Upper basilar artery aneurysms: oculomotor outcomes in 163 cases

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Object. The purpose of this study was to identify factors predictive of postoperative oculomotor nerve palsy among patients who undergo surgery for distal basilar artery (BA) aneurysms. The data can be used to estimate preoperative risk in this population. The natural history of oculomotor nerve palsy in patients with good outcomes is also defined.

Methods. The cases of 163 patients with distal BA aneurysms, who were treated surgically between 1996 and 2002, were retrospectively studied to identify factors contributing to oculomotor nerve palsy. After the data had been collected, stepwise logistic regression procedures were used to determine the predictive effects of each variable on the development of oculomotor nerve palsy and to create a scoring system. Factors that interfered with resolution of oculomotor dysfunction in patients with good outcomes were also studied.

Postoperative oculomotor nerve palsy occurred in 86 patients (52.8%) with distal BA aneurysms. The following factors were associated with postoperative oculomotor dysfunction, as determined by a categorical data analysis: 1) younger patient age (p < 0.001); 2) poor admission Hunt and Hess grade (p < 0.001); 3) use of temporary arterial occlusion (p < 0.001); 4) poor Glasgow Outcome Scale score (p < 0.001); and 5) the presence of a BA apex aneurysm that projected posteriorly (p < 0.001). For patients with good outcomes, postoperative oculomotor nerve palsy resolved completely within 3 months in 31 patients (52%) and within 6 months in 47 patients (80%). The projection of the BA aneurysm was associated with incomplete oculomotor recovery at 6 months postoperatively (p = 0.019).

Conclusions. The results of this study can help identify patients with a high risk for the development of oculomotor nerve palsy. This may help neurosurgeons in preoperative planning and discussions.

Key Words • basilar artery aneurysm • oculomotor nerve palsy • superior cerebellar artery • posterior cerebral artery • subarachnoid hemorrhage

Although oculomotor nerve palsy is one of the most frequent complications following surgical treatment of distal BA aneurysms, many neurosurgeons do not include it as part of their morbidity report.15,16,20,24,28 This attitude can be attributed to several reasons. 1) This injury occurs because the surgical approach is focused on the distal BA. 2) Oculomotor nerve palsy alone will not interfere with the patient’s ability to perform activities of daily living. 3) Many times oculomotor nerve palsy resolves spontaneously, as suggested by Drake and colleagues.4 The incidence of oculomotor nerve palsy following distal BA aneurysm surgery varies from 25 to 80%.4,7,22,31 Oculomotor nerve palsy may interfere with the rapid full recovery of asymptomatic patients harboring distal BA aneurysms, as suggested in many case reports.10,22,27 With the advent of alternative options to treat aneurysms, accurate assessments of the frequency and outcome of oculomotor nerve palsy are needed. Such information may help preoperative discussion and planning.

We present a series of 163 patients with upper BA aneurysms who were treated surgically at our institution. The incidence of oculomotor nerve palsy and clinical factors associated with this disorder are discussed. This discussion is helpful to a preoperative estimation of the risk of oculomotor nerve palsy. The literature lacks such a discussion, despite recent increases in microsurgical experience and knowledge regarding BA aneurysm surgery. Finally, we report on the natural outcome of oculomotor nerve palsy and factors associated with incomplete resolution of oculomotor dysfunction at 6 months postoperatively.

Clinical Material and Methods

The aneurysm registry of the Neurological Surgery Department at the University of Texas Southwestern Medical School and the daily operative logs for Parkland Memorial Hospital and Zale Lipshy University Hospital were reviewed. All patients undergoing surgical treatment for aneurysms of the distal BA between January 1, 1996, and December 31, 2002, were identified. Individual inpatient and outpatient records for all patients were also reviewed. Outcome status was determined by performing a clinical evaluation and assigning a GOS score2 at the time of hospital discharge or at the time of clinical follow up closest to the 6-month surgical anniversary date. An independent hospital-based nurse clinician evaluated the patients. Patients with good outcomes were defined as those with excellent or good GOS scores (GOS Scores 5 or 4), whereas unfavorable outcome was defined as fair, poor, or dead (GOS Scores 3, 2, or 1).
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One hundred sixty-three patients with distal BA aneurysms were identified as having undergone surgical treatment during the chosen period. Among them, 128 patients had aneurysms of the BA apex, 28 had lesions of the SCA, and 13 had aneurysms of the posterior cerebral artery (P, segment). Six patients had more than one type of aneurysm. Patient ages ranged from 17 to 83 years, with a mean of 53 years. The study population consisted of 54 male and 109 female patients.

In addition to clinical outcome, a variety of parameters were recorded dealing with demographic data, clinical presentation, angiographic findings, operative anatomy, and procedural specifics such as aneurysm size, location, and the projection of a BA tip aneurysm in relation to the BA axis. The use of temporary arterial occlusion or total occlusion was also recorded. Oculomotor nerve palsy is defined as a palsy that appears just after surgery. Four patients presented with oculomotor dysfunction caused by a mass effect from the aneurysms (two with BA apex aneurysms and two with SCA aneurysms); those patients were included in the study. Patients with oculomotor nerve palsy due to brain death or mass effect were not counted as having postoperative oculomotor nerve palsy. Isolated anisocoria was not counted as an oculomotor dysfunction.

In addition, oculomotor status was recorded at the 3- and 6-month follow-up examinations. We retrieved these data from the neurosurgical clinic notes. Consultation with a neuroophthalmologist was also obtained for patients with good outcomes if oculomotor dysfunction persisted more than 6 months. A minimum of 6 months follow up was required to include patients with good outcomes in the study of the natural history of oculomotor nerve palsy. This was achieved in our study population.

Surgical and Anesthetic Techniques

In all patients surgery was performed using a pterional trans Sylvian exposure. Zygomatic osteotomy was added for very high-lying BA aneurysms, and a trans cavernous approach was used for low-lying lesions. The aneurysm was accessed through the sylvian fissure lateral to the internal carotid artery. Uncal resection was used, when needed, to widen the space available to access the distal BA area. The posterior communicating artery was clipped and cut at its junction with the posterior cerebral artery if further medial mobilization of the internal carotid artery was needed. This was done only if the posterior communicating artery was small or hypoplastic. A Pentothal- or etomidate-induced burst-suppression coma and moderate hypothermia (33°C) were used in almost all cases of temporary or total occlusion. Hypothermic circulatory arrest was used in one patient with a giant BA apex aneurysm. Throughout the series, most patients with Hunt and Hess8 Grades I, II, and III SAH underwent surgery as soon as possible after their transfer and admission to Southwestern Medical Center; surgery for patients with higher-grade hemorrhages was often deferred for several days.

Statistical Analysis

The Fisher exact test was used to test associations between patient characteristics and the GOS score. Characteristics that were considered included: 1) patient age; 2) Hunt and Hess grade; 3) size of the aneurysm; 4) location of the aneurysm; and 5) projection of the BA apex. Similarly, the Fisher exact test was used to test associations between patient characteristics and the occurrence of oculomotor nerve palsy. The following characteristics were considered: 1) Hunt and Hess grade; 2) patient age; 3) size of the aneurysm; 4) location of the aneurysm; 5) projection of the BA apex; 6) use of temporary or total arterial occlusion; and 7) the GOS score. Logistic regression was performed to determine factors predictive of oculomotor nerve palsy. Once these factors were identified, a simple scoring system based on the results of the logistic regression was created to identify which patients were at greater risk of having partial or complete oculomotor nerve palsy. The Fisher exact test with an adjustment for time was used to test the association between patient characteristics and persistence of oculomotor nerve palsy at 6 months postoperatively in patients with good outcomes only. A probability level of 0.05 was used to determine statistical significance. All analyses were performed using SAS for Windows (version 9.0; SAS Institute, Cary, NC).

Results

Overall Outcome

Overall outcomes and clinical factors are listed in Table 1. Age older than 60 years did not significantly affect outcomes. Outcomes were mainly related to the preoperative Hunt and Hess grade and the aneurysm characteristics. A good outcome was achieved in 70 asymptomatic patients (88.7%) and in 126 patients (87.5%) with small aneurysms (<15 mm). On the other hand, aneurysms that were larger than 15 mm and those located at the BA tip, on the SCA, or P, segment were associated with unfavorable outcomes in 57.1 and 27.3%, respectively. Nineteen (29.7%) of 64 posteriorly projecting BA aneurysms were associated with unfavorable outcomes, compared with five BA apex aneurysms (7.8%) with a forward or upward projection (p = 0.003). The location of the aneurysm did not significantly affect the GOS score. The mortality rate in this study population was 2.5%.

Oculomotor Nerve Palsy

Postoperative oculomotor nerve palsy occurred in 86 patients (52.8%) with distal BA aneurysms (Table 2). Oculomotor dysfunction occurred in 67 patients (52.5%) with BA apex aneurysms and 17 (41.4%) with SCA or P, segment aneurysms. Two patients (1.6%) with BA apex aneurysms and two (7.1%) with SCA aneurysms exhibited oculomotor nerve palsy before surgery. Although there were no statistical differences in the incidence of preoperative and postoperative oculomotor nerve palsy between these aneurysm groups, patients with SCA aneurysms seemed to have at least a fourfold greater incidence of preoperative oculomotor dysfunction than those with BA apex aneurysms. Of 86 patients with oculomotor nerve palsy, 60.5% exhibited complete paresis of external muscles and 39.5% exhibited partial paresis. Oculomotor outcomes and clinical factors are listed in Table 2 and Fig. 1. Younger patients (≤60 years old) tended to experience oculomotor nerve palsy. This disorder was also associated with poor presurgical grades and unfavorable outcomes. Although the size of the aneurysm did
not demonstrate an association with the incidence of oculomotor nerve palsy, two thirds of patients with aneurysms larger than 15 mm exhibited a postoperative oculomotor dysfunction. Patients with posteriorly projecting BA aneurysms frequently experienced oculomotor nerve palsy (79.7%), whereas only 28.2% of patients whose aneurysms projected forward or upward experienced this disorder. The use of a temporary or total arterial occlusion technique to clip an aneurysm was associated with a higher incidence of oculomotor nerve palsy. Two thirds of patients with BA apex aneurysms, at least 85% of patients with scores greater than 5 experienced oculomotor nerve palsy (Table 7). Four fifths of the patients recovered to normal third cranial nerve function within 6 months; another four patients displayed complete resolution of symptoms at 9 months (Table 7). Four fifths of the patients recovered to normal third cranial nerve function within 6 months; another four patients displayed complete resolution of symptoms at 9 months (Table 7).

Factors associated significantly with oculomotor nerve palsy included the following: 1) younger age; 2) poor admission Hunt and Hess grade; 3) use of temporary or total occlusion; and 4) GOS score. For BA apex aneurysms, a posterior projection was strongly associated with postoperative oculomotor nerve palsy (p < 0.001). Aneurysm size and location were not associated with postoperative oculomotor nerve palsy.

Logistic regression procedures were performed for all distal BA aneurysms and again for only BA apex aneurysms. For distal BA aneurysms, the following variables were selected for use in the scoring algorithm based on their fit of the data: Hunt and Hess grade; patient age; GOS score; and use of temporary or total occlusion. For BA apex aneurysms, the following variables were selected based on their fit of the data: Hunt and Hess grade; patient age; GOS score; and projection (backward compared with forward or upward).

To predict oculomotor status among surgical patients, a simple scoring algorithm was created based on the results of the logistic regression analysis. Parameter estimates and their standard deviations for the reduced models were used in determining the weights used in the scoring algorithm. Sensitivity and specificity values were examined to assess the fit of these models. Patients were assigned an additive score between 0 and 5, as outlined in Tables 3 and 4, for distal BA aneurysms and BA apex aneurysms, respectively. For each of these scoring algorithms (distal BA aneurysms and BA apex aneurysms), the total scores for all patients are presented with the oculomotor status (Tables 5 and 6). Table 5 demonstrates that oculomotor nerve palsy developed in 76% of patients with scores of at least 8; in addition, oculomotor nerve palsy occurred in 100% of patients with a score greater than 9. Eighty-eight percent of patients with oculomotor nerve palsy had a score equal to or greater than 7. In BA apex aneurysms, at least 85% of patients with scores greater than 5 experienced oculomotor nerve palsy (Table 6).

### Natural History of Oculomotor Nerve Palsy

As shown in Table 7, 59 patients with postoperative oculomotor nerve palsy (exclusive of patients who had unfavorable outcomes) were followed up for 6 to 24 months (mean follow-up period 6.8 months). Among these patients, 31 (53%) showed complete resolution of palsy within 3 months (Table 7). Four fifths of the patients recovered to normal third cranial nerve function within 6 months; another four patients displayed complete resolution of symptoms at 9 months. A neuroophthalmologist diagnosed an aberrant abduction regeneration defect in two patients (3.4%). Both patients had minor visual complaints. Six patients (10.2%) continued to experience significant partial third cranial
nerve palsy at 9 months. The postoperative impact of oculo-
motor nerve palsy was minor in patients with unfavorable
outcomes, and thus the natural history of oculomotor nerve
palsy was not analyzed in this group.

A posteriorly projecting BA apex aneurysm was the on-
ly factor that was associated with incomplete resolution
of oculomotor function at 6 months (p = 0.019). Although
not statistically significant, an aneurysm size larger than 15
mm, a poor Hunt and Hess grade, and the use of temporary
or total occlusion were predictive of high percentages of in-
complete resolution of oculomotor dysfunction.

Discussion

Considerable improvement in outcomes for surgical
treatment of the posterior circulation has been obtained in
the past two decades. Recognition of the vital importance of
brainstem perforating vessels, which must be preserved at
all costs, enhanced diagnostic imaging techniques, and bet-
ter management of anesthesia, together with accumulated
surgical experience, have all contributed to this progress.\textsuperscript{1,4,14,23,31} Reports of many large series of surgically treated pa-
tients have been published,\textsuperscript{1,4,11,14,15,20,24,31} but these studies have
dealt primarily with major morbidity and mortality. Several
publications have documented the incidence of postopera-
tive oculomotor dysfunction or time to full recovery,\textsuperscript{12,22,28}
but very few publications contain analyses of risk factors
associated with oculomotor dysfunction following upper
BA artery aneurysm surgeries.\textsuperscript{7,22}

There are two main possible mechanisms for postopera-
tive oculomotor dysfunction, that is, direct mechanical dam-
age and vascular complications. Cruciger, et al.,\textsuperscript{2} re-
ported on a series of 31 patients with BA bifurcation aneu-
rysms clipped via a standard subtemporal approach, in 21
of whom (67.7\%) oculomotor nerve palsy developed. In
nine patients (29\%), unilateral oculomotor dysfunction was
the only complication and eight of those patients recov-
ered fully. Twelve patients had either bilateral third cranial
nerve paralysis or unilateral third nerve palsy with contralat-
eral hemiplegia, indicating a vascular injury to the midbrain.
Only one half of these patients made a full recovery from
their deficits. The authors concluded that oculomotor nerve
palsy resulting from third nerve manipulation usually re-
 solves within 2 to 3 months, whereas recovery from paraly-
sis caused by brainstem ischemia is often incomplete, pre-
sumably because of injury to the third cranial nerve nucleus
or nerve fascicles within the midbrain.\textsuperscript{2} Solomon and Stein\textsuperscript{28}
reported that 95\% of patients with third nerve paralysis re-
covered fully within 6 months.

In our study, complete resolution of oculomotor dysfunc-
tion occurred within 9 months in 86\% of patients with good
outcomes. A posteriorly projecting BA apex aneurysm was
associated with incomplete recovery of oculomotor dys-
function in these patients. This could be attributed to high-
er vascular complications associated with surgeries on pos-
teriorly projecting aneurysms.\textsuperscript{14}

Other rare reasons for postoperative oculomotor nerve
palsy include vasospasm\textsuperscript{15} and an inflammatory reaction to
muslin gauze wrapping.\textsuperscript{19} Direct trauma to the oculomotor
nerve from a dislocated clip has also been reported.\textsuperscript{10} In one
of our patients delayed (5th postoperative day) oculomotor
nerve palsy developed as a result of a mass effect from a de-
layed temporal epidural hematoma. The oculomotor nerve

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In the early experience of Drake, the third cranial nerve palsy was first obtained using the subtemporal approach. Matoma. Palsy resolved completely after an urgent evacuation of the hematoma.

The advantage of pterional over subtemporal procedures includes a better bilateral view of major blood vessels and perforating vessels because of the more anterior approach and less temporal retraction, and because it is an extension of the approach used to treat more common anterior circulation aneurysms. This approach was used exclusively for the six patients who harbored two aneurysms.

In our series, oculomotor complications occurred more frequently in younger patients and in those with SAH. The narrow surgical field under these conditions may cause greater surgical manipulation of the third cranial nerve or the surrounding vasculature. Aneurysm size is known to be one factor that affects surgical morbidity, including oculomotor nerve palsy. Horikoshi, et al., noted that oculomotor dysfunction when using the transfacial–transcervical approach to a BA aneurysm. On the other hand, sixth cranial nerve palsy occurred frequently when using this approach.

In our series, oculomotor complications occurred more frequently in younger patients and in those with SAH. The narrow surgical field under these conditions may cause greater surgical manipulation of the third cranial nerve or the surrounding vasculature. Aneurysm size is known to be one factor that affects surgical morbidity, including oculomotor nerve palsy. Horikoshi, et al., noted that oculomotor dysfunction occurs more frequently in large distal BA aneurysms. Thirty-five patients (35%) harbored aneurysms larger than 10 mm. Of these 35 patients, 18 (51.4%) experienced oculomotor dysfunctions. In contrast, oculomotor dysfunction developed in only 18 patients (27.6%) with aneurysms smaller than 10 mm. This dysfunction could be

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**TABLE 2**

Characteristics of patients by occurrence of oculomotor nerve palsy

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ONP—No. of Patients (%)</th>
<th>p Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>overall</td>
<td>486 (66)</td>
<td></td>
</tr>
<tr>
<td>age of patient ≤60</td>
<td>34 (24.2)</td>
<td></td>
</tr>
<tr>
<td>&gt;60</td>
<td>14 (31.9)</td>
<td></td>
</tr>
<tr>
<td>Hunt &amp; Hess grade</td>
<td>2 (0.0)</td>
<td></td>
</tr>
<tr>
<td>BA apex</td>
<td>3 (0.0)</td>
<td></td>
</tr>
<tr>
<td>SCA</td>
<td>4 (1.6)</td>
<td></td>
</tr>
<tr>
<td>P1 (0 or I)</td>
<td>13 (52.0)</td>
<td></td>
</tr>
<tr>
<td>≥15 mm occlusion</td>
<td>2 (0.8)</td>
<td></td>
</tr>
<tr>
<td>proximal</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>complete</td>
<td>2 (0.8)</td>
<td></td>
</tr>
<tr>
<td>projection</td>
<td>2 (0.8)</td>
<td></td>
</tr>
<tr>
<td>size of aneurysm‡&gt;15 mm</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>location of aneurysm‡</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>proximal</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>complete</td>
<td>1 (1.2)</td>
<td></td>
</tr>
<tr>
<td>projection</td>
<td>1 (1.2)</td>
<td></td>
</tr>
</tbody>
</table>

* ONP = oculomotor nerve palsy.
† Fisher exact test used to compare no oculomotor nerve palsy and partial/complete oculomotor nerve palsy.
‡ Includes data from both aneurysms for the six patients who harbored two aneurysms.

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**TABLE 3**

Scoring table for prediction of oculomotor nerve palsy for patients with BA apex aneurysms

<table>
<thead>
<tr>
<th>Variable</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunt &amp; Hess grade 0 or I</td>
<td>0</td>
</tr>
<tr>
<td>II, III, or IV</td>
<td>1</td>
</tr>
<tr>
<td>age (yrs) ≤60</td>
<td>4</td>
</tr>
<tr>
<td>&gt;60</td>
<td>0</td>
</tr>
<tr>
<td>GOS score excellent or good</td>
<td>0</td>
</tr>
<tr>
<td>fair, poor, or dead</td>
<td>5</td>
</tr>
<tr>
<td>artery occlusion none</td>
<td>0</td>
</tr>
<tr>
<td>total or partial</td>
<td>3</td>
</tr>
</tbody>
</table>
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attributed to increased manipulation, increased use of temporary clips, or an increased incidence of vascular perforator injuries.

In our series, oculomotor dysfunction did not correlate with aneurysm size; this could be attributed to the small sample size of aneurysms larger than 15 mm (these 25 aneurysms represented only 14.8% of the distal BA aneurysms in our series). Statistical significance is strongly influenced by sample size and may thus confound interpretation. We found that more than two thirds of patients with aneurysms larger than 15 mm experienced oculomotor dysfunction.

Aneurysms located at the apex of the BA and projecting posteriorly were frequently associated with oculomotor nerve palsy. This may be attributed to the greater surgical manipulation that is required at a deeper location involved in dissection of a perforating artery away from the aneurysm neck and toward the interpeduncular fossa. Similarly, oculomotor dysfunction occurred more frequently in patients with aneurysms that required the use of temporary or total arterial occlusion. Because temporary placement of a clip might physically limit the already confined space in the posterior fossa, an increase in mechanical trauma to the third nerve may occur. In addition, total occlusion may cause the nerve to be more vulnerable to trauma.

Oculomotor dysfunction in surgically treated patients may be caused by either mechanical trauma or vascular injury to perforating arteries. Therefore, oculomotor nerve palsy alone cannot predict outcome in these patients. On the other hand, oculomotor dysfunction in patients who have undergone endovascular treatment is associated with an ominous prognosis. All of these palsies have occurred as a result of an injury to a perforating artery. Raymond, et al., described a patient with diplopia as a consequence of brainstem infarction after endovascular surgery with detachable coils.

It seems that most oculomotor neurapraxia that has occurred secondary to mild or moderate mechanical trauma resolves completely in 2 to 6 months. On the other hand, oculomotor axonotmesis that occurs secondary to ischemia or severe trauma to the nerve fascicle will take a longer time to resolve and may not resolve completely to normal function. Aberrant regeneration has been reported, and it leads to an ipsilateral defect in abduction. Oculomotor nerve functions may improve as a result of regeneration; however, a quantitative change in the transverse area and the number of axons in the oculomotor nerve has been correlated with a partial return of oculomotor nerve function.

Endovascular aneurysm therapy represents an alternative and less invasive modality of treatment, with a much less natural history of oculomotor nerve palsy in patients with excellent or good GOS scores

<table>
<thead>
<tr>
<th>Oculomotor Nerve Palsy (%)*</th>
<th>Initially</th>
<th>Postop</th>
<th>Postop</th>
<th>p Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Patients w/ Oculomotor Nerve Palsy (%)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOS score excellent or good overall</td>
<td>59</td>
<td>28 (47.5)</td>
<td>12 (20.3)</td>
<td>—</td>
</tr>
<tr>
<td>Hunt &amp; Hess grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 or I</td>
<td>20</td>
<td>8 (40.0)</td>
<td>6 (30.0)</td>
<td>0.305</td>
</tr>
<tr>
<td>II, III, or IV</td>
<td>39</td>
<td>20 (51.3)</td>
<td>6 (15.4)</td>
<td></td>
</tr>
<tr>
<td>location of aneurysm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA</td>
<td>47</td>
<td>22 (46.8)</td>
<td>10 (21.3)</td>
<td>0.715</td>
</tr>
<tr>
<td>P1 or SCA</td>
<td>14</td>
<td>6 (42.9)</td>
<td>2 (14.3)</td>
<td></td>
</tr>
<tr>
<td>size of aneurysm (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤15</td>
<td>55</td>
<td>24 (43.6)</td>
<td>9 (16.4)</td>
<td>0.084</td>
</tr>
<tr>
<td>&gt;15</td>
<td>6</td>
<td>4 (66.7)</td>
<td>3 (50.0)</td>
<td></td>
</tr>
<tr>
<td>projection (BA lesion only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>forward</td>
<td>15</td>
<td>5 (33.3)</td>
<td>0 (0.0)</td>
<td>0.019</td>
</tr>
<tr>
<td>backward</td>
<td>15</td>
<td>5 (33.3)</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>artery occlusion none</td>
<td>4</td>
<td>1 (25.0)</td>
<td>0 (0.0)</td>
<td>0.573</td>
</tr>
<tr>
<td>proximal complete</td>
<td>33</td>
<td>14 (42.4)</td>
<td>6 (18.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>13 (59.1)</td>
<td>6 (27.3)</td>
<td></td>
</tr>
</tbody>
</table>

* Percentage was obtained by dividing the number of patients with oculomotor nerve palsy at that time point by the number of patients with immediately postoperative palsy.
† Probability value determined using the Fisher exact test at 6 months postoperatively.
‡ Includes data from both aneurysms for the six patients harboring two aneurysms.
frequent incidence of oculomotor nerve palsy. It should be definitely considered in patients with poor grades, whereas surgery to clip the aneurysm will establish a lifelong cure in patients with good grades. In our series, a good outcome was achieved in 82% of all cases, in 87.5% of aneurysms 15 mm in diameter or smaller, and in 88.6% of asymptomatic patients. Oculomotor morbidity developed in 52% of patients and resolved within 9 months in 86% of patients. Thus, the combined minor-major morbidity rate from surgical clip placement ranges from 10 to 18%. We thus continue to recommend aneurysm clipping for patients with good grades.

Conclusions

Clinical factors that are closely associated with postoperative oculomotor nerve palsy are a poor clinical grade, younger patient age, backward orientation of a BA tip aneurysm, and the use of temporary or total occlusion. A statistical model is thus created to predict oculomotor outcome in distal BA apex aneurysms. Furthermore, factors that interfere with the full recovery of oculomotor nerves have been identified.

These data can be used in preoperative discussion and planning. Although oculomotor nerve palsy will not change the outcome in a patient with an unfavorable outcome, an isolated oculomotor nerve palsy in a patient with an excellent outcome may interfere with some of the patient’s daily activity. Patients are considered “functionally blind” in that eye until the oculomotor dysfunction resolves completely. In patients who are expected to have excellent outcomes, preoperative counseling and an understanding of the natural history of oculomotor nerve palsy may alleviate some of the stress and anxiety that develops postoperatively.

References


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