SARS-CoV-2 Booster Vaccine Response among Patients Receiving Dialysis

Pablo García,1 Jialin Han,1 Maria E. Montez-Rath,1 Sumi Sun,2 Tiffany Shang,2 Julie Parsonnet,1,4 Glenn M. Chertow1,2,4 Shuchi Anand,1 Brigitte Schiller,1,2 and Graham Abra1,2

Data indicate a diminished antibody response to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccination among patients on dialysis (1–3). Circulating antibody titers decline rapidly, regardless of vaccine type; low circulating levels are linked with a more than ten-fold higher risk for breakthrough infections (3). To determine whether a booster dose would offer protection against SARS-CoV-2, we compared antibody responses in early postvaccination periods after completing the initial vaccine schedule versus completing the booster dose schedule of a SARS-CoV-2 vaccine in a cohort of US patients on dialysis.

We partnered with a nonprofit dialysis provider serving patients receiving maintenance dialysis in four states. The dialysis provider implemented monthly testing for SARS-CoV-2 receptor binding domain (RBD) antibody levels among a majority of their patient population from February through April 2021, and quarterly thereafter. Starting in late September 2021, the dialysis provider offered in-facility mRNA vaccine boosters to patients dialyzing in their facilities. From 8229 patients receiving dialysis and completing the initial recommended vaccination schedule for the two mRNA or Ad26.COV2.S vaccines, we identified 3041 and 2720 patients who had antibody results available within 14–60 days postinitial vaccination and postbooster, respectively. In cases where more than one antibody result was available, we used the maximum antibody results within 14–60 days. We used multinomial logistic regression to obtain the estimate margins of response level. We collected antibody data through November 10, 2021.

We quantified the antibody response using one of two semiquantitative Siemens RBD IgG assays. On the basis of our previous research (3), we categorized the response as RBD IgG antibody index value <10, 10–23, and >23. Index values of 10 and 23 correspond to 218 and 506 binding antibody units per milliliter, respectively, according to the World Health Organization international standard. We have previously shown that values <10 and in the range of 10–23 were associated with higher risks of breakthrough infection (rate ratio, 11.6; 95% confidence interval [95% CI], 3.4 to 39.5 and rate ratio, 6.0; 95% CI, 1.5 to 23.6, respectively).

Clinical characteristics, including age, sex, diabetes status, and vaccine type, were similar among patients in both cohorts (i.e., patients completing the initial vaccination schedule [n=3041] and patients completing a booster dose [n=2720]). A majority (66% and 70%, respectively) of patients completed the initial vaccine series with the mRNA1273 vaccine. Nearly all patients (97%) who received a booster received the BNT162b2 vaccine. The median time between initial vaccine series and booster vaccination was 189 days. Whereas 81% (95% CI, 80% to 82%) of patients achieved an RBD IgG index value >23 after initial vaccination (including 88% and 76% who received the mRNA1273 and BNT162b2 vaccine, respectively), 97% (95% CI, 96% to 97%) did so in 14-60 day period after the booster. Among patients with data available from both time points (n=1431), 130 patients had an RBD IgG index value <10 after the initial vaccine series. Of these 130 patients, 106 (82%) developed an RBD IgG index value >23 after the booster vaccine. The antibody response to the initial vaccine series was inversely proportional to age; however, after a third dose of mRNA vaccine, older patients achieved nearly as robust a response as younger patients (Table 1). In this cohort of patients on dialysis from four US states, a majority of whom completed two doses of mRNA1273 and thereafter received BNT162b2 as the third dose, we observed a robust response to the booster dose. In the immediate postbooster period, >95% of patients achieved an antibody index value associated with enhanced protection against SARS-CoV-2 breakthrough infection (3). These data are concordant with other studies from Europe and the United States, although the duration between the initial series and booster dose was longer than that published from European data (4,5). Response to the BNT162b2 vaccine booster after either the mRNA1273 or BNT162b2 initial vaccine series supports the so-called “mix and match” strategy, at least with respect to the mRNA vaccines. We had too few patients in the booster cohort who had initially received the Ad26.COV2.S vaccine to assess the response to an mRNA booster in this group. We could not assess cellular immune response, although recent data indicate that humoral and cellular responses are...
Table 1. Prevalence of absent response among fully vaccinated individuals by vaccine type, age group, and overall between 14 and 60 days after completion of vaccine and booster

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Completed Initial Schedule of Doses: Days 14 and 60, n=3041</th>
<th>Completed Booster Dose: Days 14 and 60, n=2720</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Receptor Binding Domain IgG &lt;10 (95% Confidence Interval), n=377</td>
<td>Receptor Binding Domain IgG = 10–23 (95% Confidence Interval), n=202</td>
</tr>
<tr>
<td>Vaccine type (initial dose)a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mRNA1273</td>
<td>1990</td>
<td>6 (5 to 7)</td>
</tr>
<tr>
<td>BNT162b2</td>
<td>832</td>
<td>9 (7 to 11)</td>
</tr>
<tr>
<td>Ad26.COV2.S</td>
<td>219</td>
<td>4 (2 to 7)</td>
</tr>
<tr>
<td>Age group, yrb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–44</td>
<td>225</td>
<td>3 (0.8 to 5)</td>
</tr>
<tr>
<td>45–64</td>
<td>892</td>
<td>6 (4 to 8)</td>
</tr>
<tr>
<td>65–80</td>
<td>1316</td>
<td>7 (5 to 8)</td>
</tr>
<tr>
<td>≥80</td>
<td>608</td>
<td>9 (7 to 11)</td>
</tr>
<tr>
<td>Overallc</td>
<td>12 (11 to 14)d</td>
<td>7 (6 to 8)d</td>
</tr>
</tbody>
</table>

Data are percentage (95% confidence interval) obtained within 14–60 days after two doses of either the mRNA1273 or BNT162b2 vaccine and a single dose of the Ad26.COV2.S vaccine.

NA, not available; —, insufficient data.

aAdjusted for age and sex.
bAdjusted for sex.
cAdjusted for age, sex, and vaccine type.
dOverall results.
discordant. Another limitation is the lack of data on prior SARS-CoV-2 breakthrough infection.

In summary, nearly all patients requiring maintenance dialysis who received a booster dose of mRNA vaccine developed a robust antibody response 14–60 days after vaccination. Perhaps most importantly, we found that a third dose of mRNA vaccine was effective in providing high levels of antibody among older patients who were not uniformly protected after the initial vaccine series.

Disclosures

G. Abra reports employment with Satellite Healthcare, consultancy agreements with Akebia, and serving in an advisory or leadership role for Nephrology News & Issues. S. Anand serves as a medical director at a Satellite Healthcare dialysis unit and reports consultancy agreements with GLG Group, honoraria from St. Rose Hospital (continuous medical education activity), and serving in an advisory or leadership role for CENCAM (unpaid) and i3C (International Society of Nephrology; unpaid). G.M. Chertow reports consultancy or leadership role for CENCAM (unpaid) and i3C (International Society of Nephrology; unpaid). G.M. Chertow reports consultancy agreements with Akebia, Amgen, Ardelyx, AstraZeneca, Baxter, Cricket, DiaMedica, Gilead, Miromatrix, Reata, Sanifit, Unicycive, and Vertex; ownership interest in Ardelyx, CloudCath, Duract, DxNow, Eliaz Therapeutics, Outset, Physiowave, and PuraCath; research funding from the National Institute of Allergy and Infectious Diseases and the National Institute of Diabetes and Digestive and Kidney Diseases; serving on the board of directors of Satellite Healthcare, a nonprofit dialysis provider, and as coeditor of Brenner & Rector’s The Kidney (Elsevier); and Data and Safety Monitoring Board service for Angion, Bayer, NIDDK, and ReCor. J. Parsonnet reports research funding from Gauss Surgical and serving in an advisory or leadership role for Doctors for America and Scrubs Addressing the Firearm Epidemic. B. Schiller reports employment with Satellite Healthcare; consultancy agreements with CVS, Quanta, and Rockwell Medical; ownership interest in Unicycive Therapeutics Inc.; serving in an advisory or leadership role for the board of directors at Unicycive; and speakers bureau for AstraZeneca. T. Shang and S. Sun report employment with Satellite Healthcare. All remaining authors have nothing to disclose.

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Author Contributions

S. Anand, M.E. Montez-Rath, P. Garcia, J. Han, and J. Parsonnet conceptualized the study; J. Han, T. Shang, and S. Sun were responsible for data curation; S. Anand, P. Garcia, and J. Han were responsible for investigation; J. Han was responsible for formal analysis; S. Anand, S. Anand, P. Garcia, J. Han, and M.E. Montez-Rath were responsible for methodology; G. Abra, S. Anand, B. Schiller, T. Shang, and S. Sun were responsible for project administration; G. Abra, S. Anand, B. Schiller, T. Shang, and S. Sun were responsible for resources; M.E. Montez-Rath was responsible for validation; G. Abra, S. Anand, S. Anand, M.E. Montez-Rath, J. Parsonnet, and B. Schiller provided supervision; P. Garcia and J. Han wrote the original draft; and G. Abra, S. Anand, S. Anand, J. Parsonnet, and B. Schiller reviewed and edited the manuscript.

Data Sharing Statement

A limited dataset without PHI may be available upon review of request and appropriate data sharing agreements.

References


P.G., J.H., B.S., and G.A. contributed equally to this work.

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