



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Comparison of BNT162b2 (Pfizer–BioNtech) and mRNA-1273 (Moderna) SARS-CoV-2 mRNA vaccine immunogenicity in dialysis patients



To the editor: Patients with end-stage renal disease undergoing dialysis are at very high risk of death in case of coronavirus disease 2019.¹ Growing evidence suggests that a relatively high proportion of dialysis patients develops anti-severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) antibodies after vaccination, albeit to a lesser extent than healthy controls.² Here, we investigated whether there are differences in anti-SARS-CoV-2 antibody levels (directed against the receptor binding domain of the S1 subunit of the Spike [S] protein, measured with the SARS-CoV-2 IgG II Quant assay [Abbott]) in patients on hemodialysis without a history of SARS-CoV-2 infection after full vaccination (2 doses) with 1 of the 2 currently available mRNA vaccines (BNT162b2, Pfizer–BioNtech; or mRNA-1273, Moderna) against SARS-CoV-2, three weeks after administration of the second vaccine dose. A patient flowchart, study methods, patient demographics, and additional analyses are shown in [Supplementary Figure S1](#), the [Supplementary Methods](#), [Supplementary Table S1](#), and [Supplementary Figures S2 and S3](#). In the entire cohort (N = 116), 3 patients (2.6%; 2 vaccinated with BNT162b2, 1 vaccinated with mRNA-1273) remained anti-S-antibody negative.

Patients vaccinated with mRNA-1273 showed significantly higher anti-S-antibody titers (median: 1507; interquartile range

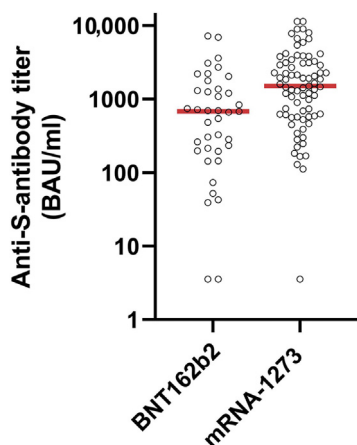


Figure 1 | Anti-S-antibody titers (log-scale) in hemodialysis patients according to vaccine type. Open circles indicate anti-S-antibody titers of individual patients. Horizontal red lines indicate median antibody titers. BAU, binding antibody units.

Editor's Note

In this issue of the *Journal*, several important preliminary data regarding the immunogenicity of mRNA vaccines in patients on maintenance dialysis are published. The Editors took option to report those data because there are accumulating questions regarding the “best vaccine” in terms of immune response and the sensitivity to vaccines of emerging variants now referred to as *variants of concerns* (VOCs). They also invite the readers to look at the paper devoted to the mechanisms of escape developed by these variants in the Journal Club of this issue of *Kidney International*. In a study comparing 2 mRNA vaccines, Kaiser *et al.* report that in a small and select cohort, hemodialysis patients vaccinated with mRNA-1273 (Moderna) showed higher anti-S antibody titers than patients vaccinated with BNT162b2 (Pfizer–BioNtech), but the cellular immune response was not analyzed. In another letter to the editor, Speer *et al.* investigated the neutralization of variants B.1.1.7 (alpha—first detected in the UK) and B.1.351 (beta—first detected in South Africa) using sera taken 3 weeks after the second BNT162b2 dose in 30 patients receiving maintenance hemodialysis and 18 healthy controls. While all healthy controls showed neutralizing activity against both the B.1.1.7 and B.1.351 variants, the ID₅₀ (i.e., serum dilution that inhibits 50% of the infectivity) was lower in hemodialysis patients with neutralizing antibodies against the VOC B.1.351 variant detected in only 15 of the 24 immunized patients. Blazquez-Navarro *et al.* examined the cellular and humoral immunity toward SARS-CoV-2 reference and alpha and beta strains in COVID-19 convalescent (n = 18) and BNT162b2-vaccinated dialysis patients (n = 22). They showed a significantly higher number of humoral responders to VOC and titers of neutralizing antibodies to both SARS-CoV-2 and VOC in convalescent compared to fully vaccinated dialysis patients. Similar data were reported for cellular immune response. While these data should be interpreted with caution due to multiple limitations, such as small sample sizes, select cohorts, and limited adjustment for comorbidities, they also raise significant concern regarding ongoing risk for COVID-19 disease in vaccinated dialysis patients. Additional data will be crucial in coordinating future vaccination recommendations in this vulnerable patient population.

[IQR]: 612–3112 binding antibody units [BAU]/ml) than did patients vaccinated with BNT162b2 (median: 676; IQR: 197–1363 BAU/ml; $P < 0.0013$; Figure 1). After correction for age, sex, diabetes status, serum albumin, dialysis dose, previous kidney transplantation, ongoing immunosuppressive medication, and active malignancy, patients who were vaccinated with mRNA-1273 showed 2.98-fold higher anti-S-antibody titers than did patients vaccinated with BNT162b2 in a linear regression analysis ($P < 0.0003$). In a sensitivity analysis including only patients without ongoing immunosuppressive therapy ($n = 102$), anti-S-antibody titers of patients who were vaccinated with mRNA-1273 were 2.39-fold ($P < 0.005$) higher compared with patients who were vaccinated with BNT162b2.

In conclusion, patients on hemodialysis who were vaccinated with mRNA-1273 showed higher anti-S-antibody titers than did patients vaccinated with BNT162b2.

SUPPLEMENTARY MATERIAL

[Supplementary File \(PDF\)](#)

Supplementary Methods.

Figure S1. Patient flowchart.

Figure S2. Patients with a history of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection ($N = 8$; mRNA-1273: $N = 5$, BNT-162b2: $N = 3$) showed higher anti-S-antibody titers (median: 9418; interquartile range [IQR]: 6114–11,360 binding antibody units [BAU]/ml) than patients without prior SARS-CoV-2 infection (median: 1200; IQR: 447–2275 BAU/ml).

Figure S3. Beta-coefficients \pm 1.96 SEs of the multivariate linear regression analysis with anti-S-antibody titers as the dependent variable.

Table S1. Patient demographics.

Supplementary References.

1. Jager KJ, Kramer A, Chesnaye NC, et al. Results from the ERA-EDTA Registry indicate a high mortality due to COVID-19 in dialysis patients and kidney transplant recipients across Europe. *Kidney Int.* 2020;98: 1540–1548.
2. Simon B, Rubey H, Treipl A, et al. Haemodialysis patients show a highly diminished antibody response after COVID-19 mRNA vaccination compared to healthy controls [e-pub ahead of print]. *Nephrol Dial Transplant.* <https://doi.org/10.1093/ndt/gfab179>. Accessed May 22, 2021.

Robert A. Kaiser¹, Maria C. Haller^{1,2}, Petra Apfalter³, Heidrun Kerschner³ and Daniel Cejka¹

¹Department of Medicine III—Nephrology, Hypertension, Transplantation, Rheumatology, Geriatrics, Ordensklinikum Linz–Elisabethinen Hospital, Linz, Austria; ²Institute of Clinical Biometrics, Center for Medical Statistics, Informatics and Intelligent Systems (CEMSIIS), Medical University Vienna, Austria; and ³Institute for Hygiene, Microbiology and Tropical Medicine, Ordensklinikum Linz–Elisabethinen Hospital, Linz, Austria

Correspondence: Daniel Cejka, Department of Medicine III Nephrology, Transplantation, Rheumatology, Geriatrics, Ordensklinikum Linz–Elisabethinen, Fadinger Strasse 1, 4020 Linz, Austria. E-mail: daniel.cejka@ordensklinikum.at

Kidney International (2021) **100**, 697–698; <https://doi.org/10.1016/j.kint.2021.07.004>

Copyright © 2021, International Society of Nephrology. Published by Elsevier Inc. All rights reserved.

Superior cellular and humoral immunity toward SARS-CoV-2 reference and alpha and beta VOC strains in COVID-19 convalescent as compared to the prime boost BNT162b2-vaccinated dialysis patients



To the editor: Patients undergoing maintenance dialysis (DP) have a high risk of fatal coronavirus disease 2019 (COVID-19).¹ Recent epidemiological data raise apprehension with respect to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) variants of concern (VOC) for DP.^{2,3} Therefore, ensuring cellular and humoral immunity directed to SARS-CoV-2 including VOC isolates is essential for this population. There are no data on vaccine-induced nor on natural SARS-CoV-2 infection-induced long-term immunity and its responsiveness to VOC isolates in DP.

Here, we assessed cellular and humoral immunity to SARS-CoV-2 reference strain and alpha as well as beta VOC in 18 patients convalescing from mild or moderate COVID-19, which were compared to 22 age- and sex-matched DP after prime boost BNT162b2 vaccination ([Supplementary Table S1](#)). The great majority of infections occurred in November 2020 in Germany; therefore, contact of the convalescent subcohort with VOCs is unlikely. Appearance of the alpha and beta variants in Great Britain and South Africa, respectively, was first reported in December 2020.

Our data demonstrate a significantly higher number of humoral responders to VOCs and titers of neutralizing antibodies to both SARS-CoV-2 and VOCs in convalescent compared with vaccinated DPs ([Figure 1a](#) and [b](#)). Accordingly, cellular immune response also demonstrated significantly higher levels and functionality of T cells directed to the Spike (S)-protein of SARS-CoV-2 and VOCs in convalescent compared with vaccinated DPs. Frequencies of S-protein-reactive CD4⁺ T cells ([Figure 1c](#)) including effector molecule-producing T cells ([Supplementary Figure S1](#)) as mono- or polyfunctional cells were significantly higher in convalescent DPs. Furthermore, frequencies of S-protein-reactive CXCR5⁺ follicular T helper cells and effector memory T cells—phenotypes associated with T-cell functionality—were also significantly higher in convalescent patients ([Figure 1f](#) and [g](#)). For the employed gating strategy, see [Supplementary Figure S2](#); representative dot plots of cytokine expression are shown in [Supplementary Figure S3](#).

The data obtained from DPs (who were convalescent for >5 months), compared with data from vaccinated DPs, suggest superiority of adaptive immunity directed to SARS-CoV-2 and VOCs. This is remarkable, due to the longer time since infection compared with time from vaccination. The data on