VALUE OF HYPOTHERMIA AND ARTERIAL OCCLUSION IN THE TREATMENT OF INTRACRANIAL ANEURYSMS

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(Received for publication April 2, 1962)

Although the problem of the appropriate treatment of patients with intracranial aneurysms remains unsettled, there can be no question that successful surgical treatment, as compared with conservative measures, offers the patient the best chance for survival and freedom from recurrent subarachnoid hemorrhage. Certainly the ideal method of treatment is one that excludes the aneurysm from the intracranial circulation without affecting the cerebral blood supply. This can be accomplished only by direct attack, with ligating or clipping the neck of the aneurysm, or by “trapping” it between clips or ligatures on the parent vessel.

An alternative method of surgical treatment is proximal ligation of either the common or the internal carotid arteries in the neck, but, in our experience, this does not necessarily prevent recurrent fatal subarachnoid hemorrhage. Also, this method is inadequate when an intracerebral hematoma is present, which is an important factor in the morbidity and mortality associated with subarachnoid hemorrhage. It is our opinion, therefore, that analogous to the management of aneurysms elsewhere in the arterial tree, when feasible, local repair of intracranial aneurysms is desirable.

With the advent of hypothermia, the treatment of intracranial aneurysms has improved, so that several workers have found that this factor alone has resulted in diminishing their mortality rate following direct surgical attack. Because of its effect in lowering the cerebral metabolic rate and cerebral oxygen consumptions, hypothermia allows a longer period of partial or complete interruption of cerebral blood flow than was possible previously. Thus, when the arterial supply to the brain is interrupted, the aneurysmal neck and sac may be collapsed partially or completely, application of a clip or ligation is facilitated and the danger of rupture of the aneurysm is reduced. In such a manner, the treatment of large lesions, previously regarded as inoperable, may be made possible. Another important factor is that often, during the course of exposure, an aneurysm ruptures before the surgeon is in a position to apply a clip or ligature. By occlusion of the total arterial inflow, the dissection can proceed in a relatively dry field, enabling a discrete and satisfactory ligation of the aneurysm. In addition, the reduction in brain volume and cerebrospinal-fluid pressure, which accompany hypothermia, aids in retraction of the brain and in exposure. The combination of hypothermia with partial or total occlusion of the intracranial arterial inflow has facilitated the direct surgical attack on intracranial aneurysms. The advantages of this technique have been described amply by Botterell and his co-workers.

In a previous publication, we reported 12 cases of intracranial aneurysms in which operation was performed, utilizing total body hypothermia and occlusion of cerebral arterial inflow. Since that time, 42 cases have been added to this series. The present article describes our further experiences with the 54 patients in whom we studied how effective arterial occlusion was in collapsing the aneurysm or in controlling bleeding if it ruptured during the operation. We also studied the nature and frequency of compli-
cations arising from the added procedure of isolation and occlusion of mediastinal vessels.

METHOD

Under general anesthesia, hypothermic levels of 27° to 30°C. were obtained in some instances by preliminary immersion of the patient in an ice tub, and subsequently transferring him to a Therm-O-Rite* blanket. We prefer, however, to cool the patient more slowly by using only the blanket. The cranial procedure and the dissection of the neck were done simultaneously by two surgical teams. The method for this exposure and subsequent occlusion has been described previously. Ordinarily, attempts were made to isolate the innominate artery and the left common carotid and subclavian arteries. However, in many cases the anatomic configuration was such that both common carotid arteries and both subclavian arteries proximal to the vertebral take-off had to be isolated and, occasionally, one or both vertebral vessels were isolated and occluded rather than the subclavian arteries. Occlusion of all isolated arteries was performed for one of two reasons: to collapse the aneurysm and facilitate application of clips or ligatures (24 cases), or to control bleeding from an aneurysm that ruptured during exposure (23 cases). In 10 cases no occlusion of the isolated vessels was deemed necessary by the surgeon and these cases can be considered as controls.

TABLE 1

<table>
<thead>
<tr>
<th>Aneurysms in each Pt.</th>
<th>Total No. Pts.</th>
<th>Results</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Bad</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>45 (89%)</td>
<td>17 (38%)</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>17 (38%)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>5 (56%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>9 (17%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>54 pts. with 65 aneurysms</td>
<td>19 (35%)</td>
<td>6 (11%)</td>
<td>3 (5.5%)</td>
<td>4 (7.5%)</td>
<td>22 (41%)</td>
<td></td>
</tr>
</tbody>
</table>

MATERIAL

Since the start of this series in 1957, hypothermia has been used in all patients who underwent intracranial surgery for aneurysmorrhaphy at this hospital. In only a very few cases, isolation of the vessels of the neck was not performed and these are not included here. This report includes a total of 54 patients with 65 aneurysms (Table 1): 7 patients had 2 aneurysms and 2 patients had 3 aneurysms, i.e., 16.7 per cent of the patients had multiple lesions, a higher figure than those reported by other workers. The presence of at least one aneurysm was detected by arteriography in all cases, and in patients with multiple lesions, arteriography, operation, or autopsy revealed the presence of other aneurysms. However, we recognize that additional aneurysms may have been missed.

Twenty-four of the patients were men and 30 were women. The patients ranged in age from 15 to 60 years and the majority fell within the 30- to 59-year-old age groups (Table 2). Most of the patients had had evidence of 1 or 2 hemorrhagic episodes before operation; 5 had 3 episodes, 2 patients had at least 4 episodes, and 1 patient entered without any history of bleeding but with palsy of the 3rd cranial nerve (Table 3).

RESULTS

The patients were graded as to operative risk, Grades 1 to 5, according to the classification of Botterell et al. Results also were determined by their schema, namely excellent, good, fair, bad, and deceased. The dis-