

## **Superimposition or Valve-on-Valve Technique for Impacted Bioprostheses**

**Khaled E. Al-Ebrahim, FRCS(C)**

*Department of Medicine, Faculty of Medicine  
King Abdulaziz University, Jeddah, Saudi Arabia  
dr.k-e@hotmail.com*

*Abstract.* In this paper, we describe a novel surgical technique that might be life saving in bioprosthetic valve reoperation. As the numbers of these surgeries are increasing, cardiothoracic surgeons have to be aware and familiar with this procedure in deeply embedded bioprostheses where exploration is very hazardous.

*Keywords:* Superimposition, Valve on valve, Bioprosthesis.

### **Introduction**

In valvular reoperations, cardiac surgeons may be faced with a deeply impacted bioprosthesis, either in the aortic or mitral position. The annulus is usually heavily covered with dense fibrous tissue. An attempt at removal of such prostheses will carry high risk of injury to nearby vital structures and cause major morbidity and mortality, which may reach up to 20%. The concept of this technique is to excise the old valve cusps and implant a bileaflet mechanical valve on top of the old bioprosthesis.

### ***Surgical Technique***

Careful resternotomy, release of adhesions, standard cardio-pulmonary bypass and myocardial protection are applied in these cases. Central cannulation is preferred to save femoral vessels for

---

Correspondence & reprint request to: Dr. Khaled Al-Ebrahim  
P.O. Box 80215, Jeddah 21589, Saudi Arabia

Accepted for publication: 28 May 2008. Received: 22 March 2008

emergency cases. In dense caval fibrosis and adhesions, a cuffed venous cannula is used<sup>[1]</sup>. This paper will discuss in detail the intracardiac part of aortic and mitral valve reoperation.

### ***Aortic Bioprosthetic Reoperation***

As soon as the aorta is opened and the integrity of the valve is confirmed, all old cusps are excised. Careful sizing is done which may require about 2 mm reduction of the old bioprosthesis. Rotatable valves either CarboMedics valves (CarboMedics, Austin, TX USA) or St Jude mechanical valve (St Jude Medical Inc., St Paul, MN USA) were chosen. The new supra annular design of the CarboMedics valve was ideal for this procedure. The reduced cuffs of the CarboMedics and the hemodynamic plus of the St Jude was second choice. Before suturing, the mechanical valve has to be seated and tested for function and free movement of both discs. The Star Edward valve was the third choice. Heavy monofilament non-absorbable non-pledget sutures with tapered cutting needles are used. In the published case report 2-0 polypropylene sutures are used<sup>[2]</sup>. Multiple interrupted close horizontal mattress sutures are applied to the sewing ring of the bioprosthesis from the ventricular to the aortic side. The sutures are then passed through the cuff of the mechanical valve. After completion of the sutures, the mechanical valve is slid down slowly and seated on the old ring. The discs are tested again for free movement and the sutures are tied down. The mechanical valve is rotated if necessary to achieve best orientation.

### ***Mitral Bioprosthetic Reoperation***

A similar sizing and suturing technique can be used for mitral valve reoperation. The same suturing technique is applied where the sutures are taken from the ventricular to the atrial side of the old ring. This is usually easier than the aortic position as the old valve struts are in the left ventricle.

A reversed aortic valve is preferred in this aortic position as this will elevate the level of the valve mechanism with its hinges away from the old bioprosthetic ring, also minimizing the risk of interference with the new disc movement. Paravalvular leaks are repaired if present. The struts are not seen or may be deeply embedded in the left ventricular wall.

## Discussion

This technique was described by this team in its first case which was in aortic position<sup>[2]</sup>. Several reports, later on, were written describing a similar technique in the mitral position<sup>[3-7]</sup>. In this paper the final modification of valve-on valve or superimposition is described. In this procedure it is usual to try and remove the old bioprosthesis if possible by creating a plane between the old ring and the surrounding cardiac tissues. Exploration of the old ring can be very hazardous especially in the elderly or when dense fibrous tissues cover the sewing ring and the struts are embedded in the aortic or left ventricular walls. Bloomfield *et al.*<sup>[8]</sup> reported 19.5% mortality of redo surgeries. There are three factors that determine the nature of artificial heart valve incorporation: 1) the fibrous tissue reaction of the host to the implanted device; 2) the type of material in contact with the tissues, mainly the cloth covering the struts and 3) over sizing of the device. These factors determine the degree of impingement on the walls of the ventricle and aorta<sup>[9]</sup>. Bioprostheses have had two basic types of sewing ring: Made of several layers of folded porous cloth and the other of a single thin layer of porous knitted cloth over impervious silicon rubber that provides the bulk of the sewing ring. The former, (characteristic of the Ionescu valve), generally results in a rather dense fibrous invasion; valves with the latter, (*e.g.*, the Hancock and Edwards valves), are invariably rather poorly incorporated<sup>[4]</sup>. Major complications caused by valvular reoperation include cardiac rupture at the aortoventricular or atrioventricular junctions, atrioventricular node damage or coronary injury, either the main ostia of one or both coronaries in aortic valve reoperation, or the circumflex artery in case of mitral valve surgery<sup>[10-13]</sup>. Extirpation of aortic bioprosthesis is usually more difficult and requires careful dissection, as the area is small and close to vital structures. The technique of superimposition is found to be suitable in difficult cases in which the removal of old bioprosthesis carries a high possibility of cardiac injury. The paravalvular leak and the downsizing are the main problems of this technique. Close application of the sutures and the new designs of mechanical valves may minimize these problems. In a large number of cases, clinical and hemodynamic follow-up are required to further support the benefits of this technique.

### References

- [1] **Al-Ebrahim K.** Use of endotracheal cuffed tubes for caval occlusion in redo surgery. *Saudi Heart J* 1990; **2**(1): 41-42.
- [2] **Raffa H, Al-Ebrahim K, Sorefan A, Naranayan L.** Superimposition of mechanical valve on an impacted aortic bioprosthesis. *Texas Heart Instit J* 1991; **18**(2): 199-201.
- [3] **Geha AS, Lee JH.** New approach for replacement of degenerated mitral bioprosthesis. *Eur J Cardiothorac Surg* 1996; **10**(12): 1090-1096.
- [4] **Frater RWM.** Replacement of bioprosthesis by insertion of a mechanical valve device within the old stent. *Eur J Cardiothorac Surg* 1993; **7**(10): 505-506.
- [5] **Patterson HS, Jacob A, Campanella C, Bloomfield P, Cameron EWJ.** Retention of bioprosthetic valve annulus in mitral prosthetic replacement. *Eur J Cardiothorac Surg* 1993; **7**(10): 511-513.
- [6] **Stassano P, Losi MA, Colino A, Gagliardi C, Iorio D, Marzullo M, Spampinato N.** Bioprosthesis replacement with mechanical valve implantation on the bioprosthetic ring. *Eur J Cardiothorac Surg* 1993; **7**(10): 507-510.
- [7] **Campanella C, Hider CF, Duncan AJ, Bloomfield P.** Must the mitral valve always be removed during prosthetic replacement? [letter] *Ann Thorac Surg* 1990; **49**(1): 167-168.
- [8] **Bloomfield P, Wheatley DJ, Prescott RJ, Miller HC.** Twelve year comparison of a Bjork-Shiley mechanical heart valve with porcine bioprosthesis. *N Engl J Med* 1991; **324**(4): 573-579.
- [9] **Berger K, Sauvage LR, Wood SJ, Wesolowski SA.** Sewing ring healing of cardiac valvular prostheses. *Surgery* 1967; **61**(1): 102-107.
- [10] **Husebye DG, Pluth JR, Piehler JM, Schaff HV, Orszulak TA, Puga FJ, Danielson GK.** Reoperation on prosthetic heart valves. *J Thorac Cardiovasc Surg* 1983; **86**(4): 543-553.
- [11] **Devineni R, Mckenzie FN.** Type 1 left ventricular ruptures after mitral valve replacement. *J Thorac Cardiovasc Surg* 1983; **86**(5): 742-745.
- [12] **Pansini S, Ottino G, Forsennati PG, Zattera G, Casabona R, di Summa M, Villani M, Poletti GA, Morea M.** Reoperation on heart valve prostheses: an analysis of operative risks and late results. *Ann Thorac Surg* 1990; **50**(4): 590-596.
- [13] **Al-Ebrahim K.** Valve-in-valve or superimposition of mechanical valves on impacted bioprostheses. *Eur J Cardiothorac Surg* 1997; **12**(1): 162-163.

## تثبيت علوي للصمام فى داخل صمام لتغيير الصمامات النسيجية العميقة

خالد إبراهيم آل إبراهيم

قسم الجراحة ، كلية الطب ، جامعة الملك عبدالعزيز  
جدة ، المملكة العربية السعودية

المستخلص. وصف فني دقيق لتفاصيل عمليات تغيير الصمامات  
النسيجية العميقة المتداخلة في أحشاء القلب القريبة من الشرايين  
التاجية والمراكز الحساسة. كذلك شرح دواعي هذه العمليات  
الجديدة.