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Aortic Valve Sparing Operation

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1. Introduction

A standard approach in the surgical treatment of severe aortic regurgitation and/or aortic root dilatation is Bentall procedure, it means replacement of the aortic valve and ascending aorta with a composite graft including mechanical or biological valve. The original technique described by Bentall and De Bono in 1968 (5). This is a „safe" method with low mortality, but patients have to accept the disadvantages of lifelong anticoagulation and comercial valvular prosthesis, such as higher risk of tromboembolic complications, bleeding, endocarditis and also rapid degeneration of biological prosthesis (28).
The alternative technique for the patients with aortic root dilatation and/or ascending aorta aneurysm and aortic valve incompetence, causing by outward displacement of the commissures is the aortic valve-sparing operation (24). The technique of aortic root remodeling first described by Sarsam and Yacoub and technique of aortic valve reimplantation first described by David and Feindel in 1993 (33,9). The both techniques preserve the native aortic valve and partialy dynamic native aortic valve annulus, which may have hemodynamic benefits over a rigid prosthetic valve stent. The major benefits are freedom from anticoagulation treatment, relative resistance to infection compared with prosthetic valves and maybe better resistance against the premature degenerative changes of the bioprosthesis (multifactorial etiology). A major drawback is the increased risk of early failure of reconstructed valve cause the valve incompetence and needing the early reoperation (24).
Aortic valve sparing operations were developed to preserve native tricuspid aortic valve without gross structural defects and absence of severe cusp prolapse or assymetry (9). In recent years, surgeons gaining more and more experience and skills and indications were liberally expanded to include older and also younger patients, patients with bicuspid valves, aortic valves with cusp prolapse, Marfan patients, patients with acute type A dissection, endocarditis and reoperation (1,14,26,19,18). Future and longer follow up will show us the best solutions for each of these categories.

2. Operative technique

For choosing the right type of valve sparing operation is important to assess the pathology of the leaflets, aortic root and asending aorta. Our approach based on the functional classification of aortic regurgitation linked to the pathophysiologic mechanism and desribed by El Khoury (tab. 1, tab. 2) (6,16).

Type I	**Normal appearing cusps with FAA dilatation**
Ia	Ascending aorta dilatation (starting at the sinotubular junction)
Ib	Valsalva sinuses and sinotubular junction dilatation
Ic	Funcional aortic annulus dilatation
Id	Cusp perforation
Type II	**Cusp prolapse**
Type III	**Cusp retraction and thickening**

Table 1. Functional classification of aortic regurgitation.

Aortic root is functional unit consist with two major components: the leaflets and the functional aortic annulus (FAA). It is a classification of the different mechanism of aortic insuficiency that allows the surgeons to define and categorize pathological findings and apply the appropriate repair technique. (6,16,26).

AI class	**TYPE I** Normal cusp motion with functional aortic annulus dilatation			**TYPE II** Cusp prolapse	**TYPE III** Cusp restriction
	Ia	Ib	Ic		
Mechanism	Ascending aorta dilatation (starting at the sinotubular junction)	Valsalva sinuses and sinotubilar junction dilatation	Funcional aortic annulus dilatation	Excess of cusp tissue, or commisural disruption	Cusp retraction and thickening
Repair techniques (primary)	**STJ remodeling** *ascending aorta graft*	**Aortic valve sparing** *Reimplantation or Remodeling with SCA*	**SCA**	**Prolapse repair** *Plication* *Triangular resection* *Free margin resuspension* *Patch*	**Leaflet repair** *Raphe shaving* *Decalcification* *Patch*
(secondary)	SCA		STJ annuloplasty	SCA	SCA

Table 2. The functional classification of aortic regurgitation linked to the pathophysiologic mechanism. (STJ- sinotubular junction; SCA- subcommissural annuloplasty).

Echocardiographic examination

Crucial and very important is echocardiography examination. All patients underwent preoperative transthoracic (TTE) and transesophageal echocardiography (TEE) and intraoperative TEE. Severity of aortic regurgitation was classified according to four grades using semiquantitative criteria. Leaflets morphology and motion were described in order to determine which leaflet was prolapsing. Also the quality of the cusp tissue (the presents of sclerosis or calcification, cusp damage), the level of coaptation, the length of the free margin of the leaflets, hight of the cusp and the anatomy of the aortic root were assessed. (Fig. 1, Fig. 2., Fig. 3.)

For long-term durability is important to respect some echocardiographic signs :

- preoperative the leaflet coaptation is minimally 6 mm above the annulus

- the length of free margin is maximal 50% longer than diameter of the annulus (Fig. 1.)
- after the operation the coaptation area is completely above inferior edge of prosthesis (type A, Hannover classification)

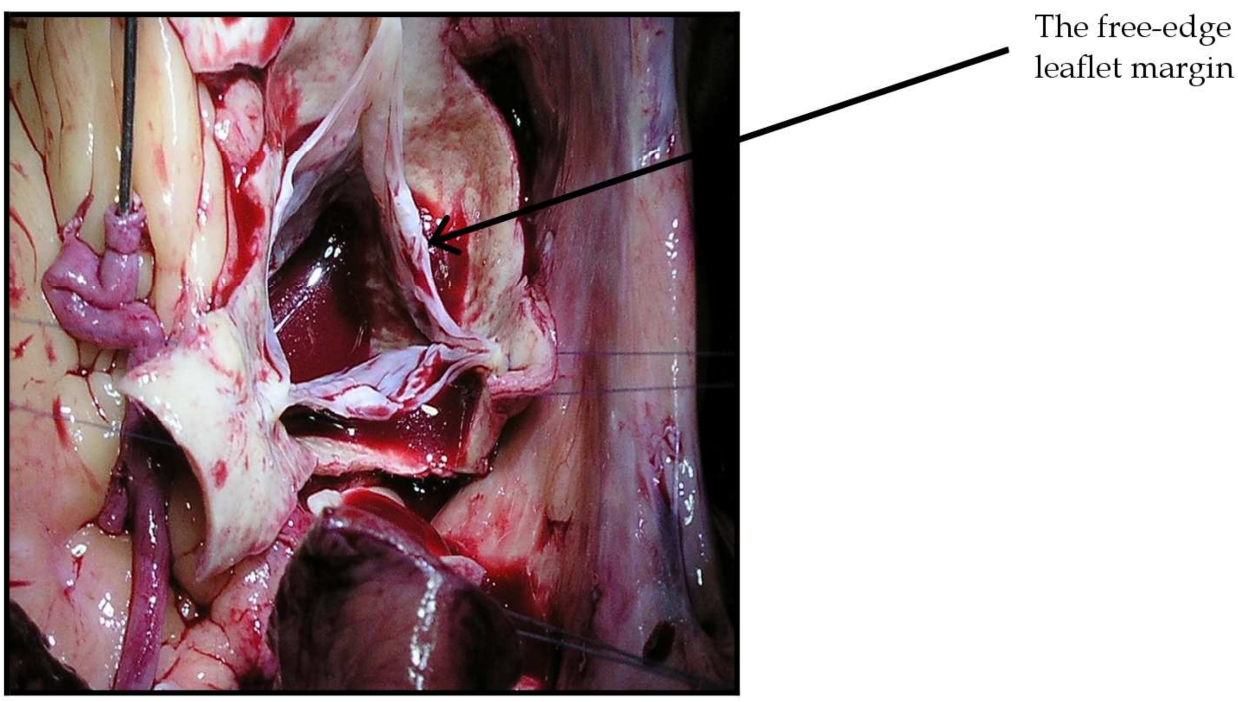


Fig. 1. The free-edge leaflet margin is maximal 50% longer than annulus diameter.

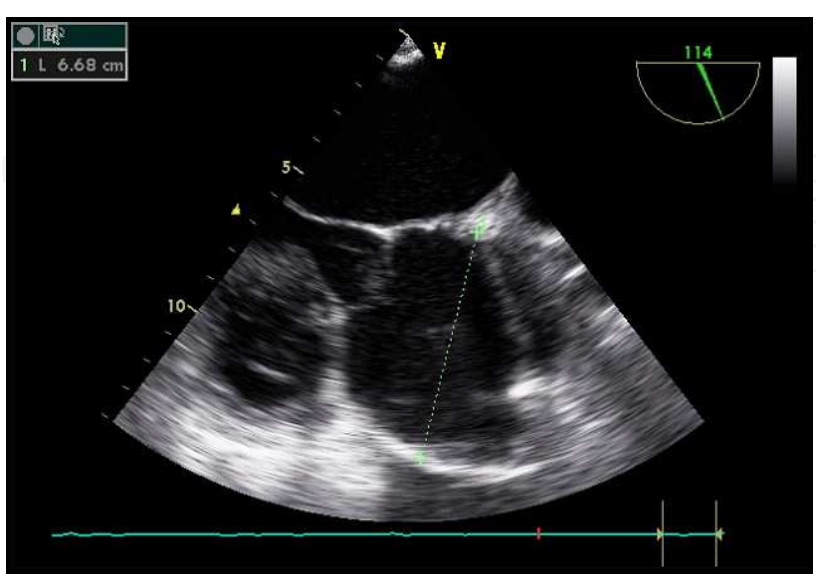


Fig. 2. Annulus, Valsalva sinuses and STJ dilatation.

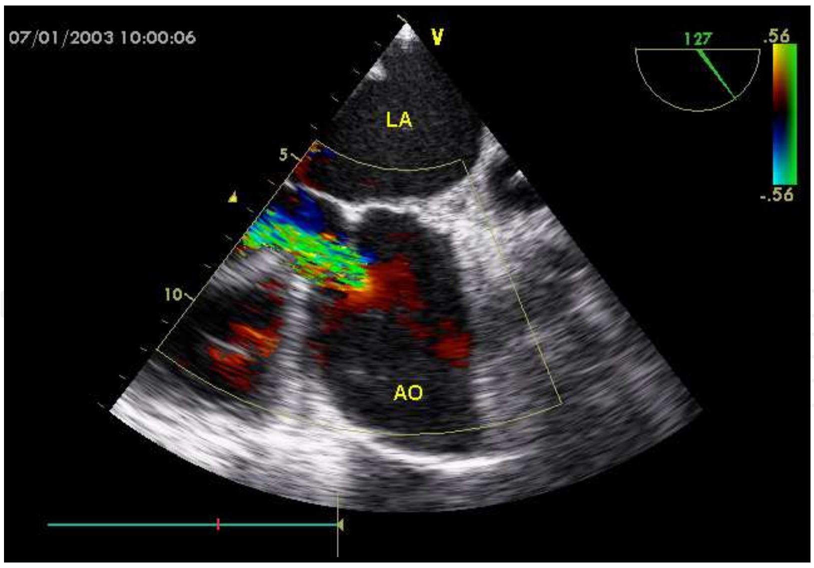
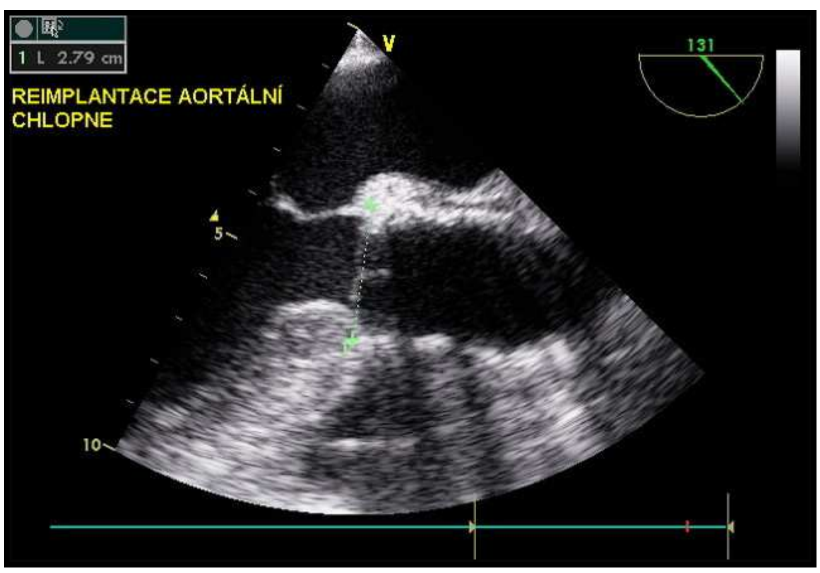
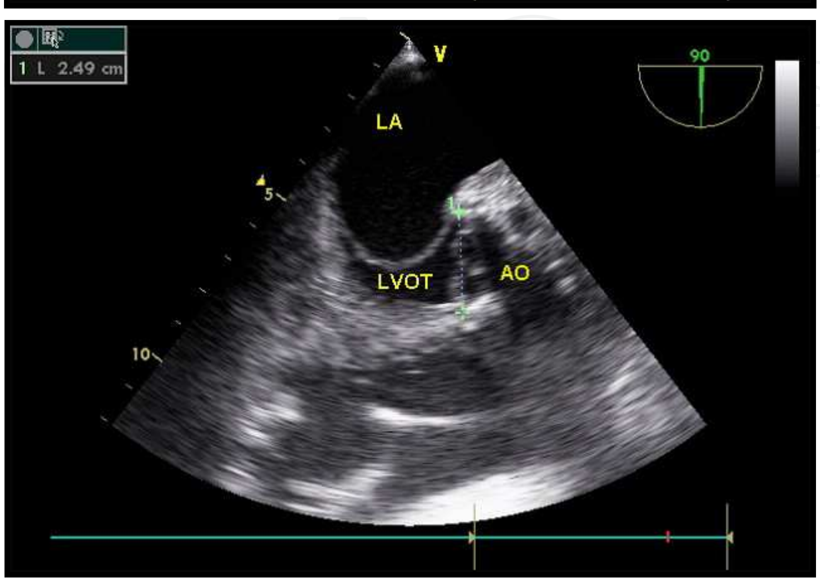


Fig. 3a. Aortic regurgitation.





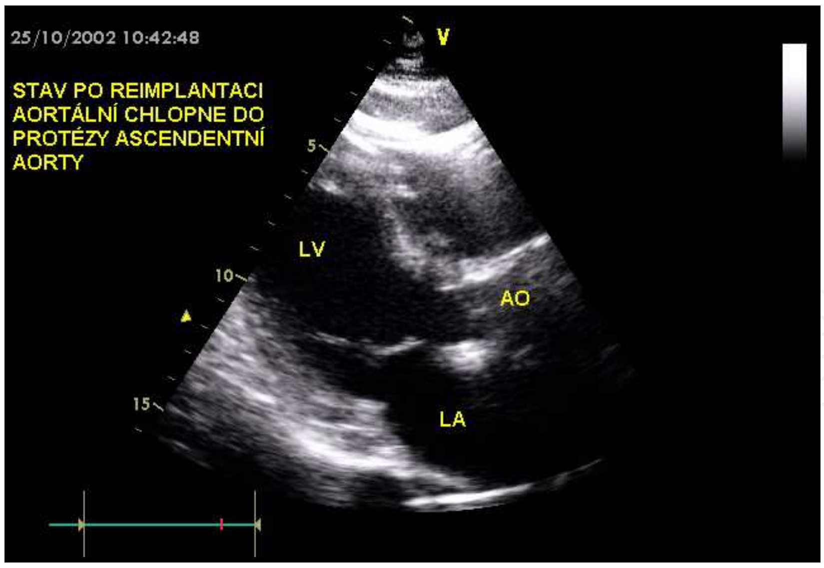


Fig. 3b. Condition after aortic valve reimplantation.

2.1.1 Ascending aorta replacement

Supracommisural ascending aorta replacement with tube dacron prosthesis is indicated in patients with isolated dilatation of sinotubular junction (STJ) and ascending aorta, where the severe aortic insuficiency is due to changes in root geometry and outward displacement of the commissures. Restoration of a normal diameter of STJ is important and obviosly enough to correct the aortic incompetence. (Fig. 4.)
We prefer to use 10% (2 or 3 mm) bigger diameter of prosthesis than native aortic annulus measured by echogardiographic examination (in diastola) and by Hegar dilator during the procedure. (Fig. 6.)

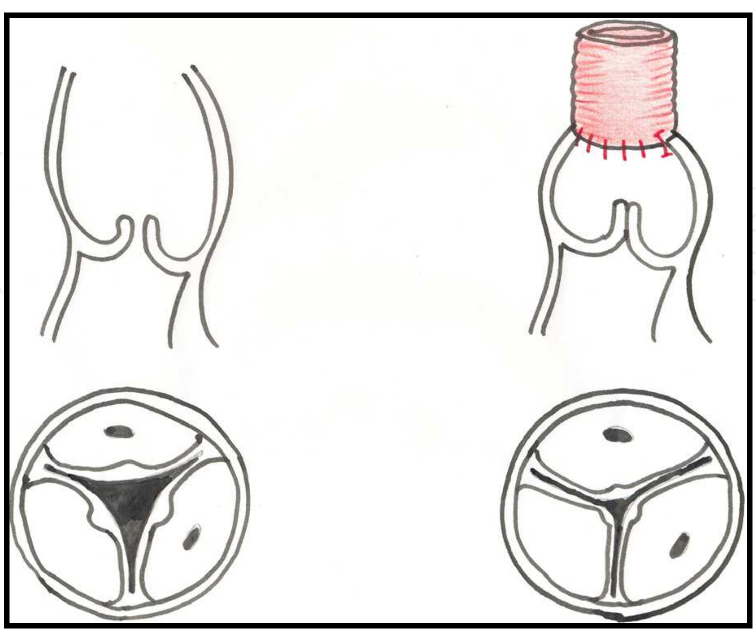


Fig. 4. Ascending aorta replacement.

2.1.2 The remodeling technique (Yacoub)

Remodeling is physiologic reconstruction of the aortic root. This approach preserves the anatomy and the function of the Valsalva sinuses. According to our opinion and experience of other surgeons, it is not a suitable method for patients with dilated annulus, because of lack of annulus support and there is a tendency toward progressive aortic insuficiency. (34)

Remodeling (sec operation. Yacoub) - aortic bulbus, diseased sinuses, including the ST junction and necessary part of the ascending aorta were trimming, leaving only 4-5 mm of the aortic wall at the base of aortic leaflets and annulus. The coronary arteries were prepared for a button reimplantation in standard manner. Subsequently, vascular prosthesis was prepared - Gelweave Valsalva prosthesis (Vascutec Ltd., UK) by trimming to obtain three tongue-shaped extensions (neosinuses) that are then sutured to the aortic annulus at the line of the attachment of the cusps. (Fig. 7.) Prosthesis size was derived from the size of annulus measured by echogardiographic examination and also we used a Hegar dilator or the size of the graft is based on the diameter of sinotubular junction (STJ). The prosthesis was subsequently chosen by 10% higher compared to the native annulus or equal to the diameter of STJ. The prosthesis was fixed to the rim of the sinuses with three running polypropylene 4-0 stitches. Stitches were placed up to the base of leaflets – that we consider crucial for long-term durability. We use of stentless valvular sizer (Toronto SPV) for measurement of extent of circumference for each sinus and after that we individualizate the extent of each neosinus on vascular prosthesis. (Fig. 5.) Coronary arteries buttons were sewn end to side into the prosthesis with polypropylene 6-0 stitches and the prosthesis was anastomosed to the distal aorta. (33,34). We don´t use a glues.

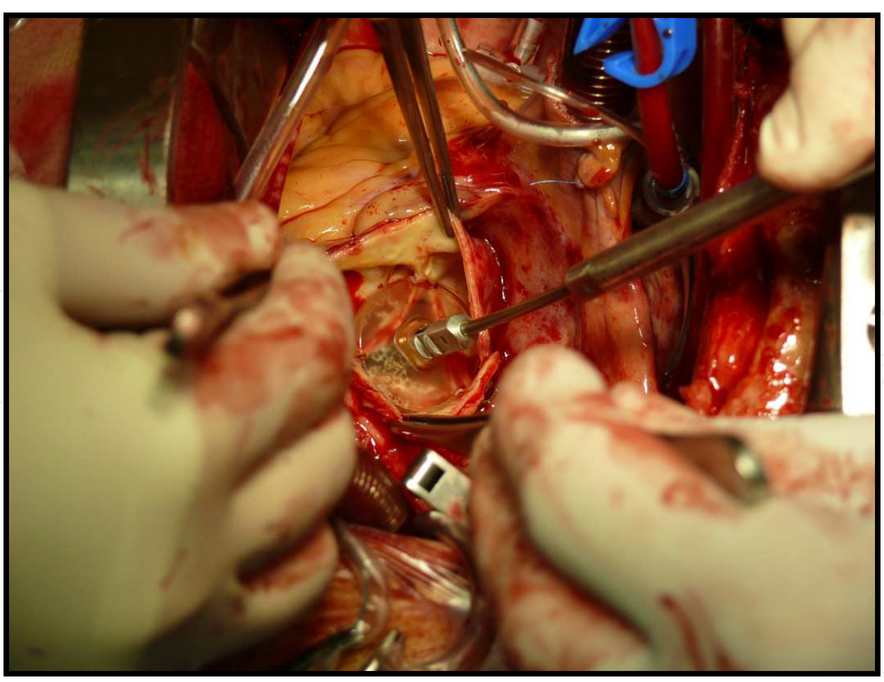


Fig. 5. The use of stentless valvular sizer (Toronto SPV).
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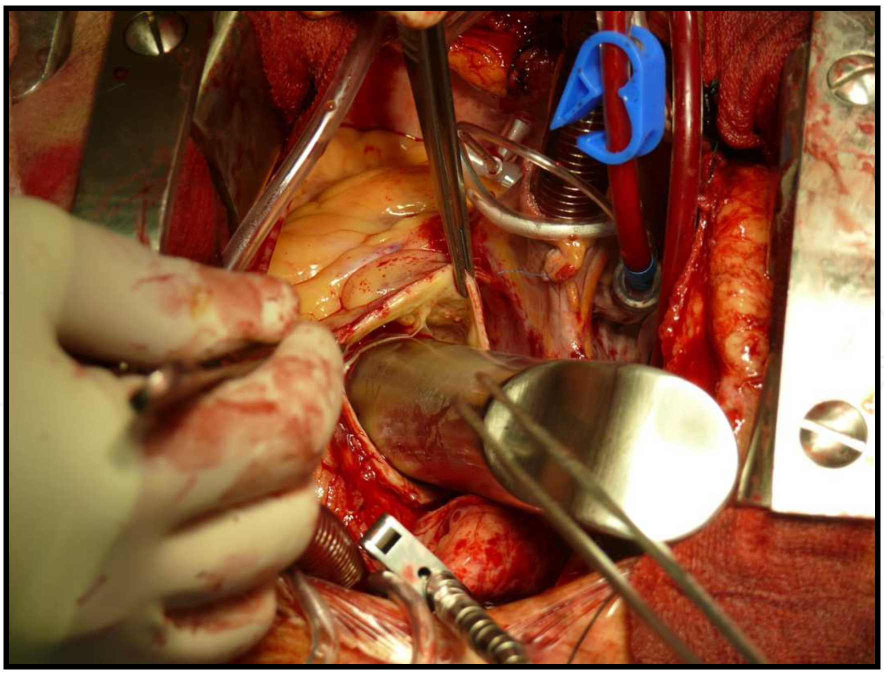

Fig. 6. The measurement of diameter annulus by Hegar dilator.
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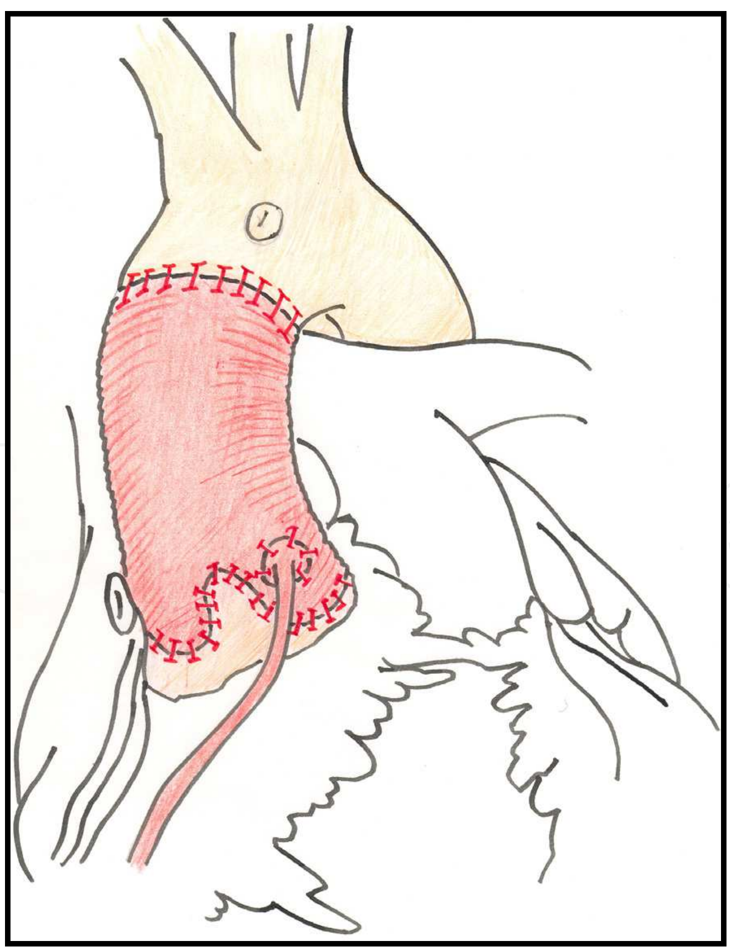

Fig. 7. Remodeling of the aortic root.

2.1.3 The reimplantation technique (David)

Reimplantation (surgery sec. David I) – the surgical procedure followed the steps originally described by David and Feindel. (9).

Detailed description of the techniques (aortotomy and exposure, aortic root preparation, prosthesis sizing, proximal suture line, prosthesis preparation and fixation, valve reimplantation) mentioned Boodhwani et al. (6).

Briefly the aorta is transected 1 cm above the sinotubular junction starting above the non-coronary sinus. Three full-thickness 4-0 polypropylene traction sutures are placed at the level of the three commissures. Very important is to externally dissect the aortic root as low as possible, started along the non-coronary sinus and continued towards the left and right commissures and leaflet with respect the external anatomical limitations (insertion of the root into the ventricular muscle). The diseased sinuses of Valsalva are then resected leaving approximately 3-5 mm of the aortic wall attached. Then the coronary buttons are prepared. (Fig. 9.)

We prefer the Valsalva prosthesis with neo-sinuses (13), which was prepared by „scaloping“ in areas of commissures to the depth 1 cm according to valve anatomy.

The diameter of the graft was about 50% smaller than the average length of the free margins of the aortic cusps. If there is some discrepancy, we could repare a leaflets too.

Then the coronary arteries buttons and aortic valve were prepared in the same manner as in remodeling.

Proximal anastomosis is bilayer. The first layer of multiple horizontal mattress sutures of 2-0 polyester are passed from the inside to the outside of the left ventricle outflow tract circumferentially below the nadir of aortic annulus and following the scalloped shape of the aortic annulus along the muscular interventricular septum. The second layer of the stitches attached the remaining sinuses into the graft using three 4-0 polypropylene sutures. Important is to achieve correct cusp geometry and sufficient height of commissural resuspension within the prosthesis at the level of the new sinutubular junction. (Fig. 8., Fig. 9., Fig. 10.) Than the coronary arteries were implanted and the distal anastomosis between the graft and the native ascending aorta was performed using running 4-0 Prolen suture. (Fig. 11., Fig. 12., Fig. 13., Fig. 14.)

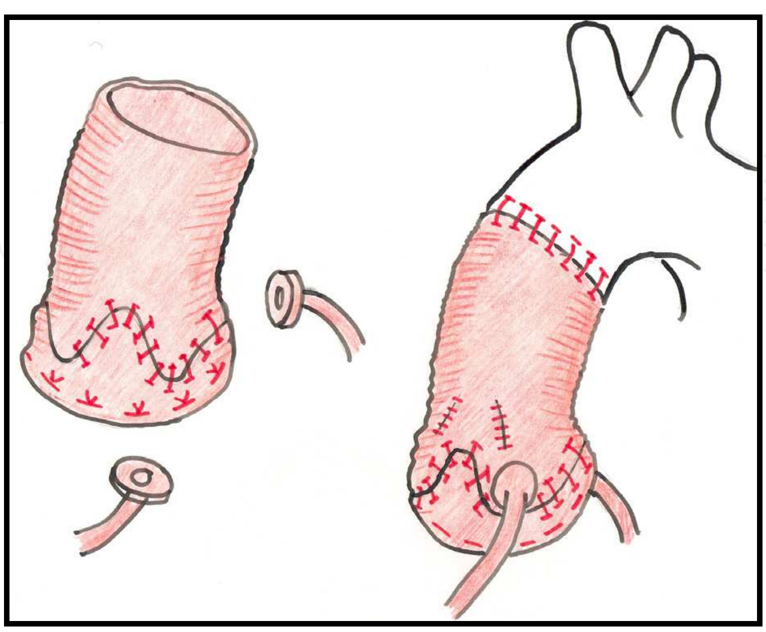

Fig. 8. Reimplantation of the aortic valve.

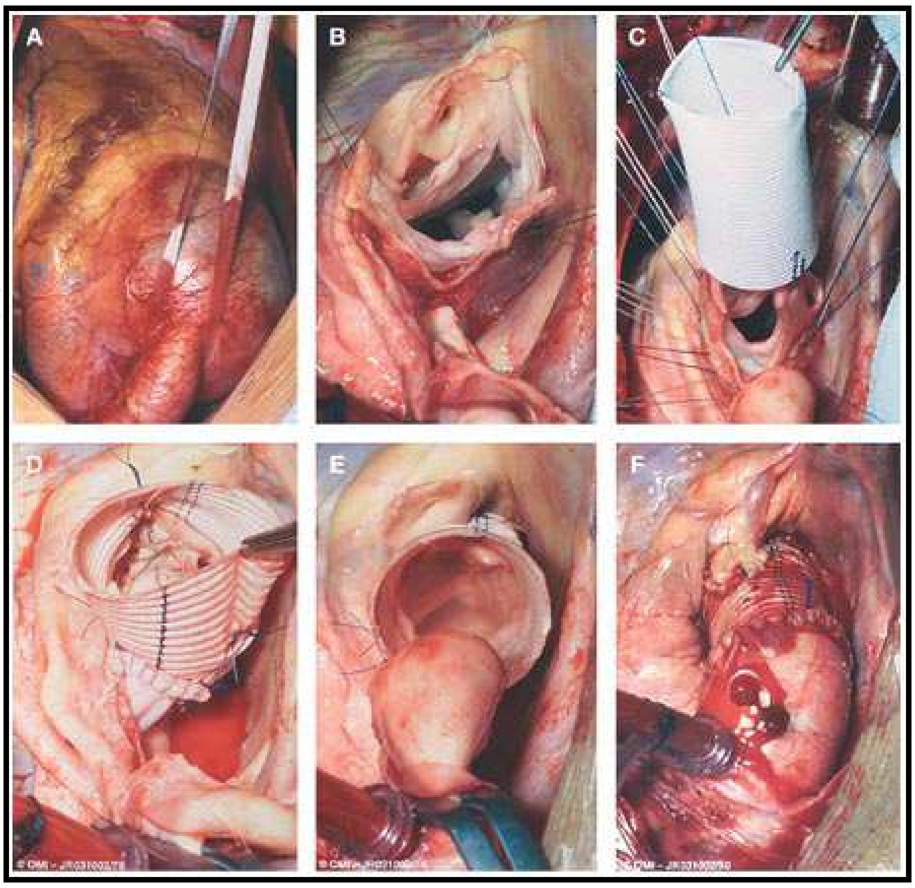

Fig. 9. A-root dilatation, B-resection of diseased Valsalva sinuses with preparing coronary artery buttons. C, D-reimplantation of the aortic valve into the prosthesis, E, F- distal anastomosis between the graft and the native ascending aorta.

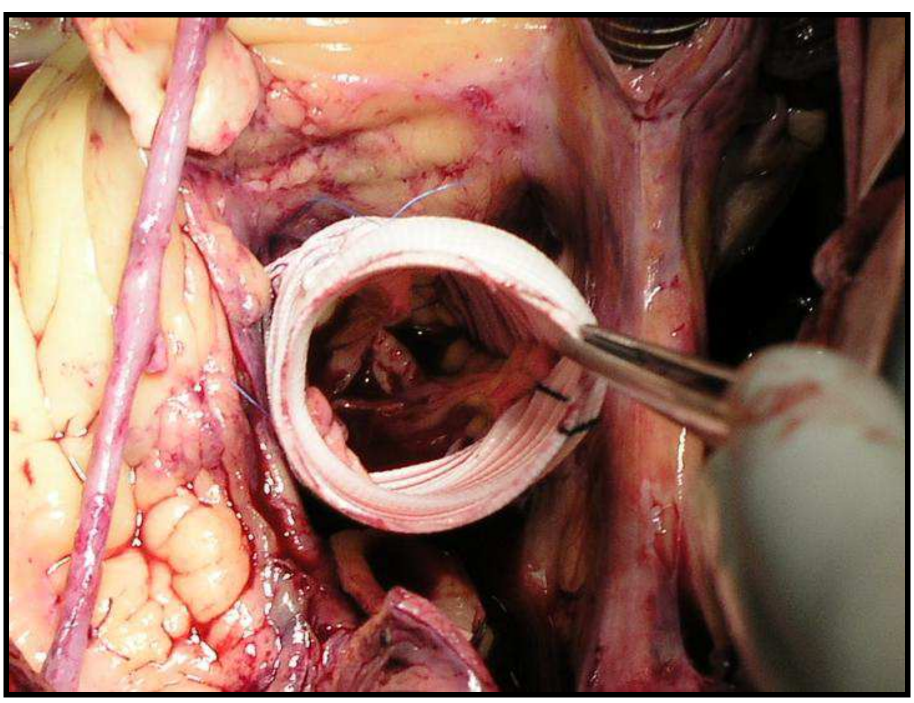

Fig. 10. Reimplantation of the valve into the prosthesis. (Photo is from the author´s archive)

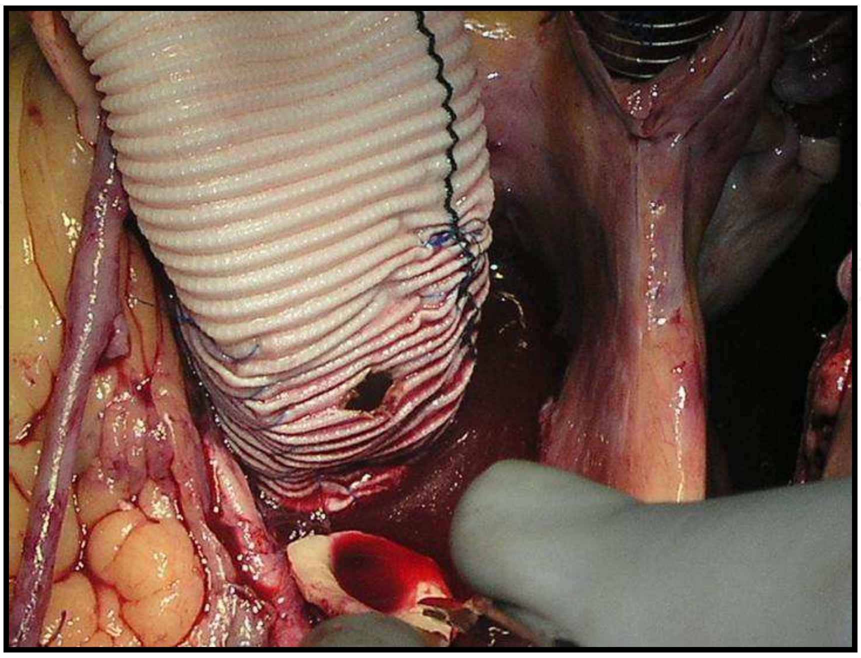

Fig. 11. Hole preparation by electrocautery for coronary artery button reimplantation. (Photo is from the author´s archive)

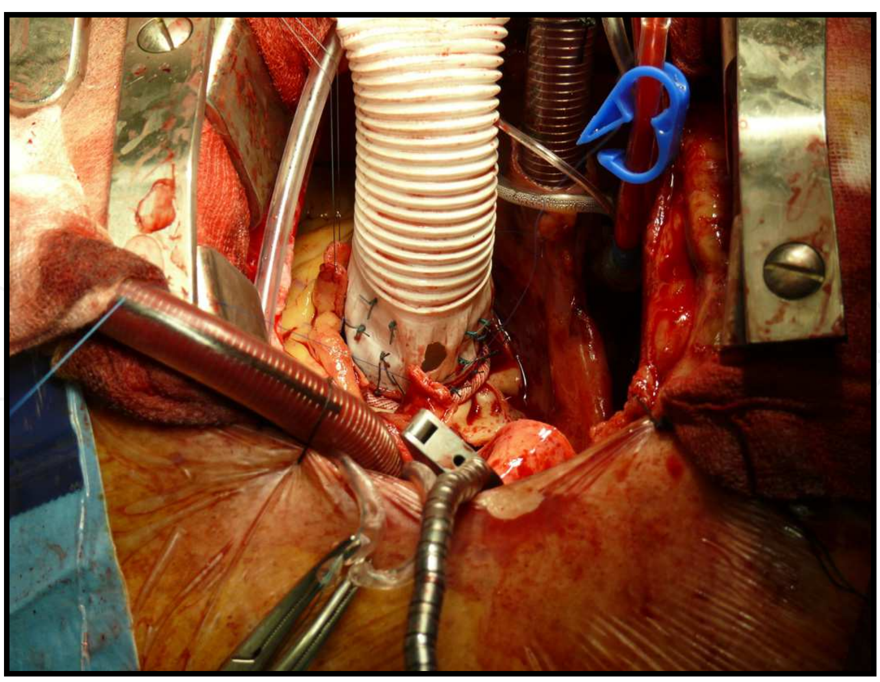

Fig. 12. The implantation of the coronary artery button end to side into the prosthesis. (Photo is from the author´s archive)

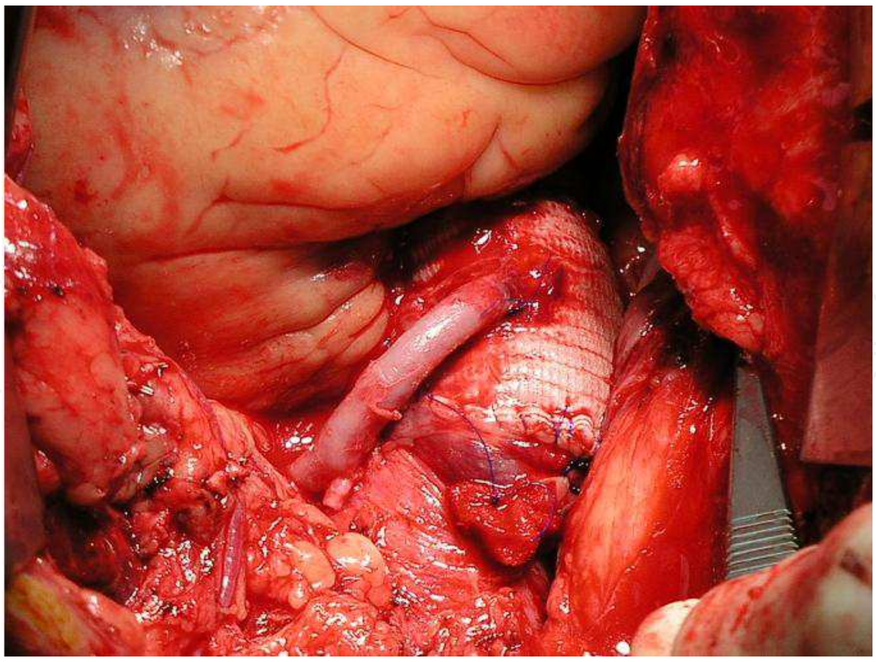

Fig. 13. Venous graft sewn into the prosthesis.
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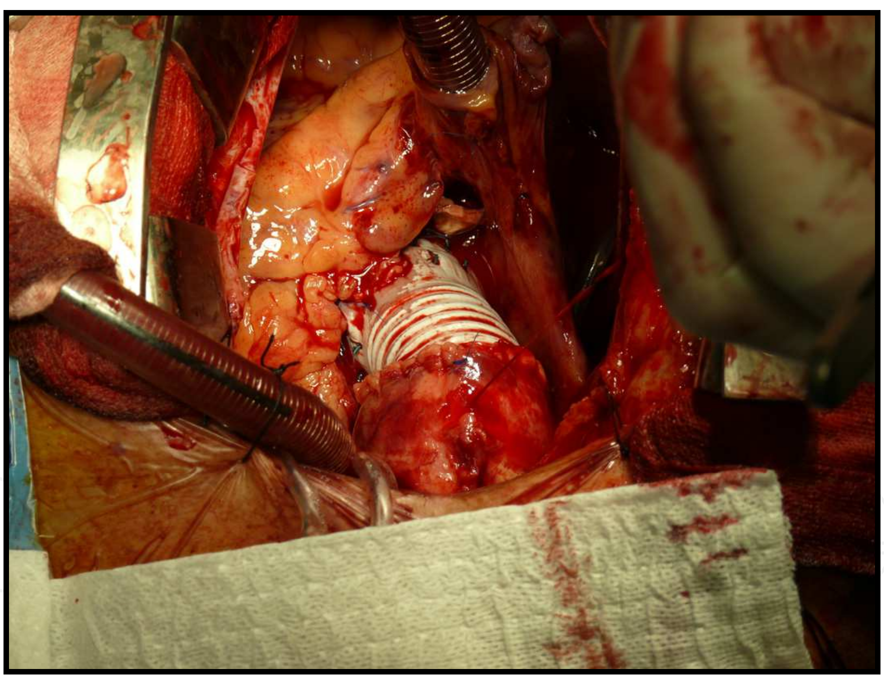

Fig. 14. The distal anastomosis between the graft and the native ascending aorta.
(Photo is from the author´s archive)

2.1.4 Replacement of the non-coronary aortic sinus (Wheat)

Indicated in patients with isolated non-coronary aortic sinus dilatation (exceptionally two sinuses). In our practise is the non-coronary sinus the most diseased sinus in case of nondegenerative diseases (atherosclerosis). The diseased non-coronary sinus and ascending aorta were replaced by a scalloped shape dacron tubular graft. (Fig. 15.)

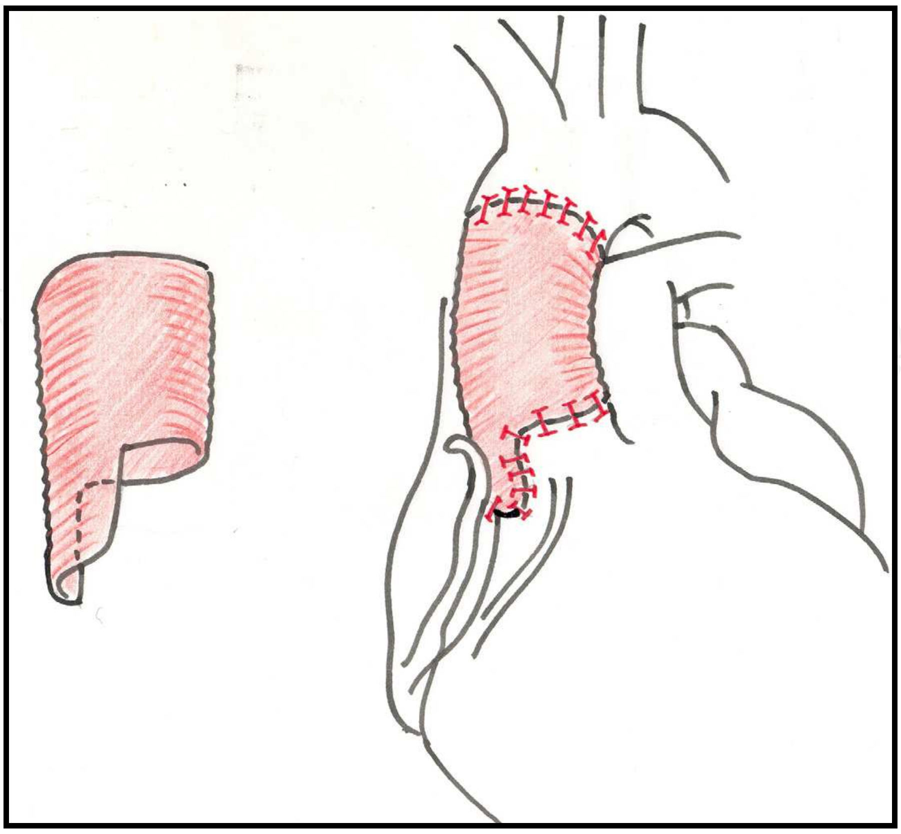

Fig. 15. Replacement of the noncoronary aortic sinus.

2.1.5 Cusp repair technique

Cusp perforation

When the leaflet defect is too large for direct closure with a running locked suture of 6-0 polypropylene, an autologous pericardial patch is used. The patch size is larger than the defect area to avoid any restriction of the repaired leaflet (26,15,27,10). (Fig. 16.)

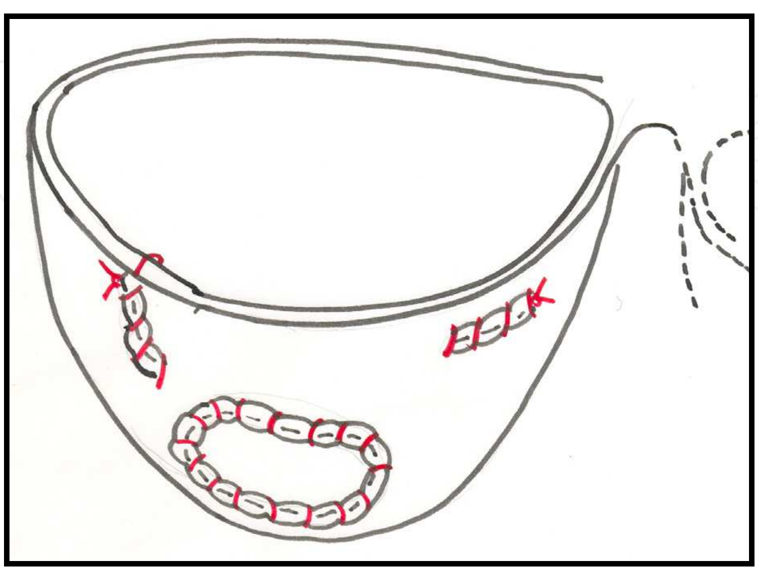

Fig. 16. Patch repair.

Stress fenestration

Caused by dilatation of the sinutubular junction (STJ) and increased mechanical stress on the free margin of the cusp. Most often located in the commissural areas and may be repared with a double layer of 6-0 PTFE suture along the free margins or by pericardial patch (11). (Fig. 17., Fig. 18.)

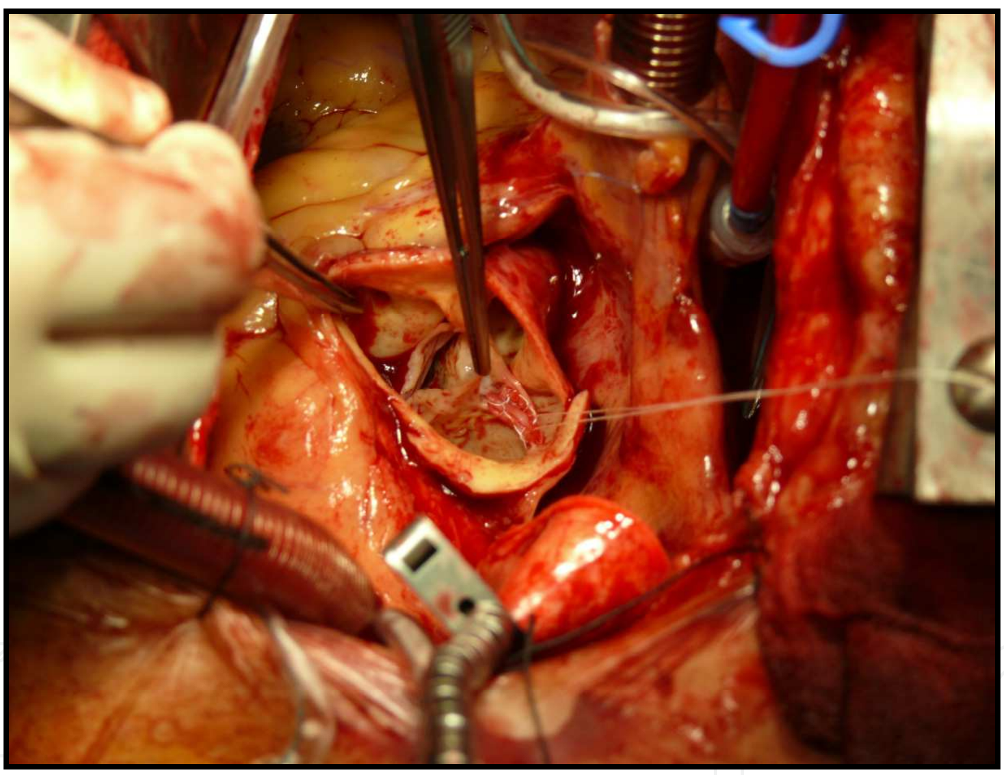

Fig. 17. Pericardial patch repair of the defect located in the commisural area.
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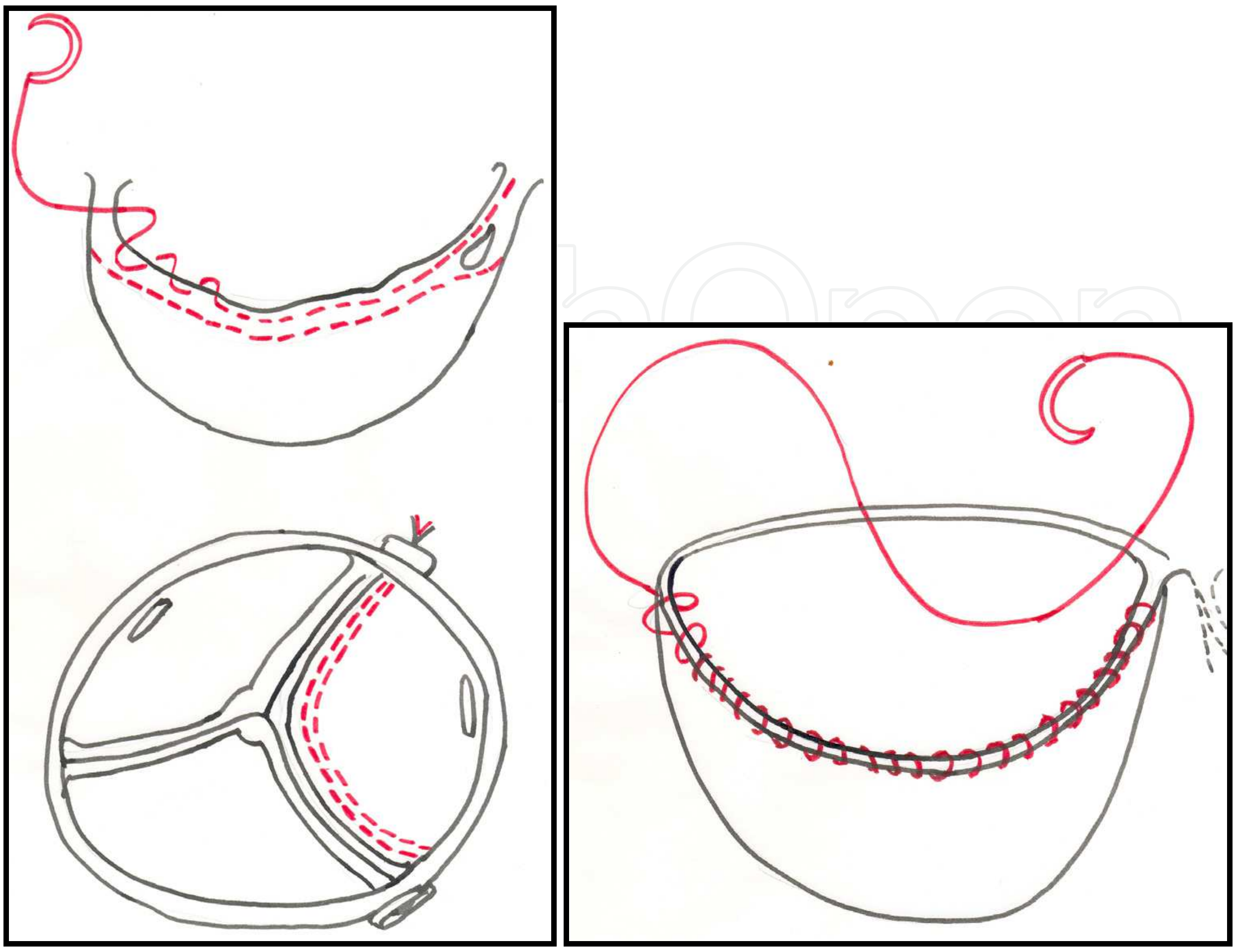

Fig. 18. Free margin reinforcement.

Leaflet prolapse

Is frequent cause of aortic insuficiency. The etiology is multiple-is frequent in bicuspid aortic valve, in patients with connective tissues diseases (Marfan syndrome), in chronic aortic root aneurysm. Acute leaflet prolapse can occur in patients with acute type A dissection, trauma. El Khoury et al. detaily desribed 4 different techniques of leaflet prolapse repair. (15,16,27).

- Central leaflet plication with 6-0 polypropylene suture
- Triangular resection

This two techniques are indicated when the leaflets are thin and flexible.

- Free margin resuspension with running suture of Gore-Tex 7-0 (Fig. 18.)
- Autologous pericardial patch repair

This techniques are prefered in case of poor quality of leaflets with thickening.
Kerchove et. al had a very good results with 146 patients with cusp prolapse corrected with this technique. During the initial hospitalization only two patients required reoperation for reccurent aortic insuficiency (AI). At 4 years freedom from reoperation and from reccurent AI (grade >2) was 94 ± 5% and 91 ± 7% respectively. (26)

3. Discussion

For long term durability and good results of the operation is essential to achieve a coaptation cusp area type A. Harringer et al. confirmed a direct correlation between early development and progression of aortic regurgitation and the type of coaptation area after the reconstruction of the valve on transthoracic echocardiography – tab. 3. (21). The authors confirmed the association between type B and C coaptation area and faster progression of aortic regurgitation compared with patients who had the type A of coaptation area. ($p<0,05$, C versus A in early postoperative period, $p<0,001$, C versus A and B after 1 year). Fig. 19. (21)

Type A	Coaptation area completely above inferior edge of prosthesis
Type B	Coaptation area at inferior edge of prosthesis
Type C	Coaptation area >= 2 mm below lower edge of prosthesis

Table 3. Type of coaptation area (Hannover classification).

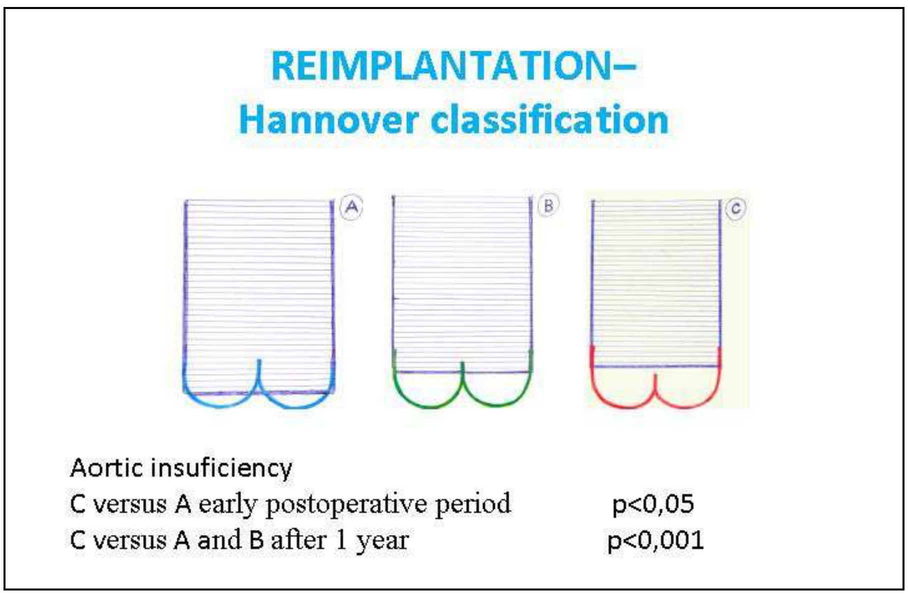

Fig. 19. Significance of aortic insuficiency.

If we decided to perform a reconstructive surgery of the aortic valve we have to answer 3 basic questions. Which **type of surgery** we perform, which **type** and **size of prosthesis** we use.

In the case of a limited expansion and dilatation of sinuses and ascending aorta the remodeling technique described by Yacoub is chosen. This technique seems more physiological. Restoration of the aortic sinuses provide a proper opening and closing velocities of the valve leaflets, with reducing their mechanical stress. (13). On the other hand remodeling is associated with higher risk of early reccurence of aortic regurgitation. The reason is lack of annular support.

If the dilatation affects the sinuses, including the annulus, we prefer reimplantation technique described by David, which provide more effective stabilization and external support of the annulus and better long term durability.

If one or maximum two sinuses are affected our decision is a created a neo-sinus by tailoring the graft with a tongue of tissue that is sutured directly to the aortic annulus replacement this part of aortic root with prosthesis.

Furthermore, we must decide what type of prosthesis we use-Dacron tube graft or prosthesis with neo sinuses. Aybek et al. showed that the tubular graft should have a greater rate of opening and closing of the valve and shorter times compared with native root and reimplantation into the prosthesis with neo sinuses. Similarly the distance between the cusps and graft wall during the systole was smallest. (9).

Also Leyh et al. (28) observed that near normal opening and closing characteristics can be achieved by a technique that preserves the shape and independent mobility of the sinuses of Valsalva. There is a theoretical assumption that neo sinuses (created by any method) will extend the durability of valve. But clinical differences in the intermediate term follow-up were clearly demonstrated.

De Paulis et al. introducing modified Dacron conduit (Gelweave Valsalva, Sulzer Vascutek, Renfrewshire, Scotland) that on implantation recreates sinuses of Valsalva of normal shape and dimension, providing a sufficient gap that should avoid any contact between the open leaflet and the Dacron wall. (34,13).

On the other hand, very good results with reimplantation technique into the Dacron tube graft achieve colleques in Hannover (24). In the 11 year interval a total of 284 patients operated on with an average follow up was 44 months (0-130 months). The number of reoperations for recurrent significant aortic regurgitation was only 11 patients. Only Marfan syndrome be considered as a risk factor for reoperation.

We also prefer the Vascutek Valsalva prosthesis which we prepare by parcial or complete scalloping.

For the good result of the operation is also important the size of prosthesis. Most authors derived it from the diameter of the annulus and length of the free margin of the leaflets in a relationship and in relation to type of valve preserving technique (remodeling or reimplantation). An interesting insight provides Maselli et al. (29), which is based on the consideration that in the case of native valve even when fully valve open in a systole remains space several millimeters between the leaflets and the wall of the aorta. Results of their simulations suggest that the ideal graft oversizing in respect the final aortic annulus diameter is +7 mm for a standard graft and +3 mm for the Valsalva grafts. It is very simply solution, available in every situation. We prefer to derive the size of prosthesis measured preoperatively by echocardiographic examination and perioperatively by Hegar dilator. Prosthesis is chosen by 10% greater for remodeling. For reimplantation technique in patients with severe dilatation of the annulus the free-edge length of the leaflet was measured in the short-axis view by tracing the leaflet outline. The parameters were determined in the closed valve and in the open valve. The size of the prosthesis was chosen by 50% less.

From 2002 to 2009, 37 patients underwent aortic valve sparing operations in our department. Mean age was 58 ± 9 (range 21 to 77) years. Of the 37 patients, 24 were male (64.8%) and 13 female (35.2%).

The average degree of aortic regurgitation was 2.9 ± 0.5, ejection fraction of the left ventricle was 56% ± 9. The average size of aortic annulus was 26,4 ± 2,6 mm, aortic root 50,6 ± 7,4 mm, sinotubular junction was 43,7 ± 5,1 mm and the ascending aorta 51,2 ± 6,8 mm. 32 (86,5%) patients underwent the reimplantation of the aortic valve according to the technique described by David, 2 (5,4%) patients underwent the remodeling procedure and 3 (8,1%) patients had a replacement of the noncoronary sinus descibed by Wheat.

Chronic ascending aortic aneurysm was present in 23 patients (62.2%), acute aortic dissection type A in 13 patients (35.1%) and chronic type A dissection in 1 patient (2.7%). 4 patients (10.8%) had Marfan syndrome and bicuspid aortic valve was present in 2 patients (5.4%).

Reoperation of the reconstructed vlave was required in 4 patients. One patient (with chronic aneurysm of the ascending aorta) has coaptation area type B in perioperative TEE and anatomical effects of the operation was not therefore prognostically optimal. In another patient, with Marfan syndrome, operated on for acute dissection, there was an abrupt aortic regurgitation 2 years after primary surgery because tearing one of the commissure. Second patient with Marfan syndrome and chronic ascending aorta aneurysm was reoperated after 4 years. The last patient with chronic aneurysm, and copatation area type A was reoperated after 3 years. It is considered that this type of procedures in carefully selected patients is safe and the mild-term follow-up is satisfactory.

3.1 Specific acces in the management of selected group of patients

3.1.1 Marfan syndrom

Composite replacement of the aortic valve and ascending aorta (Bentall procedure) is a standard approach in patients with Marfan syndrome associated with excellent long term outcomes. The major disadvantage are complications related to long-term anticoagulation treatment in young individuals. This is the main reason for increasing interest for preserve the native aortic valve.

Karck and associates (25) compare the results of aortic valve sparing reimplantation (45 patients) and aortic root replacement with mechanical valve conduits (74 patients) in patients with Marfan syndrome. The results during the mean follow up of 30 months (range 1-94 months) for patients undergoing aortic valve reimplantation and mean follow up 114 months for patients undergoing composite grafting were comparable. Freedom from reoperation and death after 5 years postoperatively was 84% and 96% in patients after vlave reimplantation and 92% and 89% in patients after Bentall procedure.

De Oliveira et al. (30) examine the long-term results of surgery for aortic root aneurysm in patients with Marfan syndrome. 44 patients underwent aortic root replacement and 61 patients underwent aortic valve sparing operations (remodeling/reimplantation). Freedoms from reoperation on aortic valve in patients with Marfan syndrome after aortic valve sparing operations was 100% et 5 and 10 years and in patients after aortic valve replacement 92±5% and 75±9% at 5 and 10 years.

Kallenbach from Hannover, Germany (23), did not observe any difference in short-term outcomes in patients with Marfan syndrome between the reimplantation technique and replacement with composite conduit.

A great supporter of the operation by the Bentall is Hagl from New York (20). He evaluates the results of 142 patients younger than 65 years (32% younger than 40 years, 58% between 40-60 years and 10% 60-65 years old) operated on by Bentall technique. Event-free interval was observed in a set of 0.85/5 years and 0.78/8 years. The gold standard in this age group the authors consider surgery by Bentall and prefer it before valve sparing operations.

3.1.2 Bicuspid aortic valve

A particular problem is the valve sparing operations for bicuspid aortic valve associated with aortic regurgitation, particularly in young patients.

Alsoufi and coworkers (2) presents the results of 71 patients with bicuspid valves and aortic regurgitation who were treated by remodeling, reimplantation or isolated aortic leaflets repair. Risk of reccurence of aortic regurgitation was greater in isolated leaflets repair as compared to remodeling/reimplantation. However, the risk of aortic regurgitation and the risk of reoperation and aortic valve replacement (in case of bicuspid aortic valve) is higher than the remodeling/reimplantation of the tricuspid valve in the same workplace. The risk of bleeding or thromboembolic complications are minimal, but the risk of significant aortic regurgitation (3+/4) is 56% 8 years.

The largest published series on aortic valve repair for aortic insufficiency due to prolapse of bicuspid aortic valve came from Cleveland Clinic. Casselman and colleagues reported on 94 patients with a mean age of 38 years. The freedom from reoperation was 84% at 7 years. (7). The only risk factor predictive of reoperation was residual aortic insufficiency at the time of repair.

Aicher and associates (3) reported a 5year freedom from recurrent aortic insufficiency of 96%, and a freedom from reoperation of 98% after the remodeling procedure in patients with incompetent bicuspid aortic valve and dilated aortic root.

Our insitutional approach in patients with bicuspid valves is very cautious. From our own experience we know that they are technically feasible very often. It is even possible to say that the correction of prolapse in bicuspid valve is simpler than the tricuspid valve. The problem we see in long term durability.

Robicsek et al. (32) showed that in bicuspid valve is never possible to achieve physiological flow and is always greater stress on the cusps in comparison with symmetrical tricuspid aortic valves. Therefore, very often we prefer a valve replacement. But this is a controversial topic with many opinions both for and against.

3.1.3 Aortic dissection type A

Acute dissection of the ascending aorta (Stanford classification type A) requires emergent surgical intervention to prevent life-threatening complications. The valve sparing techniques are innovative approach for patients in whom the aortic leaflets and annulus does not involved. Minor extension of the dissection into the aortic root with near normal size of the sinuses led to conventional valve sparing techniques using Teflon felts and glue. Severe extension of dissection including fragile tissue or aneurysmatic dilatation of more than 4,5 to 5 cm diameter of the dissected root favour valve sparing root replacement by the remodeling or reimplantation techniques. (17,18,19,8,31). Advantages of preservation of the native aortic valve are avoidance of a life-long anticoagulation treatment in mechanical valve replacement and facilitating the thrombotic obliteration of the false lumen. Persistent patency of the false lumen leads to the aneurysm formation, which has been associated with reduced late survival.

Erasmi et al. (19) reviewed 36 patients with acute aortic dissection type A who underwent aortic valve sparing operations. Only 3 patients required reoperation during the mean follow up 7,3 years (after remodeling technique) upon for redetachement of one commissure. All 3 reoperations have been associated with the use of GRF glue (at reoperation they found the necrotic and fragile tissues, which led to anastomotic dehiscences).

Also Casselman et al. (8) revealed the use of fibrinous glue and presence of an aortic valve annulus more than 27 mm as independent risk factors for aortic root reoperation.

Kallenbach et al. presents (24) excellent results in 53 patients with acute aortic dissection type A and valve sparing operations, only 2 patients required reoperation of the reconstructed aortic vlave, both because endocarditis.

Preliminary results of valve sparing techniques for type A dissection in a small series were encouraging with low hospital mortality, and aoutcome is comparable to patients treated with a Bentall procedure. But follow up is short and we have to wait for long term results.

4. Conclusion

Aortic valve sparing operations extend the spectrum of treatment options for aortic regurgitation. They provide excellent results and are associated with very low rates of valve-related complications. However, as they are technically demanding operations, only surgeons with extensive experience in aortic surgery should perform them.

The reimplantation technique with the Gelweave Valsalva prosthesis is our procedure of choice for patients with aortic root aneurysm, including the annulus dilatation with absence or minimal damages of aortic leaflets.

Long-term follow up of more number of patients are needed to confirm the eligibility of using this method in our daily practise.

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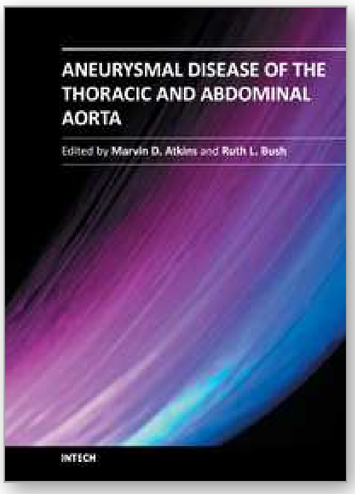

Aneurysmal Disease of the Thoracic and Abdominal Aorta
Edited by Dr. Ruth Bush

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The first successful open surgical repair of an abdominal aortic aneurysm was in 1951 by Dubost and represented a tremendous milestone in the care of this challenging disease. The introduction of endovascular repair in 1991 by Parodi furthered the care of these patients by allowing for lower morbidity and mortality rates and also, enabling surgeons to extend surgical treatment to patients traditionally deemed too high of a surgical risk. This new book on Aortic Disease covers many interesting and vital topics necessary for both the practicing surgeon as well as a student of vascular disease. The book starts with background information on the evolution of aortic management from traditional open surgical repair to modern endovascular therapies. There is also a chapter covering the data supporting current treatment modalities and how these data have supported modern management. Also, the use of endovascular means for care of the challenging situation of ruptured aneurysms is discussed. In addition to management of abdominal aneurysm, there is a chapter on treatment of aneurysms of the ascending aorta. Along with surgical treatment, one must also understand the molecular basis for how blood vessels remodel and thus, the role of cathepsins in aortic disease is elucidated. Lastly, chapters discussing the perioperative management of radiation exposure and ultrasound-guided nerve blocks as well as the need for high-quality postoperative nutrition will lend well to a full understanding of how to management patients from presentation to hospital discharge. We hope you enjoy this book, its variety of topics, and gain a fuller knowledge of Aneurysmal Disease of the Thoracic and Abdominal Aorta.

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