Management of carotid-ophthalmic aneurysms

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The authors present 26 cases of carotid-ophthalmic aneurysms that were surgically treated. Contrary to the opinion that these aneurysms, which often are of giant size, must be treated conservatively or by common carotid ligation, the authors favor radical surgery, believing that carotid ligation does not provide assurance against the risk of rebleeding, and frequently is associated with failure to restore useful vision. Often these aneurysms have a neck more suitable for ligation than shown by angiography, since a giant aneurysm may overlap the carotid artery in the angiogram. Preoperative criteria and some details of radical treatment are discussed.

KEY WORDS • carotid-ophthalmic aneurysms • radical surgery • subarachnoid hemorrhage • carotid ligation

CAROTID-OPHTHALMIC aneurysms arise near the anterior clinoid artery from the medial surface of the carotid artery, above the cavernous sinus, and below the origin of the posterior communicating artery. The proximity of this lesion to the optic nerve and chiasm and its tendency to grow to giant size justify its distinction from other carotid aneurysms on anatomical, clinical, and surgical grounds.

This paper presents the authors' surgical experience with 26 carotid-ophthalmic aneurysms observed at the Institute of Neurosurgery of the University of Rome from 1955 to 1972. The first 16 cases of this series have been the subject of a previous paper.²

Analysis of Cases

The general characteristics of this series are presented in Table 1. This series also reaffirms the predominance in females and on the left side previously reported.¹ There were 10 male and 16 female patients and 10 right-sided and 16 left-sided lesions. In 30% of our patients there were other aneurysms elsewhere, a figure which is between the 21% and 64% reported by others.¹,⁶ The mean age of our patients was 47 years.

Subarachnoid Hemorrhage

Twenty-two patients had at least one episode of subarachnoid hemorrhage: in 12 of these cases subarachnoid hemorrhage constituted the entire clinical picture. Thus hospitalization and diagnosis came early, and the preoperative history was always shorter than 5 months. However, these aneurysms when untreated showed the same tendency to rebleed as those in other locations.

Visual Signs

Fourteen patients had signs of compression of optic pathways; this was bilateral in six and unilateral in eight. Unilateral vision impairment with optic atrophy and bitemporal
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**TABLE 1**

*Summary of preoperative grade, method of treatment, and mortality and morbidity in 26 patients*

<table>
<thead>
<tr>
<th>Method of Treatment</th>
<th>Preop. Grade</th>
<th>No. of Deaths</th>
<th>Morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>neck occlusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(aneurysm incised and evacuated)</td>
<td>2</td>
<td>5</td>
<td>unilateral visual loss (1) hemiparesis (1)</td>
</tr>
<tr>
<td>(13 cases)</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>intracranial trapping</td>
<td>4</td>
<td>1</td>
<td>unilateral visual loss (1) hemiparesis (1)</td>
</tr>
<tr>
<td>(aneurysm removed, hypothermia in 6 cases)</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(7 cases)</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>aneurysm coated</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>combined extra-intracranial trapping</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(2 cases)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>exploration</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(1 case)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>surgery refused, bed rest</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(1 case)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total cases = 26</td>
<td>6</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

*Five patients were operated on for associated aneurysms. Botterell classification.

Hemianopia with bilateral optic atrophy were common findings. Nothing in the pattern of visual damage allowed differentiation from a pituitary tumor, except for the acute onset of bitemporal hemianopia associated with pain. This confirms the opinion of White and Ballantine that these aneurysms simulate pituitary tumors and that differentiation can only be made by carotid angiography. Indeed, Case 5 of our series was operated on with the diagnosis of pituitary tumor following an air study only; this misdiagnosis resulted in the necessity of performing an emergency intracranial trapping.

**Angiography**

In 25 cases there was extensive angiographical investigation. Fifteen of these aneurysms were of giant size; however, in 18 of these angiography demonstrated a neck suitable for occlusion, even if broad-based as in 10 cases (Fig. 1). Of the remaining seven cases with no angiographic evidence of a neck, surgery revealed a neck in four (Figs. 2 and 3). We concluded that angiography may not visualize the neck of giant aneurysms, even if anteroposterior (AP), lateral, oblique, and submental views are used, and believe this is due to the large aneurysm overlapping the carotid siphon and obscuring the neck of the aneurysm.

**Projection of Aneurysm**

The aneurysm projected medially in nine cases, superomedially in nine cases, superiorly in five cases, and symmetrically in the other two cases. There was a striking correlation between superomedial aneurysmal projection and visual impairment, which occurred in all nine cases; visual impairment was rare with other projections, even though in most of the latter cases the optic nerve was found to be indented or thinned at the time of operation. This observation, also illustrated in the drawings of Kothandaram, et al.,5 explains the rarity of ocular signs in the series of Drake, et al.; only one of his cases had bilateral loss of vision due to a large, superomedially projecting aneurysm. Indeed, the superomedial projection of such aneurysms appears to be quite adequate to strangulate the optic nerve between the aneurysm, the carotid artery, and the anterior cerebral artery.

**Treatment and Results**

Treatment and results are summarized in Table 1. Twenty-five of 26 cases underwent intracranial surgery, with a mortality of 24%
and a morbidity of 16%. In 13 cases the neck of the aneurysm was occluded; in five of these cases an associated aneurysm was occluded at the same stage. There were two deaths and two major postoperative neurological defects in this group. Of the seven patients treated by intracranial trapping, three died and two had major postoperative defects.

Two aneurysms were explored and coated and two others underwent a combined two-stage extra-intracranial trapping, with no mortality or morbidity. One case was explored but no treatment was performed, and another was managed by bed rest; both of these patients died of rebleeding within a month.
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FIG. 3. Left: Preoperative angiogram showing a giant aneurysm with no apparent neck, and widespread cerebral vasospasm. The neck was found and occluded, and the carotid artery saved. Cerebral vasospasm increased following surgery and lasted for several days. Right: Postoperative angiogram shows the patent carotid artery and marked vasospasm.

Discussion

The clinical and diagnostic features of these aneurysms have been widely discussed. We will limit our discussion to problems related to management of these lesions.

Carotid-ophthalmic aneurysms are usually treated conservatively or by common carotid ligation. This attitude is chiefly based on two points. First, these are often giant aneurysms with broad-based necks, and therefore radical treatment may cause serious problems. Moreover, the tendency to rebleed has been considered lower than for aneurysms in other sites, and carotid ligation has seemed to reduce the chances of recurrent hemorrhage and to relieve symptoms of compression of the optic nerves or chiasm. However, our experience has led us to favor direct attack on the lesion. Our reasons include the following:

1. Carotid-ophthalmic aneurysms constitute a tremendous risk both for life and for vision. We found their tendency to rebleed quite similar to that of aneurysms in other sites, since half of our cases sustained at least two episodes of subarachnoid hemorrhage. Moreover, the two patients whose lesions were managed conservatively died of recurrent hemorrhage within a month.
2. Common carotid ligation does not necessarily prevent the aneurysm from growing and rupturing. Furthermore, even when this procedure produces intra-aneurysmal thrombosis, it is often insufficient to relieve compression of optic pathways and to restore useful function. In two of our cases intracranial trapping and removal of the aneurysmal sac were ultimately necessary to decompress the optic nerves and chiasm.
3. The frequency of multiple aneurysms is per se an argument against carotid ligation.
4. The results of radical treatment (mortality 24%, morbidity 16%) suggest that it offers the best chance both for life and for vision.

In planning direct surgery for carotid-ophthalmic aneurysms, it is important to know the possibilities of cross-circulation via the anterior communicating artery and to test repeatedly tolerance to temporary closure of the involved carotid artery at the neck. Moreover, one must bear in mind that angiography may not disclose the possibilities and the hazards of operation. Large aneurysms overlap the carotid siphon so that
the neck of the aneurysm, if present, may not be detectable in the angiogram. This occurred in four of our patients whose aneurysms were successfully clipped despite the angiographic evidence. The origin of the ophthalmic artery in relation to the aneurysm is not always clearly visualized and our two cases of postoperative blindness emphasize the risk of acute occlusion of this artery. Accordingly, it is our policy to discuss the possibility of blindness with patients or relatives.

In performing direct surgery for these aneurysms, the following suggestion may be helpful. A generous frontotemporal flap allows the surgeon to approach the giant aneurysm by both anterior and lateral subfrontal routes, and provides adequate exposure and illumination for all operative developments. Extensive removal of the tip of the anterior clinoid artery and of the lateral part of the tuberculum sellae may be essential to expose the aneurysm neck. The microdrill is valuable for this procedure, as well as for unroofing the optic foramen. This allows an approach to the neck by pushing the optic nerve medially or laterally, and so reduces the risk of intraoperative rupture.

Separating the carotid artery from the wall of the aneurysm until a suitable neck is found constitutes the most laborious and tricky part of the operation. Giant aneurysms have varying degrees of thrombosis and a wall of predictable thickness, while the wall of the parent carotid artery is often thin and fragile, a difference that becomes quite clear when operating under the microscope. This means that gentle compression of the sac may be safely exerted to obtain exposure of the neck. However, neither the attempt to pass a ligature around the neck nor the attempt to reduce the size of this neck by bipolar coagulation are recommended. In our hands, such attempts resulted in rupture of the aneurysm at its neck in three cases (twice while passing a ligature, once while applying bipolar coagulation); all required emergency intracranial trapping. Moreover, the ligature may cause kinking or stenosis of the carotid artery; we only used a ligature in one of the 13 cases in which we occluded the aneurysmal neck. Yasargil's or Scoville's clips seem to us the most useful way to occlude the broad-based neck of these aneurysms. Occlusion of the neck must be followed by wide incision of the wall of the aneurysm and by evacuation of the blood clots and sometimes removal of the entire aneurysm, if adequate decompression of the optic pathways is to be accomplished.

Elective intracranial trapping following carotid ligation that did not result in an improvement of the visual function was a safe procedure. On the other hand, emergency intracranial trapping was associated with high mortality and morbidity, despite angiographic and clinical evidence of adequate cross-filling and the adjunct of mild hypothermia.

References


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