Case Report / Olgu Sunumu

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Efficacy of Adenosine in the Differential Diagnosis of Narrow QRS Complex Tachyarrhythmia: A Case Diagnosed with Atrial Flutter After Adenosine

Dar QRS Kompleksli Taşiaritmi Ayırıcı Tanısında Adenozinin Etkinliği: Adenozin Sonrası Atriyal Flutter Tanısı Alan Bir Olgu

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Abstract

The most common tachyarrhythmias in childhood are narrow QRS complex tachyarrhythmias. The majority of these are supraventricular tachycardia (SVT). If electrocardiography is inconsistent with typical SVT, another underlying arrhythmia should be considered. In this case, a patient with narrow complex tachycardia who was diagnosed with atrial flutter after adenosine was presented to increase awareness on the subject.

Keywords: Adenosine, atrial flutter, childhood, tachycardia

Öz

Çocukluk çağında en sık görülen taşiaritmiler dar QRS kompleksli taşiaritmilerdir. Bunların da büyük çoğunluğunu supraventriküler taşikardi (SVT) oluşturmaktadır. Çekilen elektrokardiografi tipik SVT ile uyumsuz ise altta yatabilecek başka bir aritmi olabileceği düşünülmelidir. Bu olguda, dar kompleksli taşikardi saptanıp adenozin sonrasında atriyal flutter tanısı almış hasta konu hakkındaki farkındalığı artırmak için sunuldu.

Anahtar Kelimeler: Adenozin, atriyal flutter, çocukluk çağı, taşikardi

Introduction

High heart rate for age in children is defined as tachycardia.[1] Tachycardias are classified under two main headings as narrow or wide QRS tachycardia. Supraventricular tachycardia (SVT) is the most common narrow QRS arrhythmia in childhood. SVT should be considered in cases with a sudden onset and unexplained heart rate above 200, and with abnormal P waves or without P waves on electrocardiography (ECG).[2]

Atrial flutter is a relatively common supraventricular arrhythmia characterized by rapid, regular atrial depolarizations, typically around 300 beats/min, and a regular ventricular rate corresponding to one-half or one-fourth (150 or 75 beats/minute) of the atrial rate.[3] However, both arrhythmias are not always easily recognized.

In this study, a patient diagnosed with atrial flutter after adenosine due to the presence of flutter waves, whose ECG findings were inconsistent with typical SVT, was presented to emphasize the effectiveness of adenosine in the differential diagnosis of arrhythmia.

Case Report

A 10-year-old girl patient, whose heartbeat could not be detected at the scene after an in-vehicle traffic accident, was resuscitated by health professionals. The patient, whose spontaneous circulation returned after 15 minutes of resuscitation, was intubated and brought to the emergency room. In the imaging performed here, lung contusion, brain edema, cranial infarct, spleen laceration

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and bilaterally displaced distal femur fracture were detected. After the interventions made by the relevant branches, she was hospitalized in our pediatric intensive care unit for postoperative follow-up.

The patient was started to be followed on a mechanical ventilator. Midazolam and fentanyl were started as sedoanalgesics to increase patient compliance and effective respiratory support in invasive mechanical ventilation. Piperacillin-tazobactam + teicoplanin + meropenem was given as antibiotherapy to the patient who underwent splenectomy and bilateral chest tube insertion and was operated for bilateral femur fracture. 3% hypertonic saline and mannitol were started for brain edema detected in computerized brain tomography. Inotropic adrenaline infusion (0.1 mcg/kg/min) was initiated in the hypotensive patient, and dose titrations were performed according to the need during the follow-up. Mass CK-MB: 201 ug/dL and troponin I: 0.094 ug/L were detected. Initial ECG evaluation was normal. Mild systolic dysfunction was detected in the echocardiography (ECHO) examination performed while taking inotropes, and it was recommended to continue inotropic therapy. Low molecular weight heparin (enoxaparin) was started for thromboembolism prophylaxis. Levetiracetam was given at a dose of 30 mg/kg/day as an antiepileptic. Adrenaline infusion was stopped after the ECHO examination performed on the 6th day of follow-up. On the 7th day of the follow-up, the patient was extubated and enteral nutrition was provided with the help of a nasogastric tube.

The patient, who was improving clinically and hemodynamically, had tachycardia (252 beats/min) on the 9th day of the follow-up. In the ECG, it was observed that there was an irregular tachycardia with a narrow QRS complex (Figure 1). On detailed examination, it was observed that it was an atypical supraventricular tachyarrhythmia with variable P waves morphology, which included bundle branch blocks in places, unlike classical SVT. Rapid adenosine bolus (0.1 mg/kg) was administered to the patient who underwent ECG monitoring for both treatment and differential diagnosis. A diagnosis of atrial flutter was made with the appearance of typical flutter waves after the administration of drug (Figure 2). After amiodarone loading treatment (5 mg/kg), normal sinus rhythm was restored (Figure 3). Amiodarone maintenance treatment was continued at a dose of 5 mg/kg/day. The patient, who was in good general condition and did not need

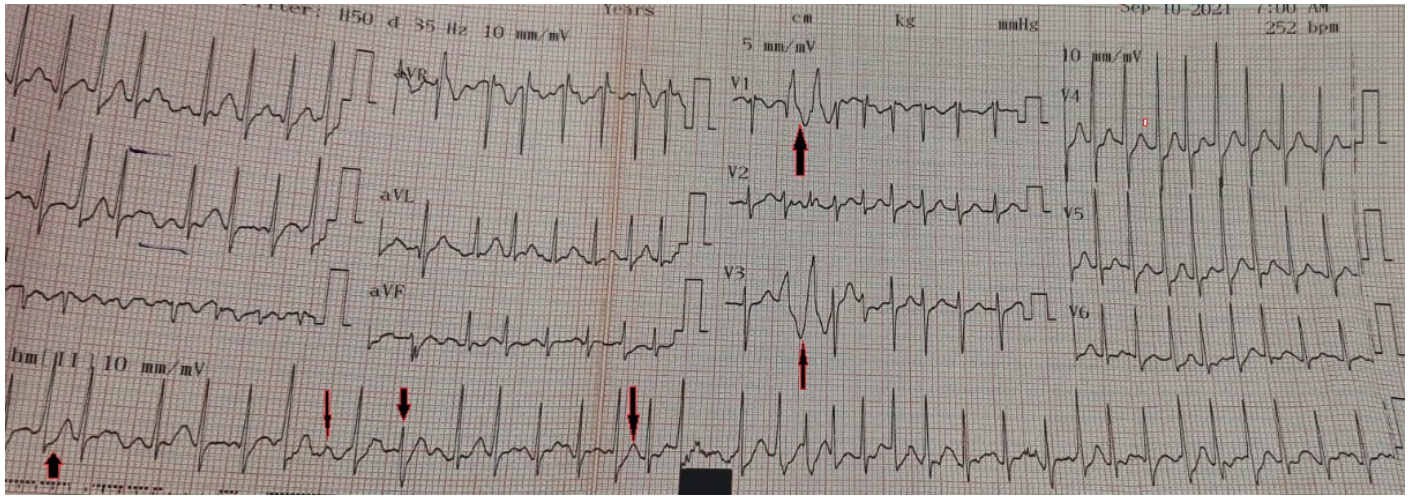

Figure 1. Before adenosine, narrow QRS complex tachycardia incompatible with typical supraventricular tachycardia. Arrows indicate the absence of well- shaped and regular P waves in front of the QRS complexes

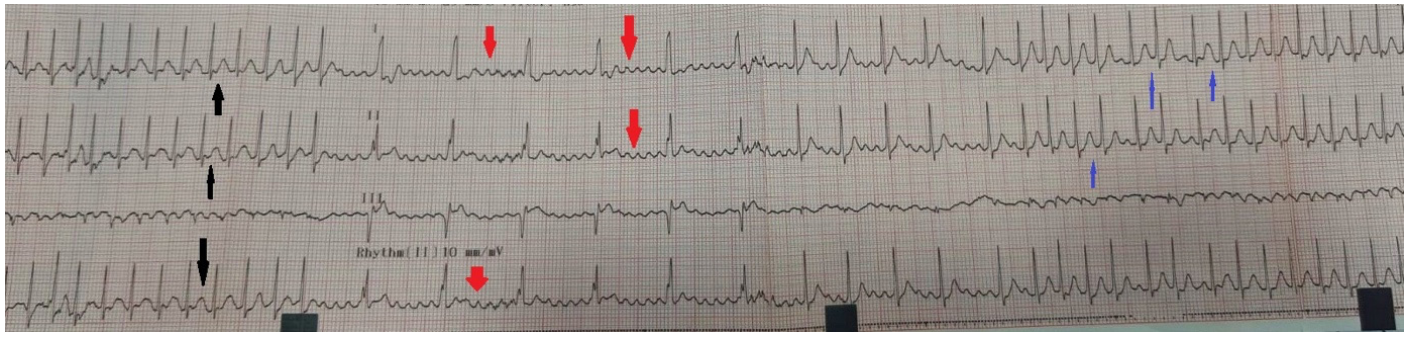

Figure 2. The appearance of typical flutter waves in the administration of adenosine. Red arrows show flutter waves, black and blue arrows show narrow complex tachyarrhythmia waves occurring when adenosine effect disappears

intensive care, was transferred to the service for rehabilitation treatments on the 21st day of her hospitalization.

Discussion

Narrow QRS complex tachycardias are common tachyarrhythmias seen in childhood. There are 3 underlying mechanisms.[4] The most common mechanism is a vicious circle that occurs via the atrium (atrial fibrillation, atrial flutter), atrioventricular (AV) node (AV node reentry tachycardia) or accessory conduction pathway (AV reentry tachycardia). The second mechanism is automaticity gain from the sinus node (sinus tachycardia) or from another part of the atrium (atrial tachycardia). The third mechanism is less common triggered tachycardias. In this study, the role of adenosine in the differential diagnosis of arrhythmia in addition to its therapeutic properties was emphasized in a patient who was initially thought of as SVT and later diagnosed as atrial flutter.

Adenosine is used more safely in the treatment of acute supraventricular arrhythmias due to its extremely short effective half-life. Adenosine has a negative dromotropic effect at the level of the AV node when administered rapidly intravenously.[5] This slowdown, and even occasional interruption of electrical impulse conduction to the AV node, can restore normal sinus rhythm in patients with reentrant SVT. Díaz-Parra et al.[5] stated that adenosine was effective in the treatment of SVT patients despite the need for repeated doses. Losek et al.[6] reported that cardioversion was achieved at the rate of 72% with adenosine administration in probable SVT patients and no side effects were observed. In addition, it was recommended as a useful diagnostic agent in patients with regular tachycardia with narrow QRS complexes of unknown origin.[7] However, a proarrhythmic effect of adenosine was reported in a patient whose diagnosis of atrial flutter was desired to be confirmed.[8] We also administered adenosine for both treatment and differential diagnosis of tachyarrhythmia with narrow QRS complex, which was present in our patient. Short-term AV dissociation was achieved in the patient and flutter waves became evident.

Atrial flutter is usually diagnosed by the presence of typical sawtooth-like flutter waves on an electrocardiogram.[3,9] Atrial flutter may remain as flutter, transform into atrial fibrillation, or turn to sinus rhythm within hours or days.[3] The mechanism of atrial flutter is macro reentry within the atrial wall. Since the AV node is not involved in the reentry circuit, adenosine cannot terminate atrial flutter, but it unmasks the flutter wave by causing AV block.[9] In our patient, while the ventricular rate was approximately 250/min before the administration of adenosine, ECG taken during adenosine push showed an atrial rate of 500/min (typical atrial flutter with 2:1 AV block). In addition, during the atrial flutter rhythm in the patient's ECG, P waves were negative in V1 and positive in V2-V4. These findings also support the diagnosis of right atrial flutter with crista terminalis localization.

Amiodarone has been shown to be beneficial in both short-term therapy and adjuvant therapy with other antiarrhythmic drugs in pediatric patients with various rhythm disorders.[10] It has been stated that standard treatments are ineffective, and intravenous amiodarone can be life-saving, especially in patients with postoperative functional ectopic tachycardia.[11,12] In one study, it was reported that amiodarone treatment successfully converted atrial flutter to normal sinus rhythm without the application of electrical cardioversion.[13] In this study, a newborn infant with narrow QRS complex tachycardia was shown to have atrial flutter with a typical sawtooth pattern underlying after intravenous administration of adenosine. In addition, flecainide acetate, amiodarone, sotalol hydrochloride or combinations of these drugs were

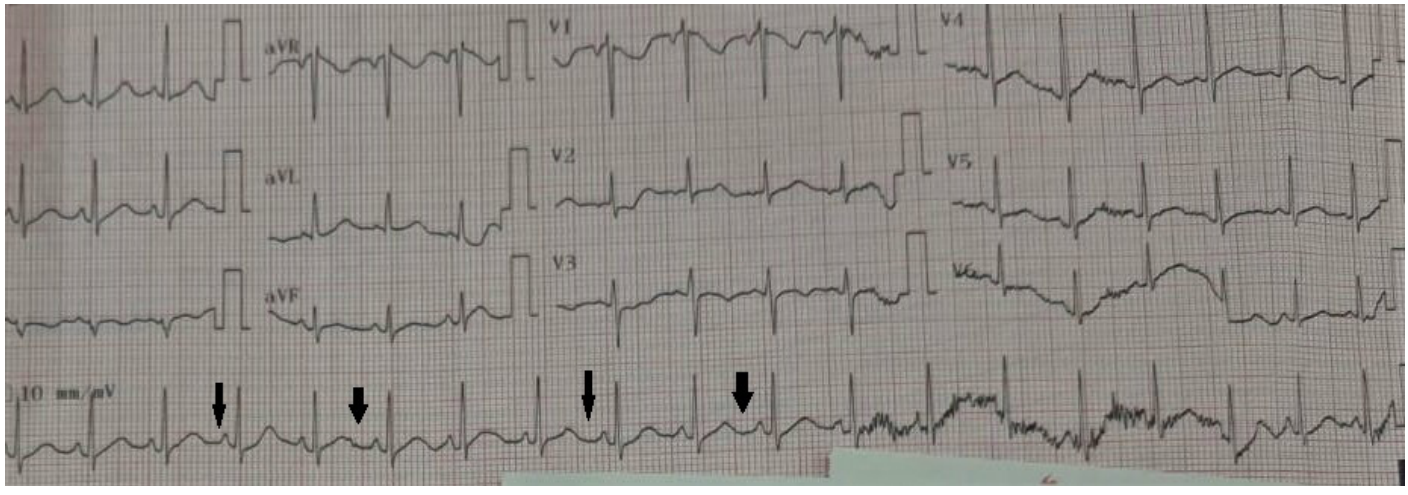

Figure 3. Electrocardiogram that returned to normal sinus rhythm after amiodarone. Arrows show reversion to sinus rhythm with a smooth P wave in front of each QRS complex

reported to be effective in patients with SVT, who were resistant to first-line drugs such as adenosine.[14]

Atrial flutter, which was masked after adenosine, was also revealed in our patient. Afterwards, a successful return to sinus rhythm was achieved with amiodarone treatment.

In conclusion, if the ECG is inconsistent with typical SVT in narrow QRS complex tachycardias, another possible underlying arrhythmia should be considered, and response to treatment with adenosine should be evaluated. Moreover, it should be remembered that successful cardioversion can be performed with amiodarone when atrial flutter is diagnosed.

Ethics

Informed Consent: Informed consent was obtained from the patient's family.

Peer-review: Internally and externally peer-reviewed.

Authorship Contributions

Concept: Ç.K., C.V., Design: Ç.K., A.Z., Data Collection or Processing: Ç.K., C.V., Analysis or Interpretation: Ç.K., C.V., Literature Search: Ç.K., A.Z., Writing: Ç.K., A.Z.

Conflict of Interest: No conflict of interest was declared by the authors.

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References

1. Doniger SJ, Sharieff GQ. Pediatric dysrhythmias. Pediatr Clin North Am. 2006;53:85-105.
2. Bibas L, Levi M, Essebag V. Diagnosis and management of supraventricular tachycardias. CMAJ. 2016;188:E466-73.
3. Ganz LI, Prutkin JM. Control of ventricular rate in atrial flutter. Available at: https://www.uptodate.com/contents/control-of-ventricular-rate-in-atrial-flutter, Accessed: 08.12.2021
4. Hanash CR, Crosson JE. Emergency diagnosis and management of pediatric arrhythmias. J Emerg Trauma Shock. 2010;3:251-60.
5. Díaz-Parra S, Sánchez-Yañez P, Zabala-Argüelles I, Picazo-Angelin B, Conejo-Muñoz L, et al. Use of adenosine in the treatment of supraventricular tachycardia in a pediatric emergency department. Pediatr Emerg Care. 2014;30:388-93.
6. Losek JD, Endom E, Dietrich A, Stewart G, Zempsky W, et al. Adenosine and pediatric supraventricular tachycardia in the emergency department: multicenter study and review. Ann Emerg Med. 1999;33:185-91.
7. Lenk M, Celiker A, Alehan D, Koçak G, Ozme S. Role of adenosine in the diagnosis and treatment of tachyarrhythmias in pediatric patients. Acta Paediatr Jpn. 1997;39:570-7.
8. Slade AK, Garratt CJ. Proarrhythmic effect of adenosine in a patient with atrial flutter. Br Heart J. 1993;70:91-2.
9. Cannon BC, Snyder CS. Disorders of Cardiac Rhythm and Conduction. In: Allen HD, Shaddy RE, Penny DJ, Feltes TF, Cetta F (eds). Moss & Adams' heart disease in infants, children, and adolescents: including the fetus and young adult. Philadelphia, Lippincott Wolters Kluwer, 9th ed. 2016:623-55.
10. Pongiglione G, Strasburger JF, Deal BJ, Benson DW Jr. Use of amiodarone for short-term and adjuvant therapy in young patients. Am J Cardiol. 1991;68:603-8.
11. Perry JC, Fenrich AL, Hulse JE, Triedman JK, Friedman RA, et al. Pediatric use of intravenous amiodarone: efficacy and safety in critically ill patients from a multicenter protocol. J Am Coll Cardiol. 1996;27:1246-50.
12. Saul JP, Scott WA, Brown S, Marantz P, Acevedo V, et al. Intravenous amiodarone for incessant tachyarrhythmias in children: a randomized, double-blind, antiarrhythmic drug trial. Circulation. 2005;112:3470-7.
13. Lim YJ. Pharmacological Cardioversion by Intravenous Amiodarone for Primary Treatment of a Neonatal Atrial Flutter. J Clin Exp Cardiolog. 2018;9:597.
14. Salerno JC, Seslar SP. Supraventricular tachycardia. Arch Pediatr Adolesc Med. 2009;163:268-74.