Journal of Society Medicine
Research & Review Articles on Diseases
Journal of Society Medicine. 2024; 3 (9)

Predictors of Success of Ablation Procedures in Patients with Non-Structural Premature Ventricular Contraction at Adam Malik Hospital

M. Rizky Priyanka Asepty[1], Anggia Chairuddin Lubis[2*], Zulfikli Mukhtar[3]

[1] *Resident of Cardiology Department, Universitas Sumatera Utara, Medan, Indonesia*
[2] *Teaching Staff, Cardiology Department, Universitas Sumatera Utara, Medan, Indonesia*

***Corresponding Author**: M. Rizky Priyanka Asepty, E-mail: rizkyais2727@gmail.com

ARTICLE INFO

Article history:
Received
8 June 2024

Revised
3 August 2024

Accepted
30 September 2024

Manuscript ID:
JSOCMED-08062024-39-4

Checked for Plagiarism:
Yes

Language Editor:
Rebecca

Editor-Chief:
Prof. Aznan Lelo, PhD

ABSTRACT

Introduction: According to previous research, catheter ablation reduces premature ventricular contractions and improves heart function more than pharmaceutical treatment. Gender, age, LVEF, and premature ventricular contraction origin are utilized to predict ablation success. This study aims to determine the predictors of success of the ablation procedure in patients with non-structural premature ventricular contractions.
Method: This study is an observational analytical study with a retrospective cohort design to assess predictors of success of the ablation procedure in patients with non-structural premature ventricular contractions at H Adam Malik General Hospital, Medan.
Results: There were 55 research subjects and the majority of patients were female, 37 people (67.3%) with an average age of 47.2 ± 12.39 years. There was a significant relationship between premature ventricular contractions originating from the RVOT and the success of the ablation procedure ($p < 0.001$), but there were no significant differences in ablation therapy based on gender, age and LVEF ($p > 0.05$).
Conclusion: The origin of premature ventricular contraction from the RVOT is a predictor of the success of the ablation procedure in patients with non-structural premature ventricular contact.

Keywords

Non-Structural Premature Ventricular Contractions, Ablation, Predictors of Success

How to cite: Asepty MRP, Lubis AC, Mukhtar Z. Predictors of Success of Ablation Procedures in Patients with Non-Structural Premature Ventricular Contraction at Adam Malik Hospital. *Journal of Society Medicine*. 2024; 3 (9): 273-279. **DOI: https://doi.org/10.47353/jsocmed.v3i9.176**

INTRODUCTION

Premature ventricular contractions are relatively prevalent and can be observed in 75% of healthy individuals utilizing a 48-hour Holter examination. Premature ventricular contractions exhibit a prevalence of 14% when evaluated on a standard 12-lead ECG examination, which increases to 40-75% when 24- or 48-hour Holter monitoring is conducted. Premature ventricular contractions are frequently associated with structural heart disease and indicate an elevated risk of cardiovascular disease and sudden death.[1-3]

Premature ventricular contractions can result from triggered activity, automaticity, or reentry and can be unifocal or originate from multiple sites exhibiting diverse morphologies. Premature ventricular contractions without structural heart disease or inherited channelopathies are classified as idiopathic, and constitute one of the most prevalent arrhythmias encountered in clinical practice. Idiopathic premature ventricular contractions are generally considered benign. The majority of patients with premature ventricular contractions without structural heart disease do not progress to cardiomyopathy, even in the absence of treatment. The most common location of premature ventricular contractions in patients without structural heart disease is the right ventricular outflow tract (RVOT).[4-7]

However, the 2015 European Society of Cardiology (ESC) guidelines recommend radiofrequency ablation for patients exhibiting symptomatic premature ventricular contractions. Predicting the target origin of premature ventricular contractions prior to the ablation procedure is essential to estimate procedural complexities and potential adverse effects. Current advancements in electrocardiographic knowledge, particularly regarding premature ventricular contractions, can be applied to predict the origin of premature ventricular contractions, thus facilitating pre-procedure planning and enhancing the outcomes of ablation therapy. Radiofrequency ablation has historically been guided by two-dimensional mapping and, in recent years, by three-dimensional mapping, demonstrating favorable safety and efficacy profiles.[8-10]

Based on previous studies, it was concluded that age, origin of premature ventricular contraction, and pre-QRS signal were predictors of successful ablation of premature ventricular contraction.[3] For long-term failure, a statistically significant predictor was decreased ejection fraction (EF) (OR = 2.67, p = 0.048) [1], and a significant predictor of long-term success was the location of premature ventricular contraction in the right ventricular outflow tract ($p < 0.01$).[11,12] Patients with RVOT of premature ventricular contraction origin demonstrated the highest success rate and low complication rate. However, epicardial premature ventricular contraction origin exhibited a lower success rate with a trend towards a higher procedural complication rate, and an increased potential for cardiomyopathy due to premature ventricular contraction.[13] In multivariable analysis, only diastolic potential [OR 15.5 (95% CI: 3.92-61.2; p<0.0001)] and local activation time value [OR 1.11 (95% CI: 1.049-1.172 p<0.0001)] were significantly associated with successful catheter ablation therapy.[7]

The ablation procedure, which eliminated all premature ventricular contraction morphologies, was associated with a significantly lower premature ventricular contraction burden and improved LVEF at long-term follow-up compared with ablation of the predominant morphology alone. In patients with low premature ventricular contraction burden, following the initial procedure, LVEF improved from 37.5% to 41.6% (mean difference [MD]: 3.39 ± 2.9%, $P < 0.001$), whereas in patients with high premature ventricular contraction burden, there was a decrease in LVEF from 39.8% to 34.5% (MD: 6.45 ± 4.7%, $P < 0.001$). A premature ventricular contraction load >24% was identified as a cardiomyopathy risk threshold.[4] High premature ventricular contraction load, defined as >20,000 premature ventricular contractions/day compared to patients with <20,000 premature ventricular contractions/day, was associated with 3.5 times greater odds of LV function improvement within six months after RF catheter ablation (OR: 3.53; 95% CI: 1.15-10.75; P = 0.023).[6]

METHOD

This study employed an observational analytic approach with a retrospective cohort design to evaluate predictors of successful ablation therapy in patients with nonstructural premature ventricular contractions at Adam Malik Hospital Medan. Data collection was conducted between July and August 2023. The target population comprised patients diagnosed with nonstructural premature ventricular contractions who sought treatment at Hajj Adam Malik Hospital Medan. The study sample consisted of individuals from the target population who met the inclusion and exclusion criteria.

The inclusion criteria for this study encompassed patients diagnosed with non-structural premature ventricular contraction who were treated at H Adam Malik Hospital Medan, had undergone ablation therapy as management for their non-structural premature ventricular contraction, possessed clinical data and supporting examinations, and provided informed consent to participate in the research. This study excluded patients diagnosed with non-structural premature ventricular contraction who were not examined according to research protocols, patients with a history of pacemaker implantation, patients with a history of NSTEMI/STEMI, patients with a history of structural heart disease/structural heart disease/SHD, and patients with congenital heart defects.

Prior to the commencement of the study, the researchers sought ethical approval from the Standing Committee for Research Ethics Assessment of the Faculty of Medicine, University of North Sumatra. The

study population comprised patients diagnosed with nonstructural premature ventricular contraction admitted to the Hajj Adam Malik Hospital Medan who fulfilled the inclusion and exclusion criteria. The diagnosis of nonstructural premature ventricular contractions was established in accordance with the AHA guidelines. Sample selection was conducted using the quota method (consecutive), wherein each subject meeting the inclusion criteria was included until the minimum sample size of 55 patients was attained.

The research subjects consisted of all patients diagnosed with non-structural premature ventricular contraction who underwent catheter ablation therapy at the cardiac center of the Hajj Adam Malik Hospital Medan. Informed consent was obtained from all eligible patients. Comprehensive documentation was maintained for baseline data, subjects' demographic information, physical examination findings, ECG, and electrophysiological studies. Successful catheter ablation therapy was defined as the elimination of targeted PVC for a minimum duration of 30 minutes following the final ablation procedure.

For bivariate analysis of categorical variables, the chi-square test was employed when the data exhibited normal distribution, while the Fisher exact test was utilized for non-normally distributed data. Bivariate analysis of numeric variables utilized the Independent T-test for normally distributed data. Variables that demonstrated statistical significance in the bivariate analysis were subsequently included in the multivariate analysis to identify the most influential factor. Statistical data analysis was conducted using computer-based statistical software, with a significance level set at $p < 0.05$.

RESULTS

Table 1. Characteristics of research subjects

Characteristics	n (%)
Gender	
Man	18 (32.7)
Woman	37 (67.3)
Age (Mean ± SD)(years)	47.2 ± 12.39 *
Origin of PVC	
RVOT	39 (70.9)
LV intracavity structure	6 (10.9)
RV intracavity structure	3 (5.5)
AMC	2 (3.6)
Mitral Annulus	3 (5.5)
Tricuspid Annulus	2 (3.6)
LVEF (Median (Min-Max)) (%)	59 (30 -71) **
Arrhythmic use	
Beta blockers	16 (29.1)
Calcium Channel Blockers	1 (1.8)
Amiodarone	6 (10.9)
None	32 (58.2)
Comorbid	
Hypertension	12 (21.8)
DM	2 (3.6)
None	41 (74.5)
PVC Morphology	
Inferior Axis	55 (100)
Leftward	39 (72.7)
Rightward	15 (27.3)
LBBB morphology	55 (100)
Ablation Therapy	
Success	47 (85.5)
Fail	8 (14.5)
Total	55 (100)

* Kolgomorov test Smirnov > 0.05, ** Kolgomorov test Smirnov < 0.05

In this study, a sample of 55 individuals was obtained, with a predominance of female participants (n = 37, 67.3%) and a mean age of 47.2 ± 12.39 years. Most patients presented with premature ventricular contractions (PVCs) originating from the right ventricular outflow tract (RVOT), accounting for 39 cases (70.9%), and exhibited a median left ventricular ejection fraction (LVEF) of 59 (30-71 Percentage). A significant proportion of patients (n = 32, 58.2%) had no history of antiarrhythmic use, while 41 individuals (74.5%) did not present with comorbidities. The predominant PVC morphology was left-sided, observed in 40 patients (72.7%). Furthermore, a high success rate was achieved in ablation therapy, with 47 patients (85.5%) undergoing successful procedures.

Table 2 demonstrates that no statistically significant difference in ablation therapy was observed based on sex, age, LVEF, history of antiarrhythmic use, comorbidities, or PVC morphology (p>0.05). Regarding the association between ablation therapy and PVC origin, a statistically significant relationship was identified between PVC originating from the RVOT and successful ablation therapy (p <0.05; p <0.001). The variables that met the criteria for multivariate analysis were RVOT, LV intracavity structure, and RV intracavity structure (P < 0.25). Consequently, a multivariate analysis of PVC origin will be conducted.

Table 2. Comparison of ablation therapy based on gender, age, PVC origin and LVEF.

Characteristics	Ablation Therapy		*P value*
	Success	Fail	
Gender (n (%))			
- Man	15 (34.1)	3 (27.3)	1,000 [a]
- Woman	32 (68.1)	5 (62.5)	
Age (Mean ± SD) (years)	46, 6 5 ± 12, 27	5 0.38 ± 13.46	0.438 [b]
PVC Origin (n (%))			
- *RVOT*	38 (80.9)	1 (12.5)	< 0 .001 [a]
- *LV Intracavity Structures*	4 (8.5)	2 (25)	0.206 [a]
- *RV Intracavity Structures*	1 (2,1)	2 (25)	0.052 [a]
- *AMC*	1 (2, 1)	1 (12.5)	0, 272 [a]
- *Mitral Annulus*	2 (4.3)	1 (12.5)	0 ,382 [a]
- *Tricuspid Annulus*	1 (2, 1)	1 (12.5)	0.272 [a]
LVEF (Median (Min-Max)) (%)	59 (30-71)	60 (45-68)	0.971 [c]
-arrhythmic use			
- Yes	19 (82.6)	4 (17.4)	0.588
- No	28 (87.5)	4 (12.5)	
Comorbid			
- There is	12 (85.7)	2 (14.3)	0.975
- There isn't any	35 (85.4)	6 (14.6)	
PVC Morphology			
- Axis inferior	47 (85.4)	8 (14.6)	-
- Leftward	33	7	0.293
- Rightward	14	1	0.423
- LBBB morphology	47	8	-
Total	47 (100)	8 (100)	

[a] Fisher Exact Test Test , [b] Independent Test T- test , [c] Mann -Whitney Test

Table 3 demonstrates that the right ventricular outflow tract (RVOT) serves as a predictor of successful ablation procedures in patients with nonstructural premature ventricular contractions. Predictors of successful ablation procedures in patients with non-structural premature ventricular contractions

Table 3. Predictors of success of ablation procedures in patients with non-structural premature ventricular contractions.

Characteristics	95% CI		OR	*p value*
RVOT	3,324	472,296	39,622	0.004 [*]
LV Intracavity Structure	0.179	15,695	1,676	0.651 [*]
RV Intracavity Structure	0.089	3,443	0.089	0.195 [*]

[*] Logistic regression test

DISCUSSION

Most patients exhibited premature ventricular contractions (PVCs) originating from the right ventricular outflow tract (RVOT), comprising a total of 39 patients (70.9%). This finding is consistent with Samir and Aboulmaaty's 2021 study, which reported that most PVCs originated from the RVOT in 48 patients. Similarly, Wang et al. (2018) observed that most patients had PVCs originating from the RVOT (56.9%). This study also aligns with Parreira et al.'s (2018) finding that the most common location of PVCs in patients without structural heart disease is the right ventricular outflow tract (RVOT). [7] In 2022, Gulletta et al. further elucidated the origin of the PVC index, which they distributed as follows: CC n = 101 (23.1); LVOT n = 70 (16.0); non-OT LV n = 83 (19.0); RVOT n = 127 (29.1); and non-OT RV n = 56 (12.8). [8] A substantial proportion of individuals experience PVCs. These arrhythmias typically originate in the right ventricular outflow tract (RVOT) and left ventricular outflow tract (LVOT), encompassing the aortic valve cusps, aortomitral continuity, and epicardial crest area. This observation is consistent with previous reports on RVOT.

A median left ventricular ejection fraction (LVEF) of 59% (30-71%) was observed in the respondents. This finding is comparable to the research conducted by Sung et al. in 2021, which reported an LVEF of 55.1% ± 12.525. In 2018, Wang et al. determined that the mean LVEF of respondents was 66.0% ± 4.3%. Latchamsetty et al. (2015) reported that the average LVEF value among respondents was 55%. Previous research in the same population as this study demonstrated favorable LVEF values, which exceeded 50%.

Bivariate analyses were conducted for the study population. The results indicated no significant difference in ablation therapy based on sex, age, multiple PVC origins, LVEF, history of antiarrhythmic drug use, comorbidities, and PVC morphology ($p>0.05$). This finding contrasts with those of Samir and Aboulmaaty, who demonstrated that age less than 58 years, as determined by multivariable regression analysis, was a predictor of successful PVC ablation. Tanaka in 2011 observed that younger age was a favorable predictor of ablation success. They attributed this to the age difference in patients with LVOT VT and RVOT VT in their study, as the mean age of patients with LVOT VT was significantly greater than that of patients with RVOT VT. Wang et al's study reported the highest success rate in patients with RVOT origin (97.1%), and the lowest success rate in patients with PVC EPI (80.3%). Latchamsetty (2015) determined that the acute success rate of excision of RVOT PVCs was significantly higher than that of PVCs from other sources. Patients with PVCs of RVOT origin exhibited the shortest fluoroscopy and ablation times, while patients with epicardial origin demonstrated the longest time, with ablation success most frequently associated with RVOT origin and failure rate most frequently associated with epicardial origin.[11,12]

The multivariate analysis results of this study demonstrated that right ventricular outflow tract (RVOT) was a significant predictor of successful ablation procedures in patients with nonstructural premature ventricular contractions ($p = 0.004$). This finding contrasts with Tanaka's 2011 multivariate analysis, which found no association between female sex and long-term success rates. According to the multivariate results of Sung et al. in 2021, sex (female) obtained an odds ratio (OR) of 2.578 (1.171–5.675) with a p value of <0.019. Previous research has indicated that male sex was the sole factor capable of predicting premature ventricular contraction (PVC)-induced cardiomyopathy. Other factors, such as the frequency, timing, and origin of ventricular ectopy, were associated with a lower ejection fraction. However, male sex remained the only factor that could predict whether cardiomyopathy would persist following a successful PVC ablation.[13-15]

CONCLUSION

The origin of premature ventricular contraction from the RVOT is a predictor of the success of the ablation procedure in patients with non-structural premature ventricular contact.

DECLARATIONS

This study was approved by Ethical Committee Universitas Sumatera Utara and Haji Adam Malik Hospital Medan.

CONSENT FOR PUBLICATION
The Authors agree to publication in Journal of Society Medicine.

FUNDING
This research has received no external funding.

COMPETING INTERESTS
The authors declare that there is no conflict of interest in this report.

AUTHORS' CONTRIBUTIONS
MRPA contributed to the preparation of the manuscript. ACL and ZM gave guidance in this study.

ACKNOWLEDGMENTS
None

REFERENCE
1. Suba S, Fleischmann KE, Schell-Chaple H, Prasad P, Marcus GM, Hu X, et al. Diagnostic and prognostic significance of premature ventricular complexes in community and hospital-based participants: A scoping review. PLoS ONE. 2021;16(12): e0261712.
2. Wang JS, Shen YG, Yin RP, Thapa S, Peng YP, Ji KT. et al. The safety of catheter ablation for premature ventricular contractions in patients without structural heart disease. BMC Cardiovascular Disorders. 2018; 18:177
3. Amir M, Mappangara I, Kabo P, Hasanuddin Z, Setiadji R, Zam SM. Park Algorithm as Predictor of Premature Ventricular Contraction Origin in Three-Dimensional Mapping Electrophysiological Studies. International Journal of General Medicine. 2020; 13: 1083–1092.
4. Mohanty S, Burkhardt JD, Biase LD, Mohanty P, Shetty SS, Giani C. et al. Best ablation strategy in patients with premature ventricular contractions with multiple morphology: a single-centre experience. Europace. 2023; 25: 1–8.
5. Muser D, Tritto M, Mariani MV, Di Monaco A, Compagnucci P, Accogli, M. et al. Diagnosis and Treatment of Idiopathic Premature Ventricular Contractions: A Stepwise Approach Based on the Site of Origin. Diagnostics. 2021; 11:1840.
6. Wojdyła-Hordyńska A, Kowalski O, Hordyński GJ. The effect of radiofrequency catheter ablation of frequent premature ventricular complexes and arrhythmia burden on left ventricular function. Kardiol Pol. 2017; 75(7): 698–704
7. Parreira L, Marinheiro R, Carmo P, Amador P, Mesquita D, Farinha J, et al. Isolated diastolic potentials as predictors of success in ablation of right ventricular outflow tract idiopathic premature ventricular contractions. PLoS ONE. 2019; 14(2): e0211232.
8. Gulletta S, Gasperetti A, Schiavone M, Paglino G, Vergara P, Compagnucci P. et al. Long-Term Follow-Up of Catheter Ablation for Premature Ventricular Complexes in the Modern Era: The Importance of Localization and Substrate. J. Clin. Med. 2022; 11: 6583.
9. Capulzini L, Vergara P, Mugnai G, Salghetti F, Abugattas JP, Bouchaibi SE. et al. Acute and one year outcome of premature ventricular contraction ablation guided by contact force and automated pacemapping software. Journal of Arrhythmia. 2019; 35:542–549
10. Nakamura T, Nagata Y, Nitta G, Okata S, Nagase M, Mitsui K. et al. Prediction of premature ventricular complex origins using artificial intelligence–enabled algorithms. Heart Rhythm Society. 2020: 76-83
11. Marcus GM. Evaluation and Management of Premature Ventricular Complexes. Circulation. 2020; 141:1404–1418.

12. Elalfy M, Zarif J, Nabil A, Samir R, AboulMaaty M. Predictors of Successful Radiofrequency Catheter Ablation Of Premature Ventricular Complexes. Journal of Cardiovascular Disease Research. 2021; 12(3): 1-21.
13. Latchamsetty R, Yokokawa M, Morady F, Kim HM, Mathew S, Tilz R. et al. Multicenter Outcomes for Catheter Ablation of Idiopathic Premature Ventricular Complexes. J Am Coll Cardiol EP. 2015; 1:116–23
14. Latchamsetty R; Bogun F. Premature Ventricular Complex–Induced Cardiomyopathy. JACC: Clinical Electrophysiology. 2019; 5(5): 537-550
15. Lavallaz JF, Mezier J, Mertz L, Mannhart D, Serban T, Knecht S, Abid Q. et al. Risk factors for the development of premature ventricular complex-induced cardiomyopathy: a systematic review and meta-analysis.Journal of Interventional Cardiac Electrophysiology. 2022: 1-19.