Transcatheter Ablation of Septal Hypertrophy: A Promising Alternative to Surgery in Hypertrophic Obstructive Cardiomyopathy

Andre Keren MD and Shmuel Banai MD

Key words: myocardial disease, hypertrophic cardiomyopathy, alcohol, catheterization, ablation

IMAJ 2002;4:114–116

The clinical presentation of patients with hypertrophic cardiomyopathy is extremely heterogeneous. A small subgroup of patients with severe left ventricular outflow obstruction suffers from incapacitating, drug-refractory symptoms. For the last 40 years, in such cases, the traditional alternative to medical therapy was the myotomy-myectomy (Morrow) procedure. More recently, dual-chamber pacing and alcohol septal ablation have been applied to achieve reduction of outflow obstruction and symptomatic improvement [1,2]. However, the results of randomized trials have dampened the enthusiasm for pacing as a primary therapy for hypertrophic obstructive cardiomyopathy [3–5].

Alcohol ablation of septal hypertrophy in HOCM was based on previous experience with intracoronary injection of alcohol for abolition of arrhythmias [6] and demonstration of transient decrease in outflow gradient during temporary occlusions of septal branches of patients with HOCM undergoing cardiac catheterization [7]. The procedure aims to enlarge the area of the left ventricular outflow tract by induction of a localized "therapeutic infarction" following alcohol injection into the coronary branch supplying the basal septal segment. The resulting myocardial necrosis, subsequent healing and scar tissue formation lead to septal thinning, outflow tract enlargement, diminished flow acceleration and thus, reduction or abolition of the mitral valve-septal apposition during systole. Thus, the outflow tract obstruction is diminished by a mechanism that mimics the anatomic and functional consequences of the myotomy-myectomy. The most frequently used denominations of the technique are non-surgical myocardial or septal reduction therapy, percutaneous septal myocardial ablation, and transcatheter ablation of septal hypertrophy. Since 1995, more than 2,000 such procedures have been performed worldwide, mostly in Germany (Kuhn Horst, MD, personal communication, September 2001).

In this issue of *IMAJ*, Mutlak et al. [8] report on the first series of patients with HOCM in Israel who underwent TASH in their service. The present editorial will set their results in the context of evolving concepts of TASH procedure in the literature [9–17]. The eight patients reported by Mutlak et al. were severely symptomatic despite medical therapy (or refused medical therapy). Although the authors did not report the measured provocable gradients, it can be deduced from their catheterization data that not all patients had baseline gradients. These are important issues to be considered in the evolving indications of TASH [13–17]. Similar to surgery, TASH was found to ameliorate symptoms and improve gradients, exercise capacity and degree of mitral regurgitation not only in patients with baseline gradients, but also in patients without baseline gradients (<30 mmHg) and high provocable gradients (usually >60 mmHg) [13–17]. Therefore, the procedure is currently recommended in both categories of patients.

In the short history of TASH, several modifications of the original technique have been described. Originally, the operators aimed to abolish the gradient [9–12]. Recently, a >50% gradient reduction (usually to a level below 30 mmHg) was accepted as a successful outcome of the procedure [13,18]. The amount of ethanol injected was reduced by more than 50%, from an original average of 4.5 ml [9–11] to 2.4 ml [13,16], and to 1.9 ml in a most recent report [18]. This was associated with a smaller infarction, as demonstrated by decrease in mean creatine kinase release from about 700, to 480 and 413 U/L, respectively [9–11,13,16–18], and decrease in left ventricular infarcted mass from 6% [13] to 3% (Kuhn Horst, MD, personal communication). In cases with an initial unsatisfactory result, re-interventions were performed shortly after the first procedure. Now, re-interventions are delayed for a few months. It was found that a moderate decrease in gradient can lead to significant symptomatic improvement in some cases, and additional decrease in the gradient occurs during follow-up in about 50% of patients [13–18]. TASH procedures can be complicated by complete heart block. Permanent dual-chamber pacemakers were implanted in such cases within 48 hours [11]. With the recognition of the transient nature of this complication in most cases, the implantation of permanent pacemakers is now delayed until a few days prior to hospital discharge. All these methodologic changes led to a decrease in the induced

HOCM = hypertropic obstructive cardiomyopathy
TASH = transcatheter ablation of septal hypertrophy

infarct size, and in complications. Permanent pacemaker implantation rates are less than 10% instead of 20–40% [9–12,15,16–20], re-intervention rates of up to 25% decreased to 10% or less [11,15,20], and procedure-related mortality is around 1–2%, instead of up to 4% [11,13–16,20]. Right bundle branch block was reported in most series in about 50% of cases [9–18]. Interestingly, the outcome during follow-up after the TASH procedure (including functional class, exercise capacity and gradient behavior) is similar in patients with and without a permanent pacemaker implant [13] and in those with and without right bundle branch block [21].

During hospitalization, in 3.5% of cases, unexpected complete heart block was reported 8–11 days post-procedure, leading to death in one patient [13,16]. Ventricular tachycardia and fibrillation occurred in 2.5% of patients during the post-procedure hospitalization, a significantly lower rate than that seen in patients with acute infarction secondary to coronary disease [13–16,20]. Despite the relative rarity of these complications, careful monitoring of the patients is indicated during the hospitalization period. Other complications reported were damage of the left anterior descending coronary artery due to leakage of alcohol, dissection or spasm of the vessel, cerebrovascular and pulmonary embolism, tamponade, and acute mitral regurgitation due to injection of alcohol in a septal branch supplying a papillary muscle [9–16,18–20].

The candidate septal branch for ablation is selected by either the "functional" [7,11,13] or the "myocardial contrast echocardiographic" approach [14–16,19]. By the "functional" approach, a >30% decrease in gradient is required during balloon occlusion of the candidate septal branch, prior to injection of alcohol. Kuhn et al. [13] suggest limiting the use of the MCE approach to cases in which the basal septum has atypical blood supply. In contrast, Seggewiss and co-workers [14,16,19] report the impact of routine MCE performance on strategy of TASH in 25% of their patients, for optimal choice of the septal branch to be ablated and avoidance of alcohol misplacement in branches supplying areas like papillary muscles, free wall, etc.

Most authors [13–16] reported a 90% procedural success rate. All groups reported an immediate decrease in outflow gradients, which can further decrease during the first post-procedural year due to shrinkage of the infarcted area. In addition, significant improvement in functional class, exercise time, VO_2 max during metabolic exercise, decrease in syncopal episodes, and normalization of blood pressure response during exercise were reported [9–16,18–23]. During follow-up, no increased risk of arrhythmic complications, septal rupture or sudden death was reported.

The short and medium-term results of TASH are comparable with those of the myotomy-myectomy procedure – the gold-standard of interventional therapy in HOCM. In selected, high volume centers the mortality from surgery is less than 3% [24,25]. However, the procedure is associated with ventricular septal defect (up to 3%), complete atrioventricular block requiring pacing (5%), aortic regurgitation (4%), and left bundle branch block (40%).

We performed the TASH procedure in our institution in three patients with HOCM, with functional class III (New York Heart Association), resting gradients of 100 mmHg or more, exercise duration of 1.5–6 minutes, and mitral regurgitation ranging from mild/moderate to moderate/severe degree. Following injection of 2–4 ml of alcohol, baseline outflow gradients decreased to 8–30 mmHg [Figures 1 and 2]. During a 6–12 month follow-up, NYHA class ranged from I to II, exercise duration ranged from 5 to 9 minutes, septal thickness decreased by 0.2–0.5 cm, and the degree of mitral regurgitation decreased in all patients.

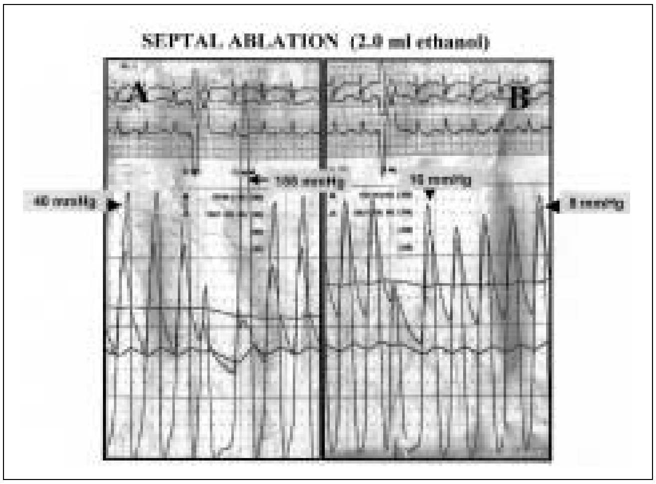

Figure 1. Simultaneous aortic and left ventricular pressure recordings in one of our patients prior to **[A]**, and following **[B]** the septal ablation procedure. The baseline gradient decreased

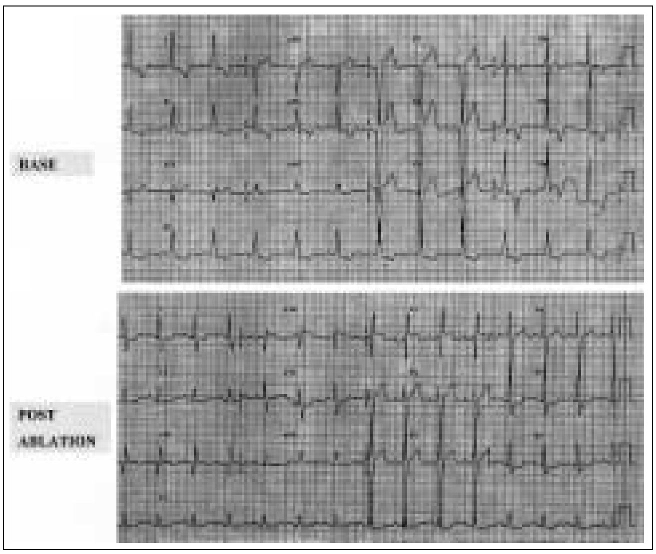

Figure 2. The electrocardiogram of the same patient shows appearance of right bundle branch block, a finding frequently associated with the ablation procedure.

MCE = myocardial contrast echocardiographic

The results reported by Mutlak and colleagues in this issue [8] correspond to the encouraging reports from the literature. However, as noted by the authors, long-term data following TASH are not yet available, the effect of the procedure on prognosis is unknown, and the procedure can be potentially associated with serious complications.

TASH should not be performed in children and adolescents, in asymptomatic individuals (even if they have high gradients), in patients with organic mitral valve disease, and in those in whom the outflow gradient is not clearly associated with systolic anterior motion of the mitral leaflet [13–17].

TASH is a promising alternative to septal myectomy in severely disabled patients with HOCM unresponsive to medical therapy. To avoid its overuse and decrease complication rates, performance of the procedure should be concentrated in centers with special expertise in management of patients with hypertrophic cardiomyopathy and experience in interventional procedures [13,14,16].

References

1. Sigwart U. Non-surgical myocardial reduction for hypertrophic obstructive cardiomyopathy. *Lancet* 1995;346:211–14.
2. Fananapazir L, Epstein ND, Curiel RV, Panza JA, Tripodi D, McAreavey D. Long-term results of dual-chamber (DDD) pacing in obstructive hypertrophic cardiomyopathy: evidence for progressive symptomatic and hemodynamic improvement and reduction of left ventricular hypertrophy. *Circulation* 1994;90:2731–42.
3. Nishimura RA, Trusty JM, Hayes DL, et al. Dual-chamber pacing for hypertrophic cardiomyopathy: a randomized, double-blind, cross-over trial. *J Am Coll Cardiol* 1997;29:435–41.
4. Kappenberger L, Linde C, Daubert C, et al. Pacing in hypertrophic obstructive cardiomyopathy: a randomized crossover study. PIC Study Group. *Eur Heart J* 1997;18:1249–56.
5. Maron BJ, Nishimura RA, McKenna WJ, Rakowski H, Josephson ME, Kieval RS. Assessment of permanent dual-chamber pacing as a treatment for drug-refractory symptomatic patients with obstructive hypertrophic cardiomyopathy: a randomized double blind, cross-over study ((M-Pathy). *Circulation* 1999;99:2927–33.
6. Brugada P, De Swart H, Smeets JLRM, Wellens HJJ. Transcoronary chemical ablation of ventricular tachycardia. *Circulation* 1989; 79:475–82.
7. Kuhn H, Gietzen F, Leuner CH, 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;18:846–51.
8. Mutlak D, Gruberg L, Reisner S, Markiewicz W. Non-surgical myocardial reduction in hypertrophic obstructive cardiomyopathy. *IMAJ* 2002;4:86–90.
9. Seggewiss H, Gleichmann U, Faber L, Fassbender D, Schmidt HK, Strick S. Percutaneous transluminal septal myocardial ablation in hypertrophic obstructive cardiomyopathy: acute results and 3-months follow-up in 25 patients. *J Am Coll Cardiol* 1998;31:252–8.
10. Lakkis NM, Nagueh SF, Kleiman NS, et al. Echocardiographic-guided ethanol septal reduction for hypertrophic obstructive cardiomyopathy. *Circulation* 1998;98:1750–5.
11. Gietzen FH, Leuner J, Raute-Kreinsen U, et al. Acute and long-term results after transcoronary ablation of septal hypertrophy (TASH). *Eur Heart J* 1999;20:1342–4.
12. Ruzyllo W, Chojnowska L, Demkow M, et al. Left ventricular outflow tract gradient decrease with non-surgical myocardial reduction improves exercise capacity in patients with hypertrophic obstructive cardiomyopathy. *Eur Heart J* 2000;21:770–7.
13. Kuhn H, Gietzen F, Leuner CH, et al. Transcoronary ablation of septal hypertrophy (TASH): a new treatment option for hypertrophic obstructive cardiomyopathy. *Z Kardiol* 2000;89(Suppl 4)4:41–54.
14. Seggewiss H. Percutaneous transluminal septal myocardial ablation; a new treatment for hypertrophic obstructive cardiomyopathy. *Eur Heart J* 2000;21:704–7.
15. Kuhn H, Seggewiss H, Gietzen F, et al. Catheter interventional therapy for hypertrophic obstructive cardiomyopathy: first two years analysis of the national registry of the German Cardiac Society [Abstract]. *Eur Heart J* 2000;Suppl.21:413.
16. Seggewiss H. Current status of alcohol septal ablation for patients with hypertrophic obstructive cardiomyopathy. *Curr Cardiol Rep* 2001;3:160–6.
17. Lakkis N, Plana JC, Nagueh S, Killip D, Roberts R, Spencer WH. Efficacy of nonsurgical septal reduction therapy in symptomatic patients with obstuctive hypertrophic cardiomyopathy and provocable gradients. *Am J Cardiol* 2001;88:583–6.
18. Boekstegers P, Steinbigler P, Molnar A, et al. Pressure-guided nonsurgical myocardial reduction induced by small septal infarctions in hypertrophic obstructive cardiomyopathy. *J Am Coll Cardiol* 2001;38:846–53.
19. 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;98:2415–21.
20. Faber L, Seggewiss H, Kuhn H, et al. Catheter interventional septal ablation for hypertrophic obstructive cardiomyopathy: an analysis of the follow-up data from the registry of the German Society of Cardiology [Abstract]. *Eur Heart J* 2001;22:379.
21. Gietzen FH, Leurner CHJ, Obergassel L, Strunk-Muller C, Kuhn H. Symptomatic and hemodynamic effects of right bundle branch block induced by transcoronary ablation of septal hypertrophy (TASH) for hypertrophic obstructive cardiomyopathy [Abstract]. *Eur Heart J* 2001;22:380.
22. Gietzen FH, Leurner CHJ, Obergassel L, Strunk-Muller C, Kuhn H. Role of transcoronary ablation of septal hypertrophy for relief of syncope in hypertrophic obstructive cardiomyopathy [Abstract]. *Eur Heart J* 2001;22:704.
23. Werlemann B, Faber L, Welge D, Fassbender D, Seggewiss H, Horstkotte D. Normalization of an abnormal blood pressure response after septal ablation for hypertrophic obstructive cardiomyopathy [Abstract]. *Eur Heart J* 2001;22:409.
24. Schulte HD, Gramsch-Zabel H, Schwartzkopff R. Hypertrophic obstructive cardiomyopathy (HOCM): surgical management. *Schweiz Med Wochenschr* 1995;125:1940–9.
25. Robbins RC, Stinson EB. Long term results of left ventricular myotomy and myectomy for obstructive hypertrophic cardiomyopathy. *J Thorac Cardiovasc Surg* 1996;111:586–94.

Correspondence: Dr. A. Keren, Dept. of Cardiology, Bikur Cholim Hospital, P.O.Box 492, Jerusalem 91004, Israel.
Phone: (972-2) 646-4124
Fax: (972-2) 624-2076
email: andrek@cc.huji.ac.il