

## Effectiveness of Repeating Valsalva Maneuver in Paroxysmal Supraventricular Tachycardia Patients Nonresponsive to Initial Valsalva Maneuver and a Single Dose of Verapamil

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### ABSTRACT

**Objective:** To determine the effectiveness of repeating valsalva maneuver in paroxysmal supraventricular tachycardia (PSVT) patients nonresponsive to initial valsalva maneuver and a single dose of verapamil.

**Methodology:** It was a descriptive case series conducted in the Emergency Department of the Punjab Institute of Cardiology, Lahore. The study was approved by the ethical committee of the institution. A total of 100 patients were enrolled by nonprobability consecutive sampling technique by taking informed written consent. The patients of any age or gender presenting with an acute episode of PSVT confirmed on ECG and nonresponsive to initial valsalva maneuver & a single dose of verapamil were included. Patients were given a trial of the valsalva maneuver. The heart rate and rhythm of the patients were continuously observed with a cardiac monitor. Repeat ECG was done 1 minute after performing the valsalva maneuver. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 24.

**Results:** The mean age of the patients was  $56.48 \pm 15.57$  years. Seventy four (74%) patients were males and 26(26%) patients were females. Out of 100 patients nonresponsive to initial valsalva maneuver and a single verapamil dose, reversion of supraventricular tachycardia was noted in 27(27%) patients. There was a statistically significant association between gender, BMI, smoking and SVT reversion.

**Conclusion:** The reversion rate of paroxysmal SVT with repeat valsalva maneuver after the failure of an initial trial of valsalva maneuver and a single dose of verapamil is satisfactory. The reversion of supraventricular tachycardia was noted in 27% of cases in our study.

**Keywords:** Valsalva maneuver. Paroxysmal supraventricular tachycardia. Verapamil.

### INTRODUCTION

Paroxysmal supraventricular tachycardia (PSVT) is a tachyarrhythmia which arises from the atrial and/or atrioventricular nodal tissue and has a sudden onset & termination. It is a narrow-complex tachycardia with a regular, rapid rhythm except for multifocal atrial tachycardia and atrial fibrillation. Supraventricular tachycardia (SVT) is a frequent clinical disease occurring in all ages and its treatment is a major challenge.<sup>1,2</sup>

The prevalence of SVT is 2.25 per 1000 population per year in the United States and is responsible for 50,000 visits to the emergency department per year.<sup>3</sup> Supraventricular tachycardia is classified into atrioventricular reentrant tachycardia (AVRT), atrioventricular nodal reentrant tachycardia (AVNRT), atrial tachycardia, atrial flutter and atrial fibrillation.<sup>4</sup> The patients with SVT can be asymptomatic or symptomatic. The clinical features include palpitations, dizziness, chest pain, difficulty in breathing and anxiety. The risk factors of SVT are caffeine, alcohol, nicotine, psychological stress and

Wolff-Parkinson-White (WPW) syndrome.<sup>5</sup> It is diagnosed by an electrocardiogram (ECG) showing a rapid heart rhythm of 150-240 beats per minute and narrow QRS complexes<sup>6</sup> (Figure 1). The complications of paroxysmal SVT include heart failure, pulmonary edema, myocardial infarction in patients with poor left ventricular function. Electrophysiological studies have determined that the etiology of SVT is the impulse generation and conduction abnormalities.<sup>1,2</sup>

Acute management of PSVT is to control the heart rate and prevent hemodynamic instability. Cardioversion with sedation is recommended if the patient has low blood pressure. The first-line treatment in hemodynamically stable patients is the vagal



Figure 1: "Electrocardiographic Clues to the Diagnosis of Atrioventricular Re-Entrant Tachycardia and Atrioventricular Nodal Re-Entrant Tachycardia Include a P Wave Following the QRS Complex, as can be Seen in Lead II (Solid Arrow) and Lead VI (Dotted Arrow), and a Short RP Interval"<sup>3</sup>

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maneuvers. Vagal maneuvers slow the AV nodal conduction and interrupt the reentry pathway. They comprise of valsalva maneuvers, carotid sinus massage, bearing down and face immersion in ice water.

The valsalva maneuver is a safe and the most effective internationally recommended vagal maneuver for the first-line emergency treatment for SVT.<sup>8,9</sup> The vagal maneuvers increase the parasympathetic tone by raising the intrathoracic pressure and stimulate the baroreceptors in the carotid bodies & aortic arch.<sup>10</sup> The success rate of vagal maneuvers varies from 6% to 54%.<sup>11</sup>

In the standard valsalva maneuver, the patient is in a semirecumbent or supine position and he is asked to exhale forcefully against a closed glottis after inspiration. The duration of strain is 10-15 seconds. Blowing hard into a 10 ml syringe that moves its plunger can also be used for this purpose.<sup>12</sup>

In the modified valsalva maneuver, the patient performs a standard strain in the semirecumbent position. Then lies in the supine position with leg raise for 15 seconds at 45°. This boosts the venous return and vagal stimulation. The efficacy of modified valsalva maneuver for SVT reversion is greater as compared to the standard method.<sup>12</sup>

If vagal maneuvers fail, pharmacological therapy is given such as calcium channel blockers or adenosine.<sup>6</sup> Adenosine causes many adverse effects such as transient asystole and a sense of impending doom in which patient feels that they are about to die.<sup>13</sup> Verapamil is a calcium channel blocker that inhibits the conduction of action potential through the AV node.<sup>1</sup> The adverse effects of verapamil are bradycardia & hypotension and are not recommended as first-line treatment for SVT. However, studies have reported that a single verapamil dose is safe without any side effects.<sup>7</sup> This study was conducted to determine the efficacy of repeating the valsalva maneuver in the reversion of paroxysmal supraventricular tachycardia in patients nonresponsive to an initial trial of the valsalva maneuver and a single dose of verapamil. Most of the acute episodes of SVT are terminated by verapamil but there is a significant risk of hypotension and bradycardia with more than one intravenous dose. Literature has reported a satisfactory reversion rate of SVT with valsalva maneuver and verapamil but the performance of repeating the valsalva maneuver after the initial trial of valsalva maneuver and a single dose of verapamil has not been evaluated in any previous study. This will help in implementing this practice in an emergency setting in the future to manage acute episodes of paroxysmal SVT and prevent the adverse effects of multiple doses of injection verapamil.

## METHODOLOGY

It was a descriptive case series conducted in the Emergency Department of the Punjab Institute of Cardiology, Lahore after approval by the institutional ethical committee. A total of 100 patients were enrolled by the nonprobability consecutive sampling technique after taking their informed consent. The sample size was calculated using a 95% confidence interval, 7.5% margin of error and 17% expected percentage of SVT reversion with valsalva maneuver.<sup>9</sup> The diagnosis of paroxysmal supraventricular tachycardia was confirmed on ECG showing regular narrow complex rhythm and a heart rate of >150 beats/min. The patients of any age or gender presenting with paroxysmal SVT were managed initially with valsalva maneuver. The patients in which SVT was not reverted with the valsalva maneuver, a single dose of verapamil was injected. The SVT patients nonresponsive to both initial valsalva maneuver and a single dose of verapamil were included in the study. The exclusion criteria included patients with sinus tachycardia, atrial flutter, atrial fibrillation, or broad complex or aberrant conduction tachycardia on ECG. The demographic profile of the patients was noted on the proforma and repeat valsalva maneuver was performed. The patients were placed in the semirecumbent or supine position and abdominal pressure was applied for 15 seconds. The heart rate and rhythm of the patients were continuously monitored. The ECG was repeated after 1 minute. The reversion of tachycardia was labeled if the ECG showed a normal sinus rhythm of <100 beats/min. Nonresponsive cases were those in which there was the persistence of paroxysmal SVT on ECG assessed after 15 minutes of a single dose of verapamil.

## STATISTICAL ANALYSIS

Data analysis was done by the Statistical Package for the Social Sciences (SPSS) version 24. Quantitative variables like age, body mass index (BMI) were expressed as mean and standard deviation. Qualitative variables like gender, smoking, diabetes mellitus and reversion of tachycardia were expressed as frequency and percentage. A chi-square test was used to compare the demographic variables with the frequency of SVT reversion. A p-value of  $\leq 0.05$  was considered significant.

## RESULTS

In our study, patients had a mean age of  $56.48 \pm 15.57$  years with the age range of 30-80 years. Fifty six (56%) patients were up to 60 years old and 44(44%) were above 60 years of age. Seventy four (74%) patients were males and 26(26%) patients were females. The

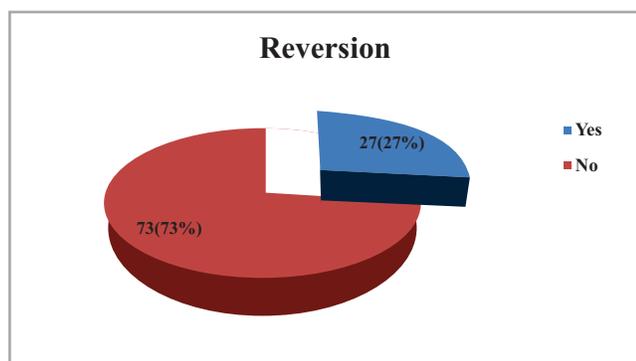


Figure 2: Frequency of SVT Reversion

mean BMI of the study participants was  $25.13 \pm 2.90$  kg/m<sup>2</sup>. The minimum BMI was 20.2 kg/m<sup>2</sup> and the maximum BMI was 30.3 kg/m<sup>2</sup>. Forty eight (48%) patients had normal BMI while 52(52%) patients were overweight and obese. Out of 100 patients, 23(23%) were smokers and 55(55%) patients had diabetes mellitus. Out of a total of 100 patients nonresponsive to the initial valsalva maneuver and a single verapamil dose, SVT reversion was noted in 27(27%) patients (Figure 2).

Eighteen (66.7%) patients with the reversion of SVT were up to 60 years of age and 9(33.3%) patients were above 60 years old. The correlation of SVT reversion with the age of patients was found statistically insignificant (p-value = 0.1913).

Out of 27 patients who reverted from SVT, 24(88.9%) were males and 3(11.1%) were females. There was a statistically significant association between gender and SVT reversion (p-value = 0.038).

The reversion of SVT was noted in 19(70.37%) patients with normal BMI and 8(29.63%) overweight/obese patients. The correlation of SVT reversion with the BMI of patients was found statistically significant i.e. p-value = 0.0065.

Fifteen (55.6%) patients with SVT reversion were smokers and 12(44.4%) were non-smokers. The

difference was statistically significant between the smoking and SVT reversion i.e. p-value=0.001.

Out of 55 diabetic patients, SVT reversion was observed in 14(51.9%) patients and out of 45 nondiabetic patients, SVT reversion occurred in 13(48.1%) cases. The difference was statistically insignificant between diabetes mellitus and SVT reversion i.e. p-value=0.7003. The association of demographic variables with SVT reversion is shown in table 1.

## DISCUSSION

Supraventricular tachycardia is a frequent heart disease presenting as a rapid heart rate.<sup>14</sup> The clinicians must diagnose SVT when they detect regular narrow complex tachycardia and also know its different treatment modalities.<sup>15</sup> The treatment of SVT involves vagal maneuver, medication and cardioversion.<sup>14</sup>

In our study, the reversion rate of SVT with repeating valsalva maneuver after an initial valsalva maneuver and a single dose of verapamil was noted in 27(27%) patients. There was a statistically significant association between gender, BMI, smoking and SVT reversion. Many studies have evaluated the reversion of SVT with valsalva maneuver or verapamil but this is the first study that determined the effectiveness of the valsalva maneuver in patients who did not respond to the initial valsalva maneuver and the first dose of verapamil.

The efficacy of the valsalva maneuver as a first-line treatment for SVT varies among different studies. A systematic review reported that the reversion rate of valsalva maneuver in SVT was 19.4%.<sup>10</sup> Walker et al. conducted a retrospective study on 19 SVT patients in Australia with the reversion of 1(5.3%) patient with standard valsalva maneuver and 6(31.7%) patients with modified valsalva maneuver.<sup>16</sup> Another systematic review by Pandya et al. included 3 studies with a total of 316 study subjects. In two studies by Mehta et al. and

Table 1: Comparison of Demographic Variables with SVT Reversion

Demographic Variables		SVT Reversion		Total	Chi-square Statistic	p-value
		Yes	No			
Age Range	Up to 60 years	18(32.14%)	38(67.86%)	56(56%)	1.708	0.1913
	Above 60 years	9(20.45%)	35(79.55%)	44(44%)		
Gender	Male	24(32.43%)	50(67.57%)	74(74%)	4.2615	0.038986*
	Female	3(11.54%)	23(88.46%)	26(26%)		
BMI	Normal	19(39.58%)	29(60.42%)	48(48%)	7.416	0.0065*
	Overweight/Obese	8(15.38%)	44(84.62%)	52(52%)		
Smoking	Smokers	15(65.22%)	8(34.78%)	23(23%)	22.1346	0.001*
	Nonsmoking	12(15.58%)	65(84.42%)	77(77%)		
Diabetes Mellitus	Diabetic	14(25.45%)	41(74.55%)	55(55%)	0.1481	0.700351
	Nondiabetic	13(28.89%)	32(71.11%)	45(45%)		

\*p-value significant  $\leq 0.05$

Wen et al., SVT was induced in patients while the third study by Lim et al. recruited patients presenting to the emergency with SVT. The reversion rate of SVT with valsalva maneuver was 20% while standing & 54% in the supine position by Mehta et al., 53% by Wen et al. and 17.9% by Lim et al. The higher reversion rate in studies by Mehta et al. and Wen et al. might be due to short duration of induced SVT and the chances that patients might not have responded to vagal maneuvers before presenting in the emergency in the study by Lim et al.<sup>17</sup>

A prospective cohort study was conducted in Iraq in which 93 SVT patients underwent a modified valsalva maneuver. The reversion of SVT was seen in 47.3% of patients. Thirty nine (41.9%) patients reverted to sinus rhythm after the first attempt and 5(5.4%) patients recovered after the second attempt of maneuver.<sup>18</sup>

In a randomized controlled trial in England, patients with SVT were randomly allocated into two groups with 214 participants in each group. Patients in one group underwent a standard valsalva maneuver while the patients in the other group underwent a modified valsalva maneuver. Supraventricular reversion was noted in 37(17%) patients with standard valsalva maneuver and 93(43%) patients with modified valsalva maneuver.<sup>9</sup>

A study determined the effectiveness and side effects of verapamil and adenosine in the treatment of SVT. The efficacy of both drugs was the same with more adverse effects with adenosine. The SVT reversion rate was 90.8% with adenosine and 89.9% with verapamil. The adverse effects were greater with adenosine (16.7-76%) in contrast to verapamil (0-9.9%). However, verapamil was associated with a higher rate of hypotension (3.7%) than adenosine (0.6%).<sup>19</sup> Another study done in Pakistan reported a 71.6% reversion rate of paroxysmal SVT with verapamil.<sup>20</sup>

### CONCLUSION

The reversion rate of paroxysmal SVT with repeat valsalva maneuver after the failure of an initial trial of valsalva maneuver and a single dose of verapamil is satisfactory. The reversion of supraventricular tachycardia was noted in 27% of cases in our study.

### RECOMMENDATIONS

- Valsalva maneuver can be repeated in patients of SVT nonresponsive to initial valsalva maneuver and a single dose of verapamil. This will prevent the adverse effects of additional doses of verapamil.
- The effectiveness of the modified valsalva maneuver was not evaluated in the study. Further research is required to evaluate the efficacy of both the standard & modified valsalva maneuvers in SVT patients nonresponsive to initial valsalva

maneuver & a single dose of verapamil and the results should be compared.

- A multicenter study should be carried out on a large number of study participants.

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