Posterior Circulation Aneurysms

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Introduction

More than 1400 patients with aneurysms arising from the vertebral and basilar arteries have been operated upon in the neurosurgical unit at the University of Western Ontario in the past 35 years. The majority (1100) underwent surgical treatment since 1970 and, therefore, enjoyed the benefits of contemporary neuroradiology, anesthesiology, and the use of the operating microscope and microtechniques. Throughout this period, a system of pre- and postoperative management, anesthetic technique, and operative approach has evolved.

Despite the relatively inaccessible location of these aneurysms in the confining space in front of the brain stem, the majority of patients with small aneurysms can be operated upon successfully and with a morbidity and mortality not dissimilar to aneurysms of the anterior circulation. Beside excellent neuroanesthesia and technical and psychological preparedness to work in this confined space, a detailed appreciation of the anatomy is necessary. The most important predictors of outcome, however, are the grade of patients going into the operating room and the size of the aneurysm. Whereas a combined morbidity and mortality of 8% has been experienced in small aneurysms, the risk of operation rises progressively as the aneurysm enlarges to 32% with giant aneurysms of the posterior circulation. Similarly, grade I and 2 patients have a significantly more favorable outcome, with most of the postoperative disability being accounted for by effects of the original bleed, vasospasm, and possibly the added insult of operation on an already injured brain.

Approach to the Upper Basilar Artery

A minor controversy exists over the optimal approach to the upper basilar artery. The subtemporal, transsylvian, and combined approaches each have strong advocates. We have favored the subtemporal approach in the vast majority of aneurysms originating on the basilar artery above the anterior inferior cerebellar artery (AICA) for the following reasons: The distance from the scalp to the aneurysm is the shortest from this approach; most of the aneurysms have a neck that is narrowest in the anterior/posterior direction and, therefore, accept the clip in the lateral approach most easily; the critical perforators arising off the origin of the P1 bilaterally and off the terminal basilar artery are posterior and can be seen and separated from the neck and protected before clipping; and, finally, the subtemporal approach is faster and allows more efficient use of limited operating room time. The transsylvian approach is also valuable in that the fundamentals of the exposure are more familiar to most neurosurgeons and it is particularly useful for high-lying aneurysms arising from the elongated basilar arteries, where the neck of the aneurysm is more than 1 cm above the posterior clinoid. Although initially the amount of brain retraction to reach the basilar bifurcation from the transsylvian approach is less, the exposure can be confining with access limited by perforating vessels arising off the posterior communicating artery and may require temporary retraction of the carotid and middle cerebral arteries. As well, the transsylvian approach gives the surgeon only limited exposure of the posterior cerebral and basilar perforators. A combined transsylvian-subtemporal approach provides the advantages and disadvantages of both exposures, but can be extremely useful for large broad-necked aneurysms, extending the visibility and providing the opportunity for safe clipping from either access. Familiarity with the anatomy, complete confidence in the approach, and pre-
vious experience are all important determinants as to how the surgeon should approach these aneurysms but, in our opinion, one should be familiar with all these methods and, in any one case, the patient should be positioned, fixed in the pin headrest, and draped in such a way that any or all of the approaches can be utilized.

**Temporary and Permanent Clips**

Most of these aneurysms have been operated upon under moderate to deep generalized hypotension. In the early years, we used Arfonad, then subsequently sodium nitroprusside, and in the past 6 years increased inhaled concentration of isoflurane to produce the lowering of blood pressure. However, in recent years, we have been more frequently using a temporary clip on the basilar artery, with the patient normotensive, with excellent success. Our rediscovery of the temporary clip technique, stimulated by Suzuki and the Sendai school, has proved to be successful, both because of the apparent measure of protection provided by mannitol and the introduction of temporary clips with gentle closing pressures by Suzuki, Sugita, and others. The temporary clip not only dramatically reduces the risk of intraoperative rupture but, more importantly, will most often make the aneurysmal sac soft enough to be gently but deliberately deformed by the dissector, permitting precise definition of the neck and separation of surrounding important structures. For the upper basilar artery, we commonly use intermittent temporary basilar artery occlusion for periods averaging 3.5 min. However, as many as 20 intermittent clippings of the basilar artery have been utilized and some for as long as 20 min with no untoward effects. We have utilized the temporary clip for intermittent upper basilar artery occlusion in more than 100 cases with no recognized permanent complications.

All of the small aneurysms, that is less than 1.25 cm in diameter, have been clipped. Of the large aneurysms, 92% have also been secured directly with clips. However, of the 353 giant aneurysms with diameters greater than 2.5 cm, only 42% could be treated with neck clipping. In the past several years, we have come to use the Sugita clip almost exclusively. Drake's aperture modification of the Sugita clip is particularly useful for aneurysms of the upper basilar artery to permit clipping of the neck while the fenestration encircles and protects the P1 and its perforators, the perforators alone, and the oculomotor nerve. For those aneurysms with large bulky necks, the aperture clip permits clipping the neck in sections by using the tandem principle. This tandem technique makes use of the stronger closing pressures over a short length of blade to secure a portion of the neck so that one, two, or more aperture clips are placed across the neck with portions of the aneurysm still filling within the aperture, which is finally closed with a straight clip. Once again, the subtemporal approach makes multiple clip occlusion of an aneurysm neck possible that may be impossible in the narrow space of the pterional-transsylvian approach.

We have rarely attempted to wrap or coat aneurysms of the posterior circulation. More often, we have been impressed with the futility of coating, having spent many anxious hours patiently removing muscle, scar, gauze, and glue when redoing aneurysms that seemed at the first exposure by another surgeon to have been too dangerous or too difficult to clip. Wrapping and coating, in our opinion, is a far inferior treatment unless the sac is completely encased, and gives little protection against further enlargement or rupture. Usually a posterior circulation aneurysm that can be completely wrapped or encased in a reinforcing material can almost always be clipped.

**Approach to Aneurysms of the Lower Basilar and Vertebral Arteries**

Aneurysms below the AICA, that is vertebral–PICA, vertebral junction, basilar fenestration, and those few aneurysms arising off the lower basilar artery not adjacent to a named branch, can most often be exposed via the suboccipital approach. The side of the exposure is determined by consideration of two factors—the side of the neck and distance. Normally, we prefer to approach the neck side of these aneurysms rather than the fundus side. This practice has three advantages. The first, and most important, is that the surgeon can expose the aneurysm from its least hazardous side while gaining the opportunity to have proximal and distal control of the parent artery and to see with greater clarity the associated branches at the neck. Moreover, because these aneurysms tend to balloon out asymmetrically within the narrow space at the base, causing the basilar artery to be displaced away from the fundus, the exposure distance is somewhat smaller on the neck side than on the fundus side. Obviously, for aneurysms of the