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Characteristic CT findings distinguishing COVID-19 from non-COVID-19 Pneumonia

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Abstract

Introduction: The newly emerged coronavirus disease COVID-19 has now spread globally and is a major public health concern. Prior to the most recent gold standard for confirming COVID-19, real-time fluorescence polymerase chain reaction (RT-PCR), a positive chest computed tomography (CT) scan can provide an immediate positive result.

Aim of the study: The study's goal was to use high-resolution chest CT to distinguish between COVID-19 pneumonia and non-COVID-19 pneumonia.

Subjects and Methods: A cross-sectional study of 50 patients was conducted. It included 50 patients who had either suspected COVID-19 (based on a history of exposure to confirmed cases or travel, clinical symptoms and signs suggestive of COVID-19, abnormal laboratory investigations, or abnormal HRCT results) or confirmed COVID-19 cases (by RT-PCR). They were given a full medical history, an RT-PCR for COVID-19, and an HRCT chest.

Results: Our final research included 50 patients, 38 of whom had positive PCR findings for the Covid-19 virus and 12 of whom had negative PCR results for the Covid-19 virus.

Conclusion: Different chest CT results can occur in patients. The chest CT scan is more than simply a diagnostic or screening tool for COVID-19 patients. In patients with COVID-19, chest CT plays an important role in evaluating the degree of Pneumonia, which impacts prognosis.

Keywords: COVID-19; HRCT Chest; CORADS; Viral Pneumonia.

1. Introduction

COVID-19, a novel coronavirus illness that developed in 2019, has become a global viral pandemic and a global public health hazard. COVID-19 guidelines state that confirmed COVID-19 patients should be sent to a specialized hospital, while suspected COVID-19 patients should be separated and monitored. A larger medical

burden and more expansive public health surveillance and response procedures are needed to segregate individuals and those with whom they have had intimate contact [1].

The gold standard for verifying COVID-19 [2] is real-time fluorescence polymerase chain reaction (RT-PCR), which has a high false-negative rate, although a chest CT can yield a quick positive result before it [3, 4]. Despite the fact that both normal and abnormal CT image findings have been described in numerous articles [2, 5, 6], overlapping CT image findings with viral pneumonia and other respiratory illnesses might make excluding a diagnosis difficult. We are working to develop a fair method for identifying instances that require several RT-PCR runs to differentiate between highly suspected and highly excluded cases.

As compared to pneumonia that was not COVID-19, COVID-19 was more commonly linked with peripheral distribution, ground-glass-like shadows, fine-mesh opacity, vascular thickening, and anti-halo symptoms, which is obviously relevant for differential diagnosis [7]. CO-RADS, a CT-based method, is utilized to evaluate if COVID-19 has lung involvement [8].

The current study aimed to use a high-resolution CT scan of the chest to discriminate between COVID-19-positive and non-COVID-19-positive pneumonia.

2. Subjects and methods

2.1. Subjects

The current cross-sectional study included fifty patients. All the patients were referred from the radiology department at the Fayoum University Hospital during the period from February 1 to December 30, 2021.

Inclusion criteria

The recruitment criteria included participants who were suspected of COVID-19 with abnormal chest CT findings, acute onset of low oxygen saturation (below 90%), an epidemiological exposure history during the previous 14 days prior to the onset of symptoms, those who suffered from any respiratory or gastrointestinal symptoms and/or fever within seven days of CT examination, those who had thromboembolic events within seven days following the CT examination, and finally, individuals within the normal range or with a decreased white blood cell count and lymphocytic count at early stages, high CRP, ferritin, LDH, ALT, or D-dimer levels at the time of the recruitment.

Exclusion criteria

That included patients for whom CT is contraindicated, such as pregnant women in the first and second trimesters, or whom CT images had excessive motion artifact, e.g., due to patient movements.

Ethical Consideration

The study was reviewed by the Faculty of Medicine Research Ethical Committee, Fayoum University, Egypt. The researcher informed the participants about

the objectives of the study, examination, and investigation that were done. Also, we explained the confidentiality of their information and their right not to participate in the study. Written consent was obtained from all patients.

2.2. Methods

Pathogenic evidence

The novel coronavirus was discovered in respiratory samples using a nucleic acid test called RT-PCR. All of the patients in the study had a final diagnosis of COVID-19 confirmed by twice-positive RT-PCR, more than twice-negative RT-PCR (range 2–5), at least one negative RT-PCR with additional pathogens (Mycoplasma pneumoniae, human immunodeficiency virus, and influenza) confirmed, or community-acquired pneumonia of unknown cause with improved follow-up chest CT findings after treatment.

CT scan

Acquiring CT image data was performed using the automatic exposure control setting and scan range. CT images of the thorax were taken, and the noise index was 12.3. On a helical 160-slice CT, scans were performed within seven days after the onset of symptoms (Toshiba, Aquilion, Japan; 1.25 mm slice thickness; 1.5 pitch; 120 kVP tube voltage; 100–200 mAs tube current; sagittal and coronal reconstruction thickness).

Patients position and cautions

Patients were lying in the supine position. Those who had difficulty breathing due to low oxygen saturation used oxygen masks during the examination. Also, intubated patients were done under ICU doctor observation.

2.3. Statistical Analysis

The SPSS statistical computer tool, version 22, was used to organize, tabulate, and statistically analyze the acquired data (IBM, Armnok, NY, United States). The mean, SD, and range are used to present quantitative data. Numbers and percentages are used to represent categorical data. Sensitivity and specificity were calculated to assess the validity of different CT findings in predicting COVID-19 when compared to PCR. Cohen's k was used to test the agreement, and *P-values* of 0.05 or less were regarded as statistically significant.

3. Results

The current study consisted of 50 patients, including 38 (76%) patients with positive PCR results for the COVID-19 virus and 12 (24%) patients with negative PCR results for the COVID-19 virus. The results illustrated that the percentage of male patients with COVID-19 and non-COVID-19 pneumonia was 68.0%, compared to the percentage of female cases with COVID-19 and non-COVID-19 pneumonia, which was 32%. The mean age was 42.9 years, ranging from 19 to 72 years.

Oxygen saturation in most of patients (56%) was above 90%, with 36% of cases measuring 80-90%, while just 8% of cases have oxygen saturation measuring

below 80%. The study revealed that lymphopenia and leucopenia were prominent findings in most patients (10% of patients had lymphopenia only, 12% of patients had leucopenia only, and 34% of patients had lymphopenia and leucopenia). Other CBC changes were reported in our cases, such as lymphocytosis (8%) and monocytosis (6%).

8% of the total cases had normal CBC findings. Patients with COVID-19 pneumonia were less likely to have an elevated white blood cell count. However, they were more likely to have a reduced lymphocyte count. The CT chest patterns revealed that ground glass opacities were 70%, lung consolidation was 12%, both of them were 12%, and the normal pattern was 6%.

COVID-19 Pneumonia was more likely to have a crazy paving sign (28%), a spider web sign (38%), and broncho-vascular thickening (92%). However, it is less likely to have pleural effusion (2%) and lymphadenopathy (6%).

In the end, 96% of our patients recovered and were released from the hospital, but 4% of them passed away. As compared to PCR, Figure 1 illustrated the sensitivity and specificity of the primary CT results. Table 1 further showed that, as compared to PCR, concomitant CT results were more sensitive and specific.

Table 1: Sensitivity and specificity of associated CT findings when compared to PCR.

Variables		PCR Result		Cohen k	*P-value*	Sensitivity	Specificity
		Positive	**Negative**				
B**roncho-vascular thickening**	**Present**	35 (70.0%)	11 (22.0%)	0.006	0.961	92.1	8.3
	Absent	3 (6%)	1 (2%)				
C**razy paving sign**	**Present**	12 (24%)	2 (40%)	0.089	0.316	31.6	83.3
	Absent	26 (52%)	10 (20%)				
S**pider web sign**	**Present**	15 (30%)	4 (8%)	0.040	0.702	39.5	66.7
	Absent	23 (46%)	8 (16%)				
Lymphadenopathy	**Present**	0 (0%)	3 (6%)	-0.125	0.001*	0.0	75.0
	Absent	38 (76%)	9 (18%)				
P**leural effusion**	**Present**	1 (2%)	0 (0%)	0.013	0.570	2.6	100.0
	Absent	37 (74%)	12 (24%)				

Significant at P<0.05.

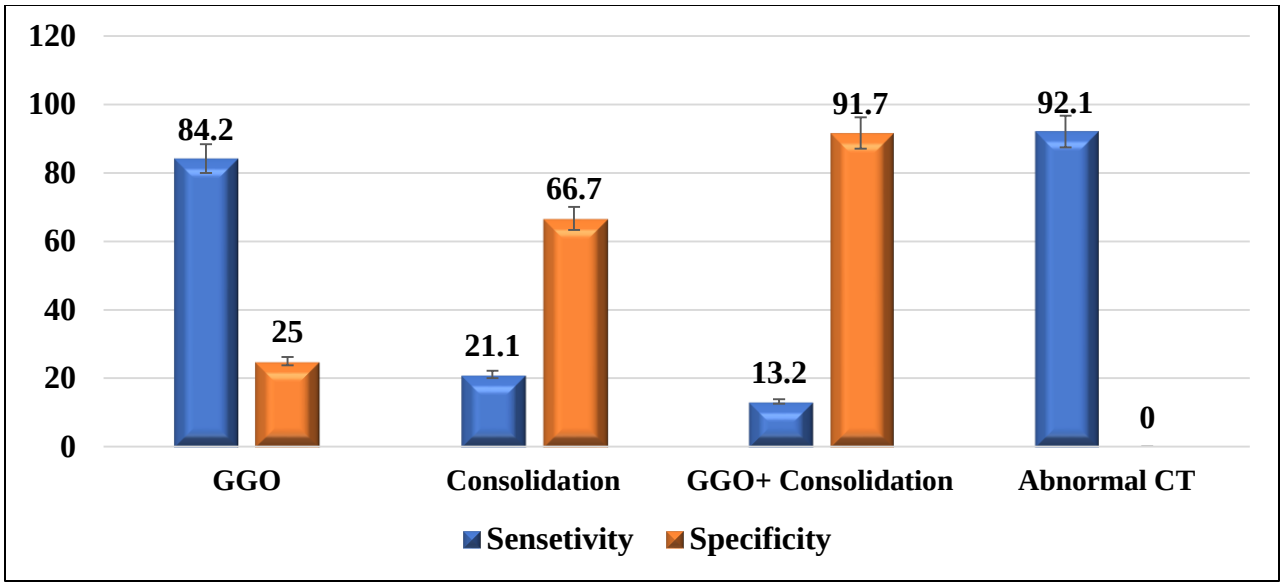

Figure 1: Diagram of sensitivity and specificity of main CT findings when compared to PCR.

4. Discussion

Notwithstanding the limits of current diagnostic procedures for viral identification, the global spread of the 2019 coronavirus (COVID-19) is increasing. The sensitivity of reverse transcription polymerase chain reaction tests diminished early in the illness. Although having a good sensitivity, chest CT has a low specificity [9]. This low specificity might be due to the difficulties in differentiating COVID-19 symptoms from those of other illnesses during chest imaging, such as seasonal flu [4].

To enhance patient management, medical treatment, and disease control, radiologists should be aware of how well chest CT differentiates COVID-19 from non-COVID-19 pneumonia. The current study shown that radiologists can distinguish COVID-19 from viral pneumonia at chest CT with excellent specificity but relatively modest sensitivity. The CT findings of COVID-19 pneumonia were more common than non-COVID viral pneumonia and included peripheral distribution, ground-glass opacity, consolidation, crazy paving signs, spider web signs, and broncho-vascular thickening.

A defining trait of COVID-19 pneumonia was determined to be the arrangement of lesions adjacent to the pleura, that is, without pulmonary parenchyma in between the lesion and the pleura. Nevertheless, the axial distribution was more dispersed or random in patients of other viral pneumonias. Our findings are in agreement with Tanaka *et al.*, 2012, analysis of the CT characteristics of influenza virus pneumonia, which typically reported diffuse and random axial distributions. The concept that COVID-19 pneumonia developed in the subpleural mesenchyme and slowly invaded is supported by the differing axial

distributions of lesions between the two viral instances of pneumonia [10].

While pleural effusion in viral pneumonia is uncommon, it has been documented in past studies in the context of influenza virus pneumonia, which may indicate a subsequent bacterial infection or worsening of the condition. Bacteria, viruses, or fungi can infect the pleura and cause pleural effusion or infectious inflammation.

Children hospitalized in Shenzhen, China, with 2009 influenza A (H1N1) infection and children with novel influenza A (H1N1) viral pneumonia in children and adolescents both had clinically significant pleural effusions [11, 12]. Pleural effusion was infrequent in cases with COVID-19 pneumonia, according to Xu *et al.,* 2020, which is similar with our findings [6].

The findings of our investigation agree with those of Garrana *et al.,* 2021, who found that the bulk of lesions caused by COVID-19 pneumonia were localized around the pleura and in the peripheral zone. Pneumonia lesions, unlike influenza virus lesions, were distributed or disseminated randomly and distant from the pleura [13].

CT should not be used as a diagnosis or screening tool for COVID-19, according to various radiological and academic organizations. The ACR recommends chest radiography and computed tomography (CT) for suspected COVID-19 infection. Ranzcr.com, American College of Radiology, COVID-19 Updates, 2020. "The Royal College of Radiologists | RCR perspective on the role of CT in patients suspected of having COVID-19 infection," RCR.ac.uk, 2020. "Canadian Society of Thoracic Radiology and Canadian Association of Radiologists Declaration on COVID-19." 2020 and Fang et al. are members of the CAR (Canadian Association of Radiologists). Chest CT sensitivity for COVID-19: a comparison to RT-PCR. Radiology (2020) [9]. Despite Mahmud *et al.,* 2020, who argued that CT features were not a critical diagnostic criterion for COVID-19 [15], others have inconclusively employed CT data as a stand-in for a diagnostic test [16].

Other viral pneumonias were more likely than COVID-19 pneumonia to generate mucoid impaction and pleural effusion. Such symptoms should be considered while studying pneumonia patients to establish whether COVID-19 or another virus is to blame. Despite the fact that the CT features of COVID-19 pneumonia and other viral pneumonia usually overlap, no significant differences were detected even utilizing AI algorithms to examine the characteristics.

Imaging alone makes distinguishing between different viral pneumonia patients difficult. As a result, for a complete evaluation, a CT examination should be combined with clinical indicators. The primary role of a CT in the epidemic, however, is in the diagnosis of lesions and the monitoring of treatment results.

Conclusion

In conclusion, our findings revealed that the majority of COVID-19 pneumonia lesions were found in the peripheral zone, adjacent to the pleura, as opposed to other viral pneumonia lesions, which were

scattered or distributed arbitrarily, distant from the pleura.

In this emerging global health calamity, CT was a critical diagnostic and evaluation method. Last but not least, early diagnosis of COVID-19 is critical for halting transmission and allowing for close clinical study of patients. Although RT-PCR remains the gold standard for COVID-19 diagnosis, due to radiation concerns, CT should only be performed in a small number of cases (COVID-19 cases with worsening respiratory symptoms, cases with moderate-to-severe clinical features of COVID-19, in medical triage of COVID-19 suspected individuals with moderate-to-severe clinical symptoms, and a high pretest probability of COVID-19 in the absence of personal protective equipment or the availability of RT-PCR test.

Consolidations, linear opacities, crazy-paving patterns, bronchial wall thickenings, spider web signs, and extrapulmonary lesions may suggest severe or serious COVID-19 pneumonia on CT. The GGO is a crucial sign to consider and analyze when diagnosing COVID-19 pneumonia. CT is critical in the diagnosis and severity evaluation of this disease since it analyzes very well the dynamic CT changes in different phases of COVID-19 pneumonia and also in case follow-up.

Ethical considerations: The Faculty of Medicine Research Ethical Committee reviewed this work. The researcher explained the study's goals, as well as the examination and investigation that had taken place. In addition, they have the right to the confidentiality of their information and to refuse to participate in the study.

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Conflicts of Interest: All authors declare no conflict of interest.

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