Original Article

New Predictor of Ventricular Arrhythmia After Alcohol Septal Ablation: Preoperative Inferolateral Wall Thickness

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Abstract

Introduction: **Predictors of arrhythmias and sudden cardiac death in patients with hypertrophic cardiomyopathy (HCM) have been identified. However, they have not been validated after alcohol septal ablation (ASA). Data to predict the occurrence of arrhythmia after the procedure are not certain.**

Objectives: **To retrospectively analyze patients who underwent ASA and to determine the predictors of post-op ventricular arrhythmia.**

Patients and Methods: **We retrospectively enrolled 53 consecutive patients with HCM who underwent ASA procedure due to symptomatic left ventricular outflow tract (LVOT) obstruction despite maximally tolerated medical treatment between January 2010 and December 2022. P < 0.05 was considered statistically significant.**

Results: **The mean age of the patients was 56.45 years, and 55% were male. Patients underwent successful ASA, and an average of 1.76 cc of alcohol was used. A 70.81% reduction in LVOT gradients was achieved. No pathological LVOT gradient was observed in any patient after the procedure. In the postprocedural follow-up, total atrioventricular block was detected in 12 patients and implantable cardiac defibrillator (ICD) implantation was performed in these patients. When patients with ventricular arrhythmias after successful ASA were compared with those without it, preoperative hypertrophic cardiomyopathy risk of sudden cardiac death (HCMSCD) Score > 6 and left ventricular inferolateral wall thickness were statistically different between the two groups (p: 0.049, p: 0.006, respectively). When multi-logistic regression was performed, basal left ventricular inferolateral wall thickness > 15.5 mm was found to be an independent risk factor for ventricular arrhythmia after ASA (p: 0.027).**

Conclusions: **Left ventricular inferolateral wall thickness is an independent predictor of ventricular arrhythmia after ASA. It can be used in postprocedural patient follow-up and ICD decision-making.**

Keywords: **Cardiac Arrhythmias; Hypertrophic Cardiomyopathy; Implantable Defibrillators.**

Introduction

Hypertrophic cardiomyopathy (HCM) is a common genetic heart disease reported in populations globally. Inherited in an autosomal dominant pattern,[1] the pathophysiology of HCM consists of dynamic left ventricular outflow tract obstruction (LVOTO), mitral regurgitation (MR), diastolic dysfunction, myocardial ischemia, arrhythmias, and autonomic dysfunction. For a given patient with HCM, the clinical outcome may be dominated by one of these components or may be the result of a complex interplay. A total of 30% to 40% will experience adverse events, including: 1) progressive limiting symptoms because of LVOTO or diastolic dysfunction, 2) sudden death events.[2]

Pharmacological treatment is the first step in the treatment of symptoms to reduce LVOTO. In patients whose symptoms persist despite pharmacological treatment, septal reduction therapy (SRT) is recommended.[3] SRT is alcohol septal ablation (ASA) or surgical myectomy.[4]

In terms of sudden death, the 2014 European Society of Cardiology (ESC) guidelines recommend the HCM Risk-SCD model, but it has not been validated after ASA.[5] Our study aimed to analyze patients who underwent ASA retrospectively and to determine the predictors of post-op ventricular arrhythmia.

Patients and methods

We included all ASA patients performed successfully in our hospital. We retrospectively enrolled 53 consecutive patients with HCM who underwent ASA procedure due to symptomatic left ventricular outflow tract (LVOT) obstruction despite maximally tolerated medical treatment between January 2010 and December 2022.

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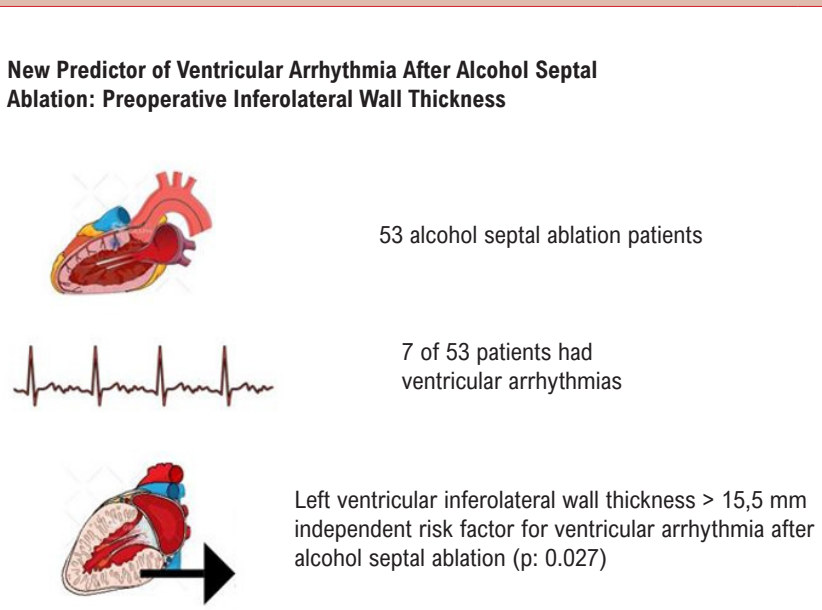
Central Illustration: New Predictor of Ventricular Arrhythmia After Alcohol Septal Ablation: Preoperative Inferolateral Wall Thickness



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Procedure

Indications and procedures for ASA.

Inclusion criteria:

1. Those who are still severely symptomatic (shortness of breath, angina or syncope, etc.) NYHA III-IV despite receiving pharmacological treatment for at least one month.

2. A LVOT gradient of > 50 mmHg was detected echocardiographically or during catheterization at rest or after exercise provocation.

3. Having septal artery anatomy that allows alcohol injection to the possible appropriate section of the LVOT in the coronary angiographic examination.

4. They were determined to be those who gave voluntary consent after being informed about the short and long-term results of the procedure.

After the cases with appropriate indications were taken to the catheterization laboratory, a 7F sheath was placed in the bilateral femoral artery and right femoral vein under local anesthesia. In all cases, the temporary pacemaker electrode was tested after being placed at the apex of the right ventricle and fixed to the femoral region with sutures, leaving it ready to be activated when necessary.

After systemically administered heparin at a dose of 60/U/kg, a "pigtail" or "multipurpose" catheter was placed in the appropriate part of the left ventricle. Then, the left coronary artery was cannulated with a 7F left Judkins guide catheter.

Using two different pressure measurement systems at the same time, the LVOT gradient was recorded at rest in order to monitor the changes after deep inspiration, Valsalva maneuver and extrasystole. The 1st, 2nd or 3rd septal perforator branches, respectively, determined as the possible target vessel in the left coronary artery images taken in at least two different poses, were catheterized using a 1.5 x 15-18 mm "over the wire" balloon. After the balloon was inflated with 6-8 atm pressure, the wire was removed. First, 1-2 cc of contrast material was slowly injected from the distal lumen of the balloon catheter to check whether the appropriate septal artery was in position or whether the contrast was leaking back. After the balloon position was deemed stable and appropriate, the isotonic sodium chloride and contrast medium mixture was agitated using two 10 cc injectors and a triple tap to be administered through the lumen of the balloon catheter. Approximately 2-4 cc of this mixture was slowly administered from the distal end of the catheter, and it was examined whether the basal part of the interventricular septum and especially the area in contact with the mitral valve, during its systolic forward movement, were stained in the transthoracic echocardiography performed during the procedure.

In addition to this location determination process, it was checked in each case whether the contrast administered spread to areas other than the target area. While the patients are carefully monitored in terms of hemodynamics and rhythm, while the possible displacement of the balloon in the septal artery is monitored by fluoroscopy, 0.95% pure ethyl alcohol is administered at 1 mL/min in a total of 2 doses, depending on the width of the septal artery and septum and the surgeon's choice. It was administered 4 ml. After the alcohol injection was completed, the balloon in the septal artery was kept inflated for approximately 10 minutes. Meanwhile, the flow in the left coronary artery was controlled with contrast injection. After the

procedure, the balloon was deflated, and control left coronary artery injections confirmed that the flow of the septal artery had significantly decreased or disappeared in all cases. After each injection, the LVOT gradient was recorded again at rest and postextrasystolic provocatively. When more than a 50% decrease in the catheter gradient was observed after the procedure, the procedure was considered successful and terminated. After the procedure, no additional treatment was given to the patients. Rhythm and hemodynamic monitoring continued in the intensive care unit for at least 24 hours after treatment.

Statistical analysis

Data were evaluated in the SPSS 22.0 (IBM Corporation, Armonk, NY, USA) program. The normal distribution of variables was evaluated with the Kolmogorov–Smirnov test and the homogeneity of variance was evaluated with the Levene test. All continuous variables presented normal distribution. Data determined by measurement were given as mean and standard deviation for those with normal distribution. The unpaired *t*-test was used in the statistical analysis of these data. Categorical data were shown as absolute and relative frequencies, and in the statistical analysis, the χ^2 test or Fisher's exact test was used, as appropriate. Variables were analyzed at a 95% confidence interval, and $P < 0.05$ was considered as significant. Receiver operating characteristic (ROC) analysis was used for the area under the curve (AUC) calculations. The multinomial logistic regression method was used to determine independent predictors.

Results

The mean age of the patients was 56.45 years, and 55% were male. 38% of the patients had hypertension, and 15% had diabetes mellitus. 38% of the patients had a family history of sudden death. The baseline demographic data of patients are given in Table 1.

Patients underwent successful ASA, and an average of 1.76 cc of alcohol was used. A 70.81% reduction in LVOT gradients was achieved. No pathological LVOT gradient was observed in any patient after the procedure. In the postprocedural follow-up, total atrioventricular block was detected in 12 patients and implantable cardiac defibrillator (ICD) implantation was performed in these patients. ICD therapy programs of these patients were performed in accordance with standard primary prophylaxis. The mean follow-up after the procedure was 75.60 months. A total of seven out of these 12 patients had ventricular arrhythmias.

When patients with ventricular arrhythmias after successful ASA were compared with those without the procedure, preoperative HCMSCD Score > 6 and preoperative left ventricular inferolateral wall thickness were statistically different between the two groups (p: 0.049, p: 0.006, respectively) (Table 2).

ROC analysis was performed to determine the predictive value of preoperative left ventricular inferolateral wall thickness, which was found to be 15.5 mm (AUC: 0.764; sensitivity: 0.857; specificity: 0.696) (Figure 1).

When multilogistic regression was performed, basal left ventricular inferolateral wall thickness > 15.5 mm was found to be an independent risk factor for ventricular arrhythmia after ASA (p: 0.027) (Table 3).

Discussion

Hypertrophic obstructive cardiomyopathy (HOCM) resistant to medical treatment can be treated surgically and

Table 1 – Baseline demographic data of patients

	(n: 53)
Age (years, mean ± SD)	56.45 ± 12.07
Sex: Male, n (%)	30 (54.7%)
Hypertension, n (%)	20 (37.7%)
Diabetes Mellitus, n (%)	8 (15.1%)
Follow-up (months, mean ± SD)	75.60 ± 3.44
Beta Bloker, n (%)	47 (88.7%)
CCB, n (%)	8 (15.1%)
LVEF, % ± SD	63.77 ± 4.52
IVS, mm ± SD	21.89 ± 3.29
ILW, mm ± SD	14.59 ± 3.79
LA, mm ± SD	45.53 ± 5.48
Creatinine, mg/dL	0.84 ± 0.33
HCMSCD Score	7.02 ± 6.68
LVOT Gradient, mm-Hg	95.62 ± 48.15

LVOT: left ventricular outflow tract; SD: standart deviation; CCB: calcium chanal bloker; LVEF: left ventricular ejection fraction; IVS: interventricular septum; ILW: inferolateral wall; LA: left atrium; HCMSCD: hypertrophic cardiomypathy risk of sudden cardiac death.

Table 2 – Comparison of patients with and without ventricular arrhythmias

	(n: 46)	(n: 7)	P-value
Age (years, mean ± SD)	50.00 ± 14.35	57.43 ± 11.56	0.130
Sex: Male, n (%)	20 (44%)	4 (57%)	0.391
Hypertension, n (%)	19 (41%)	1 (14%)	0.171
Diabetes Mellitus, n (%)	6 (3%)	2 (28%)	0.283
HCMSCD risk score > 6	14 (30%)	5 (71%)	0.049
LVEF, % ± SD	63.65 ± 4.53	64.71 ± 4.72	0.568
IVS, mm ± SD	21.82 ± 3.05	22.29 ± 4.89	0.734
ILW, mm ± SD	14.04 ± 3.37	18.15 ± 4.67	0.06
LA, mm ± SD	45.54 ± 5.76	45.43 ± 3.36	0.959
Creatinine, mg/dL	0.84 ± 0.35	0.81 ± 0.13	0.851
LVOT Gradient, mm-Hg	95.00 ± 45.92	99.71 ± 65.24	0.812

LVEF: left ventricular ejection fraction; IVS: interventricular septum; ILW: inferolateral wall; LA: left atrium; HCMSCD: hypertrophic cardiomypathy risk of sudden cardiac death.

Table 3 – Multinominal logistic regression for ventricular arrhythmia after ASA

	B	*S.E.*	*Wald*	*OR (95% CI)*	*P*
HCMSCD risk score > 6	-1.635	0.961	2.894	0.165 (0.030 - 1.283)	0.089
Pre-operative inferolateral wall thickness > 15.5 mm	-2.541	1.153	4.861	0.079 (0.008 - 0.754)	0.027

HCMSCD: hypertrophic cardiomypathy risk of sudden cardiac death; OR: odds ratio; CI: confidence interval.

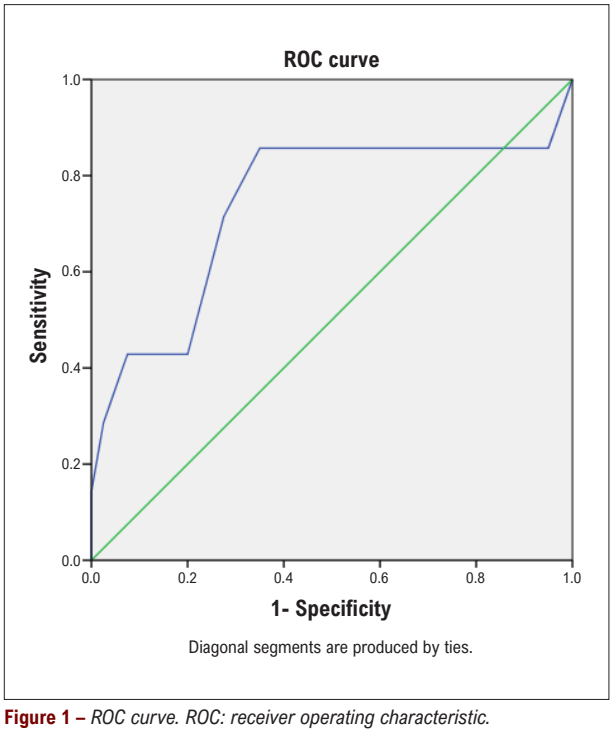

Figure 1 – *ROC curve. ROC: receiver operating characteristic.*

percutaneously. The mortality of percutaneous intervention is as low as surgical intervention.[6] Predictors of arrhythmia and sudden cardiac death after percutaneous ASA have not been clearly determined. There have been some studies on the postprocedural use of the HCMSCD risk score.[7] It is also a matter of debate whether the septal scar created in the procedure will be a predictor of arrhythmia.[8]

The fact that ventricular arrhythmias were not observed in patients without postprocedural total atrioventricular block makes the postprocedural block a natural predictor of ventricular arrhythmias. The pacemaker, which has no therapeutic properties, has been used in the treatment of HOCM for many years due to the dyssynchrony it creates.[5] According to the results of our study, if the HOCM patient needs a pacemaker, ICD implantation would be appropriate.

In our study, left ventricular posterior wall thickness was found to be better than the HCMSCD risk score in terms of predicting postprocedural arrhythmia. This suggests that postprocedural arrhythmia may not be scar-related but may be due to hyperkineticism similar to Mitral valve prolapsus.

Limitations

It was a retrospective and single-center study.

Conclusion

Left ventricular inferolateral wall thickness is an independent predictor of ventricular arrhythmia after ASA (Central Illustration). It can be used in postprocedural patient follow-up and ICD decision-making. In addition, large studies in which the cause of ventricular arrhythmia is revealed by electrophysiological study or magnetic resonance imaging in patients who experience arrhythmia after the procedure are needed.

Author Contributions

Conception and design of the research: Başkurt AA, Çolak A, Özpelit E; acquisition of data: Kumral Z, Yılancıoğlu RY; analysis and interpretation of the data: Başkurt AA, Kumral Z, Yılancıoğlu RY, Özpelit E; statistical analysis and writing of the manuscript: Başkurt AA; procedural practices: Dursun H; performing an echocardiogram: Özpelit E; operation: Badak O, Göldeli O.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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There were no external funding sources for this study.

Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Dokuz Eylul Universitesi Tip Fakultesi under the protocol number 2023/40-11. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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