

# International Journal of Pediatrics and Neonatology

ISSN Print: 2664-8350  
ISSN Online: 2664-8369  
Impact Factor: RJIF 5.26  
IJPN 2023; 5(2): 56-61  
[www.pediatricsjournal.net](http://www.pediatricsjournal.net)  
Received: 09-07-2023  
Accepted: 16-08-2023

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## Supraventricular tachyarrhythmia associated with left ventricular dysfunction in neonates & infants: Experience from a Tertiary Care Children's Hospital in Dhaka, Bangladesh

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DOI: <https://doi.org/10.33545/26648350.2023.v5.i2b.54>

### Abstract

**Introduction:** Supraventricular Tachyarrhythmia (SVT) in neonates & infants may result in left ventricular (LV) dysfunction if persists for long time. Sometimes it may result into cardiomyopathy & symptomatic heart failure. Left ventricular systolic function improves or normalizes and symptoms resolve if rhythm is corrected or rate controlled is achieved. The purpose of the study is to observe clinical features, management & outcome of various SVT associated with left ventricular dysfunction admitted at cardiac centre of Bangladesh Shishu Hospital & Institute.

**Methodology:** This prospective cross-sectional study was conducted in all the neonates & infants admitted with confirmed SVT with LV dysfunction. SVT was confirmed by ECG criteria & LV dysfunction was confirmed by Echocardiography. All the patient underwent treatment according to unit SVT management protocol for different types of SVT. Presenting complaints, ECG findings, Echo findings, Antiarrhythmic medicine with which the SVT is reverted to sinus rhythm, duration required for reversion, any complication during management was recorded. These patient was followed up at centre's arrhythmia clinic 1 month, 3 months, 6 months and 1 year after discharge from hospital. During follow up the ongoing antiarrhythmic medicine dose, duration & discontinuation, any side effects, ECG & ECHO findings was recorded.

**Result:** Total 18 neonates & infants were admitted with confirmed SVT with LV dysfunction during the study period. Median age was 43 days & median ventricular rate was 250 BPM.

One third of patient presented with symptoms & signs of heart failure, 22% presented with circulatory shock, 44% presented without heart failure or shock. The most frequent SVT was Atrio-ventricular re-entrant tachycardia (AVRT) 39%(7), Atrial ectopic tachycardia (AET) focal & multifocal constitute 33.3% (6), Two patient (11.1) each diagnosed as Congenital junctional ectopic tachycardia(JET) & Permanent junctional reciprocating tachycardia (PJRT). Only one infant diagnosed as Atrial flutter. Five patient (27.8%) has severe left ventricular (LV) dysfunction with ejection fraction of less than 35%. Median duration for reversion to sinus rhythm was 26 hours. Median duration of maintenance therapy was 7 months. Recurrence of SVT happened in 8 patients (44.4%) during maintenance therapy & median duration of antiarrhythmic medicine free period was 36 months.

**Conclusion:** Supraventricular tachycardia with LV dysfunction is an under appreciated, but treatable condition in pediatric patients with structurally normal hearts. It shows complete normalization of cardiac function and generally has an excellent prognosis once the arrhythmia is controlled.

**Keywords:** Supraventricular Tachyarrhythmia (SVT), left ventricular dysfunction, neonates & infants

### Introduction

Supraventricular tachycardia (SVT) is narrow complex tachycardia that originates from the atria or atrioventricular (AV) node. The first peak incidence of SVT onset is during the neonatal period, and most of them resolve spontaneously after the patient reaches 1 year of age<sup>[1, 2]</sup>. Neonates & infants cannot complain of tachycardia and express as irritability, excessive crying, nausea, and vomiting; sometimes as heart failure or shock, therefore, it is necessary to manage SVT that occurs at this time & to prevent recurrence through prophylactic antiarrhythmic drug treatment until resolution. An understanding of the mechanisms of tachycardia is important to make a logical management plan. The purpose of the study is to observe clinical features, management & outcome of various SVT associated with left ventricular dysfunction admitted at cardiac centre of Bangladesh Shishu Hospital & Institute.

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Different studies suggested that despite apparent resolution of the problem, tachycardia recurrence causes a precipitous decline in LVEF with concomitant symptoms and that there is an association with sudden cardiac death [3].

### Materials and Methods

This prospective cross-sectional study was conducted in all the neonates & infants admitted with confirmed SVT with LV dysfunction from January 2016 to December 2022. Patients with tachycardia after heart surgery or those accompanied by complex heart disease were excluded.

The diagnosis of arrhythmia was evaluated by 12-lead ECG in tachycardia and at normal pulse. All the patients underwent echocardiography to differentiate arrhythmia from accompanying congenital heart disease. Data on gender, age at the time of diagnosis, initial symptoms at the time of diagnosis, weight at the time of diagnosis, and whether the infant was premature, any additional congenital heart disease were investigated.

Presenting complaints, ECG findings, Echo findings, Antiarrhythmic medicine with which the SVT is reverted to sinus rhythm, duration required for reversion, any complication during management was recorded. These patient was followed up at centre's arrhythmia clinic at 1 month, 3 months, 6 months and 1 year after discharge from hospital. During follow up the ongoing antiarrhythmic medicine dose, duration & discontinuation, any side effects, ECG & ECHO findings was recorded.

The symptoms at the time of diagnosis were categorized as follows: (1) shock state, (2) heart failure state, (3) complaining of symptoms without shock or heart failure, and (4) incidental finding.

All the patient underwent treatment according to unit SVT management protocol for different types of SVT. Adenosine, DC cardioversion, digoxin and intravenous amiodarone were used as acute therapy to control tachycardia. If these drugs fails then Flecainide & ivabradin

was used in some cases. To prevent recurrence after the stabilization of tachycardia propranolol, atenolol, amiodarone, ivabradin and flecainide were used.

### Results

**Table 1:** Showed distribution of according to age range (N=18)

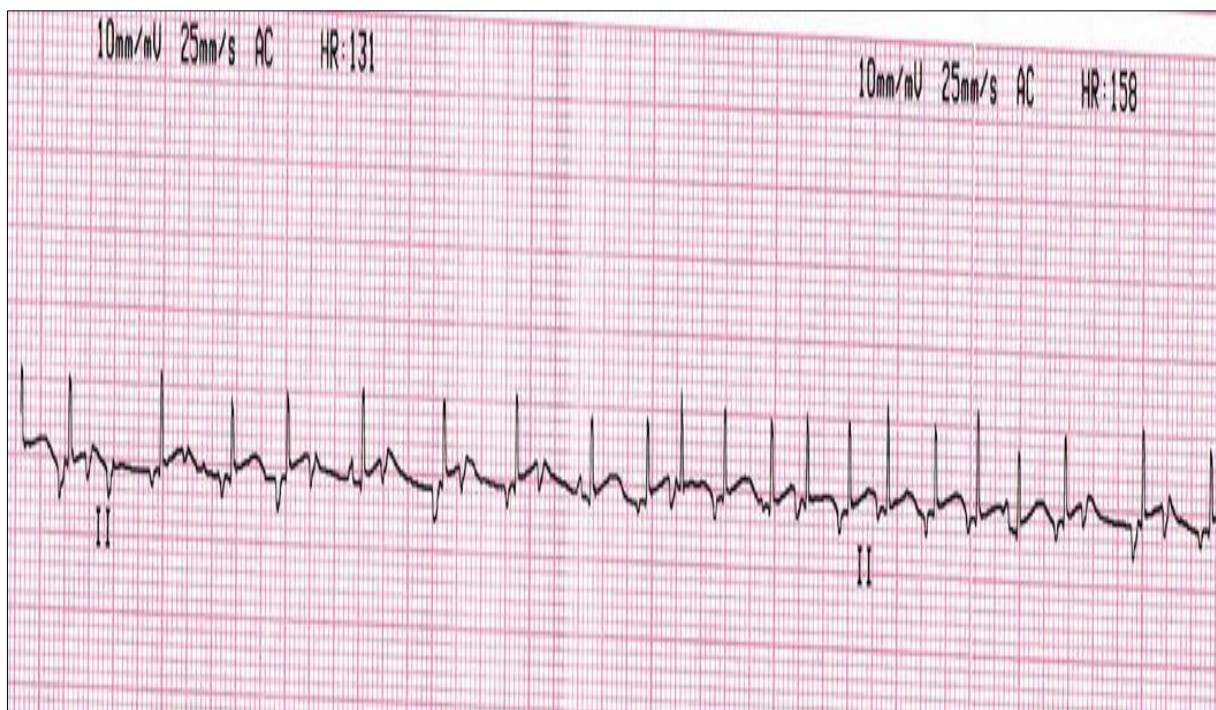
Age range	Number	Percentage
Less than 30 days of age	5	27.8
1 month to less than 3 months	7	38.9
More than 3 months to less than 6 months	5	27.8
More than 6 months to less than 1 year	1	5.6

Total 18 neonates & infants were admitted with confirmed SVT with LV dysfunction during the study period. Median age was 43 days & median ventricular rate was 250 BPM. Among them five were neonates, seven were between 1 month to 3 months, from 3 months to 6 months were five and only one was above 6 months but less than a year (Table-1).

**Table 2:** showed Distribution of patient according to presenting complaints (N=18)

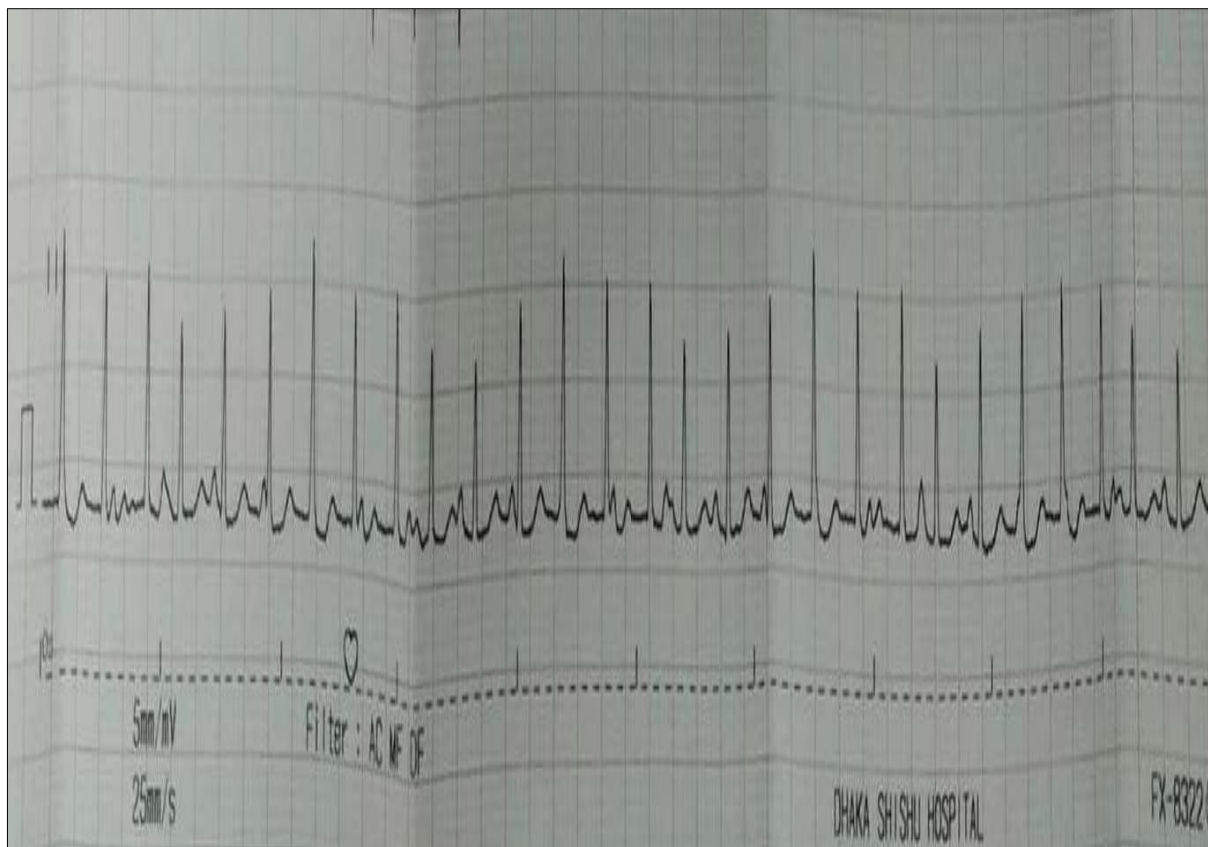
Presenting complaints	Number	Percentage
Shock state	4	22.2
Heart failure state	6	33.3
Without shock/Heart failure	8	44.4

Only one patient had a history of intrauterine tachycardia, delivered at 35 weeks, although the type of tachycardia could not be ascertained from antenatal data. One third of patient presented with symptoms & signs of heart failure, 22% presented with circulatory shock, 44% presented without heart failure or shock (Table-2). These eight patient without heart failure or shock presented with excessive cry, irritability, reluctant to feed.

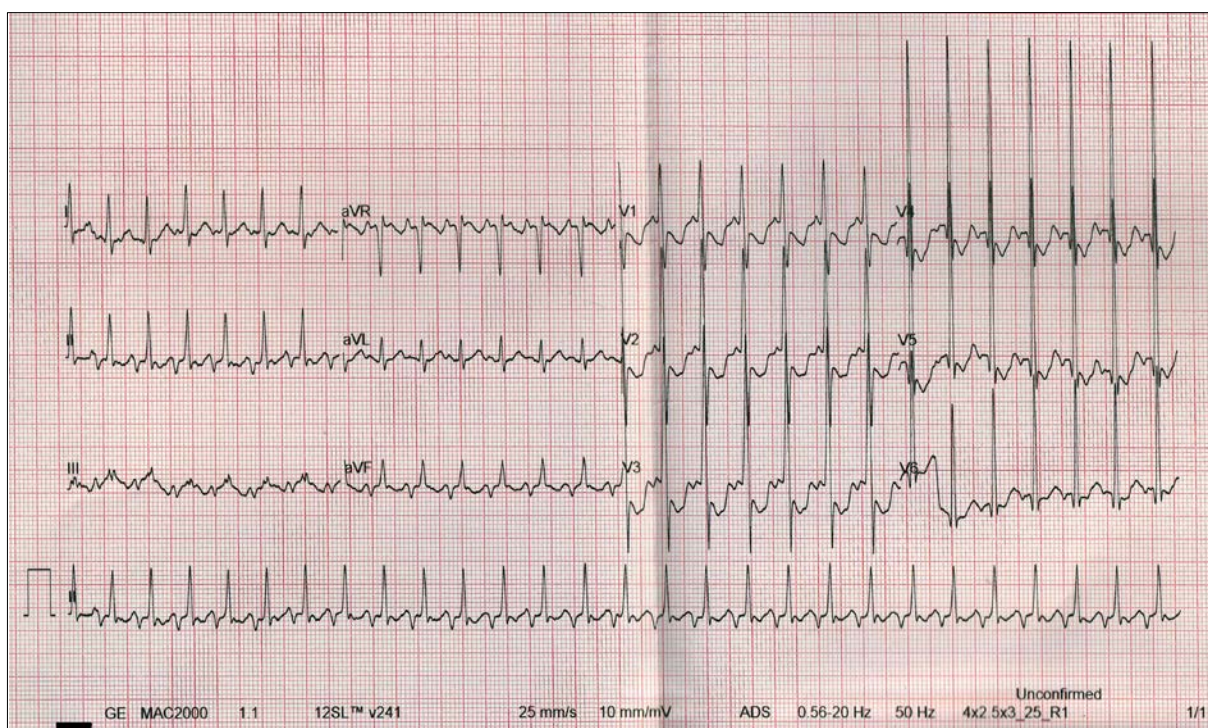


**Fig 1:** The rhythm strip showed Multifocal atrial tachycardia with variable block, ventricular rate: 158 BPM, varying RR interval.

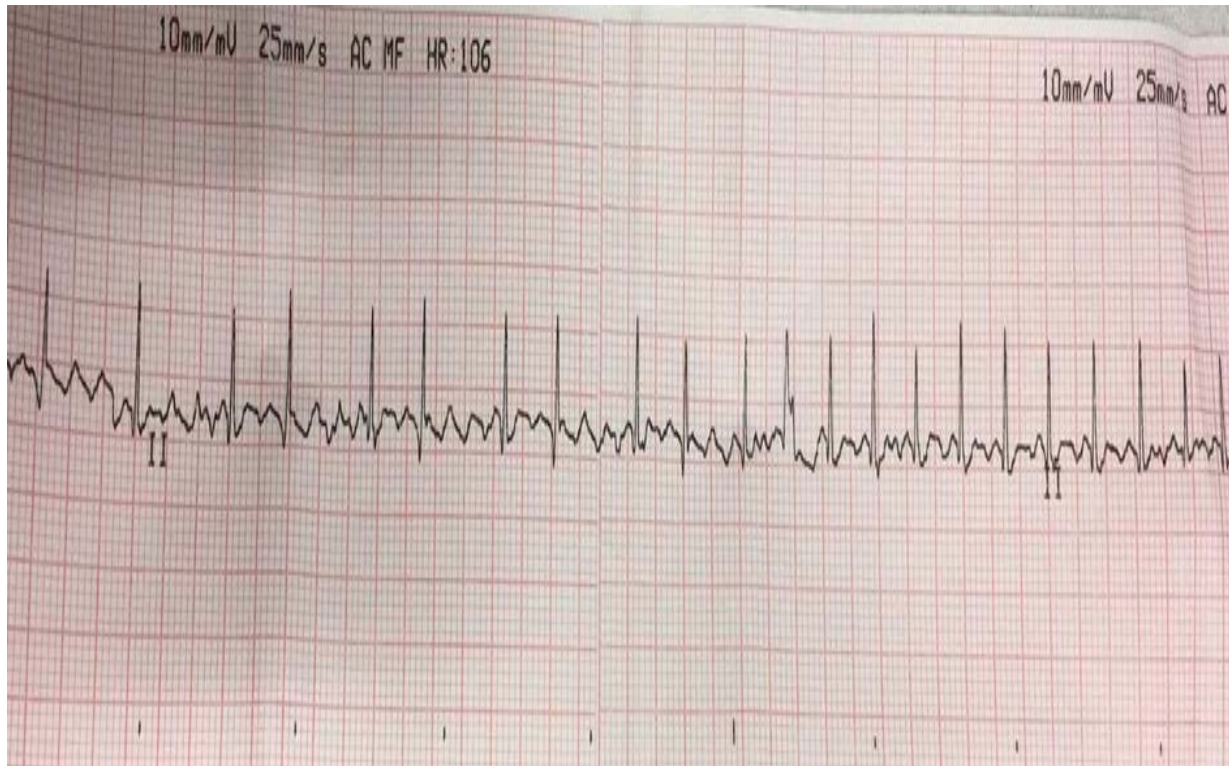




**Fig 2:** The rhythm strip showed AV dissociation (JET).



**Fig 3:** Inverted P wave in inferior leads (PJRT).



**Fig 4:** The rhythm strip showed Saw teeth atrial activity (Atrial Flutter).

**Table 3:** Showed Distribution of patient according to types of SVT (N=18)

Type of SVT	Number	Percentage
AVRT	7	38.9
Focal AET	3	16.7
Multifocal AET	3	16.7
PJRT	2	11.1
Congenital JET	2	11.1
Atrial Flutter	1	5.6

Different types of SVT seen in our patient. RR interval was regular in 13 patients (72.2%) & irregular in 5 patients (27.8%).

The most frequent SVT was Atrio-ventricular re-entry tachycardia (AVRT) 39% (7), Atrial ectopic tachycardia (AET) both focal & multifocal (Figure-1) constitute 33.3% (6), Two patient (11.1) each diagnosed as Congenital junctional ectopic tachycardia (JET) (Figure-2) & Permanent junctional reciprocating tachycardia (PJRT) (Figure-3). Only one infant diagnosed as Atrial flutter (Figure-4) (Table 3).

**Table 4:** Showed Distribution of patient according to severity of LV dysfunction (N=18)

Severity of LV dysfunction	Number	Percentage
Mild LV dysfunction	5	27.8
Moderate LV dysfunction	7	38.9
Severe LV dysfunction	6	33.3

All of 18 patients has some degree of LV dysfunction. Five patient (27.8%) has severe left ventricular (LV) dysfunction with ejection fraction of less than 35%. Seven patient (38.9%) has moderate left ventricular (LV) dysfunction with ejection fraction between 35-50%. Six patient (33.3%) has mild left ventricular (LV) dysfunction with ejection fraction of 50-60% (Table-4).

**Table 5:** Showed Distribution of patient with SVT reverted to sinus rhythm by antiarrhythmic medicine (N=18)

Reverted by antiarrhythmic medicine	Number	Percentage
Adenosine	3	16.7
Amiodarone	5	27.8
Digoxin	2	11.1
Flecainide	4	22.2
Ivabradin	2	11.1
DC cardioversion	2	11.1

There were no significant cardiac anomalies in these patient except patent foramen ovale (PFO) in four patients, two patient has mild pulmonary hypertension. Only one patient has cardiac rhabdomyoma. Supra ventricular Arrhythmia was reverted to sinus rhythm by adenosine in only 3 patients. In five patient SVT was reverted after loading dose of amiodarone 5 mg/kg over 4 hours. Two multifocal atrial ectopic tachycardia (MAT) & two Permanent junctional reciprocating tachycardia (PJRT) required oral Flecainide for reversion of SVT to sinus rhythm. Two patient with atrial ectopic tachycardia could be reverted by intravenous digoxin. One junctional ectopic tachycardia & one Focal atrial ectopic tachycardia required oral ivabradin for reversion to sinus rhythm. Atrial flutter & one AVRT with aberrancy patient required low dose DC cardioversion (Table-5). Median duration for reversion to sinus rhythm was 26 hours.

**Table 6:** Showed distribution of patient on maintenance antiarrhythmic medicine (N=18)

Maintenance antiarrhythmic Medicine	Number	Percentage
Beta blocker	5	27.8
Digoxin	4	22.2
Amiodarone +Betablocker	3	16.7
Amiodarone alone	1	5.6
Flecainide	3	16.7
Ivabradin	2	11.1



After reverted to sinus rhythm five patients were given beta-blocker as maintenance therapy. Three patients maintained with Amiodarone in addition to beta-blocker, one patient only amiodarone. Four patients put on digoxin & beta-blocker for maintenance therapy. Three patients required Flecainide & two patients required Ivabradin for maintenance therapy (Table-6). Median duration of maintenance therapy was 7 months. Recurrence of SVT happened in 8 patients (44.4%) during maintenance therapy. Three patient with AVRT, two with JET, one each for AET, MAT, PJRT recurrence happened. Six patient (33.3%) maintenance therapy could not be stopped. All PJRT & congenital JET patient maintenance therapy could not be stopped, also two patients out of three MAT maintenance therapy needs to be continued. Minor GIT side effects like vomiting, constipation & loose stool seen in 4 patients. No thyroid function abnormality was found in patients getting amiodarone. Median duration taken for normalization of LV function was 1 month & median duration of antiarrhythmic medicine free period was 36 months.

### Discussion

An arrhythmia that is insidious, persistent, and well tolerated is more likely to result in LV dysfunction [4]. LV dysfunction associated with SVT is considered a reversible condition on the basis of resolution of symptoms and normalization of the LVEF after the rhythm is corrected or the rate is controlled [5,6]. In the newborn, a single, sustained episode of typical supraventricular tachycardia may be unrecognized until HF symptoms emerge; thus, neonates may present with decreased LV function, or even shock. In our series One third of patient presented with symptoms & signs of heart failure, 22% presented with circulatory shock. In the largest pediatric series of Arrhythmia induced cardiomyopathy (AIC), AET (59%) and permanent junctional reciprocating tachycardia (PJRT; 23%) were the most common arrhythmias represented. Ventricular arrhythmias were uncommon [7]. In our series the most frequent SVT was Atrio-ventricular re-entry tachycardia (AVRT) 39%(7), Atrial ectopic tachycardia (AET) both focal & multifocal constitute 33.3% (6), Two patient (11.1) each diagnosed as Congenital junctional ectopic tachycardia(JET) & Permanent junctional reciprocating tachycardia (PJRT). Only one infant diagnosed as Atrial flutter. Studies have confirmed that infants and children aged <3 years with EAT are more like to respond to pharmacological therapy and undergo spontaneous resolution. In older children spontaneous resolution of EAT is uncommon. In a multicentre study including 249 children, 74% of children with EAT diagnosed in the first year of life achieved spontaneous resolution [8]. In our series all three focal atrial ectopic tachycardia & one multifocal atrial ectopic tachycardia patients achieved complete resolution. Persistent or permanent junctional reciprocating tachycardia in an uncommon arrhythmia first described by Coumel *et al.* [9], characterised by an incessant orthodromic tachycardia with anterograde conduction over the atrioventricular node and by retrograde conduction via an accessory pathway. Complete tachycardia suppression with medications varies from 25% in the recent series [10] to >80% in a study using regimens that included amiodarone [11]. In our series two PJRT child presented with severe LV dysfunction reverted to sinus rhythm by oral Flecainide but could not be stopped medicine. Congenital junctional ectopic tachycardia (CJET)

is a rare arrhythmia that occurs in patients without previous cardiac surgery. This is often refractory to medical therapy and associated with high morbidity and mortality. It occurs in the first 6 months of life and is usually incessant [12-14]. Amiodarone is the initial treatment of choice and is used most frequently, as a first-line agent and has been used either alone or in combination with propranolol or flecainide in infants. Ivabradine, which works by selective inhibition of hyperpolarization-activated cyclic nucleotide-gated channels, has been shown to be effective [15-17]. In our series JET was reverted one patient with amiodarone & another one using Ivabradin.

### Conclusion

Supraventricular tachycardia with LV dysfunction is an under appreciated, but treatable condition in pediatric patients with structurally normal hearts. It shows complete normalization of cardiac function and generally has an excellent prognosis once the arrhythmia is controlled.

### Acknowledgement

Not available

### Author's contribution

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

### Conflict of interest: None

### Financial support: Nil

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#### How to Cite This Article

Rima R. Supraventricular Tachyarrhythmia Associated With Left Ventricular Dysfunction In Neonates & Infants: Experience From A Tertiary Care Children's Hospital In Dhaka, Bangladesh. *International Journal of Pediatrics and Neonatology*. 2023;5(2):56-61.

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