Contrast Echocardiography to Evaluate Myocardial Perfusion During Percutaneous Transluminal Septal Myocardial Ablation

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Background: Contrast echocardiography is frequently used to enhance endocardyal definition, Doppler signals, and to assess myocardial perfusion in percutaneous transluminal septal myocardial ablation.
Material and method: We followed clinically and echocardiographic 5 female patients with Septal Obstructive Hypertrophic Cardiomyopathy, which observed symptoms despite undergoing maximal medical therapy – angina, functional class NYHA III dyspnea, which underwent septal alcohol ablation. Clinical and echocardiographical examinations were performed at admission, before, during and after the procedure, at discharge, at 6 months and at 1 year. During the ablation contrast echocardiography was used.
Results: Maximum subaortic gradient was reduced by 30 mmHg in all cases, immediately after the procedure, with no increase in further examinations and reduced mitral regurgitation (grade I or minor after the procedure). Symptoms resolved in all patients with NYHA functional class I transition. Transient complications of the procedure in the first 24 hours after ablation were paroxysmal atrial fibrillation in 2 cases, atrioventricular block 2nd degree in 1 case and 3rd degree in 2 cases. Permanent complications were right bundle branch block 3 cases, left bundle branch block 1 case, 1st degree atrioventricular block 1 case.
Conclusions: All 5 patients opted for percutaneous transluminal septal myocardial ablation, although, according to guidelines, they had indication for septal myomectomy. Contrast echocardiography has proven to be a useful addition to percutaneous transluminal septal myocardial ablation.

Keywords: contrast echocardiography, septal alcohol ablation

Received: 3 May 2012

Introduction

Hypertrophic obstructive cardiomyopathy (HOCM) is a common, genetically induced disease of the heart, with a prevalence of ~1:500. Most cariotipic anomalies associated with it have an autosomal dominant transmission with variable penetrance and expressivity and are characterized by idiopathic concentric hypertrophy of the left ventricle (LV)[1,2].

Obstruction is caused by a combination of the reduced diameter of the left ventricular output tract (LVOT) determined by the thickening of the interventricular septum, hyperdynamic LV contraction, and hemodynamic drag and Venturi forces which contribute in creating systolic anterior motion (SAM) of the anterior leaflet of the mitral valve [3].

Clinical manifestations include heart failure symptoms such as dyspnea, angina, lightheadedness and syncope and poor response to drug therapy. Common therapy applied to these patients consists of surgical myectomy, a procedure in which a small amount of myocardium is removed from the basal interventricular septum[4]. The outcome is the substantial reduction of the subaortic outflow gradient in most patients (90%) followed by the improvement of symptoms in 84–90% of cases [4,5]. In recent years, a minimally invasive procedure of transcoronary ablation of septal hypertrophy performed by selective transcatheter coronary septal branch injection of ethanol has produced similar results, reducing outflow tract obstruction in 80–90% of cases and improving symptoms in 84–90% of the treated patients [4,6]. Consequently, transcoronary ablation of septal hypertrophy is an alternative to surgery with similar efficiency [4].

Using myocardial contrast echocardiography (MCE) in guiding the procedure has proven to be particularly useful and influential in the interventional strategy, by choosing the appropriate septal branch, by changing the target vessel, or even by prompting the procedure abortion [3].

Material and method

In this study, 5 female patients with HOCM that observed symptoms despite undergoing maximal medical therapy – angina and functional class NYHA III dyspnea – were treated with percutaneous transluminal septal myocardial ablation (PTSMA).

The evaluation of patients consisted in clinical and echocardiographical examinations, which were performed at admission, before, during and after the procedure and at discharge. Follow-up examinations were performed at 6 months and 1 year. In every PTSMA procedure, myocardial contrast echocardiography was used. Patients were treated and surveyed in an intensive coronary care unit for a period of at least 48 hours.

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Fig. 1. Using MCE, a suitable proximal septal branch of the left anterior descending artery (LAD) was identified, by injecting echocardiographic contrast through a baloon catheter and performing two-dimensional transthoracic echocardiography in order to visualise the area perfused by the selected artery prior to the alcohol injection.

Fig. 2. The LVOT-Aorta maximum pressure gradient at rest was reduced from 104.2±34.0 to 31.5±23.5 mmHg

Patient characteristics

HOCM was diagnosed using the common clinical signs and symptoms and two-dimensional echocardiographic criteria.[2] Obstruction was identified by an LVOT gradient of at least 30 mmHg under resting conditions and during provocation and pressure gradients above 50 mm Hg, either at rest or with provocation, representing the conventional thresholds for surgical or percutaneous intervention, if the patients' symptoms cannot be controlled with maximal medical therapy [2]. Detailed patients characteristics are presented in the Table 1. Informed consent was obtained from each patient in writing.

Echocardiographic examination

Transthoracic echocardiography was performed on a Philips Vivid S5 system. All measurements were made according to the recommendations of the American Society of Echocardiography [2,7]. The two-dimensional and M-mode echocardiographic images were obtained using standardized transducer positions in the parasternal long- and short-axis views and apical two- and four-chamber views. Similar probe positions were achieved in each of the follow-up examinations.

Table I. Clinical characteristics of the patients undergoing PTSMA

No. of patients	5
Mean age (years)	43
Male/Female	0/5
NYHA class (with optimal drug therapy)	
I	0
II	0
III	5
IV	0
Mitral regurgitation	
Mild	0
Moderate	3
Severe	2
SAM present	5
IV Septum thickness (mm)	20.0 ± 2.0
LVOT/Aorta Max Pressure gradient (mmHg)	104.2 ± 34.0
Flux Acceleration (Vmax) (m/s)	5.08 ± 0.90

PTSMA procedure

In each evaluation, the resting and post-extrasystolic gradients were measured before and after the procedure. Using MCE, a suitable proximal septal branch of the left anterior descending artery (LAD) was identified, by injecting echocardiographic contrast through a balloon catheter and performing two-dimensional transthoracic echocardiography in order to visualize the area perfused by the selected artery prior to the alcohol injection. After selecting the suitable septal artery, absolute alcohol was injected slowly through the target vessel. After administering the alcohol, the pressure gradient was reassessed to discover an initial partial response. The balloon deflation was followed by a final angiogram in order to ensure the patency of the LAD, usually showing the occluded septal artery at the site of the alcohol injection.

Results

PTSMA was highly effective in the improvement of hemodynamic and anatomic conditions.

The echocardiographic pressure gradient was reduced significantly by the PTSMA intervention. The LVOT-Aorta maximum pressure gradient at rest was reduced from104.2±34.0 to 31.5±23.5 mmHg (Figure 2).

Moreover, flux acceleration (Vmax) was decreased from 5.08±0.9 to 2.7±1.0 m/s (Figure 3).

There was a decrease of the interventricular septum thickness from 20.0±2.0 to 18.0±2.0 mm (Figure 4).

The procedural outcome was favorable in all cases with a significant result in the remission of the patients' symptoms, with the transition of angina from NYHA class III to class I and the disappearance of dyspnea. The complications recorded were transitory or permanent and are presented in Table II.

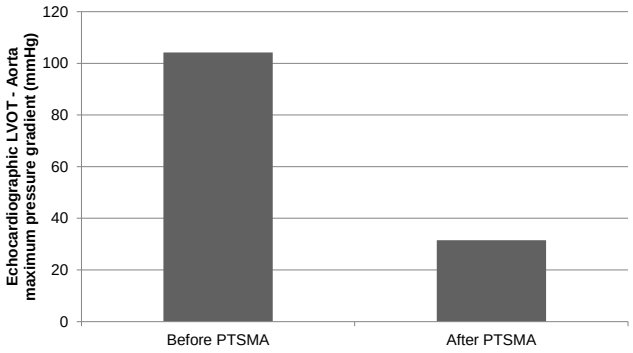

Fig. 3. Effects of PTSMA on maximum pressure gradient

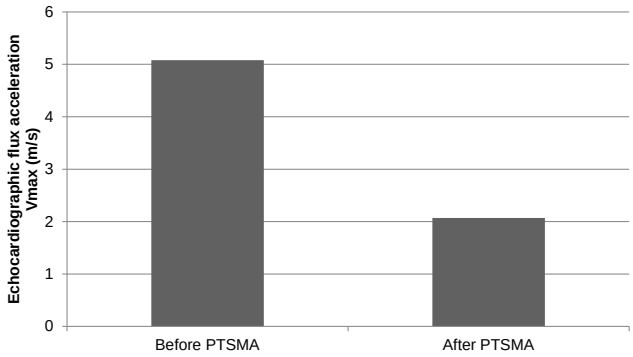

Fig. 4. Effects of PTSMA on flux acceleration

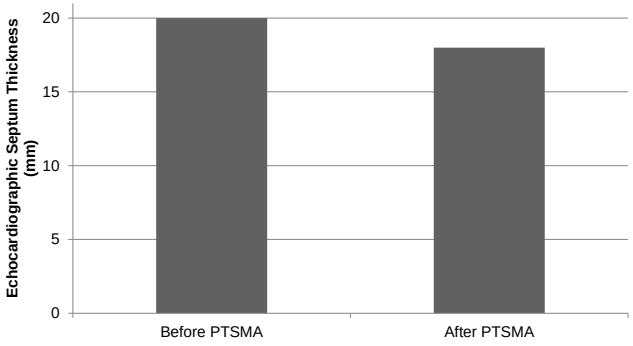

Fig. 5. Effects of PTSMA on septum thickness

Follow-up examinations after 6 months and 1 year did not reveal significant changes in clinical and echocardiographical parameters.

Discussions

The PTSMA procedure has proven to be an effective non-surgical technique for the improvement of symptoms and the reduction of LVOT gradient in HOCM. Enough evidence has been produced to show that procedure details such as the used ethanol amount and the number of coronary septal arteries ablated are directly linked to the height of the creatine kinase rise and the acute gradient reduction degree, as well as the incidence of mortality and third degree atrioventricular block [4] The evaluation of the anatomical conditions prior to the start of the intervention is paramount in avoiding atrioventricular conduction disturbances like right bundle branch block (RBBB) or high-grade atrioventricular block. The introduction of MCE by Faber et al. allows for the identification of the appropriate septal coronary artery to be used in the procedure [4,8] MCE has produced a higher success rates despite a lower infarct size, in turn reducing the rates of complications. Echographic or agitated X-ray contrast is administered transcoronary through the inflated balloon catheter during which transthoracic echocardiographic images are recorded. The most efficient results are obtained by ablation of the myocardium adjacent to the point where the anterior leaflet of the mitral valve is drawn in contact with the interventricular septum and where there is maximal flow acceleration. If the territory opacified by the contrast agent is not optimal, for example, if it is predominantly on the right side of the interventricular septum, another septal perforator artery is catheterized or ablation is not performed. Another advantage of the technique is the delineation of any retrograde leakage of contrast or the involvement of other remote myocardium structures, such as the papillary muscles or ventricular free wall [3] The amount of septum reduction has been shown to increase further with time after PTSMA, which has led to a less aggressive approach to the size of the ablated myocardium by reducing the amount of ethanol used in the procedure and the number of vessels ablated, which in turn has resulted in a decrease of complications such as heart block [4,9,10].

Table II. Post PTSMA transitory and permanent complications

Transitory	
Atrial fibrillation	2
AV block	
1st degree	0
2nd degree	1
3rd degree	2
Permanent	
RBBB	3
LBBB	1
AV block	
1st degree	1
2nd degree	0
3rd degree	0

The clinical success rates with PTSMA application are defined as a reduction of the echocardiographic LVOT gradients at rest and after provocation and of the septum thickness. Our results are in line with several studies, which demonstrate a clinical success rate varying from 90 to 100% [11].

Conclusions

All 5 patients opted for PTSMA, although, according to guidelines, they had indication for septal myomectomy. The clinical evolution of the patients subjected to this procedure was favorable in all cases both clinically, through the remission of symptoms, and echocardiographically, by the reduction of the LVOT-Aorta pressure gradient, the flux acceleration and the interventricular septum thickness.

Contrast echocardiography was shown to be a useful addition to PTSMA both in identifying the ideal target vessel and improving the procedure outcome.

Acknowledgement

This paper is partly supported by the Sectorial Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU /89/1.5/S/60782

References

1. Maron BJ, McKenna WJ, Danielson GK, Kappenberger LJ, Kuhn HJ, Seidman CE, Shah PM, Spencer WH, Spirito P, Ten Cate FJ, Wigle ED. ACC/ESC clinical expert consensus document on hypertrophic cardiomyopathy: a report of the American College of Cardiology Task Force on Clinical Expert Consensus Documents and the European Society of Cardiology Committee for Practice Guidelines. J Am Coll Cardiol. 2003;42:1687-1713.
2. Gersh BJ, Maron BJ, Bonow RO, Dearani JO, Fifer MA, Link MS, Naidu SS, Nishimura RA, Ommen SR, Rakowski H, Seidman Christine, Towbin JA, Udelson JE, Yancy CW. ACCF/AHA Guideline for the Diagnosis and Treatment of Hypertrophic Cardiomyopathy: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Circulation. 2011;124:e783-e831.
3. Fifer MA, Sigwart U. Hypertrophic obstructive cardiomyopathy: alcohol septal ablation. Eur Heart J. 2011;32:1059-1064.
4. Sohns C, Sossalla S, Schmitto JD, Jacobshagen C, Raab BW, Obenauer S, Maier LS. Visualization of transcoronary ablation of septal hypertrophy in patients with hypertrophic obstructive cardiomyopathy: a comparison between cardiac MRI, invasive measurements and echocardiography. Clinical Research in Cardiology. 2010;99(6):359-368.
5. Loogen F, Kuhn H, Gietzen F, Loesse B, Schulte HD, Bircks W. Clinical course and prognosis of patients with typical and atypical hypertrophic obstructive and with hypertrophic nonobstructive cardiomyopathy. Eur Heart J/ 1983;4:145-153.
6. Kuhn H, Gietzen F, Leuner ChJ, Gerenkamp T. Induction of subaortic septal ischemia to reduce obstruction in hypertrophic obstructive cardiomyopathy: studies to develop a new catheter-based concept of treatment. Eur Heart J. 1997;18:846-851.
7. Sahn DJ, Maria A, Kisslo J, Weymann A. Recommendations regarding quantitation in M-mode echocardiography: results of a survey of echocardiographic measurements. Circulation. 1978;58:1072-1083.
8. Faber L, Seggewiss H, Gleichmann U. Percutaneous transluminal septal myocardial ablation in hypertrophic obstructive cardiomyopathy: results with respect to intraprocedural myocardial contrast echocardiography. Circulation. 1998;98:2415-2421.
9. Gietzen FH, Leuner ChJ, Raute-Kreinsen U, Dellmann A, Hegselmann J, Strunk-Mueller C, Kuhn HJ. Acute and long-term results after transcoronary ablation of septal hypertrophy (TASH): catheter interventional treatment for hypertrophic obstructive cardiomyopathy. Eur Heart J. 1999;20:1342-1354.
10. Lakkis NM, Nagueh SF, Kleimann NS, Killip D, He ZX, Verani MS, Roberts R, Spencer WH. 3rd Echocardiography-guided ethanol septal reduction for hypertrophic obstructive cardiomyopathy. Circulation. 1998;98:1750-1755.
11. El Masry H, Breall JA. Alcohol Septal Ablation for Hypertrophic Obstructive Cardiomyopathy. Current Cardiology Reviews. 2008;4(3):193-197.