

Perimyocarditis after COVID-19 mRNA Vaccine: The Role of Cardiac Magnetic Resonance Imaging

Ashwin Kumar¹, Evan Harmon¹, Abdullah Yesilyaprak², Ankit Agrawal¹, Sayan Manna³, Paul Schoenhagen⁴, and Allan Klein¹

¹Cleveland Clinic

²Wayne State University

³Mt. Carmel Health System

⁴Cleveland Clin

February 22, 2024

Abstract

A 22-year-old male presented with chest pain 3 days after his second dose of the COVID-19 vaccine. Cardiac magnetic resonance imaging demonstrated myocardial and pericardial enhancement. Given imaging and clinical findings, he was diagnosed with perimyocarditis. He was treated with a multitude of medications including NSAIDs, colchicine, and steroids. Fortunately, he was able to achieve symptom improvement. Due to COVID-19 vaccination novelty, further research is needed to identify side effects.

Perimyocarditis after COVID-19 mRNA Vaccine: The Role of Cardiac Magnetic Resonance Imaging

Ashwin Kumar, BS^{1*}, Evan Harmon, MD^{1*}, Abdullah Yesilyaprak, MD¹, Ankit Agrawal, MD¹, Sayan Manna, MD², Paul Schoenhagen, MD³, Allan L. Klein, MD¹

*Contributed Equally

Institutional Affiliations: 1. Center for the Diagnosis and Treatment of Pericardial Diseases, Department of Cardiovascular Medicine, Heart and Vascular Institute, Department of Cardiovascular Medicine, Cleveland Clinic, Cleveland, Ohio, USA

2. Mt. Carmel Health System, Columbus, Ohio, USA

3. Imaging Institute, Cleveland Clinic, Cleveland, Ohio, USA

Corresponding Author:

Allan L Klein, MD Director, Pericardial Disease Center Department of Cardiovascular Medicine Cleveland Clinic 9500 Euclid Ave., Desk J1-5 Cleveland, OH 44195 Tel: (216) 444-3932 Fax # (216) 445-6145 Email: KLEINA@ccf.org Twitter: @AllanLKleinMD1

Word Count: 1288

Disclosures: A. Klein: research grant, scientific advisory board Kiniksa Pharmaceuticals, Ltd; scientific advisory board Swedish Orphan Biovitrum AB; scientific advisory board Pfizer, Inc. All other authors have no disclosures.

Funding: None

ABSTRACT:

A 22-year-old male presented with chest pain 3 days after his second dose of the COVID-19 vaccine. Cardiac magnetic resonance imaging demonstrated myocardial and pericardial enhancement. Given imaging and clinical findings, he was diagnosed with perimyocarditis. He was treated with a multitude of medications including NSAIDs, colchicine, and steroids. Fortunately, he was able to achieve symptom improvement. Due to COVID-19 vaccination novelty, further research is needed to identify side effects.

KEY WORDS: pericarditis, multimodality imaging, COVID-19, mRNA vaccine, cardiac magnetic resonance imaging

Presentation

A 22-year-old male with past medical history of Coxsackie myocarditis in 2019 presented to the emergency department with acute chest pressure and diaphoresis. He described his chest pain as squeezing with radiation to the back. The patient denied dyspnea, edema, and lightheadedness. Physical examination and vital signs were within normal limits. Cardiovascular exam showed regular rate, normal rhythm, S1, S2 sounds, and no pericardial rub. He was taking no medications and had received his second dose of the Pfizer (BNT162b2) mRNA Coronavirus-19 disease (COVID-19) vaccine 3 days prior to symptoms onset. Laboratory examination showed high sensitivity C-reactive protein (hs-CRP) (3.15 mg/L), troponin (126 ng/mL) and brain natriuretic peptide (105 pg/mL) levels were all elevated. Severe acute respiratory syndrome-Coronavirus-2 (SARS-CoV-2) IgG test was positive indicative of prior infection with COVID-19. Electrocardiogram (ECG) showed diffuse ST-segment elevation suggestive of pericarditis. CXR was negative. Bedside echocardiography (Echo) demonstrated mildly reduced ejection fraction (EF) (45%). Cardiac magnetic resonance imaging (CMR) identified a small pericardial effusion, and profound basal inferolateral and lateral myocardial involvement (**Figure 1A**). Given his clinical and imaging findings, he was diagnosed with perimyocarditis secondary to COVID-19 vaccination. He was prescribed Aspirin 650 mg TID, colchicine 0.6 mg BID, and 1 month prednisone taper (30 mg). At 6 week follow-up, the patient noted his pain was significantly improved. The patient had completed his steroid taper and discontinued aspirin therapy due to gastrointestinal distress. Laboratory markers and ECG were normal. Echo showed EF recovery (**Video 1**). Repeat CMR demonstrated interval improvement in pericardial effusion and delayed enhancement (**Figure 1B**). His colchicine was tapered to 0.6 mg daily and he was told to follow up in 4 months.

Discussion

COVID-19 vaccination efforts have been increasing resulting in many receiving mRNA vaccines. The COVID-19 mRNA vaccine encodes for the spike glycoprotein of the virus. The vaccine's liquid suspension particles allow for direct delivery of mRNA into host cells. Once intracellular, the mRNA upregulates ribosomal activity to create the spike glycoprotein.¹ The spike glycoprotein is then presented on the surface of the cell, this subsequently triggers the immune system to produce antibodies specific to the spike protein.^{1,2} COVID-19 vaccine side effects are typically mild and may involve local injection site pain, myalgia, and fatigue. Serious adverse effects are rare, but recent reports have suggested that mRNA COVID-19 vaccines may cause myocarditis, pericarditis, and myopericarditis. As of June 11th 2021, the Centers for Disease Control (CDC) have identified 323 cases of myocarditis, pericarditis, and myopericarditis in the United States.³ CDC findings suggest that afflicted patients are more likely to be male, younger with a median age of 19 years, and experience symptoms within two days after vaccination.³ The most common presenting symptoms include chest pain (85%-95%), fever (65%) dyspnea (19%-49%), and syncope (6%).⁴ The CDC also determined that patients were more likely to be hospitalized, but clinical course was mild as most patients recover fully.^{3,5} While no consensus mechanism has been elucidated, vaccine component hypersensitivity, inflammatory reaction, and inappropriate immune system activation have been mentioned as potential causes.⁴ Perimyocarditis diagnosis requires fulfillment of 2 out of 4 major criteria: pleuritic chest pain, auscultation of pericardial rub, ECG changes, and effusion on imaging.⁶ Additionally, patients must also have elevated biomarkers suggestive of myocardial injury (troponin) and reduced left ventricular function.⁴ Our patient presented with pleuritic chest pain, characteristic ECG changes, effusion on imaging, minor LV dysfunction, and biomarker elevation.

Imaging with Echo and CMR are useful for diagnosis and informing clinical course. Echo can identify the presence of effusion as well as be used for risk stratification in patients with cardiac tamponade.⁷ Findings of pericarditis on CMR include T1-weighted enhancement of the thickened pericardium, T2-weighted increased pericardial intensity, and presence of pericardial edema on delayed hyperenhancement (DHE).⁸ Notably, CMR findings of DHE in patients who develop non-vaccine myocarditis is associated with increased risk of cardiac complications.⁹ Therefore, assessing the long term risk of complications in patients who have DHE on CMR after vaccination is paramount.⁹ While much is still unknown about management of perimyocarditis in patients after COVID-19 vaccination, patients are treated using current guidelines for pericarditis management (non-steroidal anti-inflammatory drugs, colchicine, and/or steroids). Luckily, our patient was able to achieve clinical improvement on this regimen alone. Biologics (riloncept) are indicated in patients who develop dependence on NSAIDs, colchicine, and steroids.¹⁰ To our knowledge, this is one of the first reports of perimyocarditis after COVID-19 vaccination. Fortunately, these patients seem to experience mild disease courses. However, further observational studies are required to understand the side effects associated with COVID-19 vaccination.

Conclusion:

Perimyocarditis after COVID-19 mRNA vaccination is a rare occurrence. Patients present rapidly after vaccination, but overall have mild clinical courses. Diagnosis requires high clinical suspicion and proper clinical assessment. Multi-modality imaging especially CMR imaging is also helpful for diagnosis and management.

Author Contributions: Ashwin Kumar: Drafting article, critical revision of article, approval of article Evan Harmon: Drafting article, critical revision of article, approval of article Abdullah Yesilyaprak: Drafting article, critical revision of article, approval of article Ankit Agrawal: Drafting article, critical revision of article, approval of article Sayan Manna: Drafting article, critical revision of article, approval of article Paul Schoenhagen: Drafting article, critical revision of article, approval of article Allan Klein: Drafting article, critical revision of article, approval of article

References:

1. Jackson LA, Anderson EJ, Roupael NG, et al. An mRNA Vaccine against SARS-CoV-2 — Preliminary Report. *N Engl J Med* . 2020;383(20):1920-1931. doi:10.1056/NEJMoa2022483
2. Hendaus MA, Jomha FA. mRNA Vaccines for COVID-19: A Simple Explanation. *Qatar Med J* . 2021;2021(1). doi:10.5339/qmj.2021.7
3. Gargano JW, Wallace M, Hadler SC, et al. Use of mRNA COVID-19 Vaccine After Reports of Myocarditis Among Vaccine Recipients: Update from the Advisory Committee on Immunization Practices — United States, June 2021. *MMWR Morb Mortal Wkly Rep* . 2021;70(27):977-982. doi:10.15585/mmwr.mm7027e2
4. Hudson B, Mantooh R, DeLaney M. Myocarditis and pericarditis after vaccination for COVID-19. *J Am Coll Emerg Physicians Open* . 2021;2(4). doi:10.1002/emp2.12498
5. Lazaros G, Klein AL, Hatziantoniou S, Tsioufis C, Tsakris A, Anastassopoulou C. The Novel Platform of mRNA COVID-19 Vaccines and Myocarditis: Clues into the Potential Underlying Mechanism. *Vaccine* . 2021;39(35):4925-4927. doi:10.1016/j.vaccine.2021.07.016
6. Adler Y, Charron P, Imazio M, et al. 2015 ESC Guidelines for the diagnosis and management of pericardial diseases. *Eur Heart J* . 2015;36(42):2921-2964. doi:10.1093/eurheartj/ehv318
7. Chetrit M, Xu B, Verma BR, Klein AL. Multimodality Imaging for the Assessment of Pericardial Diseases. *Curr Cardiol Rep* . 2019;21(5):41. doi:10.1007/s11886-019-1115-y
8. Imazio M, Pivetta E, Palacio Restrepo S, et al. Usefulness of Cardiac Magnetic Resonance for Recurrent Pericarditis. *Am J Cardiol* . 2020;125(1):146-151. doi:10.1016/j.amjcard.2019.09.026
9. Dionne A, Sperotto F, Chamberlain S, et al. Association of Myocarditis With BNT162b2 Messenger RNA COVID-19 Vaccine in a Case Series of Children. *JAMA Cardiol* . Published online August 10, 2021.

doi:10.1001/jamacardio.2021.3471

10. Klein AL, Imazio M, Cremer P, et al. Phase 3 Trial of Interleukin-1 Trap Rilonacept in Recurrent Pericarditis. *N Engl J Med* . 2021;384(1):31-41. doi:10.1056/NEJMoa2027892

Figures:

Figure 1. Timeline of Disease Course

A. Initial CMR with basal inferolateral and lateral myocardial involvement (*arrows*) and associated pericardial effusion

(*star*)

B. Follow up CMR with interval improvement in pericardial effusion and delayed enhancement (*arrows*)

BNP: Brain Natriuretic Peptide

CMR: Cardiac Magnetic Resonance Imaging DHE: Delayed Enhancement Hs-CRP: High Sensitivity C - reactive protein

LV: Left Ventricle

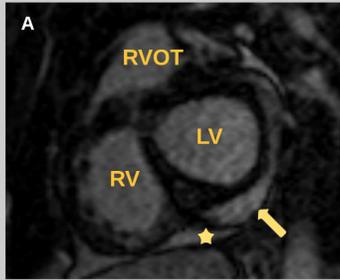
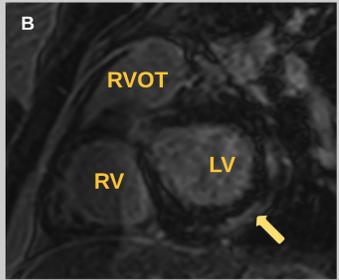
RV: Right Ventricle

RV: Right Ventricle Outflow Tract

Figure 2. Follow-Up Echocardiographic Findings

Four chamber apical view demonstrating normal biventricular function after symptom resolution.

LA: Left Atrium LV: Left Ventricle RA: Right Atrium RV: Right Ventricle

		April 2021 (Visit 1)	June 2021 (Visit 2)
Imaging Data	CMR		
	DHE		
Laboratory Data	Hs-CRP	3.15 mg/L	0.3 mg/L
	Troponin	126 ng/L	0.010 ng/L
	BNP	105 pg/mL	50 ng/mL
Management	Anti-inflammatories	Aspirin 650 mg TID, Colchicine 0.6 mg BID	Colchicine 0.6 mg QD
	Steroids	Prednisone 10 mg TID	None