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Surgical management of giant intracranial aneurysms

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Abstract

Objectives: The natural history of giant intracranial aneurysms is generally morbid. Mortality and morbidity associated with giant aneurysms is also higher than for smaller aneurysms. This study was carried out to assess the demographic profile, presenting features, complications, and outcome after surgical treatment of giant intracranial aneurysms.
Patients and methods: A retrospective review of the medical records of all patients with giant intracranial aneurysms treated in the Department of Neurosurgery, Neurosciences Centre, All India Institute of Medical Sciences, New Delhi, from January 1995 through June 2007 was performed. The demographic profiles, presenting features, radiological findings, surgical treatments, and outcomes were assessed.
Results: A total of 1412 patients harboring 1675 aneurysms were treated. Out of these, 222 patients had 229 (13.7%) giant aneurysms, and of those, 181 aneurysms in 177 patients were managed surgically while 48 were treated with endovascular therapy. In the patients treated with surgery, common clinical presentations included subarachnoid hemorrhage (SAH) in 110 (62%) cases followed by mass effect in 57 (32%) cases. In patients who presented with SAH, the Hunt and Hess SAH grading was: grade I in 43 (39%), grade II in 40 (36%), grade III in 23 (21%), grade IV in two (2%), and grade V in 2 (2%) patients. One hundred and seven aneurysms (in 103 patients) were treated using direct surgical clipping. Forty-six patients with good collateral circulation were treated by gradual occlusion and ligation of the internal carotid artery (ICA) in the neck with a Silverstone clamp. Another nine patients with good collateral circulation, but persisting symptoms after ICA ligation, required trapping for obliteration of the aneurysm. Eleven patients with poor collateral circulation required extracranial–intracranial (EC–IC) bypass before proximal ICA ligation. A post-operative digital subtraction angiography (DSA) was performed in 118 patients and revealed well-obliterated aneurysm in 106 patients. The total treatment mortality rate was 9%. In the last 5 years, 117 patients were operated on with four operative deaths. Overall, the outcome was excellent in 131 (74.0%), good in 22 (12.4%), and poor in eight (4.5%) cases.
Conclusions: It is concluded that 14% of all intracranial aneurysms are giant. The most common clinical presentation is SAH followed by features of an intracranial mass lesion. The cavernous ICA is the most common portion of the ICA affected. Direct surgical clipping is a safe and effective method of treatment and should be considered the first line of treatment whenever possible. With proper case selection, optimal radiological evaluation, and appropriate surgical strategy, it is possible to achieve a favorable outcome in almost 90% of the cases.

Keywords: Intracranial aneurysm; Giant; Surgery; Management; Subarachnoid hemorrhage

1. Introduction

Intracranial aneurysms larger than 25 mm in maximum diameter are classified as giant [1]. The natural history of giant intracranial aneurysms (GIAs) is generally morbid as a result of hemorrhage, neural compression, and thromboembolic episodes. Left untreated, the majority of patients suffer from ruptures of these aneurysms. Once ruptured, the cumulative frequency of rebleed at 14 days is 18.4%. It has been shown that mortality is above 60% within 2 years and 80% of patients with untreated symptomatic GIAs are dead or totally incapacitated within 5 years of diagnosis [2–4].

When an aneurysm grows to giant size, the neck widens and may incorporate the efferent arteries. The lumen usually contains a thrombus and the wall may become calcified. All of these features alone or in combination preclude simple surgical clipping. Endovascular treatment for GIAs is

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not optimal because of lack of relief from mass effect, cost (especially in India) and the high complication rates in broad necked giant aneurysms. The goal of aneurysm obliteration with maintenance of adequate cerebral blood flow (CBF) and relief of mass effect therefore remains a definite surgical challenge [3,5]. Mortality and morbidity associated with GIAs is higher than that for smaller aneurysms [6]. Surgical outcome for GIAs is still unsatisfactory. The reasons for the higher complication rates are the occlusion of perforators or parent arteries by the aneurysm clipping itself, or temporary occlusion of main arteries [6–10]. Furthermore, aneurysms that are most difficult surgically are the ones that offer the lowest probability for a definitive endovascular cure [5,11–14]. Most of the reported experiences of surgery for GIAs are from the west, with practically no reports from South-East Asia. We report our experience with surgical treatments of GIAs at a premier tertiary referral centre in India.

2. Material and methods

The medical records of all patients with intracranial aneurysms treated in the Department of Neurosurgery, Neurosciences Centre, All India Institute of Medical Sciences, New Delhi, from January 1995 through June 2007 were reviewed. The demographic profiles, presenting features, radiological findings, surgical treatments, and outcomes were assessed. A total of 1412 patients harboring 1675 aneurysms were treated. Out of these, 222 patients had 229 (13.7%) GIAs. A predominance of female patients was apparent (133 females to 89 males, a ratio of 1.5:1). Of these, 181 aneurysms were managed surgically while 48 were treated with endovascular therapy. The majority presented in the fifth and sixth decades of life with the youngest patient being 3 years old and the oldest 76. All patients underwent CT scans and standard four-vessel (carotid and vertebral) digital subtraction angiographies (DSAs). In patients treated in last 4 years, 3D DSAs were also available. CT scans were done to demonstrate size, calcification, thrombosis, subarachnoid hemorrhage (SAH), intracerebral/intraventricular hemorrhage, and hydrocephalus. Hypertension, metabolic derangements like electrolyte imbalances, hydrocephalus, and vasospasm were treated appropriately.

3. Results

In 177 patients treated with surgery, common clinical presentations included SAH in 110 (62%) cases followed by mass effects in 57 (32%) cases. Aneurysms in five patients were detected incidentally (three patients presented with seizures, two with embolic strokes). Symptoms and signs of local mass effects included adjacent cortical dysfunction, failing vision, cranial nerve paresis, and retro-orbital pain. In patients who presented with SAH, the Hunt and Hess SAH grading was: grade I in 43 (39%), grade II in 40 (36%), grade III in 23 (21%), grade IV in two (2%), and grade V in two (2%) patients.

Table 1
Aneurysm location

Location	Number of aneurysms (181) (number of patients, 177)
Anterior circulation	168
Internal carotid artery	151
Cavernous	58
Clinoidal seg	53
Carotid trunk	22
Bifurcation	18
Middle cerebral artery	13
Anterior cerebral artery	4
Posterior circulation	13
Basilar apex	4
Posterior cerebral artery	5
Vertebrobasilar junction	3
Vertebro-PICA	

The site and location of aneurysms is shown in Table 1. There were 168 aneurysms located in the anterior circulation. The cavernous internal carotid artery (ICA) was the most common location in these patients. In 13 patients, aneurysms were located in the posterior circulation. Multiple GIAs were found in six cases. Four patients had mirror image giant clinoidal segment aneurysms, one had mirror image middle cerebral artery (MCA) bifurcation aneurysms, and another had an aneurysm at the MCA and cavernous ICA.

The surgical procedures utilized for the aneurysms are shown in Table 2. Direct surgical clipping was used to treat 107 aneurysms (in 103 patients). A post-operative check DSA was performed in 118 patients and revealed well obliterated aneurysms in 106 patients. In the clipping group, a check DSA was performed and revealed well-clipped aneurysms in 76 out of 88 patients. A residual neck was observed in 12 patients. In five of these patients, the residual aneurysm was coiled, and the other seven patients had very small neck remnants and are being followed up with yearly angiograms.

Forty-six patients with good collateral circulation as determined by (1) filling of opposite anterior cerebral (ACA) and MCA spontaneously or at cross-compression, (2) adequate filling of posterior communicating artery, and (3) smooth filling of arteries without filling defects were treated by gradual occlusion and ligation of internal carotid artery ICA in the neck with a Silverstone clamp. Parent vessel ligation was never used in the acute phase of SAH. Another nine

Table 2
Surgical procedures (181 procedures in 177 patients)

Procedure	Number of aneurysms
Direct clipping	107
Cervical ICA ligation	46
Trapping with ligation	9
Trapping with bypass	11
Wrapping	7
Aneurysmorrhaphy	1