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A pragmatic approach in aiming to do the right things in patients with thoracic aortic pathology involving the aortic arch

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ABSTRACT

The last decade has overwhelmed the surgical community with options regarding the treatment of patients with thoracic aortic pathology involving the aortic arch as to a point where supply exceeds demand. Consequently, surgeons are confronted with a new challenge being weighing conventional surgery to several other options where some are good, some are bad and some are ugly. This manuscript is meant to serve as a pragmatic companion for the interested physician in accompanying patients with thoracic aortic disease through the natural history of the disease, to indicate the right time for treatment with adequate risk stratification, to balance options and to do the right things when advancing to treatment.

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Background

The last decade has overwhelmed the surgical community with options regarding the treatment of patients with thoracic aortic pathology involving the aortic arch as to a point where supply exceeds demand. Consequently, surgeons are confronted with a new challenge being weighing conventional surgery to several other options where some are good, some are bad and some are ugly. This manuscript is meant to serve as a pragmatic companion for the interested physician in accompanying patients with thoracic aortic disease through the natural history of the disease, to indicate the right time for treatment with adequate risk stratification, to balance options and to do the right things when advancing to treatment.

Natural history

Interestingly, the scientific basis for our decision makings when indicating the time point for intervention is mainly based on historical morphological studies as we continue to rely on maximum diameters and few advances have been made beyond conventional size criteria [1]. Anyhow we know that aneurysms will rupture sooner or later, dissections will occur with a dismal natural course without treatment and the natural history of penetrating atherosclerotic ulcers is an aggressive one without a clear correlation to diameter. Several approaches to add functional information are under way but functional imaging has not yet been fully entering the clinical arena so that maximum diameter remains our most robust surrogate of risk and thereby indication for treatment with a general consent of indicating treatment between 5 and 6 cm according to segment, accompanying valve disease, family history, additional risk factors or connective tissue component [2].

Timing/risk stratification

''Intervention is indicated when the probability of experiencing an aortic-related event is higher than the remaining risk of treatment''. As easy as this sentence is written, as complex the decision making process may be. Finally, there is no risk stratification score in predicting the risk of treatment as there is in adult cardiac surgery [3]. So other approximations have to be chosen.

A fundamental difference between proximal thoracic aortic aneurysms, dissections type A/B as well as intramural hematoma (IMH) on the one hand and penetrating atherosclerotic ulcers (PAU) on the other hand is the fact that the latter ones have an obliterative basis where the first group is on the basis of dilatative arteriopathy [4,5].

This is important as patients with proximal thoracic aortic aneurysms, dissections type A/B as well as IMH will almost never be affected by obliterative components or in other words coronary artery disease (CAD) as these two are nearly mutually exclusive whereas patients with PAU will very often have severe CAD as they do have peripheral arterial occlusive disease which often challenges delivery of stent-grafts through the iliac axis.

Furthermore, cuspidity of the aortic valve is an issue as patients with bicuspid aortic valve disease are less likely to have CAD as this also seems a kind of protecting issue [6]. After all these considerations are vital as the let us call it ''obliterative load'' in patients with PAU is high as is the risk of collateral injury by stroke and myocardial infarction (MI) whereas the obliterative load in patients with proximal thoracic aortic aneurysms, dissections type A/B as well as IMH is very low and collateral injury with regard to stroke and MI is very low.

Finally, and this is interesting, ventricular function in the vast majority in patients with thoracic aortic disease is regular which should be seen as a prerequisite for successful treatment as – this is a lesson of the personal experience of the author – patients with thoracic aortic disease and severely reduced ventricular function are at risk to die with thoracic aortic disease but not to die from thoracic aortic disease.

Summarizing, successful treatment of extensive thoracic aortic pathology will be achieved when disease of the aorta is the only limiting problem of the presenting individual, any other limiting disease burden will put success into perspective.

Balancing options and doing the right things

The most misused sentence by non-aortic surgeons is ''Conventional aortic arch surgery is still associated with significant morbidity and mortality.'' There is overwhelming evidence that thoracic aortic surgery involving the aortic arch is a safe and highly efficient procedure with low perioperative morbidity and mortality in the elective setting as well as in emergencies – predominantly acute type A aortic dissection – as long as they are uncomplicated meaning without irreversible organ malperfusion, cerebral or visceral [7–9]. Without doubt, we aim at reducing neurological injury – predominantly cerebral – to a minimum but there is work to do. Modified perfusion protocols, the routine implementation of selective antegrade cerebral perfusion and the move to warmer hypothermic circulatory arrest temperature have substantially aided in optimizing outcome [10].

Nevertheless, there are options available and some of them are important adjuncts to the armamentarium of the aortic surgeon in the decision algorithm. When discussing treatment of aortic arch pathologies we have to be very clear upon the underlying pathology as well as the segmental affection. Proximal thoracic aortic pathology originating from secondary heart fields, from the aortic root or from the ascending aorta up to the aortic arch and beyond are a very clear domain of conventional aortic surgery [10–12].

Here a relatively new approach has gained increasing acceptance being the so-called ''frozen elephant trunk technique''. The principle is the combination of a distal stent-graft with a continuing transition to a conventional Dacron prosthesis for treating patients with Megaaortas thereby reducing a potentially two-step approach to a one-step operation or to treat type A/type B acute aortic dissections with malperfusion and an entry tear at a level where conventional surgical repair is ineffective or finally patients