Wrap-clipping with polytetrafluoroethylene for ruptured blisterlike aneurysms of the internal carotid artery

Technical note

YOSHITAKA KUBO, M.D., KUNIAKI OGASAWARA, M.D., NOBUHIKO TOMITSUKA, M.D., YASUNARI OTAWARA, M.D., MIKIO WATANABE, M.D., AND AKIRA OGAWA, M.D.

Department of Neurosurgery, Iwate Medical University, Morioka, Japan

✓ A technique combining wrapping and clip occlusion of aneurysms by using polytetrafluoroethylene (PTFE) for treatment of ruptured blisterlike aneurysms of the supraclinoid internal carotid artery (ICA) is described. The diameter of the abnormal arterial lesion along the long axis of the ICA and the distance between the origin of the ophthalmic artery and the origin of the posterior communicating artery (PCoA), or the origin of the PCoA and the origin of the anterior choroidal artery are measured intraoperatively; a strip of PTFE membrane is then trimmed with scissors to match this diameter and distance. After temporarily occluding the cervical ICA, the intracranial ICA that includes the lesion is wrapped with the strip of PTFE, and one or more aneurysm clips are applied parallel to the vessel. This procedure was successfully accomplished in six patients, all of whom had an uneventful postoperative course with no recurrent subarachnoid hemorrhage during the follow-up period. "Wrap-clipping" using PTFE is a useful procedure for management of ruptured blisterlike aneurysms of the ICA.

Abbreviations used in this paper: AChA = anterior choroidal artery; ICA = internal carotid artery; PCoA = posterior communicating artery; PTFE = polytetrafluoroethylene.

Surgical Technique

The ipsilateral cervical ICA is exposed for proximal control of ICA flow. After a frontotemporal craniotomy with preservation of the superficial temporal artery is performed, the sylvian fissure is opened widely. Any subarachnoid hematoma surrounding the intracranial ICA is carefully removed without dislodging the relatively dense clot on the anterior wall of the artery. During the procedure, the cervical ICA is often occluded intermittently to avoid intraoperative bleeding from the lesion. An abnormal arterial lesion on the anterior wall of the ICA (as viewed through an operating microscope) is almost always wider than the abnormal hemispheric bulge visualized on preoperative cerebral angiography.

The diameter of the abnormal arterial lesion along the long axis of the ICA and the distance between the origin of the ophthalmic artery and the origin of the PCoA, or the origin of the PCoA and that of the AChA are measured, and a strip of 0.1-mm-thick PTFE membrane (Gore-Tex; W. L. Gore & Associates, Flagstaff, AZ), which is often used as a dural substitute, is trimmed with scissors to match the diameter and distance. After temporarily occluding the cervical ICA, the intracranial ICA that includes the lesion is wrapped with the strip of PTFE, and one or more Yasargil clips are applied parallel to the vessel, so that the clip blade grips the arterial wall beyond the lesion (Fig. 2). We have used this technique in six patients with ruptured blisterlike aneurysms in the supraclinoid ICA. Clinical and radiological characteristics of the patients and surgical results are shown in...
Table 1. An abnormal arterial lesion was present intraoperatively on the anterior wall of the ophthalmic segment of the ICA in one patient and on the anterior wall of the communicating segment in five patients.

All procedures were successfully accomplished without intraoperative bleeding, and all patients had an uneventful postoperative course and were discharged with no neurological deficit. Cerebral angiography performed between 9 and 60 days postsurgery demonstrated resolution of the aneurysm and no stenosis in the affected intracranial ICA in four patients (Fig. 3). Of the remaining two, one (Case 2) had an aneurysm remnant, which remained stable on serial cerebral angiography examinations, and the other (Case 4) did not undergo postoperative cerebral angiography because informed consent could not be obtained. None of the patients experienced recurrent subarachnoid hemorrhage postoperatively. Furthermore, the modified Rankin Scale score was 0 in all patients over the follow-up period (19–82 months).

Discussion

Several investigators have performed wrap-clipping in patients with a ruptured blisterlike aneurysm of the ICA. Abe, et al., used gauze as a wrapping material for two patients, but both of them experienced aneurysm recurrence or rebleeding within 2 weeks after surgery. In contrast, Fujitsu, et al., used a Silastic sheet coated with Dacron mesh as a wrapping material and Nakano, et al., used collagen-impregnated Dacron knitted fabric; in both instances the patient had an uneventful postoperative course. Furthermore, postoperative cerebral angiography revealed resolution of the aneurysms. Both groups reported that these materials satisfied all the requirements to serve as a wrapping material for a ruptured blisterlike aneurysm of the ICA, as follows: 1) sufficient strength to provide reinforcement; 2) durability under a high-pressure circulatory system; 3) leak-proof characteristics; 4) properties adequate to prevent slippage of the clip blades; 5) sufficient flexibility to allow insertion between the small arteries originating from the ICA; and 6) ability to be easily tailored with scissors during microsurgery. The PTFE material has sufficient strength to withstand mechanical forces, and it also has low reactivity and high biocompatibility, making it safe for implantation in humans.

Our experience demonstrated that PTFE satisfies all the

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>H &amp; K Grade</th>
<th>An Location &amp; Side</th>
<th>An Size (mm)</th>
<th>Interval‡ (days)</th>
<th>Angio Finding†</th>
<th>Intraop Finding: An Location†</th>
<th>Postop Angio Finding</th>
<th>FU (mos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>54, M</td>
<td>2</td>
<td>rt anterolateral</td>
<td>2</td>
<td>20</td>
<td>communicating segment</td>
<td>resolution</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>32, F</td>
<td>2</td>
<td>lt anterior</td>
<td>1</td>
<td>1</td>
<td>communicating segment</td>
<td>remnant</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>38, F</td>
<td>2</td>
<td>rt anteromedial</td>
<td>2</td>
<td>18</td>
<td>communicating segment</td>
<td>resolution</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>78, F</td>
<td>2</td>
<td>lt anteromedial</td>
<td>2</td>
<td>1</td>
<td>ophthalmic segment</td>
<td>no examination</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>48, F</td>
<td>3</td>
<td>rt anteromedial</td>
<td>2</td>
<td>1</td>
<td>communicating segment</td>
<td>resolution</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>43, F</td>
<td>2</td>
<td>rt anteromedial</td>
<td>1</td>
<td>1</td>
<td>communicating segment</td>
<td>resolution</td>
<td>82</td>
<td></td>
</tr>
</tbody>
</table>

* The modified Rankin Scale score was 0 in every case. Abbreviations: An = aneurysm; Angio = angiographic; FU = follow up; H & K = Hunt and Kosnik.
† Assessed according to Gibo, et al. (angiographic findings), and according to Ogawa, et al. (intraoperative findings).
‡ Interval between onset of bleeding and surgery.

Table 1. Outcomes and clinical, radiological, and intraoperative characteristics in six patients with ruptured blisterlike aneurysms of the ICA

Fig. 1. Photograph showing a strip of PTFE that has been trimmed with scissors. The arrow indicates the distance between the origin of the ophthalmic artery and the origin of the PCoA, or the origin of the PCoA and that of the AChA.

Fig. 2. Intraoperative photograph showing the treated vessel. Note that the lesion has been wrapped with a strip of PTFE and clipped with a Yasargil clip. The arrow and arrowhead indicate the PCoA and AChA, respectively.
Wrap-clipping with PTFE for ruptured blisterlike aneurysms

Fig. 3. Case 5. Cerebral angiograms obtained in a patient with a blisterlike aneurysm of the ICA. Left: Preoperative right carotid angiogram revealing a small hemispheric bulge in the anteromedial wall of the ICA. Right: Postoperative right carotid angiogram demonstrating resolution of the lesion.

aforementioned conditions. In addition, AbuRahma and colleagues demonstrated that PTFE patching was superior to collagen-impregnated Dacron knitted fabric in terms of minimizing late recurrent stenosis when the two materials were used for patch angioplasty in carotid endarterectomy. Furthermore, PTFE is widely used as an artificial dura mater in neurosurgery and is readily available in most neurosurgical operating rooms.

In our experience, removal of any subarachnoid hematoma surrounding the intracranial ICA is required prior to wrapping of the ICA and the lesion with a strip of PTFE. However, because of the fragility of the aneurysm walls, which are covered with adventitia and clot or with clot alone, blisterlike aneurysms of the ICA are prone to rupture during the procedure. Thus, to minimize the risk of intraoperative rupture of the lesions, the cervical ICA should be occluded intermittently and the clot on the anterior wall of the ICA should not be dislodged during the procedure.

References


Manuscript received November 15, 2005.
Accepted in final form April 20, 2006.
Address reprint requests to: Yoshihiko Kubo, M.D., Department of Neurosurgery, Iwate Medical University, 19-1 Uchimaru, Morioka 020-8505, Japan. email: yokubo@iwate-med.ac.jp.