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The Effects of Verapamil and Adenosine in the Treatment of Paroxysmal Supraventric-ular Tachycardia

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Abstract

Introduction: There are several drug medicines in the treatment of Paroxysmal Supraventricular Tachycardia (PST) after the inefficacious vagal stimulus. This study aimed to compare two treatments: Verapamil versus adenosine triphosphate (ATP) for treating Paroxysmal Supraventricular Tachycardia.

Methods: Sixty-six patients with PST were treated with either Verapamil (5 to 10 mg) or ATP (5 to 20 mg). The basal features of each group and the efficacy and safety of the two drugs were compared. Verapamil failures were treated with ATP and vice versa.

Results: The mean heart rate after treatment in all patients was 79.46 ± 10.67, compared to baseline in both groups, showed a decrease significantly (P <0.001)) The mean heart rate after treatment in adenosine was 87.27 + 8.39 and 71.66 ± 5.95 in the verapamil group. Between groups in heart rate, significant differences were observed after treatment of the screw (P<0.001). Of the total, 12 (18.2%) had a recurrence of adenosine in 6 patients (9.1%), and Verapamil in 6 patients (9.1%) had a recurrence. The Average time converted to sinus rhythm in all patients was 32.04+12.79 minutes. Average time converted to sinus rhythm verapamil group and 36.06 ± 12.97 minutes in the adenosine group and 28.03+ 11.45 minutes (P = 0.01).

Conclusion: The more effective the drug verapamil over adenosine is in treating PSVT, the longer it proves its effectiveness. Except for headache, side effects were higher in patients treated with adenosine. In other cases, there was no difference between the two drugs.

Keywords: Adenosine, Verapamil, PSVT, side effects.

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Introduction

Supraventricular tachycardia is the occurrence of three or more atrial extrasystoles in a row, previously called atrial tachycardia or PAT. In this condition, the heart rate is faster than sinus tachycardia, between 150 and 250 beats per minute. Since tachycardia can lead to relative insufficiency of the coronary arteries, in PSVT, symptoms such as ST segment collapse and T wave negativity may appear in leads with a positive QRS complex. When PSVT occurs, a degree of block is created in the AV node to prevent the increase in ventricular rhythm. The AV node can typically conduct 180 to 200 electrical impulses from the atrium to the ventricles. The cause of PSVT is mainly unknown, but associations with hypertension, excitement, alcohol consumption, fatigue, heart attack, thyrotoxicosis, Wolff-Parkinson-White syndrome, and cardiac rheumatism have been suggested [1-3].

Treatment decisions depend on the occurrence or non-occurrence of hemodynamic changes in the patient. In all cases of hemodynamic changes, the first treatment is cardioversion shock. However, suppose the patient's hemodynamic status is not impaired. In that case, the following actions are performed: Valsalva maneuvers, intravenous injection of Adenosine, verapamil, digoxin, propranolol, procainamide, cardioversion shock, and finally, cutting the catheter [4-6].

Verapamil is a calcium blocker drug that causes about 90% termination of PSVT. This medicine is slowly injected intravenously at a rate of 5–10 mg into the patient, and if there is no response, it is continued until the final dose of 20 mg. Adenosine is an antiarrhythmic drug that is used in the treatment of PSVT and is newer than verapamil, but it is less available in areas such as Iran. By reducing the conduction speed of the atrioventricular node, this drug stops the re-entry path and restores the sinus rhythm to the heart. This drug is also a coronary artery dilator, increasing blood supply to the heart tissue[7-12].

Adenosine is converted into inosine, adenosine monophosphate, and uric acid in blood and tissue. Its dose is 6 mg and is prescribed as a quick intravenous injection. If it does not work after 1 to 2 minutes, it is repeated with a dose of 12 mg. Adenosine has a half-life of 10 to 30 seconds, and its onset of action is faster than verapamil. Adenosine side effects include nausea, mild headache, flushing, agitation, chest pain, and, in high doses, hemodynamic drop, tachycardia, and bronchospasm. This drug is contraindicated in asthmatic patients and patients with 2nd and 3rd-degree atrioventricular block [8, 13-15]. This study compares two of these treatments: Verapamil versus adenosine triphosphate (ATP).

Methods

In this clinical trial study, 66 patients were referred to the emergency department of Baqiyat Hospital with If the entry criteria were met, the patients were selected by the census, completely divided into two groups, and a written consent form was obtained from the patients to enter the plan. Demographic information, the number of attacks in the past, and the results of examinations before treatment were entered into a researcher-made questionnaire. The patients of the first group received 6 mg of adenosine rapid IV and, if needed, a dose of 12 mg one to two minutes later, and the patients of the second group received 5 to 10 mg of verapamil as a slow IV and if needed, a dose of 10 mg 10 to 15 minutes later. If the patients did not respond to the treatment, they were first cross-over to another group, and if they did not respond, other more aggressive treatments were performed for them. Then, the rate of conversion to sinus rhythm, the speed of conversion to sinus rhythm, and side effects were investigated in these patients. The side effects include nausea, headache, flushing, excitement, chest pain, bradycardia, a drop in blood pressure, tachycardia, and bronchospasm. Each stage of sinus rhythm was established, the injection was stopped, and the amount of drug and the time to establish sinus rhythm were recorded for the patients.

Patients converted to sinus rhythm were examined for half an hour with careful observation at 5, 10, 15, and 30 minutes, monitored in the emergency room for at least 2 hours to ensure the stability of sinus rhythm, and discharged if there was no recurrence of PSVT. In cases of recurrence, the patients were under the supervision of the attending physician during their stay in the emergency room. Inclusion criteria were for patients over 18 years of age referred to the emergency department of Baqiyat A Hospital with a diagnosis of PSVT and who did not respond to the Valsalva maneuver or had PSVT rhythm at the time of the visit by the researcher. Exclusion criteria: failure to complete the consent form, letters from patients with perfusion, impaired mental status, pulmonary edema, pregnant patients, patients with a history of 2nd and 3rd-degree AV block asthma, hypotension, cardiogenic shock, bradycardia, VT, WPW syndrome, heart failure NYHA, Class II patients with unstable hemodynamics (cardioversion indication, electrical), history of taking antiarrhythmic drugs and adenosine receptor blocking drugs (theophylline, carbamazepine, and dipyramole), and patients for whom other arrhythmias are diagnosed at any stage of the plan. The questionnaire includes the following items: demographic information, history of PSVT, number of previous PSVT cases, heart rate before and after treatment, blood pressure before and after treatment, chest pain before and after treatment, and shortness of breath. Before and after treatment, drug dosage, time is taken to convert to sinus rhythm in minutes, recurrence of PSVT and recurrence time in minutes after starting treatment, duration of hospitalization in the emergency department in hours, side effects including headache, Blood pressure, nausea, bradycardia, bronchospasm, shortness of breath, and flushing.

SPSS-26 analyzed data. T-test, Mann Whitney, Chi 2, and Fisher exact tests were used to compare the two groups. The P-value for statistical significance was considered less than 0.05.

Results

The total number of people examined was 66, and the average age of all people was 51.92±17.70 years. There were 33 people in the adenosine group and 33 in the verapamil group.

Thirty-three people (50.0%) are male, and 33 (50.0%) are female. In the adenosine group, 17 people (25.8%) were men and 16 (24.2%) were women. In the verapamil group, 16 (24.2%) were men and 17 (25.8%) were women. There was no significant difference between the two groups regarding gender distribution (P=0.806).

Also, the average age in the adenosine group is

50.63±18.18, and in the verapamil group, it is 53.21±17.38, and there is no significant difference between the two groups regarding age (p=0.556). The average BMI in the adenosine group is 24.48±3.67, and in the verapamil group is 25.92±3.18, and there is no significant difference between the two groups regarding age (p=0.093).

In total, 32 patients (48.5%) had a history of PSVT, 13 people (19.7%) in the adenosine group, and 19 people (28.8%) in the verapamil group had a history of PSVT. The two groups had no significant difference regarding PSVT history distribution (P=0.139). The average heart rate before treatment in all subjects was 153.71 ± 24.02. The average heart rate before treatment in the adenosine group is 149.39±24.10 and in the verapamil group, it is 158.03±23.51, and there is no significant difference between the two groups in terms of heart rate before treatment (p=0.146).

The average heart rate after treatment was 10.67±79.46 in all subjects, which shows a significant decrease in both groups compared to 153.71±24.02 before treatment (P<0.001). The average heart rate after treatment in the adenosine group is 87.27±8.39, and in the verapamil group is 71.66±5.95. There is a significant difference between the two groups regarding heart rate after treatment (P<0.001). The average heart rate after treatment in the verapamil group has significantly decreased compared to the adenosine group (Table 1).

Table 1. Comparison of mean heart rate after treatment in two groups

Groups	Mean	N	Std. Deviation	Min	Max	P-Value
Adenosine	87.27	33	8.39	60.00	100.00	
Verapamil	71.66	33	5.95	60.00	90.00	<0.001
Total	**79.46**	**66**	**10.67**	**60.00**	**100.00**	

The average heart rate difference in the adenosine group after treatment compared to before treatment is 26.42±62.12 and in the verapamil group, 25.19±86.36, and there is a significant difference between the two groups in terms of heart rate difference (P<0.001). The average systolic blood pressure before treatment in the adenosine group is 150.09±21.67 and in the verapamil group, it is 137.72±22.29, and there is a significant difference between the two groups in terms of systolic blood pressure before treatment (p=0.026). The mean systolic blood pressure after treatment in the adenosine group is 110.00±15.25 and in the verapamil group, it is 110.60±15.60, and there is no significant difference between the two groups in terms of systolic blood pressure after treatment (p=0.874). The average difference in systolic blood pressure after treatment in the adenosine group is 18.82±40.09. In the verapamil group, 16.43±26.81, there is a difference between the two groups in terms of the difference in systolic blood pressure after treatment compared to before treatment. It is significant (P=0.003). Considering that there was a significant difference between the two groups in diastolic blood pressure before the treatment, therefore, by multivariate analysis and considering the effect of diastolic blood pressure before the treatment, it was determined that there was a significant difference between the two groups in the diastolic blood pressure after the treatment. It was not observed (P=0.067).

The average duration of hospitalization after treatment in all subjects was 1.44 ± 3.50 days. The average length of hospitalization in the adenosine group is 1.41±4.36 days, and in the verapamil group is 11.45±28.03 days, and there is a significant difference between the two groups in terms of length of hospitalization (P<0.001) (Table 2).

Table 2. The average length of hospitalization in the emergency room in two groups

Groups	Mean	N	Std. Deviation	Min	Max	P-Value
Adenosine	4.3636	33	1.41019	2.00	6.00	
Verapamil	2.6364	33	.85944	2.00	6.00	<0.001
Total	**3.5000**	**66**	**1.44914**	**2.00**	**6.00**	

All subjects' average conversion duration to sinus rhythm was 12.79 ± 32.04 minutes. The average duration of conversion to sinus rhythm in the adenosine group is 36.06±12.97 minutes, and in the verapamil group, 28.03±11.45 minutes, and there is a significant difference between the two groups in terms of the duration of conversion to sinus rhythm after treatment (P= 0.010) . In the verapamil group, the conversion duration to sinus rhythm is shorter than in the adenosine group (Table 3).

Table 3. Average duration of conversion to sinus rhythm in two groups

Groups	Mean	N	Std. Deviation	Min	Max	P-Value
Adenosine	36.0606	33	12.97579	20.00	70.00	
Verapamil	28.0303	33	11.45231	10.00	60.00	0.013
Total	**32.0455**	**66**	**12.79956**	**10.00**	**70.00**	

Six patients (9.1%) had shortness of breath, four people (6.1%) in the adenosine group, and two people (19.7%) in the verapamil group had shortness of breath. There was a significant difference between the two groups regarding shortness of breath (P=0.672). Out of all people, 13 people (19.7%) had headaches, zero people (0%) in the adenosine group, and 13 people (19.7%) in the verapamil group had headaches. There was a significant difference between the two groups regarding headache (P<0.001). Out of all people, eight people (12.1%) had bradycardia, three people (4.5%) had bradycardia in the adenosine group, and 5 people (7.6%) did not have bradycardia. In the verapamil group, five people (7.6%) had bradycardia, and 28 people (42.4%) did not have bradycardia. There was no significant difference between the two groups regarding bradycardia (P=0.451). Among all subjects, 29 people (43.9%) had delirium, 18 people (27.3%) in the adenosine group, and 11 people (16.7%) in the verapamil group had delirium. There was no significant difference between the two groups regarding delirium (P=0.083). Out of all patients, 6 (9.1%) relapsed, 3 (4.5%) in the adenosine group and 3 (4.5%) in the verapamil group. There was no significant difference between the two groups regarding recurrence (P=0.998).

Discussion

PSVT is a medical emergency and a standard clinical event that includes a large population of patients with narrow to regular QRS complex tachycardia presenting to the emergency department. For many years, the treatment of choice for PSVT was verapamil. Adenosine is also an anti-arrhythmic drug. It is used in the treatment of PSVT and is newer than verapamil. However, it is less available in regions such as Iran, considering that Iran has less access to adenosine. Also, Few studies have been done about the effects and side effects of this drug in Iran, so we designed a randomized double-masked clinical trial to compare the effect of these two drugs in the treatment of PSVT in patients referred to the emergency department to the effect of race factors, the number of attacks of PSVT, heart rate, systolic and diastolic blood pressure, and other individual conditions of the patients are evaluated in the effectiveness of these two drugs. We also help by determining the number of unwanted side effects of these two drugs in different groups.

The present study, which was conducted as a prospective study to investigate and compare the effects of adenosine and verapamil in the treatment of paroxysmal supraventricular tachycardia (PSVT) in the emergency department of Baqiyat Hospital, It was given that the average heart rate after treatment compared to before treatment showed a significant decrease in both groups and there was a significant difference between the two groups in terms of heart rate after treatment. The average heart rate after treatment in the verapamil group has significantly decreased compared to the adenosine group. There is a significant difference between the two groups regarding heart rate.

The average heart rate difference after treatment in the verapamil group has significantly decreased compared to the adenosine group.

The difference in systolic blood pressure after treatment compared to before treatment between the two groups was significantly different.

The mean difference in systolic blood pressure in the adenosine group significantly decreased compared to the verapamil group. However, the two groups had no significant difference in systolic blood pressure after treatment. There is no significant difference in diastolic blood pressure after treatment compared to before treatment. The two groups had no significant difference in diastolic blood pressure after treatment.

Also, this study showed a significant difference between the two groups regarding the duration of

conversion to sinus rhythm after treatment. In the verapamil group, the conversion duration to sinus rhythm is longer than in the adenosine group. There is a significant difference between the two groups regarding hospitalization time. In the verapamil group, the duration of hospitalization is longer than in the adenosine group. Another factor investigated in this study was the side effects of the two drugs. According to the results obtained in this study, except for the complication of headache, which was significantly higher in patients treated with adenosine than in the other group, there was no significant difference in other complications.

The results of other studies conducted in this field have been confirmed. Cheng et al., in 2003, in China, examined 122 patients with PSVT in two groups of adenosine (boluses of 3). Six and 12 mg and verapamil (5) mg with or without repeated doses did not show a significant difference between the therapeutic effects of these two drugs [13]. This study stated that the onset of the effect of adenosine in the treatment of PSVT is 380 seconds earlier than verapamil and that 18% of the side effects of adenosine are minor and controllable. However, in the current study, a significant difference was observed between the therapeutic effects of these two drugs. Regarding complications, except for headache, which was significantly higher in patients treated with adenosine, there was a significant difference. The drug was not observed.

A study (2008) pointed out the significant effects of adenosine in treating SVT. However, it did not state a significant difference between this drug and similar cheap and available drugs in the treatment of SVT. It has also been suggested that more studies be conducted in countries using adenosine [14].

A study of adenosine and verapamil in treating out-of-hospital SVT has shown similar effects; it was repeated. Also, the recurrence rate of SVT in the two groups has been stated to be the same in our study. The same results of a study conducted in 2009 examined three drugs, adenosine, verapamil, and diltiazem, in the treatment of 206 patients with PSVT 15. In the verapamil group, 98% were treated, and 2% were untreated and crossed over to the adenosine group and were treated. 66.3% of the patients in the adenosine group were treated with the first dose of 6 mg, and 11.5% were treated with the second dose. They did not respond. 8.7% responded to verapamil, and 48 responded to diltiazem. In the diltiazem group, 98 were treated; the remaining 2% responded to adenosine. In the end, this study stated that calcium channel-blocking drugs are more effective than 6 mg of adenosine in treating SVT, and it was recommended that these drugs be used in areas where adenosine is less available. In our study, we did not examine the comparative effect of diltiazem. In a systematic review in 2011, Delaney pointed out the similar effects of adenosine and verapamil in treating PSVT. They reported more side effects in the adenosine group than verapamil, but deciding the choice of these two drugs has stated that it depends on the patient's condition, and it is necessary to decide between choosing two drugs[11].

Conducting more clinical trial studies in patients with different conditions and regions has been stated. In our study, the two drugs were similar regarding side effects. In a study, the choice between treatment of PSVT with weighing and verapamil depends on the heart rate, but using this theory requires conducting trial studies with a larger population and an appropriate design.

In a study of 175 PSVT patients, both adenosine and verapamil have been shown to have a high success rate in PSVT attacks in adults [16]. This study has expressed the effect of adenosine by increasing the heart rate in patients more than verapamil. This study also showed the effect of verapamil in patients with fewer attacks of PSVT than adenosine and showed that the frequency of attacks and heart rate are good criteria for choosing the right drug to treat PSVT.

In a study conducted in 2006, 64 PSVT patients were examined in two groups, receiving adenosine and verapamil. This study has stated that adenosine protects the heart tissue and repairs injuries caused by reperfusion compared to verapamil [17].

In a systematic review and meta-analysis study conducted by Holdgate in 2006 in Australia, there was no significant difference in the major side effects of patients treated with adenosine and verapamil, but hypotension and minor side effects such as nausea, shortness of breath, and headache were significantly higher in the adenosine group. You have reported more. In our study, the two drugs were similar in terms of side effects, but the incidence of headaches was higher in patients treated with adenosine [18]. A 2013 case report article by Stengaard et al. in Denmark reported a case of acute heart failure induced by bolus verapamil administration in a young man, suggesting potential adverse effects of this drug [19].

In general, based on the results of this study and their comparison with other studies conducted in this field, it is concluded that verapamil and adenosine are two very effective drugs in treating PSVT. In terms of the effectiveness of verapamil, it is more effective than the other drugs. However, the therapeutic effects manifest themselves over a more extended period and have side effects similar to adenosine. As a result, considering Iran is one of the regions with less access to adenosine, verapamil is a very suitable option for treating PSVT.

Conclusion

The effectiveness of the drug verapamil over adenosine in treating PSVT is, the longer the drug proves its effectiveness. Except for headache, side effects were higher in patients treated with adenosine. In other cases, there was no difference between the two drugs.

Highlights

What Is Already Known?

A variety of pharmaceutical treatments are available to effectively manage Paroxysmal Supraventricular Tachycardia, particularly when vagal maneuvers prove ineffective.

What Does This Study Add?

The more effective the drug verapamil over adenosine is in treating PSVT, the longer it proves its effectiveness. Except for headache, side effects were higher in patients treated with adenosine. In other cases, there was no difference between the two drugs.

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Conflicts of interest and sources of funding

The authors declare no conflict of interest.

Authors' contribution

Conceptualization, Mehrdad Faraji, Hamid Reza Javadzadeh; methodology, Mehrdad Faraji, Hamid Reza Javadzadeh, Fahimeh Shahjooie, Sadrollah Mahmoudi, Ali Azadpour, Hasan Goodarzi.; validation, Mehrdad Faraji, Hamid Reza Javadzadeh, Fahimeh Shahjooie, Sadrollah Mahmoudi, Ali Azadpour, Hasan Goodarzi, Rezvan Mansoorinezhad; resources, Mehrdad Faraji, Hamid Reza Javadzadeh, Fahimeh Shahjooie, Sadrollah Mahmoudi, Ali Azadpour, Hasan Goodarzi, Rezvan Mansoorinezhad; writing—original draft preparation, Mehrdad Faraji, Hamid Reza Javadzadeh, Fahimeh Shahjooie, Sadrollah Mahmoudi, Ali Azadpour, Hasan Goodarzi; visualization,; supervision, Mehrdad Faraji, Hamid Reza Javadzadeh, Rezvan Mansoorinezhad; project administration, Mehrdad Faraji, Hamid Reza Javadzadeh, Rezvan Mansoorinezhad. All authors have read and agreed to the published version of the manuscript.

Consent For Publication

Patient consent for publication

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