A lesional classification to standardize surgical management of aortic insufficiency towards valve repair

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Abstract

Objective: Aortic valve repair is an alternative to valve replacement for treatment of chronic aortic insufficiency (AI). In order to standardize surgical management, we suggest a classification based on echocardiographic and operative analysis of valvular lesions. Methods: Classification was based on the retrospective analysis of chronic AI mechanisms of 781 adults operated on electively between 1997 and 2003. Results: AI was isolated (406 patients (52%)), associated with supra-coronary aneurysm (97 cases (12.4%)), or with aortic root aneurysm (278 patients (35.6%)). Etiologies of valvular or aortic lesions were respectively rheumatic, dystrophic and atheromatous in 17%, 73.6% and 9.4% of cases. Lesional classification is based on the analysis of chronic AI mechanisms defining type I with central jet (354 cases, 45.3%) and type II with eccentric jet (54.7%). Type Ia is defined as isolated dilation of sino-tubular junction (47 supra-coronary aneurysms), and type Ib as dilation of both sino-tubular junction and aortic annular base (233 root aneurysms, 74 isolated AI). The type II associates dilation of sino-tubular junction and annular base to a valvular lesion: Ila cusp prolapse (95 aneurysms, 200 isolated AI); Iib cusp retraction (132 rheumatic AI), Iic cusp tear (endocarditis, traumatic). Conclusion: A lesional classification aims to standardize the surgical management of aortic valve repair: type Ia, by supra-coronary graft; type Ib, by subvalvular aortic annuloplasty associated with the aortic root replacement with a remodelling technique (root aneurysm) or double sub- and supra-valvular annuloplasty (isolated AI). For chronic AI type II, aortic annuloplasty associated a remodelling technique or double sub- and supra-valvular annuloplasty is combined with the treatment of the cusp lesion (cusp resuspension, cusp reconstruction with autologous pericardium).

Keywords: Aortic valve repair; Aortic annuloplasty; Chronic aortic Insufficiency; Aortic root aneurysm; Valvuloplasty; Lesional classification

1. Introduction

Pure aortic insufficiency (AI) represents 9.5% of the surgical indications of valve surgery in western countries [1]. The term ‘pure chronic AI’, either on tricuspid or bicuspid valves, includes three phenotypes depending on whether the sinuses of Valsalva and/or supra-coronary aorta are dilated: (1) isolated AI; (2) aortic root aneurysms; (3) supra-coronary aneurysms [2]. Until recently, valve replacement was the only surgical option for AI, performing either isolated valve replacement, composite valve and graft replacement or supra-coronary graft and/or valve replacement. However, the unique challenges presented by the expanding demographics of the elderly and the younger patients, and particularly women desiring pregnancy, necessitate a search for more physiological alternatives, based on native aortic valve preservation or repair [3–8]. These techniques avoid the implantation of prosthetic materials and the complications associated with anticoagulation therapy. Owing to improved understanding of aortic valve dynamic anatomy, more refined reconstructive methods have been developed to treat the different types of AI mainly based on functional analysis of chronic AI mechanisms [9–12]. However, the lack of exact indications, and the lack of standardization of the wide variety of published techniques limit the spread of valve repair [1].

In the light of these issues, a classification of chronic AI could be advantageous to more adequately relate surgical intervention to aortic valve and root lesions. This report proposes a lesional classification based on echocardiographic and operative data analysis of patients operated on for pure
chronic AI between 1997 and 2003. The classification allows a better understanding of the mechanisms of AI and leads to standardize its surgical management towards a more reconstructive approach.

2. Materials and methods

2.1. Anatomic definitions

Ascending aorta is defined as the ensemble comprising two distinct entities, separated by the sino-tubular junction: (1) the aortic root, initial portion that includes the aortic valve with a sigmoid-shaped annulus, interleaflet triangles, sinuses of Valsalva and sino-tubular junction and (2) the supra-coronary aorta above the sino-tubular junction up the brachiocephalic trunk (Fig. 1). The aortic root is a dynamic complex with a systolic expansion (through the interleaflet triangles) associated to vortex formation through the sinuses of Valsalva that maximize ejection and reduce shear stress on the leaflets [9]. The three-dimensional structure of the aortic annulus can be divided into two functional diameters of the aortic root, ensuring proper valve function, namely the aortic annular base and the sino-tubular junction [9,11,13].

Cut-off point of ‘normal’ diameters of the aortic root were defined from analysis of main literature series showing that a normal aortic annular base diameter ranges from 21 to 24.5 mm (mean 22.9 mm) and a normal sino-tubular junction ranges from 27.5 to 28.1 mm (mean 27.5). Therefore, in this study, an aortic annular base diameter superior to 25 mm and a sino-tubular junction diameter superior to 30 mm were considered as dilated [14,15].

2.2. Retrospective analysis

Classification was based on retrospective analysis of 781 patients operated on electively from 1997 to 2003 for pure chronic AI. Endocarditis, aortic dissection or combined procedures (CABG, mitral valve surgery) were excluded. Only patients with a precise description of valve or aorta, based on analysis of operative surgical and/or echocardiographic reports, were included in this study. There were 531 males (68%) and 250 females (32%). Their ages ranged between 16 and 88 years with a mean of 53.5 ± 13 years. Surgical indications were isolated AI in 406 patients (52%), AI associated with supra-coronary aneurysm (97 cases (12.4%)), or with aortic root aneurysm (278 patients (35.6%)). Valves were bicuspid in 23.8% (97) of the cases with isolated AI, in 10.8% (30) of the root aneurysms, and in 5% (5) of the supra-coronary aneurysms. Among the 781 patients, etiologies were rheumatic (17%), dystrophic (73.6%) and/or related to supra-coronary atheromatous aneurysm (9.4%) (Table 1).

3. Results

3.1. Operative characteristics

Isolated chronic AIs were treated with a mechanical valve replacement in 70.4% (286) of cases, a bioprostheses in 21.7% (88), and aortic homografts in 7.9% (32) of patients. A separated valve and the replacement of the supra-coronary aorta was performed in 13.3% of cases and isolated supra-coronary grafts were implanted in 12.5% of patients to treat supra-coronary aneurysms. In the cases with aortic root aneurysm, composite graft replacement was performed in 91% (244) of the patients and valve sparing with the remodelling technique was performed in 9% (34) of the patients.

To respect the dynamic anatomy of the aortic root, our group has favored the remodelling technique since 1997. However, over the 34 patients operated up to 2003, this technique failed to restore valve competence in 1/3 of cases [8]. As already mentioned by other authors, this high rate of failure is linked to the lack of treatment of annular base dilatation which is almost constant in patients with aortic root aneurysms [8,16,17] This statement encouraged us to analyze more precisely the echocardiographic data and operative records of the 781 patients with chronic AI in order to perform a reliable valve repair.
Results are expressed as mean ± standard deviation.

### 3.2. Analysis of the lesions

In all cases (bicuspid or tricuspid valve), at least one of the two functional diameters of the aortic root was dilated (sino-tubular junction or aortic annular base) (Table 1). Supra-coronary aneurysms presented isolated dilation of the sino-tubular junction in 48.4% (47) of the cases. Dilation of both annular base and sino-tubular junction was found in all cases of isolated AI and aortic root aneurysms as well as in 51.6% (50) of supra-coronary aneurysms. Operative records showed that valvular lesions were present in 51.6% of supra-coronary aneurysms (50 cusps prolapses), in 81.7% of isolated AI (200 cusp prolapses and 132 retractions) and 16.1% of aortic root aneurysms (45 cusp prolapses). In those cases, an eccentric jet was constantly found on color Doppler analysis. Therefore, two groups of patients were defined with distinct lesional mechanisms of AI: (1) 354 patients (45.3%) with a central jet, in whom the lack of valvular coaptation was related to dilation of the sino-tubular junction and/or aortic annular base, and (2) 427 patients (54.7%) with an eccentric jet in whom the lack of valvular coaptation was related to the combination of a valvular lesion and the dilation of the aortic root diameters.

Dilation of root diameters could be either a primary or secondary mechanism of chronic AI or a combination of both. In case of aortic root aneurysms, the dilation is mostly related to a dystrophic aortic wall. In case of valvular lesions, dilation occurs mostly as a consequence of chronic regurgitation, increased cardiac output, and dilation of the left ventricle leading at last to dilation of left ventricular outflow tract.

### 3.3. Lesional classification

In the light of these issues, a lesional classification was designed to more adequately correlate the appropriate surgical intervention with the aortic valve and root lesions (Fig. 2). Chronic AI can be divided in two types regarding the direction of the regurgitant jet: type I with central jet and type II with eccentric jet. Each type of AI is subdivided according to the dilated diameter of the aortic root and/or cusp lesion. Type I is exempt from cusp lesion, and central regurgitation is related to isolated dilation of the sino-tubular junction (type Ia) or to dilation of both sino-tubular junction and the annular base (type Ib).

Type II presents constant dilation of both diameters, and eccentric jet is linked to a valvular lesion such as cusp prolapse (type IIa), cusp retraction (type IIb) and cusp tear or perforation (type IIc). Lack of data concerning AI type IIc in our analysis represents one of the limitations of this study. However, in such cases root dilation might be linked to the same mechanisms of root dilation as chronic AI with cusp lesion. For this reason, this subgroup was added to complete the lesional classification [2].

Echocardiographic and intraoperative aortic root diameters of the 781 operated patients are detailed in Table 2 according to each type of the lesional classification.

### 3.4. Reconstructive techniques

The design of lesional classifications leads us to adapt the reconstructive techniques to each type of AI in a standardized approach. Principles of the standardized techniques are (1) to treat the lesions (dilated diameters and/or cusp lesion) in order to increase the coaptation height, and (2) to preserve the dynamic anatomy of the aortic root. A subvalvular aortic annuloplasty is systematically performed using an external expandable aortic ring to reduce aortic annular base diameter (Extra-Aortic, Coroneo Inc.) [18]. Depending on the phenotype, reduction of the sino-tubular junction diameter will be achieved through a supravalvular annuloplasty, obtained either with an external expandable aortic ring (isolated AI, Extra-Aortic, Coroneo Inc.), or with a supra-coronary graft (supra-coronary aneurysm) or with a root remodelling (root aneurysm). The choice of the prosthetic ring diameter and of the tube graft is based on the sole criterion of the diameter of the native aortic annular base (Table 3). In case of cusp lesion (type II), the prosthetic ring diameter could be undersized in order to protect valve repair, releasing tension on the cusp suture lines, reducing the physical stress on the remnant cusp and providing a functional reserve in case of pressure overload [19]. Repair of valvular lesions is achieved with current techniques (cusp

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### Table 1
Population characteristics of 781 patients operated on for pure AI between 1997 and 2003

<table>
<thead>
<tr>
<th></th>
<th>Isolated AI</th>
<th>Supra-coronary aneurysm</th>
<th>Aortic root aneurysm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>406</td>
<td>97</td>
<td>278</td>
</tr>
<tr>
<td>Mean age</td>
<td>52 ± 4.5</td>
<td>62.8 ± 7.4</td>
<td>52 ± 6.2</td>
</tr>
<tr>
<td>Extremes</td>
<td>17–81</td>
<td>32–86</td>
<td>16–88</td>
</tr>
<tr>
<td>Valves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicuspid</td>
<td>97 (22.8%)</td>
<td>5 (5%)</td>
<td>30 (10.8%)</td>
</tr>
<tr>
<td>Tricuspid</td>
<td>309 (76.2%)</td>
<td>92 (95%)</td>
<td>248 (89.2%)</td>
</tr>
<tr>
<td>Etiology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rheumatic</td>
<td>132 (32.5%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dystrophic</td>
<td>274 (67.5%)</td>
<td>23 (23.7%)</td>
<td>278 (100%)</td>
</tr>
<tr>
<td>Atheromatous</td>
<td>0</td>
<td>74 (76.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Echocardiographic characteristics (mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aortic annular base diameter</td>
<td>27 ± 3.1</td>
<td>24.9 ± 2.1</td>
<td>27.2 ± 2.36</td>
</tr>
<tr>
<td>Sinuses of Valsalva diameter</td>
<td>38 ± 5</td>
<td>34.7 ± 3.8</td>
<td>54 ± 8.3</td>
</tr>
<tr>
<td>Sino-tubular junction diameter</td>
<td>35 ± 3.9</td>
<td>41 ± 8</td>
<td>51.1 ± 9.5</td>
</tr>
</tbody>
</table>

AI, aortic insufficiency.

Results are expressed as mean ± standard deviation.
4. Discussion

Until recently, comprehensive analyses of AI mechanisms were not a concern because prosthetic valve replacement was the standard surgical treatment for aortic valve disease. However, none of the current valve substitutes are ideal options in young patients, especially since mechanical valves require life-long anticoagulation [3]. In light of the good results of mitral valve repair, techniques that are more physiological are being developed in order to preserve the native aortic valve. Recent evolution of aortic valve sparing techniques mirrors the evolving understanding of the functional anatomy of the aortic root complex that includes the cusps, the sigmoid-shaped aortic annulus, the interleaflet triangles, and the sinuses of Valsalva [9]. Analysis of the literature emphasizes two basic surgical objectives of valve sparing: the treatment of the lesions (dilation of aortic annular base and/or sino-tubular junction and cusp lesions) as well as the preservation of aortic root dynamics [7,8,10,12].

Over the past decade, two types of valve-sparing procedures were mainly developed to treat aortic root aneurysm: 'Remodelling' of the aortic root and 'Reimplantation' of the aortic valve [4,5]. The remodelling technique reduces the sino-tubular junction diameter and creates three neo-sinuses of Valsalva using a scalloped graft sutured in the supravalvular position, but does not address the dilation of the annular base. Alternately, the reimplantation technique encloses the aortic valve within a cylindrical tube implanted in the subvalvular position, which reduces both the annular base and the sino-tubular junction diameters to the detriment of the aortic root dynamics. Because neither technique attains all the goals of valve sparing, multiple modifications of the original techniques have been published, trying to combine advantages of both approaches.

Latest guidelines place mitral valve repair as the treatment of choice compared to valve replacement [20,21]. The wide-spread implementation of mitral valve repair is dependent on a systematic approach combining functional classification of mitral regurgitation and standardization of the techniques based on mitral annuloplasty [22].

Few surgical classifications of AI have been proposed. Acar and Jebara [11] established a classification based on the length of the cusp free edge. Valvular coaptation is considered normal when the length of the free edge is equal to the annular base diameter. Authors described four types of AI: type I aortic annular base dilation, with cusp free edge...
shorter than aortic annular base diameter, type II valve prolapse with cusp free edge longer than aortic annular base diameter, type III valve retraction with cusp free edge longer than aortic annular base diameter and type IV: cusp tear with length of the free edge equal to aortic annular base diameter. Although based on the lesion analysis, this classification relies on a parameter that is difficult to evaluate intraoperatively or with echocardiography.

Haydar et al. [10] defined a surgical classification with three types: type I: aortic annular base dilation, type II: redundant cusp tissue and type III: restricted cusp motion due to deficient cusp tissue. More recently, El Khoury and co-workers [12] described a functional classification of AI, inspired from Carpentier’s classification of mitral regurgitation. This classification, based on echocardiographic analysis, focuses on mechanisms of valve dysfunction and relies on the functional aortic annulus (FAA), defined as the interdependency between aortic annular base and sinotubular junction diameters. It is based primarily on an assessment of cusp function (normal, prolapse, or restriction) and first introduces analysis of aortic root anatomy: type I: enlargement of the root with normal cusps (Ia: distal ascending aorta dilation (sino-tubular junction dilation), Ib: proximal (sinuses of Valsalva) dilation and STJ dilation, Ic: isolated FAA dilation), type II: cusp prolapse or commissural disruption, type III: cusp retraction or thickening. Although this classification pioneers the field to standardize surgical management of AI towards valve repair, the functional approach might be limited when two types co-exist within one patient.

Based on our clinical experience and analysis of literature [8,10—12] we propose a lesional classification, in order to simplify standardization of reconstructive aortic valve techniques. Each patient can be classified in only one type of chronic AI. Each type corresponds to a specific surgical strategy (Fig. 2). This classification relies on a systematic approach by:

- Echocardiographic analysis of the regurgitant jet leading to define aortic insufficiency according to the anatomical lesions. In case of a central jet (type I), the lack of valvular coaptation is related to dilation of at least one of the functional diameters of aortic root (sino-tubular junction and/or aortic annular base). In case of an eccentric jet (type II), the lack of valvular coaptation is related to the combination of a valvular lesion and the dilation of the aortic root.
- Intraoperative measurement of the internal aortic annular base diameter, as the sole criterion determining the choice of prosthetic rings and tube grafts, according to the type of AI (Table 3).

### Table 2
Echocardiographic and intraoperative analysis of aortic root parameters according to each type of the lesional classification

<table>
<thead>
<tr>
<th>Type</th>
<th>Lesional mechanisms</th>
<th>Cusp lesion</th>
<th>Echocardiographic</th>
<th>Intraoperative diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aortic annular base (mm)</td>
<td>STJ (mm)</td>
</tr>
<tr>
<td>Ia</td>
<td>Supracoronal aortic annulus</td>
<td>24.2 ± 2.1</td>
<td>40.6 ± 3.4</td>
<td></td>
</tr>
<tr>
<td>Ib</td>
<td>Isolated aortic insufficiency</td>
<td>27.9 ± 3.3</td>
<td>34.3 ± 2.8</td>
<td></td>
</tr>
<tr>
<td>IIa</td>
<td>Aortic root annulus</td>
<td>27.1 ± 2.2</td>
<td>50.9 ± 6.3</td>
<td></td>
</tr>
<tr>
<td>Ic</td>
<td>Supracoronal aortic annulus</td>
<td>28.2 ± 3.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ia</td>
<td>STJ + aortic annular base</td>
<td>28.6 ± 3.1</td>
<td>34.2 ± 3.9</td>
<td></td>
</tr>
<tr>
<td>Ib</td>
<td>Isolated aortic insufficiency</td>
<td>27.9 ± 1.6</td>
<td>52.3 ± 5.7</td>
<td></td>
</tr>
<tr>
<td>IIa</td>
<td>Cusp prolapse</td>
<td>28.1 ± 2.8</td>
<td>43.3 ± 7.3</td>
<td></td>
</tr>
<tr>
<td>Ic</td>
<td>Supracoronal aortic annulus</td>
<td>28.7 ± 1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ib</td>
<td>Cusp tear or perforation</td>
<td>25.8 ± 3.3</td>
<td>35.4 ± 4.2</td>
<td></td>
</tr>
<tr>
<td>IIa</td>
<td>Cusp tear or perforation</td>
<td>26.6 ± 2.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gray areas: data not available.
Results are expressed as mean ± standard deviation.
STJ, sino-tubular junction.

### Table 3
Criteria for the choice of the prosthetic aortic ring and tube graft diameter

<table>
<thead>
<tr>
<th>Aortic root aneurysm or supra-coronary aneurysm</th>
<th>Native aortic annular base Ø (mm)</th>
<th>Central jet (AI grade 0 or I)</th>
<th>Eccentric jet or AR grade II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø sub-valvular aortic ring</td>
<td>25 27 29 31</td>
<td>27 29 31</td>
<td>25 27 29</td>
</tr>
<tr>
<td>Ø tube graft</td>
<td>26 28 30 ≥32</td>
<td>28 30 ≥32</td>
<td>25 27 29 31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Isolated dytrophic AI</th>
<th>Native aortic annular base Ø (mm)</th>
<th>Ø sub-valvular aortic ring</th>
<th>Ø supra-valvular ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 27 29 ≥31</td>
<td>23 25 27 29</td>
<td>24 26 28 30</td>
<td></td>
</tr>
</tbody>
</table>

Ø, Diameter.
AI, aortic insufficiency.
Considering the issues both to treat the lesions (dilation of the aortic annulus and/or sino-tubular junction and/or cusp lesions) and to preserve the dynamic anatomy of the aortic root, the proposed standardization of aortic valve repair is based on sub- and supravalvular annuloplasty in order to increase the level of coaptation and protect valve repair. These principles are known since the early 60s, with first publications of aortic circumclusion followed by sub- and supravalvular commissural plication [23,24]. In order to perform a reproducible and calibrated subvalvular annuloplasty, we suggest implanting an external prosthetic ring at the level of the aortic annular base. Depending on the root phenotype, supravalvular annuloplasty at the level of the sino-tubular junction could be achieved by an external prosthetic ring (isolated IA), a supra-coronary graft (supra-coronary aneurysm) or a root remodelling (root aneurysm). The addition of an external subvalvular expandable ring to the physiological reconstruction of the aortic root with a remodelling procedure combines the advantages of both original approaches of valve sparing (remodelling and reimplantation) (Fig. 3) [8].

In case of isolated AI the same principles apply, that is, performing a calibrated double sub- and supravalvular external annuloplasty in order to reduce aortic annular base and sino-tubular junction diameter thus preserving the aortic root dynamics through the interleaflet triangles [13,18] (Fig. 4).

In case of AI type II, medium- and long-term results appear to validate use of the current techniques to repair cusps lesions [7,19,25]. Although AI type II b and II c present relatively less dilation of root diameters compared to dystrophic entities (II a), the aortic annular base and sino-tubular junction are at least functionally dilated. In those cases, goals of aortic annuloplasty are not only to protect the cusp sutures but also to adjust the aortic annulus diameter to the repaired cusps [7,10].

Although the feasibility of the aortic valve repair is well documented, randomized evaluation is the most reliable option to validate evidence of the best management for patients with AI [4—8]. Applicability of this lesional classification and standardized surgical techniques will be evaluated in a prospective, multicenter randomized open trial, the CAVIAAR study (Conservative Aortic Valve surgery for aortic Insufficiency and Aneurysm of the Aortic Root). This trial began in May 2007 and plans to enrol 93 patients with the standardized annuloplasty technique and 93 patients with mechanical valve replacement for dystrophic AI.

All classifications underline the actual trends towards simplification of AI mechanisms analysis and repair techniques [10—12]. Surgeons must keep on pooling their expertise to uniformly name the different types of lesions in order to standardize valve repair approaches and to spread their use among a greater number of surgeons for the benefit of patients.

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References


Appendix A. Conference discussion

Dr M. Antunes (Coimbra, Portugal): How many of those cases were repaired

Dr Lansac: In this patient population, very few valve repairs were performed because this study was conducted retrospectively from 1997 up to 2003, which corresponds to the beginning of valve sparing using isolated Remodelling technique in our team (La Pitie Salpetriere Hospital, Paris, France). Among these first 34 patients, 1/3 had to be converted intraoperatively or reoperated at short-term follow-up, mostly related to untreated aortic annular base dilation. Therefore, we decided to analyze retrospectively data of patients operated for aortic insufficiency in order to identify the exact mechanism of aortic insufficiency, with a particular focus on the dilated aortic annular base.

Editorial comment

1. Introduction

Aortic repair surgery has gained a wider interest in the last 15 years; several publications showing short- and long-term results support this trend. A brief analysis of indications and aetiology can give us an idea as to which forms of aortic regurgitation are amenable to successful repair. Eventually, aortic repair was only performed in case of rheumatic or calcific aortic regurgitation, which explains the poor results.

Because of the near disappearance of rheumatic disease in younger patients, other congenital and/or degenerative aetiologies have become more frequent indications for conservative aortic surgery. Thus, bicuspid aortic valve, degenerative diseases of the media (as Marfan syndrome), degenerative cusp prolapse and acute aortic dissection are nowadays the most common mechanisms of aortic insufficiency that can lead to conservative aortic surgery. Atherosclerotic aortic aneurysm of ascending aorta is another indication in elderly patients. Endocarditis of the aortic valve, acute or chronic, is a less favourable indication, contrary to what happens in the mitral valve. One common characteristic of the indications previously enlisted is the good quality of valvular tissue.

Although several surgical techniques have been published for treating different aortic lesions, it is rather impossible to draw any valid conclusions regarding the feasibility of aortic repair or the choice of the most appropriate technique. Actually in literature we still need a complete review of surgical results, with an overall analysis of recurrences and...