



## Incidental finding of supraventricular tachycardia with progression to atrial flutter after electrical cardioversion in neonates



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### ABSTRACT

Cardiac arrhythmias in newborns, although rare, are often associated with prematurity and congenital heart defects. Atrial flutter, a tachyarrhythmia with a continuous, elevated atrial rhythm, occurs in about 1% of pediatric cases and usually in previously healthy hearts. Supraventricular tachycardia (SVT), an abnormality in electrical conduction above the ventricles, can cause symptoms such as difficulty feeding and irritability. In neonates, SVT may be asymptomatic for long periods but may lead to sudden hemodynamic decompensation. Treatment includes antiarrhythmic medications, with adenosine being the first line. In refractory cases, such as the one described, amiodarone and synchronized electrical cardioversion may be necessary. The case reported describes a newborn with SVT and persistent Atrial Flutter, treated with adenosine, amiodarone and synchronized electrical cardioversion, resulting in normalization of the heart rhythm. The patient progressed well with oral amiodarone, with no sequelae. The combination of drugs and electrical cardioversion is effective for treating complex neonatal arrhythmias.

**Keywords:** Atrial flutter, Ventricular tachycardia, Newborn.

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## INTRODUCTION

Cardiac arrhythmias can be defined as irregular beats, which course with a decrease or increase in the expected rate for a certain age group. The sinus pattern, considered the physiological one, corresponds to the narrowing of the QRS complex, preceded by a positive P wave, at a frequency higher than 140 bpm in children over 3 years of age and higher than 160 bpm in children under 2 years of age<sup>1</sup>.

Usually, changes in heart rhythms accompany a specific target population, such as the elderly, people with structural heart disease, heart failure, or obstructive pulmonary disease, rarely observed in children, especially newborns, without previous structural changes<sup>2</sup>. According to the DATASUS<sup>14</sup>, unspecified cardiac arrhythmias were responsible for 4,315 deaths in Brazil during 2022, 84.59% of which were elderly people aged 60 years or older, and 0.78% of the population aged 19 years or less, whose population under 1 year old represented 0.13% of the sample.

Although little observed in pediatrics, cardiac arrhythmias in newborns may be related to the period of electrical instability of the immaturity of the heart itself or to the incidence of congenital heart diseases that led to the birth of 867 children in Brazil in 2022 diagnosed with non-specific cardiac anomalies<sup>14</sup>. Some studies state that arrhythmias are observed in 15.9% of neonates with heart disease and 84.1% without heart disease<sup>3</sup>. Thus, prematurity may be a major causal factor that contributes to cardiac immaturity and generation of this electrical dysfunction that courses with junctional leaks and sinus bradycardia<sup>4</sup>. No pediatric studies were found that correlate the age group with the occurrence of this electrical anomaly.

Arrhythmias correspond to an incidence of 2% in fetuses, with Flutter as the second most common cause<sup>2</sup>. Atrial Flutter is a tachyarrhythmia that normally originates in the right atrium, from a macroreentrant circuit, generating continuous atrial electrical activity with irregularity in the R-R interval, with a heart rate above 300 beats per minute. According to the literature, the incidence in pediatrics is 1%, with no established differences between the sexes and, although rare, it is more common observed in previously healthy hearts<sup>5</sup>.

Supraventricular tachycardia is a high-rhythm cardiac electrical abnormality resulting from defects in the electrical conduction of the upper parts of the heart, above the ventricles. Usually, enlargements of the QRS complex can be observed in electrocardiographic examinations, but there may be exceptions<sup>6</sup>.

Supraventricular tachycardia can be diagnosed in infants as a result of symptoms of congestive heart failure. Infants can tolerate a very rapid heart rate for many hours without showing any symptoms. If the episode lasts more than 24 to 36 hours, the heart muscle loses strength and there is a consequent decrease in output. During this period, symptoms include inadequate nutrition, excessive sleepiness, irritability, diarrhea, tachypnea, and others. The diagnosis usually arises along

with the symptoms with cardiac electrical examination or in the assiduous follow-up of patients with heart disease<sup>6</sup>.

Supraventricular tachycardia is a broader term that encompasses various forms of cardiac arrhythmias that originate above the ventricles, whereas atrial flutter is a specific type of arrhythmia with distinct electrophysiological features. Both can cause similar symptoms due to the rapid heart rate, but treatment can vary depending on the specific type of arrhythmia and the patient's clinical conditions.

It is essential that any suspicion of cardiac arrhythmia be carefully evaluated and not ignored in the face of the chances of a positive outcome. Regarding treatment, studies agree on the use of drugs and electrical cardioversion in the failure of the former. Drug use includes adenosine 0.1-0.2 mg/kg/dose; dexmetedomidine 1µg/kg; amiodarone 5 mg/kg attack or continuous use<sup>5,6,10,11,13</sup>.

## **METHODOLOGY**

This is a case report study, whose information was collected through a review of medical records. In parallel, to support the ideas discussed in this article, a literature review was carried out in scientific databases such as PubMed and Scielo. The production of this scientific article followed the regulations proposed by the National Research Council (CONEP).

## **CASE REPORT**

Neonate female, born at 37 weeks of spontaneous vaginal delivery with Apgar score 9/10, weighing 2,950g, of adequate size for gestational age, daughter of a healthy mother who presented pregnancy-specific hypertensive disease during the course of pregnancy, attends a consultation at the pediatric outpatient clinic at 4 days after discharge from the rooming-in. Neonatal screening tests with no changes. During physical examination, a heart rate of 190-200 bpm was found, and she was referred to the children's emergency room for correct evaluation and management. The mother did not present any complaints regarding the child's behavior, reporting good sleep and good latching on to the mother's breast, without loss of breath and without cyanosis.

In the children's emergency room, monitoring showed supraventricular tachycardia without hemodynamic instability. A dose of adenosine 0.1 mg/kg was performed, without response, and adenosine 0.2 mg/kg/dose once, whose rhythm remained in atrial flutter with an atrial rate of 300 bpm and ventricular rate of 200 bpm.

With the atrial flutter remaining, an attack with amiodarone was performed, which had no effect. According to the guidance of the pediatric cardiology team, the patient was referred to the Intensive Care Unit with amiodarone 10 mcg/kg/min maintenance. The patient underwent an echocardiogram that showed patent foramen ovale with a pulmonary pressure of 32 mmHg, with no

structural changes. Congenital hypothyroidism was ruled out in the laboratory. Finally, she was submitted to synchronized electrical cardioversion at a dose of 0.8 J/kg only once, returning to sinus rhythm. The patient was discharged with oral amiodarone at a dose of 5mg/kg/day in good general condition and, after 30 days, an electrocardiographic study ruled out signs of electrical anomalies.

## DISCUSSION

Recent studies show that the incidence of arrhythmias in neonates worldwide reaches about 25 for every 100,000 live births. Often, they require some medical intervention due to possible complications (which include thrombus formation, hemodynamic instability, and even death). The causes can range from iatrogenesis, idiopathic to structural anomalies. Congenital heart diseases lead the statistics of causes for arrhythmias in neonates that require medical intervention, being responsible for the development of supraventricular tachycardias (SVT) in its majority. Following this decreasing scale in incidence, junctional ectopic tachycardia, total atrioventricular block, and atrial flutter come next<sup>7,11</sup>, diverging from the *American Heart Association*<sup>10</sup>, whose latest update from 2024 states that Wolff-Parkinson-White syndrome is the most common in neonates. Such arrhythmias are defined as non-benign, precisely because they include the need for medical intervention. We must consider that for the patient to seek a hospital, logically they will be non-benign arrhythmias, therefore, the incidence of these anomalies cannot be exact, since many benign cases do not even reach the consultations.

A study carried out in a tertiary hospital in Beirut, Lebanon, with 16,346 patients admitted to the medical service with cardiac arrhythmias, showed that, in fact, supraventricular tachycardia is the most common anomaly, however, cases in which the patient requires intensive care are rare, which converges with other literature<sup>7,8,11</sup>. As in the literature, this case described here agrees with the classification of arrhythmia, which is presented as supraventricular tachycardia, but this neonate does not present cardiac structural anomalies, being part of the idiopathic group, whose incidence is lower.

What draws attention to this case is that the newborn remained asymptomatic even as a non-benign form of this electrical anomaly. However, it is said in the described science that patients up to 2 years old can remain without symptoms of heart failure for long periods of electrical instability, due to the immaturity of the heart itself, however, hemodynamic decompensation is sudden<sup>6,9</sup>.

Of the patients admitted to intensive care, the study of DOI, Yuji et al. (2022)<sup>8</sup> showed a strong relationship with low birth weight. All patients showed some negative impact factor, such as intrauterine diagnosis, history of emergency cesarean section due to fetal distress, among others. No relationship has been described regarding the appearance of supraventricular tachycardia requiring ICU in a healthy patient with no family history and with reassuring prenatal/delivery as described in this case.

According to the *American Heart Association* (AHA)<sup>10</sup>, When they have a significant clinical impact, pharmacological treatment has been the main strategy employed in cardiac arrhythmias. To reverse in sinus rhythm, this association recommends adenosine as the first choice at low doses of 0.1 mg/kg/dose and the association itself states failure on the first attempt in the vast majority of SVT cases. The patient in the case did not respond to the first attempt at this dose. Therefore, the recommendation is 0.2 mg/kg in a second attempt, assuming that it is reasonable and capable of reversing the condition. The neonatal patient in question did not achieve sinus rhythm, reverting to atrial flutter. The AHA states that after the second attempt, catecholamine levels rise considerably, making any further attempt at reversal with this drug more difficult. Therefore, a second drug should be employed. For this, esmolol bolus or dexmedetomidine 1µg/kg in 20 seconds are considered. Others, such as sotalol or ivabradine, are new medications, not yet available in the tertiary service responsible for the medical care of this reported patient. When associated with hydrops fetalis, sotalol becomes the first option<sup>12</sup>.

Amiodarone is considered refractory SVT, as is procainamide, or first choice in atrial flutter, which was the case, considering a load of 30 to 60 minutes in neonates due to the risk of hypotension<sup>10</sup>.

Countershock therapy in neonates is highly effective and includes electrical defibrillation, transesophageal stimulation, and synchronized electrical cardioversion<sup>9</sup>. Or *Flutter atrial* It is characterized by a rare appearance in neonates and with an atrial rate of 250-500 bpm, without the need for previous structural changes, marked by macrore-entry into the supraventricular circuit<sup>12</sup>. For the newborn, as well as in adults, the need for electrical cardioversion (in synchronized form or by transesophageal overdrive) occurs in hemodynamic instability both in the *Flutter* as any other tachyarrhythmia. The protocols are commonly agreed upon in the event of failure of chemical cardioversion or instability<sup>9,12,13</sup>. The non-reestablishment of sinus rhythm when trying two different drugs and the time elapsed in abnormal electrical activity was the decisive factor in this report for synchronized electrical cardioversion, opted for the lack of resources to promote transesophageal overdrive. However, the whole process was conclusive.

Supraventricular tachycardia usually occurs in a single, self-limited episode, sometimes with incessant and prolonged episodes. Studies have shown that physicians often adopt antiarrhythmic medications for a continuous period of 6 to 12 months for maintenance after primary occurrence. There is no consensus on the duration of the therapy, but it has been shown to be effective, although trials are scarce<sup>11</sup>. However, episodes of SVT resolve by 1 year of age. Currently, the patient in the case is 7 months old, without the use of antiarrhythmics, but with an electrophysiological sinus pattern. In other words, the use of amiodarone for 6 months after the episode was apparently effective, corroborating this cohort of BRUDER, Diana et al (2022)<sup>11</sup>, which states that prophylactic



antiarrhythmic medication in neonates is safe and well tolerated, but it is preferable for this author to use beta-receptor blockers, such as propranolol, due to the extensive experience worldwide with this medication, converging with *American Heart Association*<sup>10</sup>.

Therefore, for the treatment of the arrhythmia presented by this neonate, the medical team chose to follow the *American Heart Association*<sup>10</sup> throughout the rescue protocol, in contrast to the choice of subsequent maintenance that chose to maintain amiodarone orally daily, achieving success and reestablishment of the newborn's health, without sequelae and with good neuropsychomotor development. Despite the recommendations, it is necessary to take into account the evolution that the patient presented in Atrial Flutter, after the disappearance of SVT, which is considerably refractory to chemical cardioversion in neonates<sup>12</sup> and the availability of resources in the service in question.

### CONFLICTS OF INTEREST

The authors state that there is no potential conflict of interest that could compromise the impartiality of the information presented in this scientific article.



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