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Original Article

Evaluation of the prevalence and prognosis of various types of premature ventricular contractions (PVCs) following catheter ablation in patients at afshar hospital, yazd, iran (2015–2020)

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Abstract

Objectives: Premature ventricular contraction (PVC) is a common cardiac arrhythmia characterized by heartbeats originating from the ventricles rather than the sinoatrial node. Although radiofrequency catheter ablation (RFCA) is a preferred treatment, its efficacy and prognostic impact remain incompletely established, particularly in developing countries where cardiovascular diseases are a leading cause of mortality. This study aims to investigate the prevalence and predictive outcomes of different PVC types following ablation therapy.

Methods: A retrospective, cross-sectional study was performed on all patients who underwent premature ventricular contraction (PVC) ablation at the Catheterization Laboratory of Afshar Hospital in Yazd, Iran, from 2015 to 2020. Patient data were collected using a census sampling approach, based on medical records, with PVC diagnoses confirmed by an electrophysiology specialist. The study examined demographic characteristics, PVC morphology based on surface electrocardiograms (ECGs), and the anatomical origin identified through electrophysiological mapping. Ablation success was defined as a reduction of ≥80% in PVC burden, while recurrence was defined as more than 10% PVCs on a 24-hour Holter monitor during follow-up. Data were analyzed using SPSS software.

Results: The study included 75 patients (56% male, 44% female) with a mean age of 47.0 ± 13.7 years. The most common site of PVC origin was the right ventricular outflow tract (RVOT), found in 54.7% of cases. Common comorbidities included hypertension (31%) and diabetes mellitus (11%). Palpitations were the most frequently reported symptom, seen in 63% of patients. The overall success rate of ablation was 81.3%. Complications were rare and included catheter site hematoma (2.7%) and thromboembolism (1.3%). Among patients who had successful ablation, 18% experienced recurrence. A statistically significant relationship was found between the anatomical origin of PVC and ablation success ($p < 0.0001$). However, the origin of PVCs was not significantly associated with recurrence or the timing of recurrence ($p > 0.08$).

Conclusions: This study identifies palpitations as the primary symptom in patients with premature ventricular contractions (PVCs), which most commonly originate from the ventricular outflow tracts. Hypertension and diabetes mellitus were identified as significant comorbidities. Radiofrequency ablation demonstrated a high success rate, with few complications and a low recurrence rate. Notably, the anatomical origin of PVCs was a substantial predictor of ablation success.

Keywords: Arrhythmia, PVC, Ablation, RFCA

Introduction

Cardiac arrhythmia refers to any disturbance in the heart's normal rhythm, which typically originates in the sinoatrial node and is conducted through the atrioventricular node to the ventricles (1). Arrhythmias are broadly categorized based on their site of origin as atrial, junctional, or ventricular (2). One of the most common types of ventricular arrhythmia is premature ventricular contraction (PVC), an ectopic heartbeat arising from the Purkinje fibers or the ventricular myocardium, rather than from the heart's intrinsic pacemaker (3). Although PVCs are often benign and may occur in otherwise healthy individuals, frequent or complex PVCs can signal underlying cardiac pathology, such as hypertension or a history of myocardial infarction (4, 5). Radiofrequency catheter ablation (RFCA) has emerged as a leading non-pharmacological treatment for symptomatic arrhythmias, including premature ventricular contractions (PVCs), since its introduction into clinical practice (4, 6). This minimally invasive procedure utilizes radiofrequency energy to ablate the focal area of myocardial tissue responsible for initiating the arrhythmia, offering a potentially curative approach and significantly reducing the risk of recurrence (7, 8). Major international cardiology societies endorse RFCA for the management of ventricular arrhythmias (9, 10). The success of the procedure is highly dependent on the accurate localization of the PVC origin, which is essential for effective procedural planning and the optimization of patient outcomes (11) .Despite the widespread adoption of radiofrequency catheter ablation (RFCA), its long-term impact on patient prognosis remains insufficiently understood, particularly in developing countries, where cardiovascular diseases represent a leading cause of mortality. Accordingly, this study was designed to investigate the prevalence, prognostic factors, and clinical outcomes associated with different types of premature ventricular contractions (PVCs) following RFCA in a cohort of patients treated at Afshar Hospital in Yazd, Iran, between 2015 and 2020.

Materials and Methods

Study Design and Population

This research was a retrospective, descriptive, cross-sectional study conducted in 2020. The study focused on all patients diagnosed with premature ventricular contractions (PVC) who were referred for and received ablation therapy at the Catheterization Laboratory of Afshar Hospital in Yazd, Iran, from 2015 to 2020.

Sampling and Patient Criteria

A census sampling method was utilized, enrolling all patients who met the predefined criteria during the study period.

Inclusion and Exclusion Criteria

Patients were required to meet specific electrocardiographic criteria for inclusion in the study. The primary inclusion criterion was the presence of at least 15% monomorphic PVC on a 24-hour Holter monitor or a documented history of sustained monomorphic ventricular tachycardia. The study excluded patients with a diagnosis of structural heart disease, multifocal PVC, or PVC of ischemic origin, to ensure a homogeneous study population with idiopathic ventricular arrhythmias.

Data Collection

The research involved a retrospective analysis of data extracted from patient medical records stored in hospital archives. The researchers used a standardized checklist to systematically gather demographic data, clinical information, and cardiovascular risk factors from the patient files. The morphology of premature ventricular contractions (PVCs) was evaluated using 12-lead surface electrocardiograms (ECGs). Electrophys iologic (EP) mapping reports from clinical records confirmed the exact anatomical origin of the PVCs. Throughout the study, all patient information remained strictly confidential.

Study Outcomes

The primary outcomes evaluated in this study were the success rate of the ablation procedure and the incidence of PVC recurrence following treatment. Ablation Success was defined as either an ≥80% reduction in the burden of PVC or the complete elimination of PVC, as confirmed by intracardiac electrograms in the electrophysiology laboratory immediately after the procedure. PVC Recurrence was defined as the presence of >10% PVCs on a 24-hour Holter monitor at any point during the follow-up period, following an initially successful ablation.

Ethical Considerations

This study received full approval from the ethics committee of Shahid Sadoughi University of Medical Sciences (Ethics Code: IR.SSU.MEDICINE.REC.1399.297).The researchers carried out all procedures according to the ethical standards of the Committee on Human Experimentation and in compliance with the Helsinki Declaration.

Statistical Analysis

All collected data were compiled and analyzed using SPSS statistical software, version 26. Continuous variables like age were presented as mean ± standard deviation, while categorical variables such as gender and PVC origin were expressed as frequencies and percentages. The Chi-Square test and T-test were employed for analyzing associations between variables. For all statistical tests, a p-value of less than 0.05 was considered to indicate statistical significance.

Results

Patient Demographics and Baseline Characteristics

The study comprised 75 patients who underwent PVC ablation. Of these, 42 (56%) were male and 33 (44%) were female. The mean age was 47.0 ± 13.7 years, ranging from 8 to 79. The average duration of follow-up was 38.4 ± 19.0 months see Figure 1.

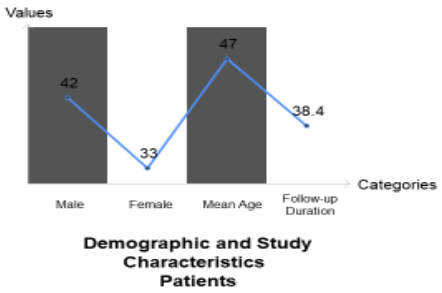

Figure 1. Demographic and Study Characteristics of Patients

PVC Origin and Associated Risk Factors

Analysis of the anatomical origin revealed that the right ventricular outflow tract (RVOT) was the most common site, accounting for 41 cases (54.7%). The left ventricular outflow tract (LVOT) was the second most frequent origin, observed in 17.3% of patients, followed by the mitral ring (12%) and the coronary cusp (7.6%). The least common origins were the epicardium and the parahisian region, each identified in a single patient (1.3%) see Table 1.

Table 1. Frequency Distribution of PVC Origins

PVC Origin	Frequency	Percentage (%)
RVOT	41	54.7
LVOT	13	17.3
Coronary Cusp	5	6.7
Mitral Ring	9	12.0
Others	5	6.7
Epicardium	1	1.3
Parahisian	1	1.3
Total	75	100.0

Regarding comorbidities, 23 patients (30.7%) had a history of hypertension, and eight patients (10.7%) had diabetes mellitus. A history of smoking and addiction was reported in 4 patients each (5.3%) see Table 2.

Table 2. Frequency Distribution of Risk Factors Among Patients

Risk Factor	Present	Percentage (%)	Absent	Percentage (%)
Diabetes	8	10.7	67	89.3
Hypertension	23	30.7	52	69.3
Smoking	4	5.3	71	94.7
Drug Abuse	4	5.3	71	94.7

Clinical Presentation and Treatment Outcomes

The most prevalent symptom reported by patients was palpitation, observed in 47 individuals (62.7%). Other common presenting complaints included chest pain (30.7%), dyspnea (20%), and dizziness (10.7%). The procedure demonstrated a low complication rate. Two patients (2.7%) developed a hematoma at the catheter insertion site, and one patient (1.3%) experienced thromboembolism. No cases of cardiac tamponade or pleural effusion were reported see Table 3.

Table 3. Frequency Distribution of Complications Related to PVC and Ablation Among Patients

Complication	Frequency	Percentage (%)
PVC-Related Complications		
Dizziness	8	10.7
Chest Pain	23	30.7
Palpitation	47	62.7
Dyspnea	15	20.0
Ablation-Related Complications		
Catheter Site Hematoma	2	2.7
Thromboembolism	1	1.3
Cardiac Tamponade	–	–
Pleural Effusion	–	–

Association Between PVC Origin and Clinical Outcomes

There was a statistically significant relationship between the anatomical origin of the PVC and the success of the ablation procedure ($p < 0.0001$). All 75 patients underwent ablation, with a procedural success rate of 81.3%, while 18.7% experienced unsuccessful outcomes. Ablation demonstrated 100% success for PVCs originating from the Coronary Cusp and Epicardium. The success rate was also very high for RVOT origins (92.7%). In contrast, PVCs originating from the parahisian region or other unspecified sites did not respond to ablation see Table 4.

Table 4. Frequency Distribution of PVC Origin by Ablation Success Among Patients

PVC Origin	Successful Ablation	Percentage (%)	Failed Ablation	Percentage (%)
RVOT	38	92.7	3	7.3
LVOT	10	76.9	3	23.1
Coronary Cusp	5	100.0	–	–
Mitral Ring	7	77.8	2	22.2
Others	–	–	5	100.0
Epicardium	1	100.0	–	–
Parahisian	–	–	1	100.0
Total	61	81.3	14	18.7

However, there was no significant statistical association between the PVC origin and the likelihood of recurrence in successfully treated patients (p> 0.36) see Table 5.

Table 5. Frequency Distribution of PVC Origin by Recurrence Status Among Patients

PVC Origin	Recurrence	Percentage (%)	No Recurrence	Percentage (%)
RVOT	5	13.15	33	86.85
LVOT	2	20.00	8	80.00
Coronary Cusp	1	20.00	4	80.00
Mitral Ring	2	28.57	5	71.43
Others	–	–	*	–
Epicardium	1	100.00	–	–
Parahisian	–	–	*	–
Total	11	18.03	50	81.96

* The origin of PVCs that did not respond to ablation was not considered in the recurrence analysis.

Similarly, the anatomical origin did not significantly influence the time to recurrence (p> 0.08). Among the 11 patients who had a recurrence, the majority (45.5%) relapsed between 5 and 8 months post-procedure Table 6.

Table 6. Frequency Distribution of PVC Origin by Time to Recurrence Among Patients

PVC Origin	< 5 Months	Percentage (%)	5–8 Months	Percentage (%)	> 8 Months	Percentage (%)
RVOT	1	20.0	3	60.0	1	20.0
LVOT	–	–	1	50.0	1	50.0
Coronary Cusp	1	100.0	–	–	–	–
Mitral Ring	1	50.0	–	–	1	50.0
Others	–	–	1	100.0	–	–
Epicardium	–	–	1	100.0	–	–
Parahisian	–	–	–	–	–	–
Total	3	27.3	5	45.5	3	27.3

Discussion

This study has RFCA outcomes for PVCs in a single-center cohort, contributing valuable regional data to the existing body of literature. The primary finding is that RFCA is a safe and effective therapeutic option, with a procedural success rate of 81.3%. Notably, the anatomical origin of the PVC significantly influenced the likelihood of procedural success. The demographic profile of our cohort, with a mean age of 47.0 years and a slight male predominance (56%), is largely consistent with findings in the existing literature. For example, Lee et al. reported a comparable mean age of 51.8 years among 100 patients with PVCs, although their cohort demonstrated a slight female majority (57%) (12). In contrast, a large-scale study by Chen et al. identified a higher prevalence of PVCs in men, supporting the gender distribution observed in our study (13). Palpitation was the most frequently reported symptom in our cohort (63%), closely aligning with Lee et al.'s findings, in which 61% of patients presented with palpitations, followed by fatigue, dizziness, and chest pain (12). These findings reinforce palpitation as the cardinal symptom prompting medical evaluation and treatment in patients with PVCs. The overall procedural success rate of 81.3% in our study is robust and aligns well with previously reported outcomes in the literature. For instance, Sarrazin et al. reported a 100% success rate in a smaller cohort of 15 patients (14), while a meta-analysis by Zang et al. documented long-term success rates ranging from 66% to 90%, depending on patient selection and ablation technique (15). The recurrence rate in our study was 18% among patients who initially achieved successful ablation, which is slightly higher than the 9.1% reported by Lee et al (12). Nonetheless, this finding supports the conclusion that RFCA offers durable, long-term symptom relief for the majority of patients with

PVCs Moreover, the procedure demonstrated an excellent safety profile in our cohort, with only minor complications observed, further reinforcing the low-risk nature of RFCA. Interestingly, a novel and clinically significant finding is the statistically significant association between the anatomical origin of PVCs and the success of radiofrequency catheter ablation ($p < 0.0001$). While previous studies, such as those by Bogun et al., have primarily investigated PVC origins in post-infarction patients (16), and Zang et al. reported no significant association between PVC origin and improvements in left ventricular ejection fraction (LVEF), our data uniquely demonstrate a direct correlation between specific anatomical sites and procedural outcomes (15) .Notably, ablations targeting PVCs originating from the coronary cusp and epicardium achieved a 100% success rate, whereas all cases with parahisian origins were unsuccessful. These findings suggest that certain anatomical locations may be inherently more amenable to successful ablation, while others pose significant technical challenges. This distinction holds important implications for patient selection, procedural planning, and pre-procedural counseling. Our finding that the right ventricular outflow tract (RVOT) was the most common origin of PVCs, accounting for 54.7% of cases, is highly consistent with the existing literature. For example, a study by Malderen et al. also identified the outflow tracts as the predominant source of PVCs, reporting a prevalence of 40% (17). These findings underscore the importance of a thorough understanding of outflow tract anatomy in electrophysiology training and clinical practice. Additionally, the observed prevalence of hypertension (31%) and diabetes mellitus (11%) in our study aligns with established cardiovascular risk profiles. This is supported by studies such as that by Tanaka et al., which demonstrated a correlation between a history of cardiovascular disease and specific PVC subtypes (18In sum, these associations highlight the relevance of comprehensive cardiovascular risk assessment in patients presenting with frequent PVCs. This study has several limitations that should be acknowledged. Its retrospective, single-center design may restrict the generalizability of the findings to broader populations. Additionally, reliance on archived medical records introduces the potential for incomplete or inconsistent data, which could impact the accuracy of some variables. Despite these limitations, the study offers valuable insights into the outcomes of PVC ablation in a regional context and underscores the prognostic significance of PVC origin. These findings lay the groundwork for future prospective, multicenter studies to validate and expand upon these results.

Conclusion

This study confirms that palpitations are the primary presenting symptom in patients with PVCs, with the ventricular outflow tracts being the most frequent sites of origin. Hypertension and diabetes mellitus emerged as notable comorbidities and potential risk factors. Radiofrequency ablation demonstrated a high success rate with minimal complications and a relatively low recurrence rate. Notably, the study found that the anatomical origin of PVCs is a significant predictor of ablation success. These findings emphasize the need for further research involving larger patient populations to enhance prognostic accuracy and treatment strategies.

Ethical statements

This study was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences in Yazd, Iran (Ethics Code: IR.SSU.MEDICINE.REC.1399.297). This study adhered to the ethical principles outlined in the Declaration of Helsinki. Due to the retrospective nature of the study, the ethics committee waived the requirement for informed consent. The patients were anonymized, and their data were handled confidentially to ensure privacy and protect their information throughout the study.

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Authors contributions

S.M.H. was involved in the conception, design, and conduct of the study. A.A.A., F.D.T., and M.S.H. were involved in the conception, design, analysis, interpretation of the results, and writing of the first draft of the manuscript. P.P. and F.G.H. contributed to writing the first draft of the manuscript. M.S.H. also participated in data analysis. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest
The authors have no conflicts of interest.

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