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Anti-SARS-CoV-2 IgG Response after First and Second Dose of COVID-19 Vaccine

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ABSTRACT

Background and objectives: Pandemics have serious adverse impacts on public health, economy, social structure, and overall growth and development of a nation. Such impacts can be mitigated by timely introduction of effective vaccination programs. This was successfully achieved in India. This study was performed to compare the anti-severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) immunoglobulin G (IgG) responses after first and second dose of coronavirus disease 2019 (COVID-19) vaccination.

Methods: This cross-sectional study included 60 people who were vaccinated with the AstraZeneca vaccine at Karnataka Institute of Medical Sciences, Hubballi, India. The subjects were divided into two groups. Group I included 30 people who had received a single dose of the vaccine, and group II included 30 people who had received two doses of the vaccine. Exclusion criteria included having a history of influenza like illness/severe acute respiratory infection/proven COVID-19 infection in past 6 months. The antibody response was measured by the Anti-SARS-CoV-2 IgG test using the VITROS Anti-SARS-CoV-2 IgG Reagent Pack.

Results: We observed that 97% of the subjects had reactive IgG antibodies after receiving two doses of the vaccine, whereas only 83% of the subjects developed antibodies after a single dose of the vaccine. A positive correlation was observed between the development of reactive antibodies and the duration between the first dose and the second dose (r=0.24).

Conclusion: Based on the results, the two-dose vaccination with the AstraZeneca vaccine is beneficial over the single-dose vaccination for protection against COVID-19. Moreover, increasing the duration between doses might improve the antibody response.

Keywords: COVID-19, COVID-19 Vaccines, Pandemics.

INTRODUCTION

The World Health Organization declared coronavirus disease 2019 (COVID-19) as pandemic on 11th of March 2020 (1).

Until the end of 2021, 286,901,118 confirmed cases and 5,446,566 COVID-19-related deaths have been reported worldwide (2). In India, 34,808,886 confirmed cases and 480,592 deaths were reported until the end of 2020 (3). The COVID-19 pandemic is a major challenge faced by the health sector of many countries. The immensity of this disease has prompted a phenomenal effort to discover treatment/preventive options, ranging from immuno-modulators, antivirals, and supportive drugs. The lack of efficacious treatment options has led to quick advancement in vaccine research and trials. Experience from previous pandemics demanded introduction of mass vaccination to control the pandemic. There is some scientific evidence suggesting that a single dose of some COVID-19 vaccines might provide sufficient protection for three to four months (4).

However, most studies and experts suggest that antibodies developed after the first dose would not last long, and a booster dose is required after a certain period (5). Most of the studies favoring two-dose vaccination rely on the corroborative evidence showing occurrence of milder symptoms among two-dose-vaccinated people (6). Nevertheless, the antibody response has not been measured after first and second doses of COVID-19 vaccines. The concept of two-dose vaccination being more effective is predominantly derived from phase–III clinical trials. In the present study, our data are derived from a subpopulation reflecting the general population.

To the best of our knowledge, there are only few Indian studies on the anti-severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) IgG responses after first and second vaccination.

Hence, we aimed to compare the IgG responses against SARS-CoV-2 after the first and second doses of COVID-19 vaccines. The study will add to the existing knowledge in favor of two-dose vaccination.

MATERIALS AND METHODS

This cross-sectional study included 60 people who were vaccinated with the AstraZeneca recombinant vaccine at Karnataka Institute of Medical Sciences, Hubballi, India.

The study was approved by the ethics committee of Karnataka Institute of Medical Sciences (registration code: ECR/486/Inst/KA/2013/RR-16). The subjects were divided into two groups. Group I included 30 people who had received a single dose of the vaccine, and group II included 30 people who had received two doses of the vaccine.

The subjects were tested for post-vaccination antibodies for at least 4 weeks. The mean gap between the doses was 40 days. Exclusion criteria included having a history of influenza like illness/severe acute respiratory infection/proven COVID-19 infection in last 6 months.

After obtaining informed written consent from the subjects, 2 ml of venous blood were collected under aseptic conditions. Serum was separated, and antibody response was measured within 2 hours of sample collection. Immunoglobulin G (IgG) response was measured by Anti-SARS-CoV-2 IgG test using the VITROS Anti-SARS-CoV-2 IgG Reagent Pack (Ortho-Clinical Diagnostics, France). The test detects IgG antibodies that bind to SARS-CoV-2 spike protein. An antibody level of less than 1.00 and more than 1.00 was considered as non-reactive and reactive, respectively.

Data were analyzed using the SPSS and MedCalc software at statistical significance of 0.05.

RESULTS

Characteristics of the participants who had received only the first dose of the vaccine and both doses are shown in tables 1 and table 2, respectively.

Based on the results, 97% of the subjects had reactive IgG antibodies after receiving two doses of the vaccine, whereas only 83% of the subjects developed antibodies after a single dose of the vaccine. The antibody levels decreased non-significantly with time (p=0.349) (Table 3).

A positive correlation was observed between the development of reactive antibodies and the duration between the first dose and the second dose (r=0.24).

Table 1- Characteristics of the participants who had received a single dose of the COVID-19 vaccine

Variables	Mean	Standard error	Standard deviation	Variance
Age (n=30) (23yrs – 55yrs) Males= 17 Females =13	34.17	3.07	16.85	284.0
IgG*	6.89	0.77	4.25	18.12
Duration in days	65.17	5.04	27.62	763.10

Table 2- Characteristics of the participants who had received two doses of the COVID-19 vaccine

Variables	Mean	Standard Error	Standard deviation	Variance
Age (n=30) (19yrs-70yrs) Males= 20 Females =10	46.20	1.57	8.62	74.30
IgG*	5.96	0.610	3.34	11.17
Duration in days	146.5	2.696	14.76	218.03

*< 1.00 is non-reactive , ≥ 1.00 is reactive

Table 3- Comparison of mean IgG levels and duration of responses between group I and group II

Variables	Group I	Group II	*p*
Mean IgG level*	6.89	5.96	0.349
Mean duration (days)	65.17	146.5	<0.0001

*< 1.00 is non-reactive, ≥ 1.00 is reactive

DISCUSSION

Vaccines play a pivotal role in the prevention and control of infectious diseases. The vaccines used today for the prevention of infectious diseases have been developed over many years and include different formats e.g. live-attenuated, inactivated, and toxoids. Most recently developed vaccines are recombinant products of antigenic peptides and their cDNAs (7).

Several COVID-19 vaccines have been developed in different parts of the world. India has effectively implemented the vaccination program for COVID-19 and has shown tremendous number of vaccinated individual in spite of the large population. However, efficacy of the vaccines remains controversial. Hence, we investigated the IgG responses against the SARS-CoV-2 after vaccination with the AstraZeneca COVID-19 vaccine. Antibodies that bind to the SARS-CoV-2 spike protein are protective in nature (8). According to the results, 97% of the individuals developed reactive IgG antibodies after receiving both doses of the vaccine, whereas only 83% of people developed reactive IgG antibodies after receiving a single dose of the vaccine. This demonstrates the efficacy of two-dose vaccination over single-dose in terms of measurable antibody response rather than relying on the occurrence or non-occurrence of COVID-19 infection. In line with our findings, a study reported that two-dose vaccination could elicit antibody response in all individuals (6). Another study showed that the risk of infection was significantly lower in fully vaccinated healthcare workers compared to unvaccinated counterparts (9). In a study in the UK, the incidence of COVID-19 infection was 3.8% in fully vaccinated individuals and 38% in unvaccinated individuals (10). First dose of vaccines usually induces immune responses in the form of antigen recognition and cell-mediated immunity. However, a second dose increases production of neutralizing antibodies and results in induction of sustained T-cell memory responses.

In our study, there was a positive correlation between the development of reactive

antibodies and the duration between vaccine doses (r=0.24). This suggests that the increase in the gap between the doses might improve the antibody response. This will justify the recently adapted vaccination policy in which the duration between the first and the second dose of the COVID-19 vaccines is increased. To the best of our knowledge, no study in India has investigated the effects of increasing the gap between COVID-19 vaccine doses. However, a study on the Pfizer BioNTech (BNT162b2) COVID-19 vaccine in the UK showed that delaying the second dose could boost the peak antibody responses in older people (11).

In this study, we also observed that receiving the two-dose regimen results in a more long-lasting IgG response against SARS-CoV-2. In addition, the antibody levels decreased non-significantly with time (p=0.349) (Table 3). Similarly, a previous study showed that antibody levels decrease over time (12). Another study demonstrated that neutralizing antibody levels decreased with time in healthcare workers infected with SARS-CoV-2 (13). Therefore, administration of booster doses to healthcare workers is recommended. The booster dose may be necessary for the T-cells to stimulate the memory B-cells to produce massive quantities of antibodies. Not receiving the booster within the appropriate window would lower the antibody response, which may not provide adequate protection against the virus.

The small sample size and not monitoring antibody responses in the same individuals after the second dose are some limitations of the present study.

CONCLUSION

We conclude that the two-dose vaccination with the AstraZeneca vaccine is beneficial over the single-dose vaccination for protection against COVID-19. Moreover, increasing the duration between the first and the second dose might improve the antibody response.

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DECLARATIONS

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Ethics approvals and consent to participate

Written informed consent was obtained from all participants. The study was approved by the ethics committee of Karnataka Institute of Medical Sciences (Registration Number: ECR/486/Inst/KA/2013/RR-16).

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding publication of this article.

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