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Antibody and Interferon response in HIV patients following mRNA-based SARS-CoV-2 vaccine

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Introduction/Summary

Published data demonstrate that the mRNA-based SARS-CoV-2 vaccine elicits humoral and cellular immunity in HIV-1 individuals. However, the impact of the innate immune response on the efficacy of COVID-19 vaccination in HIV-1 infected individuals over time remains to be defined. Therefore, we aimed to analyze the anti-Spike antibody response and type I Interferon (IFN-I) signature in HIV-1 patients receiving COVID-19 vaccine over a one-year longitudinal study.

Study Design and Methods

Blood samples were collected from HAART-treated HIV-1 individuals (n=75) at baseline (prior to SARS-CoV-2 vaccination, T0), at the time of the second (2nd) dose (T1), 1 (n=48) or 6 months (n=27) after the 2nd dose (T2) and 1 year after the 2nd dose (T3). Measurement of SARS-CoV-2 Trimeric IgG was performed by chemiluminescent immunoassay. The levels of anti-SARS-CoV-2 IgG were compared to a group of healthy donors (HD, n=28) at each time point. Gene expression of IFN-I (IFN-alpha, IFN-beta and IFN-omega) was measured by RT/Real Time PCR in PBMC from 68 patients. Statistical analysis for differences in anti-Spike IgG and IFN mRNA levels was performed on the maximum number of observations available for each time point. Anti-S IgG, IFN-alpha, IFN-beta and IFN-omega mean levels over time were compared modelling a generalized estimating equation population-averaged regression model with an identity link, a gaussian error structure and exchangeable correlation structure and performing post-hoc pairwise comparisons of IgG levels means, adjusted for multiple comparison through the Bonferroni correction. The same regression models, in multivariable fashion, were built to estimates beta coefficients (β) and associated confidence intervals (CI) of factors influencing Anti-S IgG, IFN-alpha, IFN-beta and IFN-omega mean levels over time.

Results

Anti-Spike Trimeric IgG levels increased over time

- Anti-SARS-CoV-2 Trimeric IgG levels increased significantly at T1 compared to T0, and at T2 compared to T1 ($p<0.001$), and there was a trend toward an increase at T3 in comparison to T2 (Figure 1). HDs showed the same trend of a longitudinal increase in anti-SARS-CoV-2 Trimeric IgG (T0 vs T1 and T2 vs T3 $p<0.001$) (Figure 1). No significant differences were observed in anti-SARS-CoV-2 Trimeric IgG levels between HIV-1 positive individuals and HDs.
- The development of IgG was not affected by age, gender, CD4+ count, duration of HAART therapy or by the baseline gene expression of IFN-alpha, IFN-beta and IFN-omega at any time point analyzed.

IFN-I transcriptional analysis

- Transcriptional analysis of type I IFNs over time revealed a decrease for IFN-alpha, IFN-beta, and IFN-omega at T2 in comparison with T1 and T0 ($p<0.01$) (Figure 2, Panel A-B-C). On the contrary, increased levels of IFN-alpha and IFN-omega were observed at T3 in comparison to T2 ($p<0.05$) (Figure 2, Panel A-C). Similarly, IFN-beta showed a trend toward a higher expression at T3 compared to the previous time point analyzed (Figure 2, Panel B).
- We found positive effect of CD4 baseline count on the expression levels of IFN-alpha ($p=0.019$), IFN-beta ($p=0.015$) and IFN-omega ($p=0.007$) over time.

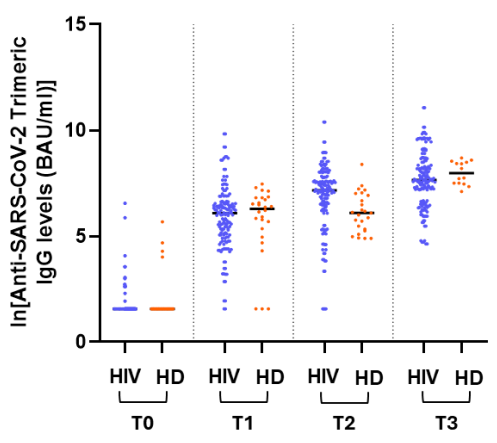

Figure 1. Levels of anti-SARS-CoV-2 IgG [ln(BAU/ml)] measured in serum samples collected from HIV-1 individuals (HIV, n=75) and in healthy donors (HD, n=28) at T0, T1, T2 and T3 according to the SARS-CoV-2 vaccine administrations. Median values of anti-S IgG levels are reported, for each group of study, with a black horizontal line.

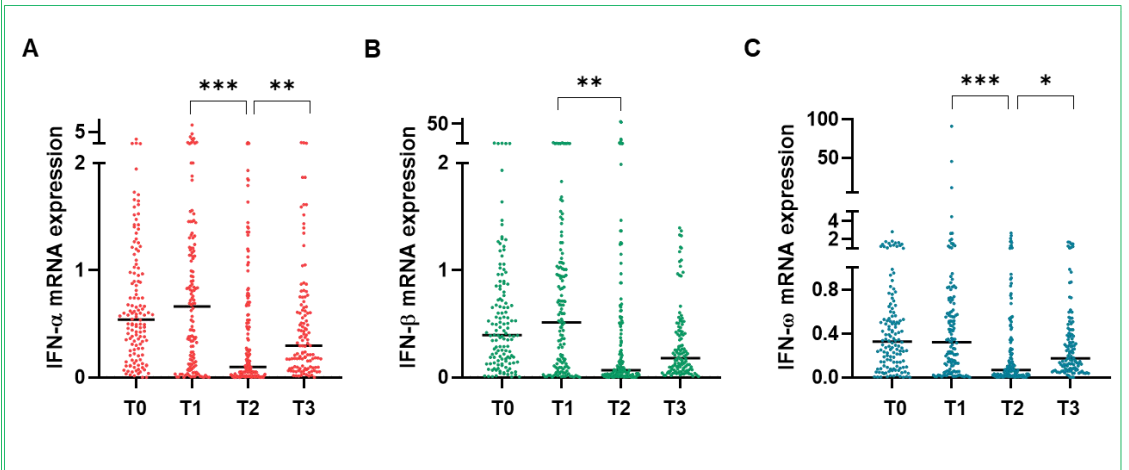

Figure 2. Longitudinal expression levels of IFN-alpha (Panel A), IFN-beta (Panel B), IFN-omega (Panel C) measured by Real Time PCR in PBMC collected from HIV-1 individuals (n=68) who underdoing SARS-CoV-2 vaccination. Median values of gene expression levels are reported, for each time point, with a black horizontal line.

Conclusion

- These results indicate that SARS-CoV-2 vaccine promote antibodies production in HIV-1 patients similar to the healthy subjects.
- Additionally, we showed that COVID-19 vaccination could be associated to the modulation of the IFN-I signature that is positively influenced by the baseline CD4 count.

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