Five Paediatric Case Reports of the Use of Adenosine in Supraventricular Tachycardia

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Abstract

The efficacy, safety and diagnostic usefulness of adenosine in the treatment of supraventricular tachycardia in children were prospectively studied over a 2-year period. Only patients who were stable and without hypotension were included. Adenosine was given at a dose of 0.1 mg/kg and increased to 0.2 mg/kg for the second and third doses if there was no response. Adenosine was used on 5 occasions in 5 patients. Adenosine was found to be effective in terminating supraventricular tachycardia in all 5 patients; 4 responded to a dose of 0.2 mg/kg while 1 responded to 0.1 mg/kg. Wolff-Parkinson White Syndrome was detected in 2 patients after termination of supraventricular tachycardia.

Transient hypotension was noted in 1 patient lasting 45 seconds with no haemodynamic consequences. Two patients had transient ventricular ectopics lasting 3 to 5 seconds. One out of 3 patients who were old enough to report side-effects, experienced chest discomfort and dizziness lasting 5 seconds. All side-effects were transient and mild.

We concluded that adenosine is effective and safe in terminating supraventricular tachycardia in children after vagal manoeuvres have failed.

***Ann Acad Med Singapore 1998;* 27:363-5**

Key words: Atroventricular, Electrocardiogram, Wolff-Parkinson White

Introduction

Adenosine has been shown to be effective in terminating supraventricular tachycardia in adults and children.[1-3] However, the use of adenosine has not been previously studied in Singapore children; hence we report our experience with the use of adenosine for the treatment and diagnosis of supraventricular tachycardia in children over a 2-year period when the drug was introduced in 1994.

Adenosine is an endogenous purine nucleoside[1,2,4] present in all cells of the body. In 1929, Drury and Szent-Gyorgyi[5] first described effects of adenosine causing transient conduction block in the atrioventricular node and depression of sinus node automacity after a rapid intravenous injection. Its half-life is less than 10 seconds; hence duration of action is short and side-effects are likely to be brief, transient and self-limited. For these reasons, adenosine has become the treatment of choice for the treatment of narrow complex tachyarrhythmia.

Materials and Methods

The patients studied were children under 12 years of age admitted to the Paediatric Intensive Care Unit, Singapore General Hospital, for supraventricular tachycardia diagnosed via electrocardiogram rhythm strip. Patients who were unstable and hypotensive were excluded from the study. Factors that were studied in this prospective review included patients' age, type of arrhythmia, adenosine dosage, effectiveness of adenosine in terminating arrhythmia, utility of adenosine in diagnosis of arrhythmia and its side-effects.

All patients in the study had cardiac monitoring and recording electrocardiogram strips taken before, during and after adenosine was given. Blood pressure was also monitored before, during and after adenosine administration using the Dinamap machine. Intravenous infusion of adenosine was given either through a central vein or cubital fossa vein. It was followed by a rapid bolus of normal saline, 5 ml in infants and 10 ml in older children. Adenosine was first given at a dose of 0.1 mg/kg (maximum dose of 6 mg) and increased to 0.2 mg/kg for the second and third doses (maximum dose of 12 mg) if there was no response to each dose at 5-minute intervals. The patient's tachyarrhythmia would need a reassess-

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ment if there was no response after the third dose of adenosine.

If the arrhythmia was stopped briefly by adenosine but then resumed, the administration was not classified as a successful termination.

If there was a drop of mean arterial pressure of more than 10% after a dose of adenosine, this would be considered as significant hypotension.

A paediatric cardiologist was consulted in each case.

Results

During the 2-year study period, adenosine was used on 5 occasions in 5 patients. A total of 9 doses of adenosine were used which ranged from 0.85 to 10 mg. The patients' ages ranged from 14 months to 11 years (Table I).

TABLE I: CLINICAL DETAILS OF PATIENTS WITH SUPRAVENTRICULARTACHYCARDIA

Patient	Age	Sex	Presentation	Terminating adenosine dose (mg/kg)
A	14 mo	Female	Cardiac failure	***0.2***
B	***22*** mo	Female	Cardiac failure*	***0.2***
C	***42*** mo	Female	Chest discomfort	***0.2***
D	10 y	Male	Chest discomfort*	0.1
E	11 y	Female	Palpitations	***0.2***

* Wolff-Parkinson White syndrome was the underlying cause of supraventricular tachycardia

Adenosine induced atrioventricular block and successfully terminated the supraventricular tachycardia in all patients; 2 of which also had cardiac failure. In 4 patients, supraventricular tachycardia was terminated by a dose of 0.2 mg/kg while 1 patient responded to a dose of 0.1 mg/kg. Two patients with underlying Wolff-Parkinson White syndrome were diagnosed only after adenosine had successfully terminated the tachyarrhythmia.

Transient hypotension was noted in 1 patient lasting 45 seconds with no haemodynamic consequence. Two patients had transient ectopics lasting 5 seconds. One out of 3 patients who were old enough to report side-effects, experienced chest discomfort and dizziness lasting 5 seconds. All side-effects noted were transient and mild lasting up to 5 seconds only.

Discussion

Adenosine has been effective in terminating supraventricular tachycardia when the atrioventricular node is a necessary limb of the tachycardia circuit, that is, in atrioventricular re-entry and atrioventricular node re-entry.[1,2,6] When the atrioventricular node is not a necessary limb of the tachycardia circuit (for example, sinus tachycardia, atrial flutter, atrial fibrillation), adenosine-induced atrioventricular node block can slow the ventricular response to the tachycardia and assist in identifying the underlying mechanism of the arrhythmia.[3-5]

Both pharmacologic agents and vagal-induced methods can terminate supraventricular tachycardia when the atrioventricular node is a necessary limb of a re-entry circuit by preventing its conduction. However, vagal manoeuvres such as ice-bag application to face, valsalva manoeuvre or carotid sinus massage are not consistently effective in aborting supraventricular tachycardia.' Verapamil, a calcium channel blocker has been shown to be useful in supraventricular tachycardia in adults and older children but can cause cardiovascular collapse in infants,[7,8] and is therefore not recommended for use in infants.

Previous reports'" have shown adenosine to be effective and safe in terminating supraventricular tachycardia. In a report by Ralston,' adenosine produced atrioventricular block in 88% of 24 paediatric patients and was useful in identifying the mechanism of the tachyarrhythmia.

However, there have been no reports of adenosine use in our local paediatric population. Our experience attempts to illustrate the efficacy, safety and diagnostic usefulness of adenosine in the management of supraventricular tachycardia in our children.

Adenosine was successful in terminating the supraventricular tachycardia in all 5 patients within 30 seconds of administration. Four out of 5 patients responded to a dose of 0.2 mg/ kg while 1 patient responded to a dose of 0.1 mg/kg. Two patients had underlying Wolff-

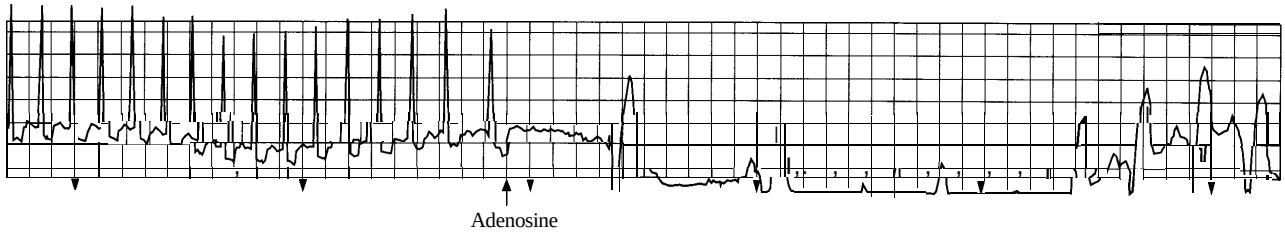

Fig. 1. Rhythm strip demonstrating narrow complex QRS tachycardia at a rate of 214 beats/min (paperspeed 25 mm/sec). Adenosine causes atrioventricular block resulting in termination of supraventricular tachycardia after a short run of ventricular ectopics.

Parkinson White syndrome revealed only after termination of supraventricular tachycardia by adenosine.

As the half-life and duration of action of adenosine is very short, it is advised that the drug is given via a central vein or cubital vein followed by a rapid saline flush for optimal therapeutic results. One must be aware of drug interactions.[5] For example, adenosine dose should be reduced to one-fourth of the usual dose when the patient is taking dipyridamole. Patients who are taking competitive antagonists such as theophylline or caffeine may require larger than usual doses of adenosine for effective results.

Though there were side-effects documented in the study which included hypotension in 1 patient, ventricular ectopics in 2 and chest discomfort and dizziness in 1 out of 3 who were old enough to report verbally, they were all transient and mild without significant consequences.[9] Hence, older children should be told that systemic effects such as chest discomfort, headaches, flushing, dyspnoea can occur but are self-limiting.[1] However, one should monitor the side-effects of adenosine especially that of ventricular ectopics (Fig. 1), transient bradycardia[1] or rarely a malignant wide complex tachycardia found in a postoperative paediatric patient with congenital heart disease.[10]

Limitations faced in the study were:

1) A small sample size: this could be due to supraventricular tachycardia being rather uncommon in our population and that our Paediatric Unit is not the only tertiary paediatric centre.
2) Neonatal Units were not involved in the study.

We concluded that when vagal manoeuvres fail, adenosine will be effective in terminating supraventricular tachycardia as well as assist in identifying the underlying mechanism of supraventricular tachycardia, provided a good quality and continuous electrocardiogram is done just before, during and after its administration. We recommend that adenosine be given at 0.2 mg/ kg for effective results with the reassurance that side-effects are mild and self-limiting.

Acknowledgement

We would like to thank medical and nursing staff of the Department of Paediatrics, Singapore General Hospital for their encouragement and support, and Sharon Au-Yeong and Dorothy Loh for secretarial assistance.

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