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# Proximal Anterior Cerebral Artery Aneurysm: Case Presentation and Review of the Literature

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**Purpose:** Aneurysms involving the proximal segment of the anterior cerebral artery (A1) are relatively rare. We report two cases we encountered and review the literature.

**Cases:** Two female patients were referred to our hospital. The first, a 71-year-old woman, was found unconscious and semicomatose at home. Computed tomography (CT) revealed diffuse subarachnoid hemorrhage (SAH) with intraventricular and intracerebral hemorrhage. Cerebral angiography (CAG) showed a saccular aneurysm in the right A1 and unruptured right middle cerebral artery aneurysm. The second patient was a 76-year-old woman in whom an unruptured right A1 aneurysm was found incidentally. During a 3-year observation period, the aneurysm enlarged and changed its shape. Both patients underwent surgical clipping. The first patient showed moderate disability due to SAH insult while the second showed no neurological deficits.

**Conclusions:** A1 aneurysms are rare intracranial aneurysms, but reportedly show strong correlations with vascular anomalies. When planning surgery, use of CAG and other radiological modalities are warranted to precisely assess the origin of the aneurysm neck and any accompanying anomalies. Anatomical speculations must be confirmed intraoperatively while paying attention to perforating arteries from the A1 segment.

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**Keywords:** cerebral artery aneurysm; anterior cerebral artery; proximal aneurysm; ruptured aneurysm; unruptured aneurysm

## Introduction

Aneurysms of the proximal portion of the anterior cerebral artery (A1) are a rare entity, accounting for only 0.8-8.9% of all intracranial aneurysms. These lesions mainly appear in the fourth to fifth decades of life, showing a female predominance and often accompanied by multiple aneurysms and other vascular anomalies[1-12]. Case numbers in reported series range from 5 to 38, reflecting the rarity of this pathology. We encountered two cases of A1 aneurysm and report our findings herein, along with a review of the literature.

## Case Presentation

### Case 1

A 72-year-old woman was found unconscious at home and brought to our hospital. Glasgow coma scale (GCS) on arrival was E1V1M3 with a decorticate posture (Hunt and Kosnik G5). Head computed tomography (CT) revealed Fisher group 3 diffuse subarachnoid hemorrhage (SAH) with intraventricular (third ventricle and both lateral ventricles) hemorrhage and intracerebral hemorrhage at the base of the rectal gyrus (Fig. 1A). Emergency right cerebral angiography (CAG) showed a saccular aneurysm at the right A1, just distal to the early branching of the fronto-orbital artery. The patient also harbored right middle cere-

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bral artery (MCA). (Fig. 1B and C). Considering the pattern of hemorrhage, rupture of the A1 aneurysm was suspected.

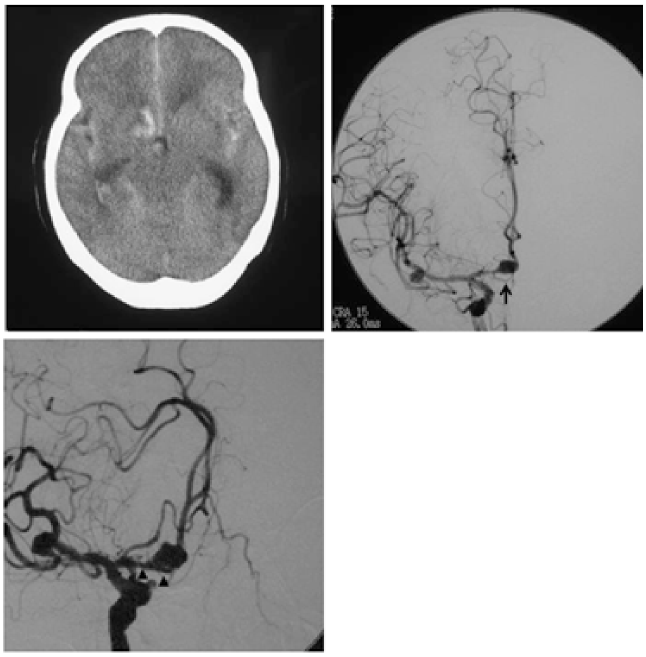

**Figure 1.** Head computed tomography (CT) on admission revealing subarachnoid hemorrhage (SAH) (A). Initial right cerebral angiography (CAG) from anterior-posterior view reveals saccular aneurysms at the right A1 artery, and the right middle cerebral artery. Arrow indicates right fronto-orbital artery branching from middle of the A1 artery, just proximal to the aneurysm neck (B). Magnified CAG from the right oblique angle shows aneurysm neck (arrowheads) (C).

### Surgery

Neck clipping of both aneurysms was performed via right decompressive pterional craniectomy. The A1 aneurysm had a broad neck and was located just distal to the bifurcation of the front-orbital artery (Fig. 2A). The aneurysm dome was embedded into the frontal cortex. The distal A1 and proximal A2 tightly adhered to the aneurysm dome. Several perforating arteries were seen arising from the back of the aneurysm neck. A straight clip was applied along the A1 axis, in an attempt to preserve the parent artery, fronto-orbital artery and perforating arteries (Fig. 2B). The MCA aneurysm was also successfully clipped. Postoperative CT revealed cerebral infarction at the right putamen and anterior limb of the right internal capsule, but no associations with any neurological deficits (Fig. 2C). Postoperative CAG showed aneurysm clipping without narrowing of the A1 (Fig. 2D). Cranioplasty and right ventriculo-peritoneal shunt followed. The final result for this patient was moderate disability due to cognitive impairment.

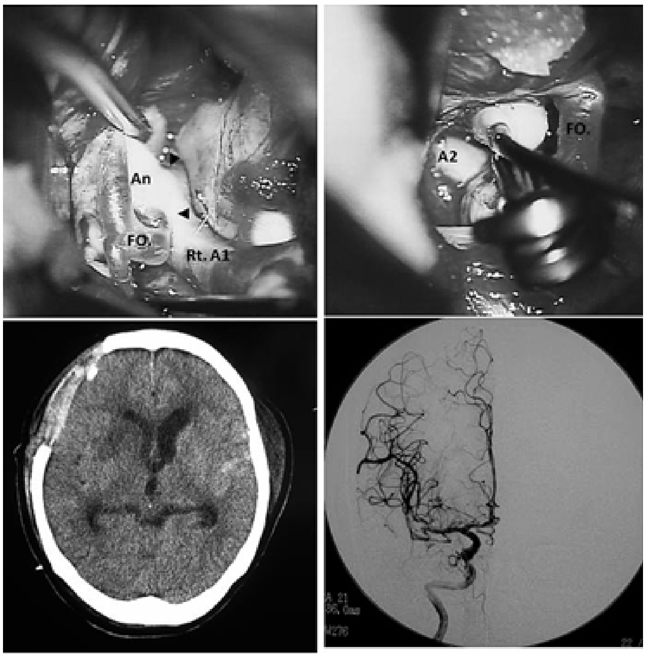


**Figure 2.** Intraoperative photograph reveals proximal aneurysm neck (arrowheads) begins just distal to the fronto-orbital artery (FO.) bifurcation (A). Neck clipping preserved the right A1 and cortical artery (B).

Postoperative CT reveals cerebral infarction at the right caudate head and putamen (C). Postoperative CAG shows complete clipping and preservation of the right A1 artery and right fronto-orbital artery (D).

## Case 2

A 76-year-old woman was originally diagnosed with asymptomatic cerebral infarction (Fig. 3A). An unruptured right A1 aneurysm was incidentally found on magnetic resonance angiography (Fig. 3B). During 3 years of follow-up, the aneurysm increased in diameter from 2 mm to 5 mm and showed an irregular change in shape (Fig. 3C). CAG showed that this aneurysm was located just distal to the bifurcation of the right internal carotid artery (ICA) and was accompanied by a bleb at the top of the aneurysm (Fig. 3D).

### Surgery

The aneurysm protruded posteriorly from the right A1 and was embedded into the frontal lobe, surrounded by a perforating artery (Fig. 4A). A fenestrated clip was applied along the A1 axis (Fig. 4B). Postoperative CT revealed no additional cerebral infarction beyond the original infarction (Fig. 4C). Postoperative CAG revealed complete clipping without right A1 stenosis (Fig. 4D), and the patient was discharged without any neurological deficits.

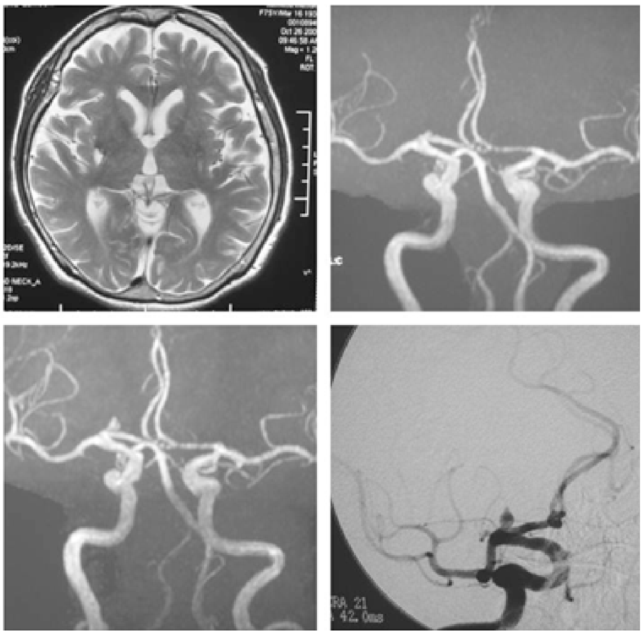

**Figure 3.** Magnetic resonance imaging incidentally revealing asymptomatic small infarction in the right putamen (A). Magnetic resonance angiography (MRA) shows a small unruptured aneurysm at the proximal portion of the right A1 artery (B). Serial MRA reveals enlargement of the aneurysm over the course of 3 years (C). CAG shows a saccular aneurysm with bleb at the proximal right A1 artery (D).

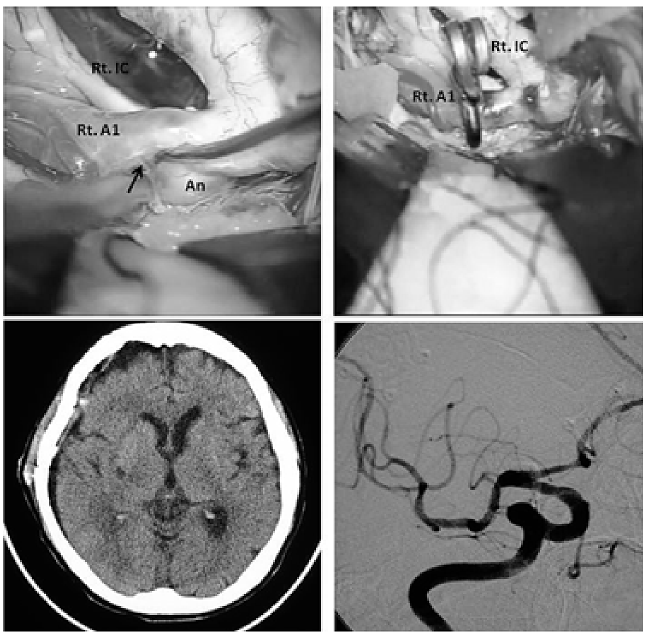


**Figure 4.** Intraoperative photograph reveals the aneurysm embedded into the frontal cortex and a perforating artery arising from the distal neck of the aneurysm (A). Arrow indicates a perforating artery branching from just distal to the aneurysm neck. A fenestrated clip was applied (B). Postoperative CT shows no cerebral infarction besides the original infarction (C). Postoperative CAG shows complete clipping without right A1 artery stenosis (D). Rt. IC: right internal carotid artery

## Discussion

Table 1 summarizes reported series of A1 aneurysms with details about clinical features[1-12]. The mean incidence of A1 aneurysm was 1%. Mean age at presentation was 52 years and a female predominance was evident (59%) without any predilection for side. The most common clinical symptom was SAH, occurring in about 83% of cases. Rupture of the A1 aneurysm was seen in about 72% of SAH cases.

A1 aneurysm is accompanied by other vascular malformations (33%), such as A1 fenestration, A1 agenesis, hypoplasty, or tortuous changes, anomalous cortical branch, and azygos anterior cerebral artery[4-6,8,10,11]. Such anomalies are sometimes identified during surgery[8]. In the first case, early branching of fronto-orbital artery at the middle of A1 was identified and we found one case having the same anomaly[5]. On the other hand, we did not detect apparent vascular malformation in the second case. But this patient' arteries showed atherosclerotic changes.

The A1 aneurysm is also associated with a high rate of other aneurysms (11-73%, mean 40%)[2,4,6,10]. Common sites seem to be the MCA and ICA[7,8,10]. The first case harbored unruptured MCA aneurysm. These anomalous features and hemodynamic stress induced by curvature of the A1 trunk may accelerate A1 aneurysm formation[7,11].

The rupture of A1 aneurysms may be considered as an anterior communicationg artery aneurysm if they locate near the distal portion of A1. In the first case, we initially thought that an anterior communicating artery aneurysm had ruptured considering the hemorrhagic pattern[8,11]. However, CAG revealed the precise location of the rupture. Conversely, we could not identify the precise location of the unruptured aneurysm of the second case until expansion occurred and CAG was finally performed. Like this, some proximal A1 aneurysm locating at just distal to the IC top may be considered as the IC top aneurysm. In this occasion, further radiological evaluation reveals precise location and of course, surgical intervention unveils too.

A1 aneurysms are relatively small (<5 mm) and accompanied by blebs[2,10]. Dashti and Wakabayashi pointed out that A1 aneurysm has a higher risk of rupture and so should be treated as soon as possible once found[2,10]. Actually, the unruptured case we encountered displayed obvious growth. Our strategy for the unruptured case was suitable in consideration of its nature.

During surgery, care must be taken in terms of preserving the perforating arteries. Even though no concordance is seen regarding where the A1 aneurysm arises (proximal,

**Table 1.** Summary of characteristics of reported A1 aneurysm cases

| Series | No. | Incidence (%) | Age | Sex (M) | SAH | ICH | A1 An rupture | Un-rupture | Side (Rt) | Multiple An | anomaly | Good results | Disabled | Death |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yasargil (1984) | 14 | 1.4 | 46 | 2 (14%) | 14 (100%) | 1 | 14 (100%) | 0 | 4 (29%) | 3 (21%) | 1 (7%) | 12 (86%) | 2 (14%) | 0 |
| Handa (1984) | 8 | 4 | 51 | 3 (38%) | 7 (88%) | 0 | 5 (71%) | 3 | 4 (50%) | 2 (25%) | 2 (25%) | 6 (75%) | 2 (25%) | 0 |
| Wakabayashi (1985) | 9 | 2.1 | 48 | 4 (33%) | 8 (89%) | - | - | - | 9 (100%) | 4 (25%) | 2 (22%) | 7 (78%) | 1 (11%) | 1 (11%) |
| Suzuki (1992) | 38 | 0.88 | 51 | 23 (61%) | 37 (97%) | 5 | 30 (81%) | 8 | 18 (47%) | 17 (45%) | 24 (63%) | 28 (74%) | 7 (18%) | 3 (8%) |
| Sako (1997) | 7 | 0.76 | 59 | 2 (29%) | 6 (86%) | 1 | 6 (100%) | 1 | 4 (57%) | 2 (29%) | - | 6 | 0 | 1 |
| Wanibuchi (2001) | 9 | 2.2 | 57 | 3 (33%) | 3 (33%) | 0 | 3 (100%) | 6 | 3 (33%) | 1 (11%) | 3 (33%) | 9 (100%) | 0 | 0 |
| Hino (2002) | 11 | 3.4 | 60 | 5 (45%) | 11 (100%) | 2 | 7 (64%) | 4 | 5 (45%) | 8 (73%) | 1 (9%) | 10 (91%) | 1 (1%) | 0 |
| Czepko (2005) | 17 | 0.8 | 50 | 7 (41%) | 16 (94%) | 5 | 13 (81%) | 4 | 10 (59%) | 5 (29%) | 5 (29%) | 14 (82%) | 0 | 3 (18%) |
| Dashti (2007) | 23 | 0.8 | - | - | 12 (52%) | 3 | 12 (100%) | 11 | 14 (61%) | 16 (70%) | - | - | - | - |
| Tanaka (2010) | 5 | 8.9 | 58 | 3 (60%) | 1 (20%) | 0 | 1 (33%) | 4 | 2 (40%) | 2 (40%) | - | 4 (80%) | 1 (10%) | 0 |
| Lee (2010) | 20 | 0.59 | 52 | 4 (20%) | 19 (95%) | - | 18 (90%) | 2 | 10 (50%) | 4 (20%) | 3 (15%) | 17 (85%) | 2 (10%) | 1 (5%) |
| total | 161 | 1.00 | 45/ 52* | 56 (35/ 41%*) | 134 (83%) | 17 | 109 (68/ 72%*) | 43 | 83 (52%) | 64 (40%) | 41 (25/ 33%*) | 93 (58/ 67%*) | 16 (10/ 12%*) | 9 (6/ 7%*) |

M; male, SAH; subarachnoid hemorrhage, ICH; intracerebral hemorrhage, An; aneurysm, Rt; right, *result from number excluding blanked area

middle, or distal), many reports have pointed out that A1 aneurysms occur at perforating artery bifurcations[4,7,8,10-12]. The most important perforating arteries arise from the proximal portion, and then supply the septum pellucidum, medial part of the anterior commisure and pellucidum, pillars of the fornix, paraolfactory area, anterior limb of the internal capsule, anteroinferior part of the striatum, and anterior hypothalamus[6]. So injury and obstruction of the arteries can cause severe complications[2,4-7,11]. In particular, the proximal A1 aneurysm protruding superiorly or posteriorly can hide most of the perforating arteries and sometimes the recurrent artery of Heubner, the anterior choroidal artery or another perforating arteries from top of the ICA and proximal MCA may be affected[4,6]. If these arteries are injured, some extent of aphasia (if dominant site), delirium, hemiparesis or facial and lingual palsy may occur. So much discussion has focused on how to handle hidden perforators during clip application[4-11]. Use of a small-sized clip or adjustment of the clip size during surgery is thus recommended[2,4]. Hino et al. reported using a fenestrated clip for three cases of A1 aneurysm, achieving good results[4]. In the present series, we used a fenestrated clip in the second case because the aneurysm protruded up and backward, achieving successful clipping without causing any neurological deficits. Contrary to this, some perforating arteries were sacrificed and resulted in infarction at the basal ganglia-in the first case. This aneurysm was larger in size and had wider neck. These features physically restricted the exploration of surrounding structures during surgery. Accidental temporary clipping or irritation of perforating arteries also leads to infarction even if these arteries are finally released[9]. Furthermore postoperative brain shift may result in a direct clip impinging on these vessels[6,11]. During surgery, the direction of clip application must be carefully considered to avoid this complication. Wide opening of the Sylvian fissure helps to relax frontal lobe, which leads to get wider view of anatomical features[1,2]. Though we never performed in the present series, adjacent frontal lobe resection is needed to protect perforating arteries and achieve safe clipping in some cases[1,2,4].

Aneurysm clipping has been the first choice of treatment, although some cases of coil embolization have been reported[6,9]. If the aneurysm neck is too broad or too small for embolization, clipping may be considered. On the other hand, when considering perforating arteries, another aneurysms or brain shift after surgery, coil embolization may become the first choice. When managing intracerebral hematoma, surgical clipping is warranted. Choice of therapy should be thus fully discussed.

## Conclusions

Aneurysm arising from the horizontal part of the anterior cerebral artery often involves vascular anomalies. When facing this rare type of aneurysm, the anatomy of the aneurysm and nearby brain structures should be considered, and the pattern of bifurcation in surrounding arteries should be determined before treatment. During surgery, we have to confirm these findings and choose appropriate procedures to preserve perforating arteries.

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