Diagnostic Performance of Chest CT-Scan and First RT-PCR Testing for COVID-19 in Iranian Population

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Dear Editor-in-Chief

Regarding the limitations of real-time polymerase chain reaction (RT-PCR) and the importance of early diagnosis of COVID-19 in reducing morbidity and mortality of disease and prevention of further spread, using a faster method with higher sensitivity is essential (1). In COVID-19 diagnosis, chest computed tomography (chest CT) scan, a routine imaging tool that frequently is used for pneumonia diagnosis, compared with RT-PCR, is faster and has a higher sensitivity and is relatively easy to perform (2). Therefore, chest CT findings might be present in patients with negative initial RT-PCR results but with clinical symptoms and guide physicians for performing the second RT-PCR in these patients. Nevertheless, chest CT scan has low specificity in COVD-19 detection on the account of nonspecific findings of COVID-19 such as ground-glass opacity (GGO) that overlap with those of other viral types of pneumonia (2, 3).

In this retrospective study, we assessed 2352 hospitalized patients with suspected COVID-19 in Tehran, Iran from Oct 1 to Nov 20, 2020. At first, patients underwent a CT scan and initial RT-PCR. Symptomatic patients with negative RT-PCR and negative or positive CT scan results underwent second RT-PCR after between 2 - 10 d. For patients with positive RT-PCR results (initial or second RT-PCR), the diagnosis of COVID-19 was confirmed. If a patient had more than one chest CT scan, we included the last CT scan (with the shortest interval with RT-PCR test) to compare with the RT-PCR assay for the analysis of diagnostic performance. Time-interval between the last CT-scan and the RT-PCR assay in these patients was equal or shorter than 5 days. Our study was approved by the University Ethics Committee and patient consent was obtained.

Of 2352 patients, 1959 patients had positive CT scan results and 393 patients had negative results. While, of 2352 patients, 1229 patients had positive initial RT-PCR results and 1123 patients had negative results. The positive rate for CT scan and initial RT-PCR was 83% and 52%, respectively. After an average of 7 d from initial RT-PCR, of 602 symptomatic patients (such as fever, cough, lymphocytopenia, CT finding) with negative initial RT-PCR, who underwent second RT-PCR, 212 patients had a positive result and 390 patient had negative results. Overall, from 2352

patients, 1441 patients confirmed COVID-19 by RT-PCR, and 911 patients had negative results for COVID-19.

In considering initial RT-PCR results as a reference, the sensitivity, specificity, PPV, NPV, and accuracy of CT scan in COVID-19 diagnosis were 87.63%, 21%, 54.98%, 61.32%, and 56.04%, respectively. With respect to overall RT-PCR (initial + second RT-PCR) results as a reference, di-

agnostic performance of CT scan in COVID-19 was increased. The sensitivity, specificity, PPV, NPV, and accuracy were presented in Table 1. The higher sensitivity was for 40-59 years' group (90.81) and higher specificity was for <40 years' groups (47.42%). While, the lower specificity was for ≥60 years (13.90%). The greater PPV and accuracy were for 40-59 years' groups (PPV: 74.81 and accuracy: 71.97%).

Table 1: The performance of chest CT for COVID-19 infection in comparison with initial RT-PCR and overall RT-PCR results as reference

Variable	Results (n)				Test performance				
	TP	TN	FP	FN	Sensitivity% (95% CI)	Specificity% (95% CI)	PPV% (95% CI)	NPV% (95% CI)	Accuracy% (95% CI)
Initial RT-PCR	1077	241	882	152	87.63 (85.66% to 89.42%)	21.46 (19.09% to 23.98%)	54.98 (54.06% to 55.89%)	61.32 (56.83% to 65.64%)	56.04 (54.00% to 58.06%)
Overall RT-PCR	1276	228	683	165	88.55 (86.79% to 90.15%)	25.03 (22.24% to 27.97%)	65.14 (64.18% to 66.08%)	58.02 (53.52% to 62.38%)	63.95 (61.97% to 65.89%)
Age sub groups*									
< 40 years	185	92	102	28	86.85 (81.56% to 91.08%)	47.42 (40.23% to 54.70%)	64.46 (61.11% to 67.68%)	76.67 (69.29% to 82.71%)	68.06 (63.29% to 72.57%)
40 - 59 years	603	75	203	61	90.81 (88.36% to 92.90%)	26.98 (21.85% to 32.60%	74.81 (73.37% to 76.21%)	55.15 (47.48% to 62.58%)	71.97 (68.99% to 74.82%)
≥ 60 years	488	61	378	76	86.52 (83.43% to 89.23%)	13.90 (10.80% to 17.49%)	56.35 (55.12% to 57.57%)	44.53 (36.99% to 52.33%)	54.74 (51.60% to 57.85%)

In lines, the performance of initial RT-PCR in comparison with overall RT-PCR results as a reference in diagnosing COVID-19 was evaluated. The sensitivity and NPV were 85.29% (1221/1441 patients) and 81.12% (911/1123 patients), respectively. The specificity and PPV of initial RT-PCR were 100% because in our system with one positive RT-PCR result the diagnosis of COVID-19 was confirmed (i.e., no false-positive results). The prevalence of the disease in subjects (hospitalized patients) of our retrospective study was 61% (1441/2352) based on overall RT-PCR

results. Our data indicated that the chest CT scan has a high sensitivity in comparison with initial RT-PCR in COVID-19 diagnosis. Further, the results of the initial RT-PCR test may be false-negative, suggesting that the symptomatic patients with or without positive chest CT results should be isolated, and repeating RT-PCR could help to avoid misdiagnosis and finally lead to early treatment and prevent further spread of COVID-19.

Conflict of interest

The authors declare that there is no conflict of interest.

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