JKM
Sai Wawai

Jurnal Kesehatan Metro Sai Wawai
Vol. 18, No. 2, December 2025. DOI: https://doi.org/10.26630/jkmsw.v18i2.5332
Journal homepage https://ejurnal.poltekkes-tjk.ac.id/index.php/JKM
Email: jkm@poltekkes-tjk.ac.id

ISSN Online
2657-1390
ISSN Print
19779-469X

Complete Atrioventricular (AV) Block In a 15-Year-Old Girl: A Diagnostic and Therapeutic Challenge in a Resource-Limited Setting

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ARTICLE INFO

Article history

Submitted: 15 September 2025

Revised: 9 October 2025

Accepted: 04 November 2025

Keywords:
Hyperthermia, Dengue Hemorrhagic Fever, Warm Foot Soak Therapy

ABSTRACT

Complete atrioventricular (AV) block is a rare and life-threatening condition in children, characterized by complete electrical dissociation between the atria and ventricles. Its diagnosis and management can be particularly challenging in resource-limited settings. This case report describes a 15-year-old girl who presented with chest discomfort, dyspnea, nausea, and vomiting. On examination, she was hemodynamically unstable with bradycardia (heart rate 48–58 bpm). Electrocardiography revealed a complete AV block with junctional escape rhythm. Further evaluation, including echocardiography, showed no structural heart defects and preserved ventricular function. Management included fluid resuscitation and dopamine infusion, titrated up to 20 mcg/kg/min. During titration, the patient developed ventricular tachycardia–induced bradycardia that resolved spontaneously after dose reduction. Following stabilization, the patient was referred to a higher-level facility for permanent pacemaker implantation and further investigation of the underlying etiology. This case highlights the importance of early recognition and timely intervention in pediatric complete AV block. In settings with limited resources, dopamine infusion may serve as a temporary bridging therapy when transfer is delayed, but careful monitoring is essential due to the risk of arrhythmias. Prompt diagnosis, appropriate stabilization, and early referral are crucial to reducing morbidity and preventing fatal outcomes.

INTRODUCTION

Third degree (complete) atrioventricular (AV) block is a cardiovascular emergency marked by complete electrical dissociation between the atria and ventricles, seen as independent P waves and QRS complexes on ECG (Knabben et al., 2025). In third-degree AV block, none of the atrial impulses are transmitted to the ventricles. The heart's rhythm then relies on an escape pacemaker that arises either from the AV junction or from the ventricles. These escape rhythms typically appear very regular, particularly when the origin is junctional. If, however, the QRS complexes occur irregularly, with a shorter R-R interval between some beats, it suggests that occasional atrial impulses are being conducted, indicating that the block is not truly complete (Wang, 2013).

Atrioventricular block may be either congenital or acquired. AV block is considered congenital when diagnosed in utero, at birth, or within the first month, while childhood AV block is defined as onset between 1 month and 18 years. Congenital AV block accounts for 2.3% of fetal cardiac abnormalities, with an incidence of 1 in 20,000–25,000 live births, but its frequency in later childhood and adolescence remains unknown. Although congenital CAVB is usually detected

Jurnal Kesehatan Metro Sai Wawai, Vol 18(2) No 2, December 2025, 138-144. E-ISSN 2548-5695 P-SSN 2086-7751

in neonates due to maternal autoimmune antibodies, its occurrence in healthy adolescents without structural heart disease is rare and diagnostically challenging (A. E. Baruteau et al., 2016).

Acquired CAVB, on other hand, may result from diverse etiologies, including infectious causes (Lyme or Chagas disease), inflammatory or degenerative processes (such as calcific aortic stenosis or autoimmune scarring), infiltrative diseases (amyloidosis, sarcoidosis), and ischemic or nonischemic cardiomyopathy leading to conduction fibrosis (Fedorowski et al., 2023). Other contributing factors include medications, myocardial infarction, rheumatic or neuromuscular disorders, and iatrogenic injury (Dewi et al., 2021).

Atrioventricular (AV) block is an uncommon condition in children and, consequently, is often underrecognized. Epidemiological data remain scarce; in a multicenter study spanning nearly three decades, only 141 cases of AV block were identified among fetuses and pediatric patients up to 15 years old, and merely 15.6% were symptomatic at the time of diagnosis. Third-degree AV block represents the most severe form of this conduction abnormality, with clinical manifestations that vary by age. Without timely recognition and management, it may become life-threatening (A. E. Baruteau et al., 2016; Bustea et al., 2025; Vrdoljak et al., 2019). Because of its rarity, heterogeneous etiology, and potentially fatal nature, every reported case of complete AV block contributes important clinical insight. We describe a case of complete AV block in a 15-year-old girl, expanding the limited literature on adolescent-onset AV block and underscoring the diagnostic and management challenges faced in a resource-limited setting.

CASE PRESENTATION

A 15-year-old girl presented to the emergency department with a two-days history of left-sided chest pain, non-radiating, described as a pressing sensation, accompanied by shortness of breath and diaphoresis. The patient also complained of nausea and vomiting, with a frequency of more than three times within 24 hours. No history of syncope or chest pain preceding this observation. The patient and family had no known history of underlying arrhythmias or cardiac problems.

On physical examination, general condition appeared moderately ill with compos mentis consciousness. Patient was normoweight (height 158 cm; weight 43kg; height for age (HAZ) -0.7 sd; weight for age (WAZ) -1.61 sd; nad BMI scores by age -1,37 sd). Initial vital signs of the patient showed hemodynamic instability, with a blood pressure of 80/50 mmHg, pulse rate of 48-58 beats per minute, and respiratory rate of 28 beats per minute. The pulse oximeter indicated a saturation of 98% at 3 L/min of oxygen through a nasal cannula. There was no congestive heart failure, pulmonary auscultation was unremarkable, and cardiac auscultation found regular pulse and no heart murmur.

The 12-lead electrocardiogram (ECG) recordings indicated complete atrioventricular (AV) block with junctional escape rhythm (Fig. 1). Initial chest radiography revealed a normal structure of cardiac and lung (Fig. 2). The routine laboratory investigations showed normal blood routine and electrolytes.

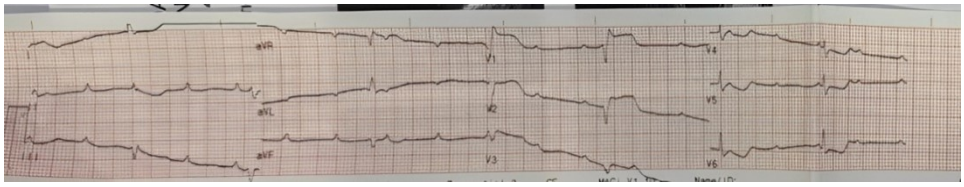

Figure 1: The ECG Revealed a Complete AV Block at Admission

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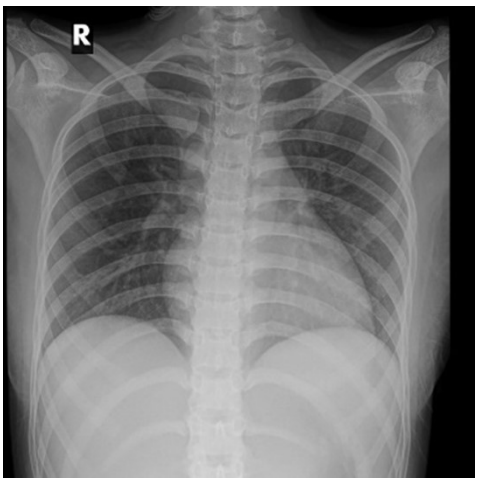

Figure 2: Chest X-ray was unremarkable

The patient was subsequently referred to the pediatric and cardiology departments for further evaluation. After consultation with the pediatric and cardiology departments, the patient immediately underwent echocardiography (Fig. 3), which revealed a structurally normal heart. In Figure 3, Image 1 shows the parasternal long-axis view demonstrating situs solitus with normal cardiac chambers and an intact interventricular septum. Image 2 presents the parasternal short-axis view showing normal great artery alignment with a left-sided aortic arch and no evidence of patent ductus arteriosus or coarctation. Image 3 depicts the apical four-chamber view showing atrioventricular and ventriculo-arterial concordance, all pulmonary veins draining into the left atrium, and no atrial or ventricular septal defect. Image 4 shows the M-mode tracing demonstrating normal systolic function with a left ventricular ejection fraction of 56% and TAPSE of 1.4 cm, with normal cardiac valves and no pericardial effusion.

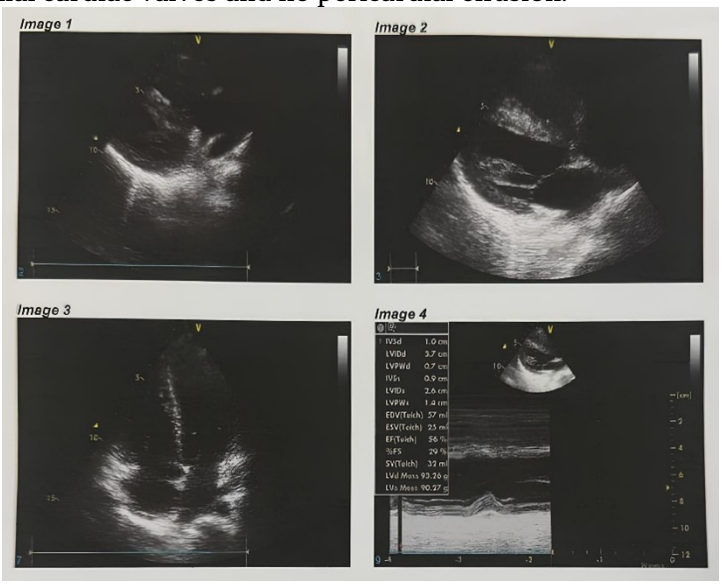

Figure 3. The echocardiogram showed a structurally normal heart (situs solitus, AV-VA concordance, all PV to LA, ASD (-), VSD (-), PDA (-), LVEF 56%, TAPSE 1.4 cm, with normal cardiac valves, mean pulmonary artery pressure of 5 mmHg, left-sided aortic arch, and no evidence of coarctation or pericardial effusion)

The patient was resuscitated with intravenous fluids, and dopamine infusion was initiated at a dose of 5 mcg/kg/minute with up-titration as needed. A urinary catheter was inserted to monitor fluid balance. Despite treatment, the patient's symptoms did not improve; the patient experienced a syncopal episode, and the heart rate decreased to 32 bpm. Dopamine was continuously titrated based on clinical response, and salbutamol 4mg was administered as an additional treatment. At a titrated dose of 20 mcg/kg/minute dopamine, the patient developed VT-induced bradycardia, which resolved spontaneously upon dose reduction. Following

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hemodynamic stabilization, the patient was referred to a hospital with more complete facilities for permanent pacemaker implantation, as well as for further evaluation to identify the underlying cause and to explore the disease in greater detail.

DISCUSSION

Complete atrioventricular block (CAVB), also known as third-degree heart block, is the most severe form of atrioventricular conduction abnormality, defined by a complete absence of atrioventricular conduction. In this condition, the atria and ventricles depolarize independently, with the ventricles relying on a slower, escape rhythm that may originate from the junction or the ventricles themselves (A. E. Baruteau et al., 2016).

The underlying cause of atrioventricular block remained unclear, making it a diagnostic challenge. CAVB is either congenital or acquired, with congenital forms prevailing in younger patients and acquired types more common in older age groups (Kusumoto et al., 2019). Atrioventricular block is termed congenital when detected prenatally, at birth, or within the first month of life, and is classified as childhood AV block when it occurs between one month and 18 years of age (Bordachar et al., 2013).

Congenital CAVB includes a genetic form and another linked to maternal autoimmune disorders such as lupus, which can impair fetal development and result in neonatal cardiomyopathy with poor prognosis (Fedorowski et al., 2023). Although congenital AV block is usually detected in utero or early infancy, it may progress silently and remain undiagnosed until age 18. Baruteau et al. (2016) reported that some individuals with CHB are asymptomatic despite bradycardia, with diagnosis often made incidentally. Symptoms typically emerge only when cardiac decompensation occurs in adulthood. On the other hand, acquired CAVB may result from infections (such as Lyme disease or Chagas disease), inflammatory or degenerative processes (including aortic valve calcification extending into the conduction system), autoimmune-related fibrosis, infiltrative conditions (such as amyloidosis or sarcoidosis), or both ischemic and nonischemic cardiomyopathies that lead to scarring of the ventricular conduction pathways (Fedorowski et al., 2023).

We presented a 15-year-old girl with symptoms and signs suggestive of low cardiac output. She had no prior cardiac history, no features of autoimmune disease, and no systemic illness indicating myocarditis or rheumatic fever. Growth and nutritional status were within normal limits, and laboratory tests, including blood and electrolytes, were unremarkable. Bradycardia with normal oxygen saturation, no fever, and no murmurs raised suspicion for conduction system disease despite otherwise nonspecific signs. A 12-lead ECG, being the gold standard, revealed complete AV dissociation with a junctional escape rhythm, consistent with CAVB. Echocardiography showed normal cardiac structure, ruling out congenital anomalies such as corrected transposition of the great arteries or endocardial cushion defects.

In our patient, the etiology of the complete atrioventricular (AV) block could not be determined. We suggest that congenital AV block is unlikely, based on the patient's age, absence of prior symptoms, and the lack of structural cardiac abnormalities on evaluation. According to Thambo et al. (2004), when complete AV block has been present over a prolonged period, as often observed in congenital cases, it typically manifests with cardiomyopathic features, including significant chamber dilatation and impaired ventricular function, none of which were evident in this case.

In the evaluation of potential acquired causes, there were no clinical signs or symptoms in our patient suggestive of common cardiac etiologies such as myocarditis, rheumatic fever, cardiomyopathy, or a history of cardiac surgery or ablation. Moreover, non-cardiovascular causes of acquired AV block—such as infectious diseases (e.g., Lyme disease, Chagas disease), autoimmune disorders (e.g., systemic lupus erythematosus, Sjögren's syndrome, sarcoidosis), or degenerative conditions—should also be considered. However, our patient had no epidemiological risk factors or systemic manifestations suggestive of these conditions. Serological testing for infectious and autoimmune etiologies was not performed, but the absence of corresponding clinical features made these diagnoses less likely.

Familial AV conduction block is known to have a genetic predisposition and has been associated with mutations in the SCN5A gene (Oertle et al., 2024). Genetic testing is therefore recommended in cases of congenital heart block or when there is a family history suggestive of inherited arrhythmias; however, no such family history was identified in this patient, and no cardiac genetic testing has been performed to date.

Pediatric patients may occasionally present with AV block of unknown origin, without maternal antibodies, structural heart defects, or identifiable causes. Literature on the pathogenesis and clinical course of such idiopathic cases remains scarce (A.-E. Baruteau et al., 2012). However, a landmark study by A. E. Baruteau et al. (2016) highlighted a strong genetic predisposition in nonimmune congenital and childhood AV block, emphasizing the need for familial screening, even when the condition appears sporadic and idiopathic.

Initial management of complete atrioventricular (AV) block begins with a rapid assessment of airway, breathing, and circulation (ABC) to evaluate hemodynamic status. In this case, dopamine infusion was chosen due to its positive chronotropic and inotropic effects via β1-adrenergic receptor stimulation. Dopamine is often used as a bridging therapy in bradyarrhythmia-related shock when pacing is not immediately available, particularly in resource-limited settings (Dewi et al., 2021). Dopamine is a peripheral vasoactive agent commonly administered to manage hypotension, bradycardia, and cardiac arrest, particularly in acute neonatal settings, through continuous intravenous infusion (Sonne et al., 2023). The recommended dopamine dosage for neonates and pediatric patients ranges from 2 to 20 µg/kg/min, delivered via intravenous infusion and adjusted according to the patient's hemodynamic status and desired clinical response (Kleinman et al., 2010).

In this case, at 20 mcg/kg/min, the patient developed a transient episode of ventricular tachycardia (VT) followed by a paradoxical worsening of bradycardia. Although the precise mechanism remains uncertain, it likely reflects a proarrhythmic effect of high-dose dopamine, particularly in patients with underlying conduction system disease (A. E. Baruteau et al., 2016; Su et al., 2022). Excessive β_1 stimulation increases myocardial automaticity and conduction heterogeneity, while increased afterload and myocardial oxygen demand (from α-mediated vasoconstriction at high doses) can promote ischemia and trigger ventricular ectopy, thus explaining paradoxical deterioration in some patients (Neumann et al., 2023). VT may reduce effective ventricular filling and stroke volume, exacerbating hypoperfusion. These events highlight the need for cautious titration and continuous ECG monitoring when using pharmacologic support in CAVB.

According to the American Heart Association (2019) and ESC guidelines (2021), permanent pacemaker implantation is the treatment of choice in symptomatic patients with CAVB (Glikson et al., 2021; Kusumoto et al., 2019). The 2021 ESC Guidelines recommend permanent pacing in cases of congenital complete or advanced atrioventricular block when any of the following risk factors are identified: the presence of symptoms, pauses exceeding three times the previous cardiac cycle, a broad QRS escape rhythm, prolonged QT interval, complex ventricular ectopy, or a mean daytime heart rate below 50 bpm. In the absence of these risk factors, pacing is considered a Class IIb recommendation (Glikson et al., 2021). In addition, the 2021 PACES Expert Consensus Statement recommends pacing in adolescents with idiopathic advanced AV block, even with narrow QRS and preserved ventricular function and suggests exercise testing as a tool for further risk stratification (Shah et al., 2021).

This case highlights the unique challenges encountered in rural or resource-limited hospitals, where access to pediatric cardiologists, echocardiography, and pacing facilities may be delayed, necessitating initial stabilization with limited resources. Early recognition, supportive management, and a clear referral pathway are essential to prevent adverse outcomes (Sunbanu, 2024). Moreover, this case of idiopathic AV block with no confirmed etiology emphasizes the need to consider cardiac conduction disorders in otherwise healthy young individuals presenting with unexplained bradycardia or hemodynamic instability. A comprehensive approach that includes thorough physical examination, prompt ECG evaluation, cautious pharmacologic support, and timely referral forms the cornerstone of effective management. Ultimately, permanent pacemaker implantation remains the definitive treatment for complete atrioventricular block, and timely

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intervention is essential to optimize clinical outcomes and reduce the risk of life-threatening arrhythmias or sudden cardiac death.

CONCLUSION

Complete atrioventricular (AV) block is rarely seen in children. Early diagnosis and timely treatment require strong clinical suspicion, an effective referral system, and proper patient evaluation to reduce associated morbidity and mortality. Idiopathic AV block in children, though rare and poorly understood, may have underlying genetic factors, highlighting the importance of considering familial screening even in sporadic cases. Dopamine may be used as a bridging therapy when transfer to a higher-level facility is not immediately possible; however, its administration requires close monitoring due to the risk of inducing cardiac arrhythmias.

AUTHOR'S DECLARATION

Authors' contributions and responsibilities

DI: Writing – Original Draft, Visualization, Conceptualization;
MRP: Writing – Original Draft (supporting);
ADK: Review and Editing;
YJ & AVDA: Supervision (lead), Validation (equal).

Funding

Personal expenses

Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interests.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to Bendan Region Hospital, Pekalongan, Central Java, for the opportunity and support provided during the medical internship program. The hospital's facilities, clinical environment, and guidance from the medical staff greatly contributed to the completion of this work.

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