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Chest CT Scan Findings in A Sample of Patients with COVID19 Infection

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) or severe acute respiratory syndrome coronavirus 2 (SARSCoV-2) on January 7, 2020, was established as a source of the discovered cases, previous name was "2019-NOVAL" corona-virus "2019 nCoV", then the epidemic was termed COVID-19; Fever, fatigue, dry cough, and dyspnea, as well as a variety of chest imaging features are what COVID-19 is characterized by.

Objective: This study focuses on critical imaging chest CT scan characteristics in COVID-19 patients with positive PCR to aid in accurate diagnosis and therapy.

Patients and methods: This study concentrated on the most recognizable CT-scan features in established cases of (COVID-19) to distinguish the various CT-scan appearance that aid in effective diagnosis as well as proper management.

Results: Ground-glass patchy opacities (33.3%) then ground-glass opacities with consolidations (24.4%), then ground-glass opacities with subpleural linear fibrotic bands abnormality (14.4), crazy-paving pattern (13.3%), single air bronchogram (10.0%), and consolidation patches only (4.4%) were the most prominent chest CT scan findings in COVID-19 patients. In the examined patients, no cavitary-like lesions or sizable lymphadenopathy were detected. The lesions in the lung displayed distinctive bilateral predominantly right side, mostly all lobes affected, especially basal, and peripheral subpleural in distribution.

Conclusion: The CT-scan imaging features seen in (COVID19) cases may aid a rapid and precise diagnosis of COVID19 then detailed evaluation of pulmonary parenchymal affection and disease severity.

Keywords: Coronavirus infections, COVID-19, Computed tomography, ground glass opacity, Case series, University of Kirkuk.

INTRODUCTION

The first four reported cases were detected by localized hospitals by utilizing surveillance measurements for pneumonia of unknown origin which was established during the 2003 SARS pandemic [(1)].

On (31 December 2019) WHO reported several instances of unknown cause type of pneumonia in Wuhan-China [(2)] on (7-January-2020), corona-virus disease 2019 (COVID19) or severe acute respiratory syndrome coronavirus 2 (SARSCoV-2) verified the etiology of such discovered cases (at previous time identified as 2019 new corona-virus 2019-n CoV), and the epidemic was dubbed COVID19 [(3)]. The World Health Organization declared a global health emergency on January 30, 2020. On 20/Feb/2020, 75,761 cases and about 2130 fatalities were reported in more than 30 countries [(4)].

Because the COVID-19 largely affects the respiratory system, chest imaging is strongly recommended for both initial screening and follow-up in suspected patients [(5)], while chest radiographs are ineffective in the early stages of illness, CT lung alterations may be detected even before clinical symptoms arise. Chest radiographs with symptoms of acute respiratory distress syndrome (ARDS) may be beneficial in the mild to severe types of COVID-19 [(6,7)], the chest imaging findings are the consequence of COVID-19 overlapping with other viral pneumonias CT-scan of the chest; In the context of diagnostic CT-scan results, the polymerase chain reaction (PCR) as a screening test may be false negative initially [(8)].

It was applied in some local studies for diagnosis of COVID among infected pregnant women [(9)].

However, with the COVID19 outbreak and the fast growing world-wide pandemic that has resulted in catastrophic mortality, accurate patient diagnosis and care requires a detailed understanding and description of diagnostic imaging characteristics, differential criteria, and chest imaging findings [(10)]. This study focuses on critical imaging chest CT scan characteristics in COVID-19 patients with positive PCR to aid in accurate diagnosis and therapy.

PATIENTS AND METHODS

This was a retrospective research in which 90 cases that test result positive for newly discovered corona-virus by naso-pharyngeal exchange received a CT-scan of the chest in July 2020. The patients' ages ranged from 20 to 80 years old. There were 55 men and 35 females, for a male to female ratio of 1.6:1.

All pictures were taken while the patients were in the supine position, using CT-Scan Chest procedures. Scans were performed from the proximal thoracic intake to the lower costophrenic angle level, with the following scan settings utilized voltage of the CT tube (120 kVp), (250

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mAs), rotation duration (1 second), and thickness of slice section (2.5mm). As a result, for multiplanar reconstruction, all pictures are delivered to the workstation and Picture Archiving and Communication Systems (PACS).

Picture analysis: Three radiologists with chest CT scan experience reviewed the image results (from 5 to 8 years). Lesions were characterized according to the number of lobar involvement (one or more lobes involved), lung impacted (right, left, or both lungs affected), and zonal distribution (peripheral, central and both). Lesions were classified as having ground- glass opacities solely, crazy-paving appearance or consolidations only, both ground-glass opacity with consolidations, ground-glass opacity with subpleural lines, or a single air bronchogram on a chest CT scan.

Ethical approval:

Both the University of Kirkuk's Departments of Anatomy and Internal Medicine's College of Medicine and the Ethics Committee of the Iraqi Ministry of Health gave their approval to the study. The consent document was signed by all involved parties. The principles outlined in the Helsinki Declaration by the World Medical Association have been strictly adhered to in all studies involving human participants.

Statistical analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (SPSS) version 20 for windows. Qualitative data were defined as numbers and percentages. Quantitative data were described as means and standard deviation (SD).

RESULT

In this retrospective study, 90 cases that were tested as PCR +ve for coronavirus by naso-pharyngeal swap underwent chest CT scan examination.

Patients ages ranged from 21 to 80 years old, as seen at (**Table 1**); the peak age group was between 40 and 60 were about 48 patients (53.3%). Results were shows 55 males with 35 females; male female ratio about 1.6:1 (Table 2).

Table (1): Distribution of age groups of the studied patients.

Age		Frequency	Percent (%)
Groups	20-40	31	34.4
	40-60	48	53.3
	>60	11	12.2
	Total	90	100.0

Table (2): Percentage of gender of the studied patients.

Sex		**Frequency**	**Percent**
Groups	**Male**	**55**	**61.1**
	Female	**35**	**38.9**
	Total	**90**	**100.0**

The detected patterns of lung parenchymal at chest CT scan are clarified in Table 3.

Table (3): CT scan patterns of lung parenchymal of the studied patients.

CT scan findings		Frequency	Percent
Findings	Ground glass opacities only	30	33.3
	Crazy paving	12	13.3
	Consolidation patches only	4	4.4
	Ground glass opacities with consolidations	22	24.4
	Ground glass opacities with subpleural fibrotic bands	13	14.4
	Single large air bronchogram	9	10.0
	Total	90	100.0

The predominance transverse distribution of the lesions was categorized as peripheral, central, diffuse (both peripheral and central distribution) (**Table 4**). While the pattern of COVID-19 lesions stated as scattered (non-confluent) were seen in about 54 (60%) of patients and confluent continuous pattern that seen in 36 (40%) of cases as demonstrated at **Table 5**.

Table (4): Transverse distribution of the lesions of the studied patients.

Distribution		Frequency	Percent
Types	Peripheral	60	66.7
	Central	2	2.2
	Both central and peripheral	28	31.1
	Total	90	100

Table (5): The pattern of COVID-19 lesions of the studied patients.

Lesions pattern		Frequency	Percent
Pattern	Scattered lesions	54	60
	Confluent lesion	36	40
	Total	90	100

Table 6 shows the number of the involved lung lobes. The number of the patients who had five involved lung lobes was 41 patients (45.6%), those who had four involved lung lobes were18 patients (20.0%), who had three involved lung lobes, were 8 patients (8.9%), those who had two involved lung lobes were 8 patients (8.9%), and there were 15 patients (16.7%) who had one involved lung lobe.

On the other hands, the laterality that mean the affected side (right, left or both sides) is seen at Table 7; right lung predominant affected in 15 (16.7%) patients, left lung in 3 (3.3%) patients, while in most of cases 72 (80%) patients both lungs involved .

Table (6): The percentage of involved lung lobes of the studied patients.

Affected lobes		Frequency	Percent
Number of lobes	One lobe	15	16.7
	Two lobes	8	8.9
	Three lobes	8	8.9
	Four lobes	18	20
	Five lobes	41	45.6
	Total	90	100

Table (7): Percentage of laterality of the studied patients.

Laterality		Frequency	Percent
CT Findings	Right lung only	15	16.7
	Left lung only	3	3.3
	Both lungs	72	80.0
	Total	90	100.0

DISCUSSION

COVID-19 computed tomography imaging characteristics are non-specific since it always interacts with other causes of acute lung illness and organizing pneumonia, however COVID-19 imaging features in new research have been documented in CT-scan. Thus, the difference in these traits through time can be utilized to distinguish COVID-19 from other viral infections with comparable features [11,12]. Furthermore, other lung parenchymal illnesses, like emphysematous lung disease and interstitial parenchymal lung disease, that may be related with increased morbidity of COVID-19 pneumonia should be documented and reported. Pneumonia that caused by viral infection have a broad range of CT-scan presentations and varied characteristics; part of these imaging abnormalities are rare or unique in COVID-19 pneumonia, example (intra-bronchial mucus plugs, tree-in-bud, and tiny nodules), So viral pneumonia as a term has a wide-spectrum of CT-scan lung parenchymal findings not all appearance are classical features of COVID-19 [13]. Chronic conditions (such as hypertension and diabetes) and advanced age are linked with a significant COVID-19 pneumonia-related death risk [14]. The chest radiograph is the initial imaging modality used in immunocompetent individuals to evaluate acute respiratory illnesses. Despite the obvious COVID-19 anomalies found on chest radiographs, in almost two/thirds of positive cases the chest radiographs were normal without detectable findings; most of published publications describe positive CT scan imaging findings such as Ground-glass opacities that are not detected on plan chest x-ray film of those individuals [15]. CT scans are important in the detection of COVID-19 pulmonary infection [16].

The chest CT-scan as a screening imaging is not recommended by the majority of radiology associations and professional organizations for COVID-19 diagnosis [17] the presentation of chest imaging abnormalities is also related to time of the imaging investigation according to the course of sickness. Most instances revealed negative chest CT-scan within the 1st two days since beginning of symptoms, then the Ground glass opacities start to detect within four days from start of symptom then the symptoms peak around 6-13 days [18]. Negative chest CT imaging did not rule out the presence of (COVID19) especially earlier in the illness. The prevalence of patchy consolidations rises as the illness progresses [19]. At present study, most patients age are within 40-60 years group were about 53.5% and male to female ratio 1.6:1 may be due sample size. Ground-glass opacities about 33.3% followed by ground-glass opacities as well as consolidation patches (reverse halo sign) were about 24.4%, then ground glass opacities with subpleural linear bands (14.4%), crazy paving pattern (13.3%), single large air bronchogram (10%), and the less common pattern were multiple consolidation patches only (4.4%) were only the most common CT findings visualized in COVID-19 patients. This is consistent with Wang et al description of the most prevalent CT results as ground glass opacities alone or combined with consolidative opacities [20]. Aside from a few minor mediastinal lymph nodes, no detected cavitary pulmonary lesions or considerable size lymphadenopathy were seen in studied sample of individuals, which might be due to viral infection. While 28 (31.1%) patients out of 60 (66.7%) patients show both central and peripheral lung distribution, only 2 (2.2%) patients had central predominance.

The most common CT scan chest findings of COVID-19 associated pneumonia are bilateral lung involvement with posterior peripheral sub-pleural distribution and no detectable pleural effusion [21]. The pattern of COVID-19 lesions stated as scattered (non-confluent) were seen in about 60% of patients and confluent continuous pattern that seen in 40% of cases as demonstrated at (Table 5).

Many investigations have been conducted on patients with COVID-19 who have documented ground glass opacities with or without lung consolidations, particularly in the posterior segments peripherally distributed at diffuse or lower lung lobes, ground glass opacity can shows either a circular or a crazy paving appearance [21,22]. According to these investigations, COVID-19 often produces CT scan patterns similar to that of Organizing pneumonia, namely peripheral distributed ground-glass opacity that may be similar to lung mass or nodal-like that are generally bilateral and multi-lobar [23].

Other CT-scan lung abnormalities such as curvilinear/linear-like, peri-lobular opacity, diffusely distributed ground glass lung opacity and consolidations, can mimic many disorders, such as medication toxicity, many pulmonary infections as well as inhalational exposure [24]. In any of the individuals evaluated, there were no lung cavitary lesions or particular abnormal lymph nodes. Other investigations have identified cavitary lung parenchymal lesion, halo-sign in chest CT-scan, mediastinal lymph nodes enlargement, pneumothorax pericardial/ pleural effusion as unusual chest CT-scan features seen in COVID-19 cases [25]. According to several researches, patient age may influence the COVID-19 appearance and findings on chest CT-scans. To put it another way, younger patients have more GGOs, whereas older individuals have predominant consolidative opacities [26].

In a prospective case study of 41 COVID-19 positive cases, chest CT-scan imaging abnormalities indicative of lung pneumonia were described in 100% of cases, with 98% of patients having bilateral pulmonary parenchymal affection, Lobar and sub-segmental consolidations were the commonest chest CT-scan features in ICU cases [27]. Isolated ground-glass opacity, reticular or inter-lobular septal thickening, and ground-glass opacity with consolidation patches are the most prevalent chest CT scan characteristics in these individuals [18]. **Chung *et al.*** the research investigated the CT scan findings of COVID-19 pneumonia in (21 individuals) and found that 76% of the patients had bilateral lung involvement and 33% had peripheral airspace opacities. At presentation, more than 50% of patients had ground-glass opacities with no consolidation, while roughly 29% had ground-glass opacities with patchy consolidations. According to study lung lesions with a circular pattern in 33% of cases, linear-pattern in about 14% then a crazy-paving lesion pattern around 19%. Furthermore, all lung lobes were damaged in 38% of the patients. The right lower -lobe (76%) was more involved than the right middle- lobe (57%) [21]. Ground glass opacities and air bronchogram opacities were shown to be the most prevalent CT chest patterns in two further investigations with (138 and 99) COVID-19 confirmed patients [28]. After the onset of symptoms, a data collection and analysis was performed by an Iraqi radiologist 4-10 days later to determine the lesion pattern, location, and severity. Ground glass opacity was one of the CT alterations that was observed the most frequently followed by consolidation, broncho-vascular thickening, crazy paving, and tree in bud with 55.23%, 17.44%, 9.88%, 5.81%, 5.23% were seen respectively [29]. In spite of the molecular technique was applied in diagnosis different genetic disease such as CML [30] and Adenocarcinoma [31,32].

However, some reports were mention the cases was confirmed using PCR for detection of the COVID-19 [33,34,35]. The current study's shortcomings were a small sample size, poor patient follow-up, and no lung tissue biopsy for histological association.

CONCLUSION

The utilization of chest CT-scan findings seen in COVID-19 cases assists in the early and correct detection the COVID19 positive cases; as well as the appropriate evaluation of the disease severity and establishment the care strategy.

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ABBRIVIATION

SARS-CoV2: Severe acute respiratory syndrome coronavirus 2; WHO: World Health Organization; GGO: Ground glass opacity; RT-PCR: Reverse transcription polymerase chain reaction.

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