[Case Report]

Surgical Treatment for a Ruptured True Posterior Communicating Artery Aneurysm Arising on the Fetal-Type Posterior Communicating Artery – Two Case Reports and Review of the Literature –

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Abstract : Only a small number of aneurysms arising on the posterior communicating artery itself (true Pcom aneurysm) have been reported. We report two cases of ruptured true Pcom aneurysms with some characteristic features of true Pcom aneurysm. A 43 year old man suffering from subarachnoid hemorrhage (SAH) had an aneurysm arising on the fetal-type Pcom artery itself, and underwent surgery for clipping. Most of the aneurysm was buried in the temporal lobe, so retraction of the temporal lobe was mandatory. During the retraction, premature rupture was encountered. After tentative dome clipping and the control of bleeding, complete clipping was achieved. Another patient, a 71 year old woman presenting with consciousness disturbance due to SAH, had an aneurysm on the fetal-type Pcom artery itself, and underwent surgery for clipping. It has been generally considered that hemodynamic factor plays an important role in the formation, the growth, and the rupture of the cerebral aneurysm. This factor is especially significant in true Pcom aneurysm formation and rupture. According to the literature, a combination of fetal type Pcom and formation of the true Pcom aneurysm has been reported in most cases (81.8%). Most of the aneurysm can be buried in the temporal lobe, and the retraction of the temporal lobe during the dissection of the neck would be necessary, which causes premature rupture of the true Pcom aneurysm. In the surgery for a true Pcom aneurysm, we should be aware of possible premature rupture when temporal lobe retraction is necessary.

Key words : fetal-type posterior communicating artery, hemodynamic stress, subarachnoid hemorrhage, surgical strategy, true posterior communicating artery aneurysm.

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Introduction

Posterior communicating artery (Pcom) is commonly a pair of blood vessels in the circle of Willis. Pcom connects the cerebral arteries. In anterior circulation, it connects to the internal carotid artery (ICA) prior the terminal bifurcation of the ICA into the anterior cerebral artery (ACA) and middle cerebral artery (MCA). In posterior circulation, it connects to the posterior cerebral artery (PCA). Most Pcom aneurysms occur at the divergence of the ICA and Pcom. An aneurysm arising on the Pcom itself is known as a "true" Pcom aneurysm. The definition of the true Pcom aneurysm is an aneurysm that is located at some distance away from the junction of the ICA. A true Pcom aneurysm has rarely been encountered. According to the literature, the reported incidence ranges from 0.1 to 2.8% of all cerebral aneurysms [1].

We report two patients having a ruptured true Pcom aneurysm, who were successfully surgically treated. We discuss the mechanisms of the formation and growth of true Pcom aneurysm and surgical treatment for such a lesion based on a review of the literature.

Case

Case 1

A 43 year old man presented with sudden onset of severe headache after taking a shower. As the severe headache did not subside, the patient visited our hospital on the next day. The patient was hypertensive, but not treated. On admission, the patient was awake and alert, and no neurological deficits were noticed except for neck stiffness.

Computed tomographic scan (CT) on admission showed a Fisher Group 3 subarachnoid hemorrhage (SAH) (Fig. 1). The neurological grade of the patient was classified as Hunt & Kosnik Grade 2, and World Federation of Neurological Societies Grade I. Cerebral angiograms revealed a saccular aneurysm arising on the fetal type left Pcom itself, distant from the junction of the left ICA (Fig. 2 A, B). A right carotid angiogram showed the fetal type right Pcom and hypoplastic right ACA. A left three-dimensional CT angiogram (3D-CT) also clearly revealed the aneurysm on the fetal type left Pcom and the bleb on aneurysm (Fig. 2 C).

The patient underwent surgery for clipping of the ruptured true Pcom aneurysm via left pterional approach on the admission day. After wide-opening of the sylvian fissure,

Fig. 1. Computed tomography (CT) of case 1 on admission showing subarachnoid hemorrhage (SAH) in the left sylvian fissure.

Fig. 2. Left carotid angiogram and 3D-CT angiogram on admission showing an aneurysm on the fetal type left posterior communicating artery (Pcom), distant from the junction of the left internal carotid artery (ICA), and the bleb on the aneurysm dome. Aneurysm size is $2.4 \times 3.5 \times 3.5$ mm. AchA: anterior choroidal artery, AN: aneurysm, PcomA: posterior communicating artery.

the left ICA and Pcom were exposed (Fig. 3 A). An aneurysm arising on the distinct fetal Pcom was identified at approximately 2-3 mm apart from the junction of the left ICA. As most of the aneurysm was buried in the temporal lobe, retraction of the left temporal lobe was necessary for the dissection of the neck. During the retraction of the temporal lobe, premature rupture was encountered (Fig. 3 A). To control the bleeding, a temporary clip was applied to the proximal portion of the fetal type Pcom. Because of fetal type Pcom and backflow, sufficient control of the bleeding from the premature-ruptured aneurysm was not obtained. As the next step, a tentative clip was applied on the dome of the aneurysm. Then, bleeding from the aneurysm was well controlled. Under these conditions, the neck of the aneurysm was meticulously dissected and complete clipping was achieved (Fig. 3 B). The Pcom and perforators were preserved (Fig. 3 B).

Fig. 3. Pictures during surgery. AN: aneurysm, ICA: internal carotid artery, ON: optic nerve, PcomA: posterior communicating artery.

Post-operative CT showed no abnormal low density areas in the perforator-territories. Post-operative cerebral angiogram showed complete obliteration of the true Pcom aneurysm. The post-operative condition of the patient was uneventful, and he was discharged without any neurological deficits three weeks after the surgery.

Case 2

A 71 year old woman presented with consciousness disturbance at mealtime, so the patient was transferred to our hospital for treatment on the same day. The patient had chronic headache and an old cerebral infarction at the bilateral frontal lobes. On admission, the patient showed consciousness disturbance (JCS10, GCS: E3V4M5) and poor spontaneous movements of the limbs.

CT on admission showed Fisher Group 3 SAH (Fig. 4), and an old cerebral infarction in the bilateral frontal lobe with ACA calcification. The neurological grade of the patient was classified as Hunt & Kosnik Grade 3, and World Federation of Neurological Societies Grade IV. Cerebral angiograms revealed a vascular dilatation arising on the fetal type right Pcom and showed diffuse vasospasm. Therefore, the patient was treated, at first, with antihypertensive and sedative drugs. On the 14th day after SAH, the second cerebral angiograms revealed a significant saccular aneurysm arising on the fetal type right Pcom itself (Fig. 5). The patient underwent surgery for clipping of the ruptured true Pcom aneurysm via the right pterional approach. Most of the aneurysm was in the temporal lobe, and the right temporal lobe was retracted. During the procedure, a premature rupture was encountered. Under point-suction, the bleeding was controlled and com-

Fig. 4. CT of case 2 on admission showing subarachnoid hemorrhage (SAH) and old cerebral infarction in bilateral frontal lobe and anterior cerebral artery (ACA) calcification.

plete clipping was achieved. Post-operative CT showed no abnormal low density areas in the perforator-territories. The patient's consciousness disturbance was improving after the surgery, except for mild gait disturbance due to being bedridden for a long time, and she was transferred to the rehabilitation hospital.

Fig. 5. The second right carotid angiogram on the 14th day after subarachnoid hemorrhage (SAH) showing an aneurysm on the fetal type right Pcom, distant from the junction of the right internal carotid artery. AN: aneurysm.

Discussion

A ruptured true Pcom aneurysm is rarely encountered. According to the literature, the incidence is 0.1–2.8% of all cerebral aneurysms [1]. Reported cases are listed in Table 1 [2–33].

It has been generally considered that hemodynamic factor plays a significant role in the formation, the growth, and the rupture of cerebral aneurysm. It can be speculated that the same situation as hemodynamic stress significantly influences the true Pcom aneurysm formation, growth, and rupture. The Pcom is classified into three types: normal, hypoplastic and fetal type, by the diameter of the vessel. Fetal type Pcom is approximately 20% of frequency, and an embryonic derivation of the PCA from the ICA [34]. A fetal type Pcom is thick, and bloodstream is abundant from the ICA. Especially, the existence of fetal type Pcom is important in the mechanisms of the formation and rupture of the true Pcom aneurysm. In the literature, a combination of fetal type Pcom and formation/rupture of the true Pcom aneurysm was reported in most cases (81.8%) (Table 1). In the present cases, the Pcom of the opposite side was also fetal type. Careful follow-up to identify the formation of true Pcom aneurysm in the opposite side is necessary.

In consideration of surgery, a true Pcom aneurysm is located more distally compared with aneurysms at the junction of internal carotid/posterior communicating arteries. It is more likely that the whole aneurysm or most of the aneurysm is buried in the temporal lobe. For sufficient and meticulous exposure of the aneurismal neck and safe clipping, retraction of the temporal

Table 1. Summary of reported cases of true Pcom aneurysms

No.	Authors (Year)	Age / Sex	SAH	Type	Pcom fetal type	Operative procedure	Premature rupture	Outcome	References
1	Poppen (1951)	unknown	+	saccular	unknown	trapping	unknown	unknown	2
2	Poppen (1951)	unknown	+	saccular	unknown	trapping	unknown	unknown	2
3	Stuntz <i>et al</i> (1970)	38 / M	+	saccular	-	unknown	unknown	D	3
4	Krayenbühl <i>et al</i> (1972)	unknown	+	saccular	unknown	unknown	unknown	unknown	4
5	Krayenbühl <i>et al</i> (1972)	unknown	+	saccular	unknown	unknown	unknown	unknown	4
6	Krayenbühl <i>et al</i> (1972)	unknown	+	fusiform	unknown	unknown	unknown	unknown	4
7	Krayenbühl <i>et al</i> (1972)	unknown	+	fusiform	unknown	unknown	unknown	unknown	4
8	Krayenbühl <i>et al</i> (1972)	unknown	+	fusiform	unknown	unknown	unknown	unknown	4
9	Krayenbühl <i>et al</i> (1972)	unknown	+	fusiform	unknown	unknown	unknown	unknown	4
10	Krayenbühl <i>et al</i> (1972)	unknown	+	fusiform	unknown	unknown	unknown	unknown	4
11	Sano (1978)	unknown	+	unknown	unknown	unknown	unknown	unknown	5
12	Yoshida <i>et al</i> (1979)	46 / M	+	saccular	-	clipping	-	GR	6
13	Kamiyama <i>et al</i> (1980)	28 / F	+	saccular	-	trapping	-	GR	7
14	Abiko and Orita (1981)	57 / F	+	fusiform	+	trapping	-	MD	8
15	Trasi <i>et al</i> (1981)	26 / F	+	saccular	+	clipping	-	GR	9
16	Tanizaki <i>et al</i> (1982)	69 / F	+	saccular	+	clipping	-	GR	10
17	Yasargil and Smith (1982)	unknown	unknown	unknown	unknown	unknown	unknown	unknown	11
18	Yasargil and Smith (1982)	unknown	unknown	unknown	unknown	unknown	unknown	unknown	11
19	Yasargil and Smith (1982)	unknown	unknown	unknown	unknown	unknown	unknown	unknown	11
20	Yasargil and Smith (1982)	unknown	unknown	unknown	unknown	unknown	unknown	unknown	11
21	Yasargil and Smith (1982)	unknown	unknown	unknown	unknown	unknown	unknown	unknown	11
22	Yasargil and Smith (1982)	unknown	unknown	unknown	unknown	unknown	unknown	unknown	11
23	Miyazawa <i>et al</i> (1983)	68 / M	+	saccular	+	clipping	-	GR	12
24	Masuda <i>et al</i> (1984)	45 / F	+	saccular	+	clipping	-	GR	13
25	Waga <i>et al</i> (1984)	54 / M	+	saccular	+	clipping	-	GR	14
26	Waga <i>et al</i> (1984)	64 / M	+	saccular	+	clipping	-	GR	14
27	Takeda <i>et al</i> (1985)	73 / F	+	saccular	+	clipping	-	D	15
28	Okada <i>et al</i> (1988)	40 / F	+	saccular	+	clipping	-	GR	16
29	Kudo (1990)	57 / M	+	saccular	+	clipping	+	GR	1
30	Akimura <i>et al</i> (1991)	57 / F	+	fusiform	+	trapping	-	MD	17
31	Akimura <i>et al</i> (1991)	45 / F	+	saccular	+	clipping	-	GR	17
32	Takahashi (1992)	27 / F	+	saccular	+	clipping	-	GR	18
33	Takahashi (1992)	23 / M	+	saccular	+	clipping	-	GR	18
34	Hayashi (1993)	51 / M	+	saccular	+	clipping	-	GR	19
35	Kurokawa <i>et al</i> (1993)	45 / M	+	saccular	+	clipping	-	GR	20
36	Kurokawa <i>et al</i> (1993)	82 / F	+	fusiform	+	trapping	-	GR	20
37	Kurokawa <i>et al</i> (1993)	57 / F	+	fusiform	-	trapping	-	MD	20
38	Koga (1994)	65 / F	+	saccular	+	clipping	-	GR	21
39	Ogasawara (1995)	58 / F	+	saccular	+	clipping	-	GR	22
40	Timothy <i>et al</i> (1995)	72 / M	+	fusiform	+	clipping	-	D	23
41	Matsumoto <i>et al</i> (1997)	27 / M	+	fusiform	-	clipping	-	MD	24
42	Kawaguchi <i>et al</i> (1998)	78 / M	-	saccular	+	no surgery	no surgery	NC	25
43	Okuchi <i>et al</i> (2000)	66 / M	+	saccular	+	clipping	-	GR	26
44	Muneda <i>et al</i> (2001)	51 / M	+	saccular	+	clipping	-	GR	27
45	Kaspera <i>et al</i> (2002)	63 / unknown	+	saccular	unknown	clipping	unknown	unknown	28
46	Matsumori <i>et al</i> (2003)	72 / F	+	saccular	-	clipping	-	GR	29
47	Nakazaki <i>et al</i> (2004)	51 / F	+	saccular	+	coiling/clipping	-	GR	30
48	Sorimachi <i>et al</i> (2004)	55 / F	+	saccular	+	clipping	-	MD	31
49	Freitas <i>et al</i> (2005)	69 / M	+	unknown	+	endovascular	-	unknown	32
50	Nakatsuka <i>et al</i> (2007)	32 / F	+	fusiform	+	trapping	+	GR	33
					81.8% (27 / 33)				
						6.5% (2 / 31)			

GR: good recovery, MD: moderately disabled, NC: no change, D: dead

lobe is useful. Moreover, it is also true that premature bleeding by retraction of the temporal lobe might tend to occur. Whenever retraction of the temporal lobe is intended, it should be noted that premature rupture could be encountered. According to the literature, premature rupture was reported in two cases (6.5%) (Table 1). Furthermore, sufficient control of bleeding cannot be obtained only by proximal temporary clip of the fetal type of Pcom because of backflow from the posterior circulation through a distinct fetal Pcom. To control bleeding from a premature rupture, a tentative dome clip is useful. Because of anatomical characteristics, a premature rupture might be caused in surgery for true Pcom aneurysm. It is very important to prepare for premature rupture in true Pcom aneurysmal clipping surgery.

Conclusions

In the formation, growth, and rupture of a true Pcom aneurysm, hemodynamic stress with the existence of fetal type of posterior communicating artery is important. In the clipping surgery for a true Pcom aneurysm, surgeons should always be prepared for the occurrence of premature rupture when temporal lobe retraction is necessary.

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胎児型後交通動脈から生じた真性後交通動脈瘤破裂症例に対する外科的治療

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要 旨：後交通動脈自体から生じる真性脳動脈瘤は少ないことが知られている。特徴を有する真性後交通動脈瘤の破裂を生じた2症例を文献的な考察を加え報告する。43歳男性, 胎児型後交通動脈から生じた真性後交通動脈瘤破裂によるくも膜下出血を生じ, 脳動脈瘤クリッピング術を施行した。手術では, 脳動脈瘤が側頭葉に埋没していたため, 脳動脈瘤を露出させるには脳の牽引が必要であった。脳の牽引を行った際に, 脳動脈瘤の術中破裂を生じたため, 仮のクリッピングを行い, 出血をコントロールし完全な脳動脈瘤クリッピングを行った。71歳女性, 意識障害が出現し, 同様にくも膜下出血を生じ, 脳動脈瘤クリッピング術を施行した。脳動脈瘤の発生, 増大, 破裂には血行力学的な要因が関与すると考えられており, 特に真性後交通動脈瘤の発生には重要な要因となる。文献によると, 真性後交通動脈瘤は胎児型後交通動脈からの発生が81.8%とほとんどであった。つまり, 胎児型後交通動脈による血行力学的な要因が脳動脈瘤の発生に強く関与していると考えられる。また, 解剖学的な位置より脳動脈瘤は側頭葉内に埋没していることが多く, 脳動脈瘤クリッピング術の際には脳の牽引が必要となり, 術中に脳動脈瘤の破裂を生じる危険性が高くなる。真性後交通動脈瘤を手術する際には, 牽引時の術中破裂を特に注意し, 出血をコントロールする対応策を備えておくべきである。

キーワード：胎児型後交通動脈, 血行力学的ストレス, くも膜下出血, 外科的治療, 真性後交通動脈瘤。

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