

Comparison of septal myectomy and transcatheter septal alcohol ablation in patients with hypertrophic obstructive cardiomyopathy

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ABSTRACT

Objectives: This study aims to compare the efficacy of septal myectomy (SM) and septal alcohol ablation (SAA) for the relief of the left ventricular outflow tract (LVOT) gradient in patients with symptomatic hypertrophic obstructive cardiomyopathy (HOCM).

Patients and methods: Between January 2005 and January 2010, a total of 45 patients (32 males, 13 females; mean age 51.5 years; range, 17 to 87 years) with symptomatic drug-refractory obstructive HOCM were consecutively enrolled. The patients were divided into two groups as SM (n=17) and SAA (n=28). All patients underwent clinical and echocardiographic examinations before, during the procedure, and at the end of one-year follow-up.

Results: There was no significant difference in clinical and demographic characteristics of the patients who underwent SM and SAA. The mean LVOT gradients early after the procedures significantly decreased ($p<0.001$). At the end of one year, the mean maximal gradients in LVOT after exercise were similar (54 ± 39 mmHg for SM and 73 ± 53 mmHg for SAA; $p=0.220$).

Conclusion: Although SM is considered the preferred treatment in patients with HOCM, SAA may be an alternative approach to SM in the LVOT gradient reduction in experienced centers for high-risk surgical patients.

Keywords: Hypertrophic cardiomyopathy, myectomy, obstruction, septal alcohol ablation.

Hypertrophic obstructive cardiomyopathy (HOCM) is a heterogeneous cardiac disease with a wide spectrum of clinical presentations such as sudden cardiac death, presenting in all age groups from infancy to the very elderly.^[1,2] Although septal myectomy (SM) has been regarded as the gold standard therapy, septal alcohol ablation (SAA) emerged as an attractive alternative for the treatment of HOCM. In patients with HOCM, the first-line medical therapy consists of beta-blockers, calcium channel blockers, and disopyramide which can adequately control symptoms. In case of refractoriness to optimal medical therapy, mechanical relief of the outflow tract obstruction choice is considered.

The Morrow operation is the classic myectomy technique which relieves obstruction by resection of a 2 to 5 g amount of muscle from the proximal ventricular septum.^[3] The main goal of the procedure is to widen the outflow tract and, therefore, to abolish the Venturi effect and gradient reduction caused by systolic contact between mitral valve and hypertrophied septum.^[3] By surgical relief of obstruction, the quality of life

is improved, and long-term survival is equivalent to general population.^[4,5] Likewise, for the same purpose, SAA can be performed with a percutaneous catheter; dehydrated ethanol, usually at a total dosage of 1 to 3 mL is, then, injected slowly through the proximal septal branches of the left anterior descending coronary artery, causing a targeted myocardial infarction.^[6]

In the literature, no conclusive data on the effect of either SAA or SM on long-term survival are available. Previous studies have shown no difference in all-cause mortality or sudden death risk for patients with SAA compared to those undergoing myectomy

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or the general population in the short-term.^[7] In this study, we aimed to compare the efficacy of these two treatment modalities, SM and SAA, on the relief of the left ventricular outflow tract (LVOT) gradient in patients with HOCM.

PATIENTS AND METHODS

Between January 2005 and January 2010, a total of 45 patients (32 males, 13 females; mean age 51.5 years; range, 17 to 87 years) with symptomatic drug-refractory obstructive HOCM were consecutively included in this study. The patients were divided into two groups as SM (n=17) and SAA (n=28). The clinical indication for SM and SAA was a LVOT gradient of >50 mmHg at rest or with provocation and New York Heart Association (NYHA) functional Class III or IV symptoms refractory to maximal medication as indicated in the current guidelines.^[8] The patients with ventricular septal defect after SM and atrioventricular block, which is a common complication of SAA, or patients died during the hospitalization period immediately after the procedure were excluded. For all patients, the clinical and transthoracic echocardiography examinations were performed before, during the procedure, and at the end of the one-year follow-up. A written informed consent was obtained from each patient. The study protocol was approved by the Kartal Koşuyolu Yüksek İhtisas Training and Research Hospital Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

SM procedure

Septal myectomy is resection of a rectangular portion of a myocardium via two parallel incisions in the basal septum extended distally to beyond the level of mitral-septal contact and subaortic obstruction performed through an aortotomy after cold blood cardioplegia. The residual mitral valve regurgitation is almost always caused by intrinsic mitral valve abnormalities such as ruptured chordae, myxomatous degeneration with prolapse, or annular dilatation and can be corrected by direct valve repair. The transesophageal echocardiography was performed in all patients to identify mitral regurgitation before and during the procedure.

SAA procedure

Septal alcohol ablation is an interventional technique in which 2 to 4 cm³ of 96% ethanol is

introduced into a septal perforator branch of the left anterior descending coronary artery to intentionally produce an infarction in the ventricular septum. The appropriate myocardial segment at basal septum was determined using contrast echocardiography. The ultimate resolution of obstruction requires several months of septal remodeling, leading to outflow tract widening and reduced systolic anterior motion of the mitral valve mimicking the pathophysiology of myectomy.^[6,9]

Echocardiographic examination

Echocardiographic parameters were obtained using standard two-dimensional and M-mode of the Vivid 7 GE echocardiography device (GE Healthcare, Little Chalfont, UK). Parasternal long and short axis, apical four-chamber, and apical two-chamber images were used for the evaluation of the left ventricular (LV) and valve functions. Pulsed Doppler ultrasound examination was performed with a 2.5 MHz transducer. Ejection fraction (EF), maximum gradient of LVOT, septal thickness, end-systolic and diastolic diameter of the LV, left atrial diameter, mitral regurgitation grade, and systolic anterior motion (SAM) were assessed separately.

Statistical analysis

Statistical analysis was performed using the IBM SPSS for Windows version 24.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean \pm standard deviation (SD), median (min-max) or number and frequency. To compare baseline characteristics, the Mann-Whitney and Wilcoxon non-parametric tests or t-test were used for continuous variables, while the Pearson chi-square test was used for categorical variables. A *p* value of <0.05 was considered statistically significant.

RESULTS

There was no statistically significant difference in the baseline demographic and clinical characteristics of the patients who underwent SM and SAA (*p*=0.973) (Table 1).

The mean diastolic diameters of the LV of the patients were similar for SM and SAA procedure (4.6 \pm 0.8 mm and 5.0 \pm 0.4 mm, respectively; *p*=0.498). Also, there was no significant difference between the mean systolic diameter of the LVs (2.9 \pm 0.5 mm for SM and 3.0 \pm 0.7 mm for SAA; *p*=0.062). The diameters of the LA of the patients were also similar

Table 1
Baseline demographic and clinical data of patients

	SM group (n=18)			SAA group (n=28)			<i>p</i>
	n	%	Mean±SD	n	%	Mean±SD	
Age (year)			51.4±18.1			51.5±13.4	0.973
Sex							0.123
Female	4	22		9	32		
Body mass index (kg/m ²)			27.3			26.9	0.865
New York Heart Association							
Class 3-4	3	16		3	10		0.701
Class 1-2	15	84		25	90		0.645
EuroSCORE II			1.2			1.4	0.893
History							
Coronary artery disease	3	16		5	17		0.843
COPD	1	5		2	17		0.625
Chronic kidney disease	1	5		4	14		0.325
Diabetes mellitus	3	16		5	17		0.863
Previous cardiac surgery	0	0		3	10		0.053
Family history	1	5		2	7		0.734
Echocardiography							
Ejection fraction (%)			61.8±6.4			59.3±6.5	0.221
LVOT max gradient (mmHg)			101±38.6			91.2±38.5	0.405
Septum thickness			2±0.4			1.9±0.2	0.652
LVEDD			4.6±0.8			5.0±0.4	0.498
LVESD			2.9±0.5			3.0±0.7	0.062
Left atrial diameter			4±0.3			3.7±0.5	0.104
Mitral regurgitation							
4-3	5	27		2	7		0.523
2-1	6	33		12	42		0.144
Systolic anterior motion	7	38		12	42		0.230

SM: Septal myectomy; SAA: Septal alcohol ablation; SD: Standard deviation; COPD: Chronic obstructive pulmonary disease; LVOT: Left ventricular outflow tract; LVEDD: Left ventricle end diastolic diameter; LVESD: Left ventricle end systolic diameter.

(*p*=0.104). There were no significant differences in the ejection fraction (EF) of the LV and the gradient of the outflow tract between the groups. The mean EF of the patients undergoing SM and SAA was 61±6.4% and 59±6.5%, respectively (*p*=0.221). The mean maximal LVOT gradient in the SM group was

101±38 mmHg and it was 91±38 mmHg in the SAA group (*p*=0.405).

The mean gradients early after the procedures significantly decreased and were also comparable between the groups of SM and SAA (40±28 mmHg and 43±34 mmHg, respectively; *p*=0.801). At the end

Table 2
Post-procedural data

	SM group (n=18)	SAA group (n=28)	<i>p</i>
	Mean±SD	Mean±SD	
Septum thickness (mm)	1.7±0.4	1.6±0.1	0.743
LVOT max gradient PP (mmHg)	40±28	43±34	0.801
LVOT max gradient (1 year) (mmHg)	54±39	73±53	0.220

SM: Septal myectomy; SAA: Septal alcohol ablation; SD: Standard deviation; LVOT: Left ventricular outflow tract; PP: Post-procedural.

of one year, the difference between the mean maximal gradients in LVOT were not statistically significant (54 ± 39 mmHg for SM and 73 ± 53 mmHg for SAA; $p=0.220$) (Table 2).

DISCUSSION

The clinical diagnosis of HOCM is conventionally made most commonly with two-dimensional echocardiography. In HOCM, the flow against the abnormally positioned mitral valve apparatus results in drag force on a portion of the mitral valve leaflets during ventricular systole which pushes the leaflets into the outflow tract. The outflow obstruction causes an increase in the LV systolic pressure, leading to prolongation of ventricular relaxation and, thus, elevation of LV diastolic pressure, mitral regurgitation, myocardial ischemia, and decrease in cardiac output eventually.^[10,11]

Although there are no randomized trials comparing SM and SAA in the literature, several meta-analyses have shown that both procedures improve functional status with a comparable procedural mortality rate.^[12] In the present study, we compared the systolic gradient of the LVOT in the patients who underwent SM versus SAA using two-dimensional transthoracic echocardiography. According to our study, although the differences at the mean gradient of LVOT between the SM and SAA increased from early after procedures to one year later, these differences were not statistically significant.

However, it is important to show that each technique does not give as much harm, as it is useful or induce new problems due to the procedure. Magnetic resonance imaging studies have demonstrated that SAA infarct may be both transmural and extensive.^[13] In SM, unlike SAA, distribution of septal perforator coronary arteries for which precise targeting of the septum that contribute to mechanical LV outflow obstruction can be visualized by the surgeon. However, it has been suggested that the alcohol-induced scar does not represent a true infarction due to its chemical origin, rather than ischemic, and controlled size.^[6]

While deciding the most optimal treatment choice of the HOCM, SM, rather than SAA, is recommended in patients with an indication for septal reduction therapy and other indications requiring surgical intervention (e.g., mitral valve repair/replacement,

papillary muscle intervention) as a Class I indication by the European Society of Cardiology (ESC) guidelines.^[8] Mitral regurgitation is usually present caused by the apposition of the anterior leaflet of the mitral valve through the bulging of the thickened septum of the LVOT during systole, namely systolic anterior motion. In this study, the presence of systolic anterior motion and mitral regurgitation were found to be associated with the higher gradient of LVOT in each procedure. Not surprisingly, in this group patients, the LA volume index was also higher.

The appropriate selection of patients for treatment procedure is an important predictor of outcome and should be individualized. The American College of Cardiology/American Heart Association (ACC/AHA) guidelines recommend the decision to proceed with SAA in advanced age, in the presence of a significant comorbidity which selectively increases the surgical risk, (e.g., significant concerns about lung or airway management), and in case of the patient's strong desire to avoid open heart surgery after a thorough discussion of both options.^[14] Due to the absence of a surgical incision and general anesthesia, SAA has the potential for greater patient satisfaction. Besides less overall discomfort, SAA recovery time is also shorter. Due to the variable septal artery anatomy in each case, which may not supply the targeted area of the septum in up to 20 to 25% of patients, SAA may have hemodynamic and symptomatic improvement compared to SM, if the area of the systolic anterior motion-septal contact can be accessed by the first septal perforator and ablated.^[15] After the procedure, a decrease in resting and provokable gradients usually occurs immediately; however, due to stunning, remodeling can result in continued gradient reduction over the first three months following the procedure. In our study, we showed the gradient reduction early after surgery and at the first year of the procedure. At the end of the first year, there was no statistically significant difference in the maximal gradient of the LVOT of the patients between the procedures.

It has been suggested that at least 50 successful procedures are required to overcome the SAA learning curve. If the patient who is either a good candidate for SM or SAA, a shared decision-making approach should be used to provide the patient all available data on the advantages and disadvantages of both strategies.

In patients with a septal thickness of <15 to 18 mm, SM poses a risk for ventricular septal defect.

Also, atrioventricular block is a common complication of SAA. In our study, we included the patients with successfully treated by SM or SAA without any complication. We also believe that systematic long-term follow-up studies are necessary to evaluate whether alcohol-induced myocardial infarction or SM poses an increased risk for ventricular arrhythmias of sudden death.

In conclusion, although the surgical SM is considered the preferred treatment in patients with HOCM, SAA may be an alternative approach to SM in the LVOT gradient reduction in experienced centers for high-risk surgical patients.

Declaration of conflicting interests

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