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Correspondence

Emergence of COVID-19 variants among ChAdOx1 nCoV-19 (recombinant) vaccine recipients

Sir,

The global spread of SARS-CoV-2 mutant strain B.1.617.2 (Delta variant) was considered responsible for the massive second wave of COVID-19 in India and the third wave in the United Kingdom[1-4]. We studied the presence of this variant and other SARS-CoV-2 lineages in the vaccinated healthcare workers (HCWs) in our hospital who presented with symptomatic infections.

The nasopharyngeal samples of symptomatic HCWs who tested positive for SARS-CoV-2 at the Indraprastha Apollo Hospitals, New Delhi, between March 27 and May 31, 2021, were sent for genomic sequencing to the National Centre for Disease Control, Delhi. All these participants had ChAdOx1 nCoV-19 vaccine (recombinant). These participants were divided into two groups: group A: infections in the early course of the second COVID wave in India (March 27 to April 24, 2021) and group B: infections during the peak and later part of this wave (April 25 to May 31, 2021). The genome sequencing involved, RNA isolation followed by sequencing on the platform of NextSeq 550™ (Illumina, USA). The data generated were processed for lineage detection. The readings were aligned to a SARS-CoV-2 reference genome (NC_045512).

A total number of 3383 HCWs (1778 females, 1595 males) were vaccinated during the study period, of whom 168 (4.96%) acquired the symptomatic post-vaccination infection (PVI), and we studied 158 (94.04%) of these samples by genome sequencing and divided them into two groups: group A (n=69) and group B (n=89) (Table I). There were 108 females and 50 males. The rate of infection in females was 6.04 per cent (108 infections out of 1788 vaccinated females) and in the males was 3.13 per cent (50 infections out of 1595 vaccinated males). The higher percentage of infection in the females could be due to the fact that the majority of the HCWs were female nurses. Although, in numbers, the female HCWs were 1.12 times more, the infections were 1.93 times higher in them compared to males.

The Delta variant of concern (VOC) (lineage B.1.617.2) was present in 45.1 per cent of samples in group A and rose to 77.6 per cent in group B. However, Alpha VOC (lineage B.1.1.7) was found in 11.8 per cent in group A and 2.6 per cent in group B. The other less commonly found lineages were B.1, B.1.1, B.1.393, B.1.617.1 and B.1.596 (Table II).

There were 31 partially vaccinated (PV) and 127 fully vaccinated (FV, 80.3%) HCWs. Since the majority of HCWs were FV, the occurrence of PVI was seen correspondingly more in these cases (73.9% in group A and 85.4% in group B). None of the HCWs in group A required admission to the intensive care unit (ICU) and there was no mortality. In group B, only two cases required hospital admission for a short duration (Table I).

SARS-CoV-2 variants have been classified into three main groups (based on their severity): (*i*) variant of high consequence, (*ii*) VOC, and (*iii*) variant of interest[5]. The WHO has renamed these variants to simplify their names and to remove the stigma attached with these. These variants have now been named as per the Greek alphabets rather than from the country of their first discovery[6]. The Delta variant is the most infectious amongst all these. It is highly transmissible, causes severe disease and bypasses the host immunity[5,7,8]. Sufficient evidence is available on the changes in the antigenicity of amino acid and spike protein in SARS-CoV-2[7]. These changes affect the antibody neutralization capabilities.

Table I. Demographic and other details of the study

Demographic details	Group A (March 27 to April 24, 2021), n (%)	Group B (April 25 to May 31, 2021), n (%)	Total, n (%)
Total healthcare workers	69	89	158
FV	51 (73.91)	76 (85.39)	127 (80.38)
PV	18 (26.08)	13 (14.61)	31 (19.62)
Sex			
Female	47 (68.11)	61 (68.54)	108 (68.35)
Male	22 (31.88)	28 (31.46)	50 (31.65)
Staff category			
Nursing	32 (46.38)	41 (46.07)	73 (46.20)
Medical	22 (31.88)	25 (28.09)	47 (29.75)
Paramedical and supporting	3 (4.35)	12 (13.48)	15 (9.49)
Administrative	12 (17.39)	11 (12.36)	23 (14.56)
Admission in ward	Nil	2 (2.25)	2 (1.26)

PV, partially vaccinated; FV, fully vaccinated

Table II. Details of the SARS-CoV- 2 lineages in vaccinated healthcare workers

	Group-A (n=69)			Group-B (n=89)		
	Infection in			Infection in		
Time to PVI	<2 wk, n (%)	≥2 wk, n (%)	Total Infections, n (%)	<2 wk, n (%)	≥2 wk, n (%)	Total infection, n (%)
FV	(n=51)			(n=76)		
B.1	2 (3.9)	13 (25.5)	15 (29.4)	Nil	9 (11.8)	9 (11.8)
B.1.1	1 (2.0)	2 (3.9)	3 (5.9)	Nil	2 (2.6)	2 (2.6)
B.1.1.7	Nil	6 (11.8)	6 (11.8)	Nil	2 (2.6)	2 (2.6)
B.1.393	Nil	1 (2.0)	1 (2.0)	Nil	2 (2.6)	2 (2.6)
B.1.617.1	Nil	Nil	Nil	Nil	1 (1.3)	1 (1.3)
B.1.617.2	3 (5.9)	20 (39.2)	23 (45.1)	4 (5.3)	55 (72.4)	59 (77.6)
B.1.596	Nil	1 (2.0)	1 (2.0)	Nil	Nil	Nil
No content	Nil	2 (3.9)	2 (3.9)	Nil	1 (1.3)	1 (1.3)
PV	(n=18)			(n=13)		
B.1	1 (5.5)	3 (16.7)	4 (22.2)	1 (7.7)	1 (7.7)	2 (15.4)
B.1.1	Nil	1 (5.5)	1 (5.5)	Nil	Nil	Nil
B.1.1.7	1 (5.5)	1 (5.5)	2 (11.1)	Nil	Nil	Nil
B.1.393	1 (5.5)	Nil	1 (5.5)	Nil	2 (15.48)	2 (15.4)
B.1.617.2	2 (11.1)	8 (44.4)	10 (55.5)	4 (30.8)	5 (38.5)	9 (69.2)

PVI, post-vaccination infection; PV, partially vaccinated; FV, fully vaccinated

A better understanding of the consequences of the spike mutations for antigenicity will encompass both T cell-mediated immunity and non-spike epitopes recognized by antibodies[7]. The severe disease presents with serious symptoms, such as difficulty or shortness of breath, chest pain or pressure and loss of speech or movement[9].

Delta variant is now rampant in the UK and accounts for more than 90 per cent of all the variants[1-3]. The incidence of Delta VOC in Delhi-NCR in the general public at the similar time of our study period was around 60 per cent[8,10]. Dhar *et a1*[10] found that the Alpha variant gradually rose from January until March 2021, whereas Delta variant

increased from February (<5%) onwards and took over Alpha variant in April (60%). In the sub-lineage B.1.617.2 the escape mutation E484Q is lost, and the new mutation is gained. This is the reason for its maximum rise from less than 10 to 80 per cent. The increase of B.1.617, more specifically B.1.617.2, was paralleled by a significant increase in positivity rate[10].

A nationwide study done by the Indian Council of Medical Research, during the peak of second wave of COVID-19 in India, studied 677 samples (throat/nasal swabs) from the FV and PV from individuals who were tested positive for COVID-19. They found that 71 per cent of them were symptomatic, 9.8 per cent required hospitalization and the fatality was only 0.4 per cent, suggesting that the vaccination provided reduction in hospital admission and mortality[11]. Another Indian study reported an incidence of 9.5 per cent of BTI, with the use of ChAdOx1 nCoV-19 vaccine in HCWs and noted that the risk of infection was 1.57 per cent higher in unvaccinated HCWs[12]. Bergwerk *et al*[13], from Israel, reported BTI in their HCWs at 2.61 per cent and found that 85 per cent of them had Alpha variant, during their study period from December 18, 2020 to April 28, 2021 (before the emergence of Delta variant, in their region).

The limitations of this study include a lack of control group of unvaccinated HCWs and non-testing of antibody titres in the post-vaccinated HCWs (due to logistic reasons). This pilot study reports that the Delta variant infection has risen significantly during the study period, and the variants can lead to a higher incidence of the PVI. However, the severity of infection was reduced in these vaccinated HCWs, avoiding the hospital or ICU admissions and reducing the fatalities.

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