Comparison of Supraventricular Tachycardia from Concealed Bypass Tract and Wolff-Parkinson-White Syndrome

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Abstract

Supraventricular tachycardia (SVT) is a common problem. There are 2 types of accessory atrioventricular pathway (AP) causing SVT: one can conduct antegradely (WPW syndrome) and another can conduct only in a retrograde direction (concealed bypass tract or CBT). There are little data of the significance and difference of the two types in Thailand. The objectives of this study were to compare characteristics of patients, accessory pathways and outcome of radiofrequency catheter ablation (RFCA) between the 2 types of accessory pathways. We reviewed the electrophysiology report of patients with supraventricular tachycardia from the accessory pathway who were referred for RFCA. There were 74 males and 74 females at a mean age of 37 years. CBT accounts for 44 per cent of SVT from AP. Compared to CBT, WPW syndrome was more in the right-sided location, more associated with heart disease, a higher number of accessory pathways, more inducible atrial fibrillation and more difficult to do ablation. However, the overall success rate of RFCA was similar. Although the recurrence rate was 8.4 per cent, all patients with recurrence were successfully reablated. We concluded from this study that RFCA is a highly effective method for the treatment for both forms of accessory pathway although there are some differences between WPW syndrome and CBT.

Key word : Supraventricular Tachycardia, Accessory Atrioventricular Pathway, Radiofrequency Catheter Ablation

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Reentry circuit caused by atrio-ventricular pathway is the second most common form of supraventricular tachycardia (SVT) behind atrio-ventricular nodal reentrant tachycardia (AVNRT). The prevalence of WPW syndrome in Thailand has been estimated to be 1.4 in a 1000 population[1]. Patients with atrio-ventricular pathway may be asymptomatic, but some may have SVT or even ventricular arrhythmia[2]. Prognosis in asymptomatic cases is excellent and treatment is usually not indicated[3]. Atrio-ventricular pathways that are capable of having antegrade conduction are called WPW syndrome, and those that can conduct only in a retrograde direction are called concealed atrio-ventricular pathway (CBT). SVT caused by WPW syndrome could be narrow complex tachycardia, wide complex tachycardia or atrial fibrillation, whereas those caused by CBT usually manifest as narrow complex tachycardia. Radiofrequency catheter ablation (RFCA) is a treatment option and usually recommended in symptomatic patients, especially those who do not respond to medication[4-7].

The objective of this study was to determine the differences between WPW syndrome and CBT in: 1) patient characteristics; 2) the characteristics of atrio-ventricular pathway, and 3) the outcome of RFCA.

MATERIAL AND METHOD

During the past 4 years, 148 patients who were referred for evaluation of SVT at Siriraj hospital were found to have atrio-ventricular pathway in the electrophysiology (EP) laboratory. Atrio-ventricular pathways were classified into WPW syndrome and CBT depending on the direction of conduction through atrio-ventricular pathway. Characteristics of patients and atrio-ventricular pathways, clinical presentation, inducible arrhythmia, out come of RFCA, and recurrence of SVT after RFCA was reviewed.

Electrophysiologic study (EPS)

Written informed consent was obtained prior to EPS. EPS was performed under local anesthesia and light sedation. The appropriate position for mapping and doing ablation was guided by the surface ECG in patients with WPW syndrome. Concealed accessory pathway was diagnosed mainly by an eccentric atrial activation during retrograde conduction. All catheters were positioned under fluoroscopic guidance and the exact sites were determined by the intracardiac electrogram. Surface ECG leads I, aVF, V1, and V6 and intracardiac electrogram at various positions were simultaneously displayed and recorded on the multichannel oscilloscopic recorder. Electrical stimulation was performed to unmask the atrio-ventricular pathways conduction and to induce the arrhythmia. Intravenous heparin was given to all patients with left sided ablation. Characteristics and cycle length of SVT were recorded.

Radiofrequency ablation technique

Mapping of the accessory pathway location was performed by looking at the site that has the earliest ventricular activation during antegrade accessory pathway conduction compared to the onset of delta wave. In patients with concealed accessory pathway, we aimed at the site of the earliest atrial activation during retrograde conduction *via* accessory pathway during ventricular pacing, or during orthodromic reciprocating tachycardia (ORT). We used the retrograde approach for ablation of left sided accessory pathway. For ablation of right sided accessory pathway, the catheter was positioned on the tricuspid annulus. The target site for RFCA was identified by the time of the local ventricular electrogram for WPW syndrome and of local atrial electrogram in retrograde direction for CBT. Accessory pathway (AP) potential may help to identify the accessory pathway location in some patients. Both right anterior oblique and left anterior oblique images were used for mapping and identifying the target site for ablation. The target temperature during RFCA was 50-55 degree celcius. If there is no evidence of ECG or electrogram changes after 10-15 seconds, radiofrequency power was then terminated. If the ECG returned to normal, the radiofrequency power was proceeded to 60 seconds. Successful radiofrequency ablation is defined as complete elimination of antegrade and retrograde accessory pathway conduction without inducible SVT, with or without isoproterenol for up to 30 minutes after successful ablation. Procedure time, fluoroscopy time and complication of procedure were recorded. Patients were followed up every 3 months. If there was evidence of recurrence of WPW syndrome or SVT, RFCA was attempted again.

Statistical analysis

Continuous data are presented as mean and standard errors and categorical variables are presented as count and percentages. Comparisons of

continuous data were made by unpaired *t*-test, and comparisons of categorical data were made by the chi-square test. The p-values less than 0.05 were considered significant.

RESULTS

Among 148 patients, 74 patients were male (50%). Eighty three patients were in the WPW syndrome group and 65 patients were in the CBT group. The mean age was 37±1.2 years (ages ranged from 6 to 74 years). Presenting symptoms include: palpitation (96%), presyncope (15%), syncope (7%), and chest pain (12%). Average duration of symptoms was 83±7 months and average frequency of attack was 95±24 per year. Seventeen patients (12%) had associated heart disease: 6 patients had Ebstein's anomaly, 6 patients had valvular heart disease, 2 patients had dilated cardiomyopathy, 1 of each for hypertrophic cardiomyopathy, atrial septal defect and coronary artery disease.

Table 1 shows the various parameters relating to the characteristics of atrio-ventricular pathways and of patients, and Table 2 shows the outcomes of RFCA in patients with WPW syndrome and CBT. Comparisons of these parameters between the 2 groups are also shown.

Table 1. Comparison of various patient and accessory pathway characteristics between patients with WPW syndrome and CBT.

	WPW syndrome	CBT	P value
Number of patients	83	65	
Age (year)	36.2±1.7	38.9±1.8	0.27
Male (%)	49	51	0.87
Heart disease (%)	15.7	6.2	0.07
Duration of symptom (month)	84.5±9.8	80.0±10.6	0.75
Frequency of symptom (per month)	103.0±30.8	86.3±38.8	0.73
Palpitation (%)	94	98.5	0.17
Syncope or presyncope (%)	21.7	21.5	0.98
PR interval (msec)*	114.5±4.5	150.2±3.8	<0.001
QRS interval (msec)*	131.2±2.0	118.2±2.0	<0.001
Multiple atrio-ventricular pathways (%)*	13.3	3.1	0.03
Number of atrio-ventricular pathways*	1.20±0.05	1.03±0.02	0.01
Inducible SVT (%)	97.3	95.4	0.55
Inducible atrial fibrillation (%)*	20.5	6.2	0.01
SVT cycle length (msec)	370±9.4	353±7.6	0.16
Atrio-ventricular pathway locations*			
a) Left (%)	42.2	72.3	<0.001
Right (%)	57.8	27.7	
b) Left lateral (%)	32.5	66.2	<0.001
Right lateral (%)	22.9	3.1	
Anteroseptal (%)	9.6	9.2	
Posteroseptal (%)	34.9	21.5	

* significant p-value

Table 2. Comparison of outcome of RFCA between patients with WPW syndrome and CBT.

	WPW syndrome	CBT	P value
Successful RFCA (%)	95.2	98.7	0.19
RFCA complication (%)	2.4	7.7	0.13
Procedure time (min)	152±8.5	150±10.1	0.88
Fluoroscopic time (min)	53.5±4.8	47.7±5.2	0.43
Number of attempts	12.6±1.7	8.9±1.0	0.06
Power used for successful RFCA (watt)*	31.9±1.5	26.9±1.4	0.02
SVT recurrence (%)*	13.1	3.8	0.03

* significant p-value

Patients with WPW syndrome tend to be more related to organic heart disease than those with CBT. The most commonly related heart disease is Ebstein's anomaly which is found only in patients with WPW syndrome. Age and gender distribution and clinical presentation are similar between both groups. As expected, baseline ECG showed shorter PR intervals and longer QRS duration in patients with WPW syndrome in comparison with those with CBT. Multiple accessory pathway (at least 2 accessory pathways) is more common in the WPW group. More than 90 per cent had inducible SVT in the EP laboratory, and SVT cycle lengths were not different among the 2 groups. Antidromic type tachycardia were demonstrated in 12 per cent of patients with WPW syndrome. Atrial fibrillation was more frequently induced in patients with WPW syndrome. Among the total of 164 accessory pathways, 84 were WPW syndrome and 80 were CBT. Locations of accessory pathways are remarkably different. Accessory pathways associated with WPW syndrome are located more on the right side, whereas CBT are more on the left. To be more precise, CBTs are found more in the left lateral region, whereas those with WPW syndrome are more in the right lateral and posteroseptal regions. Both forms of accessory pathway can be ablated at high success rate with little complication. Patients with structural heart disease had a lower success rate than those without (97.7% *vs* 88.2%, $p < 0.05$). Procedure time and fluoroscopy time used for RFCA are similar between the 2 groups. Accessory pathway associated with WPW syndrome needed more power for successful RFCA and tended to need a greater number of attempts than CBT. This may probably be related to the difference in the distribution of location of accessory pathway among the 2 groups. Minor complication occurred in 4 patients: one had large hematoma related to venous puncture; one had right femoral artery dissection; one had right bundle branch block and one had mild pericardial effusion on routine echocardiogram 1 day after RFCA, without hemodynamic compromise, which may be related to trauma during ablation. Major complication occurred in 1 patient who developed complete heart block after RFCA.

Patients were followed-up for the average duration of 22.4±12.5 months after RFCA. Thirteen patients had recurrence of SVT: 12 (8.4%) from recurrent accessory pathway conduction and 1 from atrio-ventricular nodal reentrant tachycardia. Median duration of recurrence was 1.5 month. All 12 patients recurred with accessory pathway from the same location. All of them were successfully reablated. Recurrence rate was greater with WPW syndrome than with concealed accessory pathway (11.9% *vs* 3.8%, $p < 0.05$). Structural heart disease was found more often in patients who had SVT recurrence (33.3% *vs* 9.6%, $p < 0.05$). In one patient with right posteroseptal accessory pathway, RFCA was successfully performed 3 months after unsuccessful ablation. So, the overall successful RFCA result was 97 per cent of accessory pathway. In one patient with right anteroseptal accessory pathway, accessory pathway conduction temporary disappeared during an attempt to perform RFCA. RFCA was then rescheduled and successfully performed.

DISCUSSION

We described 83 patients with WPW syndrome and 65 patients with CBT treated by RFCA at Siriraj hospital which is a tertiary center in Thailand. The proportion of CBT in our study is higher than that which has been reported from previous studies[4-7]. Patient characteristics in our study are similar to others, except gender distribution which is an equal distribution in our study, but 2 times more frequent in males in other reports[6-8]. The distribution of accessory pathway location in patients with WPW syndrome in our study is more frequent on the right, which is different from other reports where it is more left-sided[3,4,9]. However, 72 per cent of accessory pathway in patients with CBT are on the left, which is similar to previous studies.

Most commonly associated heart disease is Ebstein's anomaly which is found in 6 patients. All 6 patients had WPW syndrome.

Overall success rate was 97 per cent, which is not different between patients with WPW syndrome and CBT, and comparable to previous reports[4-7,9]. Patients with structural heart disease had a lower success rate than those without. Major complication occurred in only 1 patient with parahisian CBT who developed complete heart block requiring permanent pacemaker implantation after RFCA. The complication rate in our study is comparable to previous studies[4-7]. Total recurrence

rate was 8.8 per cent. Recurrence rate is higher in patients with WPW syndrome, compared to those with CBT. Recurrence rate was also higher in patients with structural heart disease and right sided accessory pathway. All patients with SVT recurrence were successfully reablated.

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การศึกษาเปรียบเทียบ supraventricular tachycardia ที่เกิดจาก concealed bypass tract และ Wolff–Parkinson White Syndrome

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Accessory atrio–ventricular pathway เป็นสาเหตุที่พบบ่อยอย่างหนึ่งของ supraventricular tachycardia (SVT) สามารถแบ่ง accessory pathway (AP) ตามลักษณะการนำไฟฟ้าได้เป็น 2 ชนิด คือ ชนิดที่สามารถนำไฟฟ้าจากบนลงล่างได้หรือ Wolff–Parkinson–White (WPW) syndrome และชนิดที่นำไฟฟ้าได้ทิศทางเดียว จากล่างขึ้นบน หรือ Concealed bypass tract เราทำการศึกษาวิเคราะห์ความแตกต่างระหว่าง accessory pathway ทั้ง 2 ชนิด ในผู้ป่วย 148 คน ที่ได้รับการวินิจฉัยเป็น SVT จาก accessory pathway CBT คิดเป็น 44% ของผู้ป่วย SVT ที่มีสาเหตุจาก AP จากการวิเคราะห์ทางสถิติพบว่า AP ชนิด WPW syndrome พบในหัวใจซีกขวาบ่อยกว่า พบร่วมกับ structural heart disease บ่อยกว่า, มีจำนวน AP มากกว่ากระตุ้นให้เกิด atrial fibrillation บ่อยกว่า และทำ RF ablation ยากกว่า AP ชนิด CBT แต่อัตราการสำเร็จของการทำ RF ablation สูงในระดับเดียวกัน มีอัตรากลับเป็นซ้ำหลัง RF ablation 8.4% ทุกรายที่กลับเป็นซ้ำได้รับการรักษาได้ผลด้วยการทำ RF ablation โดยสรุป RF ablation เป็นการรักษาที่ได้ผลดีในผู้ป่วย AP ทั้งชนิด WPW syndrome และ CBT

คำสำคัญ : หัวใจเต้นเร็วผิดจังหวะ, การจี้หัวใจด้วยไฟฟ้า

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