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Clinical characteristics of post-vaccination COVID-19 infection in health care workers exposed to Delta and Omicron variants in a COVID-19 dedicated facility from Qatar

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ABSTRACT

Background: Evidence suggests that vaccines efficacy lies on the prevention of severe symptomatic disease. We aim to describe the clinical characteristics of COVID-19 infection among healthcare professionals (HCPs) after vaccination, during periods of transmission of SARS CoV-2 variants in a COVID-19 dedicated facility. **Methods:** A retrospective observational study of HCPs confirmed with COVID-19 during the period March 2021 to Jan 2022 was conducted. Delta period (March-August 2021), and Omicron period (Dec 2021- Jan 2022) were defined. Clinical, laboratory, radiology and vaccination history was collected from electronic medical records. **Results:** COVID-19 infection was reported in 16 and 138 HCPs during the Delta and Omicron period respectively. By category the nurses predominate, and a significant contribution of the healthcare related transmission against the community-related one. Higher frequency of loss of taste (37.5% vs 4.3%), and loss of smell (43.8% vs 3.6%) was observed during Delta period. Myalgia (12.5% vs 37.7%), and sore throat (6.3% vs 55.8%) predominated in Omicron period. Bilateral ground-glass appearance of the lung was observed in 28.6% and 7.1% in the Delta and Omicron period, respectively. Higher cycle threshold values of the polymerase chain reaction test during Omicron period, in comparison with Delta period, was observed (22.98 vs 25.98). Time from previous vaccine dose to positive laboratory test was longer during the Delta period (131 vs 98.26 days). **Conclusion:** SARS CoV-2 viral variants infections in HCPs were associated to selected clinical and epidemiological characteristics, with less severe disease for Omicron variant, and potential shorter duration of the immune response to vaccination.

Introduction

The vaccination against SARS CoV-2 constitutes an outstanding resource to control the current pandemic, and various vaccines are in use and the pipeline [1]. In general, the evidence suggests that vaccines efficacy lies on the

prevention of severe symptomatic disease, but there is limited evidence about the durability of the immune protection [2,3]. In addition, it has been described that after natural infection the immunity remains at least for 6 months [4]. Studies conducted in Qatar, mainly population based, has shown high

protection provided by mRNA vaccines for Delta and Alpha SARS CoV variants against infection, severe disease and hospitalization, while the protection for Omicron variants was lower. Also, for all SARS CoV-2 variants of concern was observed strong protection against COVID-19 related hospitalization and death [5-9].

Worldwide the healthcare workers (HCPs) were prioritized for vaccination because of the high risk of infection and the well-known impact on the health workforce. The healthcare workers have been severely impacted during COVID-19 mainly due to the high infection risk due to close contact with patients and its adverse consequences [9]. 10.6% of healthcare workers from the main healthcare provider in Qatar (Hamad Medical Corporation) acquired COVID-19 infection [10].

Vaccination has become a highly effective measure for minimizing the adverse consequences of the disease. In Qatar, the vaccination program started in December 2020 mainly with BNT162b2 (Pfizer/BioNTech), and mRNA-1273 (Moderna). In the context of this study, it is relevant to note that some of the staff recently hired to work in the facility of interest had received the Abdalla protein subunit vaccine (BioCubaPharma, Cuba) [11].

Nevertheless, post-vaccination SARS CoV-2 infections were observed and likely related to multiple factors including the variable vaccine efficacy and the emergence of new viral variants [12-16].

Published data about the characteristics of COVID-19 after vaccination in health workers in Qatar are limited. The study aims at describing the clinical characteristics of COVID-19 in healthcare professionals after vaccination during periods of predominant transmission of Delta and Omicron variants in a COVID-19 dedicated facility in Qatar.

Methods

A retrospective observational study of HCPs (nurses, physicians, and technologists) with COVID-19 during the period 1/3/2021 to 26/01/2022 at The Cuban Hospital (Dukham, Qatar) was conducted. The staff provide care to COVID-19 in the in-patient units and in emergency department, receiving transfer of confirmed cases from other facilities in Qatar (primary care, secondary care, private facilities, others). Also, the staff accommodation located close to the hospital, is mainly as share accommodation for nurses and technologist.

The Delta variant (B.1.617.2) predominant circulation was considered from March to August 2021, and the Omicron (B.1.1.529) period from December 2021 to January 2022.

All staff confirmed with COVID-19 (as determined by the PCR or rapid antigen test (RAT) on nasopharyngeal / oropharyngeal swabs), and documented evidence for having received a vaccine before the disease confirmation was included in the study. During the pandemic bimonthly screening test (PCR or RAT) was performed on staff.

A review of electronic medical record was conducted by the research team. Demographics, vaccination history, clinical, laboratory data (C Reactive Protein (CRP), White blood count (WBC), absolute lymphocyte count, platelet count, neutrophils count, albumin, lactate dehydrogenase (LDH), creatinine, D-dimer, glycaemia, Aspartate Aminotransferase (AST), Alanine aminotransferase (ALT), PCR or RAT for COVID-19) and radiological findings were extracted. Professional category was extracted from infection control records.

Ethical

The study was approved by The Medical Research Center (Hamad Medical Corporation, Doha, Qatar) (MRC-01-22-074).

Analysis

We used the χ^2 test, or student t test to compare differences between the groups of post-vaccinated staff during Delta and Omicron periods. A two-sided α of less than 0.05 was considered statistically significant. All statistical analyses were done using statistical package SPSS, version 22.

Results

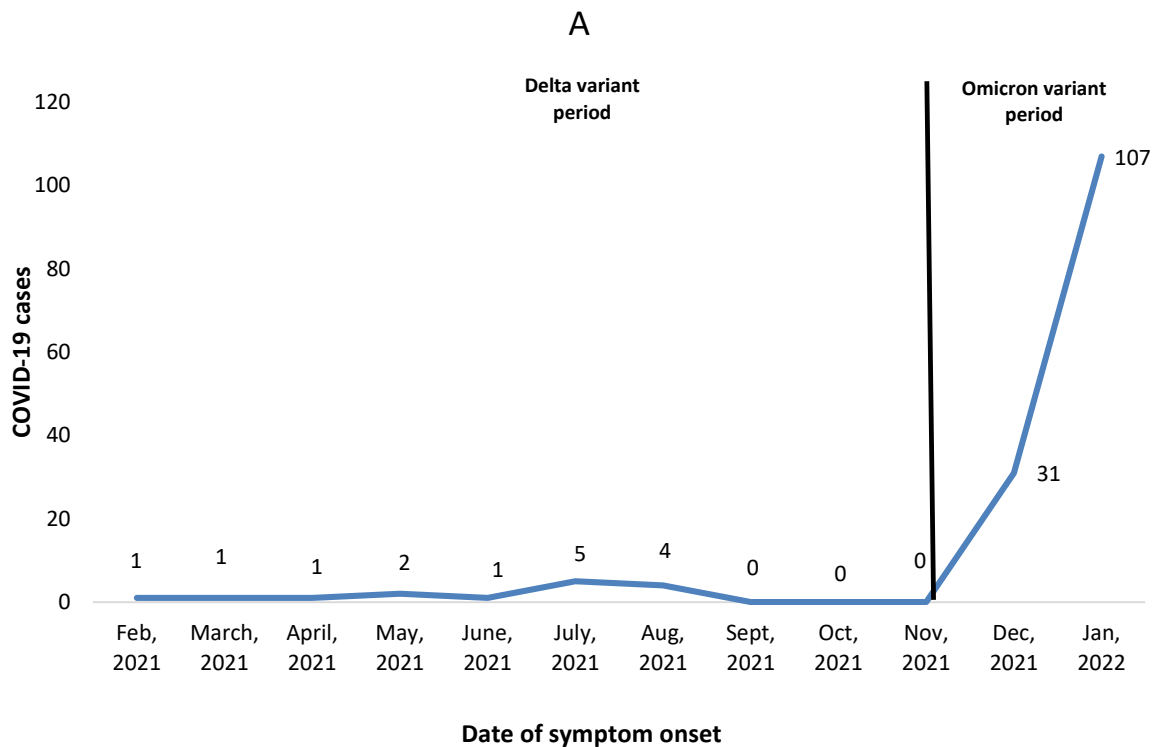
During the Delta variant period, 16 staff with COVID-19 were reported after vaccination with a sporadic distribution, while 138 cases were reported during the Omicron variant period with an outbreak-like distribution (**Figure 1**). They represented 1.7% (16/959) and 25.1% (138/550) of staff working during each period.

Nurses were the most frequently affected staff by category in both periods (81.3% in Delta variant and 60.9% in Omicron variant periods). Also, in Omicron period dental staff and technologists were reported. A significant contribution of the healthcare-related transmission against the community-related one was observed ($p = 0.022$) (**Table 1**).

The frequency of symptoms was similar during Delta and Omicron variants periods except for the loss of taste, loss of smell, myalgia, and sore throat. Loss of taste (37.5% Delta, 4.3% Omicron) and loss of smell (43.8% Delta, 3.6% Omicron) were more frequent in Delta period ($p = 0.00$). Myalgia (37.7% Omicron, 12.5% Delta) ($p = 0.04$) and sore throat (55.8% Omicron, 6.3% Delta) ($p = 0.00$) were more frequent in Omicron period. Similarly, no differences were observed for Laboratory parameters except a higher D dimer during the Delta period ($p = 0.01$). Bilateral ground-glass appearance in chest X-ray was observed in 28.6% of staff during Delta period and 7.1% in the Omicron period ($p = 0.01$), and 64.3%, and 70.5% of chest X ray studies did not show findings ($p = 0.63$) (Table 2).

All cases during Delta variant and 79.3% of the Omicron variants cases were confirmed by PCR test from nasopharyngeal swabs, and by RAT were confirmed 21.3% of cases during Omicron variant. The mean cycle threshold (CT) value during the Omicron period was higher in comparison to the Delta period (22.98 vs 25.98). The comparison of CT value among the vaccines is limited because of the sample size. Also, the Pfizer-BioNTech COVID-19 vaccine was the most frequently used with 8 staff receiving Moderna vaccine and Abdala vaccine (CIGB-66, BioCuba Pharm, Cuba). The 100% of COVID-19 cases received the primary vaccination, while during the Omicron period, 85.5% of the staff had been received boosters. The time from previous vaccine dose to positive test (PCR or RAT) was longer during the Delta period (131 vs 98.26 days) ($p = 0.02$) (Table 3).

Figure 1. COVID-19 cases during the Delta variant (Feb-Nov, 2021) and Omicron variant (Dec, 2021-Jan, 2022) circulation period according to symptoms onset (A) and daily cases during Omicron circulation period (B) in medical staff in COVID-19 dedicated facility



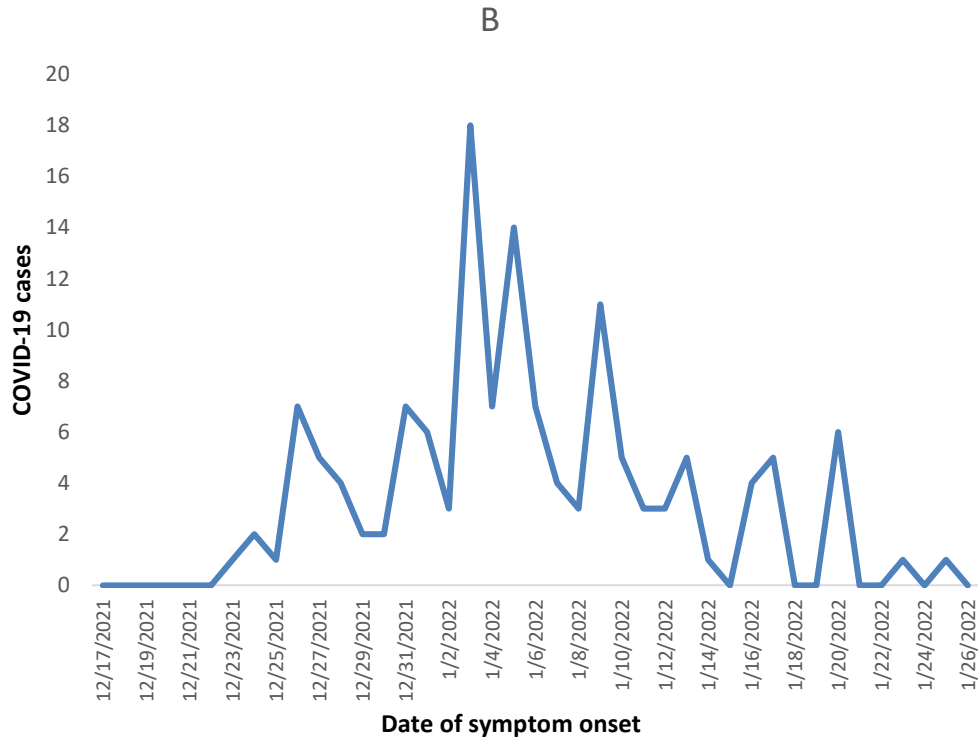


Table 1. Demographics, category and comorbidities of COVID-19 cases during Delta and Omicron variant circulation period in healthcare professionals.

Variables	SARS-CoV-2 Variant circulation period	
	Delta. n = 16	Omicron. n = 138
Age (mean± standard deviation) (years)	44.5 (9.4)	45.8 (6.0)
Sex		
Female	14 (87.5)	94 (68.1)
Male	2 (12.5)	44 (31.9)
Category		
Nurse	13 (81.3)	84 (60.9)
Dental	-	6 (4.3)
Physician	3 (18.8)	25 (18.1)
Technologist	-	23 (16.7)
Comorbidities		
High Blood pressure	5 (31.3)	58 (42.0)
Asthma	1 (6.3)	11 (8.0)
Diabetes mellitus	2 (12.5)	9 (6.5)
Source of infection		
Community	9 (56.3)	39 (28.3)
Hospital acquired	7 (43.8)	99 (71.7)*

Data presented as No. (%) unless specified, * $p=.022$

Table 2. Symptoms, lab and radiological findings of COVID-19 cases during Delta and Omicron circulation period among healthcare professionals.

Variables	SARS CoV-2 variant circulation period	
	Delta. n = 16	Omicron. n = 138
Symptoms		
Loss of taste	6 (37.5)	6 (4.3)*
Fever	3 (18.8)	37 (26.8)
Shortness of breath	2 (12.5)	10 (7.2)
Fatigue	6 (37.5)	44 (31.9)
Myalgia	2 (12.5)	52 (37.7)**
Diarrhea	1 (6.3)	11 (8.0)
Runny nose	8 (50.0)	81 (58.7)
Loss of smell	7 (43.8)	5 (3.6)*
Cough	11 (67.75)	87 (63.0)
Sore throat	1 (6.3)	77 (55.8)*
Headache	8 (50.0)	62 (44.9)
Abdominal pain	-	6 (4.3)
Nausea, vomiting	-	10 (7.2)
Lab test (mean± standard deviation)		
White Blood count	6.45 (1.95)	6.76 (1.69)
Neutrophils	3.85 (2.05)	4.35 (1.69)
Lymphocytes	1.67 (0.47)	1.43 (1.47)
Platelet	270.35 (65.33)	257.14 (60.42)
D dimer	0.84 (1.21)	0.39 (0.24)***
Creatinine	62.14 (14.20)	66.55 (17.59)
ALT	29.57 (44.46)	28.01 (8.46)
AST	22.28 (19.63)	21.81 (8.46)
LDH	175.28 (42.2)	183.54 (32.87)
CRP	11.14 (13.21)	16.32 (11.64)
Ferritin	100.28 (85.90)	114.70 (92.94)
Chest X Ray findings		
Ground glass appearance	4 (28.6)	8 (7.1)*
Interstitial patterns, reticular alveolar infiltrate	1 (7.1)	20 (17.9)
Pneumonia	-	5 (4.5)

Data presented as No. (%) unless specified * $p = 0.00$, ** $p = 0.046$, *** $p = 0.011$

Table 3. COVID-19 diagnosis and vaccination history in cases during Delta and Omicron circulation period in healthcare professionals.

Variables	SARS CoV-2 Variant circulation period	
	Delta. n = 16	Omicron. n = 138
COVID- 19 diagnosis method		
PCR	16 (100)	110 (79.7)
Rapid antigen test	-	28 (21.3)
CT value (mean± standard deviation)	25.98 (5.54)	22.98 (5.45)*
Vaccine received		
Pfizer	14 (87.5)	132 (95.6)
Moderna	2 (12.5)	4 (2.9)
Abdala	-	2 (1.45)
Vaccination scheduled		
Primary vaccination	16 (100)	138 (100)
Booster	-	118 (85.5)
Time from previous vaccine to positive test was in days (mean± standard deviation)	131.43 (54.8)	98.26 (53.27)**

Data presented as No. (%) unless specified, * $p = 0.042$ ** $p = 0.02$.

Discussion

Selected clinical elements pointed towards the viral variants' behavior in COVID-19 after vaccination in medical staff and provide support about its infectiousness, transmissibility, and duration of protective immunity.

The transmission of the Omicron variants is higher than the previous variants according to various reports, highlighting the risk of transmission in the community settings [17-19]. In the report, most of the staff affected by Omicron was identified as healthcare-associated, which is explained by selected issues including being in close and longer exposure with patients in a facility dedicated to exclusive COVID-19 care. The highly transmissible pattern of this variant overcomes the personal protective equipment (PPEs) practices of staff with skills and long experience in COVID-19 care (from April 2020). The community transmission in Delta and Omicron periods was mainly associated with contact among staff members in their accommodation.

Few clinical characteristics guide us about virus variants associated to COVID-19 infection. The predominance of neurotropic symptoms (loss of smell, loss of taste) has been reported more frequently in infection by Delta variant, while sore throat and myalgia was more frequent in Omicron variants. The findings suggestive of the severity of the disease severity related to the Delta variant in various reports, and confirmed in the study, were the higher D dimer and the ground-glass appearance of the lung [17, 20-23]. Our study did not explore differences in clinical laboratory parameters among staff received booster doses in comparison with those do not received.

Despite the research did not consider the symptoms duration as study variable, the empiric observations suggest longer duration and severity of symptoms in Delta variant infections. While all staff during Delta period should require hospital admission because of the clinical picture, and the need for antivirals or antibiotics, no staff were admitted during the Omicron variants period.

The staffs included in the study had a high uptake for the primary vaccination, and the recommended booster of COVID-19 vaccines. According to published data the lower CT values are related to the infectiousness and transmissibility, and the lower time from the previous vaccine dose received provides evidence of a shorter duration of

immune protection for COVID-19 Omicron variants. In a population-based study conducted in Qatar higher CT value was observed in breakthrough infections in unvaccinated individuals, with higher figures for mRNA-1273-vaccine (mean CT 30.2) in comparison with BNT162b2-vaccine (mean CT 24.9). This comparison was limited in our study because of the sample size and most of the staff received the BNT162b2-vaccine with a similar CT value (mean 23.4) to the one reported by **Abu-Raddad et al.** in a general population [5].

The COVID-19 vaccines efficacy has been questioned because of likely infections after vaccination and the limited duration of the immune protection. Benefits should have been measured, not only, in terms of immune protection, or as its impact in the severity and mortality of the disease in post-vaccinated cases, but the use of healthcare system resources (medication use, admissions, emergency services), among others, as well [24-26].

COVID-19 has been a challenge for professionals regardless of category and position in the healthcare system. For clinicians, should be considered the complex and changing clinical picture, including: 1) from mild to severe disease, 2) the spectrum of critical complications (respiratory, cardiovascular, others), 3) limited armamentarium for cases management, including drugs for disease treatment and infection prevention, and 4) the need for constructing the knowledge while the disease progresses.

Our study has several limitations. The study describes findings from a single center which interferes with the data comparison. Also, includes cases reported during the initial two months of the Omicron period, providing a partial picture about the incidence and clinical findings. Nevertheless, during the study period were reported most of potential Omicron case and the incidence was very low after that.

Finally, knowledge, skill, and practices acquired become a positive input to face future pandemics.

Conclusion

SARS CoV-2 viral variants infection in healthcare professional were associated to changes in clinical and epidemiological characteristics, with less severe disease for Omicron variant and potential shorter duration of the immune response to vaccination. Clinicians should be prepared to face

emerging diseases with changing pattern to minimize its impact in population health.

Conflict of interest

None.

Financial disclosures

None.

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