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Correspondence on 'Immunogenicity and safety of anti-SARS-CoV-2 mRNA vaccines in patients with chronic inflammatory conditions and immunosuppressive therapy in a monocentric cohort'

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Patients with immune-mediated inflammatory diseases (IMID) have largely been excluded in clinical trials of SARS-CoV-2 mRNA vaccines due to both disease status and immunotherapeutics used. A recent study by Geisen *et al* has shown that patients with IMID using immunotherapeutics exhibited significantly lower antibody titres against the SARS-CoV-2 spike protein (S) after full vaccination with a SARS-CoV-2 mRNA vaccine relative to vaccinated healthy controls (HCs), suggesting a compromised SARS-CoV-2 mRNA vaccine antibody response in this population.[1] Furthermore, a separate study by Boyarsky *et al* found that a proportion of patients with IMID with or without immunomodulatory therapy failed to seroconvert after the first dose with a SARS-CoV-2 mRNA vaccine.[2] Here, we quantified SARS-CoV-2 mRNA vaccine-induced anti-S and receptor-binding domain (RBD) antibodies among fully vaccinated HCs and found that antibody levels in patients with IMID using immunotherapeutics were significantly lower than HCs.

A total of 66 HCs and 8 patients with IMID who had been fully vaccinated (BNT162b2 or mRNA-1273) for at least 2 weeks were recruited. All participants received their first vaccination between 13 December 2020 and 5 February 2021 and the second dose between 3 January 2021 and 5 March 2021. Individuals with known prior SARS-CoV-2 infection were excluded. IMID diagnoses included psoriasis, rheumatoid arthritis, systemic lupus erythematosus (SLE), mixed connective tissue disease, hidradenitis suppurativa and inflammatory bowel disease. All patients with IMID were on an immunomodulatory therapy, including biologic and non-biologic disease-modifying antirheumatic drug therapy, corticosteroid or combination therapy (table 1). Demographic information is detailed in online supplemental table S1. Additionally, non-vaccinated non-convalescent healthy individuals (n=8) were included as controls. Fully quantitative anti-SARS-CoV-2 immunoglobulin G (IgG) antibodies were measured with the COVID-SeroIndex ELISA kit (Kantaro and Bio-Techne, USA), assessing both anti-S and RBD antibodies.[3]

Table 1 Patient-level IMID diagnosis, immunotherapeutic regimen and anti-S IgG level

Age	Sex	IMID diagnosis	Immunotherapeutic regimen	Anti-S IgG (AU/mL)
30s	F	HS and LCV	Tofacitinib	16.4
40s	F	Ulcerative colitis	Infliximab and azathioprine	52.0
50s	F	RA	Hydroxychloroquine	102.8
60s	F	SLE	Methotrexate	84.8
60s	M	Psoriasis and PsA	Ixekizumab	90.5
60s	F	RA, SLE and MCTD	Mycophenolate	214.1
60s	F	SLE	Methotrexate and prednisone 5 mg	120.9
60s	F	RA and SLE	Prednisone 5 mg	Undetectable

anti-S, anti-spike protein; HS, hidradenitis suppurativa; IgG, immunoglobulin G; IMID, immune-mediated inflammatory disease; LCV, leukocytoclastic vasculitis; MCTD, mixed connective tissue disease; PsA, psoriatic arthritis; RA, rheumatoid arthritis; SLE, systemic lupus erythematosus.

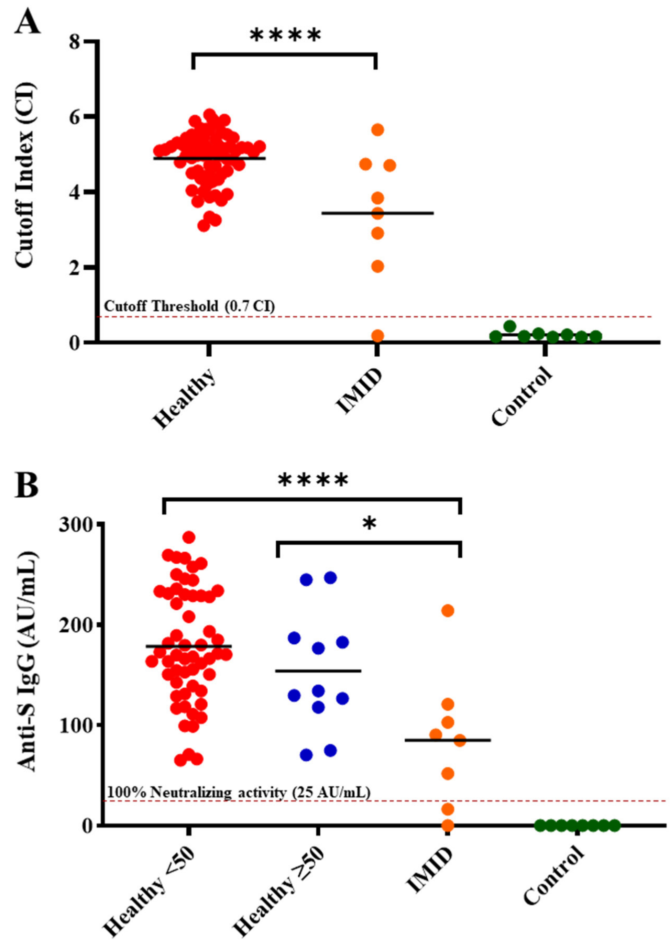

Figure 1 Patients with IMID treated with immunotherapeutics have reduced levels of SARS-CoV-2 vaccine-induced antibody. (A) Semiquantitave anti-RBD IgG levels were measured in 66 HCs and 8 IMID patients who had been fully vaccinated for at least 2 weeks. Non-vaccinated healthy participants were included as controls (n=8). The red dashed line (0.7 CI) indicates the cut-off threshold correlating to the presence or the absence of antibody per manufacturer (Kantaro and Bio-Techne). Individuals with RBD levels above the 0.7 cut-off threshold moved forward for anti-S IgG quantification. (B) Fully quantitative anti-S IgG levels were measured in the study population: healthy: <50 years old (n=55), healthy: ≥50 years old (n=11), IMID (n=8) and control (n=8). Individuals with RBD levels below the 0.7 cut-off level were assigned a value of 0. The red dashed line (25 AU/mL) indicates the threshold correlating to 100% neutralising antibody levels per manufacturer. Horizontal black bars indicate mean IgG levels. Unpaired two-tailed t-test. *p<0.05; ****p<0.0001. Anti-S, anti-spike protein; CI, cut-off index; HCs, healthy controls; IgG, immunoglobulin G; IMID, immune-mediated inflammatory diseases; RBD, receptor-binding domain.

As expected, all vaccinated HCs achieved seroconversion (anti-RBD positive), which is in line with clinical trial results from mRNA-12735 and BNT162b2.6,[4 5] while one patient with IMID and all non-vaccinated non-convalescent HCs were below the detectable limit (figure 1A). Given a mean age of 55.9 years (range: 33–68 years) among patients with IMID, HCs were split into groups of less than 50 years of age (mean age: 34.4 years (range: 21–49 years); n=55) and 50 years or older (mean age: 56.4 years (range: 50–66 years); n=11). Anti-S-IgG antibody levels were comparable between the <50-year-old and ≥50-year-old HC groups (p=0.19), with a mean of 178.7 AU/mL (95% CI, 163 to 194) and 153.8 AU/mL (95% CI, 114 to

194), respectively (figure 1B). Antibody levels among patients with IMID were significantly lower (85.2 AU/mL (95% CI, 29 to 141)) compared with two HC groups, suggesting a compromised vaccine-induced antibody response among patients with IMID (figure 1B). IMID patient-level demographics, diagnosis, immunotherapeutics regimen and individual anti-S-IgG antibody levels are outlined in table 1. One patient with SLE on low-dose prednisone failed to seroconvert, and one patient with hidradenitis suppurativa on tofacitinib had an anti-S-IgG level below the threshold of 25 AU/mL correlating to 100% neutralising antibody level.

Our study reveals that fully vaccinated patients with IMID using immunotherapeutic regimens had significantly lower levels of anti-S antibody relative to HCs, extending Geisen *et al*'s findings[1] that patients with IMID using immunotherapeutics produce lower titres of vaccine-induced anti-SARS-CoV-2 antibodies. In contrast to Giesen *et al*, where all patients with IMID had seroconversion after full vaccination, we observed one patient with IMID who did not mount a detectable antibody response after full vaccination, which was also suggested by Boyarsky *et al*,[2] although after only a single vaccination. While most patients with IMID did mount a detectable anti-S antibody response after full vaccination, it remains unknown how much protection this provides or if the response is durable. Limitations of the current study and Geisen et *al*'s findings[1] include a relatively small sample size and the absence of extended longitudinal measurements. Further investigation using greater numbers of patients with IMID and specific immunotherapeutic regimens will be required to assess antibody levels longitudinally and characterise SARS-CoV-2 memory B cell and T cell responses. These data are urgently needed to plan effective vaccination approaches for patients with IMID, including when and if booster doses will be required and if holding certain immunotherapeutics before and after vaccination may be necessary to achieve a meaningful correlate of protection.

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