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RESEARCH LETTER

A Study of Humoral Immune Response to Inactivated COVID-19 Vaccine in Patients with Psoriasis Receiving Biologics and Small Molecules

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Coronavirus disease 2019 (COVID-19) has become a global public health problem due to its rapid transmission and high infection rate. A crucial defense against SARS-CoV-2 infection is vaccination, which is mostly accomplished by generating protective antibodies.[1] Biologics and small molecule medications have been developed recently to give patients with psoriasis new alternatives.[2] COVID-19 vaccine was safe and effective for patients with psoriasis who were receiving biologics.[3] Tyrosine kinase 2 inhibitors (TYK2i) are presently employed as a novel small molecule medicine targeting TYK2 to intervene in the release of psoriasis-associated inflammatory factors; however, the majority of current data focus on clinical trials evaluating its application in the treatment of psoriasis.[4] Evidence on its effect on the immune response of patients following vaccination is lacking. By recognizing the Spike protein of SARS-CoV-2, neutralizing antibodies (NAbs) specifically target the receptor-binding domain (RBD) of Spike protein and block its binding to angiotensin-converting enzyme 2 (ACE2), thereby preventing the virus from entering host cells and preventing infection.[5] In order to investigate the impact of systemic treatments on the humoral immune response following COVID-19 vaccination in patients with psoriasis, we measured the concentrations of SARS-CoV-2 NAbs.

We recruited patients from the Department of Dermatology. Participants were excluded from having a history of exposure to or infection with COVID-19, and SARS-CoV-2 infection was excluded using PCR testing. This study was approved by the ethics committee of The First Affiliated Hospital of Chongqing Medical University, Chongqing, China (Ref no: 2023–116). The research process complied with the Declaration of Helsinki. Written informed consent was obtained from all patients. All patients received inactivated COVID-19 vaccines (either Sinovac-CoronaVac or Sinopharm/BBIBP COVID-19 vaccines).

Blood samples were collected between 2 weeks and 6 months following vaccination and were centrifuged at 1000 × g for 15 minutes at 4°C overnight. Then serum was collected, divided, and frozen at −80°C. We used the SARS-CoV-2 Neutralizing Antibody Test Kit (CusaBio) based on enzyme-linked immunosorbent assay (ELISA) to measure the concentrations of SARS-CoV-2 NAbs. Follow-up experiments were performed after diluting the serum samples by a factor of 10, and the experiments were repeated for each sample. Absorbance (OD value) was measured at 450 nm wavelength by an enzyme-labeled instrument. The specific operation process is carried out according to the manufacturer's instructions.

Statistical analyses were performed using GraphPad Prism 8 (GraphPad Software Inc., USA). Continuous variables with normal distribution were expressed as mean ± standard deviation (SD). Student's *t*-test or one-way ANOVA was applied to evaluate the difference between groups. If the continuous variables were not subject to normal distribution, the median (interquartile range) was used, and the difference between groups was evaluated by the Mann–Whitney U or Kruskal–Wallis test. A paired sample *t*-test was used to compare two groups of different samples from the same patients, and the Wilcoxon test was used if the distribution did not meet the normal distribution. P-value < 0.05 was considered statistically significant.

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A total of 46 serum samples were collected. The mean age of the participants was 47.2 ± 14.0 years, 82.6% of the patients were male, and the mean body mass index (BMI) was 24.9 ± 2.8 kg/m2. The average duration of psoriasis was 15.9 ± 8.0 years. Fourteen patients had comorbidities and 28 patients had smoking habits. All participants were vaccinated with inactivated COVID-19 vaccine, and serum samples were collected from 35 participants following 2-dose of COVID-19 vaccine, 23 participants following 3-dose of COVID-19 vaccine, and only one received 1-dose of COVID-19 vaccine (Table 1).

Following 2-dose of COVID-19 vaccination, the median (25th–75th percentiles) SARS-CoV-2 NAb concentrations of the psoriasis patients treated with TYK2i, IL-17i and IL-12/23i were 2936 ng/mL (1544–3749 ng/mL), 2337 ng/mL (1645–4198 ng/mL) and 4198 ng/mL (1701–8177 ng/mL), respectively, and the difference was not statistically significant (p = 0.9787) (Figure 1A). After 3-dose of the COVID-19 vaccination, the median concentrations of serum SARS-CoV-2 NAb in patients treated with TYK2i and IL-17i and IL-12/23i were 4980 ng/mL (4274–25,346 ng/mL), 5165 ng/mL (3615–7853 ng/mL) and 6287 ng/mL (4776–10,772 ng/mL), and the difference was not significant (p = 0.6356) (Figure 1B). The results showed that the serum NAbs in patients who received 2-dose of COVID-19 vaccine was lower than patients who received 3-dose of COVID-19 vaccine (median: 2353 ng/mL; 25th–75th percentiles: 1633–4076 ng/mL VS median: 5450 ng/mL; 25th-75th percentiles: 4148–7853 ng/mL, p < 0.0001) (Figure 1C). Thirteen participants completed follow-up visits after 2-dose and 3-dose of COVID-19 vaccination. We therefore paired and analyzed their respective blood samples and found that the 2-dose COVID-19 vaccine developed lower titers of SARS-CoV-2 NAb than the 3-dose vaccine (median: 2104 ng/mL; 25th-75th percentiles: 1601–3403 ng/mL VS median: 4837 ng/mL; 25th-75th percentiles: 3653–7962 ng/mL, p = 0.0034) (Figure 1D).

Our data found that patients treated with TYK2i produced NAbs that were similar to those treated with IL-17i and IL-12/23i. Simultaneously, 3-dose of COVID-19 vaccine were more effective than 2-dose in inducing SARS-CoV-2 NAbs production, the result was consistent with another study.[6]

Interestingly, serum samples were collected from the same patients following 2-dose and 3-dose of inactivated vaccine, respectively, for the analysis of NAbs, it was found that while booster-dose vaccination was conducive to improving the level of NAbs in psoriasis patients overall, two participants showed a decrease in NAb titers after the booster-dose vaccination. We discovered that these two participants took blood samples nearly 6 months after receiving

Table 1 Baseline Characteristics of the Cohort

Characteristic	TYK2i (n=11)	IL-17i (n=24)	IL-12/23i (n=11)	Total (n=46)
Age, years; mean±SD	45.8±14.2	49.7±14.2	43.4±13.4	47.2±14.0
Male, n (%)	8(72.7)	21(87.5)	9(81.8)	38(82.6)
BMI, kg/m^2; mean±SD	23.8±2.6	25.2±2.7	25.3±3.1	24.9±2.8
Disease course, years; mean±SD	15.6±7.2	14.8±8.0	18.4±9.0	15.9±8.0
Comorbidities*, n (%)	3(27.3)	9(37.5)	2(18.2)	14(30.4)
Diabetes	0(0.0)	2(8.3)	1(9.1)	3(6.5)
Hypertension	2(18.2)	2(8.3)	1(9.1)	5(10.9)
Psoriatic arthritis	1(9.1)	2(8.3)	1(9.1)	4(8.7)
High cholesterol	0(0.0)	2(8.3)	0(0.0)	2(4.3)
Tuberculosis infection	0(0.0)	2(8.3)	1(9.1)	3(6.5)
Non-alcohol fatty liver disease	1(9.1)	0(0.0)	0(0.0)	1(2.2)
COVID-19 vaccination, n (%)				
1-dose	0(0.0)	1(4.2)	0(0.0)	1(2.2)
2-dose	9(81.8)	22(91.7)	4(36.4)	35(76.1)
3-dose †	3(27.3)	10(41.7)	9(81.8)	22(47.8)
Smoking habit, n (%)				
Yes	7(63.6)	13(54.2)	8(72.7)	28(60.9)
No	4(36.4)	11(45.8)	3(27.3)	18(39.1)

Notes: *Participants can have more than one category. †Booster dose.
Abbreviations: BMI, body mass index; TYK2i, tyrosine kinase 2 inhibitors; IL-17i, interleukin-17 inhibitors; IL-12/23i, interleukin-12/23 inhibitors.

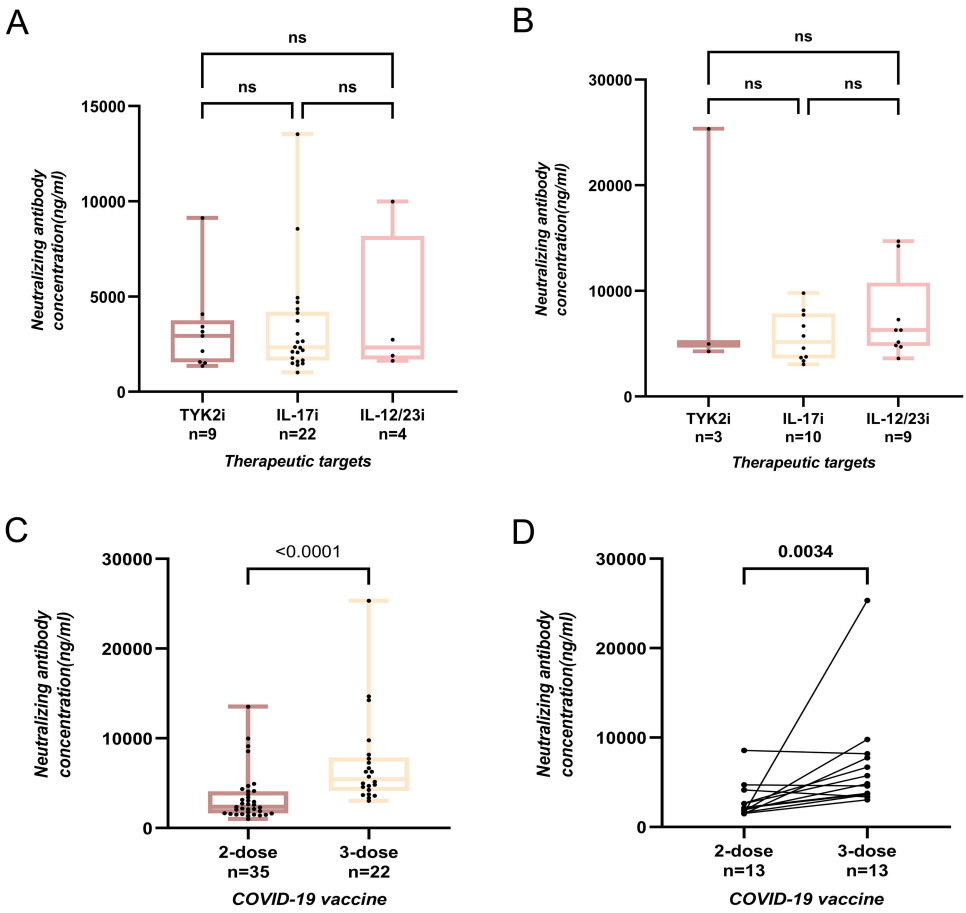

Figure 1 Serologic response to inactivated vaccine grouped by therapeutic targets and number of doses administered. (**A**) NAb concentrations (ng/mL) did not differ significantly among therapeutic targets (TYK2i, IL-17i, IL-12/23i) after 2-dose of vaccination. (**B**) NAb concentrations (ng/mL) did not differ significantly among therapeutic targets (TYK2i, IL-17i, IL-12/23i) after 3-dose of vaccination. (**C**) NAb concentrations (ng/mL) were significantly higher in patients who received 3-dose (booster dose) of COVID-19 vaccine than in patients who received 2-dose of vaccine. (**D**) Concentrations of NAb (ng/mL) were significantly higher in same patients who received 3-dose (booster dose) of COVID-19 vaccine than in those who received 2-dose. Box plots here and in subsequent figures show median (horizontal bar), with dots representing the minimum to the maximum value. "ns" represents no statistically significant difference. Differences were assessed by the Kruskal–Wallis test, Mann–Whitney *U*-test or Wilcoxon test.

the booster-dose vaccine, a much longer interval than the other 11 participants. It might be that immunity stimulated by the vaccine was waning over time[7] and that the concentrations of NAb decreased dramatically 6 months following vaccination. During the epidemic, psoriasis patients showed poor compliance due to fear of the virus and lack of proper guidance from their attending physicians, as evidenced by switching their therapeutic medications and delaying, or incompletely receiving the COVID-19 vaccine, which affected the patients' antibody level following COVID-19 vaccination. Therefore, dermatologists should be proactive in removing confusion and give personalized recommendations depending on the patient's condition.[8,9]

The study has limitations, including a small sample size and the absence of healthy individuals as controls, which made it impossible to assess whether the humoral immune response was compromised and whether the concentrations of SARS-CoV-2 NAbs differed between psoriasis patients receiving systemic therapy and the general population. Nor did we compare the concentrations of NAb in patients receiving inactivated COVID-19 vaccine from those receiving other types of COVID-19 vaccines.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Li M, Wang H, Tian L, et al. COVID-19 vaccine development: milestones, lessons and prospects. *Signal Transduct Target Ther*. 2022;7:146. doi:10.1038/s41392-022-00996-y
2. Rendon A, Schäkel K, Bedini G. Psoriasis pathogenesis and treatment. *Int J Mol Sci*. 2019;21:20. doi:10.3390/ijms21010020
3. Damiani G, Allocco F, Malagoli P; Young Dermatologists Italian Network. COVID-19 vaccination and patients with psoriasis under biologics: real-life evidence on safety and effectiveness from Italian vaccinated healthcare workers. *Clin Exp Dermatol*. 2021;46(6):1106–1108. doi:10.1111/ced.14631
4. Abduelmula A, Gooderham MJ. TYK2 inhibition: changing the treatment landscape for psoriasis? *Expert Rev Clin Immunol*. 2022;18:185–187. doi:10.1080/1744666X.2022.2008240
5. Morales-Núñez JJ, Muñoz-Valle JF, Torres-Hernández PC, Hernández-Bello J. Overview of neutralizing antibodies and their potential in COVID-19. *Vaccines*. 2021;9:1.
6. Zhang Y, Ma X, Yan G, et al. Immunogenicity, durability, and safety of an mRNA and three platform-based COVID-19 vaccines as a third dose following two doses of CoronaVac in China: a randomised, double-blinded, placebo-controlled, Phase 2 trial. *E Clin Med*. 2022;54:101680. doi:10.1016/j.eclinm.2022.101680
7. Kvist-Hansen A, Pérez-Alós L, Al-Sofi RF, et al. Waning humoral and cellular immunity after COVID-19 vaccination in patients with psoriasis treated with methotrexate and biologics: a cohort study. *Br J Dermatol*. 2023;188(5):661–669. doi:10.1093/bjd/ljad023
8. Conti A, Damiani G, Ruggeri R, et al. Switching infliximab in psoriatic patients during COVID-19 pandemics: a real-life retrospective study comparing intra-versus interclass switching strategies. *Dermatol Ther*. 2021;34(5):e15088. doi:10.1111/dth.15088
9. Bragazzi NL, Riccò M, Pacifico A, et al. COVID-19 knowledge prevents biologics discontinuation: data from an Italian multicenter survey during RED-ZONE declaration. *Dermatol Ther*. 2020;33(4):e13508. doi:10.1111/dth.13508