



# The aortic arch management for type A aortic dissection: aggressive but experienced

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We read with great interest the article entitled “Late outcomes of strategic arch resection in acute type A aortic dissection” by Yang and colleagues in *The Journal of Thoracic and Cardiovascular Surgery* (1) in which they compared, retrospectively, the perioperative and long-term outcomes in patients undergoing aggressive arch replacement and hemiarch for acute type A aortic dissection (ATAAD).

ATAAD is a serious pathology, associated with high mortality and morbidity, and considered a surgical emergency. Overall mortality in patients with ATAAD has progressively declined (2), but variability between hospitals is important and to achieve satisfactory outcomes, an appropriate management is crucial, especially regarding the distal extent of repair, where the optimal surgical approach is still controversial.

The primary surgical endpoint in ATAAD would be replacement of the ascending aorta after resection of the intimal tear. Nevertheless, the aortic arch and the supra-aortic branches are often involved in the aortic dissection, and the gold standard management is still controversial. Traditionally, an extended therapy for aortic arch involvement was the conservative hemiarch replacement. However, advances in the surgical technique and knowledge of ATAAD, have made us more aggressive replacing the entire aortic arch when considered necessary. In this sense, many groups have compared their results with one technique or another and have tried to establish indications. Different groups have published their

individual results. For example, a single experienced center published a retrospective analysis comparing hemiarch technique (proximal arch repair) with total arch repair for ATAAD. Patients with total arch repair were older and had significantly increased circulatory arrest and retrograde cerebral perfusion times. The incidences of early stroke, need for renal dialysis and mortality were not significantly different. Late survival neither showed differences between groups (3). They suggested aneurysm greater than 5 cm, complex arch tear, and arch rupture as indications for arch replacement during ATAAD.

There are more and more groups with more experience publishing their results, so the first meta-analyses have already emerged. Poon *et al.* made a systematic review and meta-analysis to compare short, medium and long term outcomes on the risk of morbidity and mortality comparing hemiarch replacement to total arch replacement (4). There were no differences in mortality outcomes between the two groups even within the context of publication bias by high volume aortic centers and non-randomized data sets. Patients with total arch replacement were younger, particularly those with Marfan syndrome. Moreover, circulatory arrest, aortic cross clamp and cardiopulmonary bypass times were obviously significantly longer in total arch replacement. In hemiarch replacement the risk of post-operative renal dialysis was lower. Furthermore, no significant difference was reported during follow up regarding freedom from aortic reoperation. Another meta-

analysis showed that less aggressive ATAAD treatments were associated with lower early mortality but higher incidence of medium-long term aortic events including reoperation of the distal aorta (5). In that regards, recently, other studies also conclude that in the acute setting, extended-arch repair of ATAAD can be introduced with no increase in perioperative morbidity or mortality. At mid-term follow-up, extended-arch repair reduces the need for open surgical reoperation and improves aortic remodeling. Extended-arch repair was defined as replacement of the ascending aorta and arch with reimplantation of supra-aortic vessels with or without distal endovascular extension. This technique allows to treat fully treat the acute aortic dissection type-A, but it is technically more difficult than the hemiarch technique (6).

Although it may appear that the choice of treatment in ATAAD is limited to hemiarch or total arch replacement, emerging hybrid techniques involving open and endovascular surgery entail different techniques that merit special attention. For example, one experienced group compared 31 patients with total aortic arch replacement (TAR group) versus 30 patients with hemiarch replacement with concomitant antegrade thoracic endovascular aortic repair (TEVAR group) (7). In the TEVAR group there were more cases of cardiogenic shock and tamponade. When the arch rupture occurred in the greater curve or at the origin of large vessels, in the TEVAR group it was repaired with interrupted sutures. Intraoperatively, TEVAR group had lower cardiopulmonary bypass and circulatory arrest times. TAR group had higher 30-day mortality but stroke rates were similar. Interestingly, 1-, 3- and 5-year actuarial survival were improved, not significantly, in TEVAR group. Furthermore, TEVAR promoted increased false lumen thrombosis. The authors concluded that hemiarch replacement with primary tear repair and concomitant TEVAR in treating ATAAD with arch tear, is a safe alternative to conventional TAR, with improved distal aortic remodeling (7). Parallel to the advancement of technology, groups are emerging daily with new hybrid techniques to be taken into account in ATAAD, such as ascending aorta replacement and fenestrated stent graft implantation, with the fenestration opening located at the ostia of 3 head vessels in the arch, in the true lumen of the aortic arch and proximal descending aorta, (8). They reported increasing false-lumen thrombosis at 1 year and no increase in the morbidity and mortality regarding the other techniques. However, these hybrid techniques, despite good initial results, are still reported in small groups of patients,

at single centers, with short time follow-up and, in addition, are not available at all centers and at any time.

The study conducted by Yang *et al.* compared outcomes of aggressive arch replacements (zones 2 and 3 arch replacement with implantation of 2–4 arch branches, (n=150) versus hemiarch (n=322) in ATAAD. The big number of patients that they compared reflects that these are results from a very experienced center and merit special attention. Demographically, and similarly to other studies, patients were significantly younger in the aggressive arch group and had significantly lower incidences of bicuspid aortic valves, acute myocardial infarction, coronary artery disease and cardiac tamponade. The aggressive group had significantly longer aortic cross-clamp, cardiopulmonary bypass and hypothermic circulatory arrest times. Both groups had a similar minimum body temperature during HCA. No significant differences were observed between groups in concomitant surgeries or intraoperative transfusion of packed red blood cells. In addition, no significant differences were found in perioperative results comparing aggressive arch and hemiarch groups, including postoperative stroke, paraplegia, myocardial infarction, new hemodialysis, newly developed renal failure, prolonged ventilation, sepsis, hospital stay and 30-day mortality. Only reoperation due to bleeding was significantly higher in the group of aggressive arch replacement. However, in our opinion, a propensity score matching would have been interesting to better distinguish between the two approaches. Another important aspect of the Yang *et al.* work is long-term follow-up: over 15 years, Kaplan–Meier survival was similar between aggressive arch and hemiarch groups. Incidence rates of reoperation over 15 years and 10-year cumulative incidence of reoperation for distal aorta and arch disease were also similar between groups. Those are excellent results, with low mortality at 30 days and perioperative stroke rates and 10-year survival over 70% in both groups.

We would like to highlight some aspects of this experienced group to be taken into account by other centers. First of all, no significant difference was observed between groups regarding malperfusion syndrome, including spinal cord, cerebral, mesenteric, celiac/hepatic, extremities and renal malperfusion. In some centers, advanced malperfusion syndrome surgical option is rejected and patients receive only medical treatment, and this mortality is often not included in the operative mortality. Yang *et al.* reported an interesting aspect: they managed patients with malperfusion syndrome (necrosis and dysfunction of the terminal

organs) applying the treatment in two phases. Initially, with endovascular fenestration and stent placement, and in a second time, with open surgical repair if patients recovered from the initial critical situation. The improvement in the situation of malperfusion allowed them to perform a more aggressive open aortic repair if necessary (1).

Whether extension of the aortic dissection into arch branches should be an indication for replacement of the arch and its branches remains controversial. Norton *et al.* reported their experience of 190 patients over 10 years who had known left common carotid artery and/or innominate dissection without malperfusion syndrome, which included hemiarch replacement (n=109)/no arch procedure (n=1) and zone 1/2/3 arch replacement (n=80) with replacement of 1 to 4 arch branch vessels (9). The zone 1/2/3 arch and hemiarch groups presented similar perioperative and midterm outcomes, including mortality at 30 days and neurological events. Furthermore, both groups also presented similar incidence rates of reoperation for distal aortic disease with a mean follow-up time of 3.5 years, and 5-year survival. However, the hemiarch group tended to have an increased cumulative incidence of reoperation (8-year, 23% *vs.* 9%;  $P=0.33$ ). The authors concluded that in ATAAD, routine zone 1/2/3 arch replacement should not be an indication for dissection of arch branches alone; however, in selected patients, zone 1/2/3 arch replacement could be considered to prevent future reoperations. Yang *et al.* reduced the ambiguity in this aspect. In recent years, their stroke rate was similar to the results reported by Trivedi *et al.* (4% *vs.* 3,4% respectively) (10), a group who replace all the dissected carotid arteries with or without malperfusion. Therefore, they stated as indications for aggressive arch replacement in ATAAD, an intimal tear at the arch unable to be resected by hemiarch replacement, or an arch aneurysm >4 cm or dissection of the arch branches in case of malperfusion (1). Malperfusion would be considered if there is blood pressure gradient (>15 mmHg) between aorta and radial arteries, stroke, or dissection of arch branch vessels with significant occlusion. Only in these cases do they use aggressive arch replacement to resolve malperfusion replacing the arch branches.

The authors also clarified that 3 aortic experienced surgeons treated all the ATAAD cases. They believe the surgical treatment of ATAAD patients should be restricted to the more experienced surgeons in the management of aortic disease rather than the junior level surgeon on call and unsupervised (1). We agree with Matalanis *et al.* that the most used surgical strategy worldwide for the

treatment of ATAAD is the replacement of the ascending aorta and hemiarch with an open distal anastomosis. This is seen as simple and reproducible by most surgeons, regardless of their abilities in the treatment of ATAAD. Therefore, it is the most used technique in the surgical emergency of ATAAD. The shortcomings of this standardized technique, in specific cases, are ignored, assuming that a future aortic complication is rare and if it occurs can be delayed and transferred to experienced aortic centers for surgical treatment with acceptably low morbidity and mortality. However, this procedure can lead to untreatable complications, acute situations of malperfusion and increased risks in the medium and long term (11). For this reason, we consider total arch as a primary approach only when there is a surgical indication according to the characteristics described above and, more importantly, only done by the hands of a senior surgeon expert in ATAAD (4). Large series, e.g., the UK aortic group analysis determined that high-volume centers with a specific multidisciplinary aortic program had a significant reduction in ATAAD mortality when compared with low-volume centers using frozen elephant trunk as standard technique (12). Nevertheless, we can ask ourselves if the results depend on the expert hands of a surgeon or the resources of a center with a high volume of aortic disease. In an attempt to address this point, Umana-Pizano *et al.* stratified outcomes for ATAAD repair by high-volume and low-volume surgeons at a high-volume center. They divided surgeons in low-volume aortic surgeons (LVASs) ( $\leq 10$  cases/year) or high-volume aortic surgeons (HVASs) ( $> 10$  cases/year). ATAAD repair by an all-LVAS team had nearly a 4-fold increase in-hospital mortality compared with an all-HVAS team. They stated that high-volume centers had better outcomes not due to the specific resources of the center, but predominantly due to the experience of the surgeon (13). Obviously, each center should adapt to its own characteristics; however, whenever possible, we recommend that whenever a surgeon with low ATAAD experience is on call, an experienced surgeon can also be on call. We should avoid having all-LVAS teams on call. Furthermore, we agree with Bachet *et al.* that the main duty of the experienced aortic surgeon should be, whenever possible, to work to make it possible for every cardiac surgeon on the team to fulfill the minimal criteria of treating patients with a reasonable and more homogeneous risk (14).

In conclusion, Yang *et al.* published their 20-year experience on ATAAD with excellent results, establishing clear indications for an aggressive approach. They showed

us an approach to lead with malperfusion first when necessary, and draw attention again to the need for a disease as serious as ATAAD to always have an expert surgeon on hand. Although this was a single-center retrospective experience, it is, in our opinion, an excellent study to be taken into account regarding ATAAD with aortic arch involvement.

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