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Time to Significant Gradient Reduction Following Septal Balloon Occlusion Predicts the Magnitude of Final Gradient Response During Alcohol Septal Ablation in Patients With Hypertrophic Obstructive Cardiomyopathy

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Objectives The purpose of this study was to investigate whether a relationship exists between an acute reduction in resting left ventricular outflow tract (LVOT) gradient with balloon occlusion and the final invasive gradient response following alcohol septal ablation (ASA).

Background ASA is an alternative therapy to myectomy surgery to reduce the basal septal thickness and decrease the resting and/or provocable LVOT gradient in patients with hypertrophic cardiomyopathy. Patients have a variable gradient response to occlusion of the septal perforator artery before ethanol infusion for ASA.

Methods From November 1998 to November 2008, 120 patients (mean age 60 years [range 16 to 87 years], 50% women) with hypertrophic cardiomyopathy underwent ASA at our institution. The resting LVOT gradient (peak systolic left ventricle [LV] pressure – peak systolic aortic pressure) was measured continuously during the ASA procedure. The time to significant LVOT gradient decrease (defined as >50% decrease from baseline) was recorded following balloon occlusion of the dominant septal perforator coronary artery, which was found to perfuse the basal septum based on contrast echocardiographic studies.

Results The mean baseline resting LVOT gradient was 86 ± 43 mm Hg, and it decreased to 17 ± 11 mm Hg following ASA (−80.2%). The mean time to significant gradient reduction was 3.6 ± 2 min (range 25 s to 11 min). The time to significant LVOT gradient reduction strongly correlated with the final magnitude of gradient reduction following ASA ($r = -0.81$, $p < 0.001$).

Conclusions This study demonstrates a correlation between the time to significant LVOT gradient reduction following septal perforator balloon occlusion and the magnitude of final gradient response after ASA. (J Am Coll Cardiol Intv 2011;4:1030–4) © 2011 by the American College of Cardiology Foundation

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Hypertrophic cardiomyopathy (HCM) is a complex inheritable cardiac disease that affects approximately 1 in 500 individuals in the general population (1–4). A significant proportion of patients with HCM have evidence of the resting and/or provocable obstruction of the left ventricular outflow tract (LVOT), which can result in severely limiting symptoms, including dyspnea, angina, syncope, and sudden death (5–8).

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Some patients with significant LVOT gradients are unresponsive to medical therapy and may require surgical myectomy or alcohol septal ablation (ASA) to reduce basal septal thickness and decrease their LVOT obstruction (9,10). At our institution, we offer ASA as an alternative to myectomy therapy in older patients with refractory symptoms who do not have concomitant requirement for other surgical repair (e.g., mitral valve repair or replacement, or coronary artery bypass graft surgery), and for patients who prefer this less invasive approach. Although we determine whether the candidate septal perforator artery perfuses the systolic anterior motion (SAM)–septal contact point through the use of contrast echocardiography during the procedure, we have noted that balloon occlusion of the vessel can result in variable gradient reduction before ethanol infusion.

The purpose of this study was to investigate whether a relationship exists between the rate of acute reduction in resting LVOT gradient with balloon occlusion of the anatomically appropriate septal perforator and the final gradient response following ASA.

Methods

From November 1998 to November 2008, 120 patients with HCM underwent ASA at the Peter Munk Cardiac Centre, University Health Network, Toronto, Ontario, Canada. The procedure was offered to patients referred to our HCM clinic with refractory symptoms despite being on maximally tolerated medical therapy (beta-blockers, calcium-channel blockers, and disopyramide) who were not candidates for surgical myectomy, due to either comorbidities or patient preference. All patients underwent comprehensive clinical, echocardiographic, and coronary angiographic evaluation at the Peter Munk Cardiac Centre. Coronary angiograms were screened pre-ethanol ablation to ensure that there was at least 1 anatomically appropriate septal perforator vessel of at least 1.5-mm diameter that perfused the proximal interventricular septum.

This study was approved by the University Health Network Research Ethics Board.

Interventional procedure. The ethanol ablation procedure took place in our cardiac catheterization laboratory with the assistance of a dedicated HCM echocardiographic team. Just before procedure initiation, resting LVOT gradient and septal thickness measurements were taken in the catheterization laboratory, at which point the patients had been off medical therapy for 24 to 48 h. Resting LVOT gradients were measured using the maximum outflow tract flow velocity using continuous-wave Doppler imaging and calculated using the modified Bernoulli equation.

After administration of conscious sedation, a right internal jugular or right femoral venous sheath was placed for insertion of a temporary pacemaker wire into the right ventricular apex in all patients unless a permanent pacemaker system was already present. The temporary pacemaker was set at 60 beats/min during the procedure and was kept in place for a minimum of 48 h after the procedure. Patients that become pacemaker-dependant at any point following the ablation procedure receive a dual-chamber permanent pacemaker implantation later during the admission. A 7-F femoral arterial sheath was inserted for the guide catheter system, and a 5-F radial sheath was inserted for pigtail catheter placement into the left ventricular cavity. Continuous invasive peak-to-peak gradients were measured across the LVOT by comparing the peak left ventricular and aortic pressures.

Abbreviations and Acronyms

ASA = alcohol septal ablation
HCM = hypertrophic cardiomyopathy
LAD = left anterior descending artery
LVOT = left ventricular outflow tract
SAM = systolic anterior motion

Initial angiographic assessment was performed to size the septal perforator and to localize the vessel origin. The targeted septal branch was usually the largest and most proximal septal branch arising from the left anterior descending artery (LAD). An over-the-wire 8-mm balloon with a diameter matching that of the target branch was advanced into the septal branch so that the proximal marker was placed just beyond the vessel ostium. Following balloon inflation, 1 ml of echocardiographic contrast agent either Levovist (Berlex Canada Inc., Lachine, Quebec, Canada) or Definity (Lantheus Medical Imaging Inc., North Billerica, Massachusetts) was injected into the index perforator vessel, while simultaneous echocardiographic assessment took place. The target vessel was considered suitable if there was appropriate contrast echocardiographic opacification of the interventricular septum at the site of the anterior mitral leaflet SAM-septal contact point, and if there was not opacification of other large nonseptal regions, such as the inferior wall or papillary muscles. Further details on the echocardiographic evaluation for ASA were previously published (11,12).

If the target vessel appeared to be perfusing the appropriate septal region, a final check of the adequacy of balloon seal was made by injection of dilute dye through the balloon to confirm the absence of spillage back into LAD. Before