Received: 13 August 2020 | Revised: 22 October 2020 | Accepted: 14 December 2020

DOI: 10.1111/ijcp.14025

ORIGINAL PAPER

INFECTIOUS DISEASES

THE INTERNATIONAL JOURNAL OF CLINICAL PRACTICE WILEY

The Effect of prolonged PCR Positivity on patient Outcomes and Determination of Isolation period in COVID-19 patients

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Abstract

Aims: The impact of ongoing PCR positivity on COVID-19 patients and the strategy and period of isolation were not fully understood. We aimed to investigate the factors that cause prolonged PCR positivity and its clinical impact on COVID-19 infection. In addition, we searched for an answer on what length of time would be best for isolation.

Methods: Patients with confirmed COVID-19 infection were included in this retrospective study. Patients with PCR positivity (after symptom onset) longer than 14 days and PCR positivity less than 14 days were compared. The relationship between duration of symptoms and PCR negation time was examined.

Results: A total of 339 patients were included in this study. Fifty (14%) patients had prolonged PCR positivity after 14 days. Demographic and clinical features, and clinical outcomes (disease severity and mortality) were similar among the two groups. Age (p 0.035) and symptom duration at admission ($P < .001$) were found as independent factors for prolonged PCR positivity. Median of total symptom duration was 7 days (IQR: 5-11). The duration of negative conversion of PCR test was median 9 days (IQR: 7-12) after symptom onset and PCR tests became negative 3 days (IQR: 2-5) after symptom improvement.

Conclusions: We found that ongoing PCR positivity has no detrimental effect on the course of the disease and clinical outcomes in COVID-19 patients. In addition, our results showed that isolation may be discontinued 10-14 days after symptom onset and/or after 2-5 days after resolution of symptoms. This results also support WHO and ECDC recommendations on this matter.

1 | INTRODUCTION

At the end of 2019, a new etiological agent, named later as severe acute respiratory syndrome corona virus-2 (SARS-CoV-2), was identified and has caused more than 8 million infections, and approximately 460.000 deaths to date.[1,2] Routine confirmation of the disease is based on the detection of SARS-CoV-2 RNA on nasopharyngeal swabs or other respiratory samples by real-time reverse-transcription polymerase chain reaction (rRT-PCR).[3] The duration from onset of symptoms to becoming PCR negative was reported as 4-25 days in a study[4]; however, this period may be prolonged up to 4-6 weeks depending on patient characteristics.[5] Previous studies showed that the clinical course and outcomes of patients with prolonged PCR positivity were not different from those who have a shorter duration of PCR positivity. However, these studies had been conducted in relatively small cases series.[6-8]

The rRT-PCR test also guides the determination of the isolation period in COVID-19 patients. To determine the isolation period,

the Centers for Disease Control and Prevention (CDC) has recommended two different strategies, test-based or symptom-based.[9] World Health Organization (WHO) has recommended isolation 10 days after symptom onset, plus at least 3 days after symptoms improved.[10] It is not yet known whether it is more advantageous to use a test-based strategy or a symptom-based strategy in discontinuation of isolation. The favourable strategy may change based on countries or centres bounds of capability.[9-11] Although the correlation between symptoms and PCR positivity has been mentioned in previous studies, it was not precisely defined.[6] Duration of PCR negativity after symptoms improve has not been defined with large case series.

In this study, we aimed to compare patient with -and without prolonged PCR positivity and to define the factors that affect long-term PCR positivity. We then aimed to investigate the correlation time between resolution of symptoms and becoming PCR negative in order to determine the optimal isolation periods.

What's known

In COVID-19 disease, patients who have had prolonged PCR positivity were not different from those who have a shorter duration of PCR positivity according to clinical and demographical features. And it has been known that PCR negativity period after symptom onset changes less than 1 week to 6 weeks.

What's new

In this study, it was revealed that prolonged PCR positivity did not necessitate additional intervention in the clinical follow-up and treatment of the patients with COVID-19. And, PCR negativity period after symptom onset was reported with the highest number of cases compared with available current literature data.

2 | MATERIALS AND METHODS

This study was carried out in Ankara City Hospital, the pandemic reference centre in the capital, between 10 March 2020 and 10 May 2020. Ethical approval was provided by the Turkish Ministry of Health and the Ankara City Hospital Ethical Committee 1. Patients over the age of 18 years, who were hospitalised with the confirmed diagnosis of COVID-19, were included in the study. Patients with positive PCR test for SARS-CoV-2 in the nasopharyngeal swab sample or other respiratory samples were identified as confirmed cases.

The PCR test was performed at the admission to the hospital for all symptomatic or asymptomatic patients. The samples taken were delivered to the laboratory using special transport systems for viruses and following the cold chain rules. Nucleic acid extraction was performed with Bioeksen RINA extraction systems. Bioeksen COVID-19 RT-qPCR Detection Kit was performed with one-step reverse transcription (RT) and real-time PCR (qPCR) (RT-qPCR).

Data were collected retrospectively. Demographic features and clinical findings were recorded from the daily follow-up forms. Age, gender, epidemiological history, comorbid disease, immunosuppression, severity of disease, presence and duration of symptoms were questioned. Laboratory test results were obtained from hospital electronic records. Complete blood count, urea, creatinine, aspartate transaminase (AST), alanine transaminase (ALT), lactate dehydrogenase (LDH), creatine kinase (CK), C-reactive protein, procalcitonin, interleukin 6 (IL-6), ferritin, D-dimer, fibrinogen and blood groups were evaluated. Chest X-ray and thorax computed tomography (CT) were performed for all patients upon admission. Radiological findings were recorded as unilateral/bilateral ground-glass opacity, diffuse infiltration, and consolidation and localisation was classified as peripheral, central and diffuse. Severity of the disease was determined according to the WHO guideline as mild disease, pneumonia, severe pneumonia and critical disease.[10] The development of complications was recorded in patient forms. The patients were divided into two groups according to the duration of becoming PCR negative after symptom onset, 0-14 days and ≥15 days. The groups were compared in terms of demographic characteristics, clinical symptoms and signs, laboratory and radiological findings and clinical outcomes including requirement of intensive care unit (ICU), mechanical ventilation and death.

The patients were followed-up based on test-based strategy to decide the isolation period. The sequential sampling was performed in patients whose SARS-CoV-2 PCR was positive in the nasopharyngeal swab or other respiratory samples. The patients were followed-up in hospital until two consecutive negative tests for SARS-CoV-2 were obtained within 24-hour intervals. To demonstrate that the PCR test became negative during follow-up, the first sample was performed routinely 4 or 5 days after the diagnostic PCR test. If negativity was achieved in the first sample, the second sample was taken after 24-36 hours. If otherwise, sampling continued until two consecutive negative samples were obtained. When two consecutive negative PCR test results were provided, the time of the first negative test was considered as the time to turn negative.

Patients were evaluated for the following periods: the duration of symptoms following admission to the hospital, the total duration of symptoms, and the duration of becoming PCR negative after symptom onset.

2.1 | Statistical analysis

SPSS 25.0 (IBM Inc) software system was used for the analyses in the study. Descriptive statistics were presented using mean ± standard deviation and median (IQR: 25th-75th percentile) for continuous data, and frequency and percent for categorical data. The comparisons of continuous and categorical data between independent groups were performed using Student t-test (Mann-Whitney U test in non-parametric conditions) and Chi-square test (Fisher's exact test

in non-parametric conditions), respectively. Logistic regression analysis was used for determining the independent factor. Spearman's non-parametric correlation analysis was used for correlation of time variables. A $P < .05$ was considered as statistically significant.

3 | RESULTS

A total of 339 patients with confirmed COVID-19 infection were included in the study. The mean age was 46.2 years, and 54.3% were males. Of the patients, 34% had at least one comorbidity; hypertension (17.4%) was the most frequent. Of the cases, 90.3% were symptomatic at admission, and cough (55.8%) and fever (43.1%) were the most common symptoms. 9.7% (n = 33) patients were tested for having contact with COVID-19 patients without any symptoms. In univariate analysis, there was no significant difference between groups in terms of age, sex, clinical symptoms and signs between groups. The duration of symptoms was longer in patients with prolonged PCR positivity. The baseline demographic, clinical and radiological characteristics of the patients based on the duration of negative PCR test results are presented in Table 1. Consolidation on thorax CT was higher in cases with prolonged PCR positivity ($P = .03$). There was no difference between patients with PCR positivity longer than 14 days and those who had PCR positivity shorter than 14 days in terms of disease severity, clinical deterioration and mortality rates (Table 1).

Laboratory and radiological test results were compared based on the first day of hospital admission (Table 2). Albumin levels were significantly lower in patients with prolonged PCR positivity (42.5 ± 4.5 vs 44.2 ± 4.1, $P = .03$). In multivariate analysis, age ($P = 0.035$) and the duration of symptoms on admission ($P < .001$) were found as independent factors for prolonged PCR positivity (Table 3).

The median duration of symptom at admission was 3 days (IQR: 2-5). Symptoms disappeared at median 7 days (IQR: 5-11) for all patients (n = 339) included in the study. The duration of becoming PCR negative after symptom onset was 9 days (IQR: 7-12) (Figure 1). The conversion of the PCR test to negative occurred 3 days (IQR: 2-5) after resolution of symptoms. PCR test was positive for more than 14 days after resolution of symptoms in only six (1.8%) patients. We detected the first control PCR test performed 4-5 days after the positive test as negative in 59% (199) of patients. The patients were hospitalised for a median of 10 days (IQR: 7-13) and an average of $3.3 \pm 1.0^{1-8}$ tests were performed per patient (Table 1).

Although no significant correlation was detected between symptom duration and the duration of becoming PCR negative after symptom onset ($r = 0.09$, $P = 0.107$), there was a modest trend between these parameters. The symptom duration was prolonged in patients who had longer PCR positivity time (Figure 2).

4 | DISCUSSION

From the beginning of the COVID-19 pandemic, it has been known that some patients have a longer duration of PCR positivity than others.[8] The issue of "ongoing PCR positivity" has significance in two aspects, its effects on disease severity and determining of isolation time (quarantine on asymptomatic). To date, no precise cut-off time has been determined for "prolonged positivity time".[4,6] In this study, we accept a longer duration of PCR positivity than 14 days from symptom onset as the cut-off day. That is determined according to guideline recommendations for the isolation period after symptom onset.[10,11]

We investigated whether there is a difference between groups with and without prolonged PCR positivity and the factor affecting prolonged PCR positivity. There were no differences in terms of severity of infection and clinical outcomes. Prolonged PCR positivity had no additional detrimental effect on the patient's clinical course. Our results have supported previous studies in the literature that evaluated a smaller number of patients and found no difference between groups.[4,6] In our study, age and the duration of symptoms on admission were found as the only predictor for prolonged PCR positivity. Similarly, older age was reported to be related to prolonged SARS-CoV-2 positivity in previous studies.[4,8] Qi et al[6], who evaluated 147 patients, reported that there was no difference in terms of age between patients with prolonged viral shedding and those who had shorter PCR positivity. However, these patients were reported to have longer duration of symptoms (median: 6 [3-10]) when hospitalised. Therefore, the late hospitalisation of patients may affect the results of the study. As a result, we can say that in light of the results of our study and previous reports, the duration of PCR positivity does not predict or guide clinical course and outcomes of COVID-19.

The second and vital issue with long-term PCR positivity is to determine the termination time of isolation. Despite large amounts of accumulated data, there are issues that are not fully explained in relation to COVID-19. Contagiousness and therefore the isolation period are among them. To decide the isolation period, two strategies are recommended based on the characteristic of patients or centres.[9-11] Both of them have some advantages and disadvantages. The value of using the test-based strategy in determining the quarantine period is uncertain and even inappropriate according to some reports. The test-based strategy may lead to unnecessarily long durations of isolation, prolonged hospitalisation and overuse of personal protective equipment. On the other hand, there is insufficient evidence for the reliability and feasibility of the symptom-based strategy.[9,12] As the European Centre for Disease Prevention and Control (ECDC) suggests, if testing and hospital bed capacity allows, isolation period should be ended after 8 days of symptom onset and providing two negative rRT-PCR tests from respiratory samples at 24-hour intervals. If testing capacity is limited, isolation can be terminated at least 3 days after symptoms have improved, or after 8-14 days after symptom onset.[11]

We followed-up patients with test-based strategy, meaning patients were hospitalised until two consecutive negative PCR tests. The total length of hospital stays in our study (median 10 days, [IQR: 7-13]) was similar to the centres that preferred the test-based strategy to determine the isolation period and the patient's discharge decision. Median length of hospital stay was reported as 13 (IQR:

TABLE 1 Demographic and clinical characteristics of patients based on the duration of negative PCR test results after symptom onset

	Days of first negative PCR result test after symptom onset		
	0-14 days (n = 289)	≥15 days (n = 50)	
	Median (IQR)	Median (IQR)	*P* value
Age (y) (median [min-max])	45 [18-93]	45 [19-86]	.16
Symptoms duration on admission	3 (1-4)	7 (3-10)	**<.001**
Total symptom duration	7 (5-11)	7 (4-10)	.77
Duration of hospitalisation	10 (8-13)	9 (7-12)	.20
	n (%)	n (%)	*P* value
Sex, male	160 (55.4)	24 (48)	.34
Presence of comorbidity	96 (33.4)	17 (34)	.94
Hypertension	49 (17)	10 (20)	.60
Diabetes mellitus	29 (10)	6 (12)	.67
Chronic lung disease	13 (4.5)	2 (4)	1.00
Immunosuppression/malignity	10 (3.5)	—	.36
Smoker/Ex-smoker	49 (17)	13 (26)	.21
Presence of symptoms	260 (90)	46 (92)	.80
Fever (>37.8 °C)	125 (43.3)	21 (42)	.87
Coughing	158 (54.7)	31 (62)	.34
Sputum	7 (2.4)	2 (4)	.63
Dyspnoea	64 (22.1)	13 (26)	.55
Sore throat	58 (20.1)	11 (22)	.75
Positive finding in computerised tomography	240 (83)	43 (86)	.60
Unilateral ground-glass opacity	60 (20.8)	6 (12)	.15
Bilateral ground-glass opacity	149 (51.6)	29 (58)	.40
Diffuse infiltration	19 (6.6)	4 (8)	.76
Consolidation	28 (9.7)	10 (20)	**.03**
Radiological localisation			
Peripheral	99 (34.3)	22 (44)	.18
Central	8 (2.8)	2 (4)	.65
Diffuse	49 (17)	9 (18)	.86
Disease severity			.24
Pneumonia	155 (54.2)	23 (46.9)	
Mild disease	91 (31.8)	14 (28.6)	
Severe pneumonia (SARI)	36 (12.6)	11 (22.4)	
Critical disease	4 (1.4)	1 (2)	
Presence of complication	19 (6.6)	2 (4)	.137
Clinical response			.14
Responsive	243 (84.4)	39 (78)	
Non-responsive (ongoing fever, coughing, etc)	19 (6.6)	2 (4)	
Clinical deterioration (respiration > 30/min or O2 saturation < 90%)	26 (9)	9 (18)	
Need for intensive care unit	33 (12.9)	10 (21.7)	.11
Oxygen supplementation	75 (26)	16 (32)	.37
Clinical outcome, death	11 (3.8)	1 (2)	1.00

Bold values are statistical significant

11.0-17.5) and 19 days (IQR: 16-25) in two previous studies conducted by Qi et al[6] and Hu et al[4], respectively. For the patients with mild to moderate symptoms, these periods are unnecessarily long to stay in hospital, especially in countries with limited sources. If patients are isolated in their homes or other outpatient centres, hospital beds will not be used unnecessarily.

TABLE 2 Laboratory analyses in all patients based on day of first negative PCR test after symptom onset

		Day of first negative PCR result test after symptom onset		
	All patients (n = 339)	0-14 days (n = 289)	≥15 days (n = 50)	*P* value
Laboratory test	Median [min-max]	Median [min-max]	Median [min-max]	
White blood cell count - ×109/L	5255 [120-59290]	5205 [120-59290]	5435 [2920-18760]	.47
Neutrophil count - ×109/L	3270 [200-16460]	3280 [200-13410]	3225 [1430-16460]	.84
Lymphocyte count - ×109/L	1180 [150-7360]	1170 [150-7360]	1265 [330-3090]	.49
Monocyte count- ×109/L	330 [40-1460]	330 [40-1460]	330 [130-670]	.79
Haemoglobin - g/L	13.8 [7.1-17]	13.8 [7.1-17]	13.8 [10.9-16.4]	.65
Platelet count - ×109/L	206 500 [13000-436000]	209 000 [13000-436000]	198 000 [14500-406000]	.40
Urea	26 [11-52]	27 [11-52]	25 [13-45]	.55
Creatinine - µmol/L	0.8 [0.1-46753]	0.8 [0.1-46753]	0.8 [0.5-43831]	.75
AST, U/L	24 [7-500]	24 [7-500]	26 [11-74]	.78
ALT, U/L	28 [7-634]	28 [7-634]	27 [9-113]	.96
Albumin - g/L	45 [30-54]	45 [33-54]	44 [30-50]	**.03**
Creatine Kinase - µ/L	93 [12-5395]	93.5 [12-5395]	93 [20-860]	.71
LDH U/L	218 [106-697]	218 [106-697]	211 [160-646]	.77
C-reactive protein - mg/L	0.009 [0.00007-0.9]	0.009 [0.00007-0.9]	0.009 [0.0001-0.3]	.35
Procalcitonin (PCT) µg/L	0 [0-2]	0.03 [0-1.3]	0.03 [0-2]	.84
Ferritin, µg/L	118.5 [1-1566]	118 [1-1023]	178 [10-1566]	.30
D-dimer - µg/L	0.4 [0-35.2]	0.4 [0-35.2]	0.4 [0-2]	1.00
Fibrinogen - g/L	3.1 [1.3-291]	3 [1.3-291]	3.2 [2-8.5]	.28
IL-6, pg/mL	12.3 [2-289]	11.3 [2-289]	24.5 [4.3-80]	.13

Bold values are statistical significant

TABLE 3 Factors associated with duration of prolonged PCR positivity of SARS-CoV-2 RNA from symptom onset

	Multivariate analysis		
	OR	95% CI	*P* value
Age (y)	1.022	1.002-1.042	**.035**
Sex (male)	0.783	0.385-1.593	.500
Symptoms duration on admission	1.456	1.306-1.624	**<.001**
Total symptom duration	1.101	0.994-1.220	.065
Consolidation	0.580	0.219-1.532	.271
Albumin - g/L	0.899	0.807-1.003	.056

We found the median duration of first negative PCR test after symptom onset as 9 days (IQR: 7-12), and 14% of patients' tests were positive for SARS-CoV-2 longer than 14 days. Previous studies have reported that PCR positivity usually lasts for up to 3 weeks but can continue for up to 6 weeks.[5,8] Similar to our study, Ling Y.et al reported the median time as 9.5 [6-11] days in 66 patients.[13] Qi et al[6] reported the median duration of viral shedding as 17 days [IQR: 12-21] in 147 patients, longer than our study. However, the study protocol does not seem suitable for giving information about viral shedding as the researchers reported performing the PCR test 1 day after the resolution of symptoms, not before. In our study population, PCR negativity was achieved in the first control PCR test in approximately two-thirds (59%) of patients. The discrepancy between our study and the previous studies that reported longer duration for PCR positivity may result from the methodology of the studies or genetic diversity between the study population.

In test-based strategy, isolation may be discontinued in patients whose fever, cough and dyspnoea disappeared and have a total of two negative respiratory samples for SARS-CoV-2.[14] In the symptom-based strategy, isolation can be discontinued 10 days after symptom onset and 3 days after disappearance of fever or respiratory symptoms.[3,14] There is no strong recommendation for determining isolation periods. The recommendations depend on the studies with limited cases.[12,15] Well-planned studies are needed to determine the isolation period, but with the available literature, isolation can be suggested for until 14 days after the onset of symptoms.[16] Hu et al[4] used test-based strategy for the decision to discharge patients from hospitals, and they have reported that the median duration of negative conversion of PCR test was 14 days (IQR: 10-18). Ai Tang Xiao et al suggested repeated confirmation of RT-PCR test from respiratory specimens for safe discharges and discontinuation of isolation regardless of duration.[8]

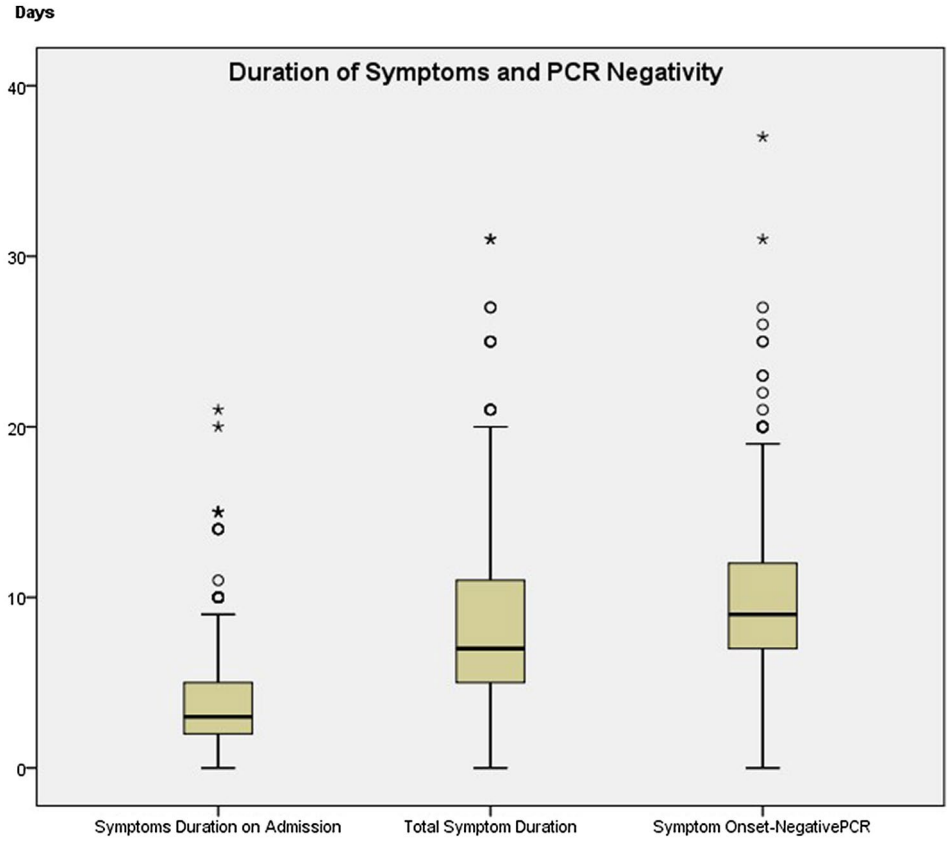

FIGURE 1 Duration of symptoms and PCR negativity for patients with COVID-19

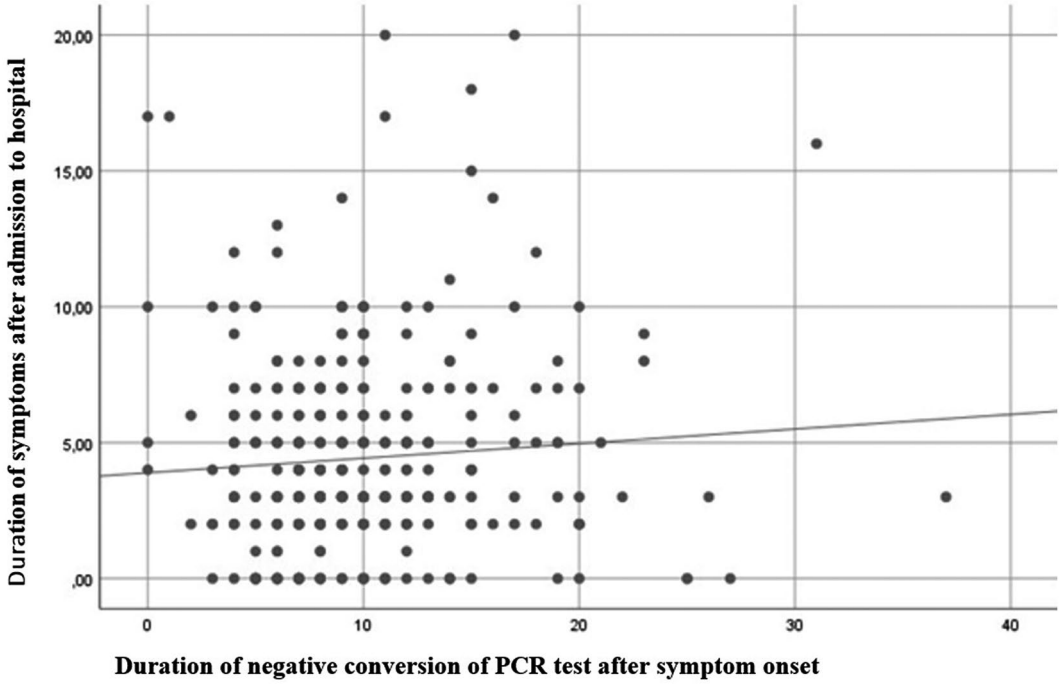

FIGURE 2 Correlation between symptom duration and PCR negativity duration after symptom onset in COVID-19 patients

We found duration of symptoms as an independent factor for prolonged PCR positivity. In addition, there was a modest trend between the duration of symptoms and the duration of becoming PCR negative. The duration of PCR positivity prolonged as the symptom duration increased. PCR test became negative at median 3 days (IQR: 2-5) after resolution of symptoms. The test-based strategy has

some difficulties in clinical practice, and possibly leads to a longer isolation period than recommended. According to our study results, symptoms persisted for 7 days (IQR: 5-11) with PCR testing positive for an additional 3 days (IQR: 2-5) after symptom resolution. As such, the recommendations of the WHO and ECDC regarding discontinuation of isolation seems an optimal approach. Based on the study results, we suggest that symptom-based strategy may be used to decide isolation discontinuation, especially in patients who can isolate themselves until 10-14 days after symptom onset in their homes or outpatients' institutions, or in centres with limited bed or test capacity.

There are limitations in our study. Because of the retrospective characteristic of the study and the presence of a large number of patients admitted to our hospitals, we could not perform PCR testing every other day. If it was possible, the results might be that the time to turn PCR negative could be shorter.

In this study, we investigated the impact of ongoing PCR positivity on patients' outcomes and the time correlation between the resolution of symptoms and becoming PCR negative. Our study supported the previous study results reporting that prolonged PCR positivity had no detrimental effect on patients' results. In addition, we think that our study will provide a contribution to the literature in determining the isolation time. According to our study results, viral shedding has been ending 3 days (IQR: 2-5) after symptom resolution. When testing cannot be performed or the symptom-based strategy is used, it seems to be sufficient to continue isolation for a total of 10-14 days after symptom onset (2-5 days after the symptoms regress).

DISCLOSURES

The authors declare no disclosures.

AUTHOR CONTRIBUTIONS

Concept/design, Data analysis/interpretation and Critical revision of article: Fatma Eser, Bircan Kayaaslan and Rahmet Güner. Statistics: Fatma Eser and Bircan Kayaaslan. Data collection: Fatma Eser, Bircan Kayaaslan, Rahmet Güner, Imran Hasanoğlu, Ayşe Kaya Kalem, Adalet Aypak and Esragül Akıncı.

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REFERENCES

1. Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med*. 2020;382(8):727-733.
2. World Health Organization. Coronavirus disease (COVID-19) Dashboard. https://covid19.who.int/. Accessed June 14, 2020.
3. World Health Organization. Laboratory testing for coronavirus disease (COVID-19) in suspected human cases: interim guidance, 19 March 2020. https://apps.who.int/iris/handle/10665/331501. Accessed June 6, 2020.
4. Hu X, Xing Y, Jia J, et al. Factors associated with negative conversion of viral RNA in patients hospitalized with COVID-19. *Sci Total Environ*. 2020;728:138812.
5. Sethuraman N, Jeremiah SS, Ryo A. Interpreting diagnostic tests for SARS-CoV-2. *JAMA*. 2020;323(22):2249-2251. https://doi.org/10.1001/jama.2020.8259
6. Qi L, Yang Y, Jiang D, et al. Factors associated with duration of viral shedding in adults with COVID-19 outside of Wuhan, China: a retrospective cohort study. *Int J Infect Dis*. 2020;96:531-537. https://doi.org/10.1016/j.ijid.2020.05.045
7. Yang R, Gui X, Xiong Y. Comparison of clinical characteristics of patients with asymptomatic vs symptomatic coronavirus disease 2019 in Wuhan, China. *JAMA Netw Open*. 2020;3(5):e2010182.
8. Xiao AT, Tong YX, Zhang S. Profile of RT-PCR for SARS-CoV-2: a preliminary study from 56 COVID-19 patients. *Clin Infect Dis*. 2020;71(16):2249-2251.
9. United States Centers for Disease Control and Prevention. Discontinuation of isolation for persons with COVID-19 not in healthcare settings. https://www.cdc.gov/coronavirus/2019-ncov/hcp/disposition-in-home-patients.html. Accessed May 05, 2020.
10. World Health Organization. Considerations for quarantine of individuals in the context of containment for coronavirus disease (COVID-19): interim guidance. 19 March 2020. https://apps.who.int/iris/handle/10665/331497. Accessed June 06, 2020.
11. European Centre for Disease Prevention and Control. Guidance for discharge and ending isolation in the context of widespread community transmission of COVID-19, 8 April 2020. https://www.ecdc.europa.eu/en/publications-data/covid-19-guidance-discharge-and-ending-isolation. Accessed June 08, 2020.
12. Wölfel R, Corman VM, Guggemos W, et al. Virological assessment of hospitalized patients with COVID-2019. *Nature*. 2020;581(7809):465-469.
13. Ling Y, Xu SB, Lin YX, et al. Persistence and clearance of viral RNA in 2019 novel coronavirus disease rehabilitation patients. Version 2. *Chin Med J (Engl)*. 2020;133(9):1039-1043.
14. United States Centers for Disease Control and Prevention. Symptom-based strategy to discontinue isolation for persons with COVID-19. https://www.cdc.gov/coronavirus/2019-ncov/community/strategy-discontinue-isolation.html. Accessed May 25, 2020.
15. Young BE, Ong SWX, Kalimuddin S, et al. Epidemiologic features and clinical course of patients infected with SARS-CoV-2 in Singapore. *JAMA*. 2020;323(15):1488-1494.
16. Lombardi A, Bozzi G, Mangioni D, et al. Duration of quarantine in hospitalized patients with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection: a question needing an answer. *J Hosp Infect*. 2020;105(3):404-405.

How to cite this article: Eser F, Kayaaslan B, Güner R, et al. The Effect of prolonged PCR Positivity on patient Outcomes and Determination of Isolation period in COVID-19 patients. *Int J Clin Pract*. 2021;75:e14025. https://doi.org/10.1111/ijcp.14025