Case Report

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Case Studies on Idioventricular Rhythm in Pediatric Patients: Clinical Insights and Outcomes

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Abstract

Accelerated Idioventricular rhythm (AIVR), an ectopic ventricular rhythm with rates of 50–120 beats/minute, is a rare arrhythmia in pediatric populations, often secondary to cardiac or systemic conditions. This review synthesizes current evidence on AIVR pathophysiology, diagnosis, and management, supplemented by four illustrative pediatric case studies. The AIVR arises from enhanced ventricular automaticity or triggered activity, commonly linked to ischemia, electrolyte imbalances, or systemic illness. While typically self-limiting, it may manifest in diverse clinical contexts, including chemotherapy-induced cardiotoxicity, acute rheumatic fever, post-surgical interventions, and post-viral myocarditis.

We present four unique cases:

1. A 5-year-old with acute lymphoblastic leukemia (ALL) and cardiac arrest due to myocardial leukemic infiltration.
2. A 14-year-old with acute rheumatic fever (ARF) and aortic insufficiency (AI), demonstrating AIVR resolution with anti-inflammatory therapy.
3. A 3-year-old developing transient AIVR post-surgical atrial septal defect (ASD) closure.
4. A 7-year-old with post-COVID myocarditis and AIVR managed conservatively.

Diagnosis relies on electrocardiographic findings (e.g., wide QRS complexes and fusion/capture beats), while echocardiography and cardiac MRI aid in identifying structural or inflammatory contributors. Management prioritizes treating underlying etiologies (e.g., correcting electrolyte imbalances, addressing cardiotoxicity) over direct arrhythmia suppression, as AIVR often resolves spontaneously. Anti-arrhythmic are generally avoided due to hemodynamic risks, though atropine may enhance sinus rhythm in symptomatic cases. These cases underscore the importance of tailored approaches, vigilant monitoring in high-risk populations (e.g., post-surgical or systemic illness), and recognition of AIVR as a potential marker of myocardial stress. While AIVR is usually benign, its presence warrants thorough evaluation for occult pathology. Further research is required to optimize long-term management in pediatric cohorts.

Key words: Arrhythmia, Cardiac Surgery, Pediatrics

Introduction

Idioventricular rhythm (IVR) is an uncommon arrhythmia in pediatric patients, often associated with underlying cardiac or systemic conditions. It is characterized by a ventricular rhythm with a rate that is slower than typical ventricular tachycardia but faster than the normal ventricular escape rhythm (1).

Accelerated Idioventricular Rhythm (AIVR) is an ectopic ventricular rhythm with a rate typically between 50 and 120 beats per minute. It occurs when the rate of an ectopic ventricular pacemaker exceeds that of the sinus node. The proposed mechanisms include enhanced automaticity of ventricular pacemaker cells and triggered activity, particularly

in the context of ischemia, electrolyte imbalances, or digoxin toxicity (1). The AIVR is often associated with increased vagal tone and decreased sympathetic tone, which may explain its transient and self-limiting nature in many cases (2). In pediatric patients, AIVR is frequently observed in the setting of structural heart disease, systemic illnesses, or post-surgical interventions (3).

The AIVR is usually a benign, self-limiting arrhythmia. It is characterized by a regular rhythm, wide QRS complexes, and a ventricular rate typically between 50 and 120 beats per minute. The diagnosis is primarily based on electrocardiographic (ECG) findings, including the presence of three or more consecutive ventricular complexes, fusion and capture beats, and a QRS duration greater than 120 milliseconds (4). In pediatric patients, AIVR may present with nonspecific symptoms such as palpitations, dizziness, or syncope, or it may be incidentally detected during routine monitoring. Echocardiography and other imaging modalities are often employed to assess underlying structural abnormalities or systemic conditions contributing to the arrhythmia (5).

In most cases, AIVR does not require specific treatment and resolves spontaneously when the sinus rate exceeds the ventricular rate. Management focuses on addressing the underlying cause, such as correcting electrolyte imbalances, restoring myocardial perfusion, or treating systemic illnesses (6). Anti-arrhythmic medications are generally avoided due to the risk of hemodynamic deterioration. However, in patients with low cardiac output states, restoration of atrioventricular (AV) synchrony may be beneficial. Atropine can be trialed to increase the sinus rate and improve AV conduction in symptomatic cases (7). Close monitoring is essential to ensure resolution of the arrhythmia and to detect any complications. In this paper discusses Case Studies on IVR in Pediatric Patients.

Cases

Case 1: Acute Lymphoblastic Leukemia (ALL) and Cardiac Arrest

A 5-year-old boy with acute lymphoblastic leukemia (ALL) experienced sudden cardiac arrest during chemotherapy. The ECG revealed an IVR (Figure 1) and echocardiography showed normal heart structure; therefore, we assumed that myocardial infiltration by leukemic cells was the cause of AIVR. The patient was managed with medications and supportive care, with chemotherapy adjusted to minimize cardiotoxicity (Figure 2). This case underscores the importance of vigilant cardiac monitoring in pediatric patients undergoing chemotherapy, particularly in the context of potential myocardial infiltration and cardiotoxicity (8).

Figure 1. A 3-lead ECG demonstrating Idioventricular rhythm.

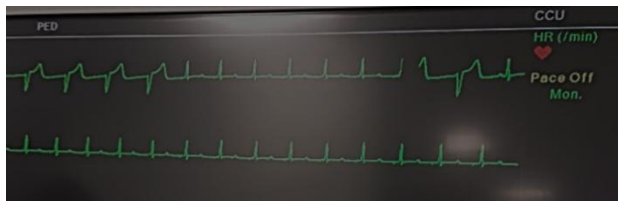

Figure 2. Episodes of transient Idioventricular rhythm and sinus rhythm.

Case 2: Acute Rheumatic Fever (ARF) and Moderate Aortic Insufficiency (AI)

A 14-year-old boy with acute rheumatic fever (ARF) and moderate aortic insufficiency (AI) presented with fever, joint pain, and signs of heart failure. The ECG demonstrated an IVR (Figure 3), and echocardiography confirmed moderate AI and mild left ventricular dilation. Management included anti-inflammatory medications for ARF (prednisone), and Captopril and Furosemide for heart failure. The AIVR converts to normal sinus rhythm within 3-4 weeks, with oral medication of underlying disease and no antiarrhythmic drug (Figure 4). This case highlights the need for comprehensive management of ARF and its cardiac complications, including the potential for arrhythmias, such as IVR (9).

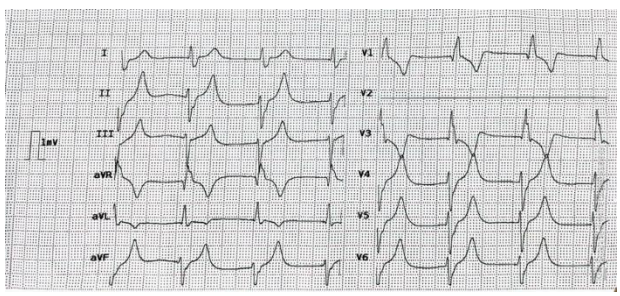

Figure 3. A 3-lead ECG demonstrating Idioventricular rhythm.

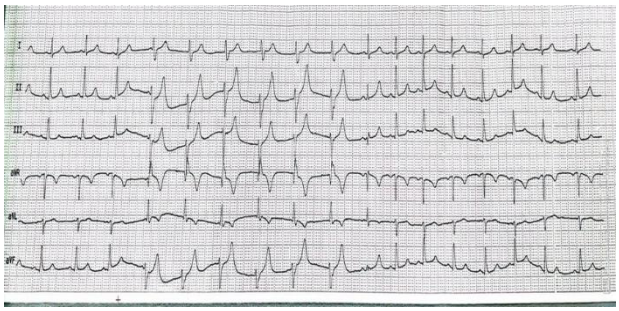

Figure 4. Episodes of transient Idioventricular rhythm and sinus rhythm.

Case 3: Post-Atrial Septal Defect (ASD) Closure Surgery

A 3-year-old girl with an atrial septal defect (ASD) was a candidate for closure using the interventional method (e.g., device closure); however, the procedure was not successful due to the size of the ASD. Consequently, the patient underwent surgical closure of the ASD and developed AIVR following surgical closure (Figure 5). The arrhythmia was characterized by a ventricular rate that exceeded the sinus rate but was slower than that of ventricular tachycardia. The patient was managed conservatively, and the arrhythmia resolved spontaneously (Figure 6). This case illustrates the potential for transient arrhythmias following congenital heart defect surgery and emphasizes the importance of careful postoperative monitoring (10).

Case 4: Post-COVID Myocarditis

A 7-year-old boy presented with fatigue and chest pain two weeks after recovering from COVID-19. The ECG revealed AIVR (Figure 7), and cardiac MRI confirmed myocarditis. Management included anti-inflammatory therapy (steroids) and close monitoring. The arrhythmia resolved within three weeks. This case highlights AIVR as a potential complication of post-viral myocarditis and the importance of cardiac evaluation in pediatric patients recovering from viral illnesses (11).

Discussion

Accelerated idioventricular rhythm is a relatively rare arrhythmia in pediatric patients, often associated with underlying cardiac or systemic conditions. While generally benign and self-limiting, AIVR can occasionally lead to significant clinical consequences, particularly in the presence of structural heart disease, systemic illnesses, or post-surgical stress. The case studies presented in this review highlight the diverse etiologies and clinical presentations of AIVR in pediatric populations, emphasizing the importance of tailored diagnostic and therapeutic approaches.

The pathophysiology of AIVR involves enhanced automaticity of ventricular pacemaker cells or triggered activity, often in the context of ischemia, electrolyte imbalances, or drug toxicity (1). In pediatric patients, AIVR is frequently observed in settings such as chemotherapy-induced cardiotoxicity, ARF, post-surgical interventions, and post-viral myocarditis, as demonstrated in the case studies (2-5). The transient nature of AIVR in many cases may be attributed to increased vagal tone and decreased sympathetic tone, which can suppress the sinus node and allow the ventricular rhythm to dominate temporarily (6).

Diagnosis of AIVR relies primarily on ECG findings, including wide QRS complexes, a regular rhythm, and a ventricular rate typically between 50 and 120 beats per minute. Fusion and capture beats are also characteristic features (7). In pediatric patients, AIVR may present with nonspecific symptoms such as palpitations, dizziness, or syncope, or it may be incidentally detected during routine monitoring. Advanced imaging modalities, such as echocardiography and cardiac MRI, are essential for identifying underlying structural abnormalities or systemic conditions contributing to the arrhythmia (8).

Management of AIVR is generally conservative, focusing on addressing the underlying cause rather than the arrhythmia itself. In most cases, AIVR resolves spontaneously when the sinus rate exceeds the ventricular rate. However, in symptomatic patients or those with hemodynamic compromise, interventions such as atropine to increase the sinus rate or beta-blockers to control the arrhythmia may be considered (9). Anti-arrhythmic medications are typically avoided due to the risk of hemodynamic deterioration, and close monitoring is essential to ensure resolution of the arrhythmia and to detect any complications (10).

The case studies presented in this review illustrate the diverse clinical scenarios in which AIVR can occur. In the first case, a 5-year-old boy with ALL developed AIVR secondary to myocardial infiltration by leukemic cells, highlighting the importance of vigilant cardiac monitoring in pediatric patients undergoing chemotherapy (11). The second case involved a 14-year-old boy with ARF and moderate AI, underscoring the need for comprehensive management of ARF and its cardiac

complications (12). The third case, a 3-year-old girl who developed AIVR following surgical closure of an ASD, demonstrates the potential for transient arrhythmias after congenital heart defect surgery and the importance of postoperative monitoring (13). Finally, the fourth case, a 7-year-old boy with post-COVID myocarditis, highlights AIVR as a potential complication of post-viral myocarditis and the importance of cardiac evaluation in pediatric patients recovering from viral illnesses (14).

Key factors contributing to AIVR in pediatric patients include hemodynamic changes, scar tissue formation, electrolyte imbalances, increased cardiac workload, and electrophysiological remodeling, particularly in the context of post-surgical stress or systemic illnesses (15-18). Conservative management with close monitoring is often sufficient, as most cases resolve spontaneously. However, in high-risk populations, such as those with structural heart disease or systemic conditions, more aggressive management may be warranted.

Conclusion

In conclusion, although AIVR is generally a benign, self-limiting arrhythmia in pediatric patients, it can occasionally lead to serious outcomes, particularly in the presence of underlying cardiac or systemic conditions. Clinicians should focus on identifying and addressing the underlying cause while avoiding unnecessary anti-arrhythmic interventions. Further research is needed to elucidate the long-term outcomes and optimal management strategies for AIVR in pediatric populations, particularly in high-risk groups.

Ethics Approval and Consent to Participate

Written informed consent was obtained from the patients prior to treatment and for participation in this report.

Consent for Publication

Not applicable.

Data Availability Statement

Further data will be available in case of appropriate request by the corresponding author, Dr. Feisal Rahimpour (feisalrahimpoor@gmail.com).

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Author's Contribution

FR analyzed and interpreted the patient data regarding the ECG data. HB and EH were major contributors in writing the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

No conflicts of interest were declared by the authors.

Declaration of Generative Artificial Intelligence in Scientific Writing

No AI tools or technologies were used to prepare this manuscript.

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