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# **Intracerebral Hemorrhage From a Ruptured Aneurysm at the Site of Anastomosis 27 Years After Superficial Temporal Artery-Middle Cerebral Artery Bypass**

## **—Case Report—**

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### **Abstract**

A 77-year-old female presented with a very rare case of intracerebral hemorrhage (ICH) from a ruptured aneurysm at the site of the anastomosis 27 years after superficial temporal artery-middle cerebral artery (STA-MCA) bypass manifesting as sudden onset of unconsciousness and right hemiparesis. Computed tomography (CT) on admission demonstrated massive ICH in the left frontoparietal region. Magnetic resonance angiography showed good patency of the anastomosis and no obvious aneurysm, but three-dimensional CT (3D-CT) angiography revealed a small aneurysm at the site of the left STA-MCA anastomosis. Emergency evacuation of the hematoma was performed, and the aneurysm was trapped and resected after ligation. After the operation, she continued to exhibit deep consciousness disturbance. Unfortunately, her general condition grew steadily worse and she died 3 months later. Patients who undergo STA-MCA anastomosis should be carefully followed up by periodical imaging examinations. 3D-CT angiography is very useful to detect aneurysm formation at the anastomosis site.

Key words: superficial temporal artery-middle cerebral artery anastomosis, aneurysm, intracerebral hemorrhage, surgery, three-dimensional computed tomography angiography

### **Introduction**

Direct cerebral revascularization through a superficial temporal artery-middle cerebral artery (STA-MCA) anastomosis has been performed to prevent ischemic attack in patients with occlusive carotid artery diseases.<sup>1,2,5,6,13,16,17</sup> Postoperative aneurysm formation at the anastomosis site is a relatively rare complication of this procedure. Moreover, formation of aneurysm more than several years after STA-MCA anastomosis is quite rare, with only 3 reported cases.<sup>11,12,18</sup> We describe a very rare case of intracerebral hemorrhage (ICH) from a ruptured aneurysm at the site of anastomosis 27 years after STA-MCA bypass.

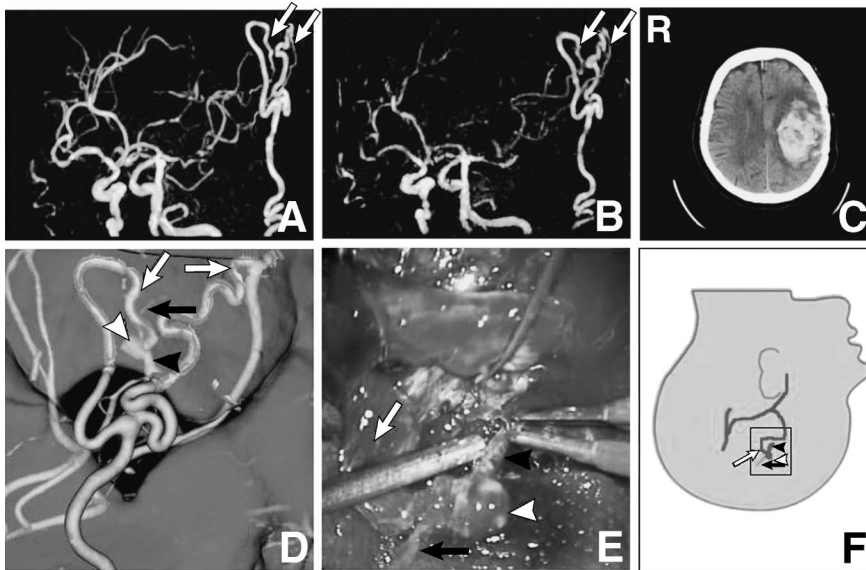
### **Case Report**

A 50-year-old female was first admitted to the Department of Neurosurgery of Hokkaido University because of periodic transient right hemiparesis in March 1981. Cerebral angiography showed occlusion of the left MCA at the M<sub>1</sub> segment. The patient underwent a left STA-MCA double anastomosis without complication on April 15,

1981. After her operation, she had worked as a nurse. Since her retirement in 1985, she had attended our hospital and had been managed with ticlopidine hydrochloride. Moderate hypertension was identified, but was not controlled adequately. She had undergone magnetic resonance (MR) imaging and three-dimensional time-of flight (3D-TOF) MR angiography every year in our hospital to confirm the patency of the anastomosis (Fig. 1A). She had not suffered a transient ischemic attack for 27 years. However, she was admitted to our hospital after sudden onset of unconsciousness and right hemiparesis on February 24, 2008, when she was 77 years.

MR imaging and MR angiography showed massive ICH and good patency of the anastomosis (Fig. 1B). Computed tomography (CT) demonstrated massive ICH in the left frontoparietal region, which is an unusual location for a hypertensive ICH (Fig. 1C). Although MR angiography had shown no obvious aneurysm (Fig. 1B), 3D-CT angiography revealed a 3.5-mm aneurysm at the site of the left STA-MCA anastomosis in the direction of the STA flow (Fig. 1D). The proximal limb of the recipient cortical artery was dilated, whereas the distal limb of the cortical artery was very narrow and almost occluded (Fig. 1D).

Emergency evacuation of the hematoma was performed



**Fig. 1** A: Magnetic resonance (MR) angiogram in 2007 showing patency of the left superficial temporal artery-middle cerebral artery (STA-MCA) double anastomosis (white arrows). B: MR angiogram on February 24, 2008, showing patency of the left STA-MCA double anastomosis as before (white arrows). C: Computed tomography (CT) scan on February 24, 2008, showing massive intracerebral hemorrhage in the left frontoparietal region. D: Three-dimensional CT angiogram demonstrating patency of the left STA-MCA double anastomosis (white arrows) and a small aneurysm at the site of anastomosis in the direction of STA flow (white arrowhead). Note that the proximal limb of the recipient cortical artery was dilated (black arrowhead), whereas the distal limb of the cortical artery was very narrow (black arrow). E, F: Photograph (E) and schematic drawing (F) showing the STA (white arrow), small

aneurysm at the site of the anastomosis in the direction of STA flow (white arrowhead), proximal limb of the recipient cortical artery (black arrowhead), and distal limb of the cortical artery (black arrow).

through a large craniotomy. The anastomosis site was dissected with preservation of the STA-MCA anastomosis, and the aneurysm was found at the site of the anastomosis in the direction of the STA flow, with the dome projecting into the hematoma cavity (Fig. 1E, F). The aneurysm was trapped and resected after ligation, considering the extensive frontoparietal irreversible damage. Histological examination showed that the surgical specimen consisted of connective tissue without muscle or elastic lamina component. Therefore, the final diagnosis was pseudoaneurysm at the site of the STA-MCA anastomosis. After the operation, she continued to exhibit deep consciousness disturbance. Unfortunately, her general condition grew steadily worse and she died 3 months later.

## Discussion

Complications of aneurysm formation at an anastomosis site after STA-MCA bypass are uncommon, with only 12 previously reported cases (Table 1).<sup>3,4,7-9,11,12,15,18</sup> Such complications usually occur within a few years after bypass surgery. Only 3 of the 12 previous aneurysms at the anastomosis site, as well as the aneurysm in our patient, ruptured more than 2 years after STA-MCA bypass surgery. Moreover, only one previous case developed complication more than 20 years after the bypass for moyamoya disease. The present case of ICH from the ruptured aneurysm at the site of anastomosis occurred 27 years after bypass surgery for occlusive carotid artery disease caused by arteriosclerosis.

Various factors are plausible for aneurysm formation at the anastomosis site. One possible mechanism of aneurysm formation after bypass surgery is intraoperative manipulation, including vascular injury by temporary clipping, resulting in excessive adventitial stripping.<sup>9)</sup>

Such technical failures might be the main cause of rapid aneurysm formation at the anastomosis site. However, aneurysm formation long after the bypass surgery could not be primarily caused by such technical failures. The experience of such complications several years after bypass surgery has suggested that hypertension and hemodynamic stress might be a factor in the development of aneurysm at the anastomosis site.<sup>11,12,18</sup> Therefore, long-term careful and constant control of blood pressure has been recommended.<sup>12</sup> In addition, repeated long-term follow-up MR angiography should be performed to confirm the patency of the anastomosis and to identify aneurysm formations after STA-MCA anastomosis.<sup>11</sup> However, turbulent flow and overlap of the artery and aneurysm are likely to make detection of aneurysms by 3D-TOF MR angiography very difficult.<sup>14</sup> Turbulent flow often occurs at the anastomosis site, and the donor or recipient arteries commonly overlap with the aneurysm. MR angiography with contrast medium is better than 3D-TOF MR angiography for the detection of aneurysms with slow flow because less signal reduction occurs due to turbulence or flow saturation effect.<sup>10</sup> Although we failed to detect the aneurysm in our case by repeated 3D-TOF MR angiography, MR angiography with contrast medium possibly could have done so.

The present case suggests that patients who undergo STA-MCA anastomosis should be carefully followed up by periodical imaging examinations. 3D-CT angiography is very useful to detect aneurysm formation at the anastomosis site.

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**Table 1** Reported patients with aneurysm formation at the anastomosis site after superficial temporal artery-middle cerebral artery (STA-MCA) bypass surgery

Case No.	Author (Year)	Age (yrs)	Sex	Hypertension	Associated vascular anomalies	Presenta-tion	Interval	Size (mm)	Treatment	Histology	Outcome
1	Fleischer et al. (1979) <sup>(4)</sup>	60	M	no	lt ICA occlusion	TIA	2 mos	4	OA-MCA	pseudo	GR
2	Leclercq and Ambler (1980) <sup>(5)</sup>	61	M	NS	bil ICA occlusion	ruptured	25 days	NS	none	pseudo	D
3	Parent and Smith (1981) <sup>(15)</sup>	60	M	yes (controlled)	rt ICA occlusion	incidental	2 wks	9	clipping	true	GR
4	Lantos et al. (1984) <sup>(8)</sup>	70	M	no	lt ICA occlusion	headache	13 mos	13	coating	true	GR
5	Fein (1985) <sup>(3)</sup>	70	M	NS	bil ICA stenosis	headache	1 yr	6	coating	true	GR
6		48	F	NS	rt ICA occlusion	headache	2 wks	NS	clipping	true	GR
7		58	M	NS	lt ICA occlusion, rt ICA stenosis	incidental	2 wks	NS	suture ligation	true	GR
8	Kohno et al. (1996) <sup>(7)</sup>	57	F	NS	lt ICA occlusion	incidental	2 wks	NS	coagulation	true	GR
9		65	M	yes (not controlled)	rt ICA occlusion	ruptured	2 mos	5	OA-MCA	true	GR
10	Sasaki et al. (1996) <sup>(18)</sup>	49	M	yes (controlled)	bil MCA (M <sub>1</sub> portion) occlusion	ruptured	4 yrs	8	clipping	true	MD
11	Nishizawa et al. (2000) <sup>(12)</sup>	43	M	yes (not controlled)	lt ICA occlusion	ruptured	5 yrs	small	clipping	pseudo	MD
12	Nishimoto et al. (2005) <sup>(11)</sup>	52	M	NS	moyamoya disease	ruptured	20 yrs	8	clipping	true	SD
13	Present case	77	F	yes (not controlled)	lt MCA (M <sub>1</sub> portion) occlusion	ruptured	27 yrs	3.5	trapping	pseudo	D

D: dead, GR: good recovery, ICA: internal carotid artery, MD: moderate disability, NS: not specified, OA: occipital artery, TIA: transient ischemic attack.

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