Alcohol septal ablation for hypertrophic obstructive cardiomyopathy: how and when?

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Abstract

Alcohol septal ablation is a percutaneous alternative to surgical myotomy-myomectomy for symptomatic patients who have hypertrophic cardiomyopathy (HCM) and left ventricular outflow tract (LVOT) obstruction. In the 11 years since its inception, the procedure has been proven safe and effective. While septal ablation may be more acceptable to patients than surgery, it lacks the long-term safety record of myotomy-myectomy. Here we discuss the mechanics of the procedure itself and examine its place in clinical practice, highlighting the importance of appropriate patient selection.

Key words: hypertrophic cardiomyopathy, alcohol septal ablation, left ventricular outflow tract obstruction, myotomy, myectomy.

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Introduction

In 1994, following preliminary experiments involving temporary balloon occlusion of the first septal artery, Ulrich Sigwart injected 3 ml of absolute alcohol down the septal artery of a woman with hypertrophic cardiomyopathy (HCM) at the Royal Brompton Hospital. The procedure was effective in reducing the severity of left ventricular outflow tract (LVOT) obstruction and her symptoms improved.[1] The birth of this novel interventional technique was not greeted with universal acclaim, however. Many physicians caring for patients with HCM were, not unnaturally, appalled at the idea of such a violent coronary assault and could not conceive that alcohol ablation might be efficacious. However, during the ensuing 12 years information about the safety and efficacy of alcohol septal ablation has led to its acceptance as a valid treatment option, even by some of its fiercest original critics. Here we discuss the mechanics of the procedure itself, and examine its place in clinical practice.

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Indications for septal reduction

HCM is a complex disease process associated with a spectrum of clinical presentations, including arrhythmia, chest pain, breathlessness, syncope and sudden death. The precise mechanisms underlying these symptoms may vary considerably between patients. They include mitral regurgitation, congenital mitral valve abnormalities, left ventricular diastolic dysfunction, abnormalities of small coronary arteries, myocardial ischaemia and LVOT obstruction. Septal reduction targets only the latter. It is important to recognise that the presence of a haemodynamically significant LVOT gradient is not always associated with symptoms, and the co-existence of symptoms with LVOT obstruction does not necessarily imply causality. The role of septal reduction is to improve symptoms that are attributable to outflow tract obstruction (exertional chest pain, breathlessness and pre-syncope/syncope) and that are refractory to conventional medical therapy. Significantly, there is no evidence to date that either surgical or percutaneous septal reduction improves prognosis.

Symptomatic patients are suitable for the procedure if they have evidence of outflow tract obstruction ($\geq$ 50 mmHg). Such patients can be treated with either surgery (myotomy-myectomy) or septal ablation. The results of surgery are excellent in experienced high-volume centres (particularly in the US), and the long-term data on safety and efficacy are naturally more extensive than for alcohol septal ablation.[2-5] Furthermore, following surgery there is a lower incidence of need for permanent pacemaker implantation than after septal ablation. Surgery also allows concomitant treatment of mitral valve abnormalities, where necessary.[6] In the absence of structural abnormality, mitral regurgitation may occur secondary to LVOT obstruction and systolic anterior motion (SAM), and may be expected to improve after percutaneous reduction of the outflow gradient. The great advantage of septal ablation is that it avoids all the problems associated with open heart surgery. There are currently no large surgical programmes in the UK.

Alcohol septal ablation – the procedure

Via a femoral arterial approach, a guiding catheter is introduced into the left main coronary artery and a 0.014 guidewire into the left anterior descending artery (LAD). Usually the first septal artery is selected (figure 1) and a short ($\approx$ 10 mm) 'over the wire' (OTW) balloon is introduced into the branch. The lumen of this device provides the route for delivery of angiographic contrast, echo contrast, and ultimately alcohol, selectively into the septal artery. As transient heart block is common at the time of injec-

Figure 1. Pre-treatment anatomy. The left anterior descending (LAD) artery and first septal artery are displayed in the right anterior oblique cranial projection

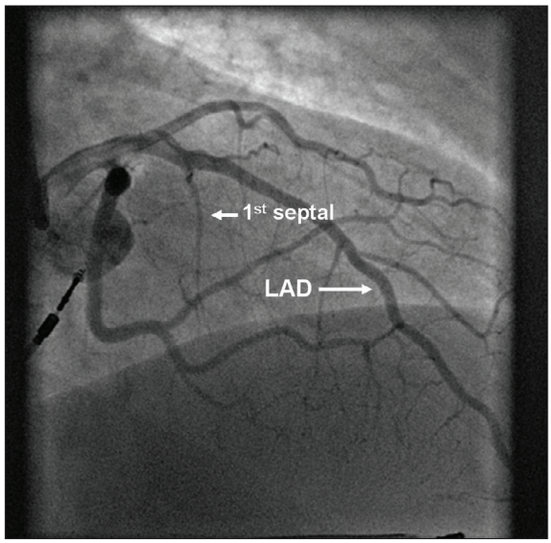


Figure 2. Via the guiding catheter a 0.014 wire is positioned in the septal vessel. An 'over the wire' (OTW) balloon is positioned within the vessel and inflated. Flow within the left anterior descending artery remains unaffected

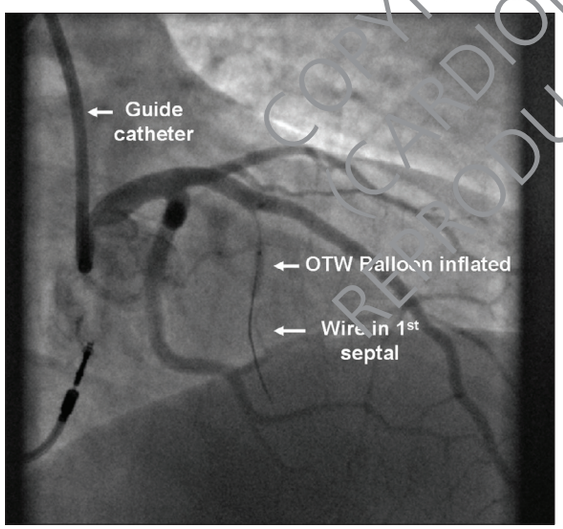


Figure 3. The wire has been removed, and contrast has been injected through the internal lumen of the 'over the wire' (OTW) balloon. There is no spill back into the left anterior descending artery

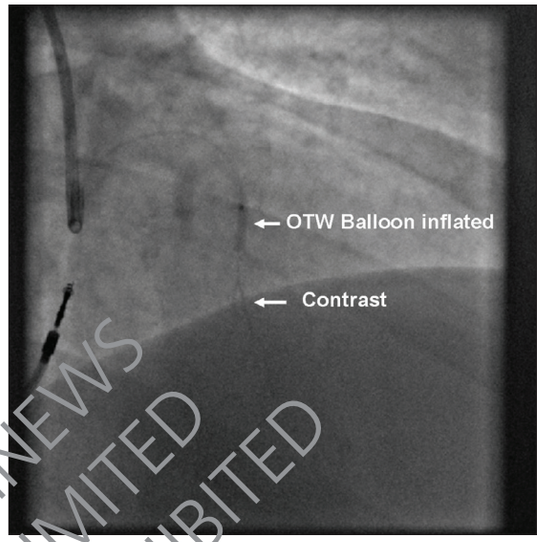
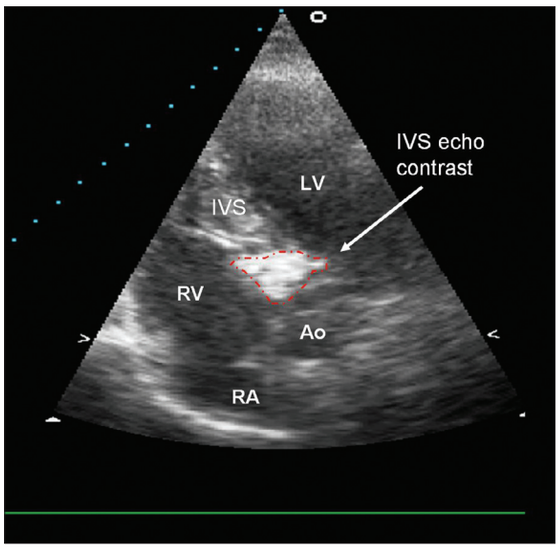


Figure 4. Transthoracic echo in the apical four-chamber view. Echo contrast has been injected through the OTW balloon internal lumen, appearing as a bright area in the proximal intraventricular septum. Ablation may now proceed



Key: AO = aorta; IVS = intraventricular septum; LV = left ventricle; RV = right ventricle; RA = right atrium

tion, a temporary pacing wire is routinely inserted, usually via the femoral vein.

The OTW balloon is positioned under fluoroscopic guidance to ensure that it is entirely within the septal branch and does not encroach on the lumen of the LAD (figure 2). The OTW balloon is inflated and the guidewire removed. A small amount of angio-

graphic contrast is injected through the OTW balloon to ensure that there is no spill back into the LAD (figure 3). The balloon should not be placed too distally as this may result in a smaller (and solely right-sided) septal infarct, with a consequent reduction in the effect on the outflow gradient.[7]

Echocardiographic localisation

An echocardiographic contrast agent (e.g. Optison™, Amersham Health, UK) is then injected through the OTW balloon, and the myocardium supplied by the septal artery is localised with transthoracic echocardiography (figure 4). The optimal location within the septum is the point of anterior mitral valve leaflet and septal contact in the apical four-chamber view. The right ventricular free wall and left ventricular apex may on occasion be supplied by proximal septal vessels. If these areas are demonstrated with echocardiographic contrast, ablation should not proceed. If present, an alternative septal artery may be investigated. Echo guidance may influence the interventional strategy in 15–20% of cases, either by aborting the procedure or changing the target vessel.[8]

If echo localisation is supportive, ablation may proceed. The transvenous pacing wire is re-checked, and intravenous analgesia is administered, as the alcohol can cause intense but transient discomfort. 1–2 ml of absolute alcohol is administered through the lumen of the OTW balloon, and the balloon is kept inflated for five minutes. Following deflation, the balloon and wire are removed. A final coronary angiogram will usually demonstrate a biphasic flow pattern in the septal vessel. The echocardiographic gradient is reassessed and will usually be markedly reduced, though this immediate measurement is likely to reflect a degree of myocardial stunning and may not indicate the long-term outcome accurately. The LVOT gradient commonly increases gradually in the first few days following the procedure, and then falls again over a period of weeks as myocardial scarring occurs.[9]

Results and complications

The short- and medium-term results of septal ablation are similar to those of myotomy-myectomy in terms of symptomatic improvement and relief of outflow obstruction, though inevitably the data come from relatively small non-randomised comparisons[10,11] and published case series.[8,12,13] The reported mortality is 1–2%. Heart block is relatively common at the time of alcohol injection but is usually only transient.

A small number of patients develop heart block later, at 3–4 days post-operatively. This always requires treatment with a permanent pacemaker and means that patients without pre-existing pacemakers/ICDs need to have in-patient monitoring for approximately five days after septal ablation. The overall incidence of heart block requiring a permanent pacemaker following septal ablation is around 10–20%. The need for permanent pacemaker implantation has been shown to be higher in female patients, when more than one septal artery is treated, with more rapid bolus injection of the alcohol, and in those with pre-existing conducting system disease such as left bundle branch block.[14] Whereas the percutaneous procedure causes transmural infarction in the basal mid septum close to the right bundle, the surgical procedure affects the epicardial part of the basal anterior septum close to the left bundle. Thus, patients with pre-existing right bundle branch block are at higher risk of requiring permanent pacing after myotomy-myomectomy.[15]

Key messages

- Septal reduction may be considered in HCM patients with symptomatic LVOT obstruction that is refractory to medical therapy
- Alcohol septal ablation is a safe percutaneous alternative to surgical myotomy-myomectomy
- Both procedures should be performed by experienced operators in specialist centres
- Surgical myotomy-myomectomy and alcohol septal ablation offer similar symptomatic improvement
- The most common complication of alcohol septal ablation is the need for permanent pacing, which occurs in 10–20% of patients treated

Numbers of procedures

In the UK the procedure is performed in relatively small numbers (around 30 per annum) in a few centres. This is probably appropriate: patients requiring septal ablation are rare and the procedure should be performed as part of a comprehensive HCM service. The procedure should not be viewed as a part of routine interventional practice. In February 2004 the National Institute for Clinical Excellence (NICE) published general guidance supporting non-surgical septal reduction as an alternative to myotomy-myectomy, provided it is performed in specialist units with adequate training in the technique.[16] The British Cardiovascular Intervention Society (BCIS) is in the process of formulating more specific guidance for individuals and institutions.

Future directions

In the last few years, approximately 3,500 septal ablations have been performed worldwide – more than all the myotomy-myomectomies performed in the last 45 years. Whilst some of this may reflect septal ablation's greater acceptability to patients, there is concern about proper patient selection. Some are also uneasy about the long-term consequences of septal ablation on cardiac rhythm, suggesting that there may be important differences between the scar induced by surgery and that induced by septal ablation. Whilst there are no data to suggest long-term arrhythmic problems following septal ablation, interventional cardiologists performing the procedure need to be vigilant in collecting and reporting long-term results.

Despite these concerns, septal ablation is now firmly established as a therapeutic option for patients with hypertrophic

obstructive cardiomyopathy, offering results that compare very favourably with surgical treatment.

Conflict of interest

None declared.

Editors' note

A case report on the first patient with alcohol septal ablation can be found on pages 62–64 of this issue.

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