Late morbidity and mortality of common carotid ligation for posterior communicating aneurysms

A comparison to conservative treatment

H. Richard Winn, M.D., Alan E. Richardson, F.R.C.S. (Eng.), and John A. Jane, M.D., F.R.C.S.(C)

University of Virginia School of Medicine, Charlottesville, Virginia, and Atkinson Morley's Hospital, Wimbledon, England

The long-term evaluation of 60 patients who suffered a subarachnoid hemorrhage and survived 6 months is reported. By bilateral carotid arteriography, all patients were shown to have a single aneurysm at the vicinity of the posterior communicating artery at its junction with the internal carotid artery. The patients had previously been randomly assigned to treatment either by bed rest or by common carotid ligation. Average duration of survival among those followed is 8 years. Late rebleeding episodes were found to occur at a similar rate, irrespective of mode of treatment in the studied populations, but morbidity following operation continued to remain somewhat less over the ensuing years of follow-up study compared with the patients treated conservatively. On final assessment many years after the original hemorrhage, there is little improvement in degree of morbidity in either treatment group, and hypertension is noted to develop in the patients undergoing carotid ligation. A larger number of cases will be required to validate these findings.

Key Words: cerebral aneurysm, subarachnoid hemorrhage, carotid ligation, carotid artery

The first randomized trial for treatment of cerebral aneurysms, reported in 1960, compared the outcome of surgery with conservative treatment for patients having a single cerebral aneurysm at the posterior communicating artery (PCoA) location. This study showed that common carotid ligation provided protection from acute rebleeding and consequent death during the first 6 months after the initial hemorrhage. An equally important question relates to the long-term morbidity and mortality in the patients who survived 6 months. Is there still an advantage in carotid ligation for those who survived at least 6 months? We are reporting a long-term follow-up study of the survivors of this original randomized trial.

Clinical Materials and Methods

All patients were admitted to either Atkinson Morley's Hospital, Wimbledon, England, or the National Hospital, Queen Square, London, during 1958 and 1959, and were originally judged to be in no danger of dying from their initial hemorrhage (Category B of
Fig. 1. Summary of the course of 78 patients with acute subarachnoid hemorrhage (SAH). All underwent bilateral carotid arteriography. None were judged to be in danger of dying from the original SAH.

McKissock and Walsh (6). All had only one aneurysm at the PCoA location as demonstrated by bilateral carotid arteriography. Forty-one patients were randomly assigned to conservative therapy while 37 were allotted to common carotid ligation (Fig. 1). For further details of these groups, the original publications should be consulted. Six months after the initial hemorrhage, 26 conservatively treated patients and 34 patients treated with common carotid ligation were alive. All 60 survivors were examined at 6 months, the end point of the original study. Patients were then followed yearly by correspondence with the patient and/or his doctor. The hospital charts of all patients, plus the results of subsequent examinations and correspondence were reviewed in preparation for this report.

The degree of recovery was divided into five categories as follows:

- **A**: Symptom free
- **B**: Minimal symptoms
- **C**: Partially disabled but working
- **D**: Unable to work but caring for self
- **E**: Requires nursing care.

This categorization of recovery is a slight modification of the original study which assessed morbidity in four parts: full work, partially disabled, totally disabled, and condition unknown. Patients who had persistent third nerve palsy serious enough for them to complain spontaneously on two separate occasions of this disability, or who had to change jobs because of this disability, were placed into Category C (partially disabled but working).

**Summary of Cases**

**Follow-Up Period**

Follow-up periods are shown by year in Fig. 2. Total duration of follow-up study ranged from 6 months to 14 years, and the average duration for known survivors was 8 years. Eight conservatively and 18 surgically treated patients were followed for 10 years; 62% of the patients were followed for at least 5 years. Causes of patient drop out, and the year in which loss occurred are shown in Tables 1 and 2. In all, 14 patients (28%) were...
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FIG. 2. Duration of follow-up study: 62% were followed for more than 5 years.

lost to follow-up study, seven from each group.

Natural Death

Natural deaths were those attributable to causes other than the initial or subsequent late hemorrhages. Table 3 lists the causes of the natural deaths in each group and the average duration from initial hemorrhage to death.

Morbidity

As noted in the original publication, the morbidity rate following operation is somewhat less than that found in the survivors of conservative treatment when assessed at 6 months. It is not surprising that this remains true for the long-term follow-up studies. Final assessment of morbidity was measured by the degree of recovery that the patient exhibited when last evaluated, a time period ranging from 6 months to 14 years. By comparing the 6 months’ assessment with the final assessment (Table 4), one can see that there is little improvement. The difference in outcome in morbidity between conservatively and surgically treated patients may be related to the difference in neurological state on original admission to the hospital (Table 5).

Onset of seizures during the long-term follow-up period occurred in three (12%) conservatively treated patients and in two (6%) of the surgically treated patients, an insignificant difference for the two groups of survivors. Both surgically treated patients were in good neurological state before common carotid ligation, but deteriorated postopera-

<table>
<thead>
<tr>
<th>TABLE 3</th>
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<tbody>
<tr>
<td>Causes of “natural deaths”*</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Cause of Death</td>
</tr>
<tr>
<td>conservatively treated pulmonary (pneumonia)</td>
</tr>
<tr>
<td>cardiovascular (MI or CHF)</td>
</tr>
<tr>
<td>total (none documented by postmortem examination)</td>
</tr>
<tr>
<td>carotid ligation cancer (lung and cervix)</td>
</tr>
<tr>
<td>cardiovascular (aortic aneurysm, MI, or CHF)</td>
</tr>
<tr>
<td>total (two documented by postmortem examination)</td>
</tr>
</tbody>
</table>

*Deaths other than those attributable to subarachnoid hemorrhage (SAH). CHF = congenital heart failure; MI = myocardial infarction.
TABLE 4
Morbidity on final assessment
(6 months to 14 years after the initial SAH)

<table>
<thead>
<tr>
<th>Category of Recovery</th>
<th>Conservative</th>
<th>Carotid Ligation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: symptom-free</td>
<td>12 (62%)</td>
<td>21 (74%)</td>
</tr>
<tr>
<td>B: minimal symptoms</td>
<td>4 (2%)</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>C: partially disabled but working</td>
<td>6 (35%)</td>
<td>6 (26%)</td>
</tr>
<tr>
<td>D: unable to work but caring for self</td>
<td>3 (2%)</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>E: requires nursing care</td>
<td>1 (1%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>total</td>
<td>26 (46%)</td>
<td>31 (68%)</td>
</tr>
</tbody>
</table>

Blood pressure recordings were obtained during the many years of subsequent follow-up study in 49 patients, and an average measurement calculated for each patient. A difference was noted in blood pressure for the two groups of survivors (Table 6). The average blood pressure of the conservatively treated survivors was 152/92 mm Hg, while that of the patients undergoing common ligation was 179/100 mm Hg. Thus, conservatively treated patients had a significantly lower average systolic (p < 0.001) and diastolic (p < 0.015) blood pressure when compared by Student’s t-test to the surgically treated patients. There was no difference noted in the original population when initially randomized.

Late Rebleeding Episodes

Late rebleeding has been defined as a subarachnoid hemorrhage (SAH) that occurs more than 6 months after the initial bleeding episode.14,33,34 Eight late rebleeds were found in the conservatively treated patients, three of which were fatal. With common carotid ligation, four late rebleeding episodes occurred over the first 10 years, and a fifth took place during the eleventh year. Four of the five late hemorrhages in the surgically treated group were fatal. The duration between original hemorrhage and subsequent late rebleeding is illustrated in Fig. 3.

TABLE 5
Relationship of neurological state on admission to category of recovery on final assessment

<table>
<thead>
<tr>
<th>Admission Grade*</th>
<th>Conservative (Category of Recovery)</th>
<th>Total (%)</th>
<th>Carotid Ligation (Category of Recovery)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A B C D E</td>
<td></td>
<td>A B C D E</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1 (4)</td>
<td>2</td>
<td>2 (6.5)</td>
</tr>
<tr>
<td>2</td>
<td>9 3 3 1 1</td>
<td>17 (65)</td>
<td>18 2 6 2</td>
<td>28 (90)</td>
</tr>
<tr>
<td>3</td>
<td>3 3 1</td>
<td>7 (27)</td>
<td>1</td>
<td>1 (3.5)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1 (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>12 4 6 3 1</td>
<td>26 (46%)</td>
<td>21 2 6 2</td>
<td>31</td>
</tr>
</tbody>
</table>

*Neurological state on admission assessed by the grading system of Nishioka.15

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In one additional case, late SAH occurred as a result of an aneurysm at a second site (contralateral PCoA). This case was excluded from analysis of late rebleeding because the aneurysm that bled was not the aneurysm for which the carotid ligation had originally been performed. This patient, a 19-year-old seaman, was admitted to the National Hospital, Queen Square, with a 2-week history of SAH verified by lumbar puncture. He was complaining of generalized headache, but his neurological examination was unremarkable except for slight meningismus. Bilateral carotid arteriograms done on the day of admission revealed a lobulated aneurysm of the right PCoA. The left carotid study was interpreted as normal. The patient was allotted by chance to common carotid ligation which he underwent on the second hospital day. He tolerated this procedure well, and made a satisfactory recovery, showing no neurological deficits on discharge.

He had the sudden onset of severe frontal headache 3 years and 8 months after his initial SAH, and was readmitted to the National Hospital. His neurological examination revealed him to be normal except for severe meningismus. Attempts at a right carotid arteriogram were unsuccessful. A left vertebral arteriogram revealed good filling of the left vertebral and basilar arteries and showed no abnormalities. The left carotid studies, however, revealed an irregular left PCoA aneurysm, a mirror image of his previous lesion. A left frontotemporal craniotomy was performed, and the aneurysm clipped at its neck. He was discharged on the eleventh postoperative day and shortly returned to full employment. He has subsequently been followed for an additional 12 years.

**Proof of Rebleeding**

Proof of rebleeding was categorized into three groups:

1. Absolute proof required a postmortem examination or compatible clinical history, plus lumbar puncture.
2. Probable proof required a clinical history of stiff neck, headache, and loss of consciousness, or neurological impairment in keeping with a previously demonstrated aneurysm. Sudden death in a few younger patients, unsubstantiated by postmortem examination, was also considered in this category.
3. Possible proof required two of the four above clinical features or a statement by the referring physician as to the causes of death.

Table 9 lists the different classifications found in the conservatively and surgically treated rebleeders. Applying $\chi^2$ analysis to those figures reveals there is no protective effect of carotid ligation against late rebleeding if all types of rebleeding classifica-

<table>
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<tr>
<th>TABLE 6</th>
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<tr>
<td><strong>Comparative mean blood pressure (mm Hg)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Cases</th>
<th>Systolic</th>
<th>Diastolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>original population*</td>
<td>41</td>
<td>155</td>
<td>90</td>
</tr>
<tr>
<td>conservative</td>
<td>37</td>
<td>160</td>
<td>91</td>
</tr>
<tr>
<td>carotid ligation</td>
<td>26</td>
<td>152</td>
<td>92</td>
</tr>
<tr>
<td>survivors†</td>
<td>34</td>
<td>179‡</td>
<td>100§</td>
</tr>
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* Averaged blood pressures on original admission.
† Averaged blood pressures on subsequent examination (range 6 months to 14 years).
‡ $p < 0.001$.
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<td>90</td>
</tr>
<tr>
<td>conservative</td>
<td>37</td>
<td>160</td>
<td>91</td>
</tr>
<tr>
<td>carotid ligation</td>
<td>26†</td>
<td>152</td>
<td>92</td>
</tr>
<tr>
<td>survivors†</td>
<td>34</td>
<td>179‡</td>
<td>100§</td>
</tr>
</tbody>
</table>

* Averaged blood pressures on original admission.
† Averaged blood pressures on subsequent examination (range 6 months to 14 years).
‡ $p < 0.001$.
§ $p < 0.015$. 
TABLE 7
Mean diastolic blood pressure for the survival period after 6 months (mm Hg)*

<table>
<thead>
<tr>
<th>Group</th>
<th>&lt;80</th>
<th>80-90</th>
<th>90-100</th>
<th>100-110</th>
<th>&gt;110</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>carotid ligation</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>conservative</td>
<td>2</td>
<td>4</td>
<td>12</td>
<td>7</td>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td>total</td>
<td>4</td>
<td>8</td>
<td>15</td>
<td>10</td>
<td>12</td>
<td>49</td>
</tr>
</tbody>
</table>

\[x^2 = 11.9475, p = 0.01803.\]

Case Reports

The following case histories are typical of late rebleeding episodes in both the conservative and surgical groups.

Conservatively Treated Group

Case 1. This 45-year-old man sustained an SAH 3 days before admission to Atkinson Morley's Hospital. Neurological examination on admission was within normal limits. Bilateral carotid arteriogram revealed a right PCoA aneurysm. He was allotted to treatment of 6 weeks of bed rest, which he tolerated well without subsequent re-hemorrhage. When examined at 6 months, he was neurologically intact and reported that he had returned to full work. He continued to enjoy good health until 3 years and 1 month after his initial bleeding episode when he developed persistent occipital headache. Three days following the development of the headache, he was readmitted to Atkinson Morley's Hospital, where lumbar puncture revealed blood-stained cerebrospinal fluid (CSF). Neurological examination was within normal limits except for a stiff neck. Bilateral carotid arteriogram revealed an irregular aneurysm, larger in size than on the previous arteriogram, arising from the right PCoA, and an associated small hematoma of the anterior part of the right Sylvian fissure.

Case 2. This 52-year-old woman suffered an SAH 24 hours before admission to Atkinson Morley's Hospital. Her neurological examination revealed her to be drowsy, and she had reduced power and hyperreflexia in the left leg. Bilateral carotid arteriograms performed 4 days after hemorrhage revealed a right PCoA aneurysm, 8 mm in length on the lateral view. She was allotted to 6 weeks of bed rest, but suffered a rebleed, confirmed by lumbar puncture, in her second week, which resulted in a mild left hemiparesis. She returned to bed rest which she tolerated well without subsequent rebleeds.

On examination 6 months after her initial hemorrhage, she was found to have no gross deficits and had returned to full function as a housewife. One year after her initial hemorrhage she was again re-examined and found to have no abnormal signs. She was, by her own words, "living a full life." Five years after the initial bleeding episode, while resting in bed, she suddenly collapsed and died within 4 hours. Postmortem examination revealed an SAH secondary to a rupture of a large aneurysm measuring 42 × 35 × 35 mm emanating from the right PCoA.

TABLE 8
Mean systolic blood pressure for the survival period after 6 months (mm Hg)*

<table>
<thead>
<tr>
<th>Group</th>
<th>120-170</th>
<th>&gt;170</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>carotid ligation</td>
<td>9</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>conservative</td>
<td>21</td>
<td>6</td>
<td>27</td>
</tr>
<tr>
<td>total</td>
<td>30</td>
<td>19</td>
<td>49</td>
</tr>
</tbody>
</table>

\[x^2 = 6.94102, p = 0.00845.\]

TABLE 9
Incidence of late rebleeding

<table>
<thead>
<tr>
<th>Proof of Rebleeding</th>
<th>Conservative Carotid Ligation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>absolute</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>probable</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>possible</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>total</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

\[*Significance calculated with Yates correction.*

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Case 3. This 54-year-old man was admitted with a 4-day history of sudden onset of severe temporal and frontal headache. He was noted to have mild neck stiffness, and bloody CSF. Bilateral carotid arteriography revealed a right PCoA aneurysm, 8 mm in length, on a lateral view. The patient was allotted to 6 weeks of bed rest which he tolerated well without subsequent hemorrhage. He was examined 6 months after his initial hemorrhage and found to be completely intact neurologically. He reported yearly, and enjoyed good health until 3 years and 2 months after his initial bleeding episode when he developed severe headache with vomiting. He was readmitted to Atkinson Morley’s Hospital where lumbar puncture showed blood-stained CSF. Bilateral carotid arteriograms on the day of his second admission revealed an enlarged right-sided unilocular PCoA aneurysm with a small local accompanying hematoma.

Surgically Treated Group

Case 4. This 58-year-old woman was well until the morning of her admission when she experienced sudden onset of severe generalized headache. Lumbar puncture revealed blood-stained CSF. She was transferred to Atkinson Morley’s Hospital where, except for neck stiffness, no other abnormal neurological findings were apparent. Bilateral carotid arteriograms on the day of admission revealed a moderate-sized left PCoA aneurysm. Within 36 hours of admission, common carotid ligation was performed under general anesthesia.

At examination 6 months after the SAH, she was fully recovered. Almost 3 years after initial hemorrhage, while preparing for bed, she had the sudden onset of severe headache and collapsed. She was taken to a local hospital and died within 24 hours. Postmortem examination revealed a fresh SAH due to rupture of a left PCoA aneurysm.

Case 5. This 38-year-old woman sustained an SAH without coma 12 hours before admission to Atkinson Morley’s Hospital. She was found on neurological examination to be drowsy but oriented. Her neck was moderately stiff and she had left-sided weakness. Arteriography was performed within 24 hours of admission and revealed a medium-sized aneurysm at the junction of the right PCoA and internal carotid artery. Right common carotid ligation under general anesthetic was performed after arteriography.

When examined at 6 months, she was partially incapacitated by persistent left-sided weakness and spasticity. Three years after her initial SAH, the patient herself wrote to say that she was “getting along fine” and was able to do housework. One month later she suddenly collapsed at home and died within a few hours of admission to a local hospital. Cause of death was certified on postmortem examination as being secondary to an SAH from a ruptured right PCoA aneurysm. An associated temporal lobe hematoma was also noted. The remainder of the postmortem examination was normal except for an enlarged heart.

Case 6. This 50-year-old man had a sudden attack of dizziness and severe headache accompanied by neck stiffness which gradually improved. A lumbar puncture revealed blood-stained CSF. On admission to Atkinson Morley’s Hospital 2 days after his initial hemorrhage, he was without localizing signs except for an equivocal left plantar response. On the day of admission, he had bilateral carotid arteriograms which revealed a moderate-sized aneurysm arising from the origin of the left PCoA. On the same day, a left common carotid artery ligation was performed under general anesthesia.

On examination 6 months after the SAH, he had returned to light work and was symptom-free except for occasional headache. Two years after his initial hospitalization, he suffered a recurrence of his SAH, and was readmitted to a local hospital. Physical examination revealed a right-upper extremity weakness and mild speech difficulties. Lumbar puncture confirmed the presence of bloody CSF. He refused any further treatment and was discharged asymptomatic after 10 days of bed rest.

Discussion

Nishioka,23 in his analysis of the Cooperative Study, critically defines successful treatment of an aneurysm by carotid ligation, not only by the simple tabulation of survivors, but also by the following five criteria: 1) tolerance of carotid ligation; 2) permanency of occlusion; 3) return to useful existence; 4) absence of any late ischemic consequences; and 5) no subsequent hemorrhages.
McKissock, et al.,20 in their original study of this population, dealt with the toleration of common carotid ligation during the acute phase. With the present report on the long-term course of patients treated by either conservative or surgical therapy, subsequent late hemorrhage is seen to occur at the same rate in both groups. Thus, carotid ligation, while protecting against rebleeding during the first 6 months, appears to be ineffectual in that regard during the ensuing years. However, a larger number of surgically treated patients (53%) were followed through the tenth year, as compared to the conservatively treated patients (31%). This difference in length of observation may account for the lack of difference in late rebleeding in the two groups. Construction of valid yearly rebleeding rates, which would account for the differences in length of the follow-up period, would require larger population groups.

Because of the following reasons, it is difficult to compare our rate of late rebleeding following carotid ligation with the rates found in other studies:

1. Many early reports15,18,24 do not separate long-term follow-up studies of patients who have suffered an SAH from those who have an unruptured but symptomatic aneurysm. The natural history of these two types of aneurysms (namely, ruptured and unruptured) may not be similar. Other studies,8,22 group supraclinoid and infraclinoid (that is, cavernous sinus) aneurysms together. Clearly, the natural histories of these two aneurysms are different.23 German and Black8 make a clear distinction in the location of the patient's aneurysm. In their supraclinoid group, late rebleeding from the original aneurysm occurred in four of 26 patients, closely approximating our figures. They, however, varied their treatment between internal and common carotid artery ligation.

2. The site of the aneurysm for which the patient has undergone carotid ligation is not always indicated. Thus, although Norlén24 reports six late hemorrhages in 31 patients followed from 1 to 14 years after carotid ligation, he does not specify where these aneurysms were located.

3. Despite the documentation of Bakay and Sweet1 and others38 showing a pressure drop in the distal branches after carotid ligation, carotid ligation alone for aneurysms lysing in the distal branches of the internal carotid artery has not been found to be effective treatment.6,21,22,34 Collateral flow through the circle of Willis is thought to be responsible for this failure of carotid ligation in treating these distal aneurysms. Thus, studies utilizing carotid ligation for aneurysms of the distal branches of the carotid artery15,22 or multiple aneurysms16,22 would not provide the ideal sample for studying the effects of carotid ligation on prevention of late rebleeding.

4. Most reports documenting late hemorrhage note only fatal recurrences.

5. The results of common carotid and internal carotid ligation are often presented together.10,11,22,23,27 The short-term as well as the long-term effects of these two types of ligations may vary.17,22,23,30

6. There is marked variation in the length and completeness of follow-up study.

Despite the reservations noted above for comparing studies, late rebleeding following carotid ligation has been noted in many previous reports.6-8,10,15,16,21-24,27,31,36 In addition to late rebleeding from the original aneurysm, one patient in our series had the subsequent development of a contralateral PCoA aneurysm, a situation that others have reported.9 This clinical development has been supported by the experimental data of Hassler,11 who found the development of contralateral aneurysms with carotid ligation in rabbits.

Improvements in the degree of recovery were not, as a rule, noted during the ensuing years of follow-up study. The 6-month evaluation differed little from subsequent assessment. We were surprised to find no episodes of subsequent cerebrovascular disease other than the recurrence of SAH. Olderershaw and Voris26 reported two patients developing hemiplegia at 1 and 13 years after carotid occlusion. Similar episodes have been noted in other series.18,19

A distinct elevation was found in the blood pressure of those patients treated with carotid ligation when compared with their original blood pressures or when compared with the patients treated conservatively. The etiology of the resulting hypertension following carotid ligation is obscure and bears further investigation. Initial elevation in systemic pressure following single common carotid artery ligation has been noted by Shenkin, et
Late effects of common carotid ligation

al., but persistence of this effect is lacking in other reports except for that of Christiansson, who studied the late effects of carotid ligation on the human eye. In his 13 patients followed on the average of 6.75 years, the three patients who had common carotid ligation alone were found on follow-up study to have marked hypertension (188/120 mm Hg) compared with the remaining 10 who underwent a variety of distal ligations (150/96 mm Hg) (t-test = 2.16, p = 0.051 for systolic pressure; t-test = 3.18, p = 0.008 for diastolic pressure). Carotid baroreceptor malfunction might be implicated, but persistent systemic changes have not been found with unilateral ablation. However, the carotid baroreceptor is more sensitive to a pulsatile pressure than to a steady pressure. Although the long-term effects of carotid ligation on distal arterial pressure have shown a return toward normal systolic and diastolic pressures, others have noted a greater persistence of initial reduction in pulse pressure. This more sustained reduction in pulse pressure, although unilateral, may be sufficient to trigger sustained systemic hypertension, a condition seen with bilateral sinus ablation.

An additional explanation for the hypertension observed in our patients is suggested by the work of Sengupta, et al., who studied the immediate effects of ipsilateral cerebral blood flow in baboons following carotid ligation and found that the circulatory reserve of the brain was not sufficient to meet physiological challenges. The delayed development of systemic hypertension may be in response to this marginal circulatory reserve.

Summary

We are reporting the long-term evaluation of patients who suffered an SAH and were determined on arteriography to have a single aneurysm at the vicinity of the PCoA. The patients are the 6-month survivors of those groups who were randomly assigned to treatment either by bed rest or common carotid ligation. Average duration of known survival was 8 years. Our major findings were:

1. Late rebleeding episodes have been found to occur at a similar rate irrespective of the mode of treatment.

2. The morbidity following operation continues to remain somewhat less over the ensuing years of follow-up study compared with the conservatively treated patients. On final assessment, many years after the original hemorrhage, there is little improvement in the degree of morbidity in either treatment group.

3. Hypertension is noted to develop in the patients undergoing carotid ligation. A larger number of cases will be required to validate our findings.

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References


Address reprint requests to: H. Richard Winn, M.D., Department of Neurosurgery, University of Virginia Hospital, Charlottesville, Virginia 22901.