

Outcome of Post-Covid Vaccination Myocarditis in an Adolescent Male

Clinical Pediatrics
2023, Vol. 62(2) 162–165
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DOI: 10.1177/00092282221116207
journals.sagepub.com/home/cpj



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Introduction

Myopericarditis is a rarely reported adverse effect of the messenger ribonucleic acid (mRNA) coronavirus disease-2019 (COVID-19) immunizations. Nonsustained ventricular tachycardia (NSVT) secondary to myocarditis post-COVID-19 vaccination has rarely been reported in literature among the pediatric population and of those reported little is known about their follow-up. We report a case of an adolescent male with myocarditis post-mRNA COVID-19 vaccination, who despite having no arrhythmias during initial admission was noted to have NSVT on a post-discharge Holter monitor and recurrence 2 months later on an event monitor. Follow-up cardiac magnetic resonance imaging (CMR) at about 5 months from his initial presentation demonstrated improvement in CMR findings. In addition, 5.5 months from his initial presentation, a cardiac stress test and follow-up 30-day event monitor demonstrated resolution of ventricular tachycardia. These serial monitor findings have rarely been reported in the literature with such longitudinal follow-up.

Case Presentation

A 16-year-old male without significant past medical history presented to the emergency department (ED) with chest pain for 1 day. Three days prior to presentation, he received a second dose of the Pfizer mRNA COVID-19 vaccine. The following day, he experienced myalgias and fever up to 100.4°F which resolved with acetaminophen. The next day, he developed chest pain radiating to his left hand and chest tightness which prompted him to present to the ED. He denied shortness of breath, tachypnea, syncope, known sick contacts, or severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) exposure. On initial presentation, the patient was mildly tachycardic at 105 beats per minute but otherwise had a normal physical examination. Initial workup indicated elevated troponin level of 0.4 ng/mL (>99 percentile, normal <0.05 ng/mL) and mildly elevated N-terminal pro b-type natriuretic peptide level of 180 pg/mL (normal <92 pg/mL).

His C-reactive protein level and erythrocyte sedimentation rate were normal. His initial chest x-ray, comprehensive metabolic panel, and 12-lead electrocardiogram (ECG) were normal. His initial 2-dimensional (2D) echocardiogram showed normal biventricular systolic function, trivial mitral regurgitation, and a trace pericardial effusion along the right ventricular free wall. The coronary arteries were normal. The patient was noted to have rare premature ventricular complexes on telemetry. He was admitted to the intensive care unit.

Further workup included a respiratory virus panel (negative), a COVID-19 polymerase chain reaction test (negative), and SARS-CoV-2 spike antibodies (positive, qualitative only). Repeat ECG on the second day of the presentation showed sinus tachycardia with new modest ST segment elevation in leads II, III, aVF, V5, V6, reciprocal ST depression, and PR elevation in lead aVR. His troponin increased initially from 0.4 to 1.24 ng/mL on day 2 of hospitalization, despite the resolution of his chest pain. He was started on ibuprofen 400 mg every 6 hours and prednisone 30 mg twice daily (approximately 1.2 mg/kg/d based on body weight). The troponin level subsequently trended down to 0.7 ng/mL by the following day. Given his age, gender, clinical signs and symptoms, and timing of events post COVID-19 vaccination, vaccine-induced myocarditis was suspected. To confirm, a CMR was obtained on day 2 of hospitalization which demonstrated late gadolinium enhancement (LGE) in the subepicardial and transmural portions of the basal left ventricular free wall, mid-portion of left ventricle free wall, and the apex, all suggestive of myocarditis (Image 1A). In addition, regional myocardial edema was demonstrated in the lateral left ventricular wall on T2-weighted short-tau inversion recovery (T2w-STIR) imaging. These findings met the Lake Louise criteria for myocarditis as well as confirmed the case

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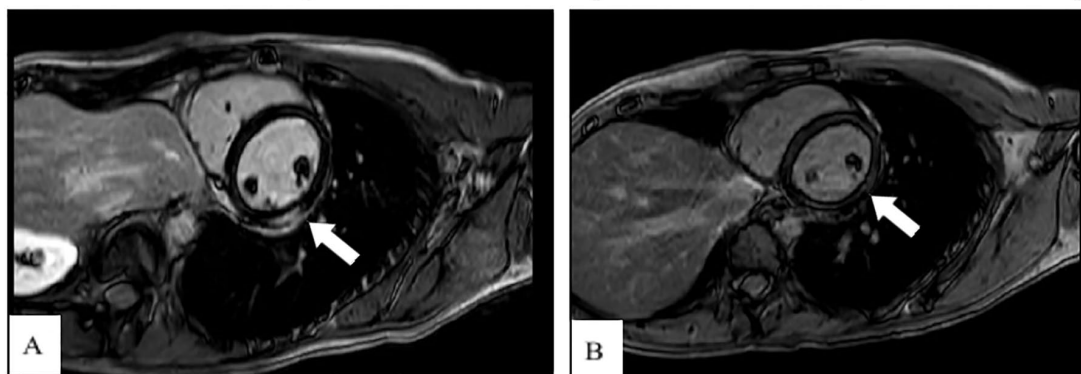
"Outcome of ventricular tachycardia in adolescent with post covid vaccination myocarditis: A case report"

Image 1. (A) Cardiac magnetic resonance imaging (MRI) demonstrating late gadolinium enhancement of left ventricular free wall (white arrow) in the subepicardial as well as transmural regions. (B) Some persistence, but improvement, in late gadolinium enhancement on follow-up MRI 5 months later.

definition of myocarditis per the Centers for Disease Control and Prevention (CDC) working case definition. The function was noted to be low normal for the left ventricle (ejection fraction 55%, lower limit normal 56%).

The patient was hemodynamically stable during the hospital stay. The patient was discharged home on day 3 of hospitalization with daily aspirin 81 mg and a 4-week prednisone taper (30 mg twice daily for 1 week, 10 mg twice daily for 2 weeks, 10 mg once daily for 1 week). At his 2-week follow-up, he reported intermittent palpitations and a 72-hour ambulatory ECG was performed, demonstrating a 24-beat run of NSVT (Image 2). He was started on atenolol 25 mg twice daily. Two months after his initial presentation, a follow-up 30-day event monitor demonstrated a 5-beat run of NSVT, during which time the patient was asymptomatic. A follow-up CMR was done about 5 months after the first, demonstrating persistence but improved LGE with no new affected areas (Image 1B). In addition, notable improvement was seen in myocardial edema. The left ventricular function was improved as well (ejection fraction 64%). At about 5 months from initial presentation, our patient had a cardiac stress test which demonstrated no arrhythmias and rare premature ventricular complexes in early recovery. Around the same time, he was placed on a 30-day event monitor which did not demonstrate ventricular tachycardia but there was rare ventricular ectopy (1%).

Discussion

Historically, myocarditis has been reported after smallpox, influenza, and tetanus vaccinations.^{1,2} Myocarditis and pericarditis have been reported in the United States

after BNT162b2 (Pfizer-BioNTech) and mRNA-1273 (Moderna) vaccines, particularly in adolescents and young adults.³ Although myocarditis was not reported following the clinical trials of mRNA COVID-19 vaccines,^{4,5} that was likely due to the limited number of patients in the clinical trials and the apparent rarity of this complication.⁶

As of April 6, 2022, the CDC reported 14.5 million US children and adolescents, aged 12 to 17, have completed 2-dose vaccination series (representing 58% of 12- to 17-year-olds).⁷ As of April 1, 2022, Vaccine Adverse Events Reporting System (VAERS) reported 599 adverse events related to myocarditis after COVID-19 vaccination in the 6- to 17-year age group. Five hundred and ninety-one cases were reported after the administration of Pfizer vaccine, of which 523 were male (88.5%), 66 were female (11.1%), and 2 were unknown (0.4%). The remaining 8 were after administration of the Moderna vaccine with a predominance toward males (62.5%) as well.⁸ Patients with COVID-19 vaccine-associated myocarditis seem to share common clinical characteristics, including a median age of 15 years (range 12-17 years), male gender, and onset of presentation 3 days after the second vaccine dose.⁹ The most commonly reported symptoms include chest pain, shortness of breath, myalgia, and tactile elevated temperature. Laboratory findings have demonstrated elevated serum troponin and B-natriuretic peptide levels. The most frequently reported ECG abnormality was ST segment elevation.⁹ Most patients had normal 2D echocardiogram findings.¹⁰ The above findings were similar to that of our patient.

A recent study reported that myocarditis following mRNA vaccine administration is associated with acute myocardial injury and edema of the myocardium in the

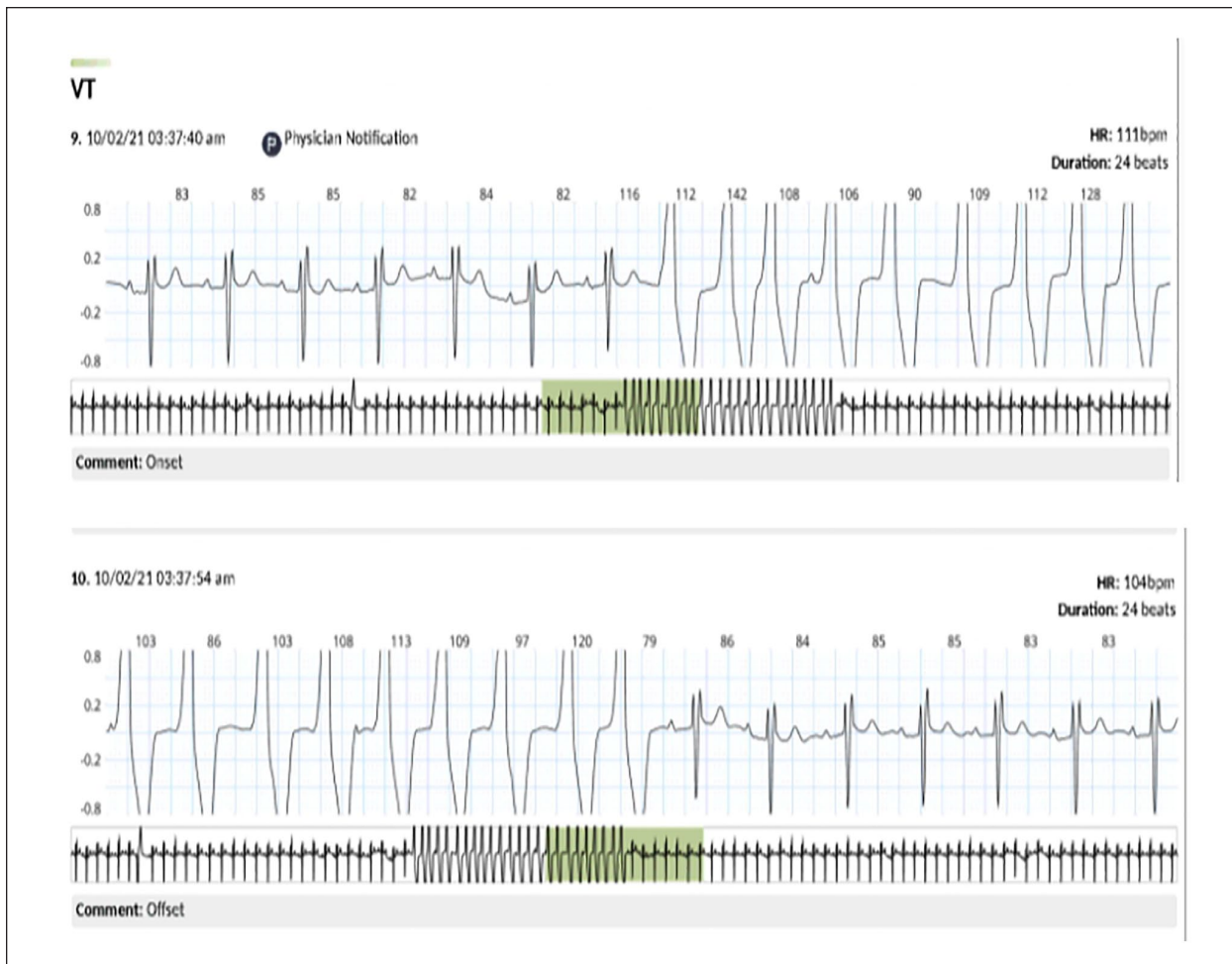


Image 2. Seventy-two-hour Holter monitoring revealing a 24-beat run of ventricular tachycardia.

presence of preserved ventricular function.¹¹ The initial clinical course and short-term outcomes are good and reassuring.¹¹ Gold standard test for myocarditis is myocardial biopsy. However, due to its invasive nature and possible sampling errors, CMR has emerged as the modality of choice to diagnose myocarditis.¹² Studies have reported LGE on CMR as a confirmatory finding to diagnose myocarditis. Management of myopericarditis for vaccine-associated myocarditis has been consistent with established treatments for other causes of myopericarditis including nonsteroidal anti-inflammatory drugs with steroids, intravenous immunoglobulin, colchicine, and with some opting for aspirin therapy as well.

Prior to receiving the vaccine, our patient neither had signs or symptoms of illness nor a personal history of arrhythmia. Although concurrent timing of a separate viral illness is theoretically possible, with a negative 17 respiratory virus polymerase chain reaction panel, normal electrolytes, absence of pertinent family history,

and no structural heart disease or cardiomyopathy, vaccine-induced myocarditis was the most plausible explanation. Genetic testing was not pursued due to lack of structural abnormality on echocardiogram or CMR, negative family history, and improvement of CMR findings over time. Our patient experienced no initial arrhythmias in the hospital. However, he was reported to have isolated premature ventricular complexes in the ED which was quite potentially related to the ventricular inflammation demonstrated on MRI. He was then discovered to have NSVT 2 weeks after discharge at home. Although one might expect arrhythmias earlier in the course of illness, it is entirely possible that he had such episodes even earlier at home but was not placed on an outpatient monitor until his first cardiology follow-up 2 weeks later. Our impression was that the new-onset ventricular tachycardia was likely a post-vaccination sequelae, similar to patients developing viral myocarditis-induced arrhythmias.

A recently published case series of COVID vaccine-induced myocarditis cases reported the evolution of CMR imaging compared with initial CMR,¹³ similar to our case. The same study also reported normal cardiac stress tests in patients with persistent CMR findings prior to sports clearance.¹³ Our study uniquely included serial home cardiac monitor results demonstrating gradual improvement in the severity of ventricular arrhythmia which has not been demonstrated in the literature.

The long-term prognosis of this adverse event is yet to be determined due to the rarity of its complication and the paucity of long-term outcome data. It is still yet to be determined how to use serial cardiac MRI findings, exercise tests, and event monitors as it pertains to returning to competitive sports. One limitation of this study similar to all suspected vaccine adverse events is the ability to confirm cause and effect rather than incidental timing. In addition, this specific patient's myocarditis course cannot necessarily be generalized to the entire population.

Conclusion

The CDC recommends vaccination of all children 6 months and older. The known risks of COVID-19 infection-associated myopericarditis far outweigh the risks associated with COVID-19 vaccine myopericarditis. That being said, it is important to acknowledge that myopericarditis from the COVID-19 vaccination may have sequelae in children such as arrhythmias acutely with long-term complications yet to be determined.

Author Contributions

Keerthana Reddy Banala has proposed the case report, completed the literature review, created manuscript draft. Stuart Covi has performed literature search, edited the manuscript and provided guidance throughout. Premchand Anne has edited the manuscript and provided guidance throughout. Shada Al-Anani has edited the manuscript and provided guidance throughout.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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