Direct approach to a traumatic giant internal carotid artery aneurysm associated with a carotid-cavernous fistula

Case report

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The case is reported of a giant intracranial internal carotid artery aneurysm associated with a carotid-cavernous fistula following a closed head injury. The aneurysm and the fistula disappeared after only the neck of the aneurysm was clipped. This is the first case in which a direct surgical approach was successful in sparing the internal carotid flow. Reports of similar cases are reviewed.

KEY WORDS • traumatic cerebral aneurysm • internal carotid artery • carotid-cavernous fistula

An intracranial internal carotid artery (ICA) aneurysm associated with a carotid-cavernous fistula is an uncommon pathology resulting from closed head injury. Ten cases have been reported, most were treated with intravascular surgery or ICA trapping. However, in five cases, the symptoms and signs of carotid-cavernous fistula persisted postoperatively.

We report the case of a traumatic giant intracranial ICA aneurysm associated with a carotid-cavernous fistula following a closed head injury. Treatment was successful after only the neck of the aneurysm was clipped via the combined epicranial and subdural approach of Dolenc. The triad of a carotid-cavernous fistula (chemosis, exophthalmos, and bruit) disappeared postoperatively.

Case Report
This 28-year-old man was struck on the head in a traffic accident on December 22, 1989. He lost consciousness and was brought to the emergency room of a local hospital. On admission, plain computerized tomography (CT) revealed a contusional injury in the left frontal lobe and subarachnoid hemorrhage in the basal and left sylvian cisterns. A skull film revealed a linear fracture in the left frontal bone (Fig. 1). He was treated conservatively and remained unconscious for about 1 week. Over the course of several weeks, he developed left-sided chemosis, exophthalmos, and a frontal bruit. On April 9, 1990, he was referred to our hospital for further treatment.

Examination. On admission, the patient was found to have left-sided chemosis, exophthalmos, a frontal bruit, and dementia. Computerized tomography revealed a supraclinoid lesion that had not been demonstrated on the CT scan obtained immediately after injury, as well as a left-sided frontal lobe contusion and ventricular enlargement (Fig. 2). Cerebral angiographic studies revealed a giant lobulated ICA aneurysm and a carotid-cavernous fistula on the left side and thrombus of the M1 portion of the left middle cerebral artery (MCA) (Fig. 3). A balloon Matas test was performed. The mean stump pressure decreased from 86 to 35 mm Hg. There appeared to be no slowing during a 10-minute electroencephalographic recording.

Operation. Through a left frontotemporal craniotomy the sphenoid ridge, the anterior clinoid process, and a portion of the superior wall of the orbit were resected. Following dural incision, the optic nerve, the ICA, and the giant ICA aneurysm were identified. The carotid fibrous ring and the dural optic sheath were opened. The aneurysm neck was broad (Fig. 4 left). A No. 37 Sugita dull-angled ring clip, a No. 41 Sugita right-angled ring clip, and a No. 21 Sugita right-angled clip were placed parallel to the ICA, reconstructing the carotid lumen and sparing the posterior communicating...
Giant internal carotid artery aneurysm with fistula

artery and the anterior choroidal artery. An internal carotid-ophthalmic artery aneurysm, 2 mm in diameter, which had not been identified on preoperative angiography was obliterated with a No. 11 Sugita side-angled clip. A thrombectomy in the proximal stenosis of the MCA was performed (Fig. 4 right). The thrombus was composed of fibrous connective tissue.

Postoperative Course. The left-sided chemosis, exophthalmos, and frontal bruit disappeared completely within 1 week after surgery. Postoperative angiography on April 26 confirmed the obliteration of the supraclinoid giant aneurysm as well as the carotid-cavernous fistula. The left-sided ICA, the MCA, and the anterior cerebral artery were patent (Fig. 5). Unfortunately, the dementia has persisted.

Fig. 1. A plain skull film obtained on the day of injury showing a linear fracture of the left frontal bone.

Fig. 2. Enhanced computerized tomography scans, axial (left) and coronal (right) views, obtained 110 days after injury, revealing a left-sided supraclinoid enhanced high-density lesion and suggesting the presence of a giant aneurysm.

Fig. 3. Preoperative left carotid angiograms, anteroposterior (left) and lateral (right) views, obtained 110 days after injury, showing a giant lobulated aneurysm of the supraclinoid portion of the left internal carotid artery and fistulous drainage into the cavernous sinus.

Fig. 4. Schematic drawings of a giant aneurysm, a carotid-cavernous fistula, and an internal carotid (IC)-ophthalmic artery aneurysm. Left: Preoperative drawing showing a giant aneurysm in the carotid artery, with the neck extending from C1 to C2. The illustration shows a fistulous opening into the cavernous sinus of the aneurysm dome, thrombus of the M1 portion of the middle cerebral artery (MCA), and an IC-ophthalmic artery aneurysm. Right: Postoperative drawing showing placement of a No. 37 Sugita dull-angled ring clip (1), a No. 41 Sugita right-angled ring clip (2), a No. 21 Sugita right-angled clip (3), and a No. 11 Sugita side-angled clip (4). Thrombectomy (5) of the M1 portion of the MCA is illustrated.

J. Neurosurg. / Volume 76 / March, 1992 525
Discussion

Literature Review

There are few reported cases of traumatic ICA aneurysm associated with a carotid-cavernous fistula following closed head injury. Bousquet, et al.,4 reviewed 10 cases of traumatic aneurysm of the supraclinoid ICA. Seven cases (70%) were due to closed head injury2,3,5,17,19-21 two (29%) of these seven were associated with a carotid-cavernous fistula.3,19

We reviewed 10 reported cases2,3,9,11,12,14,15,19,24,26,27 of traumatic ICA aneurysm associated with a carotid-cavernous fistula due to closed head injury. The mean age of these 10 patients plus our own was 28 years, and all were male. Giant aneurysms were identified in only two cases3,19 in addition to ours. In seven cases (64%),3,9,11,14,24,26,27 the triad of a carotid-cavernous fistula (chemosis, exophthalmos, and bruit) was present. The neck of the aneurysm was supraclinoidal in three patients (27%),19 intracavernous in seven (64%),2,12,14,15,24,26,27 and intrapetrous in one (9%).11 This ratio correlates with that of traumatic ICA aneurysm without carotid-cavernous fistula.24 The aneurysms were managed by ICA trapping in one patient (9%),24 embolization in two (18%),5,12 ICA trapping with embolization in seven (64%),3,11,14,15,19,26,27 and aneurysm neck clipping in one (our case). No patient with an aneurysm in the cavernous sinus or the petrous portion of the ICA underwent a direct surgical approach to the aneurysm. However, a direct surgical approach to the aneurysm was performed in our patient and that of Reddy and Sundt19 where the aneurysm arose from the supraclinoidal portion of the ICA. The latter patient was treated with ICA trapping between the ophthalmic artery and the posterior communicating artery, followed by aneurysm resection and packing in the cavernous sinus. Our patient was treated solely with clipping of the aneurysm neck. The carotid-cavernous fistula disappeared in nine (82%) of the 11 reported cases,3,9,11,12,14,15,19,26,27 In two cases (18%), the carotid-cavernous fistula decreased in size; in one, the patient was treated with a detachable balloon,6 and in the other, the patient was treated with ICA trapping and external carotid artery clipping.24 Neither treatment was successful in completely obliterating the carotid-cavernous fistula.

Reddy and Sundt19 believed that a carotid-cavernous fistula with a concomitant false aneurysm requires a direct surgical exploration in most instances. They recommended that the neck of the aneurysm or the feeding vessels be clipped or ligated and that the cavernous sinus be packed. Other investigators believe that a traumatic ICA aneurysm should be treated conservatively because of the high probability for intraoperative rupture and the difficulty in clipping the aneurysm due to a broad neck or a fibrous wall.1,10,21,28

Operative Approach

The supraclinoid giant aneurysm in our case was successfully reached using the combined epi- and subdural approach of DolenC with the benefit of a wide operating field. The ring clip was very effective for clipping the supraclinoid giant aneurysm and reconstructing the carotid lumen.6 The side-angled clip described by Day6 satisfactorily occludes most ophthalmic artery lesions while sparing the ophthalmic artery. We also obliterated the internal carotid-ophthalmic artery aneurysm while sparing the ophthalmic artery. Postoperative angiography confirmed that the supraclinoid giant and internal carotid-ophthalmic artery aneurysms were successfully clipped and that the carotid-cavernous fistula had disappeared.

Angiographic Findings

The reported angiographic features of traumatic aneurysms are: 1) delayed filling and emptying of the aneurysm sac,2,10,17 2) an irregular contour of the sac2,10,17 3) the absence of a clear neck2,10,17 and 4) a location other than at a branching point.17 We were convinced that the giant aneurysm in our case was traumatic because it had the features described above. However, the internal carotid-ophthalmic artery aneurysm did not appear to be traumatic because it had a clear neck and was located at a branching point.

Pathogenesis

Enomoto, et al.,8 suggested three mechanisms to explain the occurrence of a traumatic aneurysm of the supraclinoid ICA after nonpenetrating head injury: 1) a direct injury to the ICA due to basal skull fractures; 2) injury due to overstretching or torsion of the carotid siphon following the motion of the brain during the impact of head injury;11,21 and 3) injury due to collision of the ICA with nearby bone prominences (for example, the anterior or posterior clinoid process12,21). In our patient, there were no basal skull fractures, the injury was powerful enough to cause a linear fracture, and the aneurysm neck was not located next to bone promi-

Fig. 5. Postoperative left carotid angiograms, anteroposterior (left) and lateral (right) views, obtained 126 days after injury (13 days after the operation), showing no evidence of the supraclinoid giant aneurysm and the carotid-cavernous fistula. The left internal carotid artery, the middle cerebral artery, and the anterior cerebral artery are patent, and the internal carotid-ophthalmic artery aneurysm has disappeared.
ances. Therefore, we believe that overstretching or torsion might have been responsible for the aneurysm formation. Thrombosis associated with a traumatic aneurysm is generally thought to be caused by: 1) a prolonged spasm; 2) the bulk of the aneurysm being located on an adjacent vessel; or 3) the presence of thrombus during the aneurysm formation. In our patient, there was no symptomatic spasm and the aneurysm was some distance from the M1 portion of the MCA and the fibrous thrombus was adherent to the intima of the M1 portion. Therefore, it is thought that overstretching or torsion may have torn the intima to create the thrombus. Rupture of the supraclinoid ICA aneurysm usually occurs within 2 to 3 weeks. In our case, the fistula might have been created after rupture of the supraclinoid aneurysm since indications of a carotid-cavernous fistula emerged a few weeks after injury.

References


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