Treatment of fusiform intracranial aneurysms by circumferential wrapping with clip reinforcement

Technical note

JOSHUA B. BEDERSON, M.D., JOSEPH M. ZABRAMSKI, M.D., AND ROBERT F. SPETZLER, M.D.

Division of Neurological Surgery, Barrow Neurological Institute, Phoenix, Arizona, and Department of Neurosurgery, Mount Sinai Medical Center, New York, New York

The authors describe a new technique for treating unclippable aneurysms. The method involves a modification of the traditional wrapping technique, including a clip-reinforced cotton sling. The results of this method in four patients are presented.

KEY WORDS • aneurysm • wrapping • clip • surgical technique

Several strategies exist for treating unclippable aneurysms, including intravascular techniques, proximal occlusion of the parent artery or trapping of the aneurysm, microsurgical bypass of the involved arterial segment, and reinforcement of the aneurysm dome. Reinforcement or wrapping is frequently used when the other techniques are thought to be unsafe. Whatever treatment is chosen, complete obliteration of the aneurysm wall is required to avoid recurrence and perforating arteries must be spared to prevent ischemic deficits. Reinforcement typically does not eliminate the aneurysm and is therefore associated with a high incidence of rebleeding or postoperative progression of symptoms.

We report a modification of the traditional wrapping technique, which includes a clip-reinforced cotton sling to reduce the diameter of fusiform and atherosclerotic aneurysms while sparing important perforators.

Operative Technique

A schematic view of an aneurysm typically treated by this technique is depicted in Fig. 1. To treat such aneurysms, we use a modification of the sling/wrapping technique initially described by Kempe. An appropriately sized strip of tightly woven muslin (undyed cotton, 120 threads per inch) or Gore-Tex is passed around the aneurysm with cuts made to accommodate perforating arteries and other branches. A right-angled or curved aneurysm clip is positioned to secure the sling (Fig. 1). We have found the best clip position to be opposite the area of maximum dilation. While holding the clip open and gently advancing it toward the artery, we apply countertraction on the sling, which is tightened circumferentially around the dilated segment. The aneurysm clip is then closed over the sling (Fig. 1 right).

We have used this technique in four patients with good results (Table I). A clinical summary of Case 1 is presented below.

Illustrative Case Report

This 80-year-old woman was brought to the emergency room with severe headaches and lethargy but no focal neurological deficits.

Examination. A computerized tomography scan revealed a grade III subarachnoid hemorrhage. Angiography demonstrated an atherosclerotic supraclinoid internal carotid artery (ICA) aneurysm just proximal to the ICA bifurcation, with an ectatic dilation of the inferior and medial walls (Fig. 2 left).

Operation. At surgery, the wall of the involved artery was diffusely atherosclerotic and heavily calcified, but was markedly attenuated at the aneurysmal pouch. The anterior choroidal artery and several small perforating arteries arose from the aneurysm wall and adjacent artery. Standard clipping was thought to be unwise, given the friable nature of the medial wall immediately adjacent to the calcified parent artery. An encircling
Aneurysm wrapping with clip reinforcement

![Diagram of aneurysm wrapping with clip reinforcement]

Fig. 1. *Left:* Artist’s rendering of a typical atherosclerotic aneurysm, similar to that in Case 1. The abnormality typically involves the entire circumference of the parent artery and may give rise to perforating and named arteries. *Center:* Circumferential placement of a sling around the aneurysm is modified to accommodate arterial branches arising from the wall. A right-angled clip is positioned to secure the sling. *Right:* The clip has been advanced toward the artery while countertraction was applied to the sling, tightening the sling around the aneurysm and reducing its diameter to that of the parent artery.

![Left internal carotid artery angiograms]

**Fig. 2.** Left internal carotid artery angiograms. *Left:* Preoperative film demonstrating aneurysmal dilatation of the supraclinoid portion, proximal to the bifurcation. *Right:* Postoperative angiogram demonstrating the laterally placed clip and obliteration of the aneurysm with preservation of the parent artery.

The clip was not applied because of the perforating vessels that arose from the aneurysm. The wrapping technique with a clip-reinforced cotton sling as described above was used.

**Postoperative Course.** Postoperative angiography demonstrated obliteration of the aneurysm, restoration of the arterial lumen almost to its normal configuration, and patency of the parent artery (Fig. 2 right).

**Discussion**

The most widely accepted treatment of intracranial arterial aneurysms is exclusion from the circulation by clipping the aneurysm neck. However, this strategy is not always possible, particularly with fusiform and atherosclerotic aneurysms that often lack a well-defined neck. Fusiform and atherosclerotic aneurysms can cause symptoms by the propagation of distal embolic material, by compression of adjacent intracranial structures, and (less commonly) by hemorrhage. They often involve the entire circumference of the artery, give rise to important perforating vessels, and have friable walls with inflammatory changes that are visible on pathological examination. In such cases, clipping is not safe, and endovascular occlusion cannot be accomplished without sacrificing the parent artery. Consequently, fusiform and atherosclerotic aneurysms are sometimes treated by reinforcement.

A variety of wrapping materials have been used to reinforce aneurysms, including plastics, cyanocraylate, muscle or fascia, and cotton or muslin in different configurations. Regardless of the materials used, traditional reinforcement techniques have typically attempted to prevent further expansion or hemorrhage by covering the aneurysm surface, but they usually do not obliterate the lesion or restore normal vessel diameter. As a result, these methods have been associated with high rates of rebleeding or with a progression of symptoms.

![Table 1: Clinical data for four patients treated with clip-reinforced aneurysm wrapping]

**TABLE 1**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Aneurysm Location</th>
<th>Clinical Presentation</th>
<th>Treatment</th>
<th>Material Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80, F</td>
<td>ICA (paraclinoid)</td>
<td>SAH</td>
<td>clip-reinforced wrapping</td>
<td>muslin</td>
</tr>
<tr>
<td>2</td>
<td>73, F</td>
<td>ICA (paraclinoid)</td>
<td>SAH</td>
<td>clip-reinforced wrapping</td>
<td>muslin</td>
</tr>
<tr>
<td>3</td>
<td>40, F</td>
<td>PICA, with vertebral ( \text{intral} ) dissection</td>
<td>SAH</td>
<td>clip-reinforced wrapping, clipping</td>
<td>muslin</td>
</tr>
<tr>
<td>4</td>
<td>39, F</td>
<td>ICA (paraclinoid)</td>
<td>visual loss</td>
<td>clip-reinforced wrapping</td>
<td>Gore-Tex</td>
</tr>
</tbody>
</table>

*Abbreviations: ICA = internal carotid artery; PICA = posterior inferior cerebellar artery; SAH = subarachnoid hemorrhage.*
We have used a clip-reinforced wrapping technique to treat selected fusiform and atherosclerotic aneurysms. The primary advantage of this technique is a more uniform distribution of forces around the aneurysm by the encircling sling. The aneurysm can then be collapsed without excessive tension on any part of the friable wall. As the case described demonstrates, this method can eliminate areas of aneurysmal dilation and can restore a more normal diameter. The sling can be tailored to incorporate perforating branches and other arteries that arise from the aneurysmal wall. Disadvantages of the technique include the need for circumferential dissection of the entire aneurysm before passage of the sling. There is also a small but reported risk of foreign-body granuloma from the cotton. The use of Gore-Tex or Dacron fabrics might reduce this risk and provide greater durability. The technique has one additional problem: It requires two hands, one for the clip applier and one to apply tension on the sling. Therefore, if suction is needed, it must be supplied by an assistant.

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References


Address for Dr. Bederson: Department of Neurosurgery, Mount Sinai School of Medicine, New York, New York.
Address reprint requests to: Joseph M. Zabramski, M.D., c/o Editorial Office, Barrow Neurological Institute, 350 West Thomas Road, Phoenix, Arizona 85013.