Original Article

Antibody Responses of SARS-CoV-2 Vaccines amongst Health Care Workers in a Tertiary Care Hospital in Tripura, India: A Cross-Sectional Study

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Abstract

Background: Vaccines against COVID-19 plays an important role in limiting the spread of SARS-CoV-2 infections and also in curbing mortality and morbidity due to COVID-19. **Objective:** To estimate the anti-spike antibody response after receiving the second dose of SARS-CoV-2 vaccines amongst health care workers of a tertiary care hospital in Tripura, India. **Materials and Method:** A cross- sectional study was conducted from 1 July to 20 August 2021 at Agartala Government Medical College and GBP Hospital, Agartala among 561 health care workers who had received first and second doses of SARS-CoV-2 vaccines and had completed 14 days after receiving the second dose. **Results:** The present study showed that health care workers who had received both doses of COVID-19 vaccine had 99.5% seropositivity to anti-spike antibody. The median SARS-CoV-2 anti-spike antibody titter was 250 with an IQR (211.55–250). Seropositivity rate was higher among Covishield recipients (99.8% [550/551]) as compared to Covaxin recipients (80% [8/10]) and it was found to be statistically significant (P = 0.000). **Conclusion:** The present study suggests that a good immune response was elicited against spike antigen of SARS-CoV-2 after two complete doses of Covishield (ChAdOx1-nCoV-19) or Covaxin (BBV152).

Keywords: Anti spike antibody, health care worker, SARS-CoV-2, vaccines

Introduction

Spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections has led to a global COVID-19 pandemic.[1] Despite global spread of the virus; a large proportion of the population in many countries is thought to have thus far escaped infection and remains non-immune to SARS-CoV-2. Vaccines could play an important role in increasing population immunity, preventing severe disease, and reducing the ongoing health crisis.[2] Therefore great expectations are placed in vaccines against COVID-19 to control the pandemic and multiple vaccines have been developed that offer protection against COVID-19 by generating immune responses against the spike antigen of SARS-CoV-2.[3,4] Vaccination with two candidate vaccines, namely, Covishield and Covaxin in India started from January 16, 2021 after the Emergency Use Approval (EUA). Covishield (ChAdOx1-nCOV or AZD1222, acquired from Oxford University and AstraZeneca, manufactured by Serum Institute of India, Pune is a recombinant replication-deficient chimpanzee adenovirus-vectored vaccine encoding SARS-CoV-2 spike antigen and Covaxin (BBV-152), manufactured by Bharat Biotech, Hyderabad in collaboration with Indian Council of Medical Research (ICMR).[5]

The evaluation of anti-spike protein receptor-binding domain (anti-S-RBD) antibodies represents a useful tool to estimate the individual protection against SARS-CoV-2 infection.[6] Hence the present study was designed to estimate the anti-spike antibody response after receiving second dose of SARS-CoV-2 vaccines amongst health care workers of a tertiary care hospital, Agartala, Tripura, India.

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Methosds

This cross-sectional study was conducted amongst health care workers (HCWs) of Agartala Government Medical College and GBP Hospital, Agartala, from 1 July to 20 August 2021. We assessed SARS-CoV-2 anti-spike antibody titre among all the HCWs, that is, doctors, nursing staffs, administrative staffs, research staffs, technical staffs and paramedical staffs like general duty assistant, sanitary workers and security personnel, etc. Those who had completed at least 14 days after receiving the second dose of Covishield (ChAdOx1-nCoV-19 corona virus vaccine) or Covaxin (BBV152) irrespective of their previous SARS-Cov-2 infection and those who were willing to participate in this study on a voluntary basis were included. Active cases of COVID-19 and those HCWs diagnosed with SARS-Cov-2 infection by RTPCR or RAT testing within six weeks was excluded. A total of 609 subjects voluntarily participated in this study during the study period. Out of these, 561 health care workers fulfilled the eligibility criteria and were included in the study. Before collection of the venous blood, all the subjects were asked to fill the questionnaire which contained questions regarding age, sex, designation, religion, caste, comorbidities like diabetes mellitus, hypertension, asthma, etc., past history of confirmed SARS-CoV-2 infection and type of vaccine received. The purpose of the study was explained to all study subjects, and written informed consent was obtained before collection of demographic and clinical information and collection of blood samples. The study was conducted after receiving approval from the Institutional Ethics Committee of Agartala Government Medical College.

Laboratory procedure

Venous blood (3 ml) was collected after taking all aseptic precautions in a sterile test tube from all eligible study subjects and kept for at least half an hour undisturbed in room temperature. The test tube was then centrifuged at 2000 rpm/min for 3 minutes. The supernatant serum then separated and was kept in plain allicot vial for testing. Then the presence of IgG antibodies to SARS-Cov-2 directed against the spike protein (anti-spike antibody titre) was analyzed by using "Cobas e 411 analyzer" approved by ICMR which situated at the Department of Microbiology, Agartala Government Medical College. Anti-spike antibody titre was automatically calculated by analyzer. Antibody tire >1 IU/ml were considered as seropositive, while antibody titre <1 IU/ml were considered as seronegative.

Data analysis

Data analysis was done by using SPSS, version 25. Descriptive statistics were expressed as frequencies, percentages, median, and inter-quartile range. Fisher's exact test was applied to find out the association between type of vaccines received with seropositivity rate and *P* value of <0.05 was considered as statistically significant.

Result

A total of 609 subjects had filled the questionnaire and were screened. Out of these, serum samples were collected from a total of 561 eligible HCWs. A majority of the study subjects was in the age group of 31–40 years (43.1%) while only 2.5% were in age group 60–70 years. The mean age of the study subjects was 39.74 ± 9.97 year. The demographic profile revealed that majority of the study subjects were female (61.3%) and Hindu by religion (89.3%). Caste-wise distribution showed that majority of them belonged to General Caste (49.9%) while only 2% belonged to minority. Out of 561 subjects, 84 (15%) had one or more comorbidities or suffering from some form of chronic diseases like hypertension (7.5%), type 2 diabetes mellitus (1.8%), both hypertension and diabetes (2.7%), and other chronic diseases (3%); for example, asthma, hypothyroidism, ankylosing spondylitis, arthritis. Amongst subjects, 102 (18.2%) gave past history of confirmed SARS-CoV-2 infection. Majority of the subjects had received Covishield (ChAdOx1-nCoV-19) vaccine (98.2%) as compared to Vovaxin (BBV152) (1.8%).

The median (IQR) of SARS-CoV-2 anti-spike antibody titre was found as 250 (211.55–250). Among 561 serum samples tested, 558 (99.5%) were seropositive (anti-SARS-CoV-2 S antibody titre more than 1 IU/ml) while only 3 (0.5%) samples were seronegative (anti-SARS-CoV-2 S antibody titre less than 1 IU/ml). Seropositivity rate was 99.8% (550/551) among Covishield recipients and 80% (8/10) among Covaxin recipients, and it was found to be statistically significant ($P = 0.000$) [Figure 1].

Overall, seropositivity of anti-spike antibody was observed as 99.4% across all age groups. Seropositivity rate was higher among both female and male subjects at 99.4% and 99.5%, respectively. Individuals with history of comorbidities and who had history of confirmed SARS-CoV-2 infection was found 100% seropositive to anti-spike antibody. Seropositivity rates were also observed high (100%) among doctors, administrative staffs and others. Seropositivity rate was found 100% among the HCWs, who had completed thirty days or more of receiving second dose of SARS-CoV-2 vaccine while it was found 95.7% among those who had completed 14 days but not yet

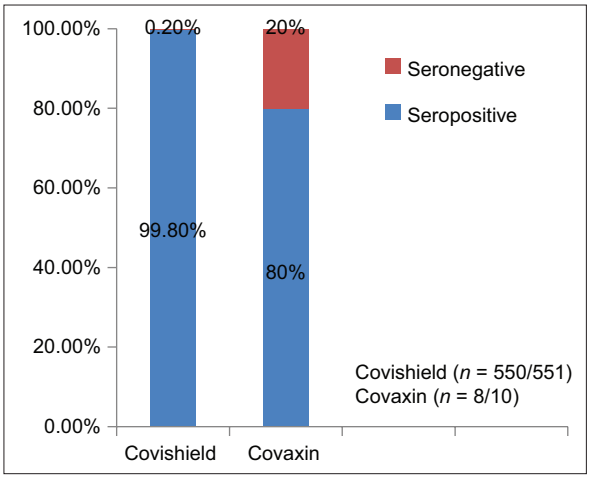

Figure 1: Seropositivity rate according to the type of vaccines received among study subjects

completed 30 days (between 14 and 29 days) of receiving second dose [Table 1].

Discussion

Our study result revealed that the overall seropositivity to anti-spike antibody was 99.5% (558/561). High antibody levels were elicited in all age groups, sex, caste, religion and designation of services. However, coronavirus vaccine–induced antibody titre (COVAT) study[5] reported that 95% (489/515) of study subjects had seropositivity to anti spike antibody and seropositivity rate among Covishield recipients was found significantly higher as compared to that among Covaxin recipients, and also similar findings was reported in a study done by Padmanabha S.[7] Our study also revealed consistent results and this observation may be due to less number of Covaxin recipients in the present study as compared to Covishield recipients.

Ella Raches,[8] in phase 2 randomized controlled trial (RCTs), reported that seroconversion rate based on $PRNT_{50}$ at day 56 was 92.9% (95% CI 88·2–96·2 and 98·3% [95.1, 99.6]) in the 3 µg and 6 µg with Algel-IMDG groups, respectively. However, seroconversion rates were 92.5 (77,7, 110·2) and 160·1 (135·8, 188·8) in the 3 µg and 6 µg with Algel-IMDG groups, respectively based on GMTs (MNT50) and seroconversion rates based on MNT50 (95% CI) were 88.0% (82.4, 92.3) and 96.6% (92.8, 98.8) in the 3 µg and 6 µg with Algel-IMDG groups, respectively.

Table 1: Seropositivity rate to anti-spike antibody titre of SARS-Cov-2 vaccines among study participants (*n*=561)

Variables	Seropositivity rate *n* (%)
Age in years	
21-30	101/102 (99.0)
31-40	241/242 (99.5)
41-50	121/122 (99.1)
51-60	81/81 (100)
61-70	14/14 (100)
Sex	
Male	216/217 (99.5)
Female	342/344 (99.4)
Designation	
Doctors	127/127 (100)
Nursing staffs	270/272 (99.2)
Technical and paramedical staffs	155/156 (99.3)
Administrative staffs	6/6 (100)
Comorbidities	
DM type 2	9/10 (90.0)
Hypertension	42/42 (100)
Hypertension and DM type 2	13/15 (86.6)
Others[#]	17/17 (94.4)
No comorbidities	477 (100)
Past history of covid-19	
Yes	102/102 (100.0)
No	456/459 (99.3)
Completed second dose of vaccination (days)	
14	67/70 (95.7)
30	25/25 (100)
60	35/35 (100)
90	51/51 (100)
120	113/113 (100)
150	215/215 (100)
180	52/52 (100)

[#] Asthma, hypothyroidism, ankylosing spondylitis, arthritis

In the present study, the median SARS-CoV-2 anti-spike antibody titre was 250 with an IQR of 211.55–250. A study on safety and immunogenicity of the ChAdOx1-nCoV-19 vaccine against SARS-CoV-2, suggests that the median anti-spike IgG antibody was 639 EU with an IQR 360–792 (at day 56) as measured by ELISA in 10 prime-boost participants after receiving two doses of ChAdOx1-nCoV-19 (Covishield) vaccine.[9] This difference in observation may be because of the analyzer ("Cobas e 411 analyzer" approved by ICMR) used in our study which could detect the highest value (antibody titre) up to 250 IU/ml.

A study was conducted to assess the immunogenicity of the ChAdOx1-nCoV-19 and the BBV152 vaccines in patients with autoimmune rheumatic diseases (AIRD) and showed that seroconversion rates as well as antibody titres were found lower among patients with AIRD as compared to patients with non-AIRD.[7] A prospective cohort study done by Benedikt S[10] also observed that dialysis patients had significantly lower anti-SARS-CoV-2 S antibody titres than healthy control patients. Similar findings was reported Ayelet G[11] study. On the other hand, the present study showed high seropositive rate as well as high antibody titre irrespective of comorbidities status. This inconsistent observation may be due to the fact that very few study subjects suffering from different types of comorbidities participated, so this result may not be generalizable to the vaccine recipients with co-morbidities. This sixth round of REACT-2 study[12] (REal-time Assessment of Community Transmission-2) revealed that after adjusting for test performance, for Pfizer the positivity after two doses was 100% (100-100) at all ages except 80 years and older when it was slightly lower at 97.8% (95.9–99.6) and for AstraZeneca adjusted positivity was over 90% up to age 69, and then 89.2% (88.5–89.9) in 70–79 year-olds and 83.6% (78.5–88.3) in those aged 80 years and over. Whereas our study findings reported seropositivity rates was higher across all age groups. This difference finding may be due to majority of the participants in this study were in age group of 31 to 40 years. Shuchi A[13] study suggests that median IgG titers were higher among patients with evidence of prior SARS-CoV-2 infection as compared to those without prior SARS-CoV-2 infection, and this observation is in line with Lili C's study.[14] In the present study, seropositivity rate was found to be higher irrespective of their previous SARS-Cov-2 infection.

The present study has several limitations: (i) this is a cross-sectional study and the study subjects were recruited only from one tertiary care hospital on voluntary participation.

Hence further follow up studies are needed to conduct involving large number of populations (ii) as study participants were not followed up, we could not comment regarding the period for vaccine effectiveness or how long the antibody response may persist (i.e. whether effectiveness declines over time following completion of second vaccination dose). (iii) Pre-vaccination antibody status among the study subjects was not known.

Conclusions

The present study revealed that anti-SARS-CoV-2 S antibody response was high after two complete doses with Covishield (ChAdOx1-nCoV-19) or Covaxin (BBV152) and seropositivity to anti-spike antibody was 99.5%. The antibody titre was also observed high in all age groups, sex, caste, designation, religion, presence or absence of comorbidities and irrespective of their previous SARS-Cov-2 infection. This study also reported that Covishield recipients had high seropositivity to anti-spike antibody as compared to Covaxin recipients.

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Conflicts of interest

There are no conflicts of interest.

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