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Patients' characteristics and procedural outcomes of premature ventricular complex ablation: Data of a single-centre arrhythmia unit experience

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ABSTRACT

Objective: Premature ventricular complexes (PVCs) are common arrhythmias and catheter ablation (CA) is the major treatment in patients with PVCs. In this study, we aimed to share our experience on PVCs patients who had undergone CA.

Patients and Methods: We investigated consecutive patients who had undergone CA because of PVCs between January 2015 and March 2021 in a single centre arrhythmia unit. Patients' characteristics, rhythm Holter recordings, echocardiography results and CA outcomes were noted. Patients were followed up for 22.3±3.7 months. Descriptive statistics were used to demonstrate features of study patients.

Results: Study population consisted of 645 patients; mean age was 51 ± 4.14 and 372 (57.7%) were male. Arrhythmia originated from the right ventricular outflow tract in 279 (46.6 %) patients, coronary cusps in 161 (26.9 %) patients, left ventricle summit in 50 (8.3%) patients and inside of the right or left ventricle in remaining patients. Sustained procedural success was achieved in 526 (88.1 %) patients. Recurrence was observed in 46 (6.7%) patients during follow-up. Major complication occurred in two patients (one procedural mortality due to coronary artery injury and one tamponade).

Conclusion: Premature ventricular contraction ablation can be utilized safely with high success rate. Most PVCs originate from the right or left ventricular outflow tract.

Keywords: Premature ventricular complexes, Catheter ablation, Outflow tract, Mapping

1. INTRODUCTION

Premature ventricular complexes (PVCs) are one of the common arrhythmias observed in routine practice which can be found in many patients undergoing rhythm holter monitoring [1]. While some patients may be asymptomatic, various kind of symptoms may manifest in most PVCs cases. Palpitation, shortness of breath, chest pain and fatigue are common complaints. In addition, some of cases may be asymptomatic even they have large arrhythmia burden demonstrated by holter monitoring. It has been shown that the PVCs patients without structural heart disease have a good prognosis [2]. Premature ventricular complexes may lead to reduced left ventricle ejection fraction (LVEF) which is evaluated by echocardiography. QRS wide, epicardial origin, PVC burden, coupling interval variability and body mass index have been demonstrated as predictors of PVC induced cardiomyopathy [3]. Although, PVCs generally originate from ventricular myocardium, they may sometimes locate in fascicules, aortic cusp or inside of coronary venous system. Arrhythmia mechanism may be re-entry, triggered activity or automaticity [4]. Medical therapy is often used as the first treatment option of PVCs. However, the effectiveness of this treatment is often limited due to its low efficacy or its intolerable side effects [5]. The aim of this study is to demonstrate the patient characteristics, outcomes and complications of catheter ablation (CA) procedures for symptomatic idiopathic PVCs in a single center.

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2. PATIENTS and METHODS

Patient Selection

Data of patients who had undergone radiofrequency CA due to symptomatic PVCs or cardiomyopathy that was assumed to be related with PVCs from January 2015 to December 2020 in our center were included. All of patients were evaluated in terms of structural heart disease prior to the ablation procedure. Patients with significant ischaemic heart disease, significant valvular disease, genetic or infiltrative cardiomyopathy were excluded from the study. Significant coronary artery disease had to be ruled out by coronary angiography or stress testing in all patients. Demographic and clinical data; including age, sex, medication status was collected.

The echocardiographic measurements were performed with an ultrasound system (Epic; Philips Healthcare Medical Systems, Andover, MA, USA) in accordance with the guidelines of the American and European Societies of Echocardiography for cardiac chamber quantification [6]. Standard echocardiographic views were obtained with a 3.5-MHz transducer in all participants.

Premature ventricular complexes burden, the origin and number of PVCs/24hour and complications were collected. Informed consent form was obtained from all patients before the procedure. Patients were older than 18 years, able to read and sign the informed consent form. The study protocol was approved by our institutional review board.

Ablation

All antiarrhythmic drugs were stopped at least 5 half-lives prior to the procedure. Electrophysiological study was performed under local anaesthesia in a fasted state. Sedation was not applied to the patients before the procedure to avoid the risk of suppressing automaticity. If few or no PVCs were observed at baseline, isoproterenol infusion and electrical stimulation techniques were used to induce arrhythmia. Intravenous isoproterenol 1-5 μg/min infusion was given to provide at least 20% heart rate increase. Electrical stimulation was performed using the right ventricular apex or right ventricular outflow tract (RVOT) using burst pacing and triple extra stimuli pacing. Mapping and ablation were guided by Ensite TM Precision (Abbott, Chicago, IL, USA), CARTO electro-anatomic mapping system (Biosense Webster, DiamondBar, CA, USA) or conventional electro-anatomic mapping. For left-sided procedures, systemic heparinization was used to maintain an activated clotting time of 300–350 s. After ablation, patients were monitored for at least 30 minutes to ensure successful ablation. Procedural success was defined as elimination or non-inducibility of the clinical PVCs. After the successful ablation, all antiarrhythmic drugs were withdrawn.

Follow-up

Patients were routinely seen in the outpatient clinic 3 months after the procedure. Holter monitoring was repeated then in many patients. Successful sustained ablation (SSA) was defined as the persistent elimination of at least 80% of the PVC burden or the absence of ventricular tachycardia (VT). Most of the study patients were followed up for 22.3±3.7 months after the procedure.

Statistical analysis

All statistical variables were analyzed with the Statistical Package for the Social Sciences (SPSS 22.0 for Mac; Inc., Chicago, IL, USA) software. The disturbances of variables were examined with analytic Kolmogorov–Smirnov or Shapiro–Wilk's tests. Continuous variables are presented as mean ± standard deviation and categorical variables as numbers and percentages.

RESULTS

A total of 645 consecutive patients were included in our study. Mean age was 51±4.14 and 57.7 % of the patients were male. The patients clinical and demographic characteristics were shown in Table I. There were 489 patients (75.8%) receiving medical therapy prior the ablation procedure. The median PVC burden was 19.4 and left ventricle ejection fraction mean was 57±13 in our study group. Fifty-five (8.7%) of the 645 patients ablation procedure were postponed due to non-inducibility of PVC during the procedure or probable risk of coronary artery or conduction system injury. 85.2 percent of the patients (508) who were ablated during first procedure were successfully ablated. While 50 patients were taken to the ablation procedure twice and 6 patients three times (Table II). After all ablation procedures, successful ablation was achieved in 526 patients (88.1%). Multiple PVC ablations were performed on a total of 24 patients.

Table I. *Demographic and clinical characteristics of patients*

Age	48±14
Male (%)	372 (57.7%)
PVC burden mean/median	20.8±9.1 19.4
PVC number	22700±10000
Hypertension	173 (27.9%)
Hyperlipidemia	89 (14.3%)
Smoking	87 (14.1%)
Diabetes mellitus	47 (7.6%)
Heart failure	118 (19.0%)
Coronary artery disease	70 (11.3%)
Implantable cardioverter defibrillatior	18 (2.9%)
Atrial fibrillation	21 (3.4%)
Palpitation	400 (67.0%)
Beta-blockers	466 (72.2%)
Calcium channel blockers	47 (7.3%)
ACEI/ARBs	142 (27.7%)
Amiodarone	28 (4.3%)
Propafenone	24 (3.7%)
Sotalol	7 (1.1%)
Ejection fraction	56.9±13,1
Body mass index	28±5

Data are presented as mean ± standard deviation while categorical variables were expressed as percentages. ACEI: Angiotensin-converting enzyme inhibitors; ARB: Angiotensin receptor blockers. PVC: premature ventricular complex.

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Table II. *Results of the clinical study*

Total numbers of procedures	
1 procedure	590 (91.5%)
2 procedures	50 (7.8%)
3 procedures	6 (0.9%)
Ablation postponed during first procedure	55 (8.7%)
Causes	51
Noninducibility	3
Parahisian	1
Proximity to LMCA	
Causes of repeat procedure	
Noninducibility	8 (13.3%)
Unsuccessful ablation	26 (43.3%)
Recurrens	26 (43.3%)
Mapping and ablation system	
Conventional mapping system	277 (46.9%)
3D mapping system	313 (53.2%)
Successful sustained ablation	526 (88.1%)
Successful sustained ablation in patients with LV dysfunction	90 (80.5%)
PVC burden after successful ablation mean/median	4.4±8.3????
More than one PVC ablation	24 (4.0%)
Mean ejection fraction post ablation	59±10
Complictions	
Pseudoaneurism	1 (0.2%)
Cardiac tamponade	1 (0.2%)
Death	1 (0.2%)
Recurrence	43 (6.7%)

Data are presented as mean ± standard deviation while categorical variables were expressed as percentages. LMCA: left main coronary artery, LV: left ventricle, PVC: premature ventricular contraction

It was seen that 238 (43.1%) of PVCs originated from the right ventricular outflow tract (RVOT), and 161 (26.9%) of PVCs originated from coronary cusps (Table III). The ratio of success according to location of PVC is shown in Table IV.

Table III. *Distribution of PVC location*

RV out-flow track	279 (46.6%)
RV	8 (1.3%)
Tricuspis annulus	4 (0.7%)
Coronary cusps	161 (26.9%)
Aortomitral continuity	41 (6.8%)
Summit	50 (8.3%)
Left ventricle	42 (7.0%)
Papillary muscle	11 (1.8)
Left ventricle Fascicle	1 (0.2%)
Mitral annulus	14 (2.3%)
Multilocation PVC	27 (4.5%)

Categorical variables were expressed as percentages. RV: right ventricle PVC: premature ventricular contraction

Table IV. *Ratio of success according to location of PVC*

Location of PVC	Successful ablation	Unsuccessful ablation
RVOT	255 (93.1%)	19 (6.9%) *
Right ventricle	5 (62.5%)	3 (37.5%)
Tricuspid annulus	4 (100%)	0 (0%)
Coronary cusps	147 (91.3%)	13 (8.7%)
Aorto-mitral continuity	35 (85.4%)	6 (14.6%)
Summit	29 (58.0%)	21 (42.0%)
Left ventricle	35 (83.3%)	7 (16.7%)
Mitral annulus	13 (92.9%)	1 (7.1%)
Multilocation PVC	(70.8%)	7 (29.2%)

*PVC: premature ventricular contraction, RVOT: right ventricle out-flow track. Categorical variables were expressed as percentages. *5 patients could not be ablated because of parahisian originated PVC.*

DISCUSSION

It has been shown in previous studies that if we monitor apparently healthy individuals by 24-hour ambulatory rhythm Holter, PVCs occurs in 50% to 54% of the subjects [7,8]. Most of the patients are asymptomatic, however as the burden of PVCs increases life qualities of the patients decrease. As palpitation is the most common complaint, drug therapies like beta blockers and calcium channel blockers are aimed to relieve this symptom via decreasing contractility in post PVC beats in addition to recommended lifestyle changes. However, it is not clear which patient groups respond well to this approach as there are some other aspects regarding patient characteristics or course of the disease process.

While medical therapy may mask the symptoms, more emphasis is given recently to catheter-based therapies as it being curative in selected patients and being safe if performed by experienced operators. These developments led to many comparative studies. It has been shown that radiofrequency ablation is more effective than medical therapy for treatment of PVCs [5,9].

Symptoms aside, there are some other entities to take into consideration. Prognosis may change drastically when patients develop PVC-induced cardiomyopathy [10] or malign arrhythmias caused by R-on-T phenomenon [11,12]. Recently, catheter ablation has been preferred as first-line therapy in patients with PVC-induced cardiomyopathy [13].

In this study, we determined the demographic characteristics, PVC localization, success and complication rates of patients who underwent PVC ablation procedure. Our findings showed that PVCs ablation resulted in high success rate in patients with frequent PVCs with a sustained successful ablation rate of 85.2% after first ablation procedure and 88.1% after all ablation attempts. The success rate of sustained successful ablation was 80.1% in patients with left ventricle systolic dysfunction. The complication rate was acceptable with 0.2% of death. When the success was evaluated according to the PVC origin, it was shown that the success rate in RVOT and coronary cusps PVCs ablation was quite higher than summit PVCs ablation.

The results of our study are consistent with the results of previous reports in the literature. As far as recent clinical studies

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were concerned, most of the studies conducted in patients with symptomatic frequent PVCs have reported over 80% success rates and low complication rates of ablation [14-16]. Similarly, successful results are obtained with PVC ablation of patients with left ventricle systolic dysfunction [15]. A metanalysis demonstrated long term success rate of up to 80% and complication rates of no more than 8%.

Conclusion

Premature ventricular contractions are one of the most common arrhythmias encountered in routine cardiology practice. One of the main treatment modality is catheter ablation and premature ventricular contraction ablation can be utilized safely with high success rate. Most of PVCs are originated from right or left ventricle outflow tract. Also, success rates are high when PVCs are originated from outflow tracts.

Compliance with Ethical Standards

Ethical approval: The study protocol was approved by the Kartal Kosuyolu Training and Research Hospital Ethics Committee (approval number: 2020.8/10-224).

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Authors' contributions: MC and AK: Literature search, SD, AK and KG,: Study design, KG and SD: Legislative applicatons, KG, AU, AT, AK and TA: Data collection, AK and CY: Supervision and quality control, AK and BGK: Statistical advice, AK and KG: Statistical data analysis, SA and TA: Data interpretation, KG: Drafting the manuscript. All authors read and approved the final version of the article.

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