ORIGINAL RESEARCH PAPER

Cardiology

# TACHYARRHYTHMIAS IN INFANTS AND CHILDREN

**KEY WORDS:** Neonatal Tachycardia, Tachyarrhythmia, Supraventricular Tachycardia.

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**ABSTRACT**

Pediatric arrhythmias are often an unrecognized clinical entity in the Indian population. These arrhythmias are different from adult arrhythmias in the mechanism of generation and termination and usually have a better prognosis in comparison to adult arrhythmia as they respond to a variety of pharmacological and nonpharmacological measures. This article highlights a few aspects of pediatric tachyarrhythmias which are now better evaluated and managed with the development of pediatric ICU and neonatal ICU in India.

## INTRODUCTION

The spectrum of paediatric arrhythmias is slightly different compared to the adult population. Some arrhythmias are peculiar to the paediatric age group like neonatal atrial flutter, permanent junctional reciprocating tachycardia (PJRT), junctional atrial tachycardia, incessant ventricular tachycardia and cholinergic ventricular tachycardia. Out of these arrhythmias PJRT and atrial junctional ectopic tachycardia may lead to tachycardia-induced cardiomyopathy. Neonatal atrial flutter and incessant ventricular tachycardia resolve over time. Broadly, tachycardia in the paediatric age group is divided into supraventricular tachycardia and ventricular tachycardia

## COMMON ARRHYTHMIA IN NEONATES AND CHILDREN

The supraventricular tachycardia is tachycardia occurring as a result of increased automaticity or an accessory pathway. Supraventricular tachycardia occurring in earlier life is commonly accessory pathway mediated. Certain arrhythmias are more common with specific congenital heart diseases (Table.1)[1,2] of which Ebstein's anomaly has been extensively studied. (Table.2)[3,4] Atrioventricular reciprocating tachycardia (AVRT) represents 85% of the arrhythmias in foetal life and 82% of the arrhythmias occurring during infancy[5]. In most cases, tachycardia will resolve spontaneously by the end of infancy although there may be late recurrences. Atrioventricular nodal re-entrant tachycardia (AVNRT) is uncommon during infancy accounting only for 4% of arrhythmias.[6]

**Av Re-Entrant (Or Reciprocating) Tachycardia** formerly called paroxysmal atrial tachycardia (PAT) involves an accessory pathway along with the main pathway through the AV node. The accessory pathway may be an anatomically separate bypass tract such as the bundle of Kent, or a functionally separate bypass tract, such as in a dual AV node pathway. Patients with accessory pathway frequently have WPW syndrome showing ventricular preexcitation with short PR interval, wide QRS complex and delta wave on electrocardiography, more common in children with Ebstein's anomaly, AV septal defects and ventricular septal defect. Incessant tachycardia may result in heart failure, non-immune hydrops fetalis and foetal demise.

**Atrio Ventricular Node Re-Entry Tachycardia(AVNRT)** is the most common form of paroxysmal tachycardia in adolescence and adulthood and is unusual in infants and toddlers characterised by two pathways having different conduction and recovery rates for re-entry to occur. AVNRT is typically triggered by physical activity. Beta-blockers and calcium channel blockers are used frequently to treat these arrhythmias.

**Ectopic atrial tachycardia** is a common variety of PSVT in infants and is usually not associated with underlying heart disease, it is characterised by increased automaticity of myocardial fibres in the atrium or re-entry within the atrial myocardium. ECG shows regular tachycardia with a narrow QRS complex. The hallmark of ectopic atrial tachycardia is the presence of different P wave morphology. Ablation should be considered for school going age group and it provides a permanent cure in 90% of cases.

**Permanent Junctional Re-Entry Tachycardia** is an unusual form of SVT, which classically occurs in children. Infrequently, accessory pathways may have unusual conduction properties that may resemble that of the AV node. PJRT[7] is caused by a slow conducting AV bypass tract that renders the AV reciprocating tachycardia very stable and unremitting. ECG shows inverted P waves in the inferior limbs that precede QRS complexes. PJRT may lead to heart failure in neonates and infants. It is resistant to medical therapy and an ablation procedure resolves the LV dysfunction.

**Atrial flutter** is an unusual arrhythmia in children. The pacemaker lies in an ectopic focus and "circus movement" in atria is the mechanism of this arrhythmia. Atrial flutter can be well tolerated if there is a high degree of AV block with near normal ventricular rate. The atrial rate is 240-360 /minute and ventricular rates of 150-200/minute is seen with AV block(2:1, 3:1, 4:1). ECG shows "saw-tooth" flutter waves. Elective cardioversion should be done in a neonate with heart failure. Class Ia, Ic, III may be used if digoxin fails to terminate the tachycardia.

**Ventricular tachycardia** is much less common in neonates. It may occur either in the structurally normal heart or in the setting of congenital heart disease. Various diseases and aetiologies like myocarditis, cardiac tumours, electrolyte imbalance and drug toxicity can contribute to ventricular tachycardias[6] in neonates. Recently, various channelopathies

such as long QT and Brugada syndrome are recognized as an important cause of ventricular tachycardia. Neonates who have structurally normal hearts usually experience a spontaneous resolution of ventricular arrhythmias.

***Table 1: Most Common Arrhythmia In Congenital Heart Disease***

| DISEASE | ASSOCIATED ARRHYTHMIA |
|---|---|
| Tetralogy of Fallot | Atrial tachycardia |
| Double outlet right ventricle | Ventricular tachycardia. Sinus node dysfunction |
| Transposition of great vessels | Ventricular arrhythmia. Atrioventricular blocks |
| Ebstein's anomaly | Supraventricular tachycardia |
| Atrial septal defect | Atrial tachycardia |

***Table 2. Major Electrophysiological Abnormality In Ebstein's Anomaly***

| Major electrophysiological abnormality in Ebstein's anomaly |
|---|
| 1. Intraarterial conduction disturbance:right atrial P wave abnormalities,PR interval prolongation.<br>2. Atrioventricular nodal conduction: PR interval prolongation<br>3. Infranodal conduction.<br>Intra-his or infra-his conduction abnormality<br>Right bundle branch block.<br>Bizzare second QRS attached to preceding normal QRS<br>Ÿ 4. Type B Wolff Parkinson White syndrome<br>5. Supraventricular tachycardia |

## MANAGEMENT OF NEONATAL AND CHILDHOOD TACHYARRHYTHMIAS

Management of neonatal tachyarrhythmias consists of pharmacological agents and DC cardioversion as well as various manoeuvres[8].

DC cardioversion[1] is the definitive therapy for hemodynamically compromised patients. Initial energy of 0.5 j/kg should be chosen and doses should be doubled if this is ineffective (max 2 J/kg)[9]. Use of the largest size paddle is necessary for an effective DC version.

**PHARMACOLOGICAL MEASURE** Adenosine is considered the drug of choice. It has negative chronotropic, dromotropic and inotropic actions with a very short half-life of <6 sec. Effective for almost all reciprocating SVT[10]. It is not effective for non-reciprocating atrial tachycardia, atrial flutter, atrial fibrillation and ventricular tachycardia Dose: Given by rapid iv bolus followed by a saline flush, staring at 50 g/kg, increasing in increments of 50 μg/kg every 1 to 2 minutes. The maximum dose is 250 μg/kg. The drug is effective in 80-100% of patients. Other alternatives are procainamide, amiodarone and beta blockers. Verapamil should be avoided in children less than 1 year of age.

For postoperative atrial tachycardia, iv amiodarone may provide excellent results.

## NON PHARMACOLOGICAL OPTIONS

Vagal stimulatory manoeuvres[11] i.e. Placing ice water over the face is often effective in infants (by diving reflex) and neonates and often revert arrhythmia to sinus rhythm.

## OTHER MODALITIES

Radiofrequency catheter ablation or surgical interruption of accessory pathways should be considered if medical management fails or frequent recurrences occur. Catheter ablation[12] is an effective modality for the management of neonatal tachyarrhythmia, generally used in those patients who are refractory to various medical regimes. Besides that, it is also used in patients with hemodynamic compromise or poor LV function and palliation for complex congenital heart disease. It is successfully used in PJRT.

In Trans oesophageal pacing[13] a pacing lead is inserted via the nostrils into the oesophagus. The proximity of the oesophagus to the atria makes it an ideal location for the recording of electrical activity from the atrium. Pacing is performed with a programmed stimulator capable of delivering currents of up to 12 - 18 ma with a pulse width of 8 - 10 msec. TEP can be used to terminate tachyarrhythmias by interrupting the re-entrant pathways. Table 3 summarizes various similarities and differences between tachyarrhythmia in children and adults[15].

***Table 3. The Difference Between Childhood And Adult Arrhythmia***

| | Arrhythmia in neonates and children | Arrhythmias in adults |
|---|---|---|
| Prevalence : | AVRT:80-85% of arrhythmia in foetal life and infancy.<br>AVNRT:23% in age group 1-5 years<br>34% in 6-10 years.<br>Ventricular tachycardia is rare in childhood | AVNRT: most common SVT in adults(50-60%)[14]<br>Ventricular tachycardia occurs more commonly in adulthood |
| Management options: | Stable patients: vagal manoeuvres :INFANTS: apply bag containing ice water to face for 15-30 seconds.<br><br>Iv adenosine: initial dose of 0.1 mg/kg followed by a saline flush.<br>If no response repeat dose 0.3 mg/kg. | Vagal manoeuvres are usually ineffective.<br>Iv adenosine, verapamil or other beta blockers are more effective.<br>Injection amiodarone is usually needed. |
| Prognosis: | Most SVT resolves before 1 year of age.<br>However, it is likely to persist if it presents for the first time above the age of 5 years. | Most adulthood arrhythmia usually needs lifelong therapy to maintain remission. |

## CONCLUSION

Neonatal tachyarrythmias are common presentation in paediatric ICU and neonatal ICU in present-day scenario. Most of these arrhythmias are SVT which can be diagnosed easily and treated by a variety of pharmacological and non-pharmacological manoeuvres. These arrhythmias usually have a good prognosis if detected early in life however some may progress to tachyarrhythmia-induced cardiomyopathy if left unattended at an early age.

Neonatal tachyarrythmias is a very vast and complex topic and is beyond the scope of this article. The present article just gives glimpses of some of the specific childhood arrhythmias. Recognition and management of these arrhythmias is a must for a physician practising at the community level.

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