Carotid-Ophthalmic Aneurysms

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Because of their infrequency, intracranial aneurysms that arise from the carotid artery at the origin of the ophthalmic artery have received little attention. Their importance is no less than that of the more common types both in regard to danger to life and involvement of neighboring structures by hemorrhage or compression. Carotid-ophthalmic aneurysms, having an intimate relation to the optic nerve which covers and tends to hide their origin, present special surgical problems for their obliteration. In addition, there is an unusual incidence of multiplicity.

In each instance but two, the aneurysm arose from the superior or superomedial aspect of the internal carotid artery, in the obtuse angle at the origin of the ophthalmic artery (Figs. 1-4). In the exceptions (Case 13 and left aneurysm Case 14), the sac arose from the infraclinoid portion of the carotid, below and medial to the origin of the ophthalmic artery. The small aneurysms projected upward, but there was a distinct tendency for the sacs to extend medially as they enlarged, probably because of the restraint of the overlying optic nerve.

Incidence

Carotid-ophthalmic aneurysms are rare in reported series. Pool and Potts cite two examples in 157 cases. The most accurate figure would appear to be that of the Cooperative Study where 143 were found in a series of 2672 patients with single aneurysms, an incidence of 5.4%. It is of interest that nine of our 14 patients had multiple aneurysms, three having bilateral carotid-ophthalmic aneurysms. There was a striking sex incidence in the series, as 11 of 14 patients were women.

Signs and Symptoms

In view of the intimate relationship to the optic nerve, it is surprising that only one of the 14 patients presented preoperative evidence of compression of this structure (Case 12), in spite of the fact that the aneurysm was large in seven other cases. The absence of definite localizing features in 13 cases was even more remarkable, for in seven the optic nerve was seen at operation to be indented and thinned by the dome of the sac. Case 12 merits brief summation, for in addition to the profound loss of vision, there were bilateral aneurysms whose site of origin and relation to the optic nerves were shown clearly at autopsy.

Case 12. A 61-year-old woman had had diminished vision in the left eye all her life. For 6 months she had noticed decreasing vision in the right eye and occasional spider-web scotomata. Two brisk subarachnoid hemorrhages occurred 7 days apart, 1 month before admission. Following the second episode, the patient noted more rapid visual loss on the right.

Examination. Visual acuity on the right was limited to finger-counting at 2 feet, while on the left with correction was 20/200. Visual fields were inconsistent, but there appeared to be a temporal defect in the right eye. Angiography revealed a large bilocular aneurysm arising from the anteromedial aspect of the right internal carotid artery at the origin of the ophthalmic artery, undoubtedly the cause of her recent loss of vision (Fig. 5). Additionally, a smaller broad-based sac was noted in a symmetrical position on the left. An operation was scheduled, principally in an attempt to restore useful vision and to prevent recurrent bleeding.

Operation. Seven weeks after her last hemorrhage, anesthesia was induced in an extremely agitated patient. The aneurysm burst as the scalp incision was made, and although a bone flap was turned down quickly, the brain was under such pressure that the procedure was abandoned. The patient survived 12 hours.

Autopsy. A large aneurysm was seen to arise from the carotid at the origin of the
ophthalmic artery, compressing the inferior aspect of the greatly elongated and thinned right optic nerve (Figs. 6 and 7). The smaller aneurysm on the left had a similar origin, and its dome could be seen bulging into the widened left optic nerve.

Comment. Although the severe visual loss in the right eye was undoubtedly due to rapid enlargement of the underlying aneurysm, the amblyopia on the left was probably unrelated to the smaller sac in view of its life-long presence and that this degree of compression had caused no visual loss in the remaining cases. It is probable that under light anesthesia the pain of the scalp incision produced a rise in blood pressure sufficient to burst the aneurysm before it could be exposed.
Technical Aspects

Although there has been considerable variation in anesthetic methods, surgical adjuncts, and timing of operation over the years, the operative technique has remained the same. A subfrontal approach along the orbital plate is in a sense ideal, in that while providing excellent exposure of the region, the carotid artery and optic nerve are approached from the safe side adjacent to the neck but away from the dome of the aneurysm. As the optic nerve rises over the fundus, the small triangles so created on either side of the neck of the aneurysm enhance its encirclement with a ligature or clip. It is usually unnecessary to manipulate the attenuated optic nerve which is intimately applied to the dome of the aneurysm.

The aneurysm in Case 13 was unique in its position, and required different measures for its surgical obliteration. It arose from the posteromedial aspect of the carotid behind the origin of the ophthalmic artery, and projected so that it was largely hidden beneath the supraclinoid segment of the carotid artery and the optic nerve. It was necessary to remove the anterior clinoid before using sharp dissection to free the neck of the aneurysm from the cavernous sinus below and the carotid above, so that a ligature could be placed around it and tied firmly. Because of its awkward situation, it was necessary to manipulate the optic nerve more than was desired. Yet there was no postoperative visual loss in contrast to that in Case 11, where optic nerve trauma was minimal (see Case 11 reported below).

Fig. 3. Cases 8–13. Tracings of carotid-ophthalmic aneurysms, direct operation (ruptured).

Fig. 4. Case 14. Tracing of carotid-ophthalmic aneurysms, indirect operation and right carotid ligation (ruptured).
Carotid-Ophthalmic Aneurysms

Results

The 14 patients can be divided conveniently into three groups:

Group A. No operation (3 cases)

Group B. Intact carotid-ophthalmic aneurysms operated on incidentally to the clipping of another ruptured aneurysm (4 cases)

Group C. Ruptured carotid-ophthalmic aneurysms, direct operation (6 cases); indirect operation (1 case).

Group A. No Operation (Fig. 1, Table 1).

In Case 1, the patient had two severe hemorrhages on the same day following the first warning leak from the aneurysm and remained unresponsive. Following angiography 2 days later, she rapidly deteriorated and died from massive intracerebral and intraventricular hemorrhage.

In Case 2, a hypertensive patient with angina was not considered to be a candidate because of severe dysphasia and hemiplegia following three hemorrhages. Three years later, he is unable to work because of hemiparesis, but plays cards and accepts minor social obligations.

In Case 3, the aneurysm was found incidentally in the investigation of posttraumatic dementia.

Group B. Incidental Operation: Aneurysm Unruptured (Fig. 2, Table 2). In each of these four cases, the carotid-ophthalmic aneurysm was intact, the hemorrhage having been caused by a ruptured carotid-communicating aneurysm in three and a basilar aneurysm in the other.

In Case 4, the carotid-ophthalmic aneurysm was not exposed, as it was small, intact, and on the opposite side to the ruptured aneurysm which had produced the patient’s dire state. Death occurred in spite of immediate evacuation of a temporal lobe clot, and clipping of the ruptured carotid-communicating as well as an intact anterior-communicating aneurysm.
Case 5 is an example of the tragedy that may occur when an intact aneurysm is clipped at the same time as a nearby ruptured sac is occluded. This carotid-ophthalmic aneurysm was small and intact, and since the clipping of the ruptured carotid-communicating aneurysm had been uneventful, a Mayfield clip was placed across the neck of the former. The patient was well for 9 hours, then suddenly became moribund. Autopsy revealed that the Mayfield clip had slipped from and torn the neck of the previously intact carotid-ophthalmic aneurysm.

In Case 6, the intact carotid-ophthalmic aneurysm was exposed on the opposite side after the ruptured carotid-communicating sac had been clipped. Because the patient was Grade 3 and it may have been necessary to sacrifice the optic nerve overlying the large, broad-based aneurysm, no attempt was made to occlude its neck. She died 1 day later with massive arterial spasm and infarction.

In Case 7, there were four aneurysms, bilateral carotid-ophthalmic and left carotid-communicating which were intact, and another at the basilar bifurcation which had

### TABLE 1

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Sex, Age</th>
<th>Side</th>
<th>No. of Hemorrhages</th>
<th>Other Aneurysms</th>
<th>Intact or Ruptured</th>
<th>Reason</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F 45</td>
<td>L</td>
<td>3</td>
<td>none</td>
<td>ruptured</td>
<td>grade 5 hypertension, angina, dysphasia, hemiplegia posttraumatic dementia disclosed during angiography</td>
<td>angiography; death alive 3 yrs; disabled dementia</td>
</tr>
<tr>
<td>2</td>
<td>M 53</td>
<td>L</td>
<td>3</td>
<td>ant. comm.</td>
<td>ruptured?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>F 50</td>
<td>R</td>
<td>0</td>
<td>none</td>
<td>intact</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(ACA = anterior communicating artery; AN = carotid-ophthalmic aneurysms; BA = basilar artery; CAR A = internal carotid artery; MCA = middle cerebral artery; OPH A = ophthalmic artery; OPT N = optic nerve; PCA = posterior cerebral artery.)
Carotid-Ophthalmic Aneurysms

TABLE 2

Unruptured carotid-ophthalmic aneurysms (incidental operation: hemorrhage caused by other aneurysms)

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Sex, Age</th>
<th>Side</th>
<th>Other Aneurysms</th>
<th>Grade</th>
<th>Operation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>M 54</td>
<td>L</td>
<td>rt. carotid comm. (3 ruptures); ant. comm.</td>
<td>4</td>
<td>same day: hypothermia, immediate evacuation, rt. temp. clot; clipping of rt. carotid-comm. and ant. comm.</td>
<td>died 1 day</td>
</tr>
<tr>
<td>5</td>
<td>F 33</td>
<td>R</td>
<td>rt. carotid comm. (2 ruptures)</td>
<td>1</td>
<td>same day: hypothermia, both aneurysms clipped</td>
<td>well for 9 hrs, then Mayfield clip slipped, tore carotid-ophthalmic aneurysm; died 1 day</td>
</tr>
<tr>
<td>6</td>
<td>F 43</td>
<td>L</td>
<td>rt. carotid comm. (3 ruptures)</td>
<td>3</td>
<td>2 days; hypothermia, carotid comm. clipped, carotid-ophthalmic exposed but left intact; tracheotomy.</td>
<td>died 1 day, massive arterial spasm</td>
</tr>
<tr>
<td>7</td>
<td>F 41</td>
<td>L</td>
<td>basilar bifurcation ruptured; rt. carotid-ophth. and lf. carotid-comm. intact</td>
<td>2</td>
<td>carotid-comm. clipped, basilar ligated</td>
<td>excellent</td>
</tr>
</tbody>
</table>

ruptured. Because of its size and uncertainty as to which aneurysm had ruptured, the left carotid-ophthalmic aneurysm was explored before ligating the basilar aneurysm which proved to have caused the bleeding. It was large and bulbous but intact, and the left optic nerve was thinned over its medial aspect. The neck was covered anteriorly by a sheath of dura where the anterior clinoid had been eroded. Ligation was considered possible but has been delayed for a year. The left carotid-communicating aneurysm was clipped also, principally so that it could be collapsed to free the entrance to the interpeduncular cistern.

Group C. Direct Operation: Ruptured Carotid-Ophthalmic Aneurysms (Fig. 3, Table 3). As the carotid-ophthalmic aneurysms in this group had ruptured, all six patients were subjected to direct operation to prevent rebleeding, and in Case 12 to restore useful vision. The deaths of three patients should not imply that a special hazard exists in the surgical treatment of this aneurysm. In Cases 8 and 9, the patients died from massive cerebral infarction and intense arterial spasm, which would have been anticipated today; both were operated on within 1 day of bleeding when they were Grade 3 and Grade 2 respectively. In Case 12, the aneurysm burst fatally when the scalp incision was made and the operation was abandoned, as has been described in the preceding case report.

Three patients did well following ligation of the aneurysm under hypotension, but Case 11 deserves special comment because of postoperative ipsilateral monococular blindness.

Case 11. This patient was Grade 1 when operated on 7 days following a second hemorrhage (Fig. 8). Seemingly without incident, the neck of the sac was defined and encircled with a ligature which was tied down firmly, flush with the carotid artery. Immediately after operation the left eye was blind, although he subsequently regained light perception.

The fear that the ligature had included the ophthalmic artery was unfounded, for the postoperative angiogram showed this vessel to be quite intact and not in spasm (Fig. 9). The aneurysm was totally occluded. It can only be surmised that what appeared to be a gentle maneuver was enough to injure an optic nerve compromised to a point just short of loss of function by the compression of the aneurysm.

Group C. Indirect Operation. (Fig. 4, Table 3). The case of the one patient who
TABLE 3
Ruptured carotid-ophthalmic aneurysms (direct and indirect operations)

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Sex</th>
<th>Age</th>
<th>No. of Hemorrhages</th>
<th>Side</th>
<th>Other Intact Aneurysms</th>
<th>Grade</th>
<th>Interval (days)</th>
<th>Operation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>47</td>
<td>1</td>
<td>L</td>
<td>none</td>
<td>3</td>
<td>1</td>
<td>hypothermia, Mayfield, clip, decompression</td>
<td>died 9 days, massive bifrontal infarction</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>56</td>
<td>2</td>
<td>L</td>
<td>rt. carotid-comm; rt. mid cereb.</td>
<td>2</td>
<td>1</td>
<td>hypothermia, ligation If. carotid-ophth.; clipping rt. carotid-comm.</td>
<td>well 8 hrs, then deterioration, proven If. carotid tree spasm, died 3 days</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>40</td>
<td>1</td>
<td>R</td>
<td>none</td>
<td>1</td>
<td>10</td>
<td>hypotension, ligation</td>
<td>excellent</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>57</td>
<td>2</td>
<td>L</td>
<td>rt. carotid-comm.</td>
<td>1</td>
<td>7</td>
<td>hypotension, ligation</td>
<td>good, blind If.eye</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>61</td>
<td>1</td>
<td>R</td>
<td>If. carotid-ophth.</td>
<td>1</td>
<td>42</td>
<td>abandoned, aneurysm burst as scalp incised</td>
<td>died 1 day</td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>37</td>
<td>1</td>
<td>L</td>
<td>none</td>
<td>1</td>
<td>8</td>
<td>hypotension, ligation</td>
<td>excellent</td>
</tr>
<tr>
<td>Indirect Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>F</td>
<td>61</td>
<td>1</td>
<td>R</td>
<td>If. carotid-ophth.; rt. cavernous carotid-ophth.</td>
<td>1</td>
<td>4</td>
<td>rt. common-carotid ligation</td>
<td>excellent</td>
</tr>
</tbody>
</table>

underwent indirect operation for bilateral carotid-ophthalmic aneurysms is described below.

**Case 14.** This frail, hypertensive 62-year-old woman was admitted following a single subarachnoid hemorrhage which did not alter consciousness.

**Examination.** There were no abnormal neurological findings; the vision was intact. Carotid angiography revealed bilateral carotid-ophthalmic aneurysms. What was most unusual was that two separate sacs appeared to arise from the region of origin of the ophthalmic artery on the right. The large and presumably ruptured sac was in characteristic position, while the smaller aneurysm projected mesially, perhaps into the cavernous sinus.

**Operation.** Because of the patient’s frailty and the presence of two carotid-ophthalmic

![Fig. 8. Case 11. Preoperative angiograms, anteroposterior (left) and lateral (right) views showing carotid ophthalmic aneurysm.](image-url)
aneurysms on the right, the smaller of which was probably inoperable and possibly a hazard to ligation of the larger ruptured sac, the right common carotid artery was occluded uneventfully with a Silverstone clamp. Postoperative angiography at 10 days revealed that the common carotid artery was thrombosed proximally to its origin. The smaller aneurysm no longer filled while the larger was one-third its previous size.

Comment. Although carotid ligation might be considered ideal for carotid-ophthalmic aneurysms, this case points up one of the drawbacks when these aneurysms are multiple in such a high percentage of cases. If the aneurysm on the left becomes dangerous in the future, a direct operation may have to be considered in spite of the patient’s general health at the time.

Summary and Conclusions

We have presented 14 patients with aneurysms arising from the carotid artery in the region of the origin of the ophthalmic artery. There was an unusual incidence of multiplicity, for 9 of 14 had more than one aneurysm and 3 patients had bilateral carotid-ophthalmic aneurysms. There was a striking sex preponderance, 11 of 14 cases occurring in women. In spite of the aneurysm’s intimate relationship to the optic nerve, only one patient had definite clinical evidence of optic nerve compression. These aneurysms can be exposed and obliterated by clip or ligature through a subfrontal approach. Manipulation of the optic nerve is minimal, yet extreme caution should be observed, for in one patient postoperative monocular blindness occurred despite an apparently gentle dissection. Common carotid ligation was used in one patient considered to be a poor surgical risk and who had multiple carotid-ophthalmic aneurysms.

Of the 14 patients, three were not operated on because of their clinical state. One died, another remains severely disabled, while in the third with posttraumatic dementia, the aneurysm was an incidental finding.

The surgical results of the 11 patients operated on can be divided into two groups:

1. In four patients the carotid-ophthalmic aneurysm had not ruptured and was operated on incidental to obliteration of another ruptured aneurysm. Three patients died, two because of severe hemorrhage, and one tragically when a Mayfield clip slipped and tore the unruptured sac. The other patient, in whom a ruptured basilar aneurysm was ligated, remains well.

2. In seven patients, the aneurysm had ruptured. Three patients died, two from massive arterial spasm with early (day 1) operation, and one when the aneurysm burst fatally as the scalp incision was made. The four survivors are well (three ligatures in the neck, one common carotid occlusion).

References
