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# Supraventricular Tachycardia at the Emergency Room

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## ABSTRACT

Supraventricular tachycardia (SVT) is the most common tachyarrhythmia in children. There are a few studies on the epidemiology, clinical characteristic and treatment of this condition in Asian children presented at the Emergency Room (ER). This study aims to determine the epidemiology, clinical characteristics, medications use for SVT and responses in children in the ER. Data were collected via retrospective reviews of SVT patients aged less than 15 years who visited the ER between January 2003 and December 2010. The aspects of these reviews included demographic data (age, gender), underlying heart conditions, heart rates and rhythms, time of onset, symptoms, types, treatments, dispositions, maintenance therapies, electrophysiologic study (EP) and radiofrequency abrasion (RF). There were 46 SVT patients; the equivalence of 0.5 per 1,000 children visited the ER. Twenty five (54%) patients required treatments at the ER. Among these, 13 were boys (52%) with a median of 9 years of age. Two patients (8%) had congenital heart diseases. Clinical manifestations varied from palpitation in 17 patients (68%), congestive heart failure in 6 patients (24%), alternation of consciousness in 2 patients (8%). The mean heart rate was 207 (±36) beats per minute (bpm). Although 4 patients (16%) were treated without medication. Among those given medication, 10 (36%) were treated only with adenosine. Adenosine successfully treated 40, 40 and 20% of patients on the first, second and third dose, respectively. Three patients required cardioversion. All were conversed to normal heart rates. Among those 17 patients (68%) received maintenance therapy, 7 (40%) were given digoxin. The further investigation, EP was done in 13 patients (52%), RF was performed and successful in 4 patients (30.8%). In conclusion, palpitation is a common clinical symptom of SVT in children at emergency room. Most patients responded well to the adenosine therapy.

**Key words:** Supraventricular tachycardia, children, treatment, emergency room

## INTRODUCTION

Supraventricular tachycardia (SVT) is the most common arrhythmia in children (Strasburger, 1991). Both prevalence and incidence of SVT are varied between 0.1-4 per 1,000 children (Nadas *et al*., 1952; Nehgme, 1998; Etheridge and Judd, 1999; Kantoch, 2005). The characteristics of SVT include rapid and regular heart rates generally exceed 180 beats per minute in children and 220 min beats per min in infants (Manole and Saladino, 2007). SVT may results from the conduction of electrical impulses along an accessory connection from atrium to ventricle (atrioventricular reentry tachycardia (AVRT): orthodromic or antidromic) or conduction within the atrioventricular node (atrioventricular node reentry tachycardia, AVNRT) (Schlechte *et al*., 2008; Salerno and Seslar, 2009). The diagnosis of SVT can be confirmed with electrocardiogram (EKG).

The treatment of SVT is guided by patient's hemodynamics status. Non-pharmacologic maneuvers (Sperandeo *et al*., 1983; Muller *et al*., 1994; Lim *et al*., 1998) performed to enhance vagal tone, such as ice-bag technique, carotid massage, vagal maneuver and Valsava maneuver (Losek *et al*., 1999; Sperandeo *et al*., 1983) are reserved for patient with stable hemodynamics. If SVT fail to respond to those non-pharmacologic maneuvers, pharmacological treatment of SVT with adenosine is recommended for patient with stable hemodynamics. For patient with unstable hemodynamics, synchronized cardioversion is recommended. The electrophysiologic study (EP) and radiofrequency catheter ablation (RF) are the technique for diagnosis and provided a definite treatment of the SVT in pediatric population.

There have been a few report of SVT in Asian children at the ER. Therefore, the objective of our study is to determine the epidemiology, clinical characteristics, treatment responses and drug uses of SVT in children presented at the emergency room.

## MATERIALS AND METHODS

**Study design and patients:** This study included retrospective observation, descriptive epidemiology and characteristics of SVT in pediatric patients aged less than 15 years who presented at the ER, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand between January 2003 and December 2010. We exclude the patient whom refer from the other hospital for further investigation or treatment. Our tertiary-care general ER take care both adult and children. The ER has received on average assists of 10,000 pediatric patients visit per year.

**Data collection:** The aspects of these reviews included demographic data (age, gender), underlying heart conditions, history of heart surgery, blood pressure, pulse oximetry, capillary refill time, heart rates and rhythm from 12 leads EKG, time of onset, symptoms, types, treatments, dispositions, maintenance therapies, electrophysiologic study (EP) and radiofrequency abrasion (RF). The definition of stable vs unstable SVT define as the patient had hypotension, acute alter mental status or not.

**Statistical analysis:** Statistical analysis of the data was performed using SPSS version 13.0; Chicago Ill. The data base was created in SPSS for the variables. Descriptive analysis of variables reported included means, SDs or medians depending on distribution of variables. The categorized variables were presented in frequencies and percentages.

## RESULTS

Among 99,000 pediatric patients visited, total of 46 SVT patients were enrolled in this present study. This number accounts for SVT the incidence 0.5 per 1,000 in children. From 46 patients, 21 were in stable condition after receiving prior treatment from referral hospitals before arrival. The remaining 25 patients required treatment at our ER. Among these patients, 13 were boys (52%) and 12 were girl (48%). The median age of these patients was 9 years, 3 patients (12%) were infant and the other 22 patients (88%) were older than 1 year, with the age range of 1 month to15 years. Two patients (8%) had congenital heart diseases (Epstein's anomaly and ASD). None had prior history of cardiac surgery. Clinical manifestations are shown in Table 1.

These clinical manifestations included palpitation (17 patients, 68%), congestive heart failure (6 patients, 24%) and alternation of consciousness (2 patients, 8%). In the group of CHF patients, there had only symptom of CHF in 3 patients, CHF plus respiratory failure in 3 patients, respectively.

Table 1: Clinical manifestation of SVT patients

| | Patients | |
|---|---|---|
| Clinical manifestation | No. | % |
| Palpitation | 17 | 68 |
| CHF | 3 | 12 |
| Respiratory failure and CHF | 3 | 12 |
| Alternation of conscious | 2 | 8 |

CHF: Congestive heart failure

Table 2: Treatment of SVT

| | Patients | |
|---|---|---|
| Treatment | No. | % |
| Non-medication | 1 | 4 |
| Non-medication and medication | 3 | 12 |
| Medication | 18 | 72 |
| Medication and cardioversion | 1 | 4 |
| Cardioversion | 2 | 8 |

Table 3: Combination of medication for treatment (n = 12)

| Medication treatment | Patients |
|---|---|
| Adenosine and other medication | 3 |
| Adenosine (2 doses) and verapamil | 1 |
| Adenosine (3 doses) and amiodarone | 1 |
| Adenosine (2 doses), verapamil and digoxin | 1 |
| Other medication | |
| Verapamil | 1 |
| Amiodarone | 2 |
| Diltiazem | 3 |
| Digoxin | 3 |

The timing prior to arrival to the hospital range from 1-96 h with a mean of 13 h. The mean heart rates were 207 (±36) bpm, with mean of 272 (±35) bpm in infant and 198 (±32) bpm in children aged more than 1 year.

We categorized the characteristics of SVT into Atrioventricular Reentry Tachycardia (AVRT) and Atrioventricular Node Reentry Tachycardia (AVNRT). Five (20%) and twenty (80%) patients were diagnosed with AVRT and AVNRT, respectively. Among 25 patients, 21 (84%) had stable hemodynamics while 4 patients (16%) were unstable.

The treatment of SVT has been shown in Table 2. There were 4 patients (16%) who received non-pharmacologic treatment as an initial treatment with each patient received ice-bag placement, Valsalva maneuver, carotid massage and combined carotid massage and ice-bag placement. Only one patient (25%) was successfully converted to sinus rhythm by carotid massage alone, while the other 3 patients were not converted and therefore subsequently received adenosine with successful result.

Medical treatments were required in 22 patients (88%). Adenosine was used in 10 out of 22 patients (45%). The remaining 12 patients (55%) were treated with other medication. Among those treated with adenosine, the successful rate of conversion to sinus rhythm within the first, second and third dose of adenosine were 4 (40%), 4 (40%) and 2 (20%), respectively.

Twelve patients were also treated with other medication. While 9 patients (75%) were treated with these other medications, 3 (25%) were under those combined with adenosine. Shown in Table 3, among 3 other patients received a combination of adenosine and other drugs, one patient received 2 doses of adenosine followed by verapamil, one received 3 doses of adenosine followed by

Table 4: Treatment according to hemodynamics status

| Treatment/hemodynamic | Stable (21 patients) | Unstable (4 patients) |
|---|---|---|
| Medication | | |
| Adenosine | 9 | 2 |
| Adenosine and other medication | 2 | - |
| Other medication | 9 | - |
| Cardioversion | - | 2 |
| Combined medical and cardioversion | 1 | - |

Table 5: Maintenance therapy (n = 17)

| | Patients | |
|---|---|---|
| Maintenance therapy | No. | % |
| Non | 8 | 32 |
| Medication | | |
| Popranolol | 2 | 8 |
| Verapamil | 18 | 72 |
| Digoxin | 7 | 28 |
| Digoxin+atenolol | 1 | 4 |
| Digoxin+propranolol | 1 | 4 |

verapamil and one received 2 doses of adenosine followed by verapamil. As combined regimen of 2 doses of adenosine and verapamil was unsuccessful, the patient had to be treated with digoxin. There were patients treated with other medications. Nine patients started of other treatment with other medication, 1 with verapamil, 2 with amiodarone, 3 with diltiazem and 3 with digoxin. All of them were successfully treated.

The categorization of treatments according to hemodynamic was shown in Table 4. In patients with stable hemodynamics, all of them received medications as a first-line treatment, with a successful rate of 95% (20 out of 21 patients), except for one patient required subsequent cardioversion. In patients with unstable hemodynamics, there were 2 patients received adenosine and 2 received cardioversion, all of them were successfully converted to sinus rhythm within the first attempt. While the electrophysiologic (EP) study was done in 13 patients (52%), RF was required in 4 patients (30.8%). The maintenance therapies were shown in Table 5.

The maintenance therapy were used in 17 patients (68%), mainly digoxin 7 patients (28%), verapamil 6 patients (24%), popranolol 2 patients (8%), digoxin and atenolol 1 patient (4%) and digoxin plus popranolol 1 patients (4%), respectively.

## DISCUSSION

In this study, we reported the epidemiology of SVT in children visited at emergency room. From our study, we found that the incidence of SVT was 0.5 per 1,000. The incidence found in our study was similar to that of several others in the range of 0.1-4 per 1,000 children (Nadas *et al*., 1952; Nehgme, 1998; Etheridge and Judd, 1999; Kantoch, 2005). The incidence of SVT manifestation at the age of over 1 year old with 22 patients (88%) and 3 patients (12%) were age less than 1 year. This was inconcordance with other study which reported that SVT was confined within age group of more than 1 year (Garson *et al*., 1981; Diaz-Parra *et al*., 2014). Whereas some reported was equally age group, the study of Vos *et al*. (2003), they report equally 50% in both age groups.

For the clinical manifestation, the most common clinical manifestation of SVT patients in ours study were palpitation 17 cases (68%) and congestive heart failure 6 cases (24%). Our finding is in parallel with other studies which demonstrate that palpitation is the most common presentation of SVT patients. (Vos *et al*., 2003; Vignati and Annoni, 2008). The mean heart rates of our study was 207 (±36) bpm which was lower compared to 238 (±42) bpm (Gargallo *et al*., 2007) and 229 (±42) bpm (Diaz-Parra *et al*., 2014). This discrepancy might be due to the fact that most of our patients

were on average age older with median age of 9.6 years compare to 3.1 year from previous study (Diaz-Parra *et al*., 2014). For the characteristic classification of SVT, Atrioventricular Nodal Reentry Tachycardia (AVNRT) was the most common mechanism (Doniger and Sharieff, 2006; Salerno and Seslar, 2009) according to our study that 20 patients (80%) were diagnose AVNRT where as 5 patients (20%) were diagnose AVRT and respectively.

The management of SVT in children is based on clinical status of patients. Stable patients mean adequate perfusion (normal mental status, normal capillary refill and normal blood pressure) are manage with non-medication for enhance vagal activity (Lawrence *et al*., 1995; Salerno and Seslar, 2009) and medication, but for unstable patient (alter mental status, delay capillary refill and hypotension) are required cardioversion. Twenty one patients (84%) in our study had stable hemodynamic, 4 patients (16%) derived non medication treatment, which only one patient was cured by carotid massage alone then the success rate of non-medication treatment was 1 out 4 patients (25%) compare with (Wen *et al*., 1998), with had successful 53%. For the medication, adenosine is the first line treatment for termination of SVT in infants and children in emergency setting (Dixon *et al*., 2005), we also almost used adenosine as the first line of treatment and all of them have been conversed to normal heart rate, with the successful for first, second and third dose of adenosine were 4 out of 10 patients (40%), 4 patients (40%) and 2 patients (20%) respectively. The rest one patients, which not conversed by adenosine underwent to cardioversion that had been conversed to normal heart rate. Therefore, the overall successful rate for using adenosine was 90% (9 out of 10 patients), compared to Gargallo *et al.* (2007) was 36.8%.

For the 4 patients (16%) that had unstable hemodynamic, two patients were used adenosine and success for conversed and the rest 2 patients underwent cardioversion and conversed to normal heart rate also. Electrophysiologic (EP) study were done in 13 patients (52%), RF was required in 4 patients (30.8%) all of them was cure do not recurrence again, despited other study (Gargallo *et al*., 2007) that had 17.6% relapse. The maintenance therapy in our study were used in 17 patients (68%), mainly digoxin 7 patients (28%) and verapamil 6 patients (24%) compare to Gargallo *et al*. (2007) with used maintenance therapy around 50%, they found the relapsed of SVT 78% during using maintenance medication, but we do not found in our study, this maybe do to a short period of follow up.

## CONCLUSION

We report the incidence of SVT in children at emergency room. Palpitation is common presentation symptom. Most of patients had good response to medication treatment especially adenosine therapy, electrical cardioversion were required in SVT patients with unstable hemodynamic for conversed to normal heart rate.

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