Journal of Communicable Diseases
Volume 53, Issue 4 - 2021, Pg. No. 114-118
Peer Reviewed & Open Access Journal

Research Article

The Relation between RT-PCR and Chest CT Scan Sensitivity as Tools in the Diagnosis of COVID-19 Patients in Al-Najaf Province, Iraq

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DOI: https://doi.org/10.24321/0019.5138.202181

I N F O

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How to cite this article:
Abdulkhaleq LA, Mounan MAWA, Obead FW. The Relation between RT-PCR and Chest CT Scan Sensitivity as Tools in the Diagnosis of COVID-19 Patients in Al-Najaf Province, Iraq. J Commun Dis. 2021;53(4):114-118.

Date of Submission: 2021-09-29
Date of Acceptance: 2021-10-21

A B S T R A C T

The typical test for diagnosis of severe acute respiratory syndrome coronavirus 2 is a reverse transcription-polymerase chain reaction (RT-PCR) technique, but the chest CT scan might play a complementary role at the first detection of Coronavirus Disease 2019 (COVID-19) pneumonia.

Objectives: To determine the sensitivity of CT scan on patients with COVID-19 in Al-Najaf, Iraq, and to compare the accuracy of CT scan with that of RT-PCR technique.

Material and Method: This is a prospective study. The patients suspicious of having COVID-19 infection and respiratory symptoms were registered. All patients were diagnosed by RT-PCR and chest CT. Diagnostic performance of CT was intended using RT-PCR as the reference standard in the centre of coronavirus investigation in Al-Najaf city, Iraq from March 2020 to September 2020.

Results: The study population included 125 consecutive participants (males and females; mean age = 53 ± 17 years). Of the 125 participants, fever was observed in 93 (74.4%), cough was observed in 81 (64.8%), dyspnoea was observed in 47 (33%), and lymphocytopenia was observed in 89 (71.2%) subjects. The sensitivity and specificity of chest CT scan was 94% (95% confidence interval).

Conclusion: The typical diagnosis of Coronavirus Disease 2019 pneumonia is by RT-PCR at the first stage of infection which can then be confirmed by chest CT.

Keywords: RT-PCR, Chest CT Scan, COVID-19, Sensitivity, Specificity

Introduction

The coronaviruses disease-19 (COVID-19) is caused by a new coronavirus, severe acute respiratory syndromes coronaviruse-2 (SARS-CoV-2). It has single-stranded ribonucleic acid with an envelope and is named according to its appearance that is similar to a solar corona, with 9-12 nm

long spikes (Wei et al., 2020). The coronavirus has four main structural proteins encoded by genomes of the coronavirus on the envelope, one of these proteins is the spike protein (S) that binds into angiotensin-converting enzyme 2 (ACE- 2) receptor and mediates subsequent union between the virus envelope and membranes of host cell to aid in viral entry into the host cell (Gorbalenya et al., 2020). On February 11, 2020, the International Committee on Taxonomy of Viruses designated it as SARS coronavirus-2 according to phylogeny, toxicity, and established practice (Dai et al., 2020). Shortly, WHO named the coronavirus disease caused by COVID-19 (Lu et al., 2020). On the basis of recent data, it appears that SARS coronavirus-2 may be primarily hosted in bats and may have been transmitted to humans by pangolins (Tan et al., 2020) or other animals (Holshue et al., 2020) sold in the human seafood markets but then may have spread by human-to-human transmission. An outbreak of coronavirus disease-2019 (COVID-19) occurred in December 2019 in Wuhan, the economic centre in China's Hubei province (Bernheim et al., 2020). While the virus probably has a zoonotic source related to the city's Huainan Seafood Markets, a widespread human-to-human transmission has caused 73451 infected cases in 26 countries, with 1875 deaths cases till February 18, 2020 (Wang et al., 2020). The disease was reported initially in the United States on January 20, 2020, and the number of overall cases in the United States had reached 15 as of February 17, 2020 (Wang et al., 2020). In Iraq, the total number of cases had reached 12 as on February 17, 2020 also as first spread of virus at Al-Najaf province. The most common symptoms are cough and fever in addition to other non-specific symptoms including headache, dyspnoea, fatigue, and muscle soreness (Mahase, 2020). The overall severe cases were around 20%, and mortality was about 3% (Zhu et al., 2020). The World Health Organization opened a global health emergency on January 30, 2020 (Azhar et al., 2019)., This is the seventh known type of virus from the coronavirus family to infect humans (Phelan et al., 2020). Two other remarkable examples include Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), the earlier of which had initiated in southern China and resulted in 774 deaths among 8098 infected individuals in 29 countries from November 2002 to July 2003, and the latter of which occurred in Saudi Arabia and was responsible for 848 deaths among 2458 individuals in 27 countries during July 2019 (Wong et al., 2020). As clinical physicians, firstly some investigators have practically detected imaging patterns on chest radiographs and CT scans (Kanne, 2020).

In this study, we have illustrated chest CT findings in 125 patients infected with COVID-19 in Al-Najaf city, Iraq in relation to the time between symptom onset and the first CT scan.

We hypothesised that some CT findings may be more common depending on the duration of infection.

Materials and Method

We obtained license the requirement to obtain written informed agreement for this prospective study that assessed de-identified data and involved no possible risk to patients. To avoid any possible violation of confidentiality, no association was made between the patients and researchers.

From March 2020 to September 2020, 125 adult patients were admitted to Al-Sader and Al-Hakeem hospitals in Al-Najaf Province in Iraq with confirmed COVID-19 and had to go through chest CT. They were enrolled in our study.

In addition to gender and age, the collected clinical data included travel from and to other countries and exposure history. All patients showed positive results for COVID-19 in laboratory analysis with reverse-transcription polymerase chain reaction (RT-PCR) done on secretions from respiratory system obtained by nasopharyngeal swab or oropharyngeal swab. The number of positive results was tabularised, and the number of days between the beginning of symptoms and the date of the first positive test was recorded. Da An Gene (Guangzhou, China) is the manufacturer of the RT-PCR test kits used in this study.

Inclusion Criteria

- Fever
- Respiratory symptoms, such as cough and dyspnoea
- Close contact with a confirmed COVID-19 positive person
- Person with a previously positive test result

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) programme version 24 was used to study the collected data. All the variables were expressed as medians and ranges, and categorical parameters were expressed as counts and percentages. The diagnostic presentation of CT was assessed with sensitivity and specificity considering RT-PCR as the reference standard.

Result and Discussion

Because of the fast spread and the increasing number of coronavirus disease 19 (COVID-19) cases, the detection which began accurate and rapid of this virus or disease is increasingly vital to control on the sources of infections and help the patients to stop the illness progression. Since December 2019, there have been huge challenges regarding the usage of ribonucleic acid test or clinical features of infected patient as the reference standard to make a definitive diagnosis of COVID-19 patients. As the primary diagnosis of COVID-19 is critical for the prevention and control of this pandemic, we cannot depend on the clinical

ISSN: 0019-5138
DOI: https://doi.org/10.24321/0019.5138.202181

characteristics alone to define the diagnosis of COVID-19, especially for patients with early onset of symptoms.

In Iraq, the virus spread rapidly according to the statistics of the Iraqi Ministry of Health (Figures 1 and 2).

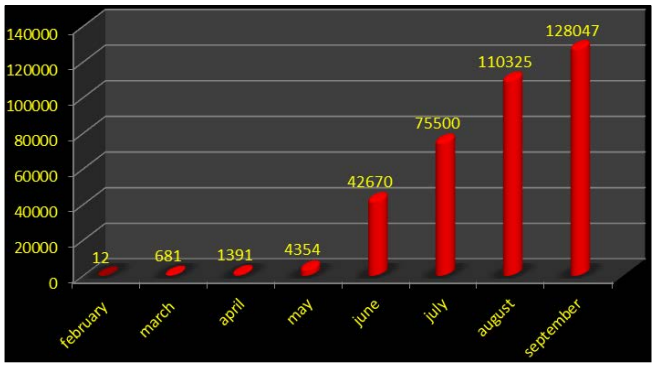

Figure 1.Number of Monthly Infections in Iraq until September

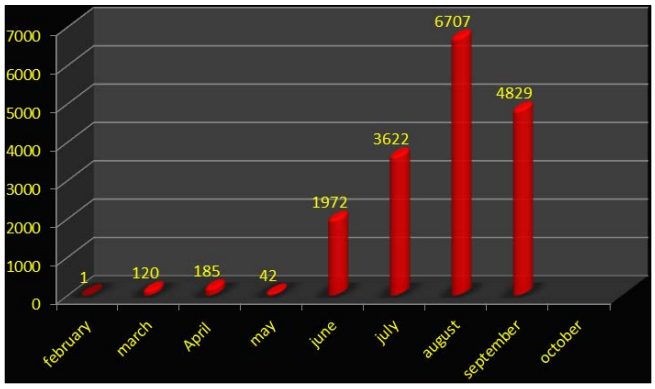

Figure 2.Number of Monthly Infections in Al-Najaf Province until September

Table 1.Demographics Features of the Study Population

Characteristic	Findings
Mean value of age and age range of patients	
Mean age (years)	53 ± 17
Age range (years)	20-89
Total no. of patients	125 (100%)
Male	65 (52%)
Female	60 (48%)
Result of RT-PCR assay	
Positive	73 (58.4%)
Negative	52(41.6%)
Signs	
Fever (37.5°C)	93 (74.4%)
Cough	81 (64.8%)
Dyspnoea	47 (33%)

Demographics Features of the Study Population

The study population included 125 contributors (65 male, 60 female, mean age: 53 ± 17 years, age range: 20-89 years). Other signs and symptoms have been mentioned in Table 1. The laboratory blood test results at admission showed lymphocytopenia (lymphocytes count > $1x10^9$ /L), with a mean lymphocyte count of (1.07 ± 0.45) $x10^9$ /L in 89 of 125 cases (71.2%).

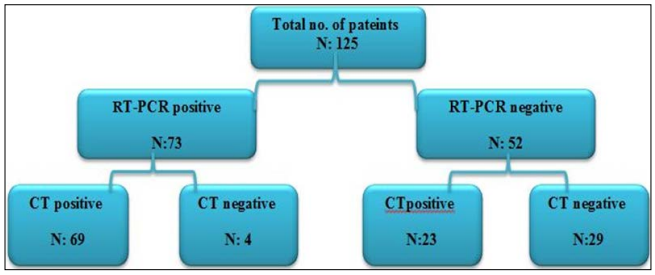

Figure 3.Flowchart of RT-PCR Result in Comparison with CT Scan

RT-PCR: Reverse- Transcription Polymerase Chain Reaction

In this study, we compared chest CT results with that of RT-PCR for COVID-19 infection. Currently, RT-PCR assay for COVID-19 is considered to be an advanced test and is predominantly used in clinics. Although RT-PCR remains the reference standard for making a final diagnosis of COVID-19 infection, false-negative results (Pan and Guan, 2020) and unavailability of RT-PCR test in the first stage of the outbreak limited prompt diagnosis of the infected patient. The radiologic investigations, specially thin-slice chest CT, play a significant role in fighting this infectious disease (Zhang et al., 2019). Chest CT scan can help recognise the early-stage lung infection (Chen et al., 2020) and induce larger public health control and response systems. Presently, chest CT results have been suggested as the main evidence for confirmed clinical diagnosis (Wang et al., 2020). Figure 3 shows the sensitivity of RT-PCR and CT scan in COVID-19 patients, where among 73 positive RT-PCR cases, only 4 appeared as negative in CT scan and 69 appeared as positive. In 125 study participants, the sensitivity and specificity of chest CT were 94% (95% confidence interval).

The cytotoxic lymphocytes, for instance, cytotoxic T lymphocyte (CTL) and natural killer cells (NK), are essential for the control of viral infection, and the functional limpness of cytotoxic lymphocyte is correlated with disease advancement (Zhang et al., 2019). The neutrophil count was remarkably higher in severe disease patients than in mild disease cases, whereas the lymphocyte count was significantly lower in severe disease cases than in mild disease cases as shown in Figures 4 and 5. Recent studies

ISSN: 0019-5138
DOI: https://doi.org/10.24321/0019.5138.202181

indicated a clear decrease in peripheral lymphocytes in COVID-19 patients but any alteration in the subsets was still unknown (Phelan et al., 2020). Wang et al. reported that COVID-19 patients had a significantly lower total number of lymphocytes (P < 0.0001) (Wang et al., 2020).

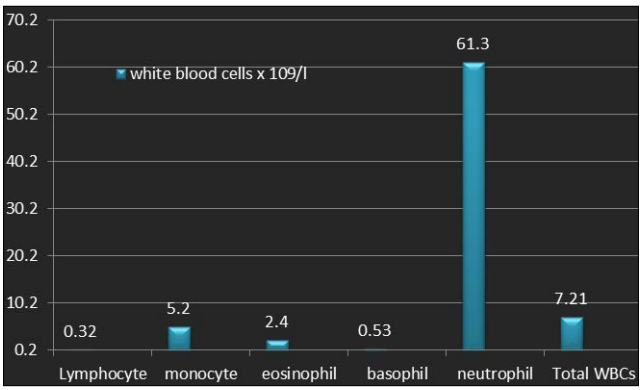

Figure 4.Levels of White Blood Cells in COVID-19 Patients

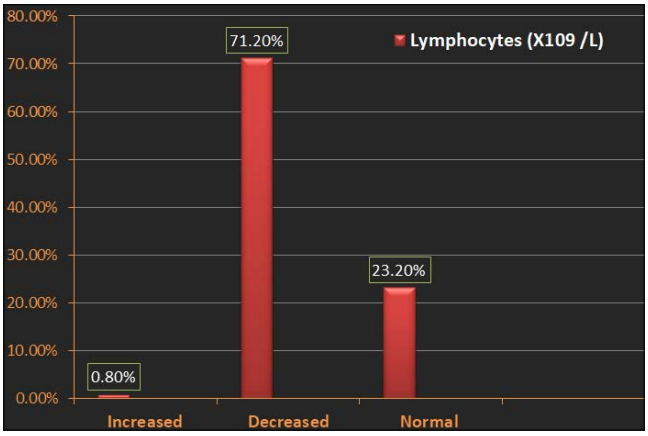

Figure 5.Levels of Lymphocytes in COVID-19 Patients

Note: Normal range of lymphocytes is 1.5-3.0 X109/L.

Conclusion

The typical diagnosis of Coronavirus Disease-2019 pneumonia is RT-PCR at the first stage of infection which can then be confirmed by chest CT.

Source of Funding: None

Conflict of Interest: None

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ISSN: 0019-5138
DOI: https://doi.org/10.24321/0019.5138.202181