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What future for vascular neurosurgery?

Vascular neurosurgery has always been at the forefront of neurosurgical advances, requiring a combination of decision making, critical care support, microsurgical skill, and advanced surgical technology. The need to secure unstable intracranial aneurysms was identified by Harvey Cushing (1923), but the first modern-era clipping procedure was performed by Walter Dandy in 1937 (Dandy 1938). Since then, the progressive evolution of devices, particularly the operating microscope, has resulted in intracranial surgery to secure aneurysms presenting with subarachnoid hemorrhage, or otherwise, becoming routine procedure.

The latest era of aneurysm treatment has seen the meteoric rise and acceptance of endovascular treatment by interventional radiologists. Endosaccular obliteration by insertion of silver wire was first reported in 1941 (Werner et al 1941). During the 1970s and 1980s, the evolution of catheters and detachable devices, most importantly metal coils, resulted in the ability to secure intracranial aneurysms without the need for operative trauma or dissection to the brain. However, even the earliest studies of modern coiling techniques pointed towards some limitations of these techniques and suggested that some aneurysms might be more challenging or unsuitable for endovascular therapy (Vinuela et al 1997). These difficulties were partially addressed over the 1990s by development of balloon and stent-assisted coiling techniques.

One of the most impressive studies on the outcomes of the two treatments for intracranial aneurysms, the International Subarachnoid Aneurysm Trial (ISAT) was presented in 2002 (Molyneux et al 2002). It suggested that the ruptured aneurysm treated endovascularly had a better one-year outcome, maintained at seven years, in terms of neurodisability and seizures. An increased risk of delayed rebleeding compared with the aneurysm treated surgically was seen. The practice of radiological follow up to identify the possible recurrence was encouraged, and rates of prophylactic retreatment following endovascular therapy were noted to be higher that for open surgery.

In parallel with these developments, advances in both the resolution and availability of neuroimaging modalities have led to an increased number of patients presenting with aneurysms that are considered asymptomatic. Epidemiological data have become accepted that offer year-on-year risk stratification of the risks of subarachnoid hemorrhage from such aneurysms (Werner et al 2007). The modern neurosurgeon or neurologist is hence routinely asked to consider treatments for the unruptured, asymptomatic aneurysm, in addition to the emergency workload of those presenting with subarachnoid hemorrhage. The patient group over time has become younger, healthier, and better informed prior to presentation. Particularly those patients that present with an unruptured aneurysm after screening following the subarachnoid hemorrhage of a close relative may have strong psychological factors influencing their decisions to have treatment or not. They may be very keen to avoid the need for long-term follow up and eliminate worry. For these patients the issues of retreatment are very serious. For the experienced vascular neurosurgeon the operative conditions in the context of unruptured aneurysms are ideal and operative morbidities should be minimal. These factors, coupled with the recognition of the key differences not only in presentation but also in treatment goal, often combine to make surgical treatment of the unruptured aneurysm a preferable option (Heros 2006).

Previous data from previous studies such as ISAT is difficult to apply to newer cohorts of patients. We now see a different patient group requiring aneurysm surgery. They have progressed from those presenting acutely in various states of disability, to a group that includes fewer such patients, but a greater proportion of recurrent or residual aneurysms post-coiling, and the unruptured group requiring treatment with the highest definitive success rate. Only further longitudinal studies of these newer groups of patients will guide us in time as to the precise outcomes.

A further area of increased endovascular technology is in the treatment of cerebral arteriovenous malformations. These increasingly present without hemorrhage, either due to epilepsy or without symptoms. Progress in embolisation with particulate matter or latterly liquid materials such as Onyx has improved the success rate of such treatments, however a large proportion of these malformations are now treated with stereotactic radiotherapy (Betti et al 1989). Whilst taking some years to achieve occlusion of the nidus of such malformations with a recognized failure rate, the side effects of such treatments are low. The role of surgery in the treatment of AV malformation is therefore now principally confined to lesions inaccessible to angiography catheters, too large or acute for stereotactic radiotherapy, or in the context of acute hemorrhage requiring evacuation.

Technology in other areas of neurovascular surgery now makes other procedures more feasible. Revascularisation of the brain vulnerable to ischemia, either from intracranial stenosis or vasculitis, is not a new procedure. The use of extracranial – intracranial bypass has long been proposed either for local revascularisation or to augment flow around a complex aneurysm that may not be approached directly, although disappointing results in the past led to a decline in these operations (Sundt et al 1985). Endovascular therapies have developed that may address some of the problems for which EC-IC bypass has been used, especially stent-assisted coiling for some aneurysms and the use of intracranial stenting for discrete stenoses. However, even the most recent series of such patients recognize an important group of patients for whom endovascular therapy is high risk and unsuitable. The technological advances in bypass which especially include laser-assisted techniques (ELANA) have to a lesser extent mirrored the advances in radiological procedures (Tulleken and Verdaasdonk 1995).

There continues to be a change in the need for neurovascular services. Aneurysm surgery has become a subspecialty interest rather than the common ground between all neurosurgeons. There will be an increase in requirement for skilled endovascular radiologists in all centres. Given the emergency surgical priority that a select group of patients with subarachnoid hemorrhage will always represent, we will surely see a future of increasing collaboration between centres to provide on-call services across large regions for these few, unpredictable patients (Derdeyn et al 2003). This will apply equally to patients considered for EC-IC bypass (Amin-Hanjani et al 2005).

In considering the future, we may look to other areas of vascular surgery that have seen differing practices evolve. Cardiac revascularisation has seen interventional physicians performing the most procedures with a corresponding decline in the workload of the surgical arm of the specialty. Peripheral vascular surgery, including those specializing in aortic disease, has seen the surgeons embrace radiological advances and the two areas move forwards together. Neurovascular intervention, in the United Kingdom at least, is most unlikely to separate from neurosurgery completely, and yet has not integrated to the same extent as other vascular interventionalists. The next ten years will surely show greater organization and cooperation of these services. What is certain is that our neurosurgical practice will change, as it always has, but not fade.

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