Clinical and Experimental Health Sciences

A Multi-center Retrospective Analysis of Healthcare Workers after COVID-19: Epidemiological and Clinical Features

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ABSTRACT

Objective: Concerns regarding the high-level risk of infection among healthcare workers (HCWs) increased after COVID19 was declared as a pandemic in March 2020. Inadequate infection control owing to a shortage of personal protective equipment or an inconvenient usage of infection control measures may play a significant role in transmission to/among healthcare personnel. The study aimed to determine the characteristics and outcomes of COVID-19 patients who are healthcare workers along with possible transmission routes of COVID-19 in four different healthcare facilities in Istanbul.

Methods: All hospital records were reviewed retrospectively. Demographic and clinical characteristics of HCWs were documented, and all infected HCWs were subjected to a phone-based mini-questionnaire and three-dimensional test (TDT). All statistical analyses were done using statistical packages SPSS Demo Ver 22 (SPSS Inc. Chicago, IL, USA).

Results: Clinical features of COVID-19 were similar to the general public's characteristics. The most frequent symptoms were cough, fever, and headache. HCWs with the O blood group tend to have asymptomatic COVID-19 infection. Hospital workers other than medical professionals have a lack of convenience of infection control measures. The median duration of PCR negativity was 9 days. HCWs who had a sore throat at the beginning of COVID-19 have a longer PCR-positive duration.

Conclusion: Understanding the clinical features or characteristics of asymptomatic COVID-19 carriers may aid in the implementation of a feasible screening program for early detection. It is strongly advised that proper infection control precautions, education, and auditing of nonclinical staff be implemented. As a result, transmission among healthcare workers can be avoided.

Keywords: COVID-19, healthcare workers, infection control, asymptomatic, Household contact.

1. INTRODUCTION

After COVID19 was introduced as a pandemic into the World in March 2020, concerns about the high-level risk of infection among healthcare workers increased (1-4). Moreover, personal protective equipment (PPE) was unreachable on some occasions and in some countries. Even while appropriately provided PPE, HCWs might not have enough awareness and proper education to use them. Shortage of both PPE itself and knowledge of using them increases the risk of infection and even death (5-8). According to a Chinese study from the early pandemic period, the majority of virus transmission happened in hospitals (9). Cross-transmission among employees could be a significant route, and asymptomatic carriers, in particular, could play a significant role in this situation (10). As a result, detecting asymptomatic carriers early is critical for infection management in hospital settings. Despite the findings of a Chinese study that concluded that the main infection route for HCWs was the hospital setting (9), Triebel et al. suggested that a screening program of asymptomatic HCWs should be implemented during possible new infection waves, as the HCWs appear to be infected in the general population rather than hospitals (11).

The study aimed to determine the characteristics and outcomes of COVID-19 patients who are healthcare workers along with possible transmission routes of COVID-19 in four different healthcare facilities in Istanbul.

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2. METHODS

The conducted study was approved by the Istanbul Medipol University Ethics Committee (date 18.03.2021/No 364). It obtained data from four different healthcare centers in Istanbul, Turkey. One of the hospitals is a university hospital, while the others are secondary care facilities. During the initial wave of the pandemic, all these healthcare centers accepted COVID-19 patients and provided COVID-19 testing to their own healthcare workers in accordance with Ministry of Health guidelines (12). Though the COVID-19 Scientific Committee modified the guideline when new scientific knowledge became available, during the study period all patients were given hydroxychloroquine, with favipiravir, tocilizumab, convalescent plasma, and anticoagulant therapy added if needed following hospitalization. Nasopharyngeal swabs for COVID-19 rt-PCR test were taken by a healthcare professional and performed in authorized laboratories with the primers provided by the Ministry of Health. If necessary, thorax computerized tomography was used in the diagnostic process and was reported by the radiologists according to the Ministry of Health guideline (13).

All hospital records provided by occupational health, safety boards, and infection control committees were reviewed retrospectively. Demographic and clinical characteristics of HCWs were documented and all the infected HCWs were subjected to a phone-based mini-questionnaire.

A questionnaire containing 4 questions (Cronbach's alpha= 0.41) was applied to evaluate knowledge and compliance of infection control measures. All data were recorded in the study have been collected by using online Microsoft Forms®. All collected data were analyzed with SPSS 22® (IBM, USA) software for statistical analysis. Chi-square or Fisher's exact tests were used to compare proportions and Student's t-test and Wilcoxon Sum rank test to compare means of parametric data. For variables that were not normally distributed, the Mann-Whitney U test was used. A two-sided α-value of less than 0.05 was considered statistically significant. All data was given in (mean ± SD) if appropriate. Median, interquartile range, min/max, and percentiles were also used.

Definitions

1. Asymptomatic infection: A patient with positive SARS CoV-2 test result and declared no symptoms and/or without any findings in chest imaging.

2. Non-clinical staff: Hospital workers who don't have any degree in medical sciences/professions.

3. RESULTS

The study included a total of 161 participants from different age groups, education levels, comorbidity frequencies, and blood types. Demographic and workplace/duty characteristics are given in Table 1.

Ninety participants (56%) out of 161 HCWs recruited to the study have A Rh-positive blood type while the rest of participants have blood groups of 0 Rh-positive (33,19%), B Rh-positive (23,14%), A Rh-negative (5, 3.1%), 0 Rh-negative (5,3.1%), AB Rh-positive (4, 2.5%) and AB Rh-negative (1, 0.6%).

Table 1: *Demographic and workplace/duty characteristics of the study population*

	All	Nurse	Doctor	Technician	Non-clinical staff
Age Median (IQR) [min-max]	27 (24-35) [20-60]	25(23-27) [20-43]	38(27-45) [26-60]	29(24-32) [22-49]	28(24-34) [20-56]
Male gender	66 (41)	13 (20)	18 (27.3)	6 (9.1)	29 (48.3)
Workplace					
Emergency room	5 (3.1)	5 (100)	0	0	0
Surgical Units	20 (12.4)	6 (30)	10 (50)	1 (5)	3 (15)
Internal Medicine Units	71 (44.1)	36 (51)	15 (21)	6 (8)	14 (20)
Laboratory	9 (5.6)	0	2(22)	6 (67)	1 (11)
Management	17 (10.6)	0	0	0	17 (100)
Mobile within hospital	25 (15.5)	0	0	3 (12)	22 (88)
Intensive Care Unit	14 (8.7)	10 (72)	1 (7)	0	3 (21)
Total N (%)	161 (100)	57 (35.4)	28 (17.4)	16 (9.9)	60 (37.3)

In a bivariate analysis, those with the A blood group had a higher probability of COVID-19 symptomatic infection (88, 92 %, *p*=0.04). Asymptomatic infection rates were observed to be considerably higher among people with the O blood group (30%, *p*=.002) and those who worked in a surgical unit (30%, p=0.04). Having O blood type is substantially connected to an asymptomatic course of infection (*p*=.001) in the multivariate logistic regression study (Hoshmer-Lemeshov *p*=0.66) that includes age, gender, O blood type, workplace, and duty. Working in a surgical unit is not linked to asymptomatic infection in this model (0.11). Furthermore, neither bivariate nor multivariate analysis found age, sex, or duty to be associated with asymptomatic infection in our study sample.

The rate of hospitalization was 13.5 % (N=22). No one was admitted to the intensive care unit and no deaths were observed during the research period. The most common symptoms were cough (69%), fever (59%), headache (57%), sore throat (39%), loss of taste (37%) and smell (39%), and sputum (13%). 71% of females reported a sore throat, which was significantly greater than males (28%) (*p*=0.01). Ninety percent of participants do not have a co-morbidity (N=146), and there was no relation between comorbidity and hospitalization in our study.

On 118 HCWs, a computerized thorax tomography (CT) was done, with the results falling into four categories: a) negative for pneumonia (N=27, 23%), b) typical for COVID-19 (N=42, 36.2%), c) indeterminate findings (N=7, 6%), and d) atypical appearance (N=40, 34.5%). There was no link between the

CT finding and the need for hospitalization. Five patients were followed up without medication. Hydroxychloroquine was prescribed to 134 patients without hospitalization as monotherapy (N=43, 32%) or combined with azithromycin (N=91, 68%). Hydroxychloroquine was given to all 22 hospitalized patients, azithromycin was combined in 20 of them (91%) and in the case of clinical deterioration, tocilizumab (11, 50%) was used as the subsequent therapy. No HCWs included in this study were deceased because of COVID-19.

During the study period, fifty-two participants declared that they were living alone and 103 HCWs reported living with one or more households (3.2 ± 1.2). Living with a household was found a risk factor for cross-transmission to get the virus from house-contact (OR:1.2; CI: 1.09-1.29) or spread it to them (OR:1.3, CI:1.16-1.43). After this risk was evaluated by duty in hospitals, getting the virus from household contact risk was higher in the non-clinical staff (OR: 1.27, CI:1.09-1.48), and spreading to others in a house risk was higher in doctors (OR:1.4, CI: 1,.005 – 1.850). There is no difference in the risk of transmission to household members between those who are asymptomatic and those who are symptomatic (p=0.6). Due to the limited number of subgroups, we were unable to investigate the association between the number of household members and transmission risk. SARS CoV-2 PCR test has been performed in all cases. Twenty-two HCWs have had no symptoms despite their PCR test results being positive. In symptomatic participants duration between symptom and PCR test median: 0 days (IQR:0-2) (min: – 2 – max: 14). The time between the first positive PCR result and the first negative result: 9 days (IQR: 7-13) (min: 1 max: 28). Figure 1 explains the time of the negative results more clearly.

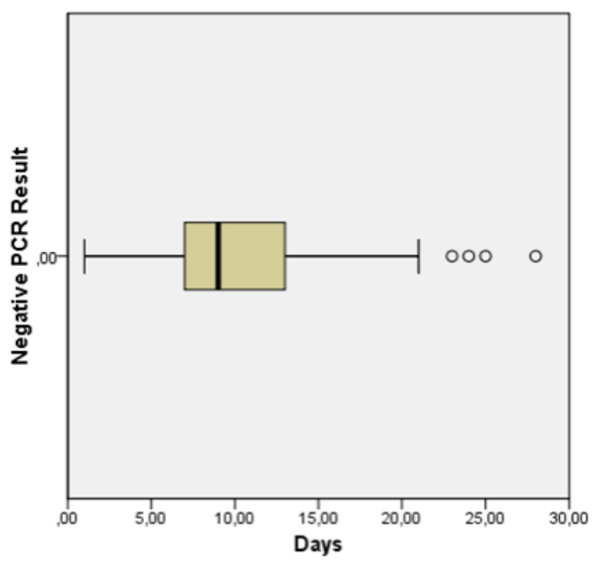

Figure 1. *Positive PCR result and the first negative result.*

There is no significant relationship between negative result duration and sex, age, blood type, smell loss, and taste loss symptoms. Patients with sore throat had a substantially longer (12 ± 4 days) interval for a negative SARS CoV-2 PCR result than those who do not (10±4 days) (***p =.005***). Negative PCR duration took a maximum of 15 days (median: 8, IQR: 7-12) in asymptomatic patients. The following is the questioner's response: (**Q1**) "How might you have gotten the virus?" a multiple-choice question was answered as "*not sure* (*Q1A1*)" by 46% of participants. Other answers were "*might be a family member contact* (*Q1A2*)" (9%), "*might be a co-worker with positive PCR test result contact* (*Q1A3*)" (28%), "*might be a patient with a positive test result contact (Q1A4*)" (17%). Participants, living alone, responded as *Q1A1* higher than ones with household (62% vs 37%, p= .006). HCWs sharing a house someone answered the same question "*Q1A2*" higher than the living alone group (13% vs. 2%, p= .04). There was no difference between living alone and A3, A4. There is a significant association between asymptomatic HCWs and "*Q1A3"* (might get the virus from a co-worker) (p= .05)

(Q2) "Did you have easy access to PPE while working? (*YesQ2=152/NoQ2=9*)" The answers of Q2 didn't show any disparity by occupation type. There is a higher rate of A3 (might got the virus from a co-worker) for Q1 in the HCWs responded in NoQ2 (N=6, 67%, p=001).

(Q3) "Did you know about the isolation precautions before you had COVID-19? (*YesQ3=151/NoQ3=9*)" Nine responded as no and all of them non-clinical staff (15%)(p<0,001) and 5 of them were mobile inside the hospital group (p= .005). The HCWs who were answered Q1 as "might be a family member contact" dominantly responded in the NoQ3 group (N=4, 44%, p=.004).

(Q4) "Were you compliant with the isolation precautions policy of your hospital? (*YesQ4=128/NoQ4=33*"). A vast major of the NoQ4 group (N=22, 67%) answered A3 (transmission might be from a co-worker) and it is higher than the *YesQ4* group (N=18, 19%) (p<0,001). In the *YesQ4* group, the rate of *Q1A2* (transmission might be from a patient) (26, 20%) is significantly higher than the *NoQ4 group (1, 3%) (p = .001).* Analysis of Q4 by workplace and duty, mobile inside hospital group (N=10, 30.3%, p= .01), and non-clinical staff (N=18, 55%, p= .02) responded *NoQ4* answer significantly higher than other groups. There is no significant difference between Q4 and clinical staff (nurse, doctor, technician) in bivariate analysis.

4. DISCUSSION

The spectrum of clinical findings in COVID-19 is wide. A systematic review suggested that up to 33 % of patients may be asymptomatic while having COVID-19 (14). 14% of HCWs were asymptomatic in our cohort. Clinical findings in symptomatic HCWs are similar to the literature (15). Asymptomatic infection in COVID-19 is a concerning problem for transmitting the virus to others in both community and healthcare settings (10, 16) yet we cannot find any association of asymptomatic HCWs with SARS CoV-2 PCR and risk of transmission to/from household members while

significant relationship occurs between asymptomatic ones might get the virus from a co-worker. In our study, participants have a good knowledge and are compliant with isolation precautions tightly while working. We may conclude isolation precautions practice may be loosened during break times and transmission within asymptomatic co-workers may be easier than on duty. There are several articles which are suggesting the probable effects of the blood group on the COVID-19 clinical course (17, 18). Wu et al found that patient with O blood type is related to an asymptomatic infection course, having an A blood group is related to a higher rate of symptomatic one. A study from Turkey aimed to evaluate the effect of blood groups on either transmission risk or clinical course, concluded O blood type is related lower rate of having SARS CoV-2 and there is no relationship between blood type and clinical outcome (19). It is relevant to our finding which is a lower rate of O blood group in SARS CoV-2 PCR, yet we found that HCWs with O blood type have a higher rate of asymptomatic course of COVID-19. Our study focuses on the transmission to HCWs as a high-risk group; thus we will not discuss the clinical outcome and blood group relation, anymore in this paper. In our viewpoint, early prediction of asymptomatic HCWs would be useful to interrupt cross-transmission in a healthcare facility. Our finding supports Triebel et al suggestion that implementing a screening program in a healthcare facility (11) would be beneficial. Rivett et al strongly suggested the implementation of a screening program in healthcare settings particularly after the lockdown was lifted (20). Further studies are required to understand the characteristics of asymptomatic COVID-19 patients leads to implementing a more feasible solution for such a screening program.

Lei et al found that household contact was 10 times higher than other contacts in the community setting (21). A systematic review revealed that household transmission is very important for community spread and has a high secondary attack rate (22). In our study, we found that living with household members is a risk factor for transmission in HCWs although has a lower rate than community-setting. We found that household transmission is particularly high in the non-clinical staff. Moreover, our questionnaire revealed that non-clinical staff has lower knowledge and compliance with isolation measures. It might make household transmission easier in this group. Hospitals should assure non-clinical staff have proper isolation precaution education and audit the compliance frequently.

In our research, we found that the median time from PCR positivity to PCR negativity was 9 days (IQR: 7-13), with HCWs who had a sore throat at the start of COVID-19 having a longer PCR positive period. According to other studies, the median duration of PCR negative for HCWs in Spain, Madrid, is 15 days (IQR: 12–19.5) (23). Another study found that the median duration of PCR negative for HCWs in Japan, Tokyo is 19 days (IQR 6-37) (24). This variance in time to PCR negative between studies may be attributed to changes in the study population, age, gender distribution, and which COVID variant is prevalent at the time of the studies. CDC recommends the implementation of a containment period based on clinical recovery – not PCR test – as a maximum of ten days. To date, the literature suggests prolonged viral shedding after recovery is not significant for the transmission of COVID-19 except for immunocompromised patients (25, 26). We found prolonged viral shedding for up to 15 days (median:8; IQR:7-12). HCWs with sore throat complaints seem to have prolonged viral shedding. Further studies are required to assess its importance in the healthcare setting.

5. CONCLUSION

Comprehending characteristics of asymptomatic infections as blood type may be useful to implement a feasible screening program. Education and audit of the non-clinical staff should be implemented to avoid transmission within both household and hospital settings.

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