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TRANSCATHETER THERAPY OF CONGENITAL HEART DISEASE

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Congenital heart disease (CHD) was generally considered without cure or hopeless just barely 50 years ago. Advances in medical science with better equipments for accurate diagnosis of congenital structural abnormalities of the heart, and refinement in surgical technique and anaesthetic and intensive care, enable surgical palliation and correction of some of these defects from the late 1960s. However, the feasibility of corrective treatment of cardiac defects without surgery was only possible in the past 20 years when advancement of material science to produce suitable devices became a reality. This short article reviews the types of therapy for congenital heart disease without surgery that have been carried out in Gleneagles Hospital, Singapore.

Ballon Atrial Septostomy. Since William Rashkind first published the pioneering work of creation of an atrial septal defect in babies with transposition of great arteries by a balloon catheter in 1966 [6], the era of transcatheter therapy of congenital heart disease has begun. In the 1970s newborns with transposition of great arteries could be salvaged by balloon atrial septostomy before repair by atrial switch. Subsequently arterial switch operation was available in Singapore. Initially balloon atrial septostomy was performed in the catheterization laboratory. When echocardiography was introduced in Singapore in the 1980s, balloon atrial septostomy was carried out in the neonatal intensive care unit with minimal interference to the care of the sick newborn.

Ballon Valvuloplasty and Angioplasty. The next breakthrough of transcatheter therapy of CHD was the pioneering work of Jean Khan in 1982 [4] who introduced the technique of balloon dilatation of the stenotic pulmonary valve. The first case of transcatheter balloon valvuloplasty for pulmonary stenosis in Singapore [11] was performed in a young child at the National University Hospital in 1987 by me. At that time pulmonary balloon valvuloplasty could only be considered innovative rather than evidence-based; subsequently it was proven to be the treatment of choice [10] for treatment of pulmonary valvar stenosis, instead of surgery, because of the results were excellent with very few complications. The technique of balloon valvuloplasty was later applied to aortic valvuloplasty, dilatation of recoarctation of aorta and peripheral pulmonary artery stenosis. The same technique was applied successfully to neonates with critical PS, albeit technically more demanding with higher risk of complication. Although recoarctation of aorta is rare after subclavian flap angioplasty, this could occur. Fortunately it can be treated by balloon valvuloplasty with satisfactory reduction of arm hypertension and enlargement of the narrowed segment, thus avoiding re-operation.

Transcatheter Closure of Common Conrenital Cardiac Shunts. The practice of transcatheter therapy continues to evolve. Echocardiography has assumed additional role in guiding transcatheter procedure, especially device closure of common congenital cardiac shunts [7]. In the past two decades different occlusive devices which can be delivered through small sheaths for transcatheter closure of congenital cardiac shunts in infants and children became available in Singapore.

Transcatheter Closure of Patent Arterial Duct. The service of transcatheter occlusion of patent arterial duct using initially the Raskind umbrella was first introduced in Singapore in August 1992 [2]. The Rashkind umbrella soon became obsolete because of less than optimal occlusion rate, embolisation risk and technical difficulty. Cook's controlled released detachable coils were subsequently brought into Singapore to replace the Rashkind umbrella. The good news is relative ease of delivery and good occlusion rate for small patent arterial duct. The disadvantages included the need of multiple coils to close large patent arterial duct with a small risk of stenosis of left pulmonary artery, and the small but well documented risk of mechanical haemolysis. These problems were largely solved when Amplatzer duct occluder was brought into Singapore in June 2000 for closure of large patent arterial duct with excellent results and very few reported complication. Our current policy is to use Cook's coils to close small patent arterial duct less than 2 mm in diameter and Amplatzer duct occluder for the larger patent arterial duct.

Transcatheter Closure of Secundum Atrial Septal Defect. From the understanding of the anatomy of the atrial septum, it is clear that the only inter-atrial communication that is suitable for device closure is secundum atrial septal defect [1, 3]. Other inter-atrial communications, i.e. sinus venosus atrial septal defect, coronary sinus defect and partial atrioventricular septal defect (ostium primum defect), are contraindication because the important adjacent anatomical structures of these defects may be compromised by the occlusive device. Although quite a few occlusive devices were available and evolving in the past two decades, many older devices reported prior to 1996 were really not ideal for transcatheter closure of atrial septal defect [5]. The reasons include complex design, many moving parts, difficulty in loading and deployment, large profile, non retrievability once deployed, use of large delivery sheaths, significant complications and less than desirable closure rate.

When the Amplatzer septal occluder (ASO) was first made available to us in April 1997, we were among the first few countries in the world to embark on this non invasive closure of atrial septal defect in both children and adults [9]. The ASO has simple design, simple loading mechanism, and simple delivery and deployment procedure, using relatively small delivery sheath. The success of transcatheter closure of atrial septal defect using the ASO depends on firstly appreciation of anatomy of the defect after initial transthoracic echocardiographic examination and detailed imaging of the atrial septal defect in relation to the atrial septal topography, especially the distance from the margin of the defect to pulmonary vein, atrioventricular valves, aortic valve and the caval veins. Secondly, proper sizing of the defect is an absolutely important prerequisite to choose the appropriate sized device. Thirdly, possession of the necessary skill and adherence to safety guidelines are equally important. The closure rate is extremely good with very few complications. Although primarily we close single atrial septal defect with one ASO, patients with double defects can also be successfully closed by double ASO. Initially we balloon sized the defect before selection of the appropriate device; we now close the defect based on transesophageal assessment alone. The results are comparable to closure with balloon sizing with the additional advantage of shorter fluoroscopy time and procedure time [12].

Transcatheter closure of atrial septal defect using the ASO will be the treatment of choice for patients with secundum atrial septal defect with significant left to right shunt. Contraindications include inadequate septal length, defect size larger than 40 mm (currently largest device available), multiple rim deficiency (especially if inferior rim is involved), defects with multiple fenestrations and large floppy atrial septal aneurysm, allergy to nickel and sensitivity to anti-platelet drugs.

Transcatheter Closure of Perimembranous Ventricular Septal Defect. In March 2004 we started the programme of closing perimembranous ventricular septal defect using the Membranous Amplatzer VSD Occluder (MAVSDO), shortly after FDA approved the phase 1 safety trial in the United States [8]. The anatomical peculiarity of perimembranous ventricular septal defect makes the other available pre-existing occluders, before the commercial availability of MAVSDO, less than ideal, and indeed unsuitable, for transcatheter closure. This is mainly due to close proximity of aortic valve cusp to the superior margin of the ventricular septal defect and also the intimate relation of the tricuspid valve septal leaflet to the ventricular septal defect. The newly available MAVSDO has largely overcome these difficulties with the ingenious asymmetric design. The asymmetric left atrial disc with shorter superior margin and a longer inferior margin provides a stable grip on the left ventricular septum while avoiding impingement of the aortic cusp. The thin central waist fits the flat profile of the membranous septum and the adequate but not oversized right atrial disc gives sufficient margin of grip without increasing the risk of interfering with the tricuspid valve. The only draw-back is that the sizes available are in steps of 2 mm rather than 1 mm, so that critical sizing becomes an issue. Our early results with complete occlusion of all the 10 cases are encouraging, although possibility of high grade atrioventricular block is an important concern [13].

Transcatheter Therapy of Other Congenital Heart Defects. With availability of different innovative mechanical devices, interventional paediatric cardiologists have ventured into treatment of other congenital cardiac defects. Postoperative peripheral pulmonary artery stenosis is a fairly common problem after surgical repair of tetralogy of Fallot and transposition of great arteries, which can now be treated satisfactorily with transcatheter placement of a stent to relieve the obstruction, without recourse to surgery. Coronary arteriovenous fistulae are rare congenital cardiac shunts. Conventional therapy has been surgical ligation. However, with the availability of different occlusive devices to cater for the very variable anatomy, these difficult lesions can now be closed by transcatheter technique. Finally additional unnecessary blood supply from the aorta to segments of the lung in the form of aortopulmonary collaterals can be associated with other CHD. These are now commonly occluded by devices by the transcatheter method rather than by surgical ligation.

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ЧРЕСКАТЕТЕРНОЕ ЛЕЧЕНИЕ ВРОЖДЕННЫХ ПОРОКОВ СЕРДЦА

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Статья-обзор методов лечения врожденных пороков сердца. Показано, что за последние 20 лет акцент здесь сместился в сторону малоинвазивных технологий. Среди врожденных пороков, которые лечатся в Сингапуре чрескатетерными методами, – клапанные стенозы аорты и легочного ствола, дефекты перегородок сердца, коарктации крупных сосудов и ряд других. Отмечаются хорошие результаты подобного метода лечения, его преимущества перед открытыми операциями и перспективы дальнейшего использования.

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