**Surgical Techniques of Composite Valve Graft Replacement**

**Bentall and DeBono Classic.**

After clamping of ascending aorta at root of the innominate artery the anterior wall of the aneurysm is vertically incised. The visual inspection shows the diseased aortic valve and the aneurysm of the aortic root characterized by an over 2cm distance between the aortic annulus and the coronary ostia. The base of the aortic root is measured with a Hegar dilator in order to choose the right prosthetic diameter. A composite valve graft is sutured at the base of the aortic root. Two holes of 1 cm diameter are made with a thermocautery in the dacron graft tube just in front of the two coronary ostia. The left coronary ostium is directly reimplanted in the dacron graft by an endoaortic running suture. The distal anastomosis between the graft and the aorta is performed. The right coronary ostium is reimplanted in the dacron graft by an endoaortic running suture. After declamping and deairing the composite graft, the aneurysmal aortic wall is closed over it. The difficulty of the Bentall and DeBono procedure is the reimplantation of the coronary ostia with an endoaortic suture technique. The anastomosis is difficult to be performed in a small aneurysm where the distance between the aortic annulus and the coronary ostia is short or where the sinus wall is fibrous or calcified. Evenmore when acute or chronic dissection of the aortic root is present.

In the Bentall and DeBono operation the bleeding and late false aneurysm may originate in a difficult endoaortic coronary ostia reimplantation. Since the original description from Bentall and DeBono different techniques have been proposed. These techniques vary essentially concerning the reimplantation of the coronary ostia, [3,4,21].

**Coronary Buttons or Carrel’s Patches.**

This variation of the Bentall and DeBono procedure is the most currently used technique. After opening the aneurysm and excising the aortic cusps the coronary arteries are dissected off and detached from the sinuses of Valsalva. The dissection should be carefully done, avoiding damage to the coronary arteries sometimes difficult to individualize. When supercoronary arteries are present, they must be included in the button made for the principal artery and be reimplanted all together. The site of reimplantation of the coronary buttons on the composite graft is cautiously chosen avoiding traction and kinking of the coronary arteries. The coronary buttons are anastomosed laterally in the composite graft with a 5-0 polypropylene running suture technique which includes the sinuses of Valsalva full thickness.

The disadvantage of this technique is the difficulty of coronary arteries dissection. Besides, it is not possible to close the aneurysmal wall around the composite graft as it is done in the original Bentall-DeBono technique. The use of a biological glue may help to stop bleeding points (See chapter 25, figures 19 A-B, page 297).

**Cabrol’s Technique.**

It has been proposed to alleviate the disadvantages of the direct endoaortic suture of the coronary ostia. It reimplants the coronary ostia in the composite graft (for further information see chapter 25, figures 20 A-E, page 298).

After insertion of the composite graft in the aortic annulus, and 8 or 10 mm diameter Dacron tubular graft (the coronary graft) is sutured at each end around the coronary ostium with running 5-0 or 4-0 polypropylene endoaortic suture technique. The distal anastomosis between the composite graft and the aorta is performed. The coronary graft turns around the composite graft. It is anastomosed to it by a side-to-side anastomosis. The coronary graft length and the site of the anastomosis with the composite graft are cautiously chosen avoiding any traction, twist or kink. The side-to-side anastomosis is often made high in front and on the right of the composite graft giving a classic look of a peculiar moustache. The aneurysmal wall may be closed around the composite graft, thus reducing bleeding as it is done in the Bentall and DeBono technique. A fistula between the periprosthetic space and the right atrium can be made to vent the bleeding around the composite graft if necessary (see Chapter 25, figure 20- E).
• VARIATIONS CONCERNING THE COMPOSITE GRAFT.

In patients with an absolute contraindication to anticoagulation treatments a composite valve graft with a bioprosthesis, regarding the foreseeable difficulties of redo operations, can be used. In addition, the aortic root may be completely replaced with a freestyle, Medtronic bioprosthesis (see chapter 25, figure 32 page 308).

In aortic endocarditis a cryopreserved homograft with the miniroot implantation technique can be used. In severe infections it should be better to use an aortic homograft with a long portion of the ascending aorta to avoid a Dacron graft in the mediastinum.

The autopulmonary graft is rarely possible in Marfan’s patients. The probability of secondary dilation and even rupture of the pulmonary graft is high. The Ross’ procedure with good short term results may be used for ascending aorta replacement [22].

A fistula between the peri prosthetic space and the right atrium could be made in order to vent a bleeding around the composite graft. In small aneurysms, suturing the coronary graft to the left coronary ostium and making a harmonious course for the coronary graft is sometimes difficult. This limitation is important because these small aneurysms are now the most frequent anatomical type operated. On the other hand, the long term results of the coronary graft and the anastomosis between the coronary graft and the coronary ostium are not well known. Recent observations of stenosis of the coronary graft by fibrous evoluting lesions impose to be cautious with this technique especially for young patients. Cabrol’s technique is still useful when coronary buttons mobilization is difficult or dangerous, like in giant aneurysms, in fibrous aneurysms and in redo operations. In most cases, we are using now a composite graft made by the industry with a Dacron tube and a mechanical valve (Saint-Jude, Carbomedics or Medtronic). It is possible to make a composite graft during the operation which allows a greater choice for the valve and the tube. Rarely, in case of absolute contraindication to anticoagulation treatment for example, we use a tube with a bioprosthesis regarding the foreseeable difficulties of redo replacement of this valve. In this rare case, some stentless bioprosthesis allows the replacement of the entire aortic root (freestyle, Medtronic) (for further information, see chapter 25, fig. 32). In case of aortic endocarditis, we use a cryopreserved homograft if disposable with the miniroot implantation technique. The best thing is to use an aortic homograft with a long portion of ascending aorta, even the aortic arch, avoiding therefore a dacron graft in the mediastinum.

The autopulmonary graft (the Ross’ procedure) is rarely possible in these patients. It is contraindicated in case of dystrophy of the elastic tissue in Marfan’s disease, because the probability of secondary dilation or even rupture of the pulmonary autograft is high. Some surgeons have used the Ross procedure with good short term results in the surgery of the aortic root [22].

• VALVE SPARING INTERVENTIONS THEORY.

Aortic valve sparing operations are a valid therapy for patients with ascending aorta and root aneurysms and aortic valve insufficiency if the aortic cusps are normal or near-normal, [14,20].

Aortic valve is often considered as a simple structure, the coaptation of 3 cusps preventing blood regurgitation during diastole. However, the aortic outflow tract and root should be considered as an integrated hemodynamic valvular system during the different parts of the cardiac cycle. The movements of their components have an important hemodynamic effect. They have the same level of complexity as the mitral valve apparatus. Aortic root includes the aortic annulus, the aortic cusps, the Valsalva sinuses and the sino-tubular junction. As shown by Kunzelman [23], normal aortic root dimensions can be expressed as a percentage of a reference diameter. If the middle part of Valsalva sinuses is considered as the reference diameter (100%), then the annulus and the sino-tubular junction diameters should be 97% and 81% respectively. Any modification to these ratios can lead to aortic valve dysfunction. In annuloaortic ectasia syndrome, the aortic root enlargement is more pronounced at the sino-tubular junction level preventing coaptation of the aortic cusps which leads to a central aortic regurgitation. However the aortic cusps can be normal [14,18,23]. Focused target of sparing valve operations is to restore normal geometry [23]. This goal can be achieved through two approaches: the inclusion method described by David [14] and the remodelling method reported by Yacoub [19, 20]. After transection of the aorta the integrity of the aortic valve is assessed. When the cusps are abnormal (tear, calcification, perforation, vegetation, calcified bicuspid) or when the free margin of the prolapsed cusp is more than 1.5 fold the length of its aortic edge at the sino-tubular junction, the aortic valve should be replaced. Thus, the composite valve graft replacement is considered. When the aortic cusps are normal the Valsalva sinuses are resected leaving a 2-3 mm edge along the aortic