Aneurysms arising from the proximal (A₁) segment of the anterior cerebral artery

A study of 38 cases

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This study reviews aneurysms of the proximal segment (A₁) of the anterior cerebral artery in 38 patients (23 men and 15 women) and their surgical, angiographic, and clinical management. Thirty-seven aneurysms were saccular and one was fusiform. The incidence of A₁ aneurysms among a total of 4295 aneurysm cases treated was 0.88%. Multiple aneurysms occurred in 17 patients (44.7%) of the 38 cases; in 10 (58.8%), there was bleeding from the A₁ aneurysm. The aneurysms were classified into five categories according to the mode of origin of the aneurysm in relation to the A₁ segment: in 21 cases, aneurysms originated from the junction of the A₁ segment and a perforating artery; in eight, from the A₁ segment directly; in six, from the proximal end of the A₁ fenestration; and in two, from the junction of the A₁ segment and the cortical branch. One patient had a fusiform aneurysm. Computerized tomography (CT) of these aneurysms revealed bleeding extending to the septum pellucidum similar to that of anterior communicating artery aneurysms. When performing radical surgery it is very important to recognize the characteristics of A₁ aneurysms, including multiplicity, a high incidence of vascular anomalies (especially A₁ fenestration), and their similarity to anterior communicating artery aneurysms on CT.

KEY WORDS • proximal anterior cerebral artery • aneurysm • angiography • vascular anomaly

Aneurysms of the anterior cerebral circulation are usually found on the anterior communicating artery (ACoA) or the peripheral portion (A₂) of the anterior cerebral artery (ACA). They are infrequently found on the proximal segment (A₁) of the ACA. Wakabayashi, et al.,26 and Handa, et al.,4 are among the few describing a series of patients with A₁ aneurysms most other reports have been studies of individual cases. Our experience of treating 38 patients with A₁ aneurysms led us to investigate the clinical, angiographic, and computerized tomography (CT) features of these aneurysms. We report our findings, together with a brief review of the relevant literature.

Clinical Material and Methods

Patient Population

Between April, 1972, and April, 1990, a total of 4295 patients with aneurysms were admitted to one of the three main neurosurgical clinics in the Sendai area. A diagnosis of "A₁ aneurysm" was made on the basis of angiographic or surgical findings in 38 patients. These patients, who represented 0.88% of all aneurysm cases, are the subject of the present study; the 15 women and 23 men ranged in age from 31 to 66 years (mean 51.1 years). The interval between the last subarachnoid hemorrhage and surgery was less than 48 hours in 11 cases (acute-stage operation), between 2 and 14 days in six, and more than 2 weeks in 20. Surgery was also carried out in one patient with an unruptured aneurysm.

Clinical Evaluation

The Hunt and Kosnik7 classification was used for evaluating the patients' preoperative condition. The presence of vasospasm, chronic pulmonary disorders, arteriosclerosis, diabetes, or hypertension was not considered in the classification. Angiographic studies were
made to determine multiplicity and the mode of origin of the aneurysms, the presence of associated vascular anomalies, and the caliber of the left and right A1 portions. In the 20 patients who underwent CT within 48 hours of rupture of the A1 aneurysm, the scans were studied for the presence of intracerebral hemorrhage, intraventricular hemorrhage, and high-density areas.

Surgical Approach
A pterional or unilateral subfrontal approach was chosen for proximal portion aneurysms, whereas an interhemispheric approach following bifrontal craniotomy was employed for distal portion aneurysms. The fusiform aneurysm was trapped and the others were clipped.

Postoperative Classification
The operative results and the patient’s condition were evaluated at the time of discharge from the hospital by the following five-stage classification system: 1) excellent, if the patient was able to return to normal life; 2) good, if mild neurological symptoms remained, but social life was possible; 3) fair, if social life was not possible, but domestic life did not require assistance; 4) poor, if assistance was needed in every phase including domestic life; and 5) dead.

Results
Angiographic and Surgical Findings
Thirty-eight aneurysms were found on the A1 segment of the ACA, 20 (52.6%) on the left and 18 (47.4%) on the right. Of the 38 A1 aneurysms, 25 (65.8%) were found on the proximal portion and 13 (34.2%) on the distal portion. The aneurysm was fusiform in one patient and saccular in the others (Fig. 1). Associated vascular anomalies were found in eight patients (21.0%) and included two cases of azygous ACA, two of ACoA fenestration, and six of A1 fenestration (including one patient with both azygous ACA and A1 fenestration and one patient with bilateral A1 fenestration and ACoA fenestration). A study of the relationship between the site of origin of the aneurysm and the surrounding vessels showed that a majority (21 cases, or 55.6%) were at the point of origin of a perforating artery on the A1 segment. The next most common site was the A1 segment itself (eight cases, or 21.0%), followed by the proximal portion of the A1 fenestration (six cases, or 15.8%), the origin of a cortical branch of the A1 (two cases, or 5.3%), and one case (2.6%) in which the A1 segment itself had become a fusiform-type aneurysm. Multiple aneurysms were seen in 17 patients (44.7%); in 10 (58.8%), the A1 aneurysm had ruptured. The multiple aneurysms accompanying the A1 aneurysms arose from the middle cerebral artery in 10 instances, the internal carotid artery in nine, the ACoA and A1 segment in four, and the verteobasilar artery in two. Contralateral A1 hypoplasia was seen in 10 patients (25.6%).

Preoperative Computerized Tomography
Preoperative CT scans were obtained in 19 patients. Five patients (26.3%) were found to have intracerebral hematoma in the frontal base, five (26.3%) had intraventricular hemorrhage (four of whom also had intracerebral hematoma), and seven (36.8%) had a high-density area at the septum pellucidum. Distinct bleeding on the side of the aneurysm was seen in the basal cistern and Sylvian fissure in six patients (31.6%).

Operative Results
The preoperative condition of the patients was Grade 0 in one case, Grade 1 in seven, Grade 1a in seven, Grade II in 14, Grade III in eight, and Grade IV in one. The outcome assessed at discharge from the hospital was excellent in 28 cases, good in six, and fair in one; three patients died (Table 1). The cause of death was vasospasm in two patients and inadequate clipping of a basilar top aneurysm in one patient with multiplicity.

Discussion
Clinical Features
With the exception of Handa, et al., reports in the literature indicate a very low incidence (1% to 2%) of A1 aneurysms. In our series, as in those of Locksley and Hacker, et al., there were more male than female patients. Other studies of A1 aneurysms, however, have found a predominance of women. Most A1 aneurysms reported in the literature were
Aneurysms of the A1 segment

TABLE 1
Operative results in 38 cases of aneurysms of the A1 segment of the anterior cerebral artery

<table>
<thead>
<tr>
<th>Preop Grade*</th>
<th>Operative Result†</th>
<th>Total Cases</th>
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<tr>
<td></td>
<td>Excellent</td>
<td>Good</td>
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<td>0</td>
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<td>V</td>
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<td>0</td>
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<tr>
<td>total cases</td>
<td>28</td>
<td>6</td>
</tr>
</tbody>
</table>

* Grading according to the classification of Hunt and Kosnik.† For definition, see text.

located on the right side,4,12,26 but we did not find any laterality.

Multiple Aneurysms

Multiple aneurysms occur in approximately one-fifth of aneurysm cases, comprising 18% in the series of Hacker, et al.,2 and 22% in the autopsy study of Locksley.12 However, multiple aneurysms are found more frequently in patients with A1 aneurysms. In two reports, multiple aneurysms occurred in 25.0% and 44.4% of such cases6,26 and, in our study, the incidence was 44.7%. This high occurrence of multiple aneurysms is thought to be a characteristic feature of aneurysms of the A1 segment. When performing radical surgery on multiple aneurysms, it is essential to have determined which aneurysm has ruptured. However, there have been many cases in which the site of the rupture remained uncertain even after CT and angiographic studies were obtained. It has been reported15,19,28 that, in cases of multiple aneurysms where an ACoA aneurysm is present, there is a high probability of rupture of that aneurysm. In the present series, we also found a high incidence (58.8%) of rupture of the A1 aneurysm among our multiple aneurysm cases. This finding suggests that, in multiple aneurysms cases, attention should be paid to the possibility of rupture not only of an ACoA aneurysm but also of an A1 aneurysm.

Site and Size of Aneurysms

In 37 patients in our study, the aneurysms were saccular; in one patient, the aneurysm was fusiform. In only a few instances have fusiform A1 aneurysms been reported.16,22,31 The most frequent site of the aneurysm in this series was at the origin of a perforating artery (55.6%). Wakahayashi, et al.,26 and Handa, et al.,4 found aneurysms at this site in 77.8% and 50% of cases, respectively, suggesting that a majority of A1 aneurysms arise at the origin of a perforating artery. The A1 segment gives rise to several perforating arteries that supply the anterior hypothalamus, the septum pellucidiun, the medial portion of the anterior commissure, and a part of the fornix and the striatum. In some cases, there is a common trunk that originates from the A1 segment and runs a recurrent course for several millimeters before dividing into several small perforating arteries. Heubner’s artery or a cortical branch seldom shares a common trunk with small perforating arteries.32 However, no aneurysms were found arising at the origin of this type of common trunk. Other reported sites include the bifurcation of cortical branches and on the A1 segment itself.

Associated Anomalies

Of particular interest in previous reports has been the finding of a relatively large number of associated vascular anomalies as well as location of the A1 aneurysm on those anomalous vessels. A total of 24 cases of A1 aneurysms with associated vascular anomalies were found in our series of patients and in those reported by others (Table 2).4,13,15,17,24,26,29,30 Fenestration of the A1 segment was the most common malformation (66.7%). As a result of such anomalies, the hemodynamics are quite abnormal and emergence of the aneurysm is likely due to vascular stress.2,5 According to Crompton,1 A1 fenestration has a defect in the media at the proximal end, and it can be presumed that the incidence of aneurysm development and growth is increased due to the further involvement of hemodynamic factors.

In our series, vascular anomalies were found in 20.5% of the 38 A1 aneurysm cases; 75.0% of these were A1 fenestrations. It is difficult to recognize a fenestration of cerebral arteries prior to surgery, even with precise angiographic analysis.18 so the increased incidence of fenestration associated with A1 aneurysms requires more careful surgical observation to avoid vascular damage. Although contralateral A1 hypoplasia might be considered another hemodynamic stress encouraging growth of an A1 aneurysm, this relationship was not obvious in our series (25.6%).

Artrovenous shunting or an increase in the blood supply to a cerebral tumor could lead to an increase in hemodynamic stress.25 It is of particular interest that Jakubowski and Kendall22 reported that, among 188
patients with tumor of the pituitary region, 11 had cerebral aneurysms, with A1 aneurysms in two (18%).

Site of Intracerebral Hemorrhage

It is noteworthy that hemorrhage in the vicinity of the septum pellucidum, which has previously been thought to be a characteristic CT finding of ACoA aneurysms,2,3,4,20,21,27 was found in 40.0% of our A1 aneurysm cases. We wish to stress that, when CT reveals a high-density area at the septum pellucidum, it is essential to consider the possibility of an aneurysm not only of the ACoA, but also of the A1 segment of the ACA and to examine the angiograms carefully for the differential diagnosis.

References


M. Suzuki, et al.

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