Original Article

Electrocardiographic and Demographic Manifestations of Premature Ventricular Complexes From the Left Ventricular Outflow Tract

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ABSTRACT

Background: This study aimed to compare the prevalence, age, sex, left ventricular ejection fraction, underlying conditions, and smoking status among patients with various types of premature ventricular contractions (PVCs) originating from the left ventricle with an inferior axis. The PVC patterns were investigated using ECG.

Methods: Patients who underwent successful catheter ablation for PVCs originating from the left ventricle with an inferior axis between 2017 and 2022 at the Rajaie Cardiovascular Medical and Research Institute were included in this study. Patient data, including ECG records, were collected by reviewing archived patient files.

Results: A total of 377 patients aged 15 to 81 years were included in the study, with 56.8% being male. The most common PVC ablation site was the left coronary cusp (39.3%), followed by the right coronary cusp-left coronary cusp commissure (26%). Most of the patients (99.5%) experienced clinical symptoms, and the mean ejection fraction was 44/60%. Nearly 38.19% of the patients had a normal ejection fraction, while 31.56% had a mildly reduced ejection fraction.

Conclusions: The study revealed that left-sided PVCs were more prevalent in men and exhibited an increasing trend with age. Among the risk factors, hypertension showed a direct and superior association. The most common PVC pattern observed on ECG was characterized by a monophasic R wave, QS complexes in leads AVL and AVR, and an R/S ratio of less than 1 in lead I and leads V1–V2. The majority of patients with left-sided PVCs exhibited a transition in lead V3, often referred to as the “gray zone.” Additionally, a breakthrough transition pattern was predominantly noted in patients with the most common type of PVCs ablated from the summit, aortomitral continuity, and subvalvular regions. ***(Iranian Heart Journal 2024; 25(4): 59-72)***

KEYWORDS: Left ventricular, Ventricular premature complexes, Catheter ablation, Electrocardiography

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Received: April 22, 2024 **Accepted:** July 18, 2024

Premature ventricular contractions (PVCs) are the most common arrhythmias identified in patients without underlying structural heart disease. Serial ECGs can detect PVCs in 1% to 4% of the general population, and 48-hour Holter monitoring reveals their presence in 40% to 75% of healthy individuals. [1] PVCs not only have the potential to cause disabling symptoms but may also result in heart failure, left ventricular dysfunction, or left ventricular dilation. [2] Several studies have demonstrated an increased risk of sudden cardiac death, cardiovascular events, and left ventricular dysfunction associated with PVCs. [3]

While PVCs most commonly originate from the right ventricular outflow tract, a smaller proportion have been found to arise from the left ventricular outflow tract, mitral valve annulus, and tricuspid valve. [4] Notably, idiopathic PVCs originating from the left ventricular septum, without involving the anterior or posterior left fascicles, have also been documented. [5] For left-sided PVCs, the second most common type of PVC, radiofrequency catheter ablation has been demonstrated to be an effective treatment for the permanent elimination of PVCs, leading to improved cardiac function in patients with cardiomyopathy mediated by PVCs. [6, 7] Radiofrequency catheter ablation is performed by utilizing mapping techniques to locate the origin, followed by successful ablation. Overall, catheter ablation is superior to drug therapy in treating PVCs. [1] Certain demographic characteristics may be associated with PVCs originating from specific cardiac sites, potentially playing a role in predicting PVC occurrence. Research has generally demonstrated an association between PVC prevalence and increasing age, hypertension, dyslipidemia, and smoking, while the associations with sex have been inconsistent. The distinct ECG patterns corresponding to PVCs originating from different cardiac sites can also help predict the success of ablation procedures. Furthermore, predicting PVC localization using surface ECG is crucial for determining the appropriate catheter selection and procedure timing, as well as for assessing the likelihood of successful ablation and potential ablation complications. [8]

Left-sided PVCs with an inferior axis typically exhibit ECG features of left bundle branch block (LBBB) and inferior axis morphology. Additionally, specific demographic characteristics are associated with these PVCs. The present study aimed to explore the demographic and ECG characteristics concerning their significant associations with successfully ablated left-sided PVCs exhibiting an inferior axis.

METHODS

Study Population

The patient data analyzed in this study consisted of 377 individuals who underwent successful ablation of PVCs originating from the left ventricular outflow tract at Rajaie Cardiovascular Medical and Research Institute, Tehran, Iran, between March 2017 and December 2021. Patients with structural heart diseases such as coronary artery disease, valvular heart disease, congenital heart disease, left ventricular hypertrophy, and right ventricular abnormalities were excluded from the study.

Forty cases with missing data were identified, comprising individuals in whom PVCs were not visible on the ECG (before ablation) and Holter recordings were unavailable. All the included patients experienced varying degrees of palpitations, atypical chest pain, dyspnea, or presyncope symptoms. Additionally, antiarrhythmic drugs failed to control the arrhythmia, significantly impacting their quality of life. Routine biochemistry, chest X-ray, echocardiography, and other tests revealed no explanatory structural abnormalities. All patient data were collected from hospital archives by cardiologists, reviewing the study population's medical records. The indications for ablation included symptomatic PVCs with a frequency of ≥10,000 beats in 24 hours, intolerance to or failure of 2 antiarrhythmic drugs, and PVCs leading to ventricular tachycardia/ventricular fibrillation. [9]

Inclusion Criteria

Patients were selected based on the following criteria:

1. Recurrent PVCs with a mean frequency of ≥10,000 beats over 24 hours
2. Inability to tolerate PVCs or failure of treatment with 2 antiarrhythmic drugs
3. Absence of structural heart disease
4. Provision of written informed consent for catheter ablation

Prior to radiofrequency catheter ablation, all the patients underwent at least one 12-lead surface ECG and 24-hour Holter ECG. Demographic and clinical data, including age, sex, diabetes, hypertension, smoking status, and left ventricular ejection fraction, were collected from the hospital information system. ECG data were extracted based on the 12-lead surface ECG taken before the ablation procedure.

Ethical Approval

The study received approval from the Ethics Committee of Rajaie Cardiovascular Medical and Research Institute, Tehran, Iran. ECG and demographic data were collected from patient records, ensuring patient confidentiality was maintained throughout the process. All necessary measures were taken to protect patient privacy and adhere to ethical guidelines.

ECG

ECG assessment was conducted on patients experiencing PVCs of left ventricular origin with an inferior axis in all leads, confirmed during the ablation procedure. Three independent cardiologists performed the assessments. The ECG variables examined included the dominant morphology pattern of PVCs in inferior, lateral, and precordial leads, which were evaluated based on the height of R or r waves, depth of S or s waves, and the presence of Q or q waves in each lead. This comprehensive analysis aimed to identify the specific characteristics of left-sided PVCs with an inferior axis. This study also assessed the R-wave amplitude in leads V1–V2, calculated as the ratio of the R-wave height to the S-wave depth. The transitional zone and transitional index during both PVCs and sinus rhythm were determined in the precordial leads. Additionally, tall waves (> 0.5 mV), which comprised Q, R, and S waves, and low amplitude waves (≤ 0.5 mV), consisting of r, q, and s waves, were evaluated to obtain a comprehensive understanding of the ECG characteristics associated with left-sided PVCs exhibiting an inferior axis.

Demographic Characteristics

Patient evaluation was conducted through a comprehensive review of medical history, physical examination findings, laboratory tests, and echocardiographic data recorded in patient records. Age, sex, diabetes, hypertension, smoking, and left ventricular ejection fraction were also assessed based on echocardiographic findings.

Anatomical Site Classification

The PVC origin sites within the left ventricle were anatomically classified as left ventricular outflow tract PVCs exhibiting an inferior axis. The following specific anatomical locations were considered: the left coronary cusp, the right coronary cusp, the non-coronary cusp, the right–left coronary cusp, the right non-coronary cusp, the left non-coronary cusp, the aortomitral continuity, the subvalvular region, the summit, the parahisian region, and the great cardiac vein sites.

Electrophysiological Study and Radiofrequency Catheter Ablation

Prior to the procedure, all patients were instructed to discontinue their antiarrhythmic medications for a minimum of 5 half-lives. The following steps were carried out during the electrophysiological study and radiofrequency catheter ablation:

1. Standard multipolar catheters were positioned in the right ventricular apex and the coronary sinus under fluoroscopic guidance via the femoral vein, when necessary.
2. Twelve-lead surface ECGs were closely monitored and recorded using a multichannel oscilloscopic recorder.
3. The mapping/ablation catheter, equipped with a 4 mm distal tip electrode and an interelectrode spacing of 2-5-2 mm, was used for the procedure.
4. Pace mapping and substrate mapping techniques were employed to identify the specific origin of PVCs.
5. A deflectable, closely-spaced multipolar catheter with a large distal electrode (4 mm) was utilized for mapping and ablation purposes.

In cases where PVCs did not manifest spontaneously or could not be induced by pacing maneuvers, intravenous administration of isoproterenol (2–4 µg/min) was employed to provoke the PVCs. Mapping was carried out during episodes of clinically observed arrhythmias. Electroanatomical mapping was performed on all patients to accurately localize the PVC origin sites and guide the radiofrequency catheter ablation procedure. Radiofrequency energy was initially applied under power control mode, starting at 15 or 20 W in the coronary sinus, or 30 W in the right ventricular/left ventricular endocardium. The power was gradually increased to 50 W to achieve an impedance drop of more than 10 Ω. Once the temperature reached 45 °C, radiofrequency energy was delivered for up to 10 seconds. Mapping-guided ablation was performed on spontaneous or pacing-induced PVCs, utilizing a point-by-point activation sequence and pace mapping to target the specific morphology. This method ensured precise and effective ablation of PVCs originating from the left ventricular outflow tract with an inferior axis. The pacing was generally conducted at 120 to 140 beats per minute, considering the coupling intervals of PVCs. For accurate localization, the QRS morphology of PVCs had to match in at least 11 out of the 12 ECG leads during the pacing. The target site for ablation was identified as the location exhibiting the earliest local ventricular activation, specifically 25 milliseconds pre-QRS, during PVC episodes. Radiofrequency energy was applied to the target sites for 60 to 180 seconds. Pace mapping was employed to determine the optimal site for ablation, and the effective target site was defined as the location where PVCs disappeared within 10 seconds of energy delivery. After the completion of the ablation procedure for 60 to 180 seconds at effective sites and additional points around the target sites, a 30-minute waiting period was observed to monitor the patient’s condition and ensure the successful elimination of PVCs. The ablation procedure was terminated once PVCs were no longer observed, and initial PVC induction methods such as pacing and intravenous isoproterenol administration became ineffective. In cases where PVCs reappeared within 10 seconds of radiofrequency energy delivery, repeat mapping of the target site was deemed necessary. Programmed electrical stimulation was conducted 30 minutes after the final application of radiofrequency energy to confirm the noninducibility of PVCs. Once confirmed, all catheters and sheaths were removed, concluding the ablation procedure. In the event of PVC reappearance during the ablation procedure, additional radiofrequency energy was applied for 60 to 180 seconds.

The site exhibiting the best pace map score was identified as the origin of PVCs. Following successful ablation, all patients underwent continuous ECG monitoring for 48 hours to ensure the sustained elimination of PVCs and monitor for potential complications or recurrence.

Definition of Successful Ablation

The standard criteria for determining short-term and long-term success of catheter ablation are as follows:

1. **Short-term success:** Short-term success is characterized by the elimination of PVCs or the presence of sporadic PVCs (≤ 1 beat per minute) and a near-absence of PVCs for 30 minutes after the procedure.
2. **Long-term success:** Long-term success is defined as the complete elimination of PVCs or a more than 75% reduction in PVC burden during 24-hour Holter monitoring within 3 months of follow-up. Additionally, PVCs should not recur, and patients must exhibit significant improvement in their symptoms. [10]

Definition of Left Ventricular PVCs With an Inferior Axis

The determination of left ventricular PVC origin with an inferior axis was based on the following criteria:

Endocardial recording during the ablation procedure, characteristic local ventricular activation and motion, and evaluation of the PVC morphology pattern on ECG before ablation.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation (SD). On the other hand, categorical variables were described as frequencies (percentages). The statistical analysis was performed using Microsoft Excel, version 24.0

RESULTS

The mapping and ablation results of PVCs originating from the left ventricle are presented in Figure 1.

All the PVC types discussed in this study originated from the left ventricle with an inferior axis. A common characteristic among these PVCs was the presence of dominant monophasic R waves in the inferior leads II/AVF, observed in 100% of cases. Additionally, 371 patients (98.4%) exhibited dominant monophasic R waves in lead III (Table 1). The remaining 6 cases displayed a QR pattern or an R/S>1 pattern, and all these 6 cases were found to originate from the right coronary cusp (Fig. 2). In this study, 376 patients displayed a QS pattern in lead AVR, characteristic of PVCs originating from the left ventricle with an inferior axis. Interestingly, 1 case exhibited an isoelectric pattern in lead AVR, which was found to originate from the right coronary cusp (Table 1). In lead I, the most common pattern observed among 137 cases was R/S<1 (Table 1), although several other patterns such as monophasic R, QS, isoelectric patterns, Rsr', R/S>1, and R/S=1 were also noted. Specific patterns were more frequently associated with certain PVC origin sites within the left ventricle. For instance, PVCs originating from the right coronary cusp had the highest incidence of monophasic R pattern in lead I (8.62%), while those from the non-coronary cusp exhibited the most common monophasic R pattern (100%). Furthermore, PVCs from the right-left coronary cusp had a 33.67% incidence of monophasic R pattern, and those from the right non-coronary cusp–left non-coronary cusp demonstrated the most frequent monophasic R pattern (100%) (Fig. 3). In lead AVL, the most frequent pattern observed was QS in 317 cases. Nonetheless, other patterns such as monophasic R, QR, isoelectric, Rsr', R/S>1, and R/S<1 were also noted. Notably, the single case of PVCs originating from the left non-coronary cusp exhibited a monophasic R pattern. In addition, among non-coronary cusp-originated PVCs, the R/S<1 pattern was most commonly observed in 3 cases (75%). In precordial leads V1–V2, the dominant pattern observed in both leads was R/S<1 (Table 1 & Fig. 4).

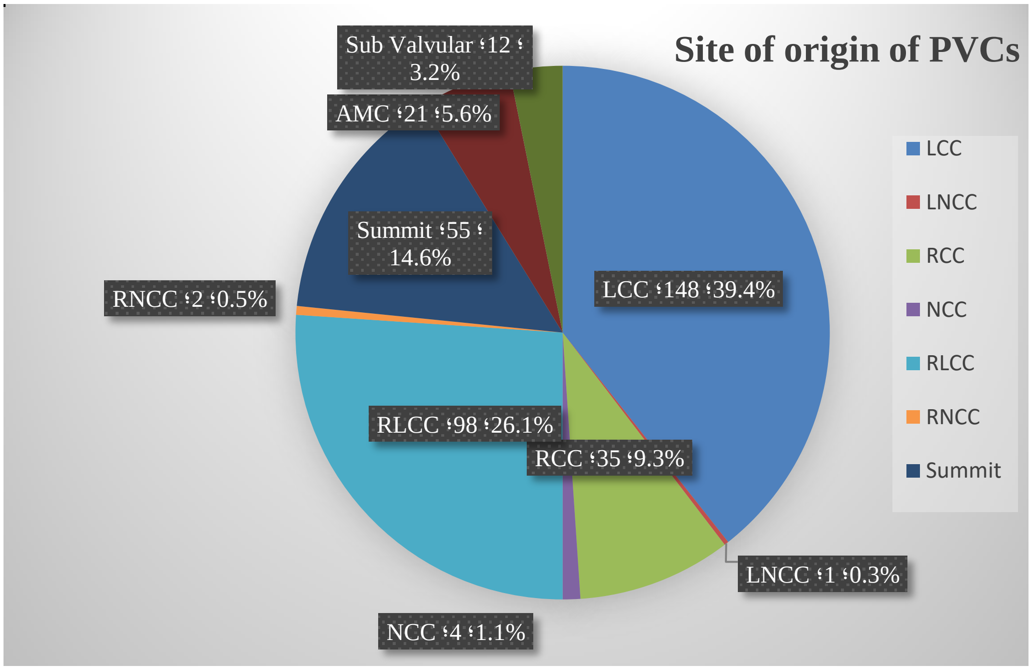

Figure 1: The image showcases the PVC origin sites.

PVC: premature ventricular contractions, LCC: left coronary cusp, LNCC: left non-coronary cusp, RCC: right coronary cups, NCC: non-coronary cusp, RLCC: right–left non-coronary cusp, RNCC: right non-coronary cusp

Table 1: Prevalence of ECG Findings in the Study Population

Prevalence	Patterns	Variables
100%	Monophasic R	The most common PVC pattern in lead II
98/4%	Monophasic R	The most common PVC pattern in lead III
100%	Monophasic R	The most common PVC pattern in lead AVF
36/3%	R/S<1	The most common PVC pattern in lead I
84/1%	QS	The most common PVC pattern in lead AVL
99/7%	QS	The most common PVC pattern in lead AVR
47/7%	R/S<1	The most common PVC pattern in lead V1
62/1%	R/S<1	The most common PVC pattern in lead V2
47/2%	V3	The most common transition pattern

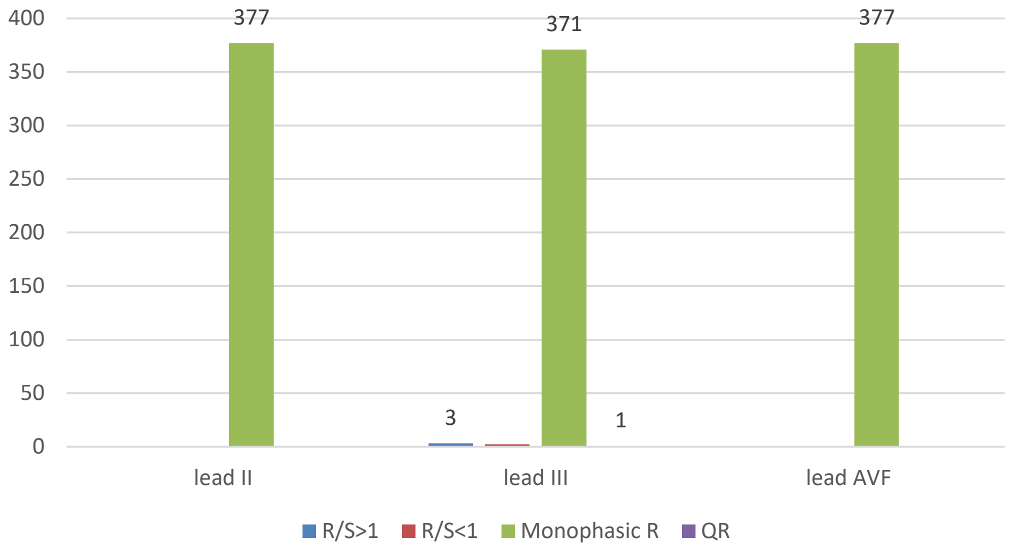

Figure 2: The image depicts the ECG characteristics of the lower leads.

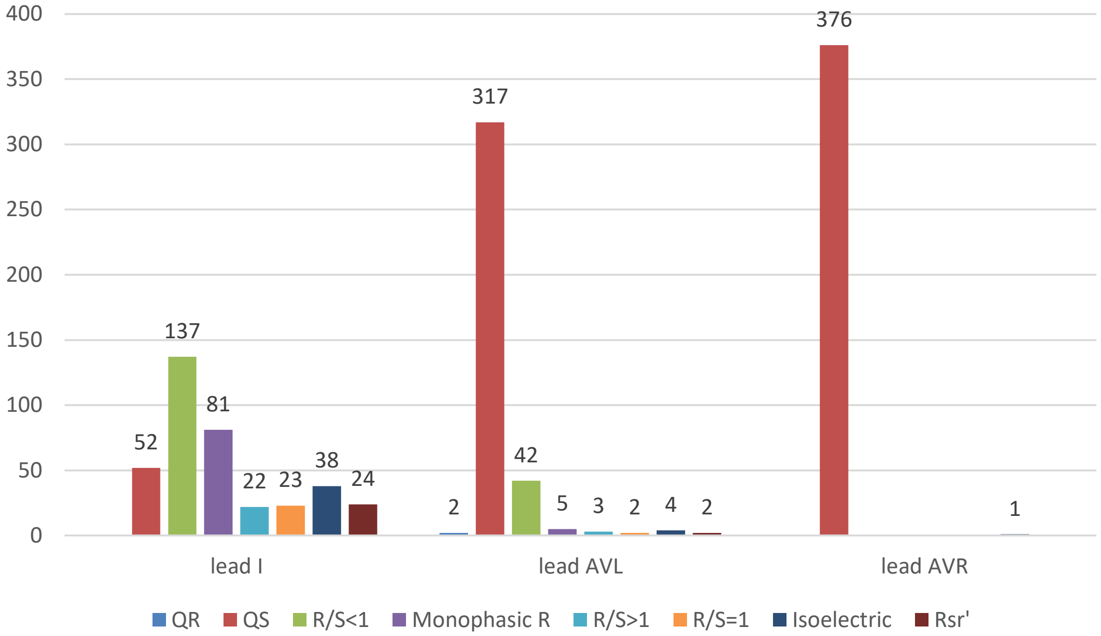

Figure 3: The image shows the ECG characteristics of the lateral leads.

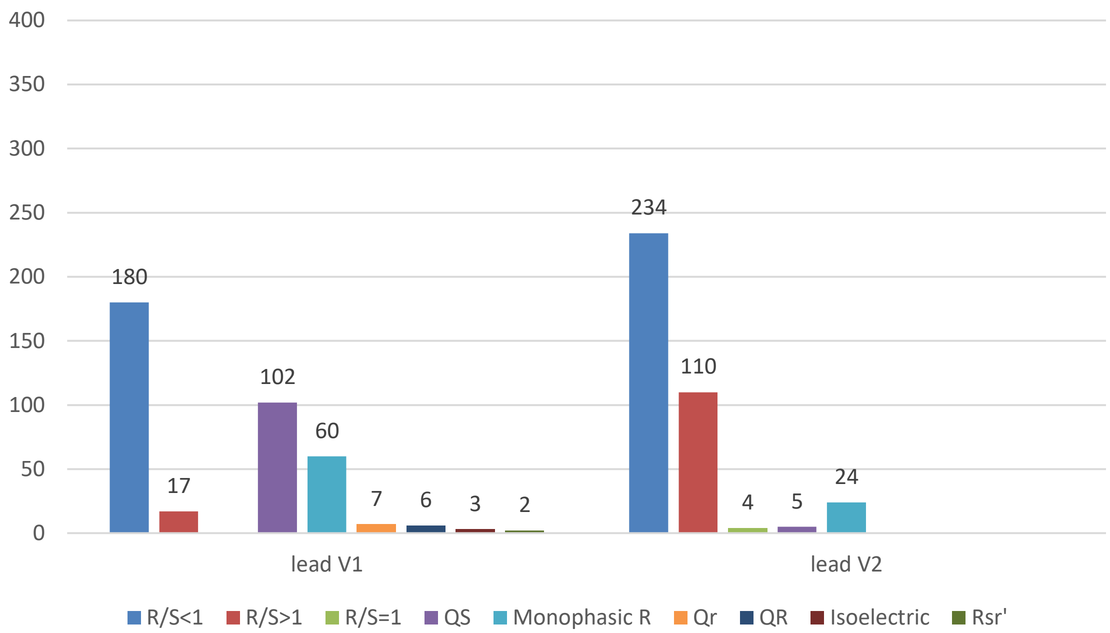

Figure 4: The image demonstrates the ECG characteristics of the precordial leads.

In lead V1, certain PVC origin sites within the left ventricle exhibited a dominant QS pattern, including those originating from the right coronary cusp (80%), the right non-coronary cusp (100%), and the left non-coronary cusp (100%). On the other hand, PVCs arising from the aortomitral continuity displayed a dominant monophasic R pattern in 52.3% of cases.

In lead V2, PVCs originating from the left coronary cusp demonstrated a distinctive monophasic R pattern in 100% of cases. Moreover, PVCs arising from the aortomitral continuity exhibited an R/S>1 pattern in 61.9% of cases.

Our transition assessment defined 4 patterns: early transition (transition in V2), delayed transition (transition after V3), the gray zone (V3), and positive concordance. Additionally, there was a breakthrough pattern encompassing cases that did not follow a specific transition pattern, often demonstrating a unique sequence of dominant S and R waves. Among the four identified transition patterns, the most common pattern observed was the gray zone transition, characterized by a transition occurring in lead V3, which was seen in 178 cases (Table 1). The next most frequent pattern was early transition, followed by breakthrough cases with 58 and delayed transition cases with 44. The least common type was positive concordance, seen in 24 cases. Notably, PVCs with early transition were most frequently associated with those originating from the left coronary cusp (Fig. 5). In the case of PVCs exhibiting a late transition pattern, the most common origin site was the right-left coronary cusp. Remarkably, it was observed that PVCs originating from the right non-coronary cusp had a late transition pattern in all cases (100%) (Fig. 6). The gray zone transition pattern, characterized by a transition occurring in lead V3, was found to be the most common type of transition observed. This pattern showed a higher frequency in PVCs originating from the left coronary cusp and the right-left coronary cusp (Fig. 7).

Breakthrough transition patterns were observed more frequently in summit PVCs than in other types. Additionally, PVCs originating from the aortomitral continuity demonstrated a breakthrough pattern in 61.9% of cases (Fig. 8).

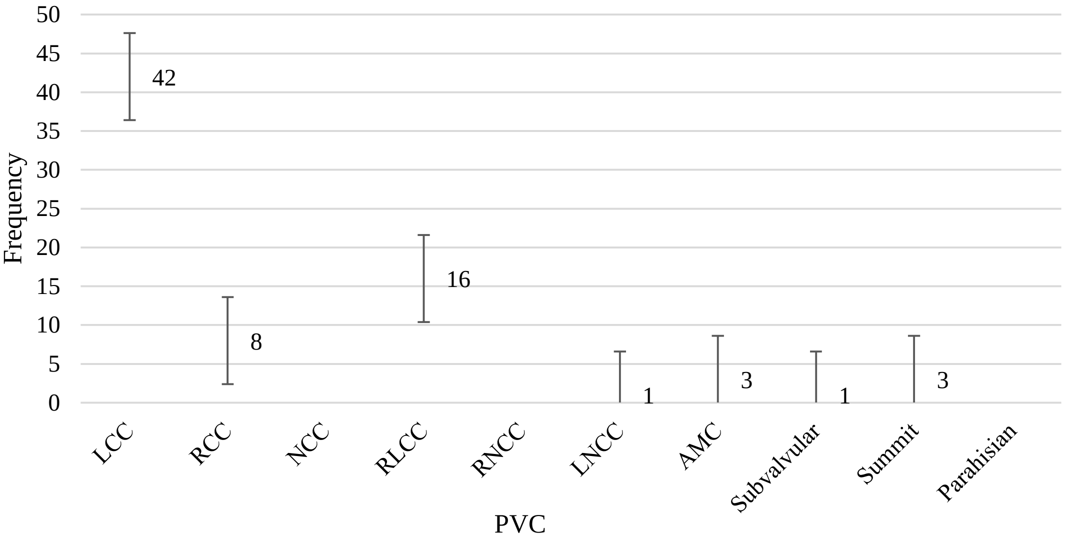

Figure 5: The image illustrates the dispersion number of PVCs with early transition.
PVC: premature ventricular contractions, LCC: left coronary cusp, LNCC: left non-coronary cusp, RCC: right coronary cups, NCC: non-coronary cusp, RLCC: right–left non-coronary cusp, RNCC: right non-coronary cusp

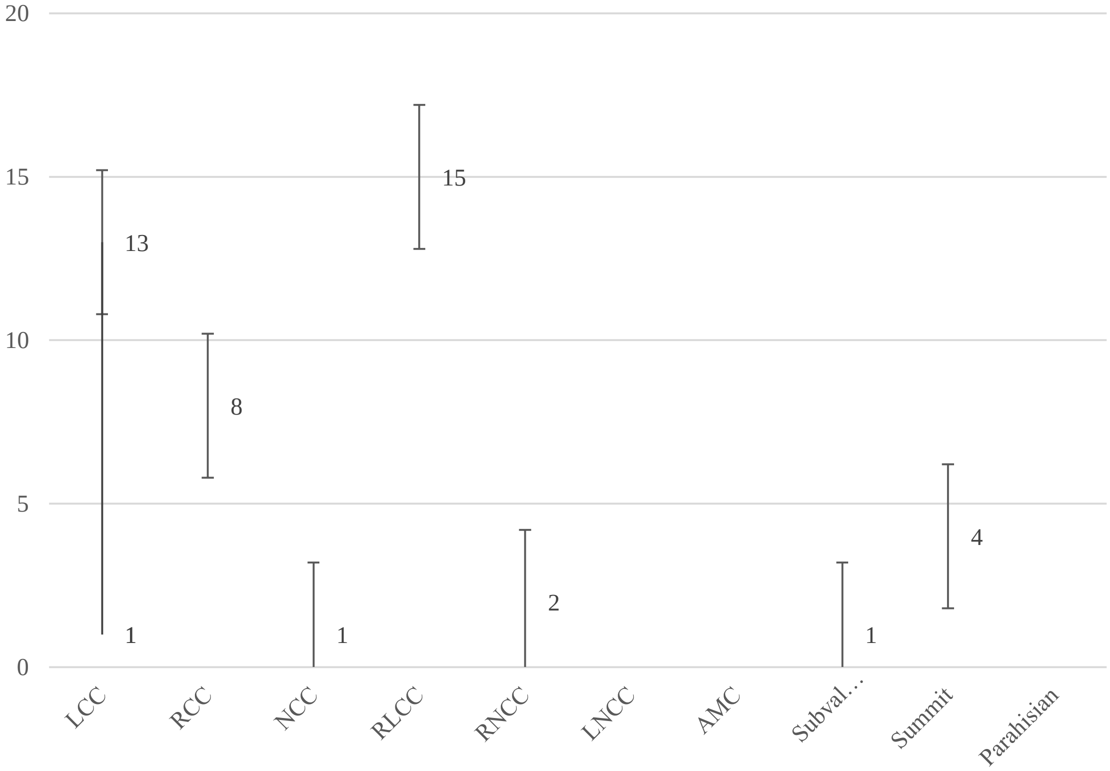

Figure 6: The image depicts the dispersion number of PVCs with late transition.
PVC: premature ventricular contractions, LCC: left coronary cusp, LNCC: left non-coronary cusp, RCC: right coronary cups, NCC: non-coronary cusp, RLCC: right–left non-coronary cusp, RNCC: right non-coronary cusp

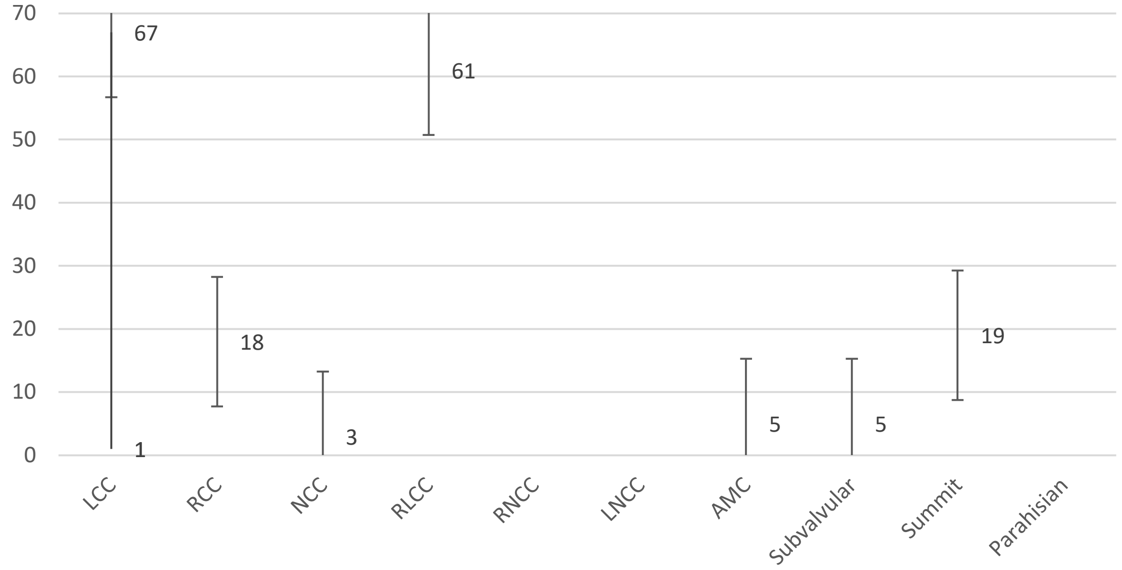

Figure 7: The image presents the dispersion number of PVCs with the gray zone (V3) transition.
PVC: premature ventricular contractions, LCC: left coronary cusp, LNCC: left non-coronary cusp, RCC: right coronary cups, NCC: non-coronary cusp, RLCC: right–left non-coronary cusp, RNCC: right non-coronary cusp

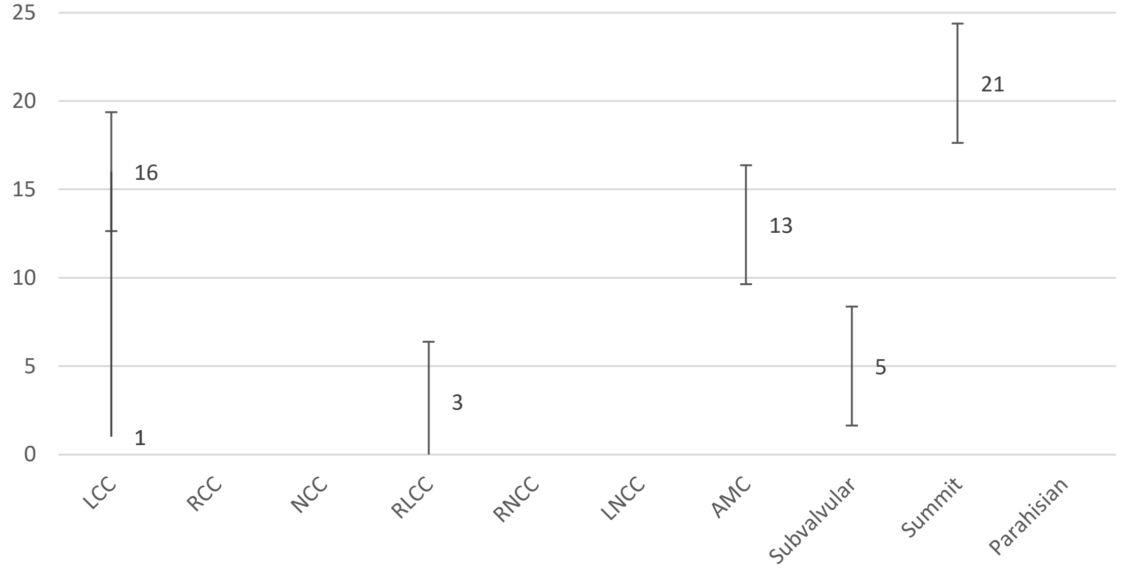

Figure 8: The image illustrates the dispersion number of PVCs with a breakthrough transition pattern.

PVC: premature ventricular contractions, LCC: left coronary cusp, LNCC: left non-coronary cusp, RCC: right coronary cups, NCC: non-coronary cusp, RLCC: right–left non-coronary cusp, RNCC: right non-coronary cusp

Among the 24 cases exhibiting positive concordance in lead V1, the distribution of PVC origin sites was as follows: 12 cases (50%) originated from the left coronary cusp, 8 (33.33%) from the left ventricular summit, 2 (8.3%) from the right-left coronary cusp, and 1 (4%) from the right coronary cusp and the great cardiac vein.

The age of patients in this study ranged from 15 to 81 years old, with a mean age of 49.68 (SD = 15) years old. The most common age group was middle-aged (30–59 years old), accounting for 58% of the patients, followed by the elderly group (≥ 60 years old) at 30% of the studied subjects (Table 2).

The study population's ejection fraction (ranged from 10 to 60, with a mean value of 44.60 (SD = 12.35). The most common ejection fraction range was normal (≥ 55%) in 38.19% of the study population, followed by a mildly reduced ejection fraction (45%–50%) observed in 31.56% of the patients.

In evaluating the prevalence of cardiac risk factors among patients with PVCs originating from the left ventricle and exhibiting an inferior axis, a history of smoking was present in 44 patients (11.7%), diabetes in 44 (11.7%), and hypertension in 119 (31.6%) (Table 2).

Table 2: Demographic Characteristics of the Study Population

Variables	Amount
Number of patients	377
Age, y	49.68 (SD=15)
Left ventricular ejection fraction, %	44.60 (SD=12.35)
Sex	Male:214 (56.8%) Female:163 (43.2%)
Diabetes mellitus	44 (11.7%)
Hypertension	199 (31.6%)
Smoking	44 (11.7%)
Symptom	375 (99.5%)

DISCUSSION

The most common site of origin for PVCs in the left ventricle is the aortic root (70%), followed by the left ventricular summit (12%) and the left ventricular ostium (5%-10%). Less common sites of origin, such as papillary muscles, fascicles, and cardiac crux, are observed less frequently. [11]

In the present study, the most common site of origin for PVCs, similar to other studies, was the left coronary cusp. The right-left coronary cusp was the second most common site of origin, followed by the summit, the third most prevalent location. The localization of PVCs based on their origin exhibits distinct ECG characteristics. For instance, PVCs originating from the left ventricular outflow tract are typically associated with an LBBB pattern, an inferior axis pattern, and a taller and wider R wave in leads V1 and V2, along with an earlier transition.

The following ECG features are helpful in the PVC localization algorithm for the left ventricle: The right coronary cusp, due to its proximity to the right ventricular outflow tract, exhibits similar features except for an early transition (as opposed to the late transition observed in right ventricular outflow tract PVCs) and a higher R-wave amplitude in lead I.

In the present study, PVCs originating from the right coronary cusp were also characterized by a higher prevalence of a monophasic R wave in lead I than other PVCs originating from the left ventricle. PVCs originating from the left coronary cusp typically exhibit W or M morphology in lead V1. Additionally, compared with those arising from the right coronary cusp, these PVCs demonstrate a higher R-wave amplitude in the inferior leads. In the present study, all PVCs originating from the left coronary cusp exhibited monophasic R waves in the inferior leads, contrasting with right coronary cusp PVCs, where 17% of cases displayed a lower R-wave amplitude in lead III. This finding may be attributed to the aortic valve's tendency to incline toward the right on the horizontal plane, resulting in the left coronary cusp being situated more laterally and superiorly than the right coronary cusp. PVCs originating from the right-left coronary cusp, another common site for these ectopic beats, frequently exhibit a QS pattern in lead V1, often accompanied by a notching on the Q wave. Transition typically occurs in lead V3. In the current study, the most prevalent pattern observed in lead V1 for right-left coronary cusp PVCs was R/S<1 (60.2%), while the QS pattern was observed in 30.6% of the cases. Moreover, 62.2% of these cases exhibited a transition in lead V3.

PVCs originating from the non-coronary cusp are uncommon, and their ECG pattern shares similarities with that of right coronary cusp PVCs, with a narrower QRS complex and a smaller QRS III/II ratio. Still, no distinct differences in morphology have been established. In the current study, only 4 cases of non-coronary cusp origin were observed, aligning with the known rarity of PVCs from this location. No significant morphological differences were noted in these cases. PVCs originating from the aortomitral continuity exhibit an LBBB pattern and a qR pattern in lead V1. In some cases, they may also present with a right bundle branch block pattern without an S wave. Due to the location of the aortomitral continuity, a prolonged intrinsicoid deflection time can be expected in this type of PVC. In the current study, the most prevalent pattern observed in lead V1 for PVCs originating from the aortomitral continuity was a monophasic R wave (52.3%). The remaining cases predominantly exhibited a qR pattern (42.8%), while a small percentage (4.76%) displayed an isoelectric pattern.

Overall, PVCs originating from the left ventricle, including those with an inferior axis, encompass PVCs that demonstrate positive patterns in the inferior leads. PVCs with an inferior axis originating from the left ventricle are typically located above the left ventricular septum. Nevertheless, it is important to note that the QRS axis may not always accurately reflect the PVC exit site, as discrepancies have been reported in cases of apical myocardial infarction. Numerous studies have categorized PVCs exhibiting an inferior axis and an LBBB pattern as a subset of PVCs, under the assumption that these PVCs originate from the outflow tract and are idiopathic in nature. Nonetheless, it is now well-established that these assumptions do not apply to all PVCs presenting with this pattern. As a result, more precise algorithms are recommended for identifying PVC origin based on surface ECG characteristics. [12, 13]

In ECG assessments of PVCs originating from the left side of the heart with an inferior axis, the predominant wave pattern observed in the inferior leads (II, III, and AVF) was a monophasic R wave. However, in 17% of cases originating from the right coronary cusp in this study, an R/S>1 or QR pattern was noted while maintaining the inferior axis. In the evaluation of the AVR lead, the most common wave pattern observed in left-sided cardiac PVCs with an inferior axis is the QS wave. This pattern was present in 99.7% of cases in the current study. In the assessment of PVC patterns in lead V1, an LBBB-like manifestation is often observed. The most common pattern typically appears as R/S<1 or QS. Additionally, an early transition pattern is generally associated with PVCs originating from the left side of the heart with an inferior axis.

The age distribution of PVCs is expected to skew toward older individuals, as the prevalence of these ectopic beats tends to increase with age. This can be attributed to the higher incidence of structural abnormalities and the presence of other abnormalities, such as underlying diseases, which become more common with advancing age. In the current study, the wide age range, particularly within the middle-aged group (30–59 years old), contributed to a higher PVC prevalence in this demographic. Nonetheless, beyond this age range, the prevalence of PVCs was higher among the elderly population. The relationship between sex prevalence and PVCs remains uncertain, as various studies have reported conflicting results. [14]

In the current study, the prevalence of PVCs was higher in males than in females. Among the study population, 214 cases (58.56%) were male, while 163 cases (41.43%) were female.

The ejection fraction in patients with arrhythmias can diminish over time due to the chronicity of the arrhythmia, potentially leading to the development of cardiomyopathy. This association is particularly evident in cases with a high PVC burden, where chronic and severe arrhythmia can result in PVC-induced cardiomyopathy. Importantly, this form of cardiomyopathy is reversible upon successful termination of the arrhythmia. Several risk factors have been identified for the development of PVC-induced cardiomyopathy, including high-frequency PVCs, longer-duration PVCs, complex epicardial or wide QRS PVCs, and interpolated PVCs. Additionally, male sex has been associated with an increased risk. [15, 16]

On the other hand, PVCs can also occur as a consequence of heart failure with reduced ejection fraction. In the present study, the mean ejection fraction was 60.44 (SD = 12.35). The majority of patients (38.19%) had a normal ejection fraction (> 55%), while a mildly reduced ejection fraction (45%–50%) was the next most common finding (31.56% of the study population). These results align with other studies.

The relationship between diabetes and PVCs is intricate and influenced by multiple factors. Potential contributing factors include hypomagnesemia, autonomic disorders, atrial and ventricular remodeling, and other diabetes-related complications, with a higher prevalence observed in individuals with type 2 diabetes. [17] In this study, only 11.7% of patients had diabetes.

The link between hypertension and various cardiac arrhythmias, including PVCs, is well-established. In the present study, 31.6% of patients had a confirmed diagnosis of hypertension, a notably high prevalence.

Long-term smoking has been associated with multiple adverse cardiovascular outcomes, including heart failure, increased PVC counts, hypertension, vascular stiffness, and coronary disease. [18] In this study, 11.7% of patients were smokers.

CONCLUSIONS

The results of this study, consistent with other research, demonstrate a higher prevalence of left-sided PVCs with successful ablation outcomes in male patients and an increasing prevalence with age. Additionally, a clear association with hypertension was observed. In the ECG assessment of PVCs originating from the right coronary cusp, a non-R monomorphic pattern in lead III may be indicative of this specific origin site. Furthermore, an R monomorphic pattern in lead I was found to be more prevalent in PVCs originating from the right coronary cusp, the non-coronary cusp, and the right non-coronary cusp. This characteristic can aid in identifying these specific origin sites during ECG analysis. Moreover, in the assessment of lead V1, PVCs arising from the aortomitral continuity exhibited a higher prevalence of an R monomorphic pattern than other types of PVCs.

Contrary to previous studies that have reported an early transition in left-sided PVCs, this study found that the most common transition location was lead V3, which is considered the “gray zone.” This finding differs from other studies where lead V3 was not explicitly examined as a distinct transition point. Interestingly, the breakthrough transition pattern was more prevalent in PVCs originating from the aortomitral continuity.

According to our ablation results, left-sided inferior-axis PVCs originating from the left coronary cusp demonstrated higher success rates. This finding is significant and should be taken into account when planning ablation strategies for patients with PVCs arising from this region.

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