

# Complete atrioventricular block due to multisystem inflammatory syndrome in children: a case report

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## ABSTRACT

**Background.** Cardiac manifestations in multisystem inflammatory syndrome in children (MIS-C) may involve the conduction system. The incidence and publication is still very limited.

**Case.** We report the case of a 2-year-old girl who presented with complete atrioventricular (AV) block with a current infection of SARS-CoV-2 and fulfilled the criteria of MIS-C. After observation for 2 weeks of the SARS-CoV-2 convalescence phase and temporary pacemaker insertion, the complete AV block was not resolved. The intrinsic junctional escape beat was only 40 beats/minute. We decided to implant a dual-chamber epicardial permanent pacemaker to maintain synchrony between atrium and ventricle and furthermore provide hemodynamic stability. We observed persistent complete AV block 9 months after SARS-CoV-2 infection in long-term follow up of this patient.

**Conclusions.** Complete AV block in MIS-C could persist months after its onset. Our case could give additional knowledge regarding the natural history of cardiac involvement after SARS-CoV-2 infection

**Key word:** MIS-C, complete AV Block, permanent pacemaker.

Two years since the start of COVID-19 pandemic, scientist have gained more knowledge about its ability to affect many organ. Although children with COVID-19 mostly show mild symptoms there is growing risk to develop multisystem inflammatory syndrome in children (MIS-C) during or after the infection. Cardiac manifestation in MIS-C has varied signs and symptoms and poses worse prognosis.<sup>1</sup> Conduction disturbance in particular could be irreversible far beyond MIS-C onset.

## Case Report

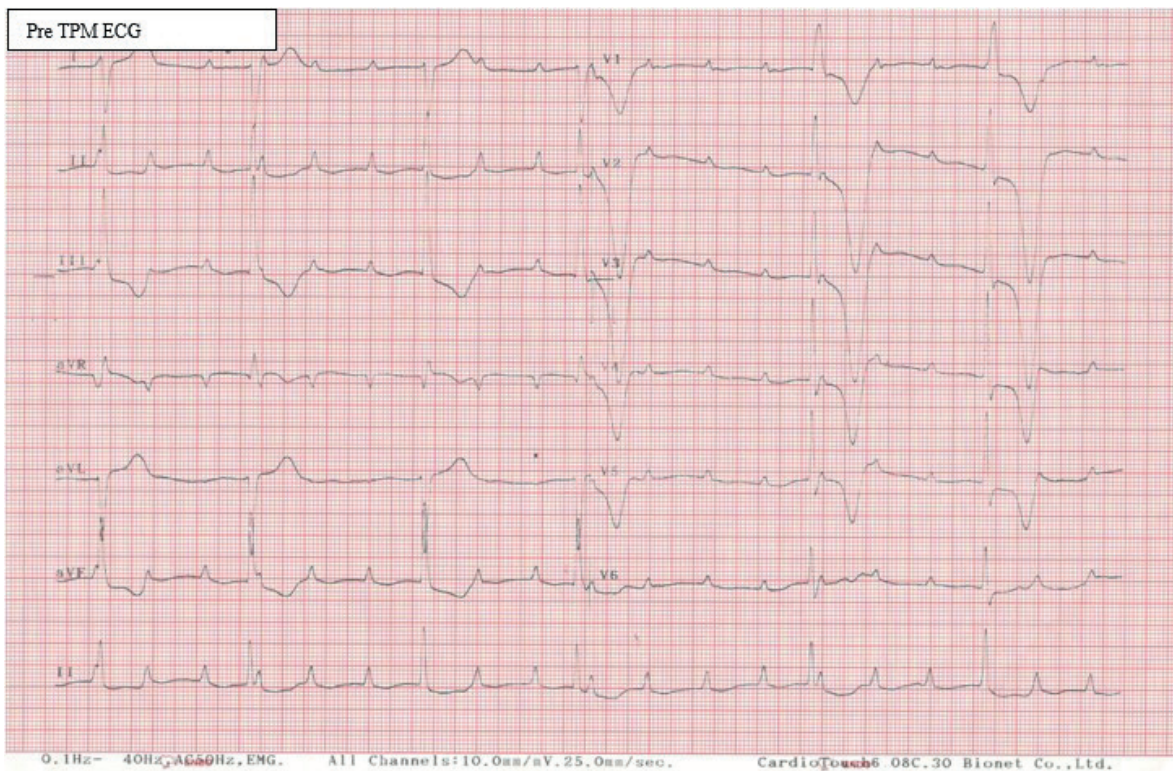
A 2-year-old girl presented with headache and syncope since one day prior. Her electrogram (ECG) revealed complete atrioventricular

(AV) block (Fig. 1). The SARS-CoV-2 PCR swab test showed positive. She had a history of 5 days of fever, vomiting, constipation, and gastrointestinal infection 2 weeks before the first hospitalization at another hospital. She was admitted to the previous hospital for 4 days and her vital signs were unremarkable. Three days after her first hospital discharge, on current admission, we sent her to the pediatric intensive care unit (PICU) for urgent temporary pacemaker. Echocardiography prior to temporary pacemaker placement showed moderate left ventricular dysfunction (ejection fraction [EF] 40%; fractional shortening [FS] 18%) and no structural heart defect.

Bedside temporary pacemaker was inserted urgently under hemodynamic monitor guidance. The lead was inserted via the right jugular vein and placed at right ventricular high mid-septal, initial setting was set at sensitivity 3 mV, output 5 mA, and rate 80 bpm. Following

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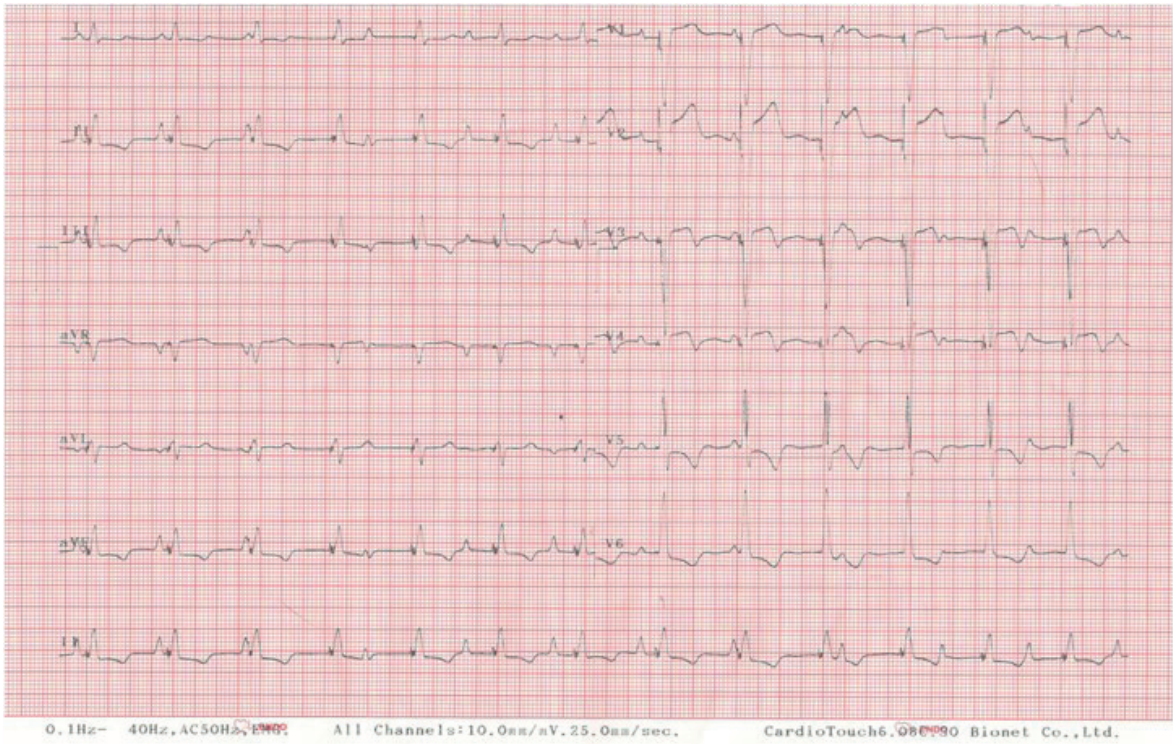


**Fig. 1.** Complete AV block ECG (Before temporary pacemaker placement).

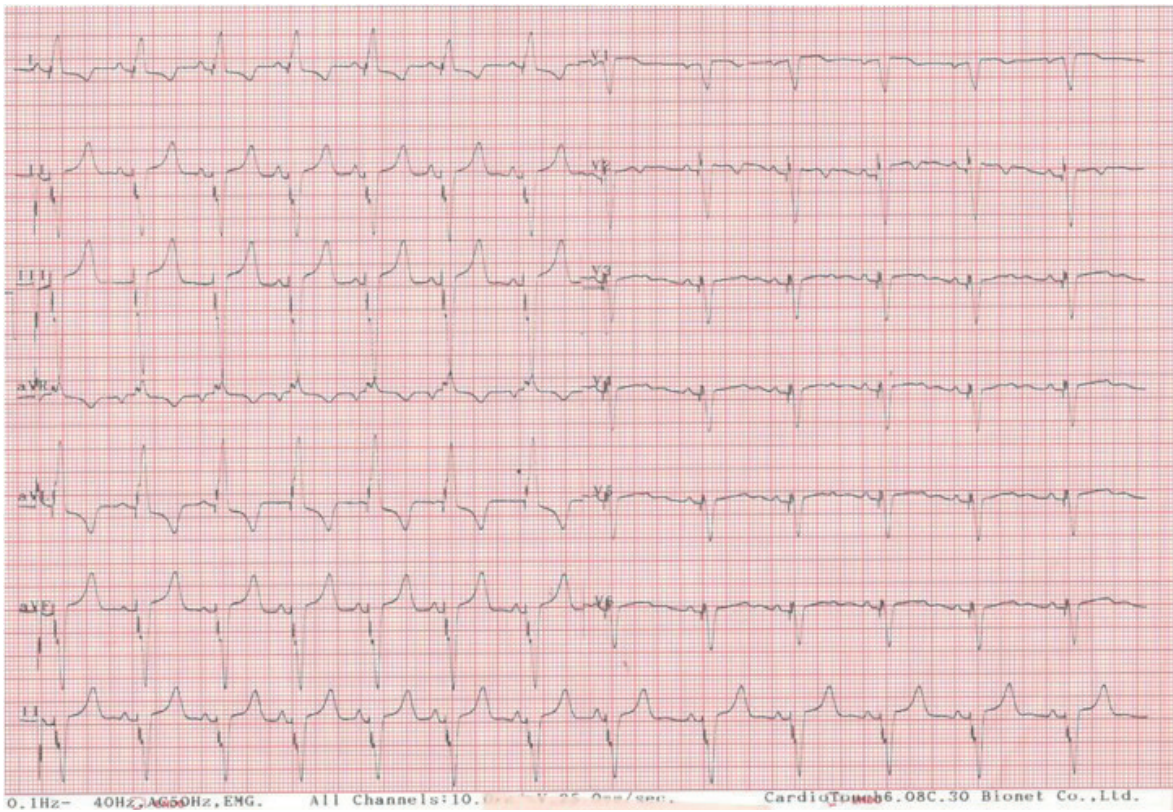
the implantation, the surface ECG showed all the pacing spike captured the ventricular myocardium with a heart rate of 80 bpm (Fig. 2). The blood pressure was 104/70 mmHg, and oxygen saturation on room air was 100%. Left ventricular dysfunction resolved (EF 56%; FS 28%) after temporary pacemaker placement.

On the following day, the blood serum investigation revealed: leucocytes  $13.15 \times 10^3/\mu\text{L}$  (N: 5000-15,000/ $\mu\text{L}$ ) and lymphocyte percentage 13.1% (N: 20-40%). C-reactive protein 27.2 mg/L (N: <5 mg/L), procalcitonin 0.14 ng/mL (N: <0.05 ng/mL), D-dimer 720  $\mu\text{g/L}$  (N: <440  $\mu\text{g/L}$ ), fibrinogen 712 mg/dL (N: 200-400 mg/dL), and Troponin I 140.9 pg/mL (N: <15.6 pg/mL). On day 2 of admission, SARS-CoV-2 PCR showed negative results and immunoglobulin G antibody of SARS-CoV-2 was reactive. On day 6 of admission, D-dimer level increased to 3300  $\mu\text{g/L}$ . She was given heparin 10 unit/kg/hour and methylprednisolone 15mg every 12 hours for two weeks.

Complete AV block with an intrinsic junctional escape rhythm at 40 bpm persisted after 2 weeks of convalescence phase of SARS-CoV-2. Therefore, dual chamber epicardial permanent pacemaker was implanted in right atrial appendage and mid right ventricle septum. The permanent pacemaker (PPM) mode was dual chamber pacing (DDD) with lower rate set at 70 bpm (Fig. 3). Parameter of atrial lead showed the sensitivity 2.5 mV, and impedance 250 Ohm, whereas, parameter of ventricular lead was sensitivity dependent (<1.5 mV), and impedance 349 Ohm. Five months after PPM implantation, during PPM check, the intrinsic ventricular rate was 20 bpm, with atrial sensing 86.9 %, and ventricular pacing 86.9 %. On the last outpatient visit, 9 months after PPM implantation, we still observed persistent complete AV block but patient condition was stable. Parents gave the authors permission to publish this case.



**Fig. 2.** Post Temporary Pacemaker ECG (VVI rate 80 bpm, sensitivity 3 mV, output 5 mA).



**Fig. 3.** Post permanent pacemaker ECG (ECG showing atrial-sensed and ventricular-paced rhythm after permanent pacemaker (PPM) implantation at a lower rate of 70 beats per minute).

## Discussion

The Centers for Disease Control and Prevention (CDC) definition of MIS-C is an individual aged <21 years with fever greater than 38°C, evidence of inflammation on laboratory examination, multisystem organ involvement, no alternative plausible diagnoses and positive for current or recent SARS-CoV-2 Infection.<sup>1</sup> In our case, the patient presented with history of 5 day-fever, headache, history of syncope before admission, complete atrioventricular block, positive result of SARS-CoV-2 infection, history of gastrointestinal problems, elevated inflammatory marker and elevated coagulation profile. The child in our case met the criteria of MIS-C.

Among children with COVID-19, 0.14% of them developed MIS-C.<sup>2</sup> Cardiac involvement was estimated in 80% of children with MIS-C.<sup>3</sup> The cardiac manifestations include ventricular dysfunction, coronary artery aneurysms, conduction abnormalities, and arrhythmias. Bradyarrhythmia in children with MIS-C varied from sinus bradycardia, first degree AV block, second degree AV block and complete AV block.<sup>3</sup> Data from small retrospective cohort study reported that 4% of children with MIS-C developed complete AV block and manifested within the first week after onset of fever in children with MIS-C.<sup>4</sup> Children under 5 years of age with MIS-C tended more often to have cardiac involvement.<sup>5</sup> Our patient was 2 years of age and complete AV block was identified 3 weeks after onset of fever.

The etiology of AV block is still unknown, but it might be a secondary response due to the inflammation and the result of direct virus invasion. It has been reported that with immunomodulatory and antiviral therapy, the inflammatory markers trended downward, and episodes of heart block resolved, thus indicating that inflammation is likely the main cause of conduction.<sup>6</sup> Recent literature showed most of bradyarrhythmia in children with MIS-C

was transient.<sup>6-8</sup> Nevertheless, other literatures involving adult subjects with COVID-19 reported persistent complete AV block requiring permanent pacemaker placement.<sup>9,10</sup> Our case showed irreversible complete AV block until 9 months following permanent pacemaker implantation.

Permanent pacemaker placement is indicated in children with complete AV block due to irreversible cause.<sup>11</sup> After 2 weeks of temporary pacemaker implantation, our patient still had persistent complete AV block that warranted the need for a permanent pacemaker. We planned to do a permanent pacemaker evaluation in the hospital. Current guidelines suggest doing pacemaker evaluations regularly, every 6-12 months.<sup>11</sup> We hope our case will give additional knowledge regarding the natural history of cardiac involvement after SARS-CoV-2 infection.

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## Ethical approval

The authors have received parental permission to publish this case.

## Author contribution

The authors confirm contribution to the paper as follows: study conception and design: AR, RS, MMD; data collection: AR, SRN; analysis and interpretation of results: AR, RS, SRN, MMD; draft manuscript preparation: AR, RS. All authors reviewed the results and approved the final version of the manuscript.

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**Conflict of interest**

The authors declare that there is no conflict of interest.

**REFERENCES**

- Centers for Disease Control and Prevention. Multisystem inflammatory syndrome. 2020. Available at: <https://www.cdc.gov/misc/hcp/> (Accessed on May, 2021).
- Hoang A, Chorath K, Moreira A, et al. COVID-19 in 7780 pediatric patients: A systematic review. *EClinicalMedicine* 2020; 24: 100433. <https://doi.org/10.1016/j.eclinm.2020.100433>
- Wu EY, Campbell MJ. Cardiac Manifestations of Multisystem Inflammatory Syndrome in Children (MIS-C) Following COVID-19. *Curr Cardiol Rep* 2021; 23: 168. <https://doi.org/10.1007/s11886-021-01602-3>
- Dionne A, Mah DY, Son MBF, et al. Atrioventricular Block in Children With Multisystem Inflammatory Syndrome. *Pediatrics* 2020; 146: e2020009704. <https://doi.org/10.1542/peds.2020-009704>
- Rakha S, Sobh A, Hager AH, et al. Cardiac implications of multisystem inflammatory syndrome associated with COVID-19 in children under the age of 5 years. *Cardiol Young* 2022; 32: 800-805. <https://doi.org/10.1017/s1047951121003140>
- El-Assaad I, Hood-Pishchany MI, Kheir J, et al. Complete heart block, severe ventricular dysfunction, and myocardial inflammation in a child with COVID-19 infection. *JACC Case Rep* 2020; 2: 1351-1355.
- Domico M, McCanta AC, Hunt JL, Ashouri N, Nugent D, Kelly RB. High-grade heart block requiring transvenous pacing associated with multisystem inflammatory syndrome in children during the COVID-19 pandemic. *HeartRhythm Case Rep* 2020; 6: 811-814. <https://doi.org/10.1016/j.hrcr.2020.08.015>
- Ciccarelli GP, Bruzzese E, Asile G, et al. Bradycardia associated with Multisystem Inflammatory Syndrome in Children with COVID-19: a case series. *Eur Heart J Case Rep* 2021; 5: ytab405. <https://doi.org/10.1093/ehjcr/ytab405>
- Haddadin FI, Mahdawi TE, Hattar L, Beydoun H, Fram F, Homoud M. A case of complete heart block in a COVID-19 infected patient. *J Cardiol Cases* 2021; 23: 27-30. <https://doi.org/10.1016/j.jccase.2020.08.006>
- Villasmil RJ, Lorenzo CJ, Abdelal QK, et al. Complete heart block in a patient with COVID-19. *Int Arch Cardiovasc Dis* 2021; 5: 039. <https://doi.org/10.23937/2643-3966/1710039>
- Glikson M, Nielsen JC, Kronborg MB, et al. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy [published correction appears in *Eur Heart J* 2022; 43: 1651]. *Eur Heart J* 2021; 42: 3427-3520. <https://doi.org/10.1093/eurheartj/ehab364>