Correlation of Chest CT and RT-PCR Testing for Coronavirus Disease 2020(COVID-19) in Palestine: A Report of 200 Cases

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ABSTRACT

Purpose: Prove that Computed Tomography (CT) is a more effective diagnostic tool for diagnosing Coronavirus Disease 2019 (COVID-19) in comparison with Reverse Transcription Polymerase Chain Reaction (RT-PCR) due to its higher sensitivity.

Methods and materials: A total of 200 cases that had records of chest CT scans and RT-PCR tests were collected from Palestinian governmental hospitals from September to November 2020.

Results: CT indicated COVID-19 in 62.5% of sample population (125 of 200) whereas RT-PCR indicated COVID-19 in 37.5% (75 of 200) cases. A P-value of 0.028 signifies the existence of a relationship between gender and CT sensitivity.

Conclusion: High resolution computed tomography (HRCT) of the chest is a more rapid, sensitive, and effective tool than the current gold standard (RT-PCR); therefore, should be considered a primary diagnostic method for COVID-19.

Keywords: COVID-19, CT, RT-PCR, Sensitivity.

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I. INTRODUCTION

The first cases infected with severe acute respiratory syndrome coronavirus 2 virus (SARS-CoV-19) appeared in Wuhan, Hubei Province, China in December of 2019. Weeks later, the virus spread rapidly across China and the rest of the world [1]. The rising numbers of confirmed cases necessitated international measures to help contain the spread. These measures included but were not limited to diagnostic testing, management of confirmed cases, and community Infection Prevention and Control (IPC) [1]. Considering that the identification of infected people is the first and most crucial step to containing the spread, a diagnostic tool that is available, rapid, sensitive, and affordable is essential [2]. The current diagnostic test for Coronavirus Disease 2019 (COVID-19) is Reverse transcription polymerase chain reaction (RT-PCR) assay [3]. Through oropharyngeal (OP) or nasopharyngeal (NP) swabs, specimens are obtained to detect the presence of SARS-CoV-2 [4]. As previously mentioned, early detection of COVID-

19 is essential to prevent and control infectious transmission; however, many issues are presented with the use of RT-PCR as the gold standard of testing [5]. The waiting time, limited availability, and costly nature renders the RT-PCR as an ineffective diagnostic tool [4]. The most concerning issue of using RT-PCR is its inability to detect the viral genome of symptomatic or asymptomatic people (5). Specifically, the sensitivity of RT-PCR is very limited (60%-71%) [5]. The first factor that limits the sensitivity of RT-PCR assays as a diagnostic tool is the inherent susceptibility to errors due to specimen collection [4]. There are many methods to collect specimens, but the most rapid and common are NP and/or OP swabs, and improper sample collection, transportation, and/or handling can result in inconsistencies [5]. Moreover, RT-PCR is vulnerable to inter-operator variability that can affect the quality of the collected sample [5]. Finally, the limited sensitivity of RT-PCR is also due to its dependence upon viral load, sampling timing, and period of the disease development [5]. A diagnostic tool that is considered to be effective due to its availability, high sensitivity, and rapidity

is chest computed tomography (CT) scan. Chest CT scans reveal anatomic details and convey the extent of pulmonary damage due to COVID-19. Known patterns of imaging manifestations of COVID-19 have been indicated on chest CT scans, such as: Ground Glass Opacities (GGOs), pulmonary consolidations, reticular patterns, and pleural thickening [6]. Despite its important role in the COVID-19 pandemic, chest CT is being used as an adjunct to RT-PCR [7]. Due to the urgency of the situation and the need of an effective diagnostic tool, this study aims at assessing the sensitivity of RT-PCR and chest CT scans in the diagnosis of COVID-19.

II. METHODS AND MATERIALS

A. Study Population

This retrospective cohort study included 200 patients with confirmed COVID-19. 100 patients (50%) were female and 100 (50%) were male. Samples were collected from Palestinian governmental hospitals from September to November 2020. Information regarding the type of diagnostic test performed and the gender were extracted through electronic medical records. The entire sample population was included in the study according to the following inclusion criteria:

1) each patient performed both chest CT scan and RT-PCR assay.

2) one of the diagnostic tests indicated a positive COVID-19 result.

B. Ethical Consideration

Approval was acquired from the Research Ethics Committee of the Palestinian Ministry of Health (MoH).

C. Statistical Analysis

The SPSS 24.0 software was used to study the difference in RT-PCR and CT. Descriptive and frequency statistics was used to study the main characteristic of the sample. Continuous variables were given as mean $\pm$ standard deviation while categorical variables were given as number and percentage. The Kruskal–Wallis test and Mann–Whitney U test were included in the analysis.

III. RESULTS

200 patients participated in this study. 100 patients (50%) were male, and 100 patients (50%) were female. The entire sample population underwent both diagnostic tests (Fig. 1). CT confirmed COVID-19 in 62.5% (125/200) of the population while RT-PCR confirmed COVID-19 in 37.5% (75/200) of population. Of the 125 patients that received a positive result through CT, 55 were female while 70 were male. Additionally, of the 75 patients that received a positive RT-PCR, 45 were female and 30 were male (Fig. 2).

Gender

Figure 1

Fig. 1. Pie chart of gender.

CT and RT-PCR Sensitivity in Females and Males

Figure 2

Fig. 2. Bar graph of confirmed cases using RT-PCR and CT. According to the two-tailed P -value: 0.028, there is a significant relationship between gender and CT sensitivity, i.e., the sensitivity varies for males and females (the results in Fig. 2. reflects this relationship).

IV. DISCUSSION

Coronavirus disease 2019(COVID-19) is a highly infectious disease that is caused by SARS-CoV-2 [1]. The first cases of this worldwide pandemic originated in Hubei Province, China and were reported in December 2019 [1]. Due to the rapid spread and increase in mortality rates, practical, available, and sensitive methods of diagnosis are needed. Early diagnosis of COVID-19 plays a pivotal role in controlling the transmission of this highly infectious viral agent. The current gold standard for diagnosing COVID-19 is reverse-transcription polymerase chain reaction RT-PCR; however, recent studies expose the lack of sensitivity and unreliability of using RT-PCR as the reference diagnostic COVID-19 test [3]. Despite its use as the gold standard to diagnose COVID-19, limitations such as long processing time, susceptibility to inherent procedural errors, inter-operator variability, and inherent erroneous results due to sample collection and analysis decrease the reliability of RT-PCR [5]. On the other hand, chest CT scans of the thorax show promise in diagnosing COVID-19. CT is rapid, cost-effective, and available rendering it a more sensitive and practical method of diagnosing COVID-19. Through viewing the extent of pulmonary damage through cross-sectional anatomical details, one can determine whether the patient has contracted COVID-19 [6].

According to studies that evaluate the imaging patterns of COVID-19 such as the study conducted by Chung *et al.*, CT findings such as Ground Glass Opacities (GGOs) were present in 73% of patients [8]. Additionally, a pictorial review conducted by Ye *et al.* reported that CT has a sensitivity of 98% when used to conclude the presence of COVID-19 [9]. Moreover, Long *et al.* revealed in his study that the sensitivity of CT was 92.7% whereas the sensitivity of RT-PCR was 83.3 % [10]. A study conducted by Ai *et al.* revealed that the sensitivity of CT was 97.2%, whereas the sensitivity of RT-PCR was 83.3%. According to these results, our study agreed with previous studies [11].

Our retrospective analysis showed similar results. Our analysis consisted of 200 patients who were tested for COVID-19 through both diagnostic tools (RT-PCR and chest CT); the sensitivity of chest CT scans was far greater than that of RT-PCR. Specifically, the sensitivity of RT-PCR test reported to be 37.5% (75 of 200 patients). On the contrary, CT indicated COVID-19 in 62.5% of the patients (125 of 200). The decreased sensitivity of RT-PCR is thought to be due to the test's susceptibility to yield false negative and false-positive results due to its dependence upon viral load, improper sample collection, and sample analysis. False-negative results can be detrimental in a pandemic due to the importance of early detection and action. A *P*-value of .028 emphasizes the existence of a significant relationship between gender and CT sensitivity.

The Mann-Whitney U-test and Kruskal-Wallis H test indicated that there was a significant relationship between gender and the result of CT scans as well. Meaning, the sensitivity of CT was slightly less in females than that for males.

V. CONCLUSION

Finally, our study strongly supports the use of high resolution chest CT scans for patients with suspected COVID-19 pneumonia. Because the use of RT-PCR can prevent early diagnosis due to its decreased sensitivity, a diagnostic test that can instigate early action is necessary. Rapid diagnosis performed through chest CT can lead to early action and increase public health care services. Overall, the speed, sensitivity, and availability of CT renders it a more effective diagnostic tool for testing the presence of COVID-19 in comparison to RT-PCR

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