

Rhythm characteristics of types of paroxysmal supraventricular tachycardia attack in young and elderly patients undergoing cardiac electrophysiology

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Summary

Objective: Describe of rhythm characteristics of types of paroxysmal supraventricular tachycardia (PSVT) attack in young and elderly patients undergoing cardiac electrophysiology. **Subject and method:** Cross-sectional descriptive and prospective study. 182 patients diagnosed with PSVT attack underwent cardiac electrophysiology in Vietnam Heart Institute from January 2014 to May 2017. The patients were divided into two groups: Group I (n = 93): Young patients (< 60 years old), group II (n = 89): Elderly patients (≥ 60 years old). **Result:** The PSVT attack was quite common in middle-aged. AVNRT type was more commonly seen than AVRT attack, typical AVNRT were more prevalent than atypical AVNRT, orthodromic AVRT was more common than antidromic AVRT. The proportion of combined AVRT attack and WPW syndrome in the elderly group were significantly higher than that in the young group ($p < 0.0001$). The heart rate on out of attack ECG in the young patient group was significantly higher than that in the elderly patient group ($p < 0.0001$, $r = -0.326$). The AFib was quite common in PSVT attacks, with the rate of elderly patients having AFib attacks was higher than that of young patients ($p < 0.05$); The AFib was common in AVRT attacks (60%) while it was not common in AVNRT attacks (4.7%). The branch block was seen in 6.0%. **Conclusion:** The likelihood of having AVNRT was higher compared to AVRT attacks, typical AVNRT were more prevalent than atypical AVNRT, orthodromic AVRT was more common than antidromic AVRT, WPW syndrome was associated with PSVT attacks, there was a moderately and negatively correlated between the heart rate and age. The AFib was quite common in PSVT attacks, with the rate of elderly patients having AFib attacks was higher than that of young patients. The AFib was common in AVRT attacks.

Keywords: Rhythm characteristic, PVST attack, cardiac electrophysiological, young patients, elderly patients.

1. Background

Paroxysmal supraventricular tachycardia (PSVT) attack is an abnormally rapid cardiac arrhythmia in which the electrophathologic

substrate locates above the atrioventricular bundle. This is a common arrhythmia in clinical practice. This type of arrhythmias often appears suddenly and can be self-extinguished. PSVT have frequency about 0.23 - 3.0% [1]. In the United States, data from the MESA study showed that the prevalence of PSVT was 2.25 per 1,000 persons, the incidence was 35 new

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case per 100,000 persons each year, and about 89,000 new cases each year [1]. In Vietnam, there are no comprehensive statistic data on morbidity.

The PSVT attack can occur to the patient at any age, it causes many uncomfortable symptoms such as palpitation, pulsation in the neck, fatigue, light headedness, sweating, tightness, chest pains, shortness of breath, dizziness and even syncope, etc... If the PSVT attack prolongs for many hours or many days, it will cause hemodynamic disorders, or heart failure, increase the risk of falls, especially in elderly patients [1]. PSVT attack is one of the arrhythmias leading to the hospitalization or admission to the emergency department. Therefore, a proper the treatment is very necessary to prevent further complications, and the ablation by intervention is a very good solution [1].

Among the types of PSVT attacks, the most common type is atrioventricular nodal reentrant (AVNRT), the quite common type is atrioventricular reciprocating tachycardia (AVRT) in which orthodromic AVRT attack is more common than antidromic AVRT. AVNRT and AVRT are two types of AV (atrioventricular) node dependent rhythms (the AV node is a part of a whole of reentrant loop). This is important in the treatment because the medications affecting the AV node may cut off the PSVT attack [1].

Nowadays, there have been many methods of treatments for PSVT attack that have been applied and also have been effective such as the vagus nerve stimulation therapy, electrical shock, overdriving pacing... to the prevention of recurrent attacks with medication. There have been many studies on different kinds of anti-arrhythmic medications [2]. However, these are only temporary treatments that do not completely resolve the origin of the PSVT attack. Nowadays, cardiac electrophysiology with radiofrequency is considered to be the most effective and most thorough treatment. Most of the PSVT attack can be completely eliminated [1], [3]. Although the selection of a specific treatment depends on the

types of PSVT attacks, it is very important to identify rapid onset ventricular tachycardia because it will help the doctor to select the appropriate treatment and treatment strategies.

There have been many studies in the world on the characteristics of the PSVT attack [1], [3], [4]. There is a relation between aging and cardiovascular system activities. However, very few authors described in detail the characteristics of the PSVT attack of young and elderly people [5], [6], [7], [8]. Therefore, our study aimed at "investigating the characteristics of the paroxysmal supraventricular tachycardia attack in young and elderly patients" and "finding some arrhythmias in young and elderly patients who have characteristics of the paroxysmal supraventricular tachycardia attack in electrophysiological procedure".

2. Subject and method

2.2. Subject

Study design: Cross-sectional descriptive and prospective study.

Study contents: 182 patients with paroxysmal supraventricular tachycardia attack were diagnosed and treated with radiofrequency (RF) at the Vietnam Heart Institute, Bach Mai Hospital from January 2014 to May 2017. The patients were divided into two groups. Group I: Young patients (under 60 years old). Group II: Elderly patients (≥ 60 years old) [2], [3], [5], [6].

Statistical analysis: Data is processed in a computer with IBM SPSS 21.0 software. The T-test was used to compare 2 mean values, Chi-squared (χ^2) was used to compare two percentages. The p-value < 0.05 was considered statistically significant.

The correlation coefficient (r) showed the strength and the direction of a relationship between two variables ranging the between -1 and +1 as follows: $r = 0$: No linear relationship; $r = -1$ or $+1$: perfect negative/positive linear correlation; $r = (-0.3 : 0)$ or $(0 : 0.3)$: weak negative/positive linear

correlation; $r = (-0.7 : -0.3)$ or $(0.3 : 0.7)$: moderate negative/positive linear correlation; $r = (-1 : -0.7)$ or $(0.7 : 1)$: strong negative/positive linear correlation [7].

2.2. Criteria for diagnosis of paroxysmal supraventricular tachycardia attack

Paroxysmal supraventricular tachycardia (PSVT) attack is episodes of tachycardia, onsets in a part of the heart above the ventricle.

The electrocardiogram pattern shows the heart rate at the range from 140 to 250 beats per minute, narrow QRS complex (< 120 milliseconds), regular, hidden or inverted P waves (behind the QRS complex) [7], [8].

2.2.1. Criteria for the AVNRT

AVNRT: Reentry is caused by the nodal pathways or tracts. There are two types of AVNRT: Typical (slow-fast) and atypical (fast-slow) [3], [4], [8], [9], [10].

Typical AVNRT:

Dual A-V nodal physiology.

Retrograde A-V conduction goes through the fast way, the retrograde atrial activation sequence during tachycardia is concentric.

VA interval during the tachycardia < 60 ms at His potential recording site and < 90 ms at high right atrium.

PV stimulation during tachycardia should not preexcite the atrium when delivered at a time when His bundle is in the refractory period.

Atypical AVNRT:

A retrograde dual AV conduction.

Tachycardia induction depends on a critical A-V or His-atrial natural during retrograde slow pathway conduction.

Retrograde atrial activation sequence during tachycardia is concentric.

A-V natural during tachycardia < 60 ms at His potential site and > 90 ms at high right atrium.

PV stimulation during tachycardia should not reset the atrium when delivered at a time that His bundle is in the refractory period.

2.2.2. Criteria for the AVRT

AVRT: Reentry caused by accessory pathways have two types including orthodromic AVRT and antidromic AVRT attacks [3], [4], [8], [9], [10]:

Orthodromic AVRT: RP interval $<$ PR interval or RP interval $>$ PR interval with a slowly conducting accessory pathway; retrograde P waves (leads DI, DII, DIII, aVF, V1); delta wave is seen with normal sinus rhythm, not with tachycardia.

Antidromic AVRT: Short RP interval < 100 msec, regular, wide QRS complex ≥ 120 msec, delta wave is seen with normal sinus rhythm and tachycardia, concealed accessory pathways do not show delta waves.

3. Result

3.1. General characteristics of types paroxysmal supraventricular tachycardia attack

The mean of age is 53.1 ± 16.1 years (range 18 - 78), 53 male (29.1%) and 129 female (70.9%), $p=0.344$ (>0.05). Among the types of PSVT ($n = 182$), there are 127 patients with AVNRT (69.8%) and 55 patients with AVRT (30.2%), the younger group had AVNRT and AVRT with 61 and 32 patients, the elderly group had AVNRT and AVRT attack with 66 and 23 patients, respectively.

Group I ($n = 93$, 51.1%) had mean age of 40.5 ± 12.6 years (range 18 - 59). Group II ($n = 89$, 48.9%) had mean age of 66.3 ± 5.2 years (60 - 78). Group I had 30 males (32.3%) and 63 females (67.7%), group II had 25 males (25.8%) and 66 females (74.2%).

The patients with AVNRT and AVRT attack had the mean of age are 54.6 ± 15.5 years and 49.6 ± 17.1 years, respectively, the difference of mean age between AVNRT group and AVRT group, $p<0.0001$.

3.2. Characteristics of arrhythmias in the paroxysmal supraventricular tachycardia attack

3.2.1. Characteristic arrhythmias of types paroxysmal supraventricular tachycardia attack on the out of cardiac pacing

The mean of heart rate on out of attack electrocardiogram (ECG) in patient with PSVT attack was 79.63 ± 15.96 beats per minute (BPM) (range 50 - 170), the mean of heart rate on ECG in younger patient group (84.71 ± 18.70 BPM (range 64 - 170)) was higher than in the elderly patient group (74.31 ± 10.13 BPM (range 50 - 100)), the difference between two group was significant ($p < 0.0001$). The heart rate and age with negatively correlated ($r = -0.326$).

There were 17 of 182 patients had combined Wolff-Parkinson-White (WPW) syndrome (9.3%), this was only seen in patients with type AVRT attack. The number of patients with combined

AVRT attack and WPW syndrome was 17/55 (30.9%). The proportion of combined AVRT attack and WPW syndrome in the elderly group with 10/23 patients (43.5%) were significantly higher than that in the young group with 7/32 patients (21.9%) ($p < 0.0001$).

3.2.2. Characteristic arrhythmias of types paroxysmal supraventricular tachycardia attack in during programmed cardiac stimulation

Results of all types of PSVT attack during pacing:

The mean of heart rate on ECG in tachycardias attacks of the PSVT attacks were 172.91 ± 20.74 BPM (range 140 - 226). The mean of heart rate on ECG in was 173.45 ± 21.56 BPM (range 140 - 226) in the young patient group and was 172.23 ± 19.79 BPM (range 140 - 210) in the elderly group, the difference between two groups was not significant with $p = 0.725$ (> 0.05).

Table 1. Type distribution of paroxysmal supraventricular tachycardia attack by pacing

Type of attack Attack	Type distribution of PSVT by pacing			
AVNRT attack (n = 127)	Typical AVNRT		Atypical AVNRT	
	n	%	n	%
	116	91.3	11	8.7
AVRT attack (n = 55)	Orthodromic AVRT		Antidromic AVRT	
	n	%	n	%
	52	94.5	3	5.5

Results showed that in patients with the AVNRT attack, 116/127 (91.3%) was typical and 11/127 (8.7%) was atypical; In patient with AVRT attack, orthodromic AVRT was seen in 52/55 (94.5%) while antidromic was seen in only 3/55 (5.5%).

The ability to induce PSVT attack during pacing:

In our study, atropin was used for the facilitation for the PSVT induction in the electrophysiological procedure. 170/182 cases (93.4%) were able to get the PSVT attack induction by programmed cardiac stimulation. The proportions of PSVT attack induction by programmed cardiac stimulation in the elderly group and in young group were 91.0% (81/89) and

95.7% (89/93), respectively but the difference was not statistically significant ($p>0.05$).

Results of other arrhythmias occurring during cardiac electrophysiology pacing:

Table 2. Other arrhythmias occurring during electrophysiological studies

Group	Young patients group Group I (n = 93)		Elderly patients group Group II (n = 89)		Total (n = 182)	
	n	%	n	%	n	%
Arrhythmias						
Atrial fibrillation (AFib)	9	9.7	33	37.1	39	21.4
p	<0.05					
Branch block	6	6.5	5	5.6	11	6.0
p	>0.05					

Table 2 showed that the proportion of the atrial fibrillation (AFib) was 39/182 patients (21.4%). 37.1% of elderly patients had AFib while 9.7% of the young patients had AFib, the difference was statistically significant ($p<0.05$). Right branch block were seen in 11/182 patients (6.0%).

Table 3. Other arrhythmias occurring during electrophysiological studies regarding types PSVT attack

Group	AVRT (n = 55)		AVNRT (n = 127)		Total (n = 182)	
	n	%	N	%	n	%
Arrhythmias						
Atrial fibrillation (AFib)	33	60	6	4.7	39	21.4
p	<0.0001					
Branch block	6	10.9	5	3.9	11	6.0
p	>0.05					

Table 3 showed that AFib was seen in 60% of patients with AVRT and in 4.7% of patients with AVNRT ($p<0.0001$).

4. Discussion

4.1. General characteristics of types paroxysmal supraventricular tachycardia attack

We divided patients into two age groups according to WHO and previously published literature [2], [3], [5]. In some developed nations,

patients can be divided into < 65 year group and ≥ 65 year group as in Leonardo AO's study in the USA [1].

In our study, PSVT attacks was quite common in middle-aged and elderly patients, but mean age between AVNRT and AVRT group was significantly different with $p<0.0001$. The mean age of patients with PSVT attacks were 53.1 ± 16.1 years, lower than that of Chen SA's study in Taiwan [3]. It is probably because

Taiwanese life expectancy was higher than that of the Vietnamese population.

There was no significant difference in the proportions of male and female in the two groups ($p>0.05$). Most of the authors also showed that prevalence of male and female with PSVT attack did not differ significantly, but in Muhammad A's study ($n = 200$), 53.5% were male and 46.5% were female ($p<0.05$) [8].

4.2. Characteristics of arrhythmias of types paroxysmal supraventricular tachycardia attack

4.2.1. Characteristic arrhythmias of types paroxysmal supraventricular tachycardia attack on the out of attack electrocardiogram

The mean of heart rate on the out of attack ECG in the younger group (84.71 ± 18.70 BPM) is higher than that of the elderly group (74.31 ± 10.13 BPM), the difference was significant ($p<0.0001$).

Younger patients are seen more with PSVT attack compared to older patients. Heart rate and age moderately and negatively correlated ($r = 0.326$). It may be because the younger people's sinus node was more sensitive than in older people. When people get older, the sinus node function, transmission capacity of pathways tends to decrease gradually. Moreover, the arteriosclerosis in the elderly patient is common [2], [5], [6].

There were 9.3% patients had combined WPW syndrome, this was only seen in patients with AVRT attack; combined AVRT attack and WPW syndrome on ECG was seen in 17 of 55 patients with AVRT attack (30.9%). This is lower than those of some authors [2], [11]; perhaps, our research was conducted on more elderly patients.

The proportion of combined AVRT attack and WPW syndrome in the elderly group were significantly higher than that in the young group ($p<0.0001$), it's because the transmission capacity of pathways tends to decrease gradually in elderly patients [2], [5], [6].

4.2.2. Characteristic arrhythmias of types paroxysmal supraventricular tachycardia attack in during programmed cardiac stimulation

Results of all types of PSVT attack during pacing:

The mean of heart rate on ECG in during cardiac stimulation program in the young patient group was higher than in elderly patients group, but the difference between two groups was not significant ($p>0.05$).

Almost AVNRT attacks were typical AVNRT (91.3%) while only 8.7% was atypical AVNRT. Beside, 94.5% of AVRT attacks were orthodromic AVRT, antidromic AVRT was found in 5.5% of AVRT attacks (Table 1).

The ability to induce PSVT attack during pacing:

During the electrophysiological pacing programmed cardiac stimulation was used to induce PSVT attack. The most used two methods are used to stimulation with increasing frequency and stimulation with early stage level. In some cases, when above stimulation methods were not successful, isoprenaline or atropin was administered into patients by the venous way to ease the pacing effect of rapid recovery. This point of view was proved by Stellbrink C et al in Germany [11].

In our study, atropin was used to assist in the rapid recovery of tachycardia in electrophysiological pacing. The results showed that most patients (93.4%) had rapid most recovery of programmed cardiac stimulation. The rate of rapid recovery of tachycardia by programmed cardiac stimulation of young patients was higher than that of the elderly group but the difference was not statistically significant (91% versus 95.7%, $p>0.05$), which is similar to Chen's study [3].

Other arrhythmias occurring in the electrophysiology pacing:

There were 11 of 182 patients (6.0%) had branch block during programmed cardiac

stimulation, but all the branch pattern of 11 patients were right branch block (Table 2), in which 5 patients were elderly (5.6%) and 6 patients were younger (6.5%). There are two AVRT patients had right branch block and left side pathway, this indicated that the branch block in these patients did not change the fast-paced cycle time. The rate of the branch block of young patients (6 patients) was lower than that of elderly group (5 patients), the difference was not statistically significant with $p>0.05$ (Table 2). Kistler PM noted that aging is associated with structural and anatomical changes causing slow conductions such as block and delay [6]; However, all patterns of branch block was right bundle branch block, while left bundle branch block was not seen. Schwartz JB demonstrated that the left bundle branch block not associated with normal aging, it is associated with cardiovascular disease and risks factor of the cardiac events, the author also showed that the PR interval increased with aging, especially in people aged more than 65 years [5].

In the elderly group, 37.1% of patients had AFib, while in the young group 9.7% had AFib. The rate of AFib in the elderly group was higher than that of the young group, the difference was statistically significant, $p<0.05$. The programmed cardiac stimulation features showed that AFib was found in 39 of 182 patients (21.4%), which were similar the Yangni O's result (19% had atrial-flutter fibrillation attacks) [2]. In Yangni O's study, 8% with WPW syndromes also was found [2]. Our rate of atrial tachycardia (AT) attack was higher than that of Joerg L in which AT attack was met in 28 of 423 (6.6%) with AT and Foci of AT, including 15 of 28 patients with AT and 13 of 28 patients with Foci of AT, 395 of 423 patients had PSVT attacks [10]. This may be because our study had higher mean of the age of the elderly group and the young group also had higher mean of age as well. Regarding to atrial-flutter fibrillation rhythm in during pacing from two groups, we found that rate of AFib in elder group

was higher than that of the younger group, the difference between two groups was statistically significant with $p<0.05$ (Table 2). This could be explained by the Kistler PM's study [6], Some studies were indicated that atrial fibrillation (AF) was a common arrhythmia in the elderly patients [5], [6], and that age and cardiovascular disease (hypertension, coronary heart disease, heart failure, etc.) were the major risk factors for AFib. The abnormal pathways in the WPW syndrome make the atrial cells be more susceptible to cardiac stimulation, inducing atrial-flutter fibrillation attack [9]. Besides, we should mention the role of the slow pathway in AVNRT attack which makes the likelihood of atrial fibrillation increase [5], [6], [9]. This suggested a potentially dangerous risk for these patients, especially in patients with other arrhythmias such as WPW syndrome, atrial fibrillation, etc., as well as aging condition [3], [11].

Furthermore, in our study, the AFib was common in AVRT attacks (60%) and it was not common in AVNRT attacks (4.7%), the difference was highly significant ($p<0.0001$) as Table 3, Many authors such as Yangni O [2], Joerg L [10] showed that the prevalence of AFib in AVRT patients was higher than that in AVNRT patients. The explanation for this result was that AFib and AVRT had causes from atrium, while AVNRT had causes from atrioventricular nodal reentrant tachycardia as well as the ability of conductance of the fast accessory pathway and slow accessory pathway through AV [1]. Besides, some studies did not see the difference of AFib rate between the two groups: Bottoni showed that AFib induction in AVRT and AVNRT groups were 26% and 25%, respectively [4]; This meant that AFib was easy to be seen in AVRT and AVNRT attack.

The rate of branch block in the AVRT and AVNRT type was 10.9% (6/55 patients) and 3.9% (5/127 patients), respectively, the difference was not significant with $p>0.05$ (Table 3). Kistler PM

et al noted that aging is the most common risk factor for AFib, they demonstrated that AFib had deleterious factors for life longevity [6], Schwartz JB demonstrated that the right bundle branch block was seen the most commonly in elderly group compared to younger group but right bundle branch block did not increase the risk for further conduction abnormalities [5].

5. Conclusion

In the study of 182 patients have PSVT attack including, 93 patients in the young group (51.1%) and 89 patients in the elderly group (48.9%).

Characteristics of types of the PSVT attack: The PSVT attack was quite common in middle-aged. AVNRT type was more commonly seen than AVRT attack. In patients with AVNRT attacks, typical AVNRT were more prevalent than atypical AVNRT. In patients with AVRT attacks, orthodromic AVRT was more common than antidromic AVRT.

Rhythm characteristics of the PSVT attack: The proportion of combined AVRT attack and WPW syndrome in the elderly group were significantly higher than that in the young group ($p < 0.0001$). The mean of heart rate on the out of attack ECG in the young patient group was significantly higher than that of the elderly patient group ($p < 0.0001$), and there was a moderately and negatively correlated between the heart rate on out of attack ECG and age. The AFib was quite common in PSVT attacks, with the rate of elderly patients having AFib attacks was higher than that of young patients ($p < 0.05$). The AFib was common in AVRT attacks (60%) while it was not common in AVNRT attacks (4.7%).

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