



Neonatal Atrial Flutter: Adenosine Dilemma

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Case Report

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Abstract

Background: Atrial flutter (AFL) is a rare type of neonatal tachyarrhythmia, which is recognized by saw-tooth waves on electrocardiogram (ECG), and an atrial rate of up to 500 beats/minute. The mechanism of AFL is sustained by a macro-reentrant circuit pathway which is limited to the atrial wall, however the atrioventricular (AV) node is not involved of the reentrant circuit.

Case Presentation: A 2-day-old, full term, male infant was born to a hypertensive mother, by cesarean section, presented to the pediatric emergency department at Maternity and Children hospital with history of cyanosis and decrease oral intake. At the physical examination, both tachypnea (70/min) and tachycardia (218/bpm) were determined. An electrocardiogram confirmed atrial flutter with 3:1 atrioventricular conduction. AFL didn't respond to adenosine administration, therefore, electrical cardioversion was required. After conversion to normal sinus rhythm, amiodarone and propranolol therapy were started to maintain sinus rhythm afterward. With no further incidence of AFL or other arrhythmias, the infant was discharged at 9th day of life and in good general state with propranolol therapy, and was followed in the cardiac clinic.

Conclusion: Electrical cardioversion with energy of (0.5-1 J/Kg) proved to be the most effective in establishing sinus rhythm, and is safe for neonatal patients. Adenosine doesn't treat tachycardia of atrial origin, such as AFL. However, adenosine administration may help in identifying AFL, demonstrating the arrhythmia-characteristic saw-tooth waves in the ECG.

Keywords: Atrial Flutter; Arrhythmia; Adenosine; Neonate; Cesarean Section

Abbreviations: AFI: Atrial Flutter; ECG: Electrocardiogram; AV: Atrioventricular; SVT: Supraventricular Tachycardia; BPM: Beats Per Minute; ASD: Atrial Septal Defect; NICU: Neonatal Intensive Care Unit.

Introduction

Neonatal arrhythmia is defined as an abnormal heart rhythm in the neonatal period [1]. There is no uniformity of classification for neonatal arrhythmias, some classify it according to the rhythm to tachyarrhythmias or bradyarrhythmias, and others classify it to benign non-life threatening arrhythmia and nonbenign arrhythmia which is

sudden and need urgent recognition and treatment [2].

Supraventricular tachycardia (SVT) is considered a nonbenign rhythm, caused by re-entrant circuit in neonate [3], and is one of the most common arrhythmias in the neonatal period [2], where it present with a heart rate between 220-300 beats per minute (bpm) [3].

Atrial flutter (AFL) is a rare type of neonatal tachyarrhythmia, which is recognized by saw-tooth waves on electrocardiogram (ECG), and an atrial rate of up to 500 beats/minute [4]. The mechanism of AFL is sustained by a macro-reentrant circuit pathway which is limited to the atrial

wall, however the atrioventricular (AV) node is not involved of the reentrant circuit [5].

Since the AV node is not involved in the re-entrant circuit, AV block doesn't terminate AFL, and because of this, adenosine cannot terminate AFL but unmask the flutter waves by causing AV block [4,6]. There are no large studies representing the incidence of AFL in the neonatal population [7]. The low incidence and small number of publications about the best treatment, and prognosis makes it difficult to carry out studies.

The aim of this study was determining the best treatment options, and prognosis. We also reviewed the literature regarding AFL in neonate. An informed consent was obtained from the parents.

Case Presentation

A 2-day-old, full term, male infant was born to a hypertensive mother, by cesarean section. At the physical examination, both tachypnea (70/min) and tachycardia (218/bpm) were determined.

An electrocardiogram (ECG) was obtained in the emergency department which confirmed atrial flutter with 3:1 atrioventricular conduction, with atrial rate of 300 bpm, and a ventricular rate of 214 bpm. An echocardiogram showed small secundum atrial septal defect (ASD). The patient was admitted under the neonatal intensive care unit (NICU), and cardiology team was consulted regarding the AFL. Intravenous adenosine therapy was started with a dosage of 0.1 mg/kg for three times with no response. Amiodarone therapy with loading dose (5mg/kg) was initiated but, the infant's blood pressure dropped to (38/25) so, amiodarone infusion was stopped, and cardiology team was contacted. Because of persistence of AFL, direct current cardioversion (1 J/kg) was performed for once. After conversion to normal sinus rhythm, amiodarone and propranolol therapy were started to maintain sinus rhythm afterward.

After 24 hours without AFL attack, intravenous amiodarone therapy was replaced with oral treatment. With no further incidence of AFL or other arrhythmias, the infant was discharged at 9th day of life and in good general state with propranolol therapy, and was followed in the cardiac clinic. AFL didn't repeat in the time of follow-up, and cardiac evaluation was reported as normal (Figures 1 & 2).

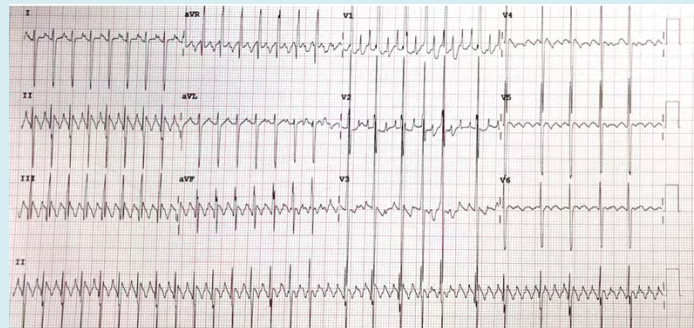


Figure 1: Electrocardiogram showing the typical "saw tooth" pattern of atrial flutter with 3:1 atrioventricular conduction in lead II.

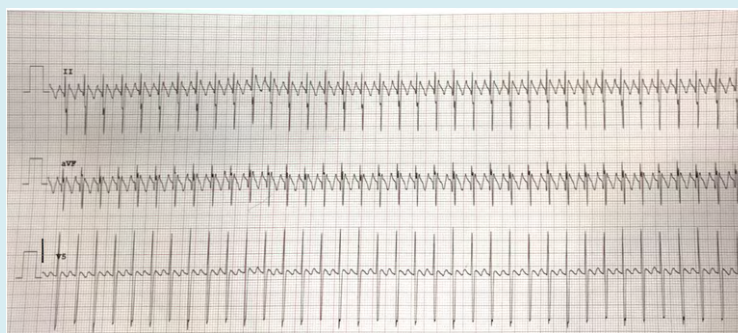


Figure 2: Electrocardiogram showing the typical "saw tooth" pattern of atrial flutter with 3:1 atrioventricular conduction in lead II, after administering adenosine.

Discussion

AFL in neonate may be resistance to first-line treatment, therefore, second-line agents such as cardioversion is required. Neonates with AFL are likely to be found born macrosomic or born to diabetic mothers [8], which wasn't present in our case. The decision of treating the infant with intravenous adenosine, following failure of vagal maneuvers followed the pediatric advanced life support guidelines [9], as it is considered first line drug treatment in termination of SVT.

Our case didn't respond to administration of adenosine and the heart rate remained between 220-230 bpm, similar reported cases showed no response to adenosine administration as well [10-13]. Therefore, following discussion with the cardiology team, a decision was made to treat infant with synchronized direct current cardioversion.

According to two studies conducted by Casey FA, et al. [14] and Konak M, et al. [15] after administration of adenosine, the diagnosis of AFL was established, revealing classic flutter waves. Adenosine triphosphate is the first choice of drug for acute termination of SVT, and the mechanism of the drug is related to AV node block [16]. So, it does not convert AFL to sinus rhythm because the AV node is not involved in the reentrant circuit [4,6].

A normal saline bolus of 10ml/kg was administered to this infant to rule out sinus tachycardia caused by hypovolemia, with no improvement. We used amiodarone, propranolol, and cardioversion. Our case was resistance to amiodarone, and AFL was stopped with cardioversion.

Amiodarone is reported to be effective in some cases of AFL as a premedication to cardioversion and to maintain sinus rhythm afterward [7,17]. Direct current cardioversion is considered the most effective in establishing sinus rhythm with reported success rate to be around 90% [13]. The first successful direct current cardioversion of neonatal atrial flutter was reported in 1965 [18]. Therefore, it is being a good option for treatment.

The diagnosis is often simple with an ECG showing classic "saw tooth" pattern, better observed in leads II, III, aVF. The prognosis of neonatal AFL is often dependent on the presence or absence of congenital heart disease, however, neonatal AFL generally has a good prognosis once sinus rhythm is established, with low risk of recurrence, and a long-term antiarrhythmic medication is unlikely to be required.

Conclusion

In this reported case, electrical cardioversion with energy

of 1J/Kg proved to be the most effective in establishing sinus rhythm, and is safe for neonatal patients. Adenosine doesn't treat tachycardia of atrial origin, such as AFL, as described in this article. However, adenosine administration may help in identifying AFL, demonstrating the arrhythmia-characteristic saw-tooth waves in the ECG.

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