Review

The New World of Cardiac Interventions: A Brief Review of the Recent Advances in Non-Coronary Percutaneous Interventions

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Advances in cardiovascular interventional techniques have allowed percutaneous treatment of conditions that either previously required open operations or have not been amenable to treatment. Conditions such as atrial and ventricular septal defects and patent foramen ovale are now amenable to percutaneous closure using implantable devices.

A number of strategies have evolved to reduce the risk of stroke such as percutaneous occlusion of the left atrial appendage for patients in atrial fibrillation. Valvular heart disease and complications of its repair are approachable via the percutaneous route. Percutaneous pulmonary and aortic valve replacements have been performed in humans. There are evolving techniques for repair of the mitral valve and of prosthetic paravalvular leaks using devices such as the Amplatzer septal occluder to repair the defects without the need for repeat open heart surgery. Hypertrophic cardiomyopathy with left ventricular outflow tract obstruction can now be approached using alcohol septal ablation with results comparable to the surgical technique.

These advances have occurred as a result of improvement in the design of the devices used as well as a better understanding of the pathophysiology of conditions. Many of these techniques are in evolution and in this paper we review some of the recent developments in this dynamic area of interventional cardiology.

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Introduction

Cardiovascular disease accounts for 37% of all deaths in Australia and the prevalence of cardiovascular conditions including stroke has increased by 18% over the last decade.[1] It is also the costliest disease for the health system accounting for AUD $3.9 billion annually, representing the major proportion (12%) of total recurrent health expenditure. Much of this relates to coronary artery disease and stroke and strategies to prevent stroke remain a major challenge, particularly with the rising incidence in the elderly.

With the aging population, the prevalence of acquired valvular disease such as calcific aortic stenosis and mitral regurgitation is likely to increase and become an even more important cause of morbidity and mortality. Surgery has been the mainstay of treatment but is associated with a significant morbidity and mortality. Technological advances may allow for percutaneous valve repair or replacement to be a viable alternative to surgery in the future. Repair of atrial and ventricular septal defects, once under the domain of the surgeon, are now increasingly being performed by percutaneous devices and techniques, in selected patient populations.

A comprehensive review of this rapidly evolving and diverse field of interventional cardiology would be impractical. The goal of this article is to provide an overview of recent advances in specific areas in non-coronary percutaneous intervention.

Percutaneous Closure of Cardiac Defects

Atrial Septal Defects (ASD)

Atrial septal defects are the third most common congenital heart defects in adults (after mitral valve prolapse and bicuspid aortic valve disease[2]) and account for around 10% of congenital heart disease overall. The commonest atrial septal defects are secundum defects and the majority of these are amenable to percutaneous closure. The ostium primum and sinus venosus defects are challenging to repair percutaneously, and remain in the domain of the surgeon for the moment.

Although ASD may be present without symptoms, most patients will become symptomatic at some point in their

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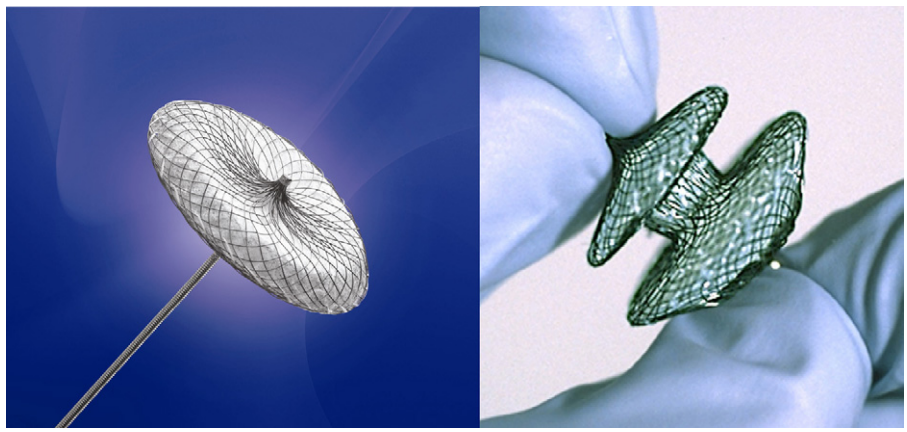

Figure 1. *Amplatzer Septal Occluder (AGA Medical, Golden Valley, MN). Reproduced with permission (Source AGA medical).*

life. The age at which symptoms appear is highly variable and it is not uncommon for the diagnosis to be made in adulthood. The most common presenting symptom is exertional dyspnoea and/or fatigue, but older patients may present with new onset atrial fibrillation or right heart failure.

In general, an ASD must be at least 10 mm in diameter to cause a significant left-to-right shunt.[3] The indications for ASD closure depend on the degree of the shunt and/or haemodynamic consequences (a ratio of pulmonary blood flow (Q_P) to systemic blood flow (Q_S) of >1.5:1.0 and/or evidence of right atrial and right ventricular enlargement in the presence of an ASD (>10 mm) and in the absence of significant pulmonary hypertension[3]).

The most common method for secundum ASD closure in the developed world is percutaneous closure. Most secundum ASDs are amenable to device closure but defects more than 36–40 mm in diameter, the presence of an inadequate septal rim (<4 mm) for stable positioning of the device, or close proximity to structures such as atrioventricular valves, coronary sinus or inferior vena cava are generally referred for surgical closure.[3,4]

There are a variety of atrial septal occluder devices available but the most commonly used in Australia is the Amplatzer Septal Occluder (AGA Medical, Golden Valley, MN). The Amplatzer device consists of two, self expanding discs joined at a waist and made out of nitinol alloy wire mesh, which has the unique characteristic of returning to its original shape after deformation (thermal shape-memory) (Fig. 1). The interior of the mesh contains a polyester material, which promotes thrombosis of the device.

Percutaneous closure of secundum ASDs is performed via the femoral vein approach under transoesophageal echocardiography and fluoroscopic guidance (Figs. 2 and 3). The atrial septum is crossed with a multipurpose catheter and the defect is sized using a balloon inflated across the atrial septum. An appropriate diameter device is then positioned and deployed. The device can be retrieved at any time if an unsuitable position is obtained. Once the device is in a satisfactory position, it is unscrewed from its cable and released. The patients can usually be discharged the next day on antiplatelet therapy and antibiotic prophylaxis for six months.

Numerous observational studies have demonstrated the effectiveness and safety of percutaneous closure with successful closure in up to 95% of patients in the short-term

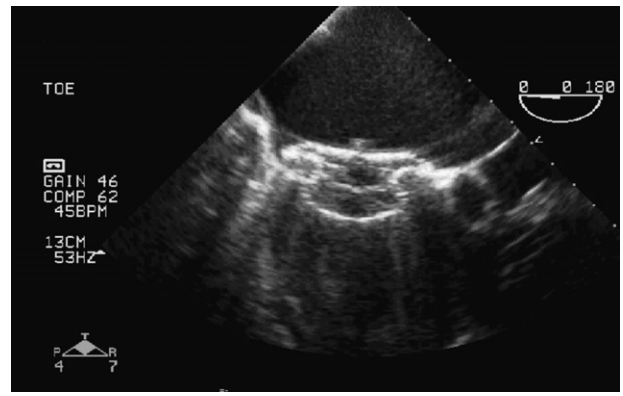

Figure 2. *Transoesopheal echocardiogram showing Amplatzer Septal Occluder across the atrial septum.*

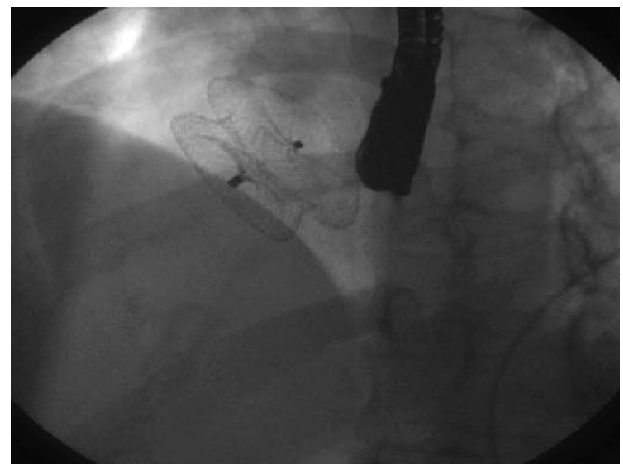

Figure 3. *Flouroscopy image showing Amplatzer Septal Occluder in position (the transoesophageal probe is seen over the spine).*