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Analysis of Myocarditis following mRNA COVID-19 Vaccination at Single-Cell Level: Integrating scRNA-Seq and scATAC-Seq

Seugi Kim[1], Jinhwa Kong[1], Sang Cheol Kim[1],Ju-Hee Lee[1*]

[1]*Division of Healthcare and Artificial Intelligence, National Institute of Health, KDCA, Cheongju-si, Chungcheonbuk-do, 28159, Republic of Korea*

**Corresponding author: juheelee.md@gmail.com*

The administration of mRNA COVID-19 vaccines has been associated with various complications, including myocarditis. This study aimed to investigate alterations in the immune system linked to myocarditis following mRNA vaccine administration, focusing on individual cell-level gene expression and the underlying biological mechanisms and accessibility patterns. To achieve this, we integrated single-cell RNA sequencing (scRNA-seq) and single-cell assay for transposase-accessible chromatin sequencing (scATAC-seq) to characterize transcriptome profiles of peripheral blood mononuclear cells (PBMCs) from COVID-19 vaccine recipients before and after vaccination, as well as from individuals who developed myocarditis.

We employed Seurat and Signac for processing and analyzing scRNA-seq and scATAC-seq data, while SingleR was used for defining cluster identities. Our analysis revealed the presence of 10 distinct PBMC subgroups both before and after mRNA COVID-19 vaccination, encompassing a variety of cell types such as T cells, B cells, monocytes, and more. Intriguingly, among patients who developed myocarditis after mRNA vaccination, we identified over 15 diverse cell-type clusters, including endothelial cells, macrophages, monocytes, T cells, and others.

Differential gene expression analysis was conducted by comparing gene expression before and after vaccination. Remarkable differentially expressed genes (DEGs) included *RPS4Y1, CRIP1, IFIRM3, THIBS1, and HBB* in the overall group. Notably, in patients with myocarditis following mRNA vaccination, the top 10 DEGs were *MALAT1, RPS18, RPS25, RPL7A, B2M, RPS4Y1, BBLN, RASAL2, ZEB1, and RGCC*, highlighting a more pronounced differential gene expression profile in this cohort.

These findings offer valuable insights into alterations in cellular composition induced by mRNA vaccination and their potential relevance to myocarditis and immune responses. Further research is imperative to delve into the intricacies of this complex phenomenon and enhance our comprehension of myocarditis prevention and treatment.