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Every face tells a story-unravelling a case of bidirectional ventricular tachycardia

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ABSTRACT

Bidirectional ventricular tachycardia is a rare form of tachycardia. We hereby report a case of bidirectional ventricular tachycardia in an 8-year-old boy wherein careful clinical examination led to the diagnosis of Andersen Tawil syndrome. The case also demonstrates the efficacy of flecainide in managing bidirectional ventricular tachycardia in the setting of Andersen Tawil syndrome.

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1. Introduction

Bidirectional ventricular tachycardia (BVT) is a rare form of ventricular tachycardia (VT). It is mostly attributable to a few specific causes and is generally associated with a grave prognosis. This brief report demonstrates the importance of a careful physical examination in identifying the exact etiology which in turn guided the management.

2. Case summary

An 8-year-old boy presented with multiple episodes of brief loss of consciousness in the preceding 2 years. The episodes happened at rest as well as on exertional activities like playing. Each episode lasted 10–15 s and none of the episodes were associated with involuntary movements and/or post-event confusion. There was no history of any other cardiac complaints or intake of any medication.

He was the only child born out of non-consanguineous marriage and had normal developmental milestones. His mother was diagnosed to have seizure disorder and reportedly died at the age of 22 years due to status epilepticus; however her medical records and ECGs were not available for review.

Physical examination was normal except tachycardia (130/min) with an irregularly irregular pulse. ECG revealed a broad QRS complex tachycardia with atrioventricular (AV) dissociation (RBBB morphology, QRS duration 120 ms and QRS axis varying beat by beat from right inferior to left superior axis) (Fig. 1). Accurate assessment of QTc interval was not possible due to incessant VT and ventricular bigeminy. Echocardiography confirmed structurally normal heart with normal ventricular function. In view of bidirectional VT, structurally normal heart, exertional syncope, and premature death in first degree relative, a provisional diagnosis of catecholaminergic polymorphic VT (CPVT) was considered. Beta-blockers were started and sample for genetic testing of channelopathies was sent. Oral propranolol was started at a dose of 4 mg/kg/day, which was increased to 6 mg/kg/day after 2 days.

During inpatient monitoring, it was observed that premature ventricular complexes (PVCs) and non-sustained VT (NSVT) were more frequent during activities such as playing a car-racing game on a mobile phone. However, formal exercise testing was not carried out. Although there were no episodes of symptomatic ventricular tachycardia in the following week, he continued to have frequent ventricular bigeminy and a high burden of PVCs with the

Abbreviations: BVT, Bidirectional Ventricular Tachycardia; ATS, Andersen Tawil Syndrome; CPVT, Catecholaminergic Polymorphic Ventricular Tachycardia.

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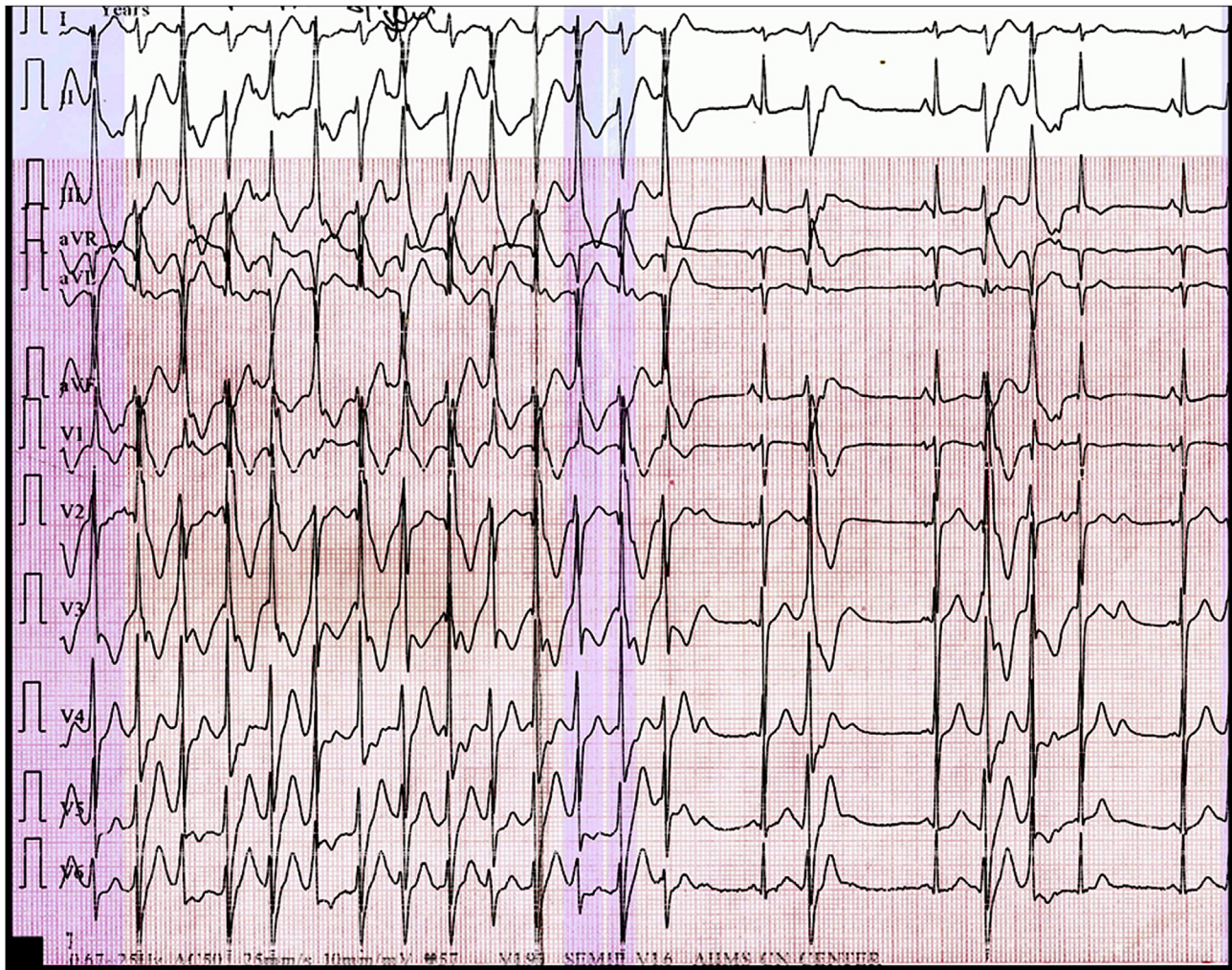


Fig. 1. Twelve lead electrocardiogram shows AV dissociation and 180-degree change in the QRS axis in the alternate beat (better appreciated in lead II, aVL, and aVF).

Holter monitoring showing 38% PVCs in 24-h, along with frequent runs of NSVT.

A closer physical examination revealed dysmorphic features including dental crowding, high arch palate, small mandible, low set ears, depressed nasal bridge and short proximal phalanx of the

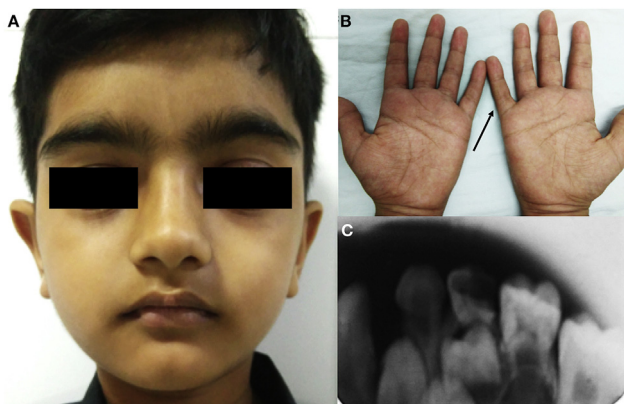


Fig. 2. Clinical photograph shows low set ears (A), depressed nasal bridge, small mandible, and short proximal phalanx of the fifth digit of both hands (arrow) (B). Intra-oral peri-apical (IOPA) radiograph shows dental crowding (C).

fifth digit of both the hands (Fig. 2). The ECG showed prolonged QTc (480 msec), prominent U wave in lead V2-3 and a prolonged QU interval (Fig. 3). The presence of characteristic dysmorphic features and depolarization abnormalities in ECG led us to suspect Andersen Tawil Syndrome (ATS) [1,2]. Unlike CPVT, ATS has a relatively benign course and flecainide is useful in treating rhythm abnormalities [3,4]. Hence oral flecainide was added at a dose of 67 mg/m²/day in two divided doses. Metoprolol, a selective beta-1 receptor blocker with less frequent dosing interval was substituted for propranolol. Holter evaluation performed 10 days after initiating flecainide showed a further reduction in PVC burden to 32%.

Flecainide dose was gradually increased to 100 mg/m² and subsequently to 135 mg/m² on follow up visits. He did not have any further syncopal episodes. The PVC burden reduced significantly with only 2.9% PVCs and infrequent episodes of NSVT noted at a Holter done at 8 months of follow up (see Table 1). Genetic testing using next-generation sequencing analysis, detected heterozygous missense variation (p.Arg67Trp) in exon 2 of KCNJ2 gene confirming the diagnosis of ATS [5]. This variant has been classified as pathogenic for ATS in the ClinVar database [6].

3. Discussion

Bidirectional VT is a rare clinical entity and can occur due to various reasons such as acute ischemia, aconite poisoning, digoxin

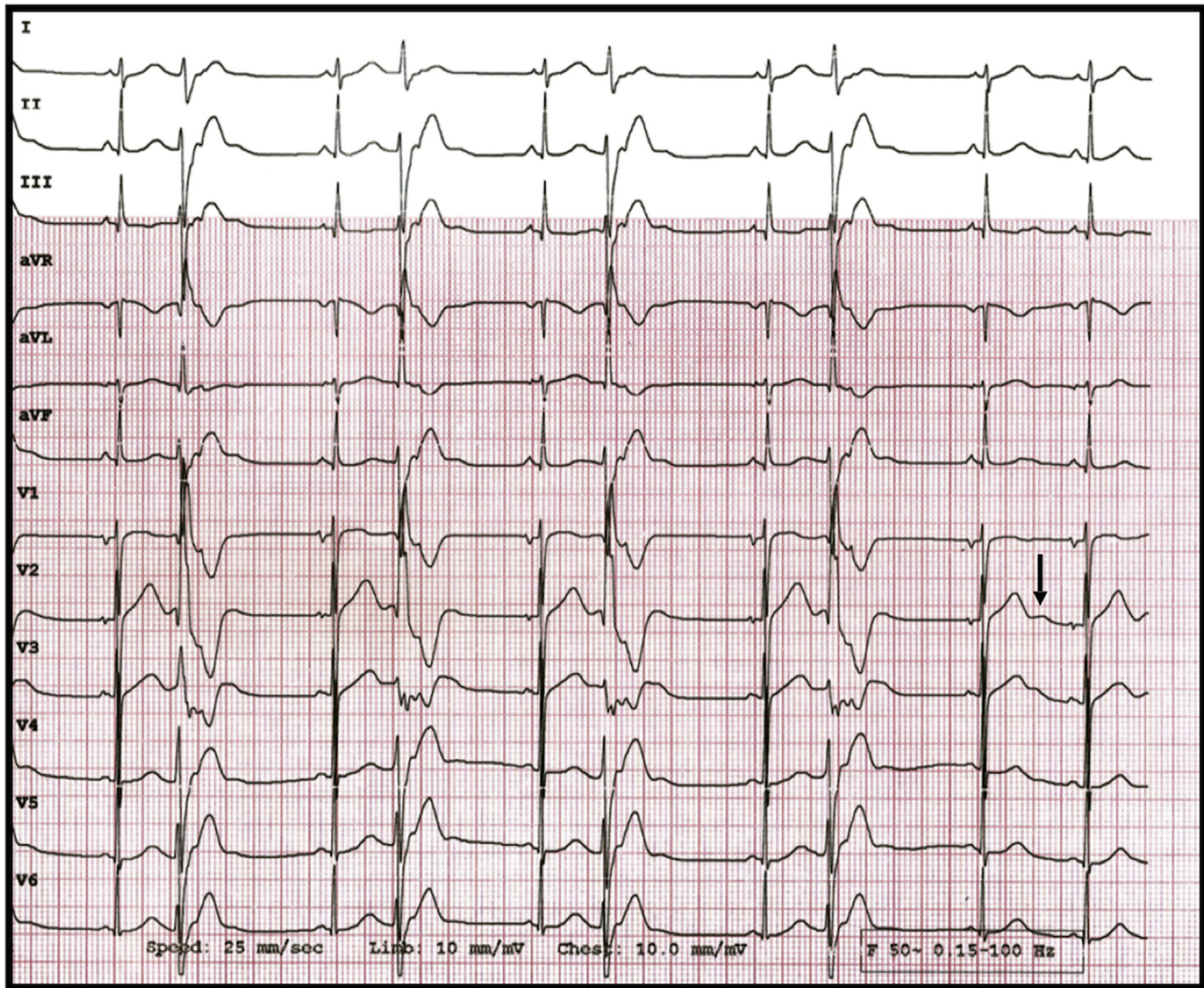


Fig. 3. Twelve lead ECG shows ventricular bigeminy. Note prominent U waves (arrow) and prolonged QTc and QU interval in leads V2–V3 in the last but one QRS complex where two consecutive beats are sinus. A high PVC burden at presentation precluded reliable assessment of QTc interval (see Fig. 1).

Table 1

PVC burden detected by Holter monitoring at various dosage of flecainide.

Dose of flecainide	Timing of Holter	Setting	PVCs (% of total beats) in 24 h	NSVT events
Baseline	Baseline	Inpatient	38%	759
65mg/m ² /day	10 days	Inpatient	32%	167
65mg/m ² /day	2 month	Outpatient	31.2%	397
100mg/m ² /day	6 month	Outpatient	25.7%	80
135 mg/m ² /day	8 month	Outpatient	2.9%	27

toxicity, myocarditis, fatty replacement in RV, tumor in the ventricle, familial hypokalemic periodic paralysis, CPVT and ATS. The absence of a history of aconite or digitalis intake and normal echocardiogram exclude most of the etiologies and make channelopathies the most likely cause of BVT in the index case. Amongst the ion channelopathies, CPVT and ATS present with BVT. CPVT is a channelopathy of ryanodine calcium-sensing receptors. ECG shows normal QTc interval and VT is typically reproducible with exercise. Due to its highly malignant nature and high risk of sudden cardiac death, CPVT necessitates bilateral cervical sympathectomy for cardiac sympathetic denervation and placement of an implantable cardioverter defibrillator (ICD) in addition to anti-arrhythmic drugs [7].

ATS, on the other hand, despite having a similar clinical and electrocardiographic presentation, is a relatively benign condition. It is an autosomal dominant channelopathy, resulting from the loss of function mutation in Kir2.1 channel encoding gene KCNJ2, located at chromosome 17q23. The mutation, however, is not universal and almost one-third of patients of ATS are negative for the mutation. The clinical diagnosis in all such cases is based on the triad of morphological features and clinical presentation (Table 2) [1]. Although the index case did not report periodic paralysis the presence of characteristic ECG abnormalities and dysmorphic features supported the diagnosis of ATS. Seizures that the deceased mother of the child had is also a known manifestation of ATS [8].

Table 2
Clinical criteria for diagnosis of ATS [1].

1 ECG abnormalities or positive genetic mutation	Bidirectional VT, frequent PVCs, prolonged QU interval Loss of function mutation of Kir2.1 encoding KCNJ2 gene at 17q23	
2 Neurological features	Periodic paralysis, syncope, seizures	
3 Morphologic features	Facial	Hypertelorism, mandibular hypoplasia, low-set ears, malar hypoplasia, broad nasal root, micrognathia, ptosis, cleft palate, high-arched palate, broad forehead, thin upper lip, triangular shape of the face
	Dental anomalies	Delayed tooth eruption, persistent primary dentition, oligodontia, dental crowding, enamel hypoplasia and discolorations
	Musculoskeletal anomalies	Muscular weakness, short stature, scoliosis, clinodactyly, syndactyly, brachydactyly, tapering fingers, short proximal phalanx of fifth digit, small hand and feet, joint laxity

Presence of any 2 out of above 3 required for diagnosis.

In presence of family history of proven ATS, only one feature required for diagnosis.

Having such dissimilar clinical presentation in a family is also a well-known feature of ATS [9]. Although mostly benign, ATS is also known to present as sudden cardiac death (SCD) [10]. Other cardiac presentations include ventricular dysfunction or other unrelated structural malformations such as a bicuspid aortic valve, coarctation of aorta and pulmonary stenosis [11,12]. The mechanism of arrhythmia include delayed after depolarization and triggered activity due to enhanced automaticity during adrenergic stress [13].

Flecainide has been consistently shown to reduce ventricular ectopy and arrhythmias in patients with CPVT and ATS. The efficacy, however, is more in patients with ATS [14–16]. Flecainide, a class IC anti-arrhythmic agent, has Na channel blocking properties. In ATS flecainide acts by increasing the inward current generated by Kir2.1 channels (IKir2.1) in ventricular myocytes and by suppression of irregular calcium ion releases through modulation of Na/Ca exchanger [17,18]. In a series of 10 mutation positive ATS patients, Miyamoto et al. showed that oral flecainide effectively suppressed VT with no cardiac events during therapy [3]. Good control of rhythm is achieved with flecainide with or without beta-blocking agents.

4. Conclusion

In summary, this case emphasizes the importance of careful clinical examination in identifying ATS as the cause of BVT which in turn led to optimal management using flecainide and beta-blocker [19].

5. Salient features

1. Bidirectional Ventricular Tachycardia (BVT) is a rare but serious form of ventricular tachycardia (VT).
2. A careful clinical examination and ECG analysis can differentiate relatively benign Andersen-Tawil Syndrome (ATS) form much more malignant Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT).
3. Frequent ventricular premature complexes (VPCs) and BVT related to ATS responds well to flecainide.

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Author contributions

All authors were involved in concept and design of manuscript. Sakshi Sachdeva drafted the manuscript. Saurabh Kumar Gupta and Nitish Naik critically reviewed the manuscript. All authors approved the finally submitted manuscript.

Declaration of competing interest

There is no conflict of interest or competing interest.

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