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MYOCARDITIS FOLLOWING COVID-19 MRNA VACCINATION IN CHILDREN: REPORT OF TWO SEVERE PEDIATRIC CASES IN VIETNAM

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ABSTRACT

Introduction and objective: COVID-19 mRNA vaccines have demonstrated high efficacy; however, rare adverse events such as myocarditis have increasingly been reported. This report describes two cases of myocarditis occurring after the first vaccine dose, a presentation that remains uncommon in the literature.

Case presentation: Two previously healthy pediatric patients without underlying conditions presented with chest pain following mRNA vaccination. The first case had a moderate course with reduced ejection fraction (EF) and elevated cardiac enzymes, responding well to corticosteroid therapy. The second case presented with severe progression, including cardiogenic shock and complete atrioventricular block (third-degree AV block), requiring temporary pacing and vasopressor support.

Intervention and outcomes: Both patients received intensive medical treatment, including corticosteroids and cardiovascular support. Cardiac function and laboratory parameters fully recovered following treatment.

Conclusion: Myocarditis following mRNA COVID-19 vaccination is a rare but potentially severe adverse event, requiring close monitoring and timely management.

Keywords: Acute myocarditis; COVID-19 mRNA vaccine.

1. INTRODUCTION

The mRNA vaccine developed by Pfizer-BioNTech was granted Emergency Use Authorization by the U.S. Food and Drug Administration in December 2020 for adults and was subsequently extended to children aged ≥12 years in May 2021. Clinical studies have demonstrated high efficacy, with protection rates of 94%–95% in individuals aged 16–55 years and up to 100% in those aged 12–15 years [1]. Despite its favorable safety profile, rare adverse events such as myocarditis have been reported, previously associated with certain vaccines and more recently observed in young individuals following mRNA COVID-19 vaccination, predominantly after the second dose [4], [5], [6], [7].

In Vietnam, data on myocarditis following mRNA vaccination in children remain limited, particularly for cases occurring after the first dose. The documentation and detailed characterization of such cases are essential to contribute to the existing body of evidence, enhance clinical awareness, and optimize post-vaccination monitoring strategies. Therefore, we report two cases of acute myocarditis occurring after the first dose of the Pfizer-BioNTech mRNA COVID-19 vaccine in pediatric patients, presented in accordance with the CARE (Consensus-based Clinical Case Reporting) guidelines [8].

2. CASE PRESENTATIONS

2.1. CASE 1

2.1.1. Patient Information

A 14-year-old male adolescent with no prior medical history, no known drug allergies, and no relevant family or genetic conditions presented to the Pediatric Center of Bach Mai Hospital. He had a height of 172 cm and weight of 65 kg (BMI 21.6). The patient received the first dose of the Pfizer-BioNTech mRNA COVID-19 vaccine 4 days prior to symptom onset. His primary complaints included fever (maximum temperature 39°C), chest pain, dyspnea, and fatigue, without respiratory symptoms such as cough or rhinorrhea. There was no history of previous medical interventions before this episode.

2.1.2. Clinical Findings

On admission, the patient was alert but fatigued with chest pain. Vital signs included SpO_2 95%, heart rate 90 bpm, and blood pressure 120/70 mmHg. Lung auscultation was normal. Cardiac evaluation revealed reduced left ventricular ejection fraction (EF 48%) without structural abnormalities. Electrocardiography showed ST-segment elevation. Laboratory findings demonstrated markedly elevated cardiac biomarkers (Troponin T hs 1426 ng/L, NT-proBNP 974 pmol/L, CK-MB 63 U/L). Hepatomegaly (3 cm below costal margin) was also noted.

2.1.3. Timeline

Symptoms began 4 days post-vaccination with fever and chest pain, prompting hospital admission on 27/11/2021. Clinical improvement occurred within hours after

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treatment initiation, with progressive recovery over the following days. Cardiac function improved significantly by day 3 and normalized by day 7. The patient was discharged after 3 weeks with complete recovery.

2.1.4. Diagnostic Assessment

Diagnosis was based on clinical presentation, laboratory testing (elevated Troponin, CK-MB, NT-proBNP), electrocardiography (ST elevation), and echocardiography (reduced EF). SARS-CoV-2 RT-PCR was negative, excluding acute infection. Differential diagnoses included viral myocarditis and multisystem inflammatory syndrome in children, both considered less likely given clinical and laboratory findings. Final diagnosis: acute myocarditis following mRNA COVID-19 vaccination.

2.1.5. Therapeutic Intervention

Treatment included oxygen therapy (5 L/min for 3 days), methylprednisolone (1 mg/kg for 7 days followed by 0.5 mg/kg for 7 days), ibuprofen (5 mg/kg three times daily for 3 days), and furosemide (0.5 mg/kg/day for 3 days). Corticosteroid therapy was tapered based on clinical improvement and normalization of cardiac function.

2.1.6. Follow-up and Outcomes

The patient showed rapid clinical improvement, with resolution of chest pain within 3 days. Cardiac biomarkers and EF normalized within 7 days. At discharge after 3 weeks, the patient was asymptomatic with normal cardiac function and laboratory parameters. Treatment was well tolerated, with no adverse or unexpected events reported.

2.2. CASE 2

2.2.1. Patient Information

A 15-year-old female adolescent with no prior medical history, no drug allergies, and no relevant family or genetic conditions presented 2 weeks after receiving the first dose of the Pfizer-BioNTech mRNA COVID-19 vaccine. She developed chest pain, dyspnea, and fatigue for 4 days prior to admission. Initial management at a local health station with paracetamol was ineffective. Symptoms progressed to pallor, abdominal pain, nausea, hypotension, and bradycardia. No prior interventions were noted.

2.2.2. Clinical Findings

On presentation, the patient exhibited signs of cardiogenic shock, including pallor, cold extremities, delayed capillary refill (>3 seconds), bradycardia (40 bpm), and hypotension. Electrocardiography revealed complete atrioventricular (AV) block (third degree). After transfer to Bach Mai Hospital, she required oxygen support (SpO_2 96%) and temporary pacing (heart rate 83 bpm). Echocardiography showed reduced EF (42%). Cardiac biomarkers were significantly elevated (Troponin T hs 1036 ng/L, NT-proBNP 974 pmol/L, CK-MB 50 U/L).

2.2.3. Timeline

Symptoms developed 2 weeks after vaccination and worsened over 4 days before hospital admission on 10/12/2021. Immediate stabilization with pacing and vasopressors led to rapid improvement within hours. Cardiac function improved by 72 hours, conduction abnormalities resolved by day 7, and full recovery was achieved by 3 weeks.

2.2.4. Diagnostic Assessment

Diagnosis was established through clinical examination, ECG (complete AV block), echocardiography (reduced EF), and elevated cardiac biomarkers. SARS-CoV-2 RT-PCR was negative. Differential diagnoses included viral myocarditis and other causes of cardiogenic shock. Final diagnosis: acute myocarditis with cardiogenic shock and third-degree AV block following mRNA COVID-19 vaccination.

2.2.5. Therapeutic Intervention

The patient received oxygen therapy (5 L/min for 3 days), temporary cardiac pacing for 7 days, methylprednisolone (2 mg/kg for 7 days, followed by 1 mg/kg for 7 days and 0.5 mg/kg for 7 days), vasopressors (adrenaline 0.2 mcg/kg/min and noradrenaline 0.15 mcg/kg/min for 3 days), sedation (midazolam and morphine), milrinone (0.5 mcg/kg/min for 7 days then 0.3 mcg/kg/min for 3 days), and diuretics. Treatments were gradually tapered as the patient stabilized.

2.2.6. Follow-up and Outcomes

Clinical improvement was observed within 72 hours, with EF increasing to 54% and discontinuation of vasopressors. By day 7, cardiac function normalized (EF 62%), and conduction abnormalities resolved, allowing removal of the pacemaker. At 3 weeks, the patient was asymptomatic with near-normal laboratory findings. Treatment was well tolerated, with no reported adverse or unexpected complications.

Table 1. Summary of Key Clinical and Paraclinical Features in Two Cases of Post–mRNA Vaccine Myocarditis

Category	Case 1	Case 2
Time from vaccination	4 days after first dose	14 days after first dose
Main symptoms	Fever (39°C), chest pain, dyspnea, fatigue	Chest pain, dyspnea, fatigue, pallor, abdominal pain, vomiting
Severe signs	No shock	Cardiogenic shock, bradycardia (40 bpm), hypotension, cold extremities, capillary refill >3s
Heart rate – blood pressure (admission)	90 bpm; 120/70 mmHg	83 bpm (paced); 83/55 mmHg
SpO_2	95%	96% (on oxygen)
Hepatomegaly	3 cm below costal margin	3 cm below costal margin
Troponin T hs	1426 ng/L → 103 ng/L	1036–1337 ng/L → 136 ng/L
NT-proBNP	974 pmol/L → 116 pmol/L	974–1324 pmol/L → 149 pmol/L
CK-MB	63 U/L → 16 U/L	50 U/L → 23 U/L
CRP	0.8 → 0.5 mg/L (mildly elevated)	0.4 → 0.1 mg/L (not significantly elevated)

Category	Case 1	Case 2
Echocardiography (EF)	48% → 62%	42% → 62%
Electrocardiogram	ST-segment elevation → normal	Complete AV block (grade III) → normal sinus rhythm
SARS-CoV-2 PCR	Negative	Negative
Conduction abnormalities	None	Complete AV block (severe)
Disease severity	Moderate	Severe (cardiogenic shock + AV block III)
Response at 72 hours	Symptom improvement, EF increased	Chest pain resolved, EF improved, vasopressors tapered
Time to EF recovery	~7 days	~7 days
Final outcome	Full recovery after 3 weeks	Full recovery after 3 weeks
Key distinguishing features	Markedly elevated cardiac enzymes, ST elevation, mild–moderate EF reduction	Cardiogenic shock, complete AV block requiring pacing and vasopressors

3. DISCUSSION

These are among the first reported cases of myocarditis in Vietnam identified after COVID-19 mRNA vaccination in children. Notably, in our report, myocarditis occurred after the first vaccine dose, which differs from most published studies where this complication is rare and typically occurs after the second dose [3], [4], [5], [6]. The incidence of post-vaccination myocarditis reported in the literature varies depending on factors such as seasonality, ethnicity, age, and sex. Reported rates include 1.95 per 100,000 children under 15 years in Finland and 2.16 per 100,000 individuals in a U.S. military population [9], [10]. A study from Israel by Witberg et al. reported an incidence of 2.13 per 100,000 individuals aged 16–29 years following mRNA COVID-19 vaccination [5]. In Vietnam, as of December 20, 2021, a total of 10,312,960 vaccine doses had been administered to children aged 12–17 years, including 7,020,377 first doses and 3,292,583 second doses, with coverage rates of 77.2% for at least one dose and 36.2% for full vaccination, all using Pfizer-BioNTech mRNA vaccines [2]. Although nationwide data on myocarditis are not yet available, our findings provide early evidence of a potentially severe adverse event associated with this vaccine in pediatric populations.

Clinically, both patients presented with chest pain, while fever was observed in only one case. Symptom onset ranged from 4 to 14 days after the first vaccine dose. The second case demonstrated severe manifestations, including cardiogenic shock with fatigue, pallor, bradycardia, hypotension, and prolonged capillary refill. Laboratory findings in both cases consistently indicated myocardial injury, with markedly elevated CK-MB, Troponin T, and NT-proBNP levels, and no evidence of multisystem inflammatory syndrome in children. Electrocardiographic abnormalities included ST-segment elevation and complete atrioventricular block (grade III), while echocardiography showed reduced ejection fraction in both cases.

Compared with previous studies, our cases exhibited several notable differences. Dionne et al. reported 15 cases of myocarditis in the United States, predominantly in male adolescents (mean age 15 years), occurring after the second dose of the Pfizer-BioNTech vaccine, with symptom onset within 1–6 days. All patients presented with chest pain, 67% had fever, and all showed elevated cardiac biomarkers. Only 20% had reduced ejection fraction, and none required intensive care [6]. Similarly, Marshall et al. described seven adolescent cases, all occurring after the second dose, with generally mild symptoms such as chest pain, limited cardiac dysfunction, and no requirement for oxygen or vasopressor support. Treatment was primarily anti-inflammatory therapy and corticosteroids, with some patients receiving intravenous immunoglobulin [7]. In contrast, one of our patients developed severe cardiogenic shock and conduction disturbances requiring advanced interventions, highlighting a potentially more severe clinical spectrum.

The World Health Organization has acknowledged a possible association between mRNA COVID-19 vaccines and myocarditis, particularly in individuals under 39 years of age. However, these events remain rare and are typically mild, with most cases resolving rapidly [3]. Importantly, the benefits of vaccination—estimated to provide 91% protection against severe COVID-19 outcomes including hospitalization and death—far outweigh the very low risk of adverse events such as myocarditis.

4. CONCLUSION

In conclusion, although myocarditis following mRNA COVID-19 vaccination is rare, it may present with severe and life-threatening manifestations in pediatric patients. Therefore, careful monitoring after vaccination, early recognition of symptoms, and prompt management at adequately equipped healthcare facilities are essential to ensure optimal outcomes.

5. PATIENT PERSPECTIVE AND CONSENT

During the study, both patients and their legal guardians demonstrated full cooperation and provided informed consent for the use of clinical information for research and publication purposes.

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