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ORIGINAL ARTICLE

Supraventricular Tachycardia, Types and Immediate Management; Experience at a Tertiary Care Hospital of South Punjab

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ABSTRACT

Objectives: The objective of this study was to determine efficacy of different optimal adenosine doses in children presenting with supraventricular tachycardia (SVT) at a tertiary care hospital.

Methods: A descriptive case series design was undertaken at the Department of Cardiology at the Chaudhry Pervez Elahi Institute of Cardiology in Multan between June 2021 and June 2022. Both genders, age groups less than 14 years, and patients with SVT. The data collection procedure involved the use of a specialized proforma to record the findings of the study. Adenosine was quickly dispensed in escalating doses of 100, 200, and 300 µg/kg. The reaction was captured using a 12-lead ECG, and instances of pre-excitation were noted. The success of the therapy was assessed by identifying a sustained sinus rhythm for a period exceeding three minutes as a positive outcome.

Results: A total of 71 participants were included in the study. Out of these, 55 (77.5%) were males. 33.8% presented with a predisposing factor. The most common predisposing factor was LRTI and diarrhea in 47 (66.2%) patients. As per our findings, out of 71 patients who were administered 100 ug per kg of adenosine for SVT, 27 (38.0%) while the remaining refractory 42 patients were administered 200 ug per kg of adenosine. Out of these 42, 26 (61.9%) reverted back to sinus rhythm i.e. 200 ug per kg dose of adenosine was effective in 61.9% cases of SVT. The remaining patients reverted back at 300 ug per kg dose of adenosine.

Conclusion: A higher dose of 200 ug per kg was effective in 61.9% of cases. This indicates that a higher dose of adenosine is more effective in treating SVT in children. Additionally, the study found that LRTI and diarrhea were the most common predisposing factors for SVT in children. These findings can be useful in improving the management of SVT in children, especially when considering the optimal dose of adenosine for treatment.

Keywords: Adenosine, Supraventricular tachycardia, Pediatric cardiology, Dose optimization, Predisposing factors Sinus rhythm

INTRODUCTION

Patients with supraventricular tachycardia (SVT) often require hospitalization because of the severe discomfort and anguish it causes[1]. Electrocardiography during tachycardia, comparing it to sinus rhythm, and examining the initiation and offset of tachycardia can often shed light on the underlying mechanism. European Society of Cardiology guidelines issued in the past several years continue to recommend adenosine and vagal maneuvers for the initial treatment of SVT[2]. Beta-blockers and calcium channel blockers are two examples of non-traditional treatments. Every single person who is given medical attention for SVT should be referred to a cardiologist for a second opinion. Numerous aspects, such as symptom frequency, risk assessment, and individual patient preference, influence the optimal course of treatment over the long term. Catheter ablation is curative in the vast majority of cases, but more conservative measures might be taken if symptoms are mild and the patient is at minimal risk.[3]

Supraventricular tachycardia (SVT) refers to tachycardias that originate in cardiac tissue above the bundle of His. This term encompasses a wide variety of different arrhythmias. At a rate of 2.25 per 1000 people, SVT is more common in women than men of any age. [4]In individuals with atrial fibrillation (AF) and ventricular pre-excitation, SVT increases morbidity, and in a subset of these patients, it can be fatal.[5]

Most pediatric tachyarrhythmias are forms of supraventricular tachycardia (SVT). More prevalent than AV nodal reentrant tachycardia is atrioventricular reciprocating tachycardia. In children with severely diminished cardiac reserve, cardiac output is directly proportional to heart rate. Therefore, compared to the adult population, these tachyarrhythmias are extremely dangerous and often deadly in youngsters[7]. Adenosine is a purine nucleotide proven very effective in controlling these tachyarrhythmias. Adenosine's optimal dosage has been debated since the drug's first clinical studies in the late 1980s. Doses between 35 and 75 g/kg were administered in the first clinical trials. Later research confirmed that greater adenosine dosages produced better outcomes in youngsters. AHA and PALS recommend a first bolus of 100 g/kg, with further boluses of 100 g/kg up to 300 g/kg. Although adenosine dosage is well-established for adults, it is still being determined for youngsters[8]. Qureshi et al [8] has reported 88.2 % efficacy of adenosine 300 µg/kg dosage, 64.5 % efficacy with 200 µg/kg and 36.4 % effective with 100 µg/kg dose regimen.

Due to scarcity of literature the present study was undertaken to guide the physicians regarding more effective treatment modality (in terms of dose regimen) which would improve prognosis of our patients and help to improve their quality of life. The objective of this study was to determine efficacy of different optimal adenosine doses in children presenting with supraventricular tachycardia (SVT) at a tertiary care hospital.

MATERIAL AND METHODS

This study utilized a descriptive case series design to investigate the effectiveness of adenosine in treating children with supraventricular tachycardia (SVT). The study was conducted in the Department of Cardiology at the Chaudhry Pervez Elahi Institute of Cardiology in Multan between June 2021 and June 2022. The sample size was determined using the Epi Info software of the Centers for Disease Control and Prevention (CDC), with a calculated sample size of n=160 children with SVT, using 88.2% efficacy[8], d = 5 %. Using a non-probability consecutive sampling technique to recruit the participants in the study.

The inclusion criteria for this study were both genders, age groups less than 14 years, and patients with SVT. The exclusion criteria were patients with underlying heart blocks, bundle branch blocks, contraindication to medication, and patients who did not provide consent for participation.

The results of this investigation will be documented using a customized proforma. Patients meeting the study's inclusion criteria will be enrolled at the Chaudhry Pervez Elahi Institute of Cardiology, Multan. Before beginning this research, we will make

sure to get the necessary approval from the Institutional Ethical Committee. Subjects and their caregivers will be given information about the study's goals, the confidentiality of their data, and the absence of danger before they sign an informed consent form. Once enrolled, participants received adenosine in rapid boluses of 100, 200, and 300 g/kg, as per PALS recommendations. Twelve-lead electrocardiograms (ECGs) will record the patient's reaction. All youngsters will get an echocardiogram once they reach sinus rhythm to document any signs of pre-excitation. This information will be recorded into a standard proforma (Annexure-I).

The effectiveness of the therapy was gauged by defining a successful response as the maintenance of sinus rhythm for a duration exceeding three minutes. The presence of sinus rhythm was confirmed via ECG and examined for indications of pre-excitation, such as a brief PR interval (< 0.08 msec) and a delta wave. Instances of SVT were classified into AVRT and AVNRT categories, using adapted guidelines that incorporated considerations like heart rate, the shape of the QRS complex, pseudo S or Q wave occurrences in lead II, III, and AVF, and either elevation or depression of the ST segment following the J-point's 80 msec mark.

SPSS-23 will be used for data entry and analysis. The mean and standard deviation for patient age and body mass index will be determined using descriptive statistics. Categorical data such as age range, gender, marital status, number of children, and success rate will be subdivided into frequencies and percentages.

We will manage the effect modifiers by using stratified tables. A chi-square test will be performed to evaluate their impact on performance after stratification. This study's p-value of 0.05 or less will be considered statistically significant.

RESULTS

A total of 71 participants were included in the study. Out of these, 55 (77.5%) were males. 33.8% presented with a predisposing factor. The most common predisposing factor was LRTI and diarrhea in 47 (66.2%) patients.

Table 1: Patient Characteristics

Age in mean (SD) in years	7.03 ± 4.4
Gender	71
Male	55 (77.5%)
Female	16 (22.5%)
Predisposing factor	24 (33.8%)
Fever	16 (22.55%)
URTI	4 (5.6%)
LRTI	47 (66.2%)
Vomiting	4 (5.6%)
Diarrhea	47 (66.2%)
Anemia	8 (11.3%)
Anxiety	24 (33.8%)
Predisposing factor previous cardiac anomaly	0
Associated cardiac anomaly	0
Atrial septal defect (AVSD)	0
Atrioventricular septal defect (AVSD)	0
Congenitally corrected transposition of the great arteries (CCTGA)	0
Ebstein anomaly	4 (5.6%)
Hypoplastic left heart syndrome (HLHS)	0
Interrupted aortic arch (IAA)	0
History	56 (78.9%)
Poor Feeding	12 (16.9%)
Irritability	16 (22.5%)
Chest Pain	4 (5.6%)
Increased Sweat	0
Palpitation	32 (45.1%)
Respiratory Distress	8 (11.3%)
Alteration Consciousness	0
Dizziness	4 (5.6%)
Duration of Symptoms	8 (11.3%)

As per our findings, out of 71 patients who were administered 100 ug per kg of adenosine for SVT, 27 (38.0%) while the remaining refractory 42 patients were administered 200 ug per kg of adenosine. Out of these 42, 26 (61.9%) reverted back to sinus rhythm i.e. 200 ug per kg dose of adenosine was effective in 61.9% cases of SVT. The remaining patients reverted back at 300 ug per kg dose of adenosine.

18 refractory cases were administered a dose of 300. Out of these, 18 patients successfully reverted back to sinus rhythm.

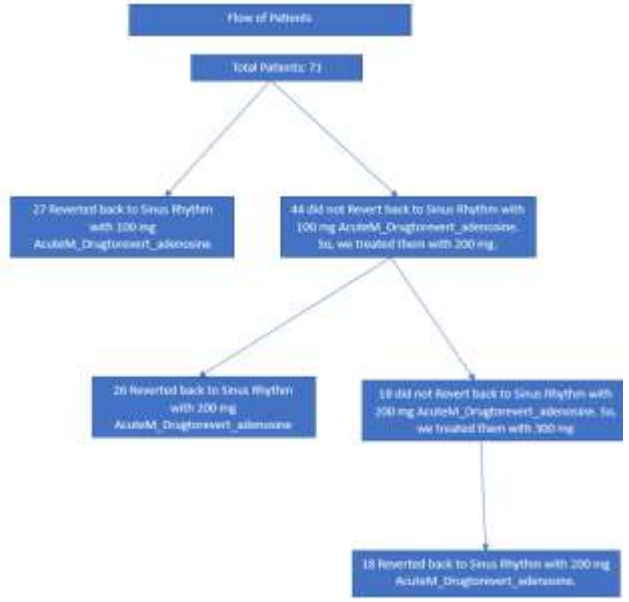

Figure 1: Flow diagram with distribution of patients who reverted back with different doses

DISCUSSION

Supraventricular tachycardias (SVTs) are a common cause of presentation to primary and secondary care services and can cause significant patient discomfort and distress.

The current study evaluated children aged 14 and below for SVT. The mean age of patients presenting with SVT was 7.04 ± 4.4. In a similar survey by Quattrocelli et al., patients between 0 and 18 years were assessed. The mean age of patients was reported to be 11.5 years, with 63.4% of children with SVT over the age of five and 36.6% of ages below five.[9] This implied that children over the age of five were more likely to bring attention to their symptoms than children below five. In a study by Lewis et al., the management of acute cases of SVT was discussed. The study showed a 62% male dominance in the pediatric population presenting with SVT.[10] This was comparable to our study, where 77.5% of the patients presenting with SVT were male.

Our study reported that 33.8% of the population suffered from ailments that predisposed them to the development of SVT. The most common predisposing factors found were LRTI (66.2%) and diarrhea (66.2%). An association between LRTI and SVT was also noted in a study by Karatza et al., which evaluated the cardiac implications of respiratory tract infections, particularly those caused by a respiratory syncytial virus (RSV). The study highlighted the extrapulmonary complications of LRTI. Of the many cardiac abnormalities, SVT commonly results from an LRTI.[11] This implies that most cardiac implications are secondary to the inflammatory mediators released via the body's immune response. An exaggerated response against the infection may cause tissue injury at extrapulmonary sites, including the heart, predisposing it to an SVT.

The study showed several cases of SVT with an underlying cardiac pathology. It showed that 66.2% of the population had cardiac issues as a predisposing factor. 16.9% of cases had an associated congenital cardiac anomaly, which made them more susceptible to the development of SVT. On the other hand, SVT was also noted in 5.6% of patients who suffered from Ebstein

anomaly. These findings were also supported by a study conducted in Taiwan, which investigated the incidence of SVT among the pediatric population. It was found that 25% of the people with SVT suffered from a congenital cardiac anomaly. The results revealed that the most common cardiac anomaly was atrial septal defect (37.8%), while Ebstein anomaly was the least common predisposing factor, with only 3.6% of patients suffering from it.[12] These findings contradicted our study, which reported Ebstein anomaly as the most common cardiac predisposing factor.

A study by Ergul et al. evaluated the association of Ebstein anomaly and SVT, revealing that about a third of the patients suffering from Ebstein anomaly reported having SVT. [13] These findings were also supported in a study by Geerdink et al., which concluded that nine of the 149 patients with Ebstein anomaly had presented with SVT.[14] This implies that SVT is a common clinical feature observed in patients with Ebstein anomaly.

Patients with SVT presented with a wide range of clinical symptoms. The most common symptom encountered amongst the pediatric population was palpitation, reported in 45.1%, while irritability was noted in 22.5% of the total cases. However, symptoms such as poor feeding and vomiting were rarely seen. Identical findings were also reported in a study by Lewis et al., in which the primary complaint at presentation was palpitation (21%) and poor oral feeding.[10] In a retrospective study by Bobbo et al., 13.5% children presented with palpitations secondary to an underlying cardiac arrhythmia. [15]

In the present study, SVT was treated with different doses of Adenosine. Most patients responded to 100 µg/kg and 200 µg/kg doses of Adenosine, while the 300 µg/kg dose was the least effective. These findings were in contrast to the study by Lewis et al., which reported that only 1 out of 17 children reverted to sinus rhythm after a 0.1mg/kg dose of Adenosine. The other 16 children needed a second dose of 0.2mg/kg to achieve desirable results.[10] A study by Quail et al. also concluded that higher doses of 0.2mg/kg to 0.3mg/kg were more effective in attaining sinus rhythm in the pediatric population.[16] This implied that a lower dose of Adenosine was least effective in the study population, a trend not seen in the present study.

Though effective results were obtained in the current study with a dose of just 100 µg/kg of Adenosine, a literature review revealed that the optimal adenosine dose is much higher. A survey by Díaz-Parra concluded that doses of Adenosine between 0.2-0.3 mg/kg were more successful in achieving normal sinus rhythm. Only 9-33% of the population responded to a 0.1 mg/kg dose.[17] A case report by Dadi et al. found that SVT could not be reverted in a seven-week-old child despite a repeated dose of 0.2 mg/kg. However, a significantly higher dose of 0.4 mg/kg helps regain normal sinus rhythm.[18] This implies that a much higher dose of Adenosine can help achieve a normal sinus rhythm in cases with refractory supraventricular tachycardia. Cases of refractory SVT have been linked with a younger age or ventricular dysfunction at the time of presentation to the emergency department.[19]

In a retrospective study by Kim et al., SVT was uniformly managed using Adenosine as a first-line treatment method. It was administered intravenously at 100 µg/kg, while in cases where sinus rhythm could not be attained, a second intravenous dose of 200 µg/kg was given. The first and second doses showed a sinus conversion rate of 49.3% and 59.8%, respectively. Overall, 79.6% of the cases reverted to sinus rhythm after the first two doses of Adenosine without requiring a third dose.[19] These findings were consistent with our study, which showed that lower doses of Adenosine produced the desired results without needing further medical intervention.

The study was limited due to a small sample size. Secondly, factors that would have hindered the process of administration, or lead to an insufficient dose, such as poor vascular access, could not be studied. A lack of electrophysiological studies made it impossible to evaluate the different types of SVT. Further research is warranted, with a much larger study population.

CONCLUSION

A higher dose of 200 ug per kg was effective in 61.9% of cases. This indicates that a higher dose of adenosine is more effective in treating SVT in children. Additionally, the study found that LRTI and diarrhea were the most common predisposing factors for SVT in children. These findings can be useful in improving the management of SVT in children, especially when considering the optimal dose of adenosine for treatment.

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