

# Evaluation and Management of Neonatal Supraventricular Tachycardia

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## Abstract

**Background:** Supraventricular Tachycardia (SVT) is the most frequent arrhythmia requiring a medical treatment in neonates.

**Objectives:** The aim of our study was to evaluate and manage neonatal supraventricular tachycardia.

**Methods:** This study was performed on 22 newborns that were diagnosed with SVT at two neonatal intensive care units (NICU) in south west of Iran from October 2012 to October 2015. Data on gender, age, weight, maternal age, gestational age, presence of congenital heart disease, blood pressure in admission, duration of hospitalization period, duration of SVT, medicine for the control of SVT, list of medicine administered at releasing time were collected. Echocardiography was performed for all patients. Data was analyzed by the SPSS version 18 software.

**Results:** Twelve neonates were male (54.5%) and ten (45.5%) were female. The mean age was  $11.68 \pm 8.17$  days. Three neonates (13.6%) had congenital heart disease. The mean duration of hospitalization was  $6.54 \pm 3.98$  days. Nine patients (41%) only had responded adenosine. One patient had hypotensive that received D/C shock.

**Conclusions:** We concluded that in most SVT patients, conventional treatment can be helpful and an only minor percentage of patients need to receive flecainide as the last line of treatment.

**Keywords:** Neonatal, Supraventricular, Tachycardia

## 1. Background

Arrhythmias are rarely observed in newborns. The incidence is about 1% during the neonatal period and 1% - 3% in late pregnancy (1). Ventricular and supraventricular ectopics are benign and self-limited. Routine examination before discharge of neonates showed ectopics in about 1%. These arrhythmias may be due to metabolic disorders and hypoxia and also can be seen even in normal cases. The prognosis is excellent and usually disappears in the first month of life (2). If incidence of SVT in children was 1 in 25000 based on an estimate made in 1967, but with a higher index of suspicion and better methods of detection, it now is estimated to be 1 in 100 for children of all ages and 1 in 250 for neonates (3). Supraventricular Tachycardia (SVT) is the most common neonatal dysrhythmia. Supraventricular tachycardia includes forms of tachycardia that either arises above the bifurcation of the bundle of His or that have mechanisms dependent on the bundle of His. Mechanisms of tachycardia are atrioventricu-

lar nodal reentrant tachycardia, atrioventricular reciprocating tachycardia, and atrial tachycardia (4). Re-entrant tachycardia with accessory pathway is the most common SVT in children and neonates (5). The most important clinical signs of tachycardia are usually associated with heart rate. These include hypotension, heart failure, and signs of shock, pallor, or decreased level of consciousness. Signs in infants may include irritability, poor feeding and tachypnea. Diagnosis is not a problem because heart rate is sustained at  $\geq 220$  beats per minute with a QRS  $< 0.08$  seconds (6). Circulatory collapse with a tachycardia needs DC cardioversion, which should be synchronized. If the patient is not critical, it is reasonable to first try vagal maneuver and adenosine. Adenosine at an initial dose of 50 - 100  $\mu\text{g}/\text{kg}$  can be given rapidly intravenously into a large vein. Intravenous amiodarone is considered for several reasons. It can be used in SVT or VT. It has little negative inotropic effect, so it is relatively safe when myocardial function may be compromised (7). Many different drugs are used in the management of neonatal tachycardias. Acute

drug therapy for SVT (intravenous therapy) and ongoing drug therapy for SVT (oral administration) are shown (8) in Tables 1 and 2. The recommendation for acute treatment of SVT of unknown mechanism is shown in Table 3. In supraventricular tachycardia sensitive to adenosine, which is easily treated, we would choose a long acting  $\beta$  blocker. Special monitoring is not needed, and  $\beta$  blockers are safe. For an infant, who presented shock, or in whom cardioversion was difficult, we would choose a more powerful antiarrhythmic drug, such as sotalol, flecainide, or amiodarone, each requiring more intensive monitoring. Digoxin is sometimes used as adjunctive treatment. Digoxin is not used in the presence of a delta wave, because of the potential risk of accelerating antegrade accessory pathway conduction in the event of an atrial tachycardia. Flecainide and sotalol have a proven effect on refractory SVT as single agents and with other antiarrhythmic agents in children and adults (9-11). Spontaneous disappearance of the tachycardia in the majority of neonates in the first year of life is expected. Prophylactic drug therapy is recommended in this group because recognition of tachycardia is often delayed until the occurrence of symptoms. Cessation of drug treatment should be recommended around the end of the first year (12). Radiofrequency ablation can be employed successfully in medically refractory cases, but should be avoided in this age group (increased complication rate) (13).

**Table 1.** Acute Drug Therapy for Supraventricular Tachycardia, Intravenous Administration

Group	Drug
Nucleoside	Adenosine
Beta Blocker	Propranolol, Esmolol
Cardiac glycosides	Digoxin
Class III antiarrhythmic agent	Amiodarone

**Table 2.** Ongoing Drug Therapy for Supraventricular Tachycardia, Oral Administration

Group	Drug
Beta blocker	Atenolol, Metoprolol, Nadolol, Propranolol
Calcium channel antagonist	Diltiazem, Verapamil
Cardiac glycoside	Digoxin
Class Ic antiarrhythmic agent	Flecainide, Propafenone
Class III antiarrhythmic agent	Amiodarone, Sotalol

**Table 3.** Recommendation for Acute Treatment of Supraventricular Tachycardia of Unknown Mechanism

Recommendations	Class of Recommendation
Vagal maneuvers	I
Adenosine	I
Synchronized cardioversion	I
Oral beta blocker	I
Flecainide	IIa
Digoxin	IIb
Amiodarone	IIb
Sotalol	IIb

## 2. Objectives

The aim of this study was to assess the efficacy and safety of different drugs for the treatment of SVT in neonates.

## 3. Methods

In this study we evaluated 22 neonates, who were admitted to two main Neonatal Intensive Care Unit (NICU) centers of Ahvaz city only due to Supraventricular Tachycardia (SVT) during October 2012 to October 2015. Neonates with sepsis, metabolic disease, and central nervous system problem were excluded from the study. We collected data such as gender, age, weight, maternal age (< 18 years, 18 - 35 years, > 35 years), gestational age, presence of congenital heart disease, blood pressure on admission (normotensive, hypotensive), duration of hospitalization period ( $\leq 3$  days, 4 - 7 days, and > 7 days), duration of SVT ( $\leq 1$  hour, 1 - 6 hours, and > 6 hours), Drugs that controlled SVT (adenosine, digoxin, propranolol, amiodarone, flecainide, and D/C shock), and list of medicine administered at releasing time (digoxin, propranolol and flecainide). An electrocardiogram (13 leads) was taken from all neonates before and after treatment with a Mindray beneheart r3 instrument that was analyzed by a pediatric cardiologist. For the first line of treatment, all patients received vagal maneuvers and adenosine (100  $\mu\text{g}/\text{kg}/\text{dose}$ , up to three times). One out of 22 patients got D/C shock (1 j/kg) due to hypotension. Blood pressure was and cardiac monitoring was taken by Saadat Novin s1800 Masimo set. For the second line of treatment, patients received intravenous digoxin and then oral propranolol. If SVT was persistent, patients received intravenous amiodarone. Third line was flecainide. Nine patients (41%) responded to adenosine and were discharged with maintenance therapy. The twelve remaining patients received digoxin as the second line

of treatment, with only seven patients responding to the treatment. Four patients responded to amiodarone or propranolol with digoxin. Only one patient, who showed resistance to pointed medication received flecainide for the last treatment option. A complete echocardiogram was performed by a pediatric cardiologist with a vivid 5s instrument with a 7 MHz transducer to assess ventricular function and to evaluate for congenital heart disease.

#### 4. Results

Amongst the twenty-two neonates, 12 (54.5%) were male and 10 (45.5%) were female. The mean weight of neonates was  $3680 \pm 388$  grams. Their ages ranged from 1 to 28 days and mean age was  $11.68 \pm 8.17$  days. Almost half of the patients were more than one week old at the time of admission. All the maternal ages were between 18 and 35 years. Three neonates (13.6%) had congenital heart disease and all of them had secundum atrial septal defect. Two neonates (9.1%) were preterm. Mean gestational age was  $38.63 \pm 1.18$  weeks. Nine patients (41%) only had received adenosine. One patient had hypotensive that received D/C shock. This patient had low ejection fraction in echocardiography (EF = 40%) that in follow up during hospitalization had normal contractility. Duration of hospitalization in neonates was  $\leq 3$  days in five patients (22.7%), 4 - 7 days in 12 patients (54.6%) and  $> 7$  days in four patients (22.7%) and the mean was  $6.54 \pm 3.98$  days. Drugs, which were used during admission for terminate tachycardia (adenosine, digoxin, propranolol, amiodarone and flecainide) and at discharge time (propranolol, digoxin and flecainide) are shown in [Table 4](#). No side effects were seen in any patients during the entire treatment. The mean duration of PSVT time at admission was  $5.31 \pm 6.11$  hours with a range of 1 to 20 hours. After discharge, SVT did not occur in any patient during the follow-up.

#### 5. Discussion

Supraventricular tachycardia is an umbrella term used to describe tachycardia, the mechanism which involves tissue from the His bundle or above. These SVTs include inappropriate sinus tachycardia, AT (including focal and multifocal AT), macro-reentrant AT (including typical atrial flutter), junctional tachycardia, AVNRT, and various forms of accessory pathway-mediated reentrant tachycardia (8). Although the frequency of arrhythmias in the newborn period is not high, supraventricular tachycardia is the most observed arrhythmias in this period (14). Treatment of SVT is one of the challenges in neonates. Most of these arrhythmias are asymptomatic and rarely life-threatening. Vari-

**Table 4.** Demographic and Treatment Data of Patients

Variable	Data
<b>Gender</b>	
Male	12 (54.5)
Female	10 (45.5)
<b>Age, day</b>	
0 - 2	4 (18.2)
2 - 7	7 (31.8)
7 - 28	11 (50)
<b>Gestational age, week</b>	
$\leq 37$	2 (9.1)
38 - 40	18 (81.8)
$> 40$	2 (9.1)
<b>Blood pressure</b>	
Normal BP	21 (95.5)
Hypotension	1 (4.5)
<b>Congenital Heart Disease</b>	
Yes	3 (13.6)
No	19 (86.4)
<b>Duration of hospitalization, day</b>	
$\leq 3$	5 (22.7)
4 - 7	12 (54.6)
$> 7$	5 (22.7)
<b>Duration of PSVT, h</b>	
$\leq 1$	11 (50)
1 - 6	5 (22.7)
$> 6$	6 (27.3)
<b>Drug (treatment)</b>	
Adenosine	9 (41)
Adenosine, digoxin	7 (31.8)
Adenosine, digoxin, propranolol	2 (9.1)
Adenosine, digoxin, amiodarone	2 (9.1)
Adenosine, digoxin, amiodarone, flecainide	1 (4.5)
Adenosine, D/C shock	1 (4.5)
<b>Drug (discharge)</b>	
Digoxin	5 (22.7)
Propranolol	15 (68.1)
Digoxin, propranolol	1 (4.5)
Flecainide	1 (4.5)

ous studies have identified that 15.3% of arrhythmic newborns have congenital heart disease. Atrial arrhythmias in

particular are reported more frequently in newborns with congenital heart disease (14, 15). In our study 13.6% of patient had CHD. Incidence of WPW in our cases was apparently lower than the study of Etheridge et al. (9% vs. 30%) (16). In 41% of patients, adenosine was successful, which was similar to the study of Etheridge et al. (42.4%) (16). Adenosine impairs conduction through the AV node and is thus effective in terminating tachycardias involving the AV node. Adenosine is the most effective medication for the treatment of supraventricular tachycardia; it is given Intravenously (IV) as a rapid bolus (17). Generally, prognosis of treatment of single SVT is excellent. Usually, drug treatment for the prevention of recurrence of supraventricular tachycardia during the first year of life is recommended (18). Medical therapy appears to be effective and safe in infants with SVT (19). Based on extensive clinical studies, conventional antiarrhythmic agents are generally the first-line therapy in the management of most supraventricular tachycardias in children (20). In newborns and in infants with first presentation of an episode of tachycardia, drug prophylaxis of recurrences is usually recommended for the whole of the first year of life. Prophylactic treatment may consist of a beta-blocker as first choice, with oral digoxin as an alternative, which is used as the first line treatment in the present study. In an infant with Wolff-Parkinson-White syndrome it may be wise to avoid digoxin and to start treatment with a beta-blocker. We followed the same instruction for two of our patients by diagnosis of WPW. Antiarrhythmic class Ic drugs such as flecainide, and class III agent sotalol, are widely used as the next step of therapy when digoxin and beta-blockers fail to prevent recurrences. Only one of the patients showed resistance to other treatments, which received flecainide. Amiodarone is considered to be an agent that should be reserved for use in situations when the tachycardia is refractory to previously named agents (21). Amiodarone was used for the control of SVT in three patients but concerning its side effects on neonates, other medicines are prescribed at discharge time.

### 5.1. Conclusion

Diagnosis of arrhythmias in the neonatal period is essential for appropriate and optimal treatment at this time. Control of SVT was possible in all patients. According to the result of our study we concluded that in most SVT patients conventional treatment can be helpful and only minor percentage of patients need to receive last line of treatment.

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### Footnotes

**Authors' Contribution:** Study concept and design, Mohammad Reza Khalilian and Arash Malekian; acquisition of data, Mohammad Reza Khalilian and Heydaripoor; analysis and interpretation of data, Mohammad Reza Khalilian and Heydaripoor; drafting of the manuscript, Mohammad Reza Khalilian and Arash Malekian; critical revision of the manuscript for important intellectual content, all authors; statistical analysis, Mohammad Reza Khalilian; administrative, technical, and material support, Mohammad Reza Khalilian and Arash Malekian; study supervision, All authors.

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