Radiofrequency Catheter Ablation for Frequent Premature Ventricular Contractions : A Preliminary Report of 15 Cases

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Abstract

Between February 1995 and March 1997, 15 patients, 13 women and 2 men, underwent radiofrequency catheter ablation (RFCA) for symptomatic frequent premature ventricular contractions (PVC's). The mean age was 43.3 ± 11.9 years. Thirteen patients (86.7%) had right PVC's and the remainder had both right and left PVC's. RFCA were done under local anesthesia, using both earliest endocardial activation time and pace mapping in complement. The immediate success rate was 14/15 (93%) with only minor complications in 2 patients (13.3%). The fluoroscopic and procedure times were 40.6 ± 24.0 and 170.7 ± 81.2 minutes, respectively. From the Holter monitoring, total PVC count, per cent of PVC per total heart beat in 24 hours and couplets count were significantly reduced, (more than 90%, $p < 0.05$), by RFCA. Triplets and repetitive ventricular tachycardia were totally abolished.

During the follow-up period of 10.1 ± 7.5 months, 2 patients (14.3%) had recurrences of right PVC's within 2 weeks after ablation. Reablation was successfully done in both patients without recurrence, giving the final success rate of 93 per cent.

In conclusion, RFCA could be safely performed with a high success rate in patients with symptomatic frequent PVC's. It can be considered an alternative treament in patients resistant to medical therapy.

Premature ventricular contraction (PVC's) is the most common form of rhythm disturbance, both in healthy and in diseased hearts[1]. It may persist, even as bigeminy, for many years. Most of them have mild or no symptoms. The symptoms of these patients are palpitation, dizziness, presyncope and syncope which occur during exercise, anger or mental stress[2]. The prognosis of these

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patients is usually excellent[3,4]. The treatment in these patients is reassurance and some minor transquillzers. However, some patients may be very symptomatic and need frequent clinic visits and multiple hospital admissions to initiate or adjust antiarrhythmic agents. Because of failure to suppress PVC's and/or occurrence of side effects of these antiarrhythmic agents, the patients may develop more psychological stress.

Radiofrequency catheter ablation (RFCA) has been used as non-pharmacologic management for various cardiac arrhythmias. The efficacy and safety of RFCA in different types of supraventricular arrhythmia[5-7] and ventricular tachycardia[8-12] (VT) have been demonstrated. The purpose of this study is to assess the efficacy and safety of RFCA in refractory PVC's as a new technique for management of this arrhythmia.

PATIENTS AND METHOD

Study patients

Between February 1995 and March 1997, 60 patients were referred to Her Majesty's Cardiac Centre, Siriraj Hospital for management of symptomatic ventricular arrhythmia. Of these, 15 patients, 13 women and 2 men, were cases with refractory PVC's. The mean age was 43.3±11.9 years (range 23 to 61 years). All complained of palpitations, presyncope in 5, syncope in 6, chest pain in 2 and dyspnea on exertion in 1 patient. The mean duration of symptoms was 48.8±46.5 months (range 2 months to 12 years). All previously had either unsuccessful medical treatment or were intolerant to treatment with a mean of 2 ± 2.1 (range 1 - 4) antiarrhythmic agents.

Holter monitoring (Zymed system, model 1610-1) was performed within 1 month before RFCA in all patients while on no antiarrhythmic agent. The orthogonal lead system and derived 12-lead ECG utilized EASI system[13] was used. The entire 24-hour recording was reviewed using a full disclosure system. All PVC's, couplets, triplets and repetitive VT were visually - validated. Derived 12-lead ECG was performed when considered necessary. The frequent PVC's and repetitive VT were defined as PVC's ≥ 100 PVC per hour and 4-6 consecutive beats, respectively. The patients with non-sustained VT, defined as PVC ≥ 10 consecutive beats, and sustained VT, defined as VT > 30 seconds, from Holter monitoring were excluded from the study. Informed written consent was obtained in all patients.

Electrophysiological testing

The electrophysiologic test was performed in the fasting state and after discontinuation of all antiarrhythmic agents for more than 3 half-lives. Under local anesthesia with 1-2 per cent xylocaine, a 6 Fr quadripolar electrode catheter was advanced under fluoroscopic guidance from the right femoral vein and positioned at the right ventricular apex. Surface ECG lead I, II, aVF, V_1 and V_6 and intracardiac electrograms were simultaneously displayed and recorded on a multichannel oscilloscopic recorder (ART system). Programmed ventricular stimulation with up to 3 extrastimuli at 3 drive cycle lengths and rapid ventricular pacing were performed from the right ventricular apex and/or right ventricular outflow tract (RVOT) in order to induce PVC's or VT which had the same morphology as shown in standard ECG or derived 12-lead system from Holter monitoring, if VT or PVC's could not be induced in the baseline state, rapid atrial pacing was performed. If ventricular arrhythmia was still noninducible, Isoproterenol was infused from 1 to 5 mcg/min to increase the heart rate by 25-30 per cent. The atrial and ventricular stimulation protocols were then repeated. Frequent spontaneous PVC's was considered sufficient for mapping.

Mapping and ablation

Mapping and ablation was performed with 7 Fr quadripolar electrode and a deflectable curve (Mansfield Webster or EPT). The mapping catheter was introduced from the right femoral vein and advanced into the RVOT in patients with left bundle branch block and inferior axis PVC. If mapping of the left ventricle was necessary, the mapping catheter was passed from the right femoral artery and was positioned in the left ventricle by crossing the aortic valve. A bolus of 2,500 units of heparin was administered intravenously before mapping of the left ventricle, followed by a maintenance dose of 1,000 units hourly.

Attempts were made to record the earliest endocardial activation time at least 30 msec before the onset of the QRS complex of PVC on surface ECG recording. Pace mapping was then performed at that site during sinus rhythm. The aim was to attempt a perfect, 12/12 identical, or almost perfect i.e. at least 10/12 identical, pace map. Both techniques were used to complement each other.

Once the origin of PVC's was localized, ablation was performed using radiofrequency energy (EP technologies) delivered between the distal pole of the ablation catheter and a large surface-area skin patch placed over the left scapula. Energy of 20 to 50 watts were delivered for 30 to 60 seconds or until a sudden increase in impedance indicative of coagulum formation. The catheter was then removed and cleaned and repositioned. Ablation was performed until total elimination of the PVC's and that was defined as immediately successful ablation. Programmed stimulation, both with and without isoproterenol, was repeated for 30 minutes after the last application of RF energy to confirm the absence of inducible frequent PVC's before removing all catheters and sheaths. Total procedure time, defined as total time in the electrophysiological laboratory, and fluoroscopic time were recorded.

Follow-up

After the procedure, all patients were monitored continuously in the hospital for 24 to 48 hours. Echocardiogram was obtained the day after the procedure to look for the complication especially pericardial effusion. Patients with successful ablation were discharged without antiarrhythmic agent. Each patient was observed on a regular basis every $^1/_2$ -3 months by one of the first three authors. Holter monitoring was performed in all patients regardless of symptoms at 2 - 4 weeks after ablative procedure and in patients who had symptoms and signs suggestive of recurrence at any time during the follow-up period. Long-term successful outcome was defined as 80 per cent reduction of total PVC, 90 per cent reduction of couplets and 100 per cent reduction of triplets and repetitive VT on Holter monitor without any antiarrhythmic agent and the absence of symptoms of PVC's.

Statistical analysis

Continuous variables are expressed as mean $\pm$ SD. Variables are compared using Student's paired *t*-test. The p - value ≤ 0.05 is considered statistically significant.

RESULTS

All, 15 patients, had frequent PVC's and 2 patients had repetitive VT. The result of Holter monitoring before RFCA is shown in Table 1. From the derived 12-lead ECG, left bundle branch block (LBBB) PVC, originated from right ventricle, was detected in 13 patients (88.7%). The remainder had 2 morphologies of PVC, left and right bundle branch block pattern, indicating that the origins were from both ventricles.

During the electrophysiologic study, ventricular tachycardia, sustained or repetitive forms, could not be induced in any patient. All of them had adequate frequency of PVC for mapping and ablation. Right PVC's, originating from right ventricular outflow tract (RVOT), was found in 13 patients. Right and left PVC's were detected in 2 patients i.e. similar to the VPC on surface ECG. The origins of left PVC were from infero-apical septum of left ventricle in PVC with RBBB and superior axis and from left ventricular outflow tract in RBBB PVC with inferior axis. The origins of right PVC's in these two patients were from RVOT. The earliest endocardial activation time at the successful site was 39.9 $\pm$ 9.0 msec (range 26 - 61 msec) before the onset of QRS complex of the PVC's. The minimal pace mapping concordance at the successful site was 10/12. The fluoroscopic and procedure times were 40.6 $\pm$ 24.0

Table 1. Holter monitoring of the study population before and after radiofrequency catheter ablation.

	Before	After	% Reduction	p-value
Total (beats)	22,691.1 $\pm$ 20,116.3	1,553.2 $\pm$ 4,161.7	93.2	0.04
% PVC	19.7 $\pm$ 15.2	1.9 $\pm$ 5.1	99.9	0.02
PVC/hour	704.2 $\pm$ 689.2	72.9 $\pm$ 174.1	89.7	0.03
Couplets (events)	643.1 $\pm$ 1068.0	1.2 $\pm$ 3.2	99.8	0.02
Triplets (events)	186 $\pm$ 611.5	0	100	-
Repetitive VT (events)	64.5	0	100	-

PVC = premature ventricular contraction, VT = ventricular tachycardia

(range 9.3 - 94) and 170.7 ± 81.2 (range 60 - 400) minutes, respectively.

RFCA was considered immediately successfully in 14 patients (93.3%). Failure occurred in 1 patient (6.7%), who could achieve only 9/12 pace mapping and earliest endocardial activation time of 28 msec. Minor complications occurred in 2 patients i.e., chest discomfort and hematoma at the puncture site in each patient.

The result of Holter monitoring after RFCA is also shown in Table 1. The variables were significantly reduced or abolished ($P<0.05$).

During the follow-up period of 10.9±7.5 (range 0.5 to 25) months, two patients had recurrences (right PVC from RVOT). Reablation was successfully done in both patients without recurrence in 4 and 6 months period of follow-up, giving a final success rate of ninety three per cent.

DISCUSSION

Main finding : The results of this study show that RFCA in frequent PVC is feasible and safe. The late success and early recurrence rate were 93 and 14 per cent, respectively. Reablation could also be performed with a high success rate.

Mapping technique : All patients with right PVC, had its origin in the RVOT. Earliest endocardial activation time longer than 30 msec and 12/12 pace mapping were obtained in 14 (93.3%) and 11 (73%) patients, respectively. These patients had long-term success similar to the previous reports[11,12]. Coggins et al[14] suggested that pace mapping should be used to identify the site of origin than earliest endocardial activation time. However, Calkins et al[15] did not consider 12/12 pace map to be essential for success. Four patients (26.7%) in this study could be ablated from the site of pace map less than 12/12, 2 from 11/12 and the other 2 from 10/12 pace mapping. One patient, who had right PVC, failed in this study because we could not obtain pace map more than 9/12 and the activation time was only 28 msec. This finding suggested that pace mapping, at least 10/12, and endocardial activation time, early than 30 msec, should be used complementary to each other, similar to previous reports in ablation of RVOT- VT[11,12]. However, two patients in this study, who had 10/12 pace map and earliest endocardial activation time more than 30 msec, had recurrence. These patients had infrequent spontaneous PVC immediately after RFCA when compared to the patients who had total elimination of PVC's. Reablation was successfully done at the site of 12/12 pace mapping and earliest endocardial activation time more than 30 msec. The experience from these recurrences suggested that perhaps 12/12 pace map, earliest endocardial activation time more than 30 msec and total abolition of PVC might be essential to predict long-term success rate for ablation in PVC group.

Complication of RFCA : Only minor complications were detected in this study, similar to the previous reports for ablation in VT patients[12-15].

Procedural comparison with RFCA of VT : The present fluoroscopic time was similar to our previous report[12] on VT. However, the procedure time in the PVC group was longer, probably due to more difficulty in manipulation of the ablation catheter to achieve 12/12 pace map (73% *vs* 88%) and/or using more time in EP lab to confirm the total abolition of PVC.

Conclusion : Our data demonstrated that RFCA could be a highly successful method in the treatment of symtomatic frequent PVC's. We found that 12/12 pace map, earliest endocardial activation time more than 30 msec and total abolition of spontaneous or inducible PVC were the primary end points to predict long-term success. Because of the high success rate and safety procedures, RFCA should be considered an alternative treatment in this group of patients.

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การใช้ radiofrequency catheter ablation รักษาภาวะ premature ventricular contractions ที่เกิดขึ้นบ่อย : รายงานประสบการณ์เบื้องต้น 15 ราย

องค์การ เรืองรัตนอัมพร, พ.บ., เกียรติชัย ภูริปัญโญ, พ.บ.*, รุ่งโรจน์ กฤตยพงษ์, พ.บ.*, กาญจนา หวานสนิท, พย.บ.*, จารุวรรณ คังคะเกตุ, วท.ม. (ชีวสถิติ)*, ศุภชัย ไชยธีระพันธ์, พ.บ.**

คณะผู้รายงานได้ใช้ radiofrequency catheter ablation (RFCA) ในการรักษาผู้ป่วย premature ventricular contractions (PVC) จำนวน 15 ราย หญิง 13 ราย ชาย 2 ราย อายุเฉลี่ย 43.3 $\pm$ 11.9 ปี ผู้ป่วย 13 ราย (86.7%) มีจุดกำเนิดของ PVC จากเวนตริเคิลขวา ผู้ป่วย 2 ราย (13.3%) มีจุดกำเนิดของ PVC จากเวนตริเคิลขวาและซ้าย การใช้ RFCA ประสบผลสำเร็จในระยะแรกร้อยละ 93 จำนวน PVC จากการติดเครื่องบันทึกการเต้นหัวใจ 24 ชั่วโมง ลดลงอย่างมีนัยสำคัญ ($p < 0.05$) โดยไม่มีภาวะแทรกซ้อนที่รุนแรง ผู้ป่วย 2 รายกลับเป็นซ้ำใน 2 สัปดาห์ และสามารถใช้ RFCA ได้ผลสำเร็จ ดังนั้น RFCA เป็นวิธีการรักษาที่ได้ผลดีในผู้ป่วย PVC โดยเฉพาะในผู้ป่วยที่มีไม่ตอบสนองต่อการรักษาทางยา

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