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Original Article

A novel approach in the use of radiofrequency catheter ablation of septal hypertrophy in hypertrophic obstructive cardiomyopathy

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ABSTRACT

Objective: Alcohol septal ablation (ASA) is a therapeutic alternative to surgical myectomy in patients with hypertrophic obstructive cardiomyopathy (HOCM). However, the anatomical variability of the septal branch, risk of complete heart block, and late onset ventricular arrhythmias are limitations to its therapeutic usage. There is recent interest in the use of radiofrequency catheter ablation (RFCA) as a therapeutic option in HOCM. We aimed to assess the safety and efficacy of RFCA in the treatment of symptomatic HOCM.
Methods: Seven patients with symptomatic HOCM (mean age 43.7 $\pm$ 15.6 years, five males), and significant left ventricular outflow tract (LVOT) gradient despite optimal drug therapy, underwent ablation of the hypertrophied interventricular septum. These patients had unfavorable anatomy for ASA. Ablation was performed under 3D electro-anatomical system guidance using an open irrigated tip catheter. The region of maximal LV septal bulge as seen on intracardiac echocardiography was targeted. Patients were followed up at 1, 6, and 12 months post-procedure.
Results: The mean baseline LVOT gradient by Doppler echocardiography was 81 $\pm$ 14.8 mm of Hg which reduced to 48.5 $\pm$ 22.6 ($p = 0.0004$), 49.8 $\pm$ 19.3 ($p = 0.0004$), and 42.8 $\pm$ 26.1 mm of Hg ($p = 0.05$) at 1, 6, and 12 months respectively. Symptoms improved at least by one NYHA class in all but one patient. One patient developed transient pulmonary edema post-RFA. There were no other complications.
Conclusion: RFCA of the hypertrophied septum causes sustained reduction in the LVOT gradient and symptomatic improvement among patients with HOCM. Electroanatomical mapping helps to perform the procedure safely.

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Abbreviations: LVOT, left ventricular outflow tract obstruction; ASA, alcohol septal ablation; RFCA, radio frequency catheter ablation; HOCM, hypertrophic obstructive cardiomyopathy; LAD, left anterior descending artery; ICE, intra cardiac echocardiography; LBB, left bundle branch; CHB, complete heart block.

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1. Introduction

Hypertrophic cardiomyopathy is a genetic condition affecting one in 500 of the general population.[1] It is characterized by hypertrophy of the interventricular septum caused by mutations in the genes encoding sarcomere or sarcomere-associated proteins.[2] About two-third of the patients have significant left ventricular outflow tract obstruction (LVOTO) at rest (≥30 mmHg) or at physiologic provocation (≥50 mmHg).[2] Outflow obstruction causes increased LV systolic pressure which is responsible for myocardial ischemia, mitral regurgitation, and impairment in diastolic and systolic function leading to pulmonary hypertension and heart failure.

In the treatment of hypertrophic obstructive cardiomyopathy (HOCM), surgical myectomy is widely employed for symptomatic patients with elevated LV outflow gradient despite optimal medical therapy.[2] A non-surgical alternative to myectomy is alcohol septal ablation (ASA).[3–5] It involves catheter-based alcohol infusion into the septal coronary arteries which reduces LVOTO by causing a limited infarction of the hypertrophied septum.[6] However, the outcome of ASA largely depends on the anatomy of the septal arteries and therefore, the procedure is not a suitable in many patients.[5,7]

Radiofrequency catheter ablation (RFCA) is a newer and a well-established technique in the management of cardiac arrhythmias.[8,9] Recent studies have demonstrated that RFCA of the hypertrophied septum in patients with HOCM is feasible and effective in reducing LVOT gradients by the mechanism of discrete septal hypokinesia.[10,11] Patients who are not suitable candidates for surgical myectomy and ASA can get benefit of RFCA of hypertrophied septum. However, atrioventricular blocks and cardiac tamponade are known to occur with this procedure.[10,11] We hypothesized that the effective use of multimodality imaging can mitigate these complications. We present here our experience with RFCA in the treatment of septal hypertrophy in patients with symptomatic HOCM. In our study, we aimed to assess the immediate and long-term safety and efficacy of this procedure.

2. Methods

This is a retrospective study done on patients who have undergone RFCA for septal hypertrophy in HOCM at our center. Data of patients were retrieved from archived medical records.

2.1. *Patient selection*

Patients with HOCM having an LVOT gradient of >50 mmHg at rest and symptomatic on adequate medical therapy were first considered for surgical myectomy. Those patients who were unwilling for surgical myectomy or deemed high-risk for surgery were assessed for the suitability of ASA. RFCA was employed on patients who were not considered as optimal candidates for ASA. All patients were taken up for the procedure after obtaining a written informed consent.

2.2. *Evaluation for alcohol septal ablation*

A selective left coronary angiogram was performed in multiple views to visualize the first, large septal branch of the left anterior descending coronary artery. After visualizing the first septal branch, a 0.0014 in. guidewire was inserted into the artery over which a 2.0 mm × 10 mm balloon was advanced and positioned at the proximal part of the artery. Then, one milliliter of myocardial echo contrast (MEC) was injected through the lumen of the catheter to assess the supply area of the septal branch. For a targeted flow, the balloon was first inflated and it was ensured that there was no leak of the contrast agent occurring along the sides of the balloon. Patients who either had a small first septal branch (<1.5 mm) or in whom contrast spill over was observed in the cavity of right ventricle were considered unsuitable for ASA and proceeded with RFCA.

2.3. *Radiofrequency catheter ablation technique*

Both right femoral arterial and venous access were obtained. The procedure was done under sedation and local anesthesia under the guidance of intracardiac echocardiography (ICE) and 3-D mapping system (CARTO-Biosense Webster, Diamond Bar, California, USA or EnSite-NavX-Endocardial Solutions, St. Jude Medical, Inc., St. Paul, MN, USA). Anatomical map of the LV was created with the help of 3-D mapping system. Bundle of His, left bundle branch (LBB), left anterior and posterior fascicular Purkinje potentials were tagged to prevent injury to these structures during the procedure.

A retrograde, trans-aortic approach was used for mapping and ablation of the LV septum in all patients. Intracavitary LV pressure was recorded through the lumen (irrigation port) of the mapping catheter. The LV cavity was divided into three zones (high pressure zone, transitional, and low pressure zone) as shown in Fig. 1. Ablation was performed with a 3.5 mm open, irrigated-tip ablation catheter on the septal surface of the transitional pressure zone at the area of maximal septal bulge avoiding tagged potentials (Fig. 1). Catheter location and stable contact with LV septum were also monitored under real-time ICE images (Fig. 2). Lesions were delivered for 60–120 s each with a power setting of 30–40 W and saline irrigation of 30 ml/min (Cool Flow Irrigation Pump, Biosense Webster, Diamond Bar, California). Patients also received adjusted doses of heparin to maintain activated clotting time of 250–300 s throughout the procedure.

While ablating near the areas of tagged potentials, extra care was taken to keep catheter tip stable and power setting was titrated down to 25 W. Bipolar electrograms from the distal tip of the ablation catheter were continuously monitored during procedure to avoid injury to the conduction system. The lesion was assumed to be adequate when local bipolar voltage reduced to 50% from the baseline value at the ablation site. Baseline and post-procedure LVOT gradients were measured invasively.

2.4. *Follow-up*

A comprehensive transthoracic echocardiography (iE33, Philips Medical System) performed at baseline and at each