

## Management and outcome of children with supraventricular tachycardia presenting to the emergency room of a tertiary centre in Nigeria

\*Wilson E Sadoh<sup>1</sup>, Ogho O Olubor<sup>1</sup>, Gold O Osueni<sup>1</sup>, Queennette Daniel<sup>2</sup>

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### Abstract

**Background:** Supraventricular tachycardia (SVT) is the commonest arrhythmias in children. Prompt and appropriate treatment with adenosine and other medicines can be lifesaving.

**Objectives:** To determine the prevalence, management and outcome of children with SVT in an emergency room in a tertiary centre in Nigeria.

**Method:** This prospective, cross sectional and descriptive study was conducted between June 2013 and May 2017 among children from birth to 17 years of age who had SVT. Clinical information was obtained with the aid of a proforma. Electrocardiogram and echocardiogram were performed. The subjects were managed with vagal manoeuvre and administration of available medicines including adenosine, beta blockers and digoxin. Their responses to the treatment offered and outcomes were noted. Data was entered into and analysed with IBM-SPSS version 20.0.

**Results:** Twenty nine (0.4%) of 7693 children seen during the study period had SVT. The median age was 4 months and 12 (41.4%) were males. Seven (24.1%) were unconscious and 14 (48.3%) were either in heart failure or shock at presentation. Only four (13.8%) had adenosine while 17 (58.6%) received both beta blockers and digoxin of whom 50% responded. Eleven (37.9%) children died.

**Conclusions:** In this study the prevalence of SVT was 0.4%. Whilst 08 (27.6%) children with SVT were treated only with vagal manoeuvres, 04 (13.8%) were treated with adenosine, 09 (31.0%) with metoprolol and 08 (27.6%) with digoxin. Mortality was 38%.

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<sup>1</sup>University of Benin Teaching Hospital, Nigeria,

<sup>2</sup>Zankli Medical Centre, Nigeria

\*Correspondence: [ehidiamen.sadoh@uniben.edu](mailto:ehidiamen.sadoh@uniben.edu)  
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### Introduction

Supraventricular tachycardia (SVT) is the sudden onset of a rapid regular heartbeat that exceeds 220 beats per minute (bpm) in infants and 200 bpm in older children and adolescents<sup>1</sup>. The SVT impulse arises from above the bundle of His and it is either due to a rapidly firing ectopic focus or a re-entry mechanism<sup>1</sup>. The re-entry mechanism involves an alternate or accessory pathway, which can either be atrio-ventricular or atrio-ventricular nodal re-entry tachycardia<sup>1</sup>. The SVTs that depend on the atrio-ventricular node (AVN) are the commonest form of SVT<sup>2</sup>. SVT is a common tachyarrhythmia in children with an incidence of 1:250 to 1:1000 individuals<sup>3,4</sup>.

A common cause of SVT in children in the emergency room is viral myocarditis and can be the first pointer to that diagnosis in affected children<sup>5</sup>. Other causes include post cardiac surgery in the intensive care units, complex congenital heart diseases like Ebstein anomaly and univentricular heart<sup>1</sup>. SVT can manifest with a stable cardiovascular state with normal blood pressure or in unstable state as in shock or heart failure<sup>4</sup>.

Some workers have classified the treatment of SVT into three different categories. Firstly, the initial treatment of SVT which is to abort the tachycardia with vagal manoeuvre or use of adenosine. Secondly, acute treatment of cases refractory to abortive measures with medications that reduce the heart rate or make the tachyarrhythmia more susceptible to be reverted to sinus rhythm. Thirdly, prevention of recurrence of SVT which requires maintenance treatment with antiarrhythmic medicines such as digoxin or amiodarone<sup>6,7</sup>.

Previous documentation of SVT in Nigerian children are case reports of single cases<sup>8,9</sup>. To the best of the authors' knowledge, studies on the incidence/ prevalence of SVT and the outcome of treatment of this condition have not been previously reported.

### Objectives

To determine the prevalence, management and outcome of children with SVT in an emergency room in a tertiary centre in Nigeria

## Method

The subjects were consecutive children aged from birth to 17 years who presented to the children's emergency room of a tertiary institution in Nigeria with SVT. The diagnosis of SVT was made by the attending physician based on a heart rate >200 bpm in infants and children and >180 bpm in adolescents with narrow QRS complexes on the ECG monitor. This was a prospective study carried out between June 2013 and May 2017. With the aid of a proforma, information on biodata and the socioeconomic class using the method described by Olusanya *et al*<sup>10</sup> was collected. The other information obtained with the proforma were the presence of cyanosis, shock/ heart failure and unconsciousness at presentation. The heart rate as recorded using a stethoscope, the underlying diagnoses, especially if the child had congenital heart disease and outcome were documented.

The intervention for the SVT and the response to the intervention were noted. As a first line of action, vagal manoeuvres using icepacks on the face for 15 seconds were tried, if the patient was not in shock and the blood pressure was normal. If vagal manoeuvre was unsuccessful, adenosine, if available, was given to abort the tachycardia. When unavailable, intravenous metoprolol (an analogue of propranolol) was administered. Adenosine was given at a dose of 100mcg/kg rapidly through a vein close to the heart such as a scalp vein or brachial vein and flushed with 5ml of injection water. If unresponsive, subsequent doses were increased by 50mcg/kg up to a total dose of 300mcg/kg and given two minutes apart according to the recommendation of the advanced paediatric life support<sup>11</sup>. Intravenous metoprolol was administered in a dose of 1mg/kg in an infusion and repeated if necessary until a resolution of the SVT. Digoxin was given in a total digitalizing dose of 30 mcg/kg. Half of the total daily dose (TDD) was given as start dose followed by quarter of the TDD 8 hours later and then a maintenance dose of 1/8 TDD every 12 hours after a normal potassium level was confirmed. The beta blocker and digoxin were given in some cases on follow up until the SVT reverted to sinus rhythm. Diagnosis of shock was made clinically if the pulses were fast and of small volume and the blood pressure was low. Diagnosis of heart failure was made based on criteria described by Omokhodion *et al*.<sup>12</sup>.

The patients were placed on a multi-parameter monitor with ECG monitor. For detailed analysis, ECG was performed using a portable Schiller AT1 in the standard fashion. The tracings were read according to standard guidelines<sup>13</sup>. Transthoracic echocardiography was performed after the acute condition, with an Aloka Prosound SSD-4000SV (Aloka, Meerbusch, Germany) machine. Two dimensional (2D), M mode and Doppler imaging

were employed. The report was analysed according to the recommendations of the American Society of echocardiography<sup>14</sup>.

Ethical approval for the study was obtained from the ethics and research committee of the University of Benin Teaching Hospital, Benin City, Nigeria.

## Statistical analysis

Data from the proforma were coded and entered into an SPSS spread sheet and analysed. Simple proportions were represented in percentages. The means of continuous variables were compared with the student t-test while the data that were not normally distributed such as the age, the median ages of different variables were compared with the median test. Association between proportions was tested with the Chi-squared test or Fisher exact test as appropriate. Statistical level of significance was set at <0.05 at 95<sup>th</sup> confidence interval.

## Results

Over the study period, 7693 children were seen in the children's emergency room of which 29 children presented with SVTs, representing a prevalence of 0.38% or 1: 265 children. The 29 children consisted of 12 (41.4%) males and 17 (58.6%) females. The median age (range) was 4 months (1 month – 6 years). Fourteen (48.3%) were from low socio-economic strata while 10 (34.5%) and 5 (17.2%) were from high and middle classes respectively.

## Clinical findings

Nine (31.0%) were cyanosed clinically, while 07 (24.1%) were unconscious with an average Blantyre coma score of 2/5. Fourteen (48.3%) were either in heart failure or shock. The cause was suspected to be myocarditis from bronchopneumonia in 19 (65.5%) and diarrhoea in three (10.3%). One case each of neuroblastoma and intussusception were the underlying conditions in two cases which were suspected to have caused the SVT. A case of possible caffeine (in coca cola) induced SVT. The remaining four had no identifiable trigger for the SVT.

## Electrocardiographic and echocardiographic findings

Of the 29 subjects 21 (72.4%) had their ECGs recorded and only five of the 21 (23.8%) were recorded before intervention was commenced. Three (14.3%) of the 21 patients had right bundle branch block and 1/21 (3.4%) had left anterior hemi-block. Of the five who had pre-intervention ECG, all had narrow QRS complexes and no p wave preceding each QRS complex. (Figure 1).

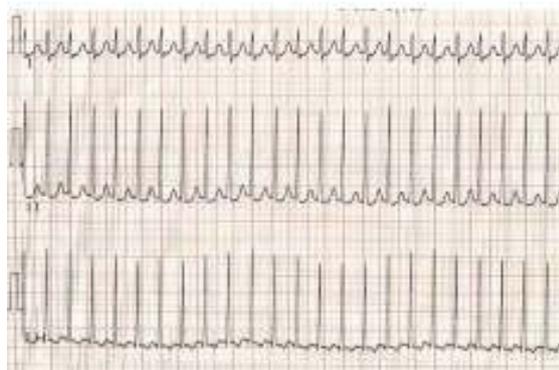


Figure 1: SVT in a 4 year old girl showing narrow QRS complexes

Echocardiography was done in 14 subjects, of whom 04 (28.6%) had congenital heart disease. The other findings are shown in table 1.

*Treatment of the SVT*

Eight (27.6%) children had vagal manoeuvres only. In one 4 year old girl cardioversion was induced by vomiting. The other 22 children were given antiarrhythmic medicines. Four (13.8%) had

adenosine. Of the three (75%) who responded to adenosine administration, one responded to the first dose while the other two responded to the second dose. Seventeen (58.6%) had beta blockers or digoxin. Of these, 15 had their heart rates reduced to normal within 7 days, while in the other two, normal heart rates were achieved in the second week. The interventions / medicines given and the responses are shown in table 2.

**Table I**  
*Echocardiographic findings in 14 subjects*

Findings	Number (%)
Atrial septal defect (ASD)	02 (14.3)
Myocarditis	02 (14.3)
Patent ductus arteriosus/ASD	01 (07.1)
Ventricular septal defect	01 (07.1)
Pericardial effusion	01 (07.1)
Normal echocardiogram	07 (50.0)
<b>Total</b>	<b>14 (100.0)</b>

**Table 2: SVT interventions and the responses**

Intervention	Response		Total Number (%)
	Yes Number (%)	No Number (%)	
Vagal manoeuvre only	04 (50.0)	04 (50.0)	08 (100.0)
Adenosine	03 (75.0)	01 (25.0)	04 (100.0)
Metoprolol	07 (77.8)	02 (22.2)	09 (100.0)
Digoxin	06 (75.0)	02 (25.0)	08 (100.0)
Total	20 (69.0)	09 (31.0)	29 (100.0)

*Outcome*

Of the 29 children 18 (62.1%) survived and were discharged home while 11 (37.9%) died. Two of the 11 that died had cardioversion of their arrhythmia but died from their underlying conditions which were one case each of diarrhoea and bronchopneumonia. The 11 mortalities comprised four (36.4%) males and seven (63.6%) females. The median ages of those that died 5 (1 – 48) years, was not significantly different from the survivors 4 (1 – 8) months, p = 0.70. There were no deaths recorded among those with congenital heart disease.

**Discussion**

In this study, a large proportion (8/29) of the children had vagal manoeuvre alone to abort the SVT because of non-availability of adenosine or other medicines/ defibrillator to abort the SVT. This is at variance with studies from developed countries where administration of adenosine/ cardioversion are provided as appropriate without delay<sup>3,15</sup>. It is also noteworthy that only 4 children had adenosine to abort their SVT in this study. Adenosine being the medicine of choice to abort SVT, should be an important component of the emergency tray. In this

setting, adenosine was not regularly available because of the high cost. Another factor that militated against its regular availability was the infrequent presentation of SVT to the emergency room leading to expiration of the infrequently used adenosine. Therefore, the regular purchases of this expensive medicine with its high probability of expiring in the emergency tray amidst the multiple competing interests for available scarce resources in a resource constrained country such as Nigeria was difficult.

Half of the children who had only vagal manoeuvre, which was the application of ice pack to the face reverted back to sinus rhythm. A 50% success rate was obtained in this study. This value is within the 33-62% success recorded from previous works<sup>16</sup>. One of the children, a 4 year old, had their SVT reverted to sinus rhythm after vomiting. Vomiting is one of the ways of inducing Valsalva manoeuvre which may have stopped the SVT. The 75% response rate for adenosine in this study, is consistent with previous report where response of 72-77% were obtained<sup>3,15</sup>.

The poorly available adenosine resulted in most of the children receiving other medicines meant to be prophylactics for preventing recurrence of SVT. The use of propranolol (a beta blocker) and digoxin as prophylactics in the treatment of SVT have been previously documented<sup>17</sup>. Although there was no immediate cardioversion of the arrhythmia, the rates were brought down sufficiently for better perfusion and ultimate abortion of the SVT over the course of several days to a week in the majority of cases. Even though the use of these medicines is not ideal to abort SVT, it however provided an important intervention in a situation that could have led to death in some of these children.

Over 75% of the children had underlying bronchopneumonia or diarrhoea both of which were suspected to be caused by viruses. Viral myocarditis is a well-documented trigger for SVT in children<sup>5</sup>. Although viral studies were not done in the present study, viral aetiology was strongly suspected in these cases of bronchopneumonia and diarrhoea.

The mortality recorded in this study is high when compared to the 2% recorded in a multicentre study in the United States<sup>7</sup>. A number of reasons could account for this finding. About half of the children presented in shock or heart failure indicating significant cardiovascular instability at presentation. These cases ideally would require electrical cardioversion as a first line intervention. Defibrillator was however unavailable and this may have contributed to the high mortality recorded in this study. Another possible reason is the late presentation of patients to the hospital, although late presentation was not evaluated in this study, it however has been documented in previous studies amongst patients from the study locale<sup>18</sup>. The underlying condition may also have contributed to the mortality as two cases in whom their SVT were aborted only to later succumb to the illnesses, were noted. High mortality amongst children with SVT and comorbidities have similarly been documented<sup>19</sup>.

There was no mortality in children with congenital heart disease in this study. This is at variance with a previous report that had shown that mortality was higher in children with congenital heart disease compared with those without the condition<sup>7</sup>. This may have been due to the small sample size in this study.

In this study, the incidence of SVT of 1:265 is consistent with the documented range of 1:250 to 1:1000 children<sup>2,3</sup>. It is pertinent to note however that the denominator of the value obtained in the present study is the population of children presenting in the emergency room rather than the general population. It is possible that the value will

be much smaller if the denominator is the general population. The difficulty with regular supply of adenosine can be ameliorated by networking between paediatric cardiologists and pharmacists across the country to make available adenosine and other lifesaving medicines to centres that require them before they expire.

### Conclusions

- In this study the prevalence of SVT was 0.4%.
- Whilst 27.6% children with SVT were treated only with vagal manoeuvres, 13.8% were treated with adenosine, 31% with metoprolol and 27.6% with digoxin.
- There were 11 (38%) deaths.

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