammatory burden resulting in vascular inflammation, myocarditis and cardiac arrythmias.[8] Patients who are older than 65 years, male gender and those with underlying chronic illnesses are found to have a worse outcome with COVID-19.[9]

Diagnosis

COVID-19 is mainly diagnosed at this time by using reverse transcriptase polymerase chain reaction (RT-PCR) using nasopharyngeal swab, oropharyngeal swab, mid-nasal turbinate swab or anterior nares specimen. Lower respiratory tract aspirate or bronchoalveolar lavage may be obtained in patients receiving invasive mechanical ventilation.[10] Serological tests to detect antibodies such as IgG and IgM in the serum of infected and recovered patients are also developed. The sensitivity for the rapid IgM-IgG Combined Antibody test for COVID-19 has a sensitivity of 88.66% and a specificity of 90.63%.[11]

Imaging has also been found to have a high sensitivity to diagnose COVID-19. A study of 1041 patients in China comparing Chest CT with RT-PCR suggest that Chest CT may be used for detection of cases in endemic areas. Chest CT has a sensitivity of 97% and specificity of 25% for COVID-19.[12] The main deterrent to using CT as a screening tool for COVID-19 is the increased radiation exposure.[13]

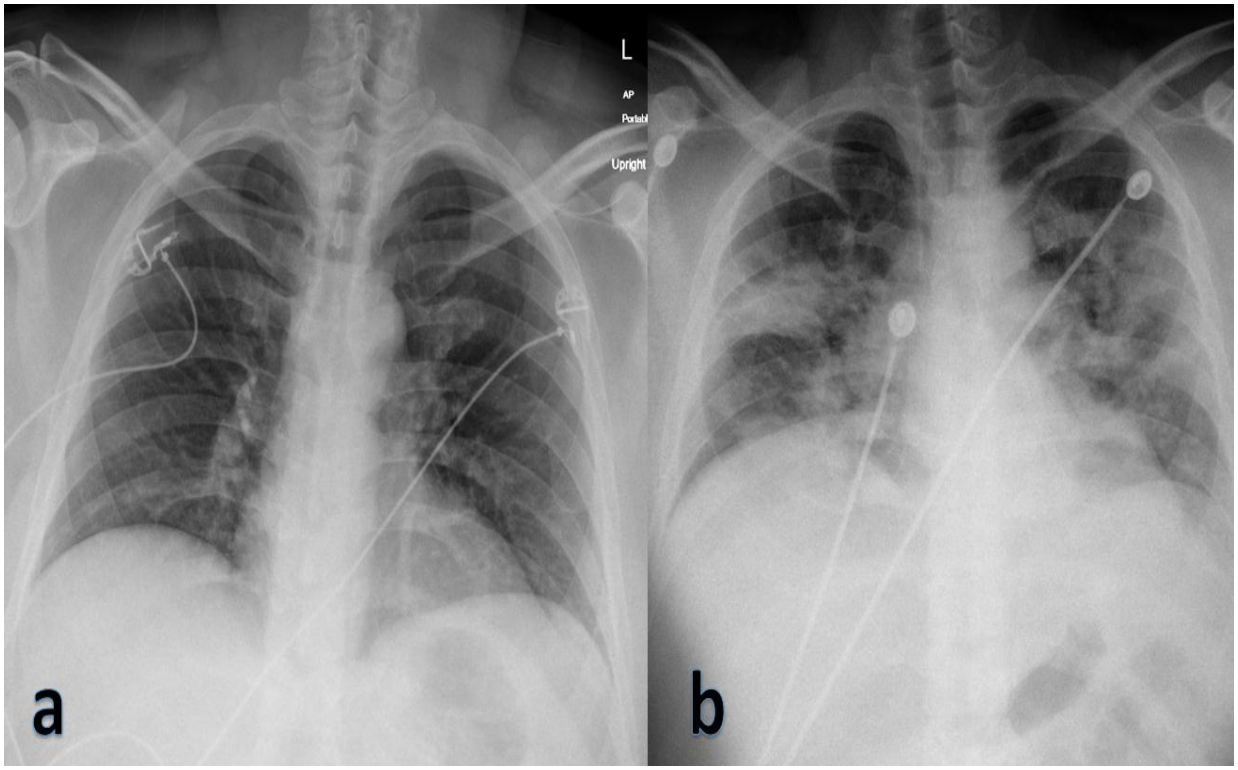

Figure 1: a. Chest X ray of a 60year old male COVID-19 patient on day 0 showing clear lungs. b. Chest X ray of the same patient on day 11 showing bilateral infiltrates.

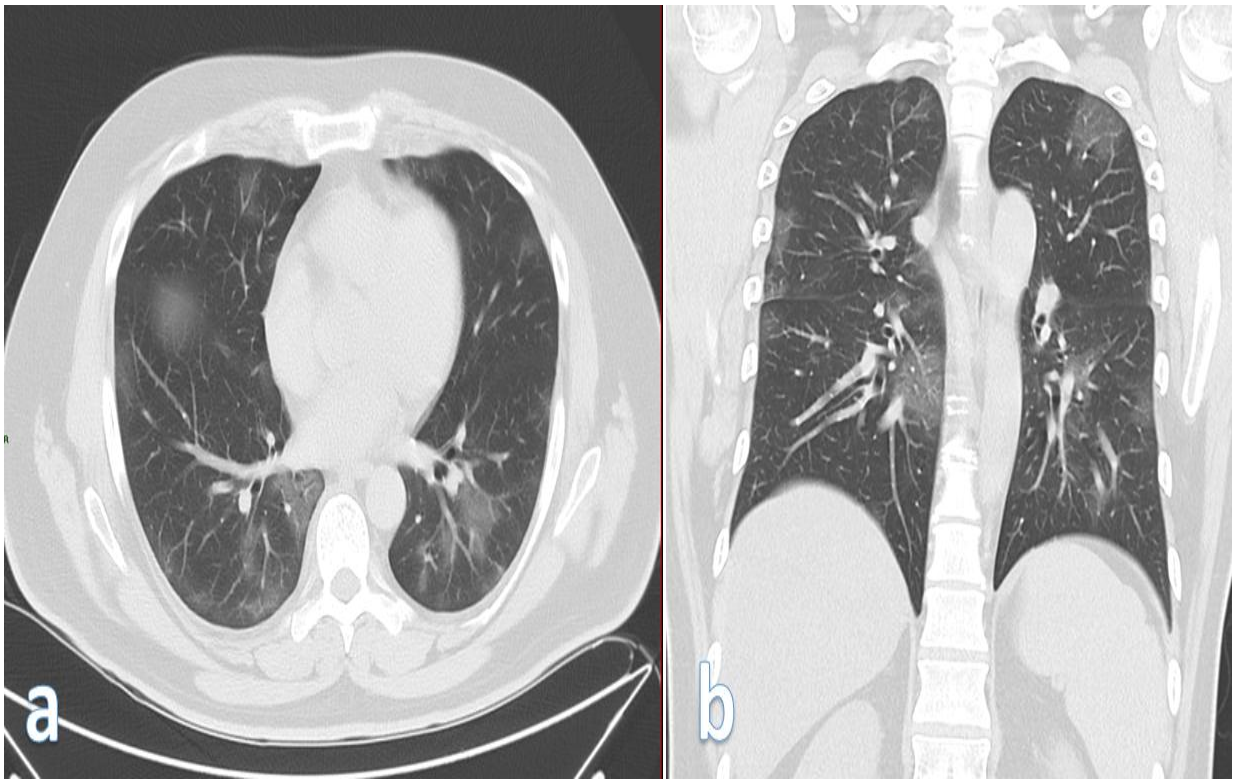

Figure 2: a, b. Axial and coronal Chest CT images of a 72year old male COVID-19 patient demonstrating ground-glass opacities.

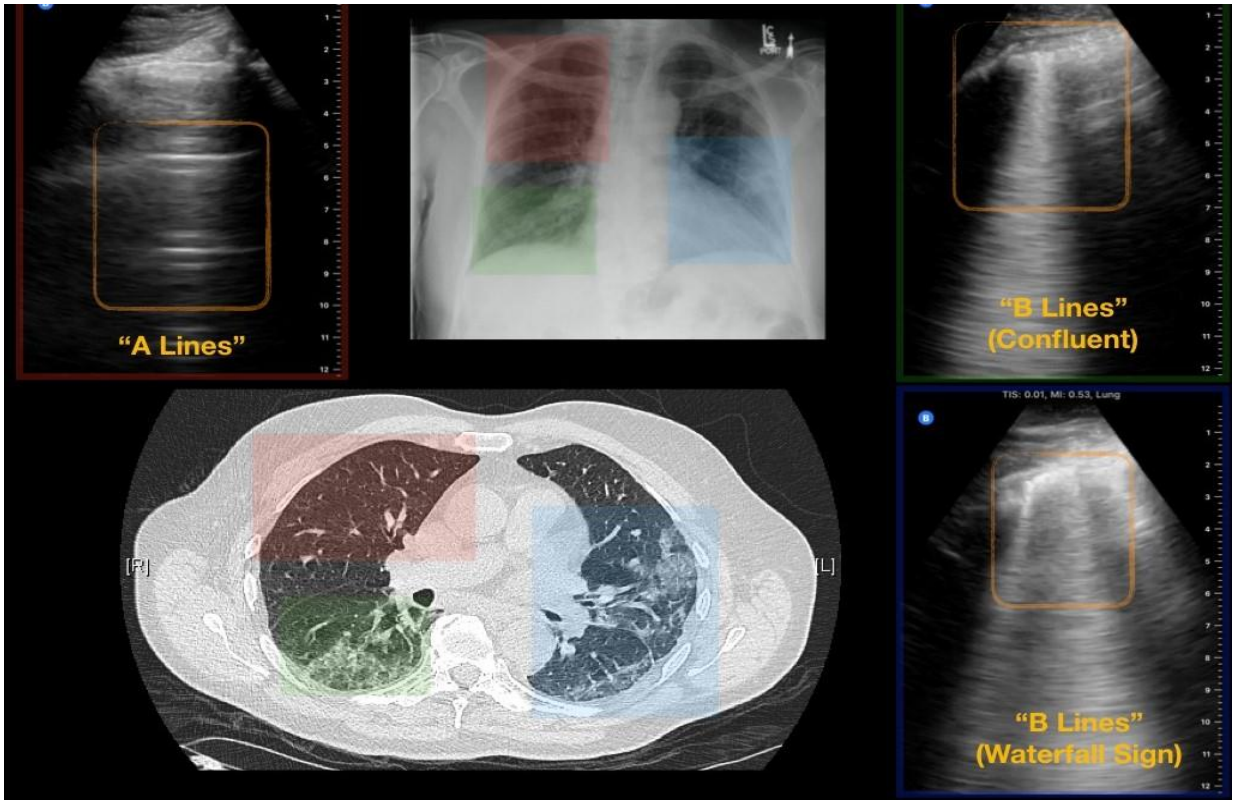

Figure 3: 56year old COVID-19 female patient. Day 10 since symptom onset. Lung ultrasound shows discrete and confluent "B-Lines", Consolidation and Pleural thickening. CXR shows bilateral opacification and CT scan shows ground-glass opacities.

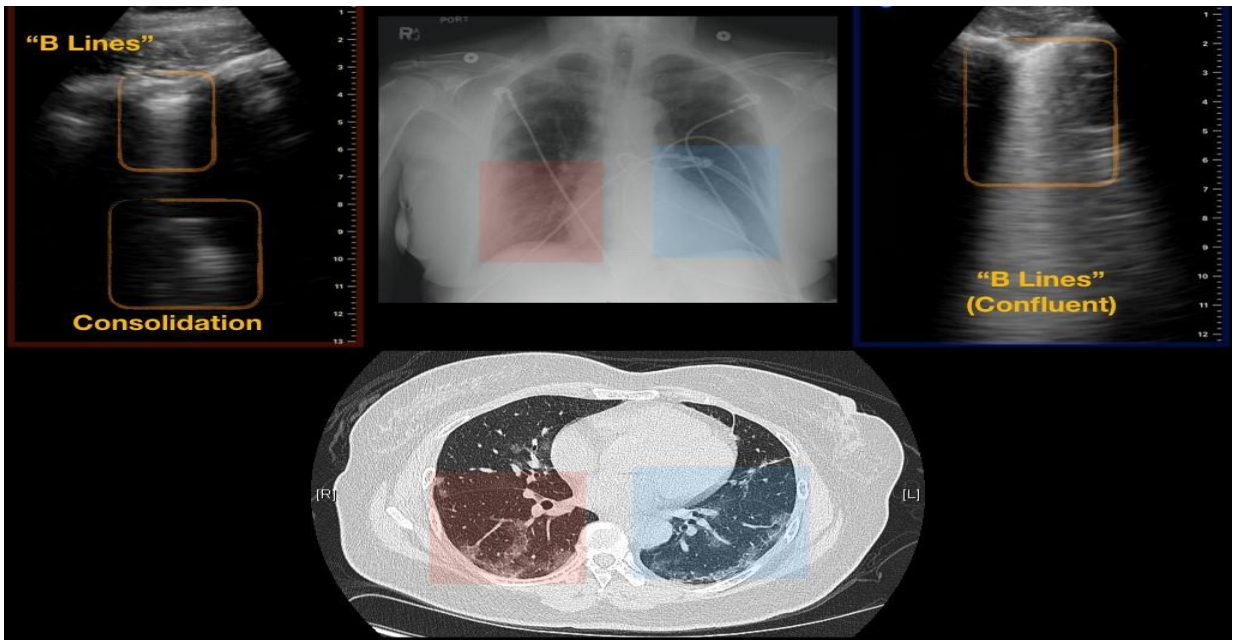

Figure 4: 69year old male COVID-19 patient. Day 12 of symptom onset. Lung ultrasound shows; "A-lines", confluent "B-lines", "waterfall sign. CXR shows peripheral opacification. CT chest shows ground-glass opacities and early consolidation.

Imaging Findings

Chest X rays

COVID-19 has a very varied appearance on plain radiographs, ranging from normal appearance to multilobar involvement. Different patients also show different rates on progression on chest X rays (Figure 1).[14,15,16] The common features on plain radiographs of the chest include parenchymal abnormalities with a peripheral distribution. Ground-glass opacities (GGO) and patchy consolidation are also seen. Majority of the lesions are found in the lower lung zones.[17] Chest X rays have been found to be quite insensitive in mild or

early COVID-19 infection.[18] However as recently seen in New York City, where patients were told to quarantine at home unless very sick, the chest X rays were often abnormal at presentation. The Fleishner Society Consensus statement totes the utility of chest X rays in assessing disease progression and alternate diagnosis such as bacterial super-infection, pneumothorax and pleural effusion.[19]

CT scans

CT findings in COVID-19 are also very varied, ranging from normal CT appearance to multilobar disease.[16] Common findings include Ground-glass opacities (GGO) (Figure 2), multilobar involvement, peripheral distribution of disease, opacities with a rounded morphology and crazy paving.[16,17,20] Chung et al. conclude that more findings of extensive GGO than consolidation on chest CTs in the first week of illness is highly suspicious for COVID-19.[1] Lung involvement gradually increased to consolidation up to 2 weeks after disease onset.[22] GGO with small areas of consolidation may suggest an organizing pneumonia pattern of lung injury.[23]

Pan et al. describe 4 stages of lung involvement on CT.
Stage 1 (0-4 days): Ground-glass opacities (GGO)
Stage 2 (5-8 days): Increased crazy paving patterns
Stage 3 (9-13 days): Consolidation
Stage 4 (>= 14 days) – Gradual resolution of consolidation without crazy paving pattern.[24]

Other CT findings include pleural thickening, and less commonly pleural effusion.[22] Bronchiectasis and bronchial thickening are also reported.[25,26,27] Vascular enlargement described as dilatation of pulmonary vessels around and within lung lesions have also been described.[28] CT is also useful to evaluate acute heart failure from COVID-19 myocardial injury.[29]

Ultrasound

Lung ultrasound has also been used to evaluate COVID-19 pneumonia. (Figure 3, 4) The findings on ultrasound include pleural thickening, subpleural consolidation (also known as skip lesions) and multi-focal B lines.[30] A study on 20 COVID-19 patients showed pleural thickening, B lines and consolidation in the disease phase and A lines in the recovery phase.[31] The multinational consensus statement from the Fleishner Society reports that ultrasound is a potential triage and diagnostic tool for COVI-19, but there is limited evidence at this time and also infection control issues.[19]

PET/CT

COVID 19 patients demonstrate intense Fluorodeoxyglucose (FDG) uptake in the lungs on PET/CT corresponding to Ground-glass opacities or consolidation seen on the low dose CT without contrast.[30,31] FDG PET/CT has been shown to help diagnose COVID-19 in asymptomatic patients.[30]

Imaging differentials

The main differentials diagnosis that a radiologist needs to differentiate COVID-19 from are other viral pneumonias and community acquired pneumonias.

A blinded study comparing 219 patients with COVID-19 pneumonia (confirmed by RT-PCR) and 205 patients with viral pneumonia (confirmed by positive Respiratory Pathogen Panel for viral pneumonia) showed that radiologists were able to differentiate them with high specificity but only moderate sensitivity. Compared to viral pneumonia, COVID-19 pneumonia is more likely to have a peripheral distribution, Ground-glass opacities (GGO), fine reticular opacities and vascular thickening, but less likely to have central plus peripheral distribution, pleural effusion and lymphadenopathy.[32]

Artificial intelligence was found to be useful in differentiating community acquired pneumonia from COVID-19 in a study consisting of 4356 Chest CT exams from 3322 patients in Hubei Province, China.[33]

Treatment

Most of the current treatment for COVID-19 is supportive including mechanical ventilation and extracorporeal membrane oxygenation (ECMO).[34]

Trials with antimalarial drugs such as chloroquine and hydroxychloroquine are being studied.[34] Trials with antiviral drugs such as Remdisivir are also being done.[35]

Vaccine development is also underway with identification of potential vaccine targets on the COVID-19 virus.[36]

Prognosis

Patients older than 60 years and those with underlying chronic health conditions such as heart disease, cancer, hypertension, diabetes mellitus and chronic lung disease are found to be at greater risk of severe disease. Children are found to have milder disease with a very small proportion developing severe disease.[37] Crude fatality rate has been higher in male compared to females (4.7% versus 2.8%).[37] The mortality rate from COVID-19 is reported to be 3.6 %.[38]

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