Microsurgical Treatment of Unruptured Intracranial Aneurysms

A Consecutive Surgical Experience of 450 Cases in the Endovascular Era

THE NATIONAL BRAIN ANEURYSM CENTER

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Abstract

Objective

With the progressive refinement of endovascular techniques, fewer intracranial aneurysms (IAs) are being treated with open microsurgery. There is limited information regarding the impact of this rend on the ability of younger neurosurgeons to achieve proficiency in the surgical management of IAs. We describe a consecutive series of patients with unruptured IAs treated by a neurosurgeon initiating a dedicated cerebrovascular practice in the "endovascular era".

Methods

We retrospectively reviewed the records of all patients who had undergone surgical repair of a saccular IA by a single neurosurgeon from the time of completion of neurosurgical training in July, 1997 until April, 2005. Ruptured IAs were excluded from review. Of 1,450 patients with IAs treated during this period, 376 patients underwent microsurgical repair of 450 unruptured IAs. Microsurgical aneurysm neck clipping was possible in most cases, although distal revascularization with proximal occlusion was employed in many of the more complicated aneurysms. Major complications occurred in six patients (1.60%), and one patient died (0.27%). At six-month follow-up, four patients (1.06%) were left with a new focal neurological deficit related to surgery.

Conclusions

Despite the growing role of endovascular therapy in the management of IAs, it is possible for the young neurovascular surgeon to achieve acceptable results with open microsurgical treatment of IAs. The factors that were deemed important in achieving success in this series included a collaborative approach with endovascular colleagues, careful surgical judgment, continual reanalysis of personal results, and the early support of experienced mentors.

Introduction

Over the past decade, several major factors have reduced the number of intracranial aneurysms (IAs) undergoing open microsurgical repair. These include the progressive refinement of endovascular techniques (balloon-assisted and stent-supported coiling) and the impact of the ISAT and ISUIA trials (1,3,5,6). As fewer surgeons perform fewer open microsurgical procedures for IAs, general competence and comfort levels with this operation decline. It is difficult to assess the subtle but definite impact this trend has had and will have on the ability of younger neurosurgeons to become proficient in the surgical management of IAs.

Methods and Materials

From July, 1997 to April, 2005, our neurovascular service treated a total of 1,450 patients with IAs. During that period, a single neurosurgeon (ESN) repaired 450 unruptured IAs in 376 patients (140 men, 236 women). Ages ranged from 22 to 84 years. 290 patients had a single aneurysm, 86 had multiple lesions. Only patients with saccular IAs treated in the absence of acute SAH were included in this study. Fifty-four patients had suffered a remote SAH from another previously treated aneurysm, and 30 patients presented with mass effect resulting in either cranial neuropathy or cerebral dysfunction. Neuroimaging studies, inpatient charts, operative reports and drawings, and follow-up clinic notes were available in each case. All patients in this series underwent intraoperative angiography. One month follow-up was available for all patients; six-month follow-up was available for 97% of patients and for all patients who suffered an early complication. Outcome was graded based on the Glasgow Outcome Scale (GOS), SF-12, and SF-36.

Results

There were 314 small (70%), 99 large (22%), and 37 giant (8%) lesions. Aneurysm locations and sizes are summarized in Table 1. Microsurgical neck clipping was achieved in 381 cases (85%). Thirty-three patients underwent distal revascularization with proximal occlusion. Bipolar electrocoagulation with gauze reinforcement was utilized in the treatment of 27 microaneurysms, and nine patients underwent gauze wrapping as primary treatment. Eighteen aneurysms were clipped after having been previously coiled, and seven patients underwent clipping of previously operated aneurysms. Four patients underwent intentional subtotal clipping followed by subsequent endovascular coil obliteration of the residual aneurysm.

Major non-fatal surgical complications occurred in six patients (1.60%)-Table 2. Major complications developed in three small (0.96%), one large (1.01%), and two giant (5.41%) aneurysms. At six-month follow-up, four patients (1.06%) were left with a new focal neurological deficit related to surgery. The mortality rate was 0.27% (1 patient). Symptomatic ischemic injury occurred in three patients (0.80%). Three patients suffered complications presumably related to direct surgical trauma. Additional complications included: delayed wound infection (1), lower extremity DVT (2), delayed chronic subdural hematoma (2), perioperative seizure (2), and third nerve palsy not present preoperatively (7). To date, no patient has experienced SAH following surgical treatment of their aneurysm with follow-up ranging from six months to seven years. Patient evaluation using the SF-12 and SF-36 identified nine patients who would have been graded as normal (GOS=1 on the Glasgow Outcome Scale) but who felt their quality of life was worse post-operatively.

Table 1. Aneurysm Locations and size Distribution

Aneurysm Location	Small	Large	Giant	Total
All	**314**	**99**	**37**	**450**
Internal Carotid	*108*	*36*	*17*	*161*
Petrous/Cavernous	0	1	3	4
Paracliniod	31	17	8	56
PCOMMA/AchA	61	13	5	79
Carotid Bifurcation	16	5	1	22
Anterior Cerebral Artery	*59*	*29*	*2*	*90*
ACOMMA	46	29	1	76
Distal Anterior Cerebral	11	-	1	12
A1 Segment	2	-	-	2
Middle Cerebral Artery	*127*	*28*	*14*	*169*
MCA Bifurcation	117	22	11	150
M1 Segment	9	4	2	15
Distal MCA	1	2	1	4
VertebroBasilar	*20*	*6*	*4*	*30*
PICA	10	-	3	13
Basilar Apex	10	5	1	16
Basilar Trunk	-	1	-	1

Table 2. Serious Complications and Associated Outcomes in 450 Unruptured Aneurysms

Age/Sex	Location	Size	Complication	GOS*
59/F	MCA	18mm	Perforator injury, Hemiparese (severe)	2
41/F	Basilar apex	8mm	Perforator injury Hemiparesis (mild)	1
65/F	MCA	4.8cm	Posterior dividion MCA infarct, SVG thrombosis	3
51/F	MCA	7mm	Retraction injury, transient dysphasia	1
68/F	Paracliniod	8mm	Subfrontal contusion	2
58/F	Paracliniod	4.2cm	Severe visual impairment	3
44/F	ACoA	6mm	Systemic thromboemboli	5 (Dead)

* GOS measured at six-month post-operative follow-up

Discussion

The appropriate management of unruptured IAs remains controversial. Although it appears that these lesions don't bleed often, when they do, the consequences are severe and potentially life-threatening (7,8). Although earlier reports advocated treating most unruptured IAs, some more recent studies have recommended treating only larger or symptomatic aneurysms because of their more aggressive natural history (2,4,9). Nevertheless, multiple investigators have described the rupture of small, asymptomatic, previously unruptured IAs that were being followed without treatment (7,10). Clearly, unruptured IAs should be treated only if surgical and endovascular complication rates can be kept at very low levels. Because these numbers may vary significantly based on surgical experience and treatment volume, it becomes critical for individual surgeons and centers to track their personal outcomes in these cases. In our experience, a collaborative team approach is critical in the management of unruptured IAs. By viewing open microsurgery and endovascular therapy as complimentary rather than competitive, each patient is offered the option that the team feels will have the highest likelihood of yielding the optimal result, balancing morbidity with durability of repair. Although the superior durability of microsurgical clipping as opposed to coiling is an important consideration, there is little benefit to the patient of leaving the operating room with a well-clipped aneurysm if the cost is a permanent disabling deficit that could have been avoided by an alternative treatment option. In the setting of unruptured IAs, we have generally recommended open surgery only when we feel confident that our surgical risk is extremely low. When it has been our impression that an aneurysm should be treated but the surgical risk in our hands is unacceptably high, we typically recommend endovascular therapy or referral to a center with greater expertise.

Conclusions

We present a large consecutive series of patients with unruptured IAs treated by a single neurosurgeon. The acceptable results in regard to morbidity and mortality in this complex group of patients support the idea that a young neurosurgeon can become proficient in the surgical management of even very complicated intracranial aneurysms despite the decreasing percentage of aneurysms that are being treated with open surgery. Of equal importance, it appears that this proficiency can be achieved without putting patients at undue risk by exercising careful surgical judgment. It is suggested that younger neurosurgeons who wish to manage intracranial aneurysms will have to work closely with endovascular colleagues and experienced surgical mentors and should demonstrate a dedicated interest in this area in order to treat an adequate volume of patients and ascend the learning curve over a reasonable period of time.

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