Kurdish Studies
Jan 2024
Volume: 12, No: 1, pp. 3886-3895
ISSN: 2051-4883 (Print) | ISSN 2051-4891 (Online)
www.KurdishStudies.net

Received: October 2023 Accepted: December 2023
DOI: https://doi.org/10.58262/ks.v12i1.278

CT Chest Findings and Clinical Characteristics of COVID-19 Patients in Taif Region

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Abstract

Background: Medical imaging was frequently the sole way to prioritize individuals suspected of having COVID-19 in the early stages of the epidemic when comprehensive Polymerase Chain Reaction diagnostic assays were not yet available. Medical imaging plays a crucial role in the diagnosis of this disease. This study aims to evaluate the diagnostic criteria of chest CT findings and clinical characteristics of confirmed COVID-19 patients in the Taif region. Methods: One hindered medical record of confirmed COVID-19 patients aged 18 years old and above with various signs and symptoms who were admitted to the emergency department of King Faisal Hospital in Taif were included retrospectively from picture archiving and communication system (PACS) in the period from Jan to June 2022, Saudi Arabia. All patients who underwent chest X-ray, chest CT imaging, and follow-up, were included in this study. Result: The majority of the patients were aged 61 years and above (44%), followed by the age group 46-59 years (32%), The mean age of patients was 44.5 (±12.5) years. (67%) were Saudi. (30%) had fever, cough &\or shortness of breathing, followed by (22%) had fever and cough. The majority of COVID-19 patients had abnormal chest CT findings; ground-glass opacities and consolidations were the most frequent findings, with peripheral and diffuse scattered ground-glass opacities and patchy consolidations within the lung zones. Conclusion: This study evaluates the diagnostic criteria of chest CT findings and clinical characteristics of confirmed COVID-19 patients in the Taif region. The elderly population with chronic conditions such as diabetes and hypertension were more affected by COVID-19. Fever, cough, and breathing difficulties are the most common clinical signs. Most of the patients showed peripheral and diffuse scattered ground-glass opacities and patchy consolidations in the lung zones, according to CT scans.

Keywords: *Chest, CT, COVID-19, Elderly, Hypertension, High Altitude city.*

Introduction

A viral respiratory illness known as coronavirus disease 2019 (COVID-19) initially appeared in Wuhan, China, in December 2019. It soon spread around the globe, infecting more people and killing more of them.[1]

Initially, it was stated that several patients had specific interactions with a huge seafood and animal market, implying an animal-to-human transfer. Soon after, an increasing number of patients who had not been exposed to the animal market began to grow exponentially, indicating the possibility of human-to-human transmission. This type of pneumonia is currently recognized as a new type of acute respiratory infectious illness caused by coronavirus infection.[2]

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Medical imaging was frequently the sole way to prioritize individuals suspected of having COVID-19 in the early stages of the epidemic when comprehensive Polymerase Chain Reaction (PCR) diagnostic assays were not yet available. Medical imaging plays a crucial role in the diagnosis of this disease although PCR and other serological testing are widely available. This is because of the limitations mentioned above.[3]

Early and very reliable COVID-19 detection is crucial. High detection sensitivity and detection speed for COVID-19 by computed tomography (CT) scans as compared to PCR have been reported in previous investigations.[4]

Fever, coughing, and shortness of breath are the most typical clinical signs of COVID-19.[5] According to the WHO assumption that the virus takes 0–14 days to incubate, these symptoms may start to show up 3–6 days after exposure.[6]

The accessibility of RT-PCR testing is the key worry during a pandemic. Therefore, for the early identification and management of COVID-19 development, RT-PCR has been employed in various studies coupled with chest radiographic examinations using CT and X-rays. [7,8]

Due to its higher sensitivity for spotting early pneumonic alterations, CT is a useful screening technique. By identifying severe instances, CT can help with illness management and triage. Chest CT is also noninvasive and simple to carry out in a facility that has the necessary equipment. However, many institutions do not provide round-the-clock radiologic diagnostic support.[9]

Competing and supplementary candidates for PCR tests include medical imaging procedures including chest CT imaging and chest X-rays.[10] Radiologists can more precisely detect interior structures and assess their texture, density, size, and shape using CT imaging. Compared to X-rays, chest images from a CT scan typically show the patient's health far more accurately.[11]
To the best of our knowledge, little is known regarding the chest imaging characteristics of patients infected with COVID-19 in the Taif region, so this study aims to evaluate the diagnostic criteria of chest imaging and clinical characteristics of confirmed COVID-19 patients and find the related risk factors.

Methods

Study Population and Definition

Medical records of one hundred confirmed COVID-19 patients aged 18 years old and above, with various signs and symptoms who were admitted to the emergency department (ED) of King Faisal Hospital in Taif, Saudi Arabia, and underwent chest X-ray, chest CT imaging, and follow-up, were included in this study.

The exclusion criteria were established as follows: cases that did not enter King Faisal Hospital, any non-confirmed COVID-19 patient, or any patient less than 18 years old.

Data Collection

A well-structured checklist was designed specifically for data collection of this study; Clinical characteristics included age (in years), gender, signs and symptoms, presence of chronic diseases, and patients' outcomes according to chest CT imaging features of the patients.

All chest CT images were blindly and independently examined in consensus by two radiologists (with 5 to 10 years of experience).

All images were seen in the lung (width, 1500 HU; level, -700 HU) and mediastinal (width, 350 HU; level, 40 HU) mode. The following image features were evaluated, including the presence of ground glass opacity, consolidation, mixed ground glass opacity and consolidation, centrilobular nodules, cavitation, bronchial wall thickening, pneumonia, bronchiectasis, and pleural effusions. As stated in detail in this previous study.[12]

Statistical Analysis

Data was analyzed using SPSS version 23 and all abstained results were represented in tables and graphs with a Pearson cut point of ≤ 0.005.

Ethics Statement

This study was approved by the Institutional Review Board of both the Radiological Sciences Department, Taif University, and Directorate of Health Affairs, Taif city-Saudi Arabia No: (IRB No. HAP-02-T-067-BApproval No:637), and it was carried out in compliance with the Helsinki Declaration principles.

Results

Socio-Demographic and Clinical Characteristics

A total of one hundred confirmed COVID-19 results and who underwent chest imaging were included in this study.

The majority of patients with positive RT-PCR results in this study were aged 61 and older (44%), followed by the age group 46-59 years with (32%), The mean age of patients was 44.5 (±12.5) years. (67%) of the participants were Saudi.

The clinical characteristics of the study sample are summarized in Table 1. Shows that (30%) of confirmed COVID-19 patients had fever, cough &\or shortness of breathing, followed by (22%) had fever and cough, while (16%) complained of dry cough only, followed by shortness of breathing (10%).

Table 1. Clinical Characteristics of Confirmed COVID-19 Patients.

%	Clinical characteristics
8.0	Asymptomatic
30.0	Fever, cough &\or shortness of breathing
22.0	Fever & cough
16.0	Cough only
10.0	Shortness of breathing
9.0	Fever only
5.0	Vomiting and\or diarrhea
100.0	Total

Fig.1. Shows the distribution of the most common chronic diseases among confirmed COVID-19 patients; diabetes in (23%), both diabetes and hypertension in (15%) and (12%) were hypertensive.

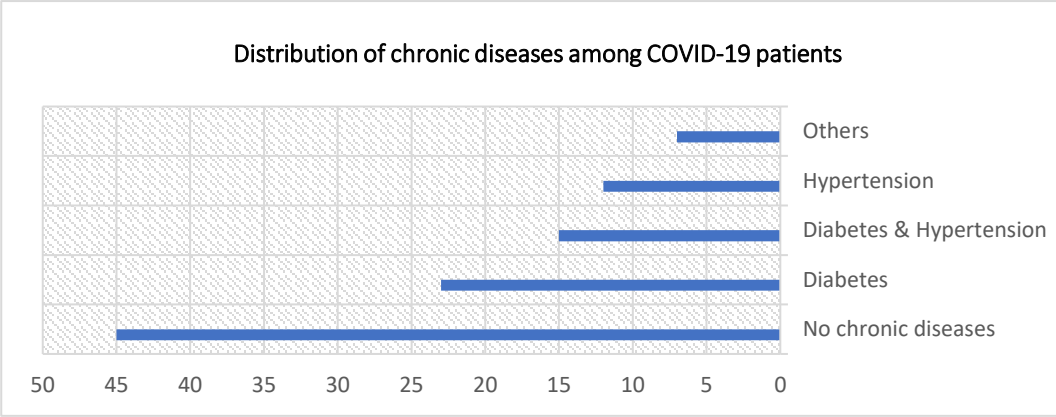


Fig.1. Distribution of Common Chronic Diseases among COVID-19 Patients.

Chest CT Findings of Confirmed COVID-19 Patients

Chest X-rays were taken using digital or portable chest X-ray machines in the routine postero-anterior (PA) projection with full inspiration or in the antero-posterior (AP) projection in situations of supine patients. Chest X-rays were used to examine all laboratory-confirmed COVID-19 patients in this study. CT scans were used to evaluate advanced severe cases during follow-ups.

Tables 2. Demonstrate the chest imaging findings of laboratory-confirmed COVID-19 patients. The majority of COVID-19 patients had abnormal chest CT findings; (92%) of the sample had bilateral ground-glass opacities and consolidations, while peripheral and diffuse scattered ground-glass opacities and/or patchy consolidations within the lung zones were found in (48% & 45%) of the sample respectively.

Table 2. Radiological Findings on CT Chest Images.

%	**Chest imaging features**
42.0	Ground-glass
14.0	Patchy Consolidation
12.0	Pneumonia
11.0	Bronchiectasis
10.0	Pleural effusion
7.0	Patchy air space
%	Location of the lesions
92.0	Bilateral
5.0	Unilateral (Right side)
3.0	Unilateral (Left side)
%	Distribution of the lesions within the lungs
48.0	Peripheral
45.0	Diffuse
6.0	Central
%	Outcome
89	Alive
11	Dead

* All confirmed COVID-19 patients had follow-up chest imaging during their presence in the hospital; patients outcome result was reported in the patient's records.

Other imaging features found on chest CT images of COVID-19 patients were related to respiratory symptoms; pneumonia (12%), bronchiectasis (11%), pleural effusion (10%), and patchy air space was found in a small number of patients.

Table 2. Demonstrate a significant correlation between confirmed COVID-19 patients and the presence of chronic diseases, represented in p-values (0.07 & 0.06), respectively.

Table 3. Chest CT Imaging Findings and Presence of Chronic Diseases among Confirmed COVID-19 Patients.

Asymp. Sig. (2-sided)	Total	Presence of chronic diseases					Chest CT findings
		Renal failure	Diabetes & hypertension	Hypertension	Diabetes	Have no chronic diseases	
	42	2	8	2	10	20	Ground-Glass
	14	0	0	4	4	6	Patchy consolidation
0.07 0.06	12	2	1	1	4	4	Pneumonia
	11	0	3	1	1	6	Bronchiectasis
	10	1	2	4	2	1	Pleural effusion
	7	0	0	0	0	7	Patchy air space
	4	0	1	0	2	1	Pneumothorax
	100	5	15	12	23	45	Total

Table 3. Shows chest CT findings concerning patient outcome of confirmed COVID-19 patients; (28,5%) of patients who passed away with COVID-19 had patchy consolidation and (18,1%) had ground-glass lesions, with significant correlations of (0.01 & 0.03), respectively.

Table 4. Chest CT Findings * Patient Outcome Crosstab.

Asymp. Sig. (2-sided)	Total	Outcome		Chest CT image findings
		Dead	Alive	
	42	2	40	Ground-glass lesions
	15	5	10	Patchy consolidation
	12	0	12	Pneumonia
0.01 0.03	11	2	9	Bronchiectasis
	10	1	9	Pleural effusion
	7	0	7	Patchy air space
	4	2	2	Pneumothorax
	100	11	89	Total

Discussion

This study retrospectively assessed the chest CT findings, clinical characteristics, and patient outcomes of one hundred confirmed COVID-19 patients. Also evaluating patient's treatment responses using follow-up chest CT imaging changes during therapy was considered.

The current study revealed that the average age group infected with COVID-19 was 60 years old and above, all of them had chronic diseases, with an equal ratio between male and female (1:1). (30%) of them had fever, cough &\or shortness of breathing, followed by (22%) had fever and cough, as the most common clinical signs. These findings are consistent with previous studies conducted in China.[13,14]

This study reported that; (8%) of the sample were symptomatic, which is inconsistent with a previous study conducted in Jeddah city reported that; (13.1%) of the cohort study were a symptomatic.[15]

The majority of current study patients showed typical CT imaging characteristics such as ground-glass opacity lesions and patchy consolidation that are peripherally diffused and bilaterally involved, as in Fig.1. Furthermore, (89%) of the study group showed a steady improvement of lung lesions throughout their chest radiological imaging follow-ups. All these findings were consistent with earlier research; Most patients had ground-glass opacity or mixed GGO, as well as consolidation.[16,17,18]

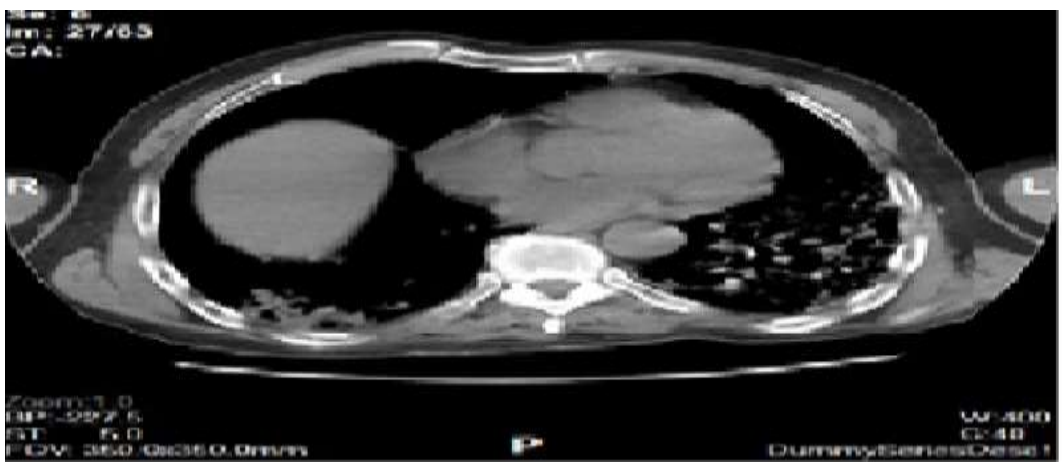
CT scanning is a clinical diagnostic tool that can help in the early detection and diagnosis of COVID-19.[19] All confirmed COVID-19 patients in this study were examined using X-rays as routine investigation to evaluate their lung abnormalities, as reported in previous studies, which revealed that; the chest X-ray is considered a routine imaging modality for the diagnosis and monitoring of COVID-19 patients.[7,17,22]

The same findings were reported by other studies [20,21,22], stating that; Multiple patchy areas of ground glass opacity and consolidation, predominantly in the periphery of the lungs, are imaging features on chest CT that are extremely helpful in the early detection and diagnosis of this disease.

Regarding lesion distribution in this study; all patients were more likely to have peripheral distribution and bilateral involvement, which agrees with the results of previous studies.[23,24]

This study showed that progressive conditions were found to be in older diabetes and hypertensive patients. These findings corroborated previous studies that revealed aging and hypertension as risk factors for COVID-19 development. [25,26,27]

Also, previous research revealed that higher CT lung scores in individuals with Middle East Respiratory Syndrome (MERS) were associated with poor outcomes.[26]



Graph.1. A 71-Year-Old Confirmed COVID-19 Patient Complained of Severe Cough, Fever, and Shortness of Breathing, his CT Image Shows Scattered Bilateral Multiple Peripheral Consolations and Ground Glass Opacities.

The primary strength of this study is the availability of follow-up CT images in the patient's records to investigate changes in the chest CT imaging characteristics and compare them with

clinical parameters for patients with severe cases to predict patient outcomes at the end, as in comparison Fig.2. showed a chest CT image of a 66-year-old patient after follow-up. Changes in follow-up chest CT scans during treatment aid in monitoring patients' treatment responses. This is confirmed by one study[28] stated that; follow-up findings could aid in disease progression management and outcome prediction to improve clinical decision-making.

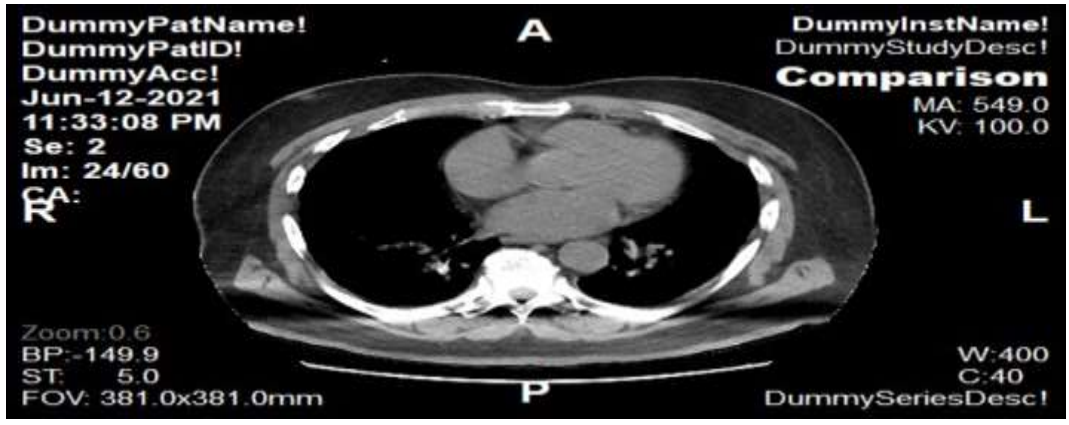


Fig (2): 66 Years Old Male Complain of Severe Cough and Fever, his CT Image Follow-up Showed Improvement in his Bilateral Multiple Ground Glass Opacities.

Regarding chest CT findings about the severity of COVID-19 patient's conditions and patient outcomes; (28,5%) of patients who passed away with COVID-19 had patchy consolidation and (18,1%) had ground-glass lesions, with significant correlations of (0.01 & 0.03), respectively. These findings agree with one study that discussed an important topic regarding the association between clinical data and 25point CT severity score in COVID-19 patients, which might help in diagnosis and management to improve outcomes of COVID-19 patients.[29]

Finally, there are two drawbacks to this study. To begin with, this was a retrospective study involving a small number of patients who had been proven to have COVID-19. So, the use of bigger, more diverse samples to explore the chest CT features of different phases of COVID-19 will be more beneficial.

Conclusion

This study evaluates chest CT findings and clinical characteristics of COVID-19 patients in the Taif region. Elderly patients aged 60 years old and above with chronic conditions such as diabetes and hypertension were more affected by COVID-19, while the age group of 18-25 years old was considered the least. Fever, cough, and breathing difficulties are the most common clinical signs. Most of the patients showed peripheral and diffuse scattered ground-glass opacities and/or patchy consolidations in the lung zones, according to chest CT scans, the majority of mortality (45.5%) were from individuals who had patchy consolidations. The current study establishes chest CT characteristics of COVID-19 patients in the Taif region and is consistent with prior studies published nationally and internationally in many aspects.

Acknowledgments

The researcher would like to acknowledge the Deanship of Scientific Research, Taif University for funding this work. Also, I'd like to thank the technicians and radiologists at King Faisal

Hospital in Taif, Saudi Arabia, and my students for their assistance in acquiring the necessary data for this study.

Conflict of Interest

There is no potential conflict of interest for the author.

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