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CT Scan Findings of 400 COVID-19 Patients in Kuwait Bangladesh Friendship Government Hospital

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Abstract **Original Research Article**

Background: The COVID-19 pandemic is an ongoing pandemic of coronavirus disease caused by severe acute respiratory syndrome coronavirus 2 (SARS‑CoV‑2). Bangladesh faces significant challenges in combating COVID-19 as it is a densely populated country with limited resources. The aim of this study is to evaluate the radiological findings of COVID-19 with the hope that this information will help to mitigate the disease. ***Methods:*** This retrospective study has been carried out among the patients of COVID-19 pneumonia tested by RT-PCR aged between 18-80 years. The data are collected from biochemical and radiological investigations with the help of biochemical instruments for obtaining blood samples and CT scan. Quality of data is strictly maintained and ethical issues are properly maintained in all the steps of this study. ***Results:*** 400 patients admitted to hospital between March 15, 2020, and August 25, 2020, were included in this study. The cohort included 277(69.3%) men and 123 (30.8%) women, and the mean age was 44·9 years (SD 15.2). In the CT chest findings, 342 (85.5%) patients had abnormal findings and the remaining 58 (14.5%) were normal. Among the abnormal CT findings, 270 (67.5%) had ground-glass opacity and 250 (62.5%) were present with ground glass opacity with crazy paving. The predominant pattern of abnormality observed in 312 (78.0%) patients was bilateral. ***Conclusion:*** This study provides essential information regarding CT chest of COVID-19 patients for prompt diagnosis in hopes to alleviate the ongoing pandemic.

Keywords: COVID-19, coronavirus, SARS‑CoV‑2, pandemic, CT scan.

INTRODUCTION

The outbreak of COVID-19 was first identified in Wuhan, capital of the Hubei Province, China on December 2019 [1]. In the following weeks, infections spread across China and other countries around the world resulting in a pandemic. The causative organism for the disease was found out to be a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; previously known as 2019-nCoV).

The virus has been shown to infect human respiratory epithelial cells through an interaction between the viral S protein and the angiotensin converting enzyme 2 receptor on human cells allowing it to have a strong capability to infect humans [2]. The current mortality rate is 2.3% in some series of patients. However, since the number of people infected cannot be determined due to limited testing, the actual mortality rate of the people who are infected could be much higher.

On January 30, 2020, the World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern (PHEIC) [3]. On February 12, 2020, WHO named the disease caused by the novel coronavirus as Coronavirus Disease 2019 (COVID-19) [4]. Bangladesh reported its first confirmed COVID-19 case on 08 March 2020, reached 100 cases on 9 April, exceeded 200 cases within the next two (2) days, so case doubling time was 2 days. The case doubling time of new cases was then slowing down from two to three, then five days. As of 25 May 2020, according to the Institute of Epidemiology, Disease Control and Research (IEDCR), there are 35,585 confirmed COVID-19 cases in Bangladesh,

including 501 related deaths; Case Fatality Rate (CFR) is 1.41% [5].

The diagnosis of COVID-19 is currently being relied upon RT-PCR. The PCR test is specific but has a lower sensitivity, meaning that the result can be false negative in a patient even if he or she is infected. The other problem of this test lies in the amount of time required to get a result, usually around 24-72 hours. To overcome these difficulties, CT chest examination can act as a reliable tool for prompt diagnosis and treatment.

CT Chest is an important radiological investigation in the diagnosis and treatment of lung diseases. The role of CT in this Covid-19 pandemic is crucial as it can assist in determining the severity of the disease. In addition, CT can help to identify whether a patient is infected by COVID-19 or not especially when the PCR-test is false negative. Moreover, the time between onset of symptoms and the development of acute respiratory distress syndrome (ARDS) can be very short in COVID-19 pneumonia patients' and recognition of the disease is essential for the management of these patients [6].

Furthermore, the radiological role of CT scan in combating against the coronavirus pandemic is crucial as they can provide major evidence in confirmed clinical case diagnosis. Chest CT can identify the early phase lung infection and hopefully diminish the threatening impacts caused by this disease [7].

To summarize, CT scan can play in a role in triage of patients i.e. differentiating patients who are non COVID, suspected and most likely to have this disease. It can also predict in the possible fate of the disease and help to facilitate prompt treatment.

MATERIALS AND METHODS

The nature of this research was a retrospective study conducted in Kuwait Bangladesh Friendship Government Hospital, Uttara, Dhaka. The duration of this study was from March 15. 2020 to August 25, 2020.

The CT scans of 400 positive COVID-19 patients were completed during this time along with a few laboratory investigations. Initially, there were two groups that were present in this study. The first group i.e. 331 patients were admitted with positive PCR report and the second group i.e. 69 patients were admitted with either negative PCR report or as suspected cases of COVID-19. All the patients were later tested and confirmed positive by RT-PCR of nasal swab specimen during their stay in the hospital regardless of their initial COVID status. The collection of the specimen was carried out according to the guidelines published by Centers for Disease Control and Prevention (CDC) [8]. The diagnosis of the cases in this study were based on the criteria posted by WHO [9].

The parameters used for all CT scans obtained were as follows: model of the CT scan machine was Hitachi Scenaria SE 128 slice; tube voltage 120 kV; tube current-exposure time product, 200-300 mAs; section thickness after reconstruction was 1-1.5mm and patients were placed in the supine position. The reconstructed images were transmitted to the workstation and picture archiving and communication systems (PACS) for multiplanar reconstruction post-processing.

The images of the CT scans were analyzed by the two radiologists working in Kuwait Bangladesh Friendship Government Hospital. The evaluators independently and freely assessed the CT features using both axial CT images and multiplanar reconstruction images. The CT scans were assessed based on the CO-RADS classification (Table-1).

Table-1: CO-RADS Classification

Stage	Chance of COVID-19	CT findings
CO-RADS 1	Highly unlikely	Normal or non-infectious abnormalities
CO-RADS 2	Unlikely	Abnormalities consistent with infection other than COVID-19
CO-RADS 3	Equivocal	Unclear whether COVID-19 is present
CO-RADS 4	Probable	Abnormalities suspicious for COVID-19
CO-RADS 5	Highly likely	Typical COVID-19
CO-RADS 6	PCR proven	

The CO-RADS classification is a standardized reporting system for patients suspected of harboring the COVID-19 infection. It is a preliminary classification of the likelihood of COVID-19 infection present in an individual and was proposed by the Dutch Radiological Society [10].

In the event of a differing verdict, a conclusion was reached after discussion on the subject matter among the radiologists. The final reports of the CT scan were preserved in the Radiology Department of the Hospital.

RESULTS

The 400 patients admitted in the hospital who were confirmed positive of having COVID-19 were included in this study. In this study, 277(69.3%) were males and 123 (30.8%) were females. The mean age was 44.9 years (SD 15.2; range 18–80) (Figure -1).

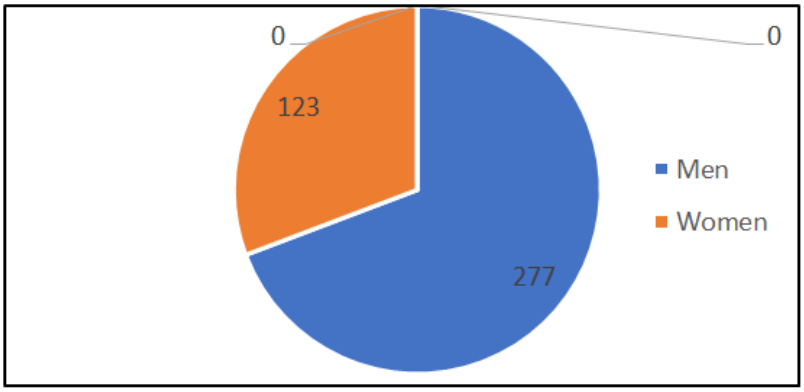

Fig-1: Pie chart showing the distribution of gender in COVID-19 patients

Among the patients, 50 (12.5%) were healthcare professionals mostly doctors who were in contact with patients having COVID-19 from various hospitals in the country. 110 (27.5%) patients had reported of either coming to contact with a suspected or confirmed COVID-19 individual. The rest i.e. 140(35.0%) reported that they were presumably not exposed to an individual having the signs and symptoms of the disease nor did they work in a hospital setting (Table-2).

Table-2: Socio-demographic profile of the patients

Attributes		**Frequency (%) (n = 400)**
Sex	Male	277 (69.3)
	Female	123 (31.8)
Age	18-34	115 (28.8)
	35-50	153 (38.3)
	51-65	102 (25.5)
	> 65	32 (8.0)
Occupation	Health care professionals	50 (12.5)
	Others	350 (87.5)
History of exposure	Working in a hospital setting	50 (12.5)
	Contact with suspected/confirmed patient	110(27.5)
	Unspecified	140 (35.0)

The most common symptoms at onset was fever present in 355 (88.1%) patients followed by dry cough which was present in 330 (82.5%) patients. Majority of the patients i.e. 253 (63.3%) had an underlying disease. Diabetes mellitus was present in 178 (44.5%), hypertension in 144 (36.0%), asthma in 90 (22.5%) and ischaemic heart disease in 16 (4.0%) patients (Table-3).

Table-3: Clinical characteristics of the patients

Attributes		**Frequency (%) (n = 400)**
Symptoms	Fever	355 (88.8)
	Dry Cough	330 (82.5)
	Respiratory distress	240 (60.0)
	Anosmia	53 (13.3)
	Sore Throat	41 (10.3)
	Diarrhea	7 (1.8)
Comorbidities	Any	253 (63.3)
	Diabetes mellitus	178 (44.5)
	Hypertension	144 (36.0)
	Asthma	90 (22.5)
	IHD	16 (4.0)

The laboratory investigations revealed that 65 (16.3%) patients had leukocytosis, 136 (34.0%) displayed decreased level of haemoglobin and 330 (82.5%) had raised C-reactive protein (CRP) levels (Table-4).

Table-4: Laboratory investigation findings of the patients

Attributes		Frequency (%) (n = 400)
Lymphocyte count	4,000 -11,000/ mm^3 of blood	335 (83.8)
	> 11,000/ mm^3 of blood	65 (16.3)
Hb%	Normal Hb level	264 (66.0)
	Decreased Hb level	136 (34.0)
C-reactive protein	<5 mg/ ml	70 (17.5)
	> 5mg/ ml	330 (82.5)

CT imaging revealed that considerably i.e. 369 (92.3%) had abnormal findings and the remaining 31 (7.8%) were normal. Among the abnormal CT findings, 270 (67.5%) had ground-glass opacity, 257 (64.3%) had ground-glass opacity with crazy paving 39 (9.8%) had vascular thickening (Table-5)

Table-5: CT chest findings of the patients

Attributes		Frequency (%) (n = 400)
Ground-glass opacity		270 (67.5)
Ground-glass opacity with crazy paving		257 (64.3)
Vascular Thickening		39 (9.8)
Normal CT		31 (7.8)
Bilateral Lung Involvement		312 (78.0)
Unilateral Lung Involvement	Right	46 (11.5)
	Left	19 (4.8)
Nodules and/or Discrete Opacity		42 (10.5)
Air Bronchogram		148 (37.0)

In addition, 312 (78.0%) displayed bilateral lung involved and 148(37.0%) showed air bronchogram in the lung fields. There were other CT findings that were sparsely present in some patients i.e. nodules with/without discrete opacity in 42 (10.5%). The CT scan findings revealed that all lobes could be involved with a small inclination towards the right side (11.5%) compared to left side (4.8%) in the case of unilateral lung involvement (Table-5).

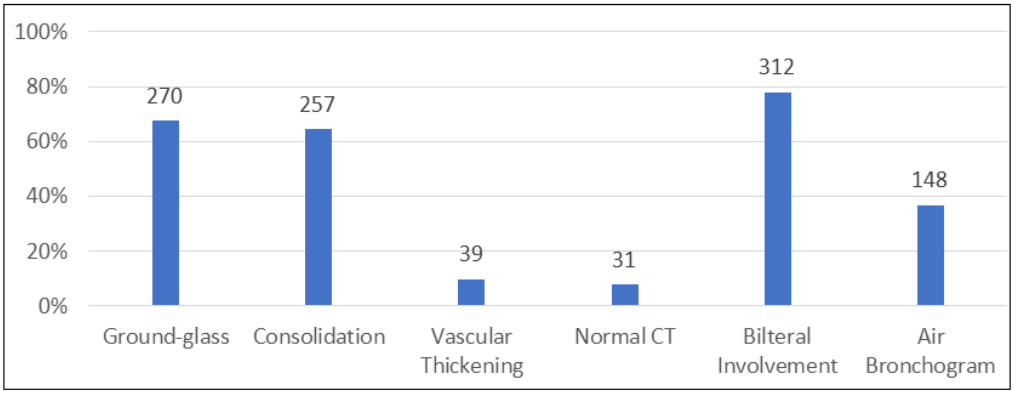

Fig-2: Bar chart showing frequency of selected CT findings

During this study, the number of recorded deaths was only 1. The patient who died was an18-year-old male with fever, cough and sever breathlessness. The patient died on the day of his admission after CT Chest was done. The findings of CT were bilateral involvement of both lungs with ground-glass opacity with crazy paving. The perplexing nature of this death was that the individual was young and had no comorbidities.

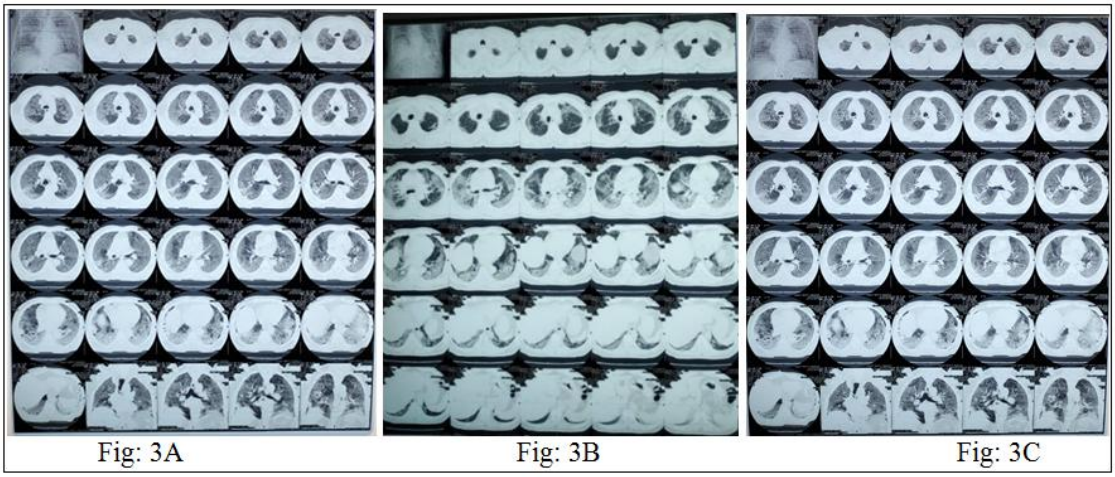

Fig-3: From left to right (A) 36-year-old man, CT shows bilateral ground-glass opacities in the lobes with a rounded morphology (B) CT of the deceased 18-year-old male showing extensive ground-glass opacities and crazy paving in the bilateral lower lobes with a rounded morphology (C) 67-year-old woman, CT shows bilateralground-glass and consolidative opacities

Fig-4 (a,b,c): 47 years old male COVID-19 patient CT scan shows bilateral GGO involving multiple lobes (early stage)

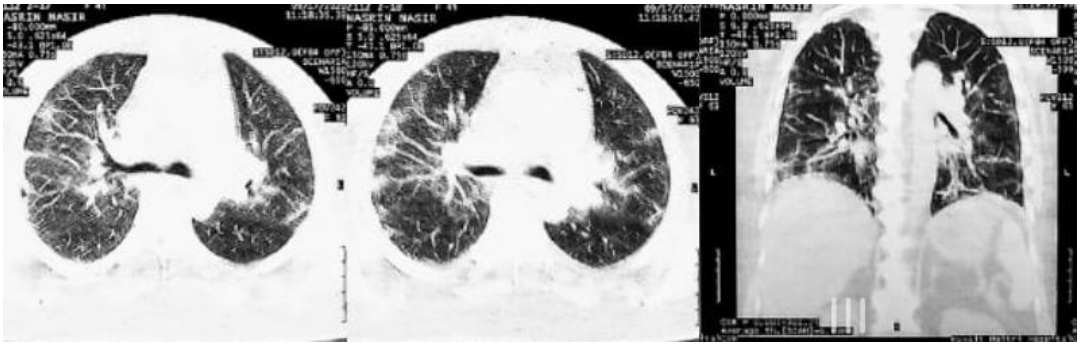

Fig-5 (a,b,c): 33 years old male COVID-19 patient CT scan shows bilateral GGO in peripheral location along with septal thickening

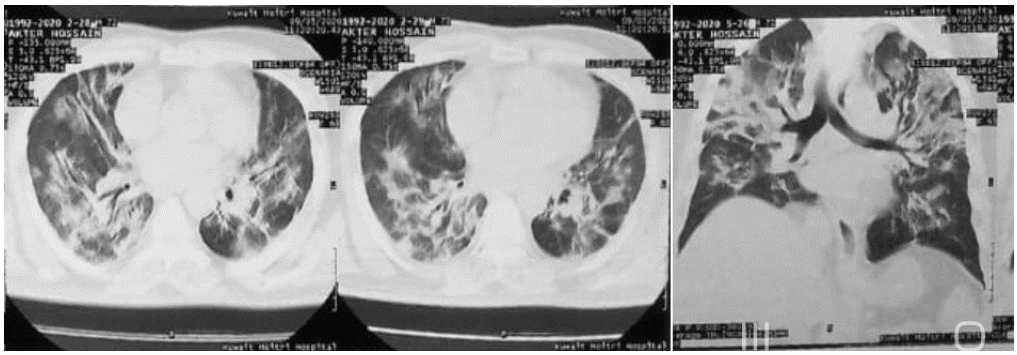

Fig-6 (a,b,c): 58 years old male COVID-19 patient CT scan shows bilateral consolidation with air bronchogram in anterior, posterior, superior and basal lung segments

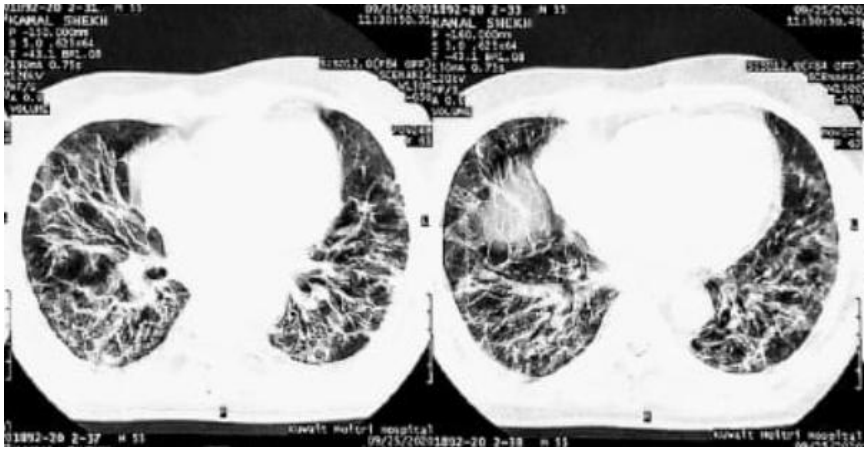

Fig-7 (a,b): 68 years old female COVID-19 patient with extensive bilateral consolidation and septal thickening involving basal lung segments

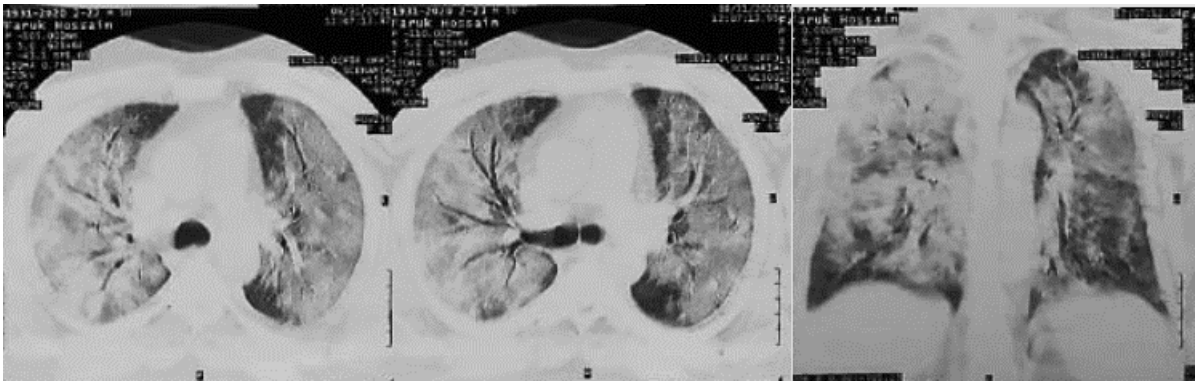

Fig 8 (a,b,c): 33 years old male with extensive bilateral consolidation involving almost all lung segments

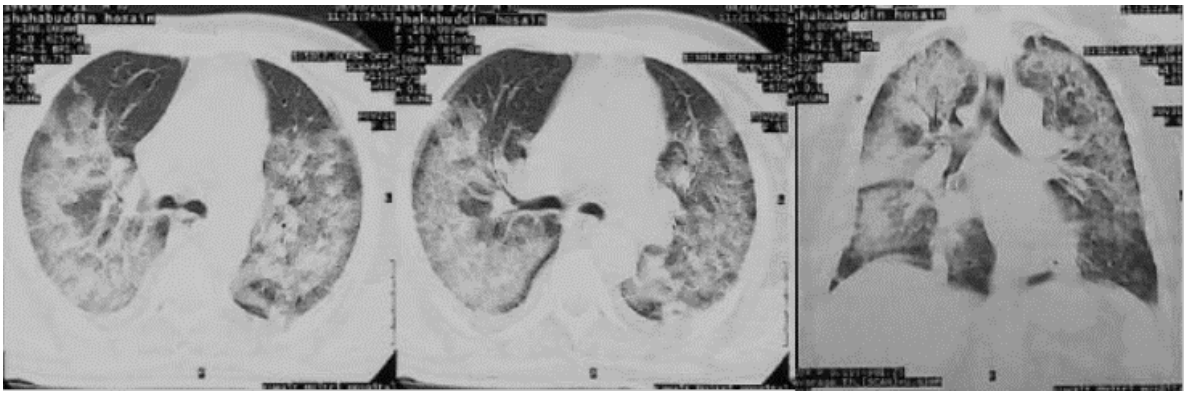

Fig-9 (a,b,c): 28 years old male COVID-19 patient with extensive bilateral consolidation and vascular thickening involving predominantly anterior, posterior and superior lung segments

DISCUSSION

The agent causing COVID-19 comes from the Coronaviridae family of viruses. The Coronaviridae are enveloped, non-segmented, RNA viruses that can be found infecting humans and other mammals. The novel coronavirus SARSCoV2 is the seventh member of the Coronaviridae family known to infect humans [11]. Previously two epidemics were caused by two beta corona viruses, SARSCoV in 2002 and MERSCoV in 2012, involved more than 8000 patients and 1000 patients, respectively, with high mortality rates (10% for SARSCoV and 37% for MERSCoV). The mortality rate of COVID19 is lower than that of SARS or MERS coronavirus diseases; however, that may change as the SARSCoV2 is highly infectious and is proving to be a significant health threat [12, 13].

CT scan is one of the modern diagnostic tools which can play a major role both in diagnosis of patients with high suspicion of COVID-19 and in the management of COVID-19 patients. In this study we mainly focused on the chest CT scan findings of 201 laboratory confirmed (RT-PCR) COVID-19 cases [14, 15].

The most commonly observed opacification observed in patients with COVID-19 was ground glass opacification (67.5%), which appeared predominantly in the peripheral zone and most often involved lower lung lobes and segments. A study conducted in China reported that pure ground glass opacity was found in 77% of patients and that they showed predominantly bilateral, posterior, and peripheral distribution [16]. It was found that small ground glass opacification develops in early stage of disease and predominantly involves basal segments of lungs.

Crazy paving was the second most common findings (64.3%). crazy paving was always accompanied by ground glass opacification. Most patients in this study showed bilateral lung involvement (78.0%). In a study of 41 patients conducted in China found that 40 patients (98%) had bilateral involvement [17]. The other findings that were found common were vascular thickening (9.8%) and air bronchogram (37.0%).

However, 31 (7.8%) RT-PCR COVID19 positive patients showed normal CT scan findings and there was no visible parenchymal change. This was also seen in another study where 20 of the 36 patients (56%) imaged 0–2 days after symptom onset had a normal CT scan with complete absence of ground-glass opacities. The similarity between these two studies could be due to the manifestation caused by the virus in the lungs take some time to appear. In addition, COVID19 pneumonia shares CT features with other noninfectious conditions and displays no specific or diagnostic change. There was no tree-in-bud signs, masses, cavitations, and calcifications, often suggestive of bacterial or chronic infections, present in this study.

The study conducted had a few limitations. The follow up CT scans were not available due to unavailability of time and resources. However, the main patterns were seen on CT imaging in patients with COVID19 pneumonia and long term radiological follow up is needed to better understand the fate of this disease. Furthermore, some patients may have received medical intervention once they were suspected of having or confirmed to have infection (e.g. antimicrobial therapy, steroid therapy) that may affect chest CT findings. This was not accounted for in this work.

CONCLUSION

Clinicians are evaluating more patients suspected of having COVID-19 as radiologists are similarly interpreting more chest CT scans in those suspected of infection. Chest CT is a vital component in diagnosing patients suspected of havingCOVID-19 infection. As there is limited number of real-time reverse transcript as polymerase chain reaction (RT-PCR) kits and the possibility of false negative real-time RT-PCR results, it is essential to diagnose based on clinical and chest CT findings alone.

In this study, COVID19 pneumonia tends to manifest on lung CT scans as bilateral, ground-glass opacities, ground-glass with crazy paving and a slight preference in the right lung. Normal lung CT findings has been found to be present in diagnosed COVID-19 patients confirmed by RT-PCR. Therefore, long term radiological follow up is needed to follow the course of this disease.

It is imperative that recognizing imaging patterns based on infection time course is done as it will not only help in understanding the pathophysiologic features and natural history of infection, but also for helping to predict patient progression and potential complication development**.**

REFERENCES

1. WHO. Novel coronavirus—China. Jan 12, 2020. https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/ (Accessed March 16, 2020).
2. Tan W, Zhao X, Ma X, et al. Notes from the field: a novel coronavirus genome identified in a cluster of pneumonia cases—Wuhan, China 2019–2020. China CDC Weekly 2020; 2: 61–62.
3. World Health Organization. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV.https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov) (Accessed March 18, 2020)
4. World Health Organization. WHO Director-General's remarks at the media briefing on 2019-nCoV on 11 February 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020. (Accessed March 18, 2020)
5. WHO Bangladesh COVID-19 Situation Reports: https://www.who.int/Bangladesh/emergencies/coronavirus-disease-(covid-19)-update/coronavirus-disease-(covid-2019)-bangladesh-situation-report (Accessed on May 25, 2020)
6. Shi H, Han X, Jiang N, Cao Y, Alwalid O, Gu J, Fan Y, Zheng C. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. The Lancet Infectious Diseases. 2020 Feb 24.
7. Kanne JP. Chest CT Findings in 2019 Novel Coronavirus (2019-nCoV) Infections from Wuhan. China: Key Points for the Radiologist. 2020 Feb 4; 8:2019.

8. Centers for Disease Control and Prevention. Interim guidelines for collecting, handling, and testing clinical specimens from persons for coronavirus disease 2019 (COVID-19). Updated May 2020; 5.
9. World Health Organization. Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected: interim guidance, 13 March 2020. World Health Organization; 2020.
10. Smithuis F, Smithuis R. 32 cases of suspected COVID-19 Imaging findings and follow up. Radiology Assistant. 2020.
11. Richman DD, Whitley RJ, Hayden FG, eds. Clinical virology, 4th edition. Washington: ASM Press, 2016.
12. Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, Tong S, Urbani C, Comer JA, Lim W, Rollin PE. A novel coronavirus associated with severe acute respiratory syndrome. New England journal of medicine. 2003 May 15;348(20):1953-66.
13. Zaki AM, van Boheemen S, Bestebroer TM, Osterhaus AD, Fouchier RA. Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. N Engl J Med 2012; 367: 1814–20.
14. Mossa-Basha M, Medverd J, Linnau K, Lynch JB, Wener MH, Kicska G, Staiger T, Sahani D. Policies and guidelines for COVID-19 preparedness: experiences from the University of Washington. Radiology. 2020 Apr 8:201326.
15. Xiong Y, Sun D, Liu Y, Fan Y, Zhao L, Li X, Zhu W. Clinical and high-resolution CT features of the COVID-19 infection: comparison of the initial and follow-up changes. Investigative radiology. 2020.
16. Song F, Shi N, Shan F, Zhang Z, Shen J, Lu H, Ling Y, Jiang Y, Shi Y. Emerging 2019 novel coronavirus (2019-nCoV) pneumonia. Radiology. 2020 Apr; 295(1):210-7.
17. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The lancet. 2020 Feb 15; 395(10223):497-506.