

The future of aortic surgery in Europe[†]

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Summary

At least every ten years, each specialty should reflect upon its past, its present and its future, in order to be able to reconfirm the direction in which it is headed, to adopt suggestions from inside and outside and, consequently, to improve. As such, the aim of this manuscript is to provide the interested reader with an overview of how aortic surgery and (perhaps more accurately) aortic medicine has evolved in Europe, and its present standing; also to provide a glimpse into the future, trying to disseminate the thoughts of a group of people actively involved in the development of aortic medicine in Europe, namely the Vascular Domain of the European Association of Cardio-Thoracic Surgery (EACTS).

Keywords: Aorta • Surgery • TEVAR • Future

HISTORY

Where have we come from?

In order to understand where aortic surgery currently stands—and how it is likely to progress—we have to appreciate its history. As an integral part of cardiovascular surgery—itsself an old, well-defined and well-developed specialty—aortic surgery in Europe has a tradition spanning at least four decades. Initially limited to a few developmental centres, surgery experienced a rapid expansion in the early 1990s when surgical techniques and perfusion strategies were refined and new diagnostic and treatment modalities became available [1–3]. Scant data were available on the natural course of aortic diseases and few people at that time claimed true aortic surgery as their main field of interest. Furthermore, the aim was treating more than preventing as to the avoidance of complications directly related to the surgical

approach. Due to the separation of cardiac and vascular surgery in many centres, diverging interpretations and treatment strategies of acute and chronic aortic diseases resulted. The development of true aortic specialists was undoubtedly hampered or delayed by this distinction.

CURRENT SITUATION

Where do we stand now?

In many centres, predominantly cardiac surgical units, a broad interest in the physician–patient relationship in aortic diseases has developed by establishing aortic outpatient clinics. This is significant as, for the first time, the surgical centre, rather than being a simple destination for surgical referrals, has now become the monitor of disease progression and the need for intervention. Therefore the treating surgeon, now acting as a diagnosing physician, has a new role as patient manager, choosing adequate diagnostics, advising the right time for treatment, as well as the right modality, and maintaining surveillance of both the integrity

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of the repair and the natural progression of as-yet-untreated aortic segments. The result of this developmental process is a surgeon-physician with a detailed knowledge of several contributing factors—the aortic specialist, in fact—unifying specific knowledge which encompassed underlying disease processes, natural course, pathophysiology, imaging, all treatment options including open, endovascular and pharmacological treatment, perfusion, hypothermia and organ protection, as well as the knowledge of post-treatment surveillance.

THE FUTURE

Where are we heading?

Disease of the aorta is now being recognized as a distinct entity with increasing incidence. It is acknowledged that the management of both acute and chronic aortic conditions now has such a broad evidence base that specialist knowledge, training and skills are required to provide the best patient care. The specialism embraces all age groups: young patients are mostly affected by connective tissue diseases (CTS); middle-aged patients are affected by degeneration of bicuspid aortic valves, with or without aneurysmal formation of the sinus of Valsalva or the ascending aorta, caused by accompanying medial degeneration. Elderly patients, in turn, may also develop the same phenotype of disease (aortic valve and ascending aorta) but, due to other underlying pathomechanisms, predominantly atherosclerosis and calcific degeneration.

All age groups may be afflicted by acute aortic dissection. Valve-preserving strategies in acute and chronic situations are highly likely to be implemented more widely. Furthermore, an old disease has regained interest in the aging population, penetrating atherosclerotic ulcers (PAU), with its incidence rising exponentially in the elderly [4]. Its discovery by chance, as well as through enhanced alertness, has increased referrals. Furthermore, better distinction of underlying disease mechanisms has improved our knowledge (e.g. a 4.5-cm PAU is different to a 4.5-cm atherosclerotic aneurysm in terms of risk of rupture).

Based on the above-mentioned considerations, it is to be expected that the known incidence of acute and chronic aortic disease will increase [5]. Interestingly, in many aortic patients, the underlying aortic disease is the only limiting problem substantiating the likelihood that our treatment definitely improves survival. However, we must learn more if we are to provide true benefit to the patients under our care. Further trials and registries are necessary to refine our decision-making and treatments in conditions such as acute aortic dissection. The following are some unanswered questions that need to be addressed:

- **Acute aortic dissection type A:** Can the speed of diagnosis be improved? When and where should patients undergo surgery? Should the false lumen be treated prophylactically or followed in anticipation?
- **Acute aortic dissection type B:** In which patient groups is urgent thoracic endovascular aortic repair (TEVAR) applicable? Could TEVAR for all be advantageous? Does TEVAR-induced remodelling confer a prognostic effect? Do bare-metal stent extensions confer an advantage?
- **Chronic aortic dissections:** Is the natural history truly known? Are the current indications for intervention robust? Is the frozen elephant trunk providing prognosis or paralysis?
- **Chronic aneurysmal disease:** Do our size criteria for intervention need to be validated? Is off-label TEVAR use really working? When should saccular aneurysms be treated?
- **Acute aortic syndromes:** Have we entirely understood the natural history of intramural haematoma and penetrating atherosclerotic ulcers and the need for intervention?
- **Organ protection:** Can we safely move to warmer temperatures during hypothermic circulatory arrest? Are our brain and spinal cord protection strategies adequate? Can we augment the 'safety net' by adding pharmacological adjuncts?

Several other important and interesting questions in the diagnostics and treatment of acute and chronic proximal thoracic aortic pathology have to be addressed in the near future, such as the degree of atherosclerotic involvement of the ascending aorta as a predictor for cardiac as well as non-cardiac ischaemic events after coronary artery bypass grafting (CABG) [6].

The surgical community is increasingly challenged to advise for or against treatment in elderly patients and we should realize that, in the same way that a paediatric patient should not be seen as a small adult, the elderly should not be seen as advanced adults [7].

A closer look at the composition of the aortic wall, its mechanical behaviour, its elastic properties and their impact on dilation, dissection and rupture in bicuspid aortic valve disease will help to prevent unforeseen acute events in the future [8].

A precise experimental and subsequent clinical evaluation of warmer systemic circulatory arrest times is further warranted, as well as the significance of pressure and perfusion of the brain in relation to systemic and perfusate temperatures [9]. The additional consideration of lower body perfusion in aortic arch surgery, either ante- or retrograde, and its implication in preventing clinical and subclinical organ injury, presents a broad field of research [10].

TREATMENT OPTIONS OF AORTIC PATHOLOGIES

Endovascular stenting has broadened the scope of aortic therapeutics and has led to the development of many alternative treatment approaches using isolated stenting and hybrid stent-surgery techniques. Some of these have become routine and may be judged as validated and standardized [11–13]. However, better understanding of the limitations of endovascular therapy, as well as acknowledgement of the excellent results for conventional aortic surgery, must be considered before extending endovascular options to all aortic pathologies and new patient populations [14]. A multidisciplinary approach may clearly serve to choose the adequate treatment modality in the individual setting as induced complications might not be handled in an adequate fashion by non-cardiac surgeons (e.g. endovascular treatment of ascending aortic pathology).

AORTIC CENTRES

The logical consequence of the evolution of aortic surgery is the creation of aortic centres, capable of treating the entire organ with all available diagnostic and therapeutic options. The leaders of such centres are likely to be cardiovascular surgeons with experience in both cardiac and vascular surgical disciplines, including endovascular skills. All treatment options should be available

for the individual patient, with choice of treatment being decided consensually at multidisciplinary team (MDT) meetings. These MDT meetings should be populated by open and endovascular surgeons, cardiologists, cardiovascular physicians, interventional and diagnostic radiologists, and neurophysiologists. Additional expertise including anaesthesiology, rheumatology and microbiology will be essential when evaluating treatment options. The referral pattern of an aortic centre must be similar to the referral pattern for percutaneous coronary interventions, with 24 hours a day, 7 days a week, year-round availability. Regarding referral patterns, cardiovascular surgeons can have their own recruitment of aortic lesions if they screen more systematically the cardiovascular population they are already taking care of.

YOUNG ACADEMICS

How to attract younger colleagues?

Aortic surgery and the management of the aortic patient are intellectually and technically challenging and it is important that the current specialty fosters high-calibre candidates to be the leaders of the future. In an era in which aspects of our specialty are unpopular with younger doctors in training, in order to get the highest calibre candidates, we have to attract them. Halsted's master-apprentice model is no longer applicable in today's educational system. Young physicians need a career model as well as achievement-based rewards, otherwise they will reorientate themselves. We have to do our best to ameliorate the framework conditions for trainees. The management of patients with aortic disease is a fascinating medical challenge that should attract the best in our fields, as long as we take the time to mentor bright individuals who show interest in the area.

REQUIRED SKILLS

A short summary of the diagnostic skills required of the aortic specialist

As the ultimate and main responsibility rests with the surgeon, it is imperative that the aortic specialist has a broad knowledge in imaging. Consequently, interpretation of echocardiography, computed tomography angiography (CTA) and functional magnetic resonance imaging (MRI) is essential [15]. Intravascular ultrasound (IVUS) may serve as an adjunct, not only because of its potential for intraoperative measurements but, even more significantly, because it provides the surgeon with his own decision-making tool.

Surgical and endovascular skills

Young surgeons must have the chance to develop and mature through a broad surgical training program, with a clear and defined aim in a defined time period, designed to provide a solid grounding in surgery, endovascular therapy and science. For future generations it will be imperative to restructure education in cardiac and vascular surgery in respect of the minor

subjects, such as endovascular training versus trauma surgery and legal medicine.

Perfusional and anaesthesiological knowledge

Any kind of open, endo or hybrid thoracic aortic repair must provide a 'safety net' of optional cardiopulmonary bypass (CPB) and hypothermic circulatory arrest, in case of unforeseen complications such as retrograde type A aortic dissection. As a consequence, the availability of CPB and the knowledge of adjunctive organ protection techniques, such as antegrade selective cerebral perfusion and cerebrospinal fluid drainage, are an indispensable part of these operations. Performing such procedures without these facilities should be abandoned.

TIMEPOINT OF SPECIALIZATION

When and how to specialize in aortic medicine?

It is imperative that the aortic specialist of the future has a broad training in both cardiac and vascular surgery. Interest in the specialty should arise early but a definitive focus on aortic medicine with, for example, a 50% aortic case-load of his or her specialism should be the zenith after one-and-a-half decades of cardiovascular surgery. It has to be the task of the academic surgical community to decide whether a certification for an aortic specialist might improve the quality of the specialty. After all, it is clear that treatment of the aorta does also include treatment of its branches and demands a broad theoretical and practical knowledge of disease processes in the entire vascular system.

RELATIONSHIP TO INDUSTRY

Without support and partnership of the medical industry, a highly emergent and implant-dependent specialty like aortic medicine is not possible. However, future developments have to be made according to a common sense of need and request of the closely collaborating physician and engineer: otherwise technology seeks indication and not *vice versa*. Improved coordination and interaction between physicians and industry could solve many issues.

ROLE OF THE VASCULAR DOMAIN OF EACTS

Aim of the Vascular Domain

The restructuring of EACTS into domains initiated a boost in the focusing of knowledge and helped substantially in driving projects and ameliorating the quality of congresses and courses. By creating the opportunity to work in smaller groups of dedicated specialists, flexibility and target orientation were substantially promoted and the results can already be seen. So the aim of facilitating meetings with highly skilled and motivated people, in order to enhance professional, scientific and educational productivity was achieved in a short period of time.

Professional productivity

By adding 'professional challenges' sessions to the programme of the annual EACTS meeting, we were able to distribute broad knowledge regarding the current state of the art, not only of surgical but—equally importantly—perfusional, monitoring and pharmacologic aspects of treating acute type A and type B aortic dissection. This approach of selecting specific topics and going into detail, with the additional aid of intraoperative videos, has turned out to be a major success and will be continued in the future. Furthermore the open attitude of the group towards provision of support in individual cases has encouraged physicians to ask for professional exchanges resulting in mutual benefit.

Scientific productivity

Current achievements. The Vascular Domain was founded in 2008 and objectives for its term of office were quickly established. The domain decided to found a European Registry for Aortic Disease (EuRADa), which is already functional, working and growing (<http://eurada.pro>). Additionally, several hot topics in the aortic field were addressed and review articles and position papers were published, as well as original articles. One of the greatest achievements of the group was the common ESC-EACTS position paper on the current use of thoracic endovascular aortic repair (TEVAR), a benchmark paper on the evidence—or lack thereof—in treating acute Type A aortic dissection, as well as a literature review on the importance of preserving the left subclavian artery as a collateral vessel to the spinal cord during TEVAR [16–18].

Future projects. There are several projects under way, which address important, unsolved questions such as the implementation of new biomarkers in the diagnosis of acute and chronic thoracic aortic pathology, as well as a randomized trial of adding a frozen elephant trunk prosthesis to a hemi-arch replacement in acute Type A aortic dissection. Furthermore, a state-of-the-art paper on spinal cord perfusion and the prevention of spinal cord injury during open and endovascular treatment is under way, as well as a position paper addressing the current status on thoraco-abdominal hybrids and total endovascular approaches. Finally, in late 2012, results of a multi-centre registry on conventional aortic arch replacement will be shared with the scientific community.

Educational productivity

The EACTS Vascular course in Windsor, being held on an annual basis at the end of March, enjoys growing popularity by establishing a programme tailored to current needs, not only for physicians in training but equally for experienced physicians who want to catch up with the latest trends and technologies in aortic medicine. Recently, simulators have been added to the programme and will help to make physicians familiar with endovascular techniques and their current applications. Furthermore, during the annual meeting, education in imaging will be added so that the surgeon will also make a step forward in being independent with regard to image guidance and quality control.

Global activities of the Vascular Domain

By creating the position of a liaison officer to the United States, the EACTS council has enabled an important step in strengthening scientific relations to North America. This position's role is to promote mutual exchange during annual meetings by integrating one another and also by enhancing intercontinental scientific collaboration on the aortic sector. Early results have already been achieved.

Domain forecast for the years to come

It is our aim to continue to function as a source of competence in all questions regarding aortic disease and its treatment, not only in theory but as active specialists. We aim to expand our aortic database (EuRADa) to become the benchmark of knowledge regarding each and every detail of aortic medicine. A focus, not only on patients treated but also on patients under surveillance before treatment, will provide a better understanding of the natural course of aortic diseases, as well as the impact of pharmacological intervention (connective tissue disease, bicuspid aortic valves). We do want to attract young physicians to make a career decision in favour of cardiovascular surgery with an aortic focus, and to support them during their development into aortic specialists.

Through the mutual efforts of past and active members of the Domain, as well as with the support of every EACTS member willing to contribute, the Vascular Domain will expand its leading role in differentiated discussion, analysing problems, answering open questions and advancing the field of aortic medicine for the sake of our patients, as well as for our own development in order to better understand the disease and improve its treatment.

Conflict of interest: none declared.

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Obituary

On 29th October 2012 a great surgeon and academic teacher passed away. Robert Stuart Bonser was known to the medical community not only in the United Kingdom and Europe but also around the world, not merely because of his outstanding skills as a surgeon but mostly due to his altruistic sense of teaching and academic leadership. We, as members of the Vascular Domain of EACTS, were able to welcome Robert to the group in 2008. From the outset it was clear that Robert's contributions enhanced our efforts in many ways. We remember fondly a highly stimulating programme committee in Windsor. Robert produced a remarkable and scientifically enriching programme for the annual meeting. His efforts for EACTS culminated in a brilliant review addressing evidence, lack of evidence, controversy and debate in the provision and performance of the surgery of acute type A aortic dissection. This is but one of the many fields in which he was an expert. Throughout his final illness, he kept in touch with us and continually hoped to resume the work that he so much valued, enjoyed and excelled at.

It is clear that Robert will be missed, especially by those who had an interest in aortic surgery in the UK, where he was the surgeon of last resort. Many of his colleagues recall stories of Bob coming to the rescue and sorting out a difficult case or situation. We are grateful that we had the privilege of knowing him and learning from him. Robert represented the ideal of an altruistic teacher and a thoughtful and supportive academic leader. This memory will be cherished by all who knew him.

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On behalf of past and present members of the Vascular Domain of EACTS