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CASE REPORT

A case of SVT: response to the third dose of Adenosine

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ABSTRACT

Background: Supraventricular tachycardia (SVT), manifested as rapid and regular heartbeat, is the most frequent symptomatic tachyarrhythmia requiring medical intervention in children. SVT occurs in 1 in every 250-1,000 children. The heart rate can be as high as 180 beats/minute in children and 220 beats/minute in Infants. Evidence suggests that the primary dose of adenosine should be given as 0.1 mg/kg, administered in an intravenous bolus with a dose up to 6 mg. If the primary dose is insufficient, then the amount is increased by 0.1 mg/kg-0.2 mg/kg to a maximum of 12 mg. Our case demonstrates the response to adenosine after the third dose.

Case presentation: A 12-year-old boy, previously diagnosed with recurrent SVT, presented with a complaint of palpitation for the last 30 minutes. There was no obvious trigger for his palpitation on history and examination. He was conscious, well looking with normal blood pressure, and good perfusion. We started the management in accordance with pediatric advanced life support guidelines, in which we noted a partial response after the administration of the second dose of adenosine. Subsequently, a third dose of adenosine of 0.2 mg/kg was administered, terminating SVT and regaining a normal sinus rhythm in the patient.

Conclusion: After reviewing recent evidence regarding stable SVT management and adenosine side effects, we found that there is no evidence limiting the use of adenosine to only two doses, especially in a case of short or minimal response following the second dose.

Keywords: Tachycardia, Supraventricular; Adenosine.

Introduction

Supraventricular tachycardia (SVT), manifested as rapid and regular heartbeat, is the most frequent symptomatic tachyarrhythmia requiring medical intervention in children. SVT occurs in 1 in every 250-1,000 children. The heart rate can be as high as 180 beats/minute in children and 220 beats/minute in Infants [1]. Its pathophysiology can be due to a pathological electrical connection and conduction between the atrium and ventricle or due to a pathological recurrent conduction inside the atrioventricular node (AV) [1,2]. The clinical manifestation for infants or children with SVT differs with their age, tachycardia rate and duration, and any underlying cardiac pathologic condition [3]. Therefore, the frequency of SVT occurrence can range from few/year to few every week. Its treatment and management is dependent on the severity of the condition and cardiovascular stability of the patient [1].

Adenosine is an endogenous nucleoside found in the cardiac conduction system and it affects its cell membrane through A1-purinoceptors [4]. It is a first-choice antiarrhythmic drug for treating patients with SVT at any age [1]. Adenosine is administered to stabilize patients with SVT when vagal maneuvers fail and destabilize patients before performing cardioversion. It could terminate SVT among 77% of SVT cases [5]. Evidence suggests that the primary dose of adenosine should be given as 0.1 mg/kg, administered in an intravenous (IV) bolus with dose up to 6 mg. If the primary dose is insufficient, then the amount is increased by 0.1 mg/kg-0.2 mg/kg to a maximum of 12 mg [1].

Adenosine is a safe, effective, rapid action, and convenient drug for treating and managing SVT [6]. Due to its short half-life, it has only mild, short-

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lived side effects. However, side effects such as ventricular extrasystoles, temporary complete AV block (for <6 seconds), sinus bradycardia (for <40 seconds), nausea, headache, flushing, and disturbance in the respiratory system can still be seen in rare cases [7].

Case Report

A 12-year-old boy, with a known case of recurrent SVT, presented to the emergency department with a complaint of palpitation for the last 30 minutes. The patient was feeling no special change in his state of health till he started to feel his heartbeats, which started suddenly while he was comfortably and unstressed watching TV. This palpitation continued until he presented to our emergency department. He had no history of fever, change in the level of consciousness, shortness of breath, cyanosis, apnea, and syncopal attack. Other systemic reviews were unremarkable. He was taking metoprolol regularly which was stopped 2 months ago by his pediatric cardiologist, who planned to perform ablation in case of a recurrence of an SVT attack. He had a history of similar presentations, a total of four stable SVT attacks, with the last one being 7 months before the current presentation. Physical examination revealed a conscious and well-looking child. Vital signs were all stable, except for his heart rate, which was 254 beats per minute with good tissue perfusion.

He was put on a resuscitation bed, and immediately a 12-lead electrocardiogram (ECG) recording was initiated (Figure 1). The resulting ECG showed narrow QRS complex tachycardia in the patient at the rate of 254 beats/minute with a fixed beat-to-beat interval and an absent P wave. The impression of a stable SVT was established. Concurrently after inserting the IV line, vagal stimulation was ongoing (carried out twice by blowing into a closed straw only for around 30 seconds in each trial), but there was no response.

Once the IV line was established (in the left hand peripheral IV line, using 20 gage), we began administering adenosine with a primary dose of 0.1 mg/kg IV as the standard (rapidly followed by saline flush), which showed no response 1 minute later, and the second dose of adenosine was increased to 0.2 mg/kg IV as the standard (rapidly followed by saline flush), which resulted in around 8 seconds of complete heart block, followed by a minimal response of 2 seconds of the regular sinus rhythm, which soon reverted back to SVT, as shown in the ECG (Figure 2). Afterward, 5 minutes later, we noted a partial response with the second dose, so we decided to administer the third dose of adenosine of 0.2 mg/kg IV as the standard (rapidly followed by saline flush) and hence the patient had a stable SVT, which resulted in a complete heart block for about 9 seconds, followed by a sustained regular sinus rhythm, as shown in the ECG (Figure 3). The 12-lead ECG after stabilization of the patient is shown in Figure 4. The patient was seen by a pediatric cardiologist afterward; he was admitted for observation for 24 hours and resumed his metoprolol 25 mg once daily. During the admission, he did not develop SVT attacks and was discharged home on the same B-blocker, with an appointment for cardiac ablation.

Discussion

In our patient, we followed the pediatric advanced life support (PALS) guidelines [8,9], in which we started with adenosine with a primary dose of 0.1 mg/kg, which showed no response. Subsequently, adenosine's second dose was increased to 0.2 mg/kg, which resulted in 8 seconds of complete heart block and a minimal response of 2 seconds of the regular sinus rhythm soon, followed

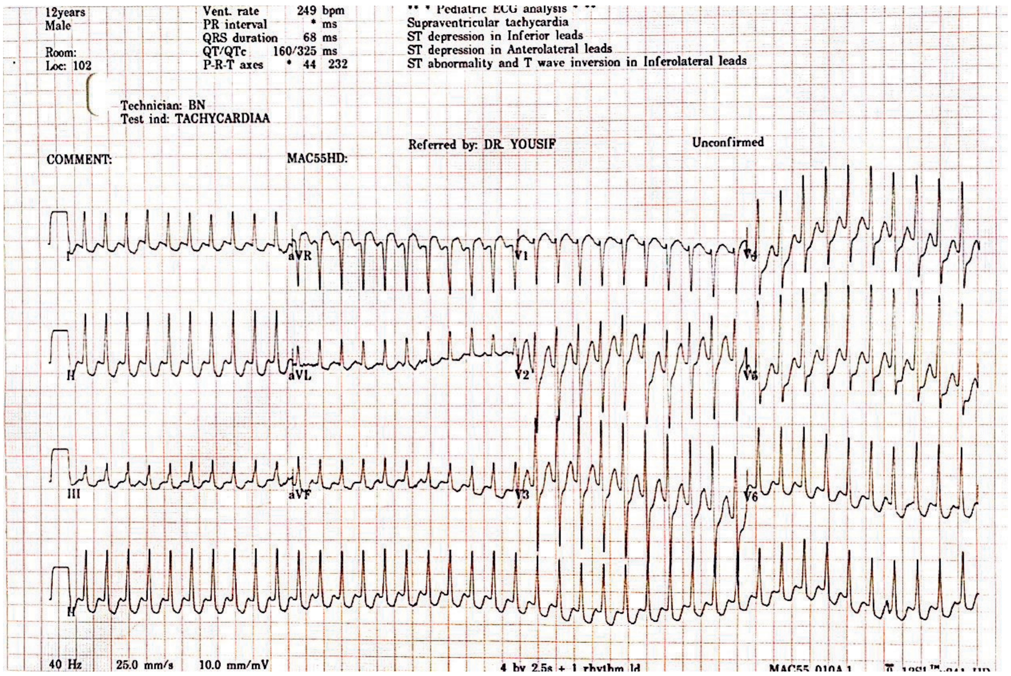

Figure 1. *ECG showing narrow QRS complex tachycardia in the patient at the rate of 254 beats/minute with a fixed beat-to-beat interval and an absent P wave.*

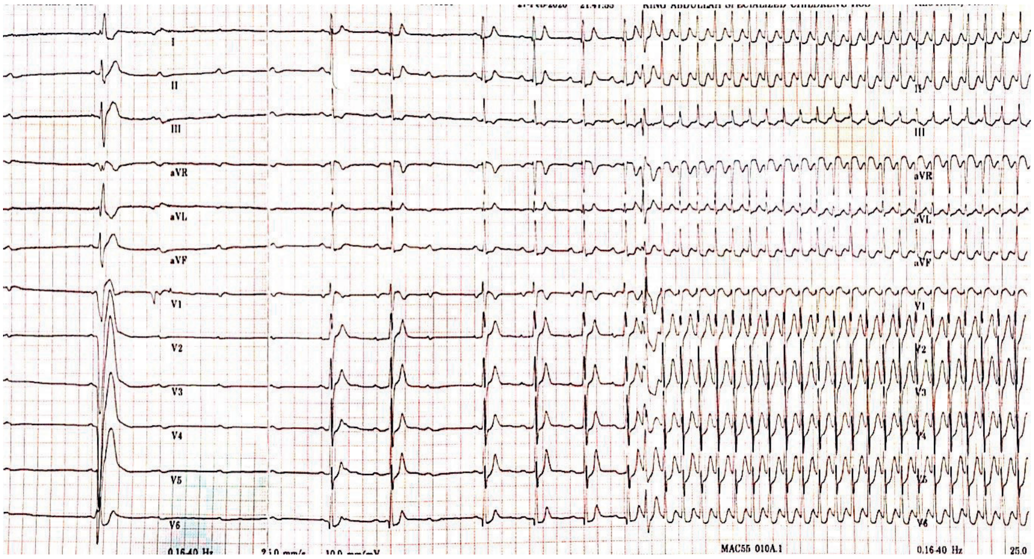

Figure 2. *Eight seconds of complete heart block, followed by a minimal response of 2 seconds of the regular sinus rhythm, which soon reverted back to SVT.*

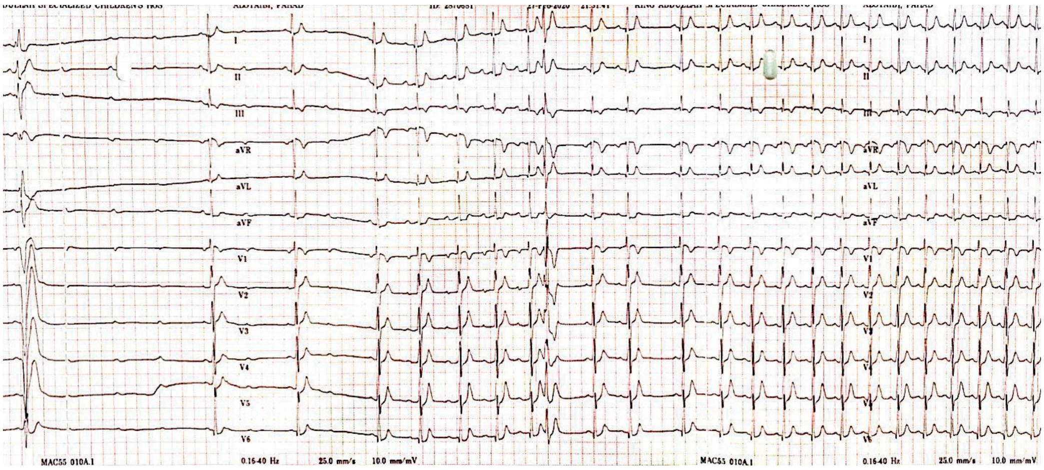

Figure 3. *A complete heart block for about 9 seconds, followed by a sustained regular sinus rhythm.*

by SVT reinitiation. Based on the partial response of the second dose and the evidence of adenosine's relative safe profile, administration of adenosine's third dose of 0.2 mg/kg was permitted, which resulted in a complete heart block for about 9 seconds, followed by a sustained regular sinus rhythm.

A previous retrospective study conducted among children of mean age 3.1 years with SVT reported similar results to our findings supporting administration of multiple doses of adenosine. Almost 30% of children were administered a single dose of adenosine [mean ± standard deviation (SD) = 112 ± 35 μg/kg], 41% received two doses (mean ± SD = 188 ± 55 μg/kg), 24% received three doses (mean ± SD = 249 ± 108 μg/kg), and 4% of children received four doses with responses to 300 μg/kg [10].

Another study was conducted among 43 patients with a history of SVT aged from 1 day to 16 years old. Adenosine was used as an intervention, with an initial dose of 0.05 mg/kg and increased, if required, up to 0.3 mg/kg/dose. The largest administrated bolus dose in this study was 0.5 mg/kg/dose for a single patient. This study concluded adenosine as a safe and effective drug in the management of SVT in children [6]. In another study, a range of 0.05-0.1 mg/kg was used as the initial dose of adenosine [11].

In Oman, for three girls with SVT, aged 4.5 years, 5 years, and 9 years old, respectively, adenosine was administrated in an IV bolus with an initial dose of 0.1 mg/kg and repeat dose of 0.2 mg/kg, with a maximum dose of 0.3 mg/kg. The oldest girl (9 years old) required three doses of adenosine to arrest SVT, concluding IV bolus administration of adenosine as the most appropriate intervention to terminate SVT in patients not responding to vagal stimulation [12].

An experimental study was conducted on the administered incremental doses of adenosine of 100, 200, and 300 μg/kg for 85 children with SVT aged from 6 days to 14 years old, according to PALS guidelines [8,9]. It was reported that adenosine administration effectively reverted 97 cases of SVT back to sinus rhythm. A smaller dose of

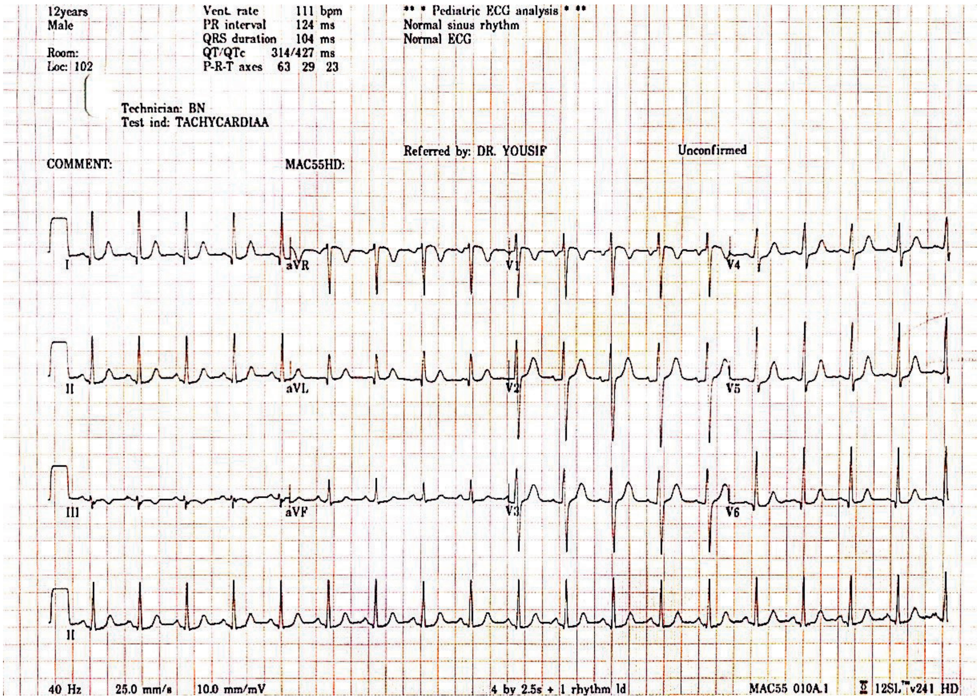

Figure 4. *The 12-lead ECG after stabilization of the patient.*

100 µg/kg was effective among 36.4%, while those (44.3%) who did not respond to 100 µg/kg received a higher dose of 200 µg/kg, and 25 patients who did not respond to previous low doses received a dose of 300 µg/kg. It was concluded that adenosine is significantly effective in treating SVT among children, and a higher dose of 200 µg/kg might be administrated as the initial dose, particularly in children with preexcitation [13].

Another study on 43 children suffering from SVT and treated with adenosine between 1992 and 1995 reported some associated risks including abdominal pain, tiredness, light-headedness, nausea, and discomfort at the injection site. All these side effects were temporary and short-lived, and none of them required treatment [6].

Conclusion

This case illustrates the need for multiple doses of adenosine, not limited to only two doses, especially in a case of short or minimal response to the second dose, keeping in mind the evidence of a relatively safe profile of adenosine.

List of Abbreviations

ECG	Electrocardiogram
IV	Intravenous
kg	Kilogram
Mg	Milligram
PALS	Pediatric advance life support
SD	Standard deviation
SVT	Supraventricular tachycardia
µg	Microgram

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this article.

Funding

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Consent for publication

Written informed consent was obtained from the parents to publish this case report and accompanying images.

Ethical approval

Ethical approval is not required at our institution to publish an anonymous case report.

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