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Circulating Spike Protein Detected in Post–COVID-19 mRNA Vaccine Myocarditis

Lael M. Yonker, MD, Zoe Swank, PhD, Yannic C. Bartsch, PhD, Madeleine D. Burns, MS, Abigail Kane, MD, Brittany P. Boribong, PhD, Jameson P. Davis, BS, Maggie Loiselle, BS, Tanya Novak, PhD, Yasmeen Senussi, MBBS, Chi-An Cheng, PhD, Eleanor Burgess, MS, Andrea G. Edlow, MD, Janet Chou, MD, Audrey Dionne, MD, Duraisamy Balaguru, MD, Manuella Lahoud-Rahme, MD, Moshe Arditi, MD, Boris Julg, MD, PhD, Adrienne G. Randolph, MD, Galit Alter, PhD, Alessio Fasano, MD and David R. Walt, PhD

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Shedding Light on Mechanisms of Myocarditis With COVID-19 mRNA Vaccines

Abstract

Background:

Cases of adolescents and young adults developing myocarditis after vaccination with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)–targeted mRNA vaccines have been reported globally, but the underlying immunoprofiles of these individuals have not been described in detail.

Methods:

From January 2021 through February 2022, we prospectively collected blood from 16 patients who were hospitalized at Massachusetts General for Children or Boston Children's Hospital for myocarditis, presenting with chest pain with elevated cardiac troponin T after SARS-CoV-2 vaccination. We performed extensive antibody profiling, including tests for SARS-CoV-2–specific humoral responses and assessment for autoantibodies or antibodies against the human-relevant virome, SARS-CoV-2–specific T-cell analysis, and cytokine and SARS-CoV-2 antigen profiling. Results were compared with those from 45 healthy, asymptomatic, age-matched vaccinated control subjects.

Results:

Extensive antibody profiling and T-cell responses in the individuals who developed postvaccine myocarditis were essentially indistinguishable from those of vaccinated control subjects, despite a modest increase in cytokine production. A notable finding was that markedly elevated levels of full-length spike protein (33.9±22.4 pg/mL), unbound by antibodies, were detected in the plasma of individuals with postvaccine myocarditis, whereas no free spike was detected in asymptomatic vaccinated control subjects (unpaired *t* test; $P<0.0001$).

Conclusions:

Immunoprofiling of vaccinated adolescents and young adults revealed that the mRNA vaccine–induced immune responses did not differ between individuals who developed myocarditis and individuals who did not. However, free spike antigen was detected in the blood of adolescents and young adults who developed post-mRNA vaccine myocarditis, advancing insight into its potential underlying cause.

Footnotes

*L.M. Yonker, Z. Swank, and Y.C. Bartsch contributed equally.

†A. Fasano and D.R. Walt contributed equally.

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Correspondence to: Lael M. Yonker, MD, Massachusetts General Hospital, 55 Fruit St, Jackson 14, Boston, MA 02114. Email Lyonker@mgh.harvard.edu
David R. Walt, PhD, Brigham and Women's Hospital, 60 Fenwood Rd, Boston, MA 02115. Email dwalt@bwh.harvard.edu

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