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Guidelines for Surgery of Aortic Diseases from Brazilian Society of Cardiovascular Surgery

Diretrizes para o tratamento cirúrgico das doenças da aorta da Sociedade Brasileira de Cirurgia Cardiovascular

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INTRODUCTION

However the advances in diagnostic examinations, in monitoring and hemodynamic support methods and in the surgical repair techniques that have occurred over the last few years, aorta diseases are still a significant cause of cardiovascular mortality and morbidity and a continuous challenge for cardiologists and surgeons.

In cases of acute dissection (AD), the consensus regarding the necessity of immediate surgery is well stablished. However, even after more than three decades, the correct moment to intervene in degenerative diseases of the ascending aorta, which determine its asymptomatic dilation, are still under discussion and have been the subject of many recent publications. The same can be said for the management of the aortic root and the aortic valve.

When the transverse arch is involved, the controversies are focused on the definition of when and to what extent the arch must be included in reconstruction, and in the choice of the best method of cerebral protection. The types of protection may include hypothermic cardiocirculatory arrest, venous retrograde perfusion, selective cerebral perfusion and more recently anterograde perfusion through subclavian-axillary axis.

In the treatment of the descending aorta and thoracic-abdominal diseases, spinal cord ischemia is still the main concern, with variable but significant involvement, in the different approaches described. This was one motivation

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for the development of self-expanding stents. Additionally, in cases of degenerative aneurysms, results from recent studies on the prediction of dissection and rupture rates, probably will change the decision of intervention based exclusively on the diameter, allowing more individualized decisions including factors such as age, co-morbidities and experience of the surgical team.

Concerning abdominal aorta, the classic indication for surgical repair of asymptomatic infra-renal aneurysms, larger than 4 cm in diameter, may be modified by the results of recent European and North-American trials. Similarly, experience with endoluminal exclusion, using stents described in many studies that compare this technique with open surgery, has been the subject of discussions and a consensus is still non existing.

These guidelines aim at critically reviewing the indications and the surgical results in the treatment of several aortic diseases, utilizing the degree of evidence as proposed by the American Heart Association / American College of Cardiology and are classified as:

Class I: situations in which there is evidence or general agreement that the procedure is beneficial and effective.

Class II: situations in which there is conflicting evidence or divergences over the usefulness and efficacy of the procedure or treatment.

Class IIa: situations in which the weight of evidence and opinions encourages the use of the procedure or treatment

Class IIb: situations in which the utilization and the efficacy of the procedure or treatment are not well supported by evidence and opinions

Class III: situations in which there is evidence or general agreement that the procedure or the treatment is not beneficial and may even be deleterious.

Level of evidence A: data obtained from several randomized trials or a meta-analysis of randomized clinical trials.

Level of evidence B: data obtained from just one randomized clinical assay or from several non-randomized studies.

Level of evidence C: data obtained from consensual opinions of specialists on the matter.

ACUTE AORTIC DISSECTIONS

Acute Type-A Dissections

In ascending aortic dissections, surgical intervention must be immediate with the principal aim of avoiding rupture and death by cardiac tamponade. Additional aims include repairing aortic regurgitation when present, avoiding myocardial ischemia, occluding the site of intima laceration and re-directing the flow through the true lumen to the supra-aortic branches and to the descending aorta [1-7].

In the choice of surgical reconstruction technique, three questions must be considered: 1. – The diameter and the condition of the aortic root and of the Valsalva's sinus at the moment of the intervention and if possible, prior to the acute event; 2. – the condition of the aortic valve; 3. – the extent or existence of injury to the intima of the transverse arch.

If the diameter of the ascending aorta and of the aorta root are normal and there is no misalignment of the aortic valve commissural plane, nor is there distortion of the coronary ostia, the repair usually involves the use of a straight Dacron graft, anastomosed near to the aortic sinotubular junction. If there is a loss of support of one or more commissures in the aortic valve, they should be resuspended during the repair of the commissural angles, before the insertion of the straight graft. However, if it is impossible to repair the aortic insufficiency by valvuloplasty or if the aortic valve is bicuspid, replacement must be performed using a prosthesis, before the supra-commissural implant of the graft [6-8], although some authors report success with the repair of bicuspids valves [9].

The conventional approach to surgical repair of type-A dissections is median sternotomy with the CPB circuit established by cannulation of the right atrium (RA) and of the femoral artery, generally utilizing moderate hypothermia of from 28 ºC to 32 ºC.

When aortic dissection occurs in a previously dilated ascending aorta or in patients with annulus-aortic ectasia, associated with Marfan's syndrome or not, the surgical repair necessarily requires the replacement of the aortic valve, of the sinotubular junction and of the Valsalva's sinuses and re-implantation of the coronary ostia, utilizing a composite graft for the valvar prosthesis and a Dacron mesh, known as a valved tube [10,11].

In the technique originally described by Bentall & De Bono [12], the coronary ostia are included in the ascending portion of the Dacron tube, by direct anastomoses after valve implantation. The significant incidence of late pseudo-aneurysms, associated with the difficulty of direct re-implantation of the coronaries, in cases of not so significant dilations of the Valsalva's sinus, supports the use of a modification proposed by Kouchoukos et al. [13] in which the coronary ostia are excised and implanted in the tube in the form of buttons. This technique denominated 'button Bentall' has presented with low hospital mortality and a lower incidence of complications [14-16]. Alternatively, the modification proposed by Cabrol et al. [17] in which a PTFE graft is connected to the ascending portion of the Dacron tube and anastomosed end-to-end to the coronary ostia may be useful in old patients or in cases in which there is a necessity of very complex reconstruction of the other segments of the thoracic aorta.

The utilization of autograft or pulmonary valvar homograft for the reconstruction of the aortic root, although recommended by some authors [18-21], has presented a high incidence of reoperations due to long-term degeneration [22] and must be reserved for specific cases, especially when endocarditis is associated[23].

Recently, techniques of preservation and remodeling of the aortic valve and of the aortic root have been suggested by authors including David & Feindel [24] and Sarsam & Yacoub [11]. In these techniques, the coronary ostia are excised and the sinotubular junction is trimmed again between 3 and 5 mm above the annulus, maintaining the cuspids and the insertion line of the commissural angles intact; a line of individual sutures using Teflon pledgets reinforces the remaining annulus-aortic junction, which is anastomosed to the Dacron graft; and finally, the coronary buttons are re-implanted similar to the Bentall button technique. As the remodeling techniques are more complex and generally demand more time than others which use valved tubes, they must be employed by very experienced surgeons in elective situations, leaving procedures that use composite grafts as is recommended in annulus-aortic ectasia [23]. If the delamination of the aortic wall affects the coronary ostia, impeding satisfactory reconstruction, the alternative is to use only saphenous vein grafts.

In type-A dissections, for a better hemostasis of the proximal and distal sutures, Teflon sheets, tissue adhesives such as the gelatin-resorcine-formol biological glue (GRF) or both may be used; traditionally, the leaflets separated by the false lumen are joined by a suture line which includes a Teflon sheet placed between the leaflets or placed as a external reinforcement. Even though there is no consensus in respect to the benefit of the biological adhesives and this product has not been approved for use in the USA, the GRF is recommended by many authors, as an adjuvant technique [23] or in isolation [25]. With the same purpose, and already with the recent acceptance for clinic use in the USA, can be used the Cryolife Bioglue adhesive.

Despite of the excellent surgical results of some groups that report a hospital mortality of between 6% and 12% [3,4,6,7,16,25-28], the International Registry of Acute Aortic Dissection [29], in a retrospective evaluation of 464 cases of acute aortic dissections attended in 12 reference centers in the USA between 1996 and 1998, showed a surgical mortality of 26% in acute type-A dissections, a level closer to the average in our setting.

When the aortic dissection involves the transverse arch, the discussion in the different approaches usually is focalized on: 1) when to include the arch in the surgical repair; 2) how and to what extent to reconstruct it and 3) what is the best method of cerebral protection to be employed.

It is generally accepted that, when the intimal injury does not affect the inside the transverse arch, it can be repaired through an open approach (without clamping), joining the leaflets of the aortic wall, anastomosing the ascending aorta graft and redirecting the flow to the true lumen, a technique described as hemi-arch repair [30-36]. However, in around 10% to 20% of aortic dissections, the intimal injury occurs inside the transverse portion of the arch, which makes a complete reconstruction indispensable including re-implantation of the supra-aortic trunks, as a block or individually [36].

This decision is frequently difficult, as the morbidity and mortality rates of total repair of the arch seem to be substantially higher than hemi-arch repair, because of the longer time of cardiocirculatory arrest (CCA) and more intense hypothermia, which means a significant incidence of permanent brain injury and bleeding due to dyscrasia.

In a historical series of the Texas Heart Institute between 1976 and 1982, 60 cases of aortic dissection involving the arch with the use of hypothermic CCA, Livesay et al. [37] reported re-intervention rates for bleeding and postoperative stroke of 19% and 10% respectively.

In the recent experience of the Mount Sinai Medical Center Group, total replacement of the transverse arch was employed in 11 of 19 cases of type-A aortic dissection, with a mean CCA time under deep hypothermia of 56 minutes, with an incidence of excessive bleeding (which justified the use of peri-aortic shunts to the right atrium) in 40% of the patients [38].

Borst et al. [34] utilizing the hemi-arch repair or total arch reconstruction techniques, in 92 patients with aortic dissection, demonstrated that the mean CCA time doubled and the mortality tripled using the second procedure (17 minutes versus 34 minutes and 12% versus 36%, respectively). Similarly, Grawford et al. [33], studying 82 patients with type-A aortic dissections reported a significantly higher mortality rate in total replacement of the arch (31%), than in restricted intervention of the ascending aorta or a partial repair of the arch (17%).

These findings, as well as other reports [30,31,39,40], justify a carefull approach of the arch, with preference for the hemi-arch repair technique with open anastomosis and the adjuvant use of biological adhesive, except for cases with much intra-arch destruction or discontinuity of the descending portion of the thoracic aorta; in these situations the best alternative is to implant a Dacron tubular graft in the descending aorta, with the distal end free without anastomosis (“elephant’s trunk”) and re-implant the supra-aortic branches [41,42]. In late outcome, if it is necessary to repair the descending aorta, the free end of the graft can be directly anastomosed to the aortic wall or extended by means of an additional tube to more distal segments using left thoracotomy.

Among the methods described for cerebral protection during interventions of the transverse arch, the most utilized have been 1) CCA under deep hypothermia, 2) hypothermic CCA with retrograde cerebral perfusion and 3) hypothermic CCA with anterograde cerebral perfusion through the carotid artery or more recently, through the subclavian-axillary axis.

As early as the 1970s and 1980s, hypothermic CCA was confirmed as the method of choice of cerebral protection as it is easy to inspect the arch in respect to intimal injury, to allow repair completely along its length, including the proximal portion of the descending aorta and to impede aorta clamping near the arch from creating sites of dissection near the distal anastomosis [30,37,38,43]. The technique consists of establishing CPB by cannulization of the femoral artery, slow cooling to 18 or 20ºC (temperatures at which the metabolic rate is 18% of normal), and the use of iced bags for topical cooling of the head and neck.

Rewarming must also be slow, somewhere close to 1ºC each 3 minutes to minimize hemolysis and the deleterious effects to coagulation factors. Several groups have shown that hypothermic CCA is effective and safe in respect to neurological morbidity, if the period of CCA is no more than 45 minutes, with a stroke rate of between 3% and 12% [34,37,44]. Even so, authors such as Ergin et al. [45] report favorable results with up to 60 minutes of CCA and suggest that neurologic injury is more related to the advanced age and pre-existent cerebral atherosclerotic disease than to the CCA. However, consistent data of Svensson et al. [46], in an analysis of 656 cases of hypothermic CCA, show a significant increase of the postoperative stroke rate when the CCA time exceeds 40 minutes and of the early mortality with more than 60 minutes. Recently, control of the cerebral metabolic rate has been proposed by measuring the oxygen saturation in the jugular bulb, as a parameter to start hypothermic CCA, but its applicability and safety still need to be proved [47].

The cerebral retrograde perfusion (CRP) through the superior vena cava during CCA, first introduced by Ueda et al. [48], has the advantages of offering controlled brain cooling, of eliminating metabolites resulting from ischemia, of removing the air or even debris with emboligenic potential and of allowing nutritional substrate infusion during CCA. However, potential limitations such as non-homogeneous intracerebral distribution, presence of valves in the jugular system [49], cerebral edema [50], insufficient cerebral blood flow [51] and bleeding in the operative field question its use.

Coselli et al. [52] in a recent study of 479 cases of aortic arch reconstructions, in which hypothermic CCA with CRP was performed in 290 patients (60%) and isolated hypothermic CCA in 189 (40%) demonstrated a significantly lower hospital mortality in the group submitted to CRP (3.4% versus 6.3%). In respect to the efficacy of the cerebral protection, favorable findings of CRP were also described by Safi et al. in a retrospective study of 161 patients submitted to arch surgery: protection against stroke was three times higher when CRP was employed (3% versus 9%) and this benefit was more obvious in over 70-year-old patients. However, there was no significant difference in the stroke or death rates between the groups when the CCA time was less than 60 minutes, which may infer that benefits of CRP were involved.

In a multicentric Japanese study, coordinated by Ueda et al. [48] the results of 249 cases of aortic arch replacement utilizing CRP between 1994 and 1996 were analysed: the mean CRP time was 46 minutes, the postoperative stroke rate was 4% and the hospital mortality l3%. A multivariable analysis identified prolonged CPB time, advanced age and the urgency of the surgery as the most significant risk factors related to strokes or death.

Another cerebral protection technique includes anterograde perfusion during CRP, when cooled blood infusion via the supra-aortic arteries (cerebroplegia) or maintenance of perfusion by the axillary artery with clamping of the brachycephalic trunk can be utilizing. In the technique originally described by Guilmet et al. [54] the temperature of the patient is maintained at 25 ºC during CRP, part of the blood of the oxygenator is cooled to between 6 and 12 ºC and infused directly into the carotid arteries at a rate of 200 to 250 mL/min at a pressure of 60 to 70 mmHg. Between 1984 and 1998 the authors utilized CCA and cerebroplegia in 171 cases of aortic arch replacement, 42 of which were because of type-A dissections. In these cases the mean CPB time was 121 minutes, the mean selective cerebral perfusion time was 60 minutes, hospital mortality was 17% and the occurrence of postoperative neurological damage was 13% [55].

Although other studies also suggest superiority of anterograde perfusion over CRP and hypothermic CCA, both clinically [50,57] and experimentally [56], complications such as bleeding at the site of cannulation and intra-cerebral bleeding have restricted its use to only a few centers.

Cannulation of the axillary artery and the maintenance of the flow through one of the carotids during CCA, as described by Sabik et al. [57], theorically have several advantages. These include avoiding handling the femoral artery, which is often affected by dissections, maintaining the flow in the anterograde direction through the true lumen (important when the elephant trunk is utilized), and not needing deep hypothermia, which minimizes dyscrasic complications. Additionally, problems of malperfusion of important organs, and new reentry points are created by a pressure increase in the false lumen are eliminated, as was demonstrated by Van Arsdell et al. [58]. In this technique, the axillary artery is dissected near the delta-pectoral groove, preferable to use the right side when possible , CPB is maintained through the D axillary-atrial artery and the temperature is maintained at approximately 24 ºC. On establishing CCA, the innominate artery is clamped at its root and the flow is reduced from 150 to 300 mL/min/m^2 to reconstruct the arch.

The initial experience is promising in a small series [59,60] but its efficacy and safety still need to be proved.

Recommendations for the surgical treatment of acute type-A dissections are shown in Table I.

Acute Type-B Dissections

There is still general agreement that surgical treatment of acute type-B dissections depends on the presence of complications. These include signs of aortic rupture (hemothorax, rapid expansion of the aortic diameter, mediastinal widening), pseudoaneurysm formation, severe visceral ischemia or ischemia of the extremities, or progression of the dissection during medicinal therapy characterized by persistent or recurrent pain. Also cases of previously aneurysmatic aortas which suffer acute dissection must be considered for urgent surgery.

However, groups such as the one from Stanford University demonstrated in a cohort of 136 patients with acute type-B dissections, that a more aggressive approach might be employed with young, low-operative risk patients, by early surgery, without increasing hospital mortality (11%), when compared to medicinal therapy, thereby avoiding chronic aneurysmatic degeneration of the descending aorta [7]. Even though these results were extremely favorable, they were not considered reproducible by other centers. Indeed, the International Registry of Acute Aortic Dissection [29] which is considered to be an expression of the real world reveals that in cases of type-B dissections treated conservatively, the mortality over 30 days was only 10%, while in the operated patients the mortality rate was 31% and the incidence of paraplegia was 18%.

The surgical approach in descending aortic dissections normally consists of the replacement of the affected portion using a tubular Dacron graft by left thoracotomy through the 4th or 7th intercostal spaces, which can be performed with simple proximal clamping [61,62] with atrial-femoral CPB either with or without hypothermia [63-66], partial femur-femoral CPB [67] or even using CCA under deep hypothermia for a proximal open anastomosis [68]. Depending on the chosen technique, the dose of heparin and the effects of the hypothermia level in the cascade of coagulation could determinate variable effects on the hemostasis or in the production of dyscrasia.

Another reported technique to repair type-B dissections is the "elephant trunk" method, initially proposed by Borst et al. [42] for the surgical treatment of complex aneurysms.

Table 1. Recommendations for the treatment of acute type-A dissections

Recommendations	Evidence Class	Evidence Level
1. Immediate surgery to avoid rupture / tamponing / death	I	C
2. Straight graft in the ascending aorta, if aortic root and aortic valve are normal	I	C
3. Straight graft in the ascending aorta and aortic valvar resuspension, if aortic root is normal and the valve is insufficient due to loss of support	I	C
4. Valved tube, if ascending aorta is dilated or annulus/aorta suffers ectasia and aortic valve is insufficient	I	C
5. Auto or homograft, if situation number 4 is associated with endocarditis	IIA	C
6. Aortic valvar resuspension and remodeling of the aortic root in Marfan's syndrome	IIA	C
7. Partial repair of the aortic arch (hemi-arch repair), if dissection involves the arch, but there is no destruction or lesion to the intima	I	C
8. Total reconstruction of the arch if it presents with intimal destruction or injury	I	C
9. In the case of intervention of the arch, open reconstruction using cerebral protection (hypothermic CCA - cerebral retrograde perfusion – cerebroplegia – axillary perfusion)	I	C
10. Saphenous vein grafts, if coronary ostia are affected with delamination and re-implantation is not possible	I	C

CCA - cardiocirculatory arrest

After median sternotomy and conventional CPB, hypothermic CCA is induced and the transverse arch is opened lengthways; a Dacron tubular graft is introduced into the proximal portion of the descending aorta and anastomosed only in the proximal segment after the left subclavian artery, with the distal end continuing free in the thoracic aorta. Subsequently, Palma et al. [69] also used this technique in all cases of acute type-B dissections, in spite of the existence of complications; the authors performed 70 consecutive insertions of the "elephant trunk" graft, between 1988 and 1995 by median sternotomy with a short period of hypothermic CCA (mean time of 31 minutes) and presented a hospital mortality rate of 20% and an overall survival over 5 years of 62%.

For the management of renal and mesenteric ischemia or ischemia of the extremities, specifically when the origin of these vessels is in the false lumen [70], it is generally accepted that fenestration by catheter is the method of choice, which is justified by the high mortality that follows type-B aortic dissection surgery in these situations: from 50 to 70% in the case of renal ischemia [71,72], 89% in mesenteric ischemia [71,73-75] and up to 87% in peripheral ischemia [72,74].

Since the first successes using fenestration by balloon-catheter, to communicate the false and the true lumens, in a case of type-B aortic dissections with mesenteric ischemia, which were described by Williams et al. [76] in 1990, several studies have tried to validate this approach [77-84]. Additionally, the advent of aortic stents, originally utilized to exclude infra-renal abdominal aneurysms, provided a new alternative in the management of complicated descending aortic dissections.

In general, branches affected by static obstructions at their root are better treated by the intraluminal implantation of stents, while vessels obstructed by dynamic displacement of the blood column through a false lumen may be reperfused by fenestration using a balloon catheter, with or without stent implantation in the true lumen. In other situations, stents can be used in the true lumen to maintain the original position of some branches [83], or to maintain the fenestration open [85]. Another indication for endovascular fenestration may be to create a reentry in cases in which a "dead-end" false lumen significantly compresses the true lumen, even though this maneuver can increase the risk of peripheral embolization [85,86] or of aneurysmatic dilations over the long-term by maintaining the false lumen patent [83,87].

The technical objective of fenestration is to create a 'window' between the false and true lumens, by "opening" the intimal layer, normally near to the artery to be saved; preferentially from the smallest lumen (generally the true lumen) to the biggest lumen (generally the false lumen), utilizing a special needle [70,79,84,85] and, if possible, intravascular ultrasound (IVUS), followed by a 12- to 15-mm balloon catheter, which is insufflated to promote enlargement of the 'window' [80]. If necessary, a stent of from 10 to 14 mm can be implanted to reduce the possibility of occlusion of the fenestration, due to a 'flap' or thrombosis [85].

The results of reperfusion after percutaneous fenestration of branches obstructed by aortic dissection, even those reported in non-controlled studies [83-85,88] have been consistent: the flow restoration rate varies between 90 and 100%, the mean mortality over 30 days is 10% and no additional revascularization procedures were necessary over a mean follow-up of 12 months. Additionally, all the deaths were related to the irreversibility of the ischemia at the moment of the intervention, with progression of the dissection or surgical complications of associated interventions.

Stent implantation in the descending aorta involves a great diversity of devices and techniques, with the margin of the healthy aorta in respect to the left subclavian artery root, the length of dissection, the existence of a reentry point and the involvement of visceral trunks being especially important. The diameter of the endoprosthesis, often between 2 and 4 cm, is estimated by magnetic resonance, computed tomography, transesophageal echocardiography or by IVUS, with the length or the use of more than one device varying according to the length of the lesion. Depending on the proximity of the visceral branches, one part of the prosthesis should not be lined to maintain the patency of the ostia involved. The right femoral artery is the commonest insertion site; here the endoprosthesis can be guided by angiography, IVUS or both methods. Arterial pressure monitoring is important during implantation, normally there are increases during the expansion of the device with a significant drop after its placement. It is recommended that the mean arterial pressure is maintained between 50 and 60 mmHg, which requires the use of sodium nitroprusside [23]. Although the majority of the available stents are self-expanding, a balloon can be useful to improve fixation and remodeling of the true lumen.

Preliminary results indicate that the use of stents in complicated type-B dissections is more reliable and causes a smaller risk implanted percutaneously when compared to the implantation by open surgery [89], and that the incidence of paraplegia maybe be significant with the use of prostheses longer than 15 cm [89,90]. Thus, when it is necessity to treat longer segments of the aorta, in cases with distal reentries, a method using multiple shorter prostheses is preferable, which has the additional advantage of better modeling in cases of aortae that present with much curvature. Performing a carotid-subclavian bypass before implantation may also be useful in cases where the treated portion is very close to the root of the left subclavian artery, a maneuver, which in the experience of Grabenwöger et al. [91], should be employed in nearly 40% of patients. The short-term follow-up has demonstrated that the obliteration of the intimal injury is maintained and the aortic diameter is reduced with the thrombosis of the false lumen; in cases in which peri-prosthetic leaks are discovered and in those in which reentries not seen in the first diagnosis are identified, the treatment, in general, may be the implantation of another stent [92].

Recently, an interesting contribution was proposed by the group of the Escola Paulista de Medicina, (Paulista Medical School) with the use of percutaneous self-expanding stents, in all cases of descending aorta dissections. Palma et al. [93] treated 70 patients with type-B dissections (60% of which were true dissections and 40% corresponded to intramural hematomas or penetrating ulcers), with implantation by the femoral artery of polyester-covered endoprostheses (Braile Biomedica®), under general anesthesia, systemic heparinization and induced hypotension. The procedure was considered a success in 65 (93%) patients, with the exclusion of the false lumen documented using aortography. In 5 cases (7%) conversion to surgery was necessary but there were no occurrences of paraplegia or death. In a mean follow-up of 29 months (from 1 to 55 months), 91% of the patients were alive but the insertion of additional stents was required in 49% of the cases. In a more recent report on this series [97] with 120 cases of type-B dissections, the results were consistent: the hospital mortality was 10%, surgical conversion occurred in 6 (5%) cases, there were no cases of paraplegia (even though 2/3 of the descending aorta was excluded in 38 cases and the treated region was between T9 and T12 in 34 patients) and the long-term survival rate was 87%. The necessity of implantation of additional stents occurred in 51% of the series, in 14 patients the left subclavian artery was intentionally occluded using an endoprosthesis and in only one case, a carotid-subclavian surgical shunt was necessary [94].

In summary, there are not doubts as to the benefits of percutaneous intervention techniques in the management of complications involving the acute descending aortic dissections, when compared with conventional surgery. Even so, issues such as whether routine implantation of stents will substitute the initial medicinal treatment in uncomplicated cases, as well as the role of endoprosthesis implantation in the descending aorta during ascending aorta surgeries remain unclear, in spite of the preliminary promising results.

Table 2 summarizes the recommendations and forms of interventions in acute type-B dissections.

The long-term follow-up of patients with acute aortic dissections, operated on or treated using conservative methods in the acute phase, demonstrates that the false lumen is maintained patent in about 80% of the cases [95]; additionally, it is known that in only 10% of patients operated on for type I De Bakey dissections, the false lumen is maintained obliterated [96-99]. However, this patency should not be seen as an imminent catastrophic event; often it may be the main source of blood of some noble organs [95]. In the experience of the Mount Sinai Medical Center [100], persistence of a false lumen was associated with a low incidence of aneurysmatic degeneration and no significant

Table 2. Recommendations for the treatment of acute type-B dissections

Recommendations	Evidence Class	Evidence Level
1. Clinical management with analgesics and aggressive control of the arterial pressure	I	C
2. Surgical treatment, if persistent/recurrent pain, signs of expansion, rupture or bad perfusion of the extremities	I	C
3. Endovascular fenestration, if there is mesenteric or renal ischemia or ischemia of the lower limbs or neurologic deficits	IIA	C
4. Stent to unblock the visceral branch root, or to maintain the fenestration open	IIA	C
5. Fenestration by balloon and stent implantation, if there is severe compression of the true lumen, with or without distal reentry	IIA	C
6. Implantation of stent in true lumen to treat compression by false lumen	IIA	C
7. Implantation of covered stent in true lumen to occlude the intimal injury and to promote thrombosis of the false lumen	IIA	B

differences were seen in the long-term survival rate: two of 18 cases of patent false lumen needed interventions (11%) and the event-free survival rate over 5 years was 83% for false lumen with thrombosis and 64% in cases of patent false lumen (p-value not significant).

The patency of the false lumen after aortic dissection surgery seems to be more related to the high frequency of distal reentries than to the success of the exclusion of the initial injury site. This reinforces the necessity of a follow-up with extremely rigorous clinical control, in particular in respect to systemic arterial hypertension (SAH) and imaging in the 1st, 3rd, 6th and 12th post-procedure months and thereafter annually [23].

There is agreement that the choice method for long-term monitoring and eventual indication of intervention should be nuclear magnetic resonance (NMR) as it avoids exposure to radiation or to nephrotoxic contrasts used in computed tomography (CT) and is less invasive than transesophageal echocardiogram (TEE). A comparison of serial images makes early detection of increases in the false lumen or of the entire aorta easy, as well as the identification of the important visceral branches possible and their relationships to the dilated portion [101,102].

There is clear evidence that the aggressive management of SAH with negative inotropic agents is the most important independent factor in the prevention of chronic aneurysmatic degeneration or rupture although the use of beta-blockers are the first-line therapy, as they decrease the dp/dt. In general the association of more than one drug is required [23]. As was demonstrated by DeBakey et al. [103] in 527 patients after acute aortic dissection, aneurysms developed in 46% of the cases with uncontrolled arterial pressure, but only in 17% of normotensive patients. Of all the cases of mortality in the experience of Stanford University [39,75], at least 15% occurred due to aortic rupture, while a 20-year follow-up performed by Baylor College of Medicine [103] revealed that 30% of late deaths were due to the rupture of chronic aneurysms. In truth, it is estimated that about 30% of cases operated on for acute aortic dissection will suffer aneurysmatic degeneration, more frequently on the thoracoabdominal axis (35%), followed by proximal descending aorta (14%) [103,104]. Similar data were published in Europe, where a survival rate of from 70 to 85% is reported in the first year and 60% over two years in cases of type-B dissections, with the best prognosis in cases with non-communicant false lumens (80% of survival over 2 years) [96].

Patients with Marfan's syndrome must follow familiar investigations, to anticipate catastrophic events or recurrences, although cases of multiple interventions are not rare [105,106]. In this specific group earlier criteria are considered as commented in the next topic, although the definitive cutoff point should be defined in still unavailable longitudinal studies, which would determine the normal diameter of the aortic root in young patients with Marfan's syndrome [107,108]. A moderate restriction of physical exercise also seems to be beneficial in children and young adults, because of the potential association of hypertension and rupture induced by exercise [109].

Information about the natural history of intramural hematomas (IMH) is limited and sometimes contradictory in the literature. Generally, this can be considered a condition as potentially catastrophic as acute aortic dissections inferring that the mortality rate is significant – from 20 to 80% [110-112]; the evolution to true dissections occurs in 15 of 41% of the cases [112-116], to ruptures in 5% to 26% of the patients and evolution to spontaneous cure varies [117,118]. In a recent study of 360 cases of acute aortic dissections, Nienaber et al. [113] observed that 25 (12%) cases presented evident false lumen, but without identified intimal injury in the diagnostic examinations. The mortality over 30 days, when there was involvement of the ascending aorta, was 80% in clinically treated cases and zero in operated patients, similar to the type-A aortic dissection. Vilacosta et al. [118] analysed the evolution of 21 cases of IMH, of which 15 were spontaneous – 8 involving the ascending aorta and 7 confined to the descending portion – and 6 were caused by trauma. In the group considered type-A, 3 (37%) cases evolved to sudden death, 3 (37%) were successfully operated on and 2 (25%) evolved to a cure. In the type-B group 1 (15%) sudden death occurred and 6 (85%) had favorable clinical courses by medicinal therapy, while in the trauma group there were spontaneous cures in 3 (50%) patients. Another 3 cases (50%) in this group evolved to death, but due to causes not related to ruptures. Even though the sample was small, the authors suggest that the natural history of IMH is better in trauma or cases restricted to the descending aorta than cases that involve the ascending aorta.

The evolution of ulcerated aortic plaque is also not completely known and controversial, in the few reports available. While some authors consider that it is as dangerous as true acute aortic dissections with a high possibility of rupture, others point out its benign clinical course that does not require immediate surgical treatment [119,120]. However, the existence of sub-intimal hematomas or penetrating ulcers should be viewed as possible imminent ruptures. In a retrospective study of 198 aortic dissection cases, the group from Yale University [121] detected the presence of 15 penetrating ulcers (8%), identified in imaging examinations prior to the acute event, of which 13 (87%) were found in the descending aorta. The mean age and the size of the aorta in this group were significantly higher than in the total sample and an association with infra-renal abdominal aortic aneurysms was seen in 40% of these patients, with ruptures seen in the hospital evolution in approximately 40% of the cases. The development of pseudoaneurysms in these ulcerated plaques is another complication observed over the long-term [122,123], with the development of true dissections estimated in from 10% to 20% of the cases [23].

The recommendations for the long-term follow-up of patients after suffering from acute aortic dissections are illustrated in Table 3.

CHRONIC DISSECTIONS – THORACIC ANEURYSMS

Ascending Aorta - Aortic Arch

The aorta is considered pathologically dilated when its diameter exceeds the normal for a specific age and body surface area. When the diameter is more than 50% of the expected size, the segment is considered aneurysmal.

In the ascending aorta, progressive dilation can lead to aortic valve insufficiency (even in anatomically normal valves), to acute dissection or to spontaneous rupture. These are events which dramatically change the natural history and survival and the amount of risk is related to the diameter and to the type of structural disease of the aortic wall.

Indications for the surgical replacement of the ascending aorta in patients with Marfan's syndrome, acute dissections, intramural hematomas or endocarditis with extensive annular damage are supported by consistent evidence. However, the moment of the intervention in asymptomatic patients with degenerative dilations, as well as in the association of dilation of the aorta with the bicuspid aortic valve, remain uncertain.

In Marfan's syndrome, there is an agreement that prophylactic surgical repair is indicated when the diameter reaches 5.5 cm, although it may be smaller (from 4.5 to 5 cm) in patients with familiar history of dissections, ruptures or sudden death [23,107,124-128]. In the other cases, although the presence of symptoms or the severity of aortic insufficiency can indicate intervention, independent of the aortic size, it is generally accepted that a diameter of 6 cm is indicative of surgery in asymptomatic aneurysms [23,129]. Even so, groups such as that of the Mount Sinai Medical Center [16], based in its recent experience, have proposed differentiated criteria for intervention, such as diameters of 4.3 cm in under 40-year-old adults with Marfan's syndrome, from 4.8 to 5 cm in cases found by chance during heart surgery for different diseases and 4.5 cm in surgeries of bicuspid aortic valves [16].

The aortic root or descending aorta surgical reconstruction options have already been described previously. In cases of chronic aneurysms, some aspects can contribute to the choice of the technique, as proposed by Ergin et al. [16]:

- Age and life expectation in very old or high surgical risk patients, valve replacement and the reduction in the caliber of the aorta by a lengthways suture with support may be a good alternative [130]; equally, valve replacement followed by the implantation of a Dacron straight graft, separately, can be appropriate for patients with limited life expectation [131];
- Quality of aortic wall: a weakened aorta as in acute dissections or in Marfan's syndrome generally requires removal of all friable tissue of the aortic root and of the ascending portion; in these cases, the Bentall button technique can be useful [14] or valve remodeling [132];
- Anatomy of the aortic valvar apparatus – Valsalva's sinus - Sinotubular portion: when there is dilation of the apparatus, Bentall button-type valved tube implantation [14] or the use of thetechnique described by Cabrol et al. [17] or exceptionally auto/homografts. If the valve is normal but there is dilation of the sinus or of the sinotubular region, valve remodeling techniques as suggested by Tirone David can be employed [24];

Table 3. Recommendations to the follow-up of patients with aortic dissection

Recommendations	Evidence Class	Evidence Level
1. Continuous control of systemic arterial hypertension with beta-blockers	I	C
2. Imaging examinations (NMR, CT etc)	I	C
3. Moderate restriction of physical exercises	I	C

NMR – nuclear magnetic resonance; CT – computed tomography;

- Anticoagulation risks: in patients at considerable risk of bleeding, the remodeling techniques or auto/homografts must be given preference;
- Association with aortic valvar endocarditis: although there is no conclusive evidence, the majority of groups recommend auto or homografts in this situation.
-
- Using this systematization, Mount Sinai Medical Center group recently published their experience of 497 cases of annulus-aortic or ascending aorta reconstruction in mainly elective surgeries (n=310), corrected using the Bentall button technique (n= 250). The overall hospital mortality was 8% and 5.5% when excluding urgent surgeries; in the 250 cases of the modified Bentall technique the hospital mortality was only 4% and the reoperation-free survival rate was 79% over 5 years and 62% over 8 years, results that substantiate the authors recommendation of this technique [16].

In respect to aneurysms located in the transverse arch, the currently accepted indications for surgical resection include: 1) an absolute diameter > 6 or 7 cm, or greater than two times the expected diameter for that patient; 2) growth in the diameter greater than 7 or 10 mm per year; 3) pain or symptoms of compression and 4) saccular aneurysms [133, 134] Patients with Marfan's syndrome generally are indicated for early surgery, with growth greater than 3 to 5 mm per year, or absolute diameters of 5 cm [135]. Technical details referring to the surgical repair methods and cerebral protection described in acute dissections involving the transverse arch are applicable here too.

Descending Aorta – Thoracic-abdominal

In asymptomatic patients with descending aorta aneurysms (DAA), the identification of predictors of dissection, rupture and death have been exhaustively studied, attempting to establish a safe cutoff point to indicate surgery, as the mortality and the operative morbidity rates are significantly higher than in ascending aortic surgery. Thus, some complicated exponential equations have been proposed to calculate an estimation of acute events in cases of DAA [136,137]. The group from Yale University has performed consistent and simplified studies [74,129,133,138], showing the diameter as the most relevant independent risk factor for complications. Based on a database of 721 patients with DAA, the authors followed the evolution of 304 asymptomatic cases, with a minimum diameter of 3.5 cm and clearly demonstrated that the incidence of associated complications – rupture, dissection or death – was 15.6% for aneurysms with diameters of from 5 to 6 cm and only 3.9% for diameters between 4.0 and 4.9 cm (p=0.004). When analysed separately ruptures, the Odds ratio increased 27 times when the diameter reached 6 cm when compared to cases of 4.0 cm or less (p=0.002). Additionally, the 5-year survival curve of patients with diameters > 6 cm was only 56% and 85% for elective operations (p=0.003), survival similar to that found in the normal population with the same mean age. These findings, associated with operative mortality of 11% presented by the group [139] have led the authors to choose 6 cm as the parameter for the surgical indication of DAA, a conduct considered consensual by specialists [23].

The principal problem in the surgical repair of descending or thoracic abdominal aneurysms is still paraplegia, with an incidence reported at between 4 and 32% in recent works [140-151]. Indeed, medullar injury still is a devastating event for the patient, family and surgical staff. Although paraplegia is clearly multifactorial, it occurs due to one or more of the following conditions: 1) duration and degree of medullar ischemia; 2) failure to reestablish the blood flow to the spinal column after repair and 3) biochemical-mediated reperfusion injury.

To reduce medullar ischemia, many techniques have been recommended, with conflicting clinical results. When no method of distal perfusion is used during the reconstruction, the aorta should only be clamped proximally, as recommended by Crawford et al. [152], to impede increases in the CSF pressure, the level of the clamping should be lowered gradually, as the main intercostal branches and the visceral branches are anastomosed to the prosthesis. While ischemia times of less than 30 minutes are relative safe, this approach presents with an unacceptable incidence of paraparesis or paraplegia with times greater than 60 minutes [153]. In contrast, when distal perfusion is maintained to optimize the nutrition of the intercostal and lumbar arteries, short periods of sequential ischemia can be performed; in this technique, CPB is established by left atrium-femoral or femur-femoral vessels which allows the maintenance of perfusion up to the T5 or T6 level during the first clamping of the proximal aorta and of the left subclavian artery. Concluding the proximal anastomosis, the distal clamp is usually placed just above the celiac trunk and the main intercostal vessels are included in the graft. In the next step, the clamp of the prosthesis is placed below the intercostal arteries and the distal aorta clamp below the renal arteries, which are included as a block or individually. Subsequently, the aortic clamping is transferred to the infra-renal portion and the distal repair is concluded. With this approach of sequential ischemia there has been a significant reduction in the rates of paraplegia and renal insufficiency [7].

Other methods of distal protection may include CPB with hypothermic cardiocirculatory arrest or the use of temporary internal or external shunts. While Kouchoukos et al. [68] supported by incidences of 6.5% for paraplegia and of 10% for death over 30 days, recommended total CPB with CCA under deep hypothermia, Crawford et al. [154] considered this technique particularly useful in aneurysms that involve part of the arch or in arches extensively calcified in their proximal portions, presenting paraplegia and mortality rates of 9.5% and 16% respectively.

Alternatively, several types of temporary shunts have been proposed, justified by the necessity of smaller doses of heparin and because they do not exclude hypothermia, thereby minimizing bleeding complications. The greatest experience in the literature was published by Verdant et al. [155] who utilized aorto-aortic or aorto-femoral bypasses in 366 consecutive cases of DAA, giving hospital mortality of 12% and no cases of paraplegia; however and curiously, even with these highly positive results, the authors now recommend atrio-femoral CPB due to the significant incidence of strokes and of aortic injuries at the sites of the shunts.

Drainage of cephalic-rachidian liquid (CRL) to reduce the intrathecal pressure constitutes another form of medullar protection, widely tested in several animal models, associated or not with infusion of neurotropic-negative drugs [156-163].

Preliminary studies performed in the Mayo Clinic were favorable to the protector effect of CRL drainage, but the subsequent results did not demonstrate significant benefits [164]. Other groups have defended CRL drainage associated with the local infusion of naloxone [143] or during atrio-femoral CPB [165].

Although Acher et al. [143] in a non-controlled study suggested that naloxone associated with CRL drainage can even dispense with the re-implantation of intercostal arteries; no benefits of this technique were evidenced in subsequent randomized trials [166] making its use empirical.

The effect of epidural administration of papaverine on the function of spinal medulla has been referred to as having a promising effect.

In experimental models of thoracic aorta clamping for up to 60 minutes at normothermia, an intrathecal injection of papaverine was highly effective in preventing paraplegia, demonstrating a significant increase in the blood supply in the anterior portion of the spinal medulla by the use of radionuclides [159]. At a clinical level, removal of a small volume of CRL followed by the intrathecal application of papaverine, also showed potential benefits in some non-controlled prospective studies [149,167], motivating further clinical trials [168].

Other pharmacological agents proposed as adjuvant in the prevention of paraplegia include corticosteroids [144], lidocaine [144], mannitol [169], magnesium sulphate [161], prostaglandins [153], allopurinol [170], flunarizine [171], but none has proved to be effective in the clinical practice.

A consensual recommendation discusses the necessity of re-implantation of the maximum number of main intercostal arteries, particularly in the lower 1/3 of the thorax and upper abdomen, between T7 and L1 [168]. Several anatomic studies have already demonstrated that the blood supply to the medulla at the thoracic level is predominantly supplied by the intercostal arteries between T4 and T12 and by the lumbar arteries between L1 and L4 [172-174] and that in more than 90% of patients the most important radicular artery, referred to as the Adamkiewicz artery or radicular magna, emerges between T7 and L1. In chronic processes such as atherosclerotic aneurysms there can be development of collateral circulation capable of maintaining the medullar functioning, even when there is extensive sacrifice of intercostal branches, or when early thrombosis of some intercostal paths is an arteriographically documented event [175], all effort must be made to protect these vessels. Thus, preservation of the posterior wall of the terminal thoracic aorta as proposed by Williams [176] can be a valid conduct.

Due to the diversity of anatomic variations in the medullar blood supply that can include from a well-developed and easily identified magna radicular artery, or many large caliber terminal intercostal arteries or, even, many small caliber arterioles, intraoperative mapping models of the segmental arteries have been tested, aiming at selecting arteries to be re-implanted and to reduce the aortic clamping time, such as the intraoperative infusion of hydrogen to identify intercostal branches that effectively contribute to medullar perfusion [177].

Similarly, many experimental and clinical studies [47, 154, 159, 178-184] have been developed trying to define the role of the motor-evoked or somatosensorial potentials, in monitoring the activity of the segmental medulla and in the prevention of the paraplegia, although with very variable results and with recommendations still not consensual in respect to the efficacy as an isolated method in the prevention of medullar ischemia [179].

Crawford et al. [172] prospectively analyzed the role of the somatosensory evoked potentials (SSEPs) in a randomized trial of 198 patients submitted to DAA or thoracoabdominal aortic aneurysms correction. As not only did monitoring SSEP not demonstrate a protecting neurological effect, there were incidences of 13% false-negative and 67% false-positive cases in the responses of the monitored group, leading the authors to believe that there is no sustenance for this technique.

As mentioned in the section about acute dissections, an innovative and highly promising approach in the treatment of DAA is the implantation of self-expanding stents, developed by the Stanford University group [185]. Preliminarily, the authors used the percutaneous implantation of self-expanding stents covered by Dacron in the femoral artery in 13 cases of chronic thoracic aneurysms with a mean diameter of 6.1 cm. An immediate exclusion was observed in 12 patients and no deaths or cases of paraplegia in the hospital phase were reported and not even over a mean follow-up period of 11.6 months. In a clinical assay developed subsequently [90], the same authors amplified the experiment to 103 implantations, the majority of which had prohibitive surgical risk and obtained immediate success rates of 83%. The early mortality was 9%, paraplegia was observed in 3% of the patients and 7% developed ischemic strokes during the hospital stay. The long-term follow-up of 3.7 years demonstrated an event-free survival rate of 53% and the group started to recommend this technique for selected high operative risk patients. However, the greatest experience with the percutaneous exclusion of DAA was published recently by Buffolo et al. [94]. Between 1996 and 2002 191 stent implantations were performed in cases of type-B dissections (n=120), true thoracic aneurysms (n=61), deep ulcer hematomas (n=6) and trauma of the descending aorta (n=4). For all patients the authors used general anesthesia, induced hypotension (mean arterial pressure between 50 and 60 mmHg), heparinization only during the procedure (5000 IU/IV) and polyester-covered stents (Braile Biomédica ®), the sizes of which were calculated as 10% to 20% bigger than the diameter of the aorta. The success rate of the implantation, defined as the obliteration of the intimal laceration or the complete exclusion of the aneurysms without extravasation, was 91% [144,183], the hospital mortality was 10%, conversion to surgery was necessary in 6 cases (3%) and no cases of paraplegia were observed.

If these results will be confirmed in subsequent studies, may represent the most important advance in the treatment of a cardiovascular disease which has extremely high morbidity and mortality rates and is one of the most challenging for surgeons: the thoracic and thoracic-abdominal aneurysms.

Table 4 presents recommendations for the management of chronic aneurysms of the thoracic aorta.

Abdominal Infra-renal Aorta

In few situations, surgical intervention called "prophylactic" has had such a great impact in the modification of the natural history of a disease, as in the case of infra-renal abdominal aneurysms (AAA), not only due to its high prevalence (from 90% to 95% of all cases of aortic aneurysms), but also due to the increase in morbidity and mortality that follow its emergency repair (the mortality risk is 10 times greater than in elective surgeries). To establish guidelines for the indication of elective repair of AAAs, aiming at assisting decision making, some aspects about the pattern of this disease must be considered.

Abdominal aneurysms are often found by chance, mainly in old people. Many studies have estimated that AAA are found in 2% of people with from 60 to 69 years of age and approximately 5% of over 70-year-olds and it is 2 to 3 times commoner in men than in woman [186, 187].

The association of AAA with some diseases is well known and relatively predictable: it is known that AAA is found in about 5% of patients with coronary atherosclerosis [188], 9% of peripheral artery disease cases [189] and from 30% to 50% of the patients with popliteal or femoral aneurysms [190].

AAA is easily detectable by clinical examination and by non-invasive diagnostic methods. In general, an experienced

Table 4. Recommendations for the surgical treatment of chronic thoracic aorta/ thoracic-abdominal aneurysms

Recommendations	Evidence Class	Evidence Level
Ascending aorta		
1. Surgery, if there are compression symptoms, aortic insufficiency or aortic diameter ≥ 6.0 cm	I	C
2. In Marfan's syndrome, prophylactic surgery if diameter ≥ 5.5 cm or ≥ 5.0 cm in cases with familiar history of dissection or sudden death	IIA	C
Descending aorta		
1. Surgery, if symptoms or aortic diameter ≥ 6.0 cm	I	C
2. Stent implantation, if aortic diameter ≥ 6.0 cm and favorable anatomy	IIA	B

physician can detect aneurysms of 5 cm in diameter directly by palpation, but the precision of the diagnosis only by touch is < 50%, while ultrasound is able to diagnose AAAs of any diameter in 100% of cases.

Ruptures of AAAs are considered a severe public health problem: It is estimated at 15,000 deaths per year in the USA of cases that reach hospital and maybe two or three times this number if all cases of sudden death by AAA that occur out of the hospital are included [187].

Ruptures of AAAs are more related to large aneurysms, to rapid growth or to the recent initiation of symptoms. The risk of rupture over 5 years for aneurysms smaller than 5 cm in diameter is estimated as less than 5%, while in aneurysms larger than 5 cm the accumulated risk is from 25% to 43% [191-195]. Multivariable analysis of some studies identified rapid expansion and the presence of significant abdominal or low back pain as the most important predictors for rupture, independently of the size of the AAA [196-198].

Small aneurysms grow at a variable speed: although it is estimated that the mean expansion of AAAs must be about 0.4 cm/year, there is a great variability making it impossible to predict the evolution in a specific patient [199].

The risk of death or worse complications with elective surgery of AAA is dependent on the experience of the surgical group and on the numbers of surgeries in the hospital, but currently the mortality rate must be lower than 5%. Although metanalysis of recent studies point to a mean mortality rate of 3.5% [192,194,200-206], a variation of up to 10% is observed between surgeons and institutions [207].

The presence of symptoms in AAAs is a consensual surgical indication independent of the diameter. These symptoms include pain/lumbar or abdominal discomfort, distal embolization or signs of compression of neighboring structures. Obviously, emergency surgery is essential in the cases when rupture is suspected.

Also aneurysms of an inflammatory etiology are indicative of elective repair independent of the size, as they are followed by significant systemic manifestations, such as fever and weight loss [187].

For asymptomatic patients, the indication of intervention must consider the risk of rupture versus the operative risk of the individual and the life expectancy. In the 1990s, the International Society for Vascular Surgery recommended elective surgeries for AAAs with diameter exceeds 5.0 cm, or even 4.0 cm in patients with chronic obstructive bronchopulmonary disease based on the low postoperative mortality rate found in this group (1%) [187,195]. There was also a clear recommendation to contraindicate the surgical repair of AAAs of any size when metastatic neoplasias, severe heart insufficiency or other conditions that limit survival to no more than 2 to 3 years are observed [187].

However, results of 2 recent large clinical trials may change these criteria.

In the United Kingdom in the ‘Small Aneurysm Trial’ [208] 1090 patients with asymptomatic aneurysms with diameters between 4.0 and 5.5 cm were randomized for conservative treatment with serial ultrasound examinations or elective surgical repair and follow-up over a period of from 6 to 10 years (mean 8 years). The operative mortality rate was 5.5% and survival over 8 years was similar in both groups, although slightly better in the group that underwent interventions after this period. No differences were observed in this pattern in respect to age, gender or initial size of the aneurysm and the authors concluded that patients with asymptomatic AAAs with diameters up to 5.0 cm can be conservatively followed-up, without additional risks.

The findings were also confirmed in the Aneurysm Detection and Management Veterans Affairs Cooperative Study [209], in which 1136 patients with infra-renal aneurysms with diameters of between 4.0 and 5.4 cm were randomized for surgical treatment (n=569) or for periodic echographic control (n=567). The hospital mortality in the operated group was 2.7% and there was no difference in the 5-year survival rate between the two groups. There was no reduction in the death rate related to complications of the AAA in the group submitted to intervention (3% versus 2.6%) and the rupture risk in the non-operated patients was minimal (0.6% per year). However, the authors did not recommend elective surgery for AAAs with diameters of up to 5.4 cm, even when the surgical mortality of the group was low.

On the other hand, the high incidence of ruptures of the AAAs with diameters > 5.5 cm has been well documented by the same authors [210] in a cohort of 198 patients with absolute contra-indications for surgical repair. The annual rupture rate was 9.4% for diameters between 5.5 and 5.9 cm; 10.2% for cases between 6.0 and 6.5 cm; 19% between 6.6 and 7.0 cm; and of 32.5% in patients with diameters > 7.0 cm, results that corroborate those of previous studies.

The interventionist therapy using stent implantation has recently been proposed as an alternative to the surgical treatment of AAAs. Since Parodi et al. [211] performed the first percutaneous exclusion of an intra-renal aneurysm 12 years ago many devices have been developed and tested, without arriving at an agreement that this technique may substitute conventional surgery.

The current results point to an immediate success rate near 95%, with conversion to surgery in between 3% to 5% of the cases and a hospital mortality rate of approximately 3%. The commonest early complications are inguinal hematomas (7%), arterial thrombosis (3%) and rupture of the iliac artery (1.5%). Over the long-term, endoleaks have been demonstrated in from 10% to 20% of the cases, with

Table 5. Criteria of intervention in intra-renal aortic aneurysms

Recommendations	Evidence Class	Evidence Level
1. Surgical treatment – if symptoms – lumbar or abdominal pain, compression of vertebral body or adjacent structures	I	C
2. In asymptomatic cases, surgery, if diameter ≥ 5.5 cm and low operative risk / long life expectation	I	A
3. Consider diameters of 6 cm, if high operative risk	I	C
4. Stent implantation, if high surgical risk and favorable anatomy	IIA	C

spontaneous solutions in from only 40% to 50% of them [212]. When stent implantation and conventional surgery are compared, as in the studies by Hallet et al. [213] and May et al.[214] there are no significant differences in the early mortality and morbidity, however the event-free survival rate over 2 years is notably better in surgical group (93% versus 67%).

In conclusion, based on the most recent Guidelines of the American Association for Vascular Surgery and the Society for Vascular Surgery we may state that: 1) Low risk asymptomatic patients should be considered for elective surgery with a minimum diameter of 5.5 cm (in women the diameter may be 5.0 cm); 2) Significant perioperative risk cases with 6.0 cm; and 3) the optimal clinical management must include control of hypertension and cessation of smoking. Endovascular therapy may be a valid alternative in high risk surgical patients, although this is a not consensual [215].

Table V presents the current criteria of intervention in cases of AAA.

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NOTE OF THE EDITOR

Following this we have published the comments of Dr. Joseph Coselli in respect to the Guidelines for the Surgical Treatment of Aortic Diseases. The idea is to enrich the knowledge of the BJCVS readers and to try to adequately implement the guidelines in the medical practice.

COMMENTS

Dr. Joseph COSELLI

In first place, I would like to congratulate the authors for the extremely well-written manuscript, preparing the guidelines for surgery of aortic diseases. I would like to append some comments and contributions.

In type-A dissections, the risk of imminent death due to rupture or congestive heart failure by sudden aortic insufficiency and severe complications from arterial branch occlusion, such as brain strokes or ischemia of the extremities, reinforce the necessity of early recognition of this situation. In respect to the location of arterial perfusion, I would like to stress that the use of the right axillary artery cannulated directly or through a Dacron graft, as opposed to the femoral, artery has become the first-line technique in the correction of dissections and is routinely used by our team.

In relation to the technical alternatives when dissection occurs at a root of the previously dilated aorta, I would like to suggest, as an alternative, the possibility of using stentless biological valves which were recently approved for clinical use in the USA. In relation to the technique described by Cabrol et al. for the re-implantation of the coronary ostia, it was well remembered by the authors that we have preferred to use them in reoperations where fixing of the mediastinum, due to the presence of adherences, impedes great mobilization of the ostia or the coronary buttons. I completely agree with the authors about the validation of biological adhesives as adjuvant of hemostasis in the correction of acute dissections. I would only like to add the possibility of using Cryolife Bioglue adhesive which was also approved by the FDA. In respect to the levels of hypothermia described by the authors, when treating transverse arches, I totally agree and add the alternative of using isoelectric EEG as a parameter to determine the lower limit of the systemic temperature and include that the use of anterograde brain perfusion, in general, allows the correction at higher temperatures, such as 28 ºC or even 32 ºC.

I congratulate the authors on their use of the data from the International Registry of Acute Aortic Dissection, as they are a real picture of the world and not the result of selected series coming from high-reference institutions that often present much more favorable results.

In type-B aortic dissections, the authors appropriately mention the benefits of percutaneous interventions compared to conventional surgery in the management of complicated cases. However, caution should be taken in cases of diseases of the connective tissue (as for example Marfan's syndrome and Ehlers-Danlos), in re-dissections, or in acute dissections overlapping chronic dissections where more than two lumens might be present.

On the medulla protection methods in descending aortic surgeries, I would like to stress the role of drainage of the cerebrospinal liquid in diminishing the incidence of paraplegia, in cases of more extensive thoraco-abdominal aneurysms as demonstrated in several trials and additionally the use of left femoral-atria circulation assistance that seems to be beneficial for the same reason.

Once again I congratulate the authors of the Guidelines for the Surgical Treatment of Aortic Diseases of the Brazilian Society of Cardiovascular Surgery for their excellent work and really hope that my comments will be helpful.