Short Report

Comparison of SARS-CoV-2 vaccine induced antibody response among healthy individuals and chronic renal failure patients

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Abstract

AZD1222 (Covishield) COVID-19 vaccination response among healthy adults and chronic renal disease patients has been compared in this analysis. Compared to healthy individuals, vaccine induced immune response seems to be suboptimal after two doses of the vaccine in patients with chronic renal disease on hemodialysis. Infection following full course of vaccination can boost the vaccine induced antibody levels in both healthy individuals and patients with chronic renal disease.

It is necessary to conduct comprehensive prospective research to further evaluate these conclusions made based on this preliminary data evaluation, and to find out its overall impact for future SARS-CoV-2 infection and its disease outcome.

Keywords: SARS-CoV-2, COVID-19, Vaccination, S Antibody response, N Antibody response, Healthy adults, Chronic renal disease patients

Introduction

The SARS-CoV-2 virus has caused widespread infection across the globe, with intermittent rise in hospitalization and mortality from time to time in different countries. The main focus of vaccination during this COVID-19 pandemic is to prevent severe complications and death, especially in high-risk groups.[1-3] Additionally, vaccination contributes to achieving herd immunity in combination with natural infection.

There are different types of vaccines available, such as inactivated vaccines, mRNA vaccines, and adenoviral vector vaccines. Adenoviral vector vaccines like AZD1222 (Covishield) and mRNA vaccines like BNT162b2 and mRNA-1273 induce antibodies against the S (spike) protein (S antibody response).[4] These vaccines do not produce an N antibody response. In

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such vaccine recipients, an N antibody response would suggest natural exposure to the virus in addition to vaccination.

The S antibody response could be considered as a surrogate marker of immunity[5], although it might not be the neutralizing antibodies. The development of antibodies following vaccination has been found to be impaired in CKD patients owing to their compromised status.[6]

Method

We retrospectively analyzed SARS-CoV-2 antibody results generated in the laboratory during its routine testing service from September to November 2021. There were two cohorts of tested individuals identified. One was a group consisting of 50 healthcare workers (normal healthy adults) who had completed two doses of AZD1222 (Covishield) vaccination and the second group of 25 patients diagnosed with chronic kidney disease on regular haemodialysis who had completed two doses of AZD1222 (Covishield) vaccination.

We tested SARS-CoV-2 S total antibody titres and SARS-CoV-2 N antibody response in both cohorts around one month after the second dose of vaccination. SARS-CoV-2 S antibody titres were detected using Elecsys Anti-SARS-CoV-2 S Roche Quantitative assay and its upper limit of linear quantification range was 250 Units/ml. SARS-CoV-2 N antibody responses were detected using Elecsys Anti-SARS-CoV-2 N Roche Qualitative assay. Comparison of vaccine responses in the two groups was analyzed by Chi-Square test.

Results

Table 1: Age-wise vaccine response in healthy adults

Age group (years)	**20-40**		**40-60**		**P value**
	n	%	n	%	
S antibody seroconversion rates	25	100	25	100	-
Rate of maximum S antibody response (>250 U/ml)	22	88	23	92	0.6407

Age-wise comparison of the S antibody seroconversion including maximum response did not reveal any statistical significance. (Table 1)

S antibody seroconversion rates between healthy adults and CKD patients revealed a statistically significant difference with a marked difference in maximum S antibody response of >250 U/ml. (Table 2)

Table 2: Comparison of results between healthy adults and chronic renal disease patients on regular hemodialysis

	Healthy adults		**Chronic kidney disease patients on dialysis**		**P value**
	n	%	n	%	
S antibody seroconversion rates	50	100	23	92	0.0440
Rate of maximum S antibody response (>250 U/ml)	45	90	11	44	<0.0001

Assessment of S antibody titres in the presence or absence of N antibody response

Among healthy individuals, 30 had antibodies to N antigen (evidence of past SARS-CoV-2 infection). All of them had S antibody response of >250 U/ml. However, there were only 15 individuals with an S antibody response of >250 U/ml among 20 patients without evidence of past infection (Table 3). There was a statistically significant difference in S antibody development between the two groups.

Table 3: Healthy adults (Healthcare workers) after AZD1222 (Covishield) vaccination

	Serological evidence of past infection (positive N antibody results)		**No serological evidence of past infection (negative N antibody results)**		**P value**
	n	%	n	%	
S antibody seroconversion rates	30	100	20	100	-
Rate of maximum S antibody response (>250 U/ml)	30	100	15	75	0.0043

The same significant difference was noted among the CKD cohort too. There were 11 individuals with S antibody response >250 U/ml in a total of 12 patients with serological evidence of past infection (N antibody positive). None of the 13 patients without serological evidence of past infection developed the S antibody response >250 U/ml. (Table 4)

Table 4: Chronic renal disease patients on regular hemodialysis after AZD1222 (Covishield) vaccination

	Serological evidence of past infection: (positive N antibody results)		**No serological evidence of past infection: (negative N antibody results)**		**P-value**
	n	%	n	%	
S antibody seroconversion rates	12	100	11	84.6	0.1649
Rate of maximum S antibody response (>250 U/ml)	11	91.7	0	0	<0.0001

Discussion

In this study, we showed that the maximum immune response (>250 U/ml) to Covishield is affected in CKD patients. This finding is in line with other immunogenicity studies involving CKD patients.[7,8] Nevertheless, the maximum spike antibody level was achieved by the combination of COVID-19 vaccination plus past infection (indicated by N-antibody positivity) among both healthy individuals and CKD patients in our study. This finding was observed in another similar study which analyzed 607 N antibody positive and 6473 N antibody-negative patients.[8] We suggest that boosting at more frequent intervals or with higher doses could be investigated in CKD patients to increase the vaccine effectiveness.

There were some limitations in our study. This was a retrospective analysis of available laboratory data from routine testing services. Therefore, only the available sample results

were considered for the analysis. Other parameters such as age and immune status were however matched among different groups for comparison.

The assay used to detect S antibody levels in this analysis does not necessarily detect neutralizing antibodies but is considered a surrogate marker for immunity. Further, the minimum protective level of the S antibody titre for the assay is not defined.

Conclusion

Compared to healthy individuals, the vaccine-induced immune response seems to be suboptimal after two doses of vaccines in patients with chronic renal disease on hemodialysis. A combination of past infection and full course of vaccination seems to boost the vaccine-induced antibody levels in both healthy individuals and patients with chronic renal disease. It is necessary to conduct comprehensive prospective research to further evaluate these conclusions which are based on preliminary data evaluation.

Declarations

- Acknowledgement: Not applicable
- Funding: Not applicable
- Conflict of Interest: Not applicable
- Ethics statement: Not applicable as this analysis was done on available laboratory data retrospectively
- Author contributions:
- SNJ: concept, designing the methodology, interpretations, analysis, and supervision; RSS: analysis and writing under supervision; LSA: data analysis; KDSTA: analysis; YYU: analysis and writing under supervision.
  AWRD: data management and analysis; NDSA: data management and analysis

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