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Vascular Surgery and HSM – A Perfect Match

The specialty of vascular surgery has evolved dramatically in the last three decades.

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While traditional vascular surgery techniques such as endarterectomy, bypass surgery or open aortic aneurysm repair are – or should be – still a mainstay of vascular surgery today, the emergence and improvement of endovascular techniques for the treatment of many vascular pathologies has not only been an evolution, but a revolution.

A very good example for this revolution is the endovascular treatment of aortic dissections, both in the acute and in the chronic (post dissection aneurysm) setting. Traditionally and in most cases still today, uncomplicated acute type B aortic dissections have been treated conservatively. So far, no randomized controlled trial was able to clearly demonstrate a benefit from unselective endovascular treatment over best medical treatment of uncomplicated acute type B dissections.[1-3] Accordingly, guidelines recommend to only consider early endografting of uncomplicated type B dissections selectively.[4] On the other hand however, for complicated acute type B dissections, the situation is entirely different. A complicated type B dissection is defined by the presence of one or several of the following findings:

Frank or impending rupture

End-organ malperfusion. This includes any organ perfused by aortic branches that arise at or below the level of the dissection, namely the spinal cord, liver, spleen, gastro-intestinal tract, kidneys or the lower extremities.

– Refractory or recurrent pain in spite of adequate medical treatment

– Refractory hypertension in spite of adequate medical treatment

– A rapidly expanding false lumen

In line with international guidelines, endovascular repair with thoracic endografting should be the first line intervention in patients with complicated acute type B aortic dissection.[4] The aim of this treatment is to restore distal perfusion, to cover the primary entry tear and therewith reduce blood flow and blood pressure inside the false lumen. This in turn is thought to promote false lumen thrombosis and aortic wall remodeling which ultimately prevents extension and rupture. Three meta-analyses of patients treated endovascularly for acute type B dissections reported technical success rates of 95% to 99%, hospital mortality rates of 2.6% to 9.8% and

neurological stroke rates from 0.6% to 3.1%. While these analyses include patients with both complicated and uncomplicated type B dissections, a prospective multicenter trial of patients with complicated type B dissections reported a 1 year mortality rate of 10%, stroke rate of 7.5%, TIA rate of 2.5%, and progression of dissection of 5%.[5] We have to keep in mind that these outcomes are from patients with a devastating, highly life-threatening disease that has catastrophic outcomes with conservative treatment and extremely high complications rates with open aortic repair. One study of patients with acute complicated type B dissections reported 30-day mortality rates of 2.4%, 40% and 33% after endovascular repair, open repair and conservative treatment, respectively.[6] Those patients treated endovascularly also had significantly reduced mortality rates after 1, 3 and 5 years.

Modern endovascular treatment of aortic dissections, both acute (complicated) type B dissections and chronic postdissection aneurysms, in many instances not just a “simple” implantation of stentgrafts in the thoracic aorta but can be much more difficult than that. Techniques include one or combinations of the following:

– Implantation of proximal stentgrafts that reach into the aortic arch. This can make it necessary to perform open supraaortic debranching procedures before covering the ostia of some of the supraaortic branches such as the left subclavian artery or the left common carotid artery; or alternatively use stentgrafts that include one or several branches to preserve those supraaortic branches; or perform in situ laser fenestrations to preserve those branches.

– Occlude the false lumen in the distal thoracic aorta to prevent retrograde flow into the false lumen. Several techniques to achieve this have been described such as the knickerbocker technique or the candy plug (or false lumen occluder) technique. Some of these techniques can involve the modification of an off-the-shelf device by the experienced surgeon.

– Extend the true lumen and reduce/occlude the false lumen in the visceral segment of the aorta. This can be achieved by implanting dedicated non covered aortic dissection stents (PETTICOAT (provisional extension to induce complete attachment) procedure).[7] In addition, both the thoracic stentgrafts and the abdominal stents can be actively expanded using balloons which leads to a rupture of the dissection membrane (STABILISE (stent-assisted balloon-induced intimal disruption and relamination in aortic dissection repair) procedure).[8] Only this usually allows for the true lumen to fully expand and the false lumen to fully occlude.

– Selectively protect or stent aortic side branches such as the coeliac trunk, the superior mesenteric artery or renal arteries that are occluded by the dissection membrane, either spontaneously or caused by the procedure itself. This is usually achieved by stenting of the respective vessel.

– Planning and performance of complex endovascular procedures using fenestrated (and to a lesser extent branched) devices to treat mainly chronic dissections, i.e. post dissection aneurysms. Due to the anatomical conditions with a potentially very narrow true lumen and aortic side branches arising from different lumina, planning and executing such procedures can be even more complex than in patients with non-dissection aneurysms.

Achieving the above results and applying some or all of the techniques described above requires a deep understanding of the pathology, the pathophysiology and the anatomy of the aorta and aortic dissections. Such an understanding can only be gained with experience which in turn depends

on the number of patients one has seen and treated and the number of pitfalls one has encountered and overcome. Furthermore, in this example, that deep understanding also requires an extensive experience not only with (complex) endovascular, but also with open aortic repair of acute and chronic dissections (which is still required at times) and not least with the acute and chronic non-invasive management of patients with aortic dissections including medical management, proper follow-up and indicating of late (re-)interventions. It is essential that such patients be treated in experienced centers by experienced surgeons, intensive care physicians and many other specialists who see sufficient numbers of patients presenting with the respective disease. This is the central idea of the concept of highly specialized medicine.

There is a second issue that warrants discussion

As mentioned briefly in the first paragraph of this article, expertise with traditional open vascular surgical techniques must not be lost in the endovascular era. While – as outlined in this article – endovascular techniques have revolutionized vascular surgery and allow to treat patients with highly complex diseases minimally invasively, this does not mean in any way that endovascular surgery has replaced, should replace or can replace open surgery. There are still many instances where open vascular surgery has clear benefits and is clearly superior in terms of mid- and long-term outcomes for the patient. This is true for many fields of vascular surgery: Patency rates of peripheral bypass surgery vs. endovascular treatment in complex lesions[9]; Feasibility and durability of open AAA repair in patients with anatomies not perfectly suitable for EVAR[10]; Feasibility and outcomes of carotid endarterectomy vs. carotid stenting in certain anatomical situations[11] to name just a few of many more examples. The obvious advantages of endovascular compared to open surgical procedures (minimal invasiveness; less perioperative systemic complications such as perioperative myocardial injury, pulmonary complications, surgical site infections; shorter hospital stays; patient preference) have led to a dramatic increase in the numbers of such procedures while the number of open surgical procedures has decreased[12]. This is further amplified by the fact that endovascular interventions are performed by non-surgical specialists who are not able to offer the open surgical option to the patient. These factors cause two main problems: First, expertise in open vascular procedures that has been developed and passed on over decades is now dramatically decreasing and young vascular surgery trainees are not sufficiently exposed to them to become proficient[13]. Second, this will inevitably lead to a situation the type of procedure offered to the patient is not necessarily the best but simply the only one the treating doctor knows how to perform. With endovascular, minimally invasive procedures meant to improve patient outcomes, this could paradoxically lead to the opposite outcome. To counteract these problems, introducing the requirement for minimal numbers of specific procedures to be performed per center is certainly one step in the right direction. Furthermore, requiring minimal numbers of open procedures to be able to perform endovascular procedures for the same disease and vice versa seems reasonable because only this prevents biased indications as mentioned above. reasonable as well

Therefore, the allocation of at least some vascular surgical procedures to HSM, a process that is happening at this moment, is an overdue necessity and a step towards improving outcomes of our highly complex and multimorbid vascular patients.

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