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## **Anastomosis of the Superficial Temporal Artery to the Middle Cerebral Artery (STA-MCA bypass) for Vascular Dementia**

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**Abstract** Anastomosis of the superficial temporal artery to a cortical branch of the middle cerebral artery (STA-MCA bypass) was useful in three cases with vascular dementia.

The ages of the patients were 27, 61 and 53 years, respectively. The main clinical symptoms in these patients were impairment of memory, dyscalculia and urinary incontinence following ischemic insults. The grade of dementia was mild in all cases by the Wechsler Adult Intelligence Scale, Hasegawa's Dementia Scale and Kohs' Block Design Test.

Computerized tomography scans demonstrated multiple small infarcts in all patients and angiogram showed moya-moya like features in case 1 and occlusion of both the internal carotid arteries in the others. A study of the regional cerebral blood flow (r-CBF) showed diffuse hypoperfusion in both hemispheres in all patients. Cognitive function as revealed by tests showed remarkable improvement with increased CBF after the STA-MCA bypass. It is concluded that STA-MCA bypass is a promising treatment for vascular dementia caused by diffuse hypoperfusion.

*Key Words* : Alzheimer's disease, Vascular dementia, STA-MCA bypass, Hypoperfusion.

The incidence of the dementia in older age groups has greatly increased with the lengthening of life expectancy in the developed countries, particularly in Japan<sup>1)</sup>.

Although there are many causes of dementia, the two that are most are primary degenerative disease (Alzheimer's disease) and vascular disease, commonly referred to as multi-infarct dementia, occurring in older individuals <sup>2)3)</sup>. In Japan, the incidence of vascular dementia is higher than in Europe or the USA <sup>2)3)4)</sup>. The authors recently performed anastomosis of the superficial temporal artery (STA) to a cortical branch of the

middle cerebral artery (MCA) in patients with vascular dementia, and obtained good results.

In this paper, the authors present our experiences and discuss the indications and rationale of STA-MCA bypass for vascular dementia.

### **Case reports**

#### **Case 1**

A 27-year-old man was admitted to our hospital with impairment of memory and transient weakness of the left hand followed

Table 1 Results of the cognitive function tests before and after STA-MCA bypass

Cognitive function tests	Case 1			Case 2			Case 3	
	preope.	postope. (6 mos).(12 mos)		preope.	postope. (2 mos).(12 mos)		preope.	postope. (1 month)
HDS	30.5	32.5		17.0	27.5	32.5	26.5	28.5
WAIS (Verbal Performance)	88 (90/87)	97 (95/100)	110 (111/108)			92 (92/88)	62 (78/under 60)	79 (82/78)
Kohs				34.0	80.0	84.4		

HDS : Hasegawa's Dementia Scale.  
Kohs : Kohs' Block Design Test.

WAIS : Wechsler Adult Intelligence Scale  
ope. : operation. mos : months

Table 2 Results of r-CBF before and after STA-MCA bypass

		Case 1			Case 2			Case 3	
		preope.	postope. (6 mos).(12 mos)		preope.	postope. (6 mos).(12 mos)		preope.	postope. (1 month)
r-CBF (ml/100gr/min.)	Rt	40.6	46.0	51.0	31.3	35.0	32.5	29.1	31.1
	Lt	40.5	47.0	49.0	33.0	36.0	41.9	27.7	31.4

r-CBF : regional cerebral blood flow, ope. : operation  
mos : months, rt : right, lt : left

by transient right hemiparesis on August 27, 1985. In the summer of 1983, he had noticed a transient tingling sensation in the finger tips of both hands, weakness of the extremities and speech disturbance. However, he did not consult a physician because the symptoms developed only about once a month and because resolved spontaneously within two or three minutes. One month before admission, he had complained of sensory disturbance in the left hand and transient weakness of the right hand followed by loss of consciousness while drinking alcohol. Following these attacks, his family noticed that he had gradually developed impairment of memory and disorientation as to time.

On neurological examination, his consciousness was clear. Impairment of memory, dyscalculia and disorientation were recognized and he showed slight weakness of the hand. Results of cognitive function tests according to the Wechsler Adult Intelligence Scale (WAIS) and Hasegawa's Dementia Scale (HDS) were subnormal (Table 1).

Computerized tomography (CT) scans showed small multiple infarcts in both internal capsules and the right frontal white matter (Fig.1A,B). Angiogram showed multiple stenosis in the right C<sub>1</sub>, M<sub>1</sub>, A<sub>1</sub> and occlusion of the left M<sub>1</sub> with moyo-moya vessels

(Fig.2A,B). A study of regional cerebral blood flow (r-CBF) by inhalation of radioactive xenon gas showed decreased flow in both hemispheres (Table 2).

Based on the neurological findings and the r-CBF parameters, an anastomosis of the right STA to the proximal MCA was performed on September 9, 1985. One month after the right bypass surgery, left STA-MCA bypass with encephalo-duro-arterio-synangiosis was performed in order to increase the blood flow in the brain. The postoperative course was uneventful, and the impairment of memory, dyscalculia and disorientation have gradually improved. A follow-up study of r-CBF and cognitive function tests have also improved markedly, as indicated in Table 1,2. Postoperative selective right external carotid angiogram showed a patent bypass with good filling of the branches of the right MCA (Fig.2C,D) and a patent bypass with poor filling of the left MCA.

#### Case 2

A 61-year-old hypertensive man was admitted to our hospital with impairment of memory, and disorientation as to time and place on January 19, 1988. In December, 1987, he had suffered abruptly from right hemiparesis.

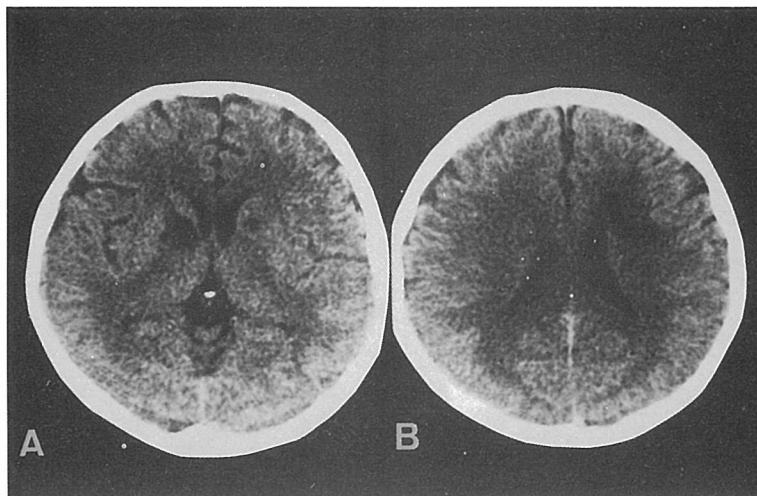


Fig. 1 Computerized tomography (CT) scans in case 1. Plain CT (A and B) shows small multiple infarcts in bilateral internal capsules and frontal white matter in the right paraventricle.

At that time, he was admitted to a hospital with a diagnosis of cerebral infarct. Since this attack, his family had noticed his depression, disorientation as to time and urinary incontinence. One month before admission, he developed left hemiparesis.

On neurological examination, his consciousness was clear. He showed slight weakness of the left upper extremity. Cognitive function tests by HDS and Kohs' block Design Test (KBD) showed predementia (Table 1). A CT scan revealed multiple lacunar infarcts in bilateral basal ganglia and the left frontal white matter (Fig. 3A,B). Angiogram showed occlusion of the internal carotid artery at the right cervical bifurcation and of the left internal carotid artery at the C<sub>2</sub> level with filling of some branches of the left MCA via a potential anastomosis to the external carotid artery (Fig.4A,B).

R-CBF determined by inhalation of cold xenon gas and CT (Xe-CT CBF) showed markedly decreased blood flow in both hemispheres (Table.2). Based on these data, the authors considered that the predementia was caused by chronic hypoperfusion of CBF. First, a right STA-MCA bypass was performed on February 8, 1988 and the postoperative course was uneventful. Dyscalculia,

disorientation and urinary incontinence improved two months after the operation but study of the CBF still showed a decrease in both hemispheres. Left STA-MCA bypass was performed about three months after the first operation. After this second operation, cognitive function tests showed remarkable improvement (Table 1). Postoperative selective angiogram showed a patent bypass with good filling of the MCA branches on both sides (Fig.4C,D).

### Case 3

A 53-year-old man was admitted to our hospital with impairment of memory, weakness of the right lower leg and dyscalculia on February 24, 1989. At the end of March, 1987, he developed left homonymous hemianopsia and weakness of the left upper extremity. At that time, angiogram revealed occlusion of the right internal carotid artery at the cervical portion. Right STA-pMCA bypass was performed on July 9, 1987. Since this event, he had been well except for left homonymous hemianopsia. However, he complained again of weakness and sensory disturbance of the right extremities in December, 1988. After this attack, he often developed transient weakness of the right extremities and began to suffer from

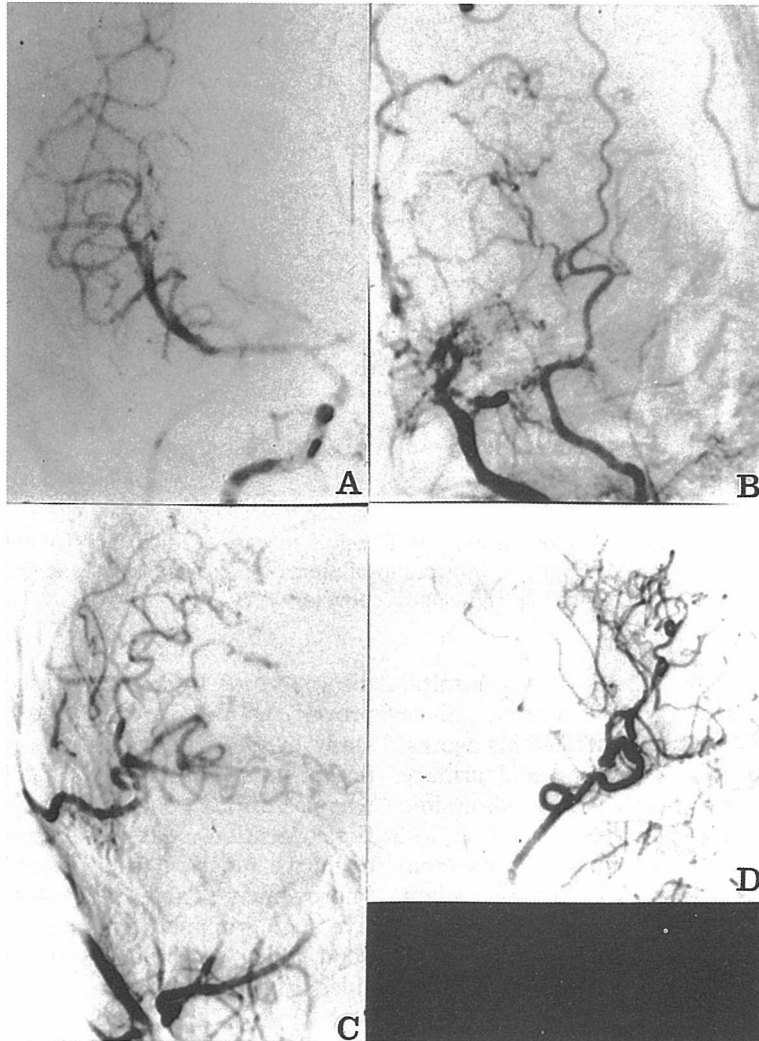


Fig. 2 Angiograms in case 1. Angiograms of the bilateral internal carotid arteries show stenosis in the right C1, M1 and A1 (A: anteroposterior view) and also occlusion of the left M1 with moyo-moya vessels (B: anteroposterior view). Postoperative angiograms of the right external carotid artery, anteroposterior view (C) and lateral view (D), show a patent bypass with good filling of the branches of the right MCA.

impairment of memory and dyscalculia.

On neurological examination, his consciousness was clear but he was depressive and he also showed left homonymous hemianopsia and slight weakness of the left leg. The results of cognitive function tests according to the WAIS and HDS were subnormal (Table 1). CT scans showed multiple infarcts in the right frontal, parietooccipital

and left parietal lobe (Fig. 5A, B). Angiogram showed occlusion of the left internal carotid artery at the cervical portion and a patent bypass with good filling of the branches of the MCA on the right side (Fig. 6A, B). A Xe-CT CBF study showed markedly decreased blood flow in both hemispheres (Table 2). Left STA-MCA bypass was performed on April 10, 1989.

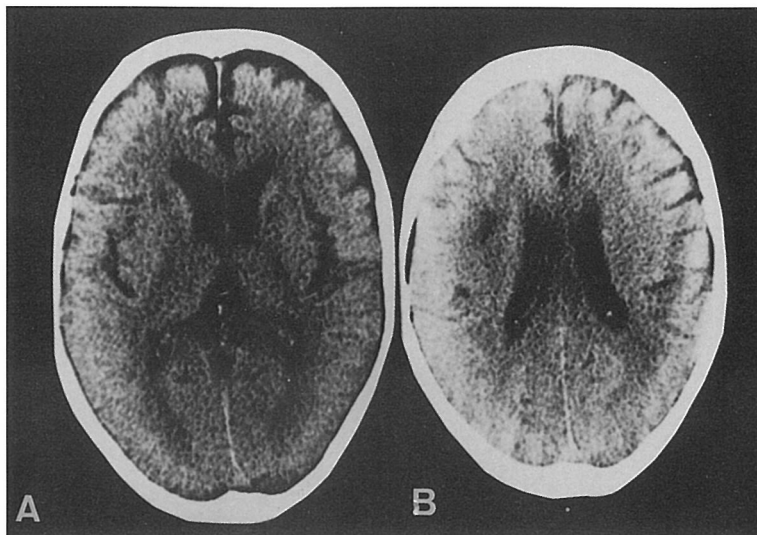


Fig. 3 Computerized tomography (CT) scans in case 2. Plain CT (A and B) shows multiple lacunar infarcts in bilateral basal ganglia and in the left frontal white matter.

The postoperative course was uneventful and the symptoms and results of cognitive function tests have gradually improved with increased flow. Postoperative selective external carotid angiogram revealed a patent bypass with good filling of the branches of the left MCA (Fig.6C).

#### Discussion

The worldwide incidence of dementia is about 4-5% of all people over 65 years old<sup>4)</sup>. The dementia has become an important medical and social problem, especially in Japan, where the proportion of individuals has rapidly increased. Therefore, it is very important to find an effective treatment for dementia. It has been reported that vascular dementia is more common in incidence than Alzheimer's disease in Japan<sup>2)3)4)</sup>. In general, the clinical features of vascular dementia usually are abrupt onset and a stepwise or fluctuating course of deterioration, with focal neurological signs frequently present<sup>4)5)</sup>. On the other hand, Alzheimer's disease shows insidious onset and a slow, progressive deterioration of cognitive function and personality<sup>5)6)7)</sup>. However, the clinical differentiation of vascular dementia from Alz-

heimer's disease is not always easy. Hachinski<sup>6)</sup> and Rosen<sup>5)</sup> devised the "Ischemic Score" by using characteristic features of vascular dementia in order to distinguish the two diseases. In present three patients, Hachinski's ischemic scores were 11, 11 and 12, respectively. All cases fulfilled the criteria for vascular dementia. The main cause of vascular dementia is thought to be multiple infarcts and hypoperfusion in the brain<sup>4)</sup>.

Using the intracarotid xenon-133 method, Hachinski studied the CBF in 24 patients with dementia including Alzheimer's disease and vascular dementia. CBF was normal in Alzheimer's disease, while it was low in vascular dementia and there was a correlation between the degree of dementia and CBF. El-Fiki<sup>8)</sup> also reported the results of extracranial-intracranial arterial bypass in 39 patients with bilateral carotid occlusion. Among these patients, dementia or personality changes were observed in 19 (49%) and the dementia was improved in 14 after STA-MCA bypass surgery. Based on this result, he suggested that the high incidence of dementia and personality changes might be caused by chronic hypoperfusion and that the STA-MCA bypass might become a useful

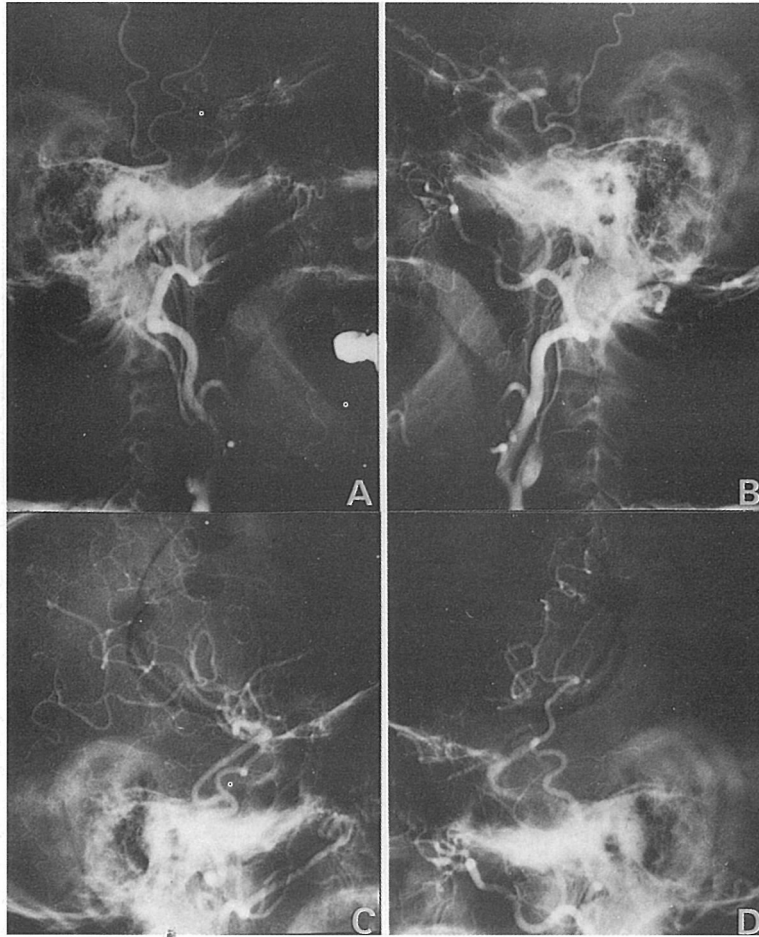


Fig. 4 Angiograms in case 2. Angiograms of the bilateral common carotid arteries show occlusion of the right internal carotid artery at the cervical portion (A:lateral view) and occlusion of the left internal carotid artery at the C2 level with filling of some branches of the left MCA via a potential collaterals to the external carotid artery (B:lateral view). Postoperative angiograms of the bilateral external carotid arteries show patent bypasses with good filling of the branches of the bilateral MCA (C:lateral view on the right side, D:lateral view on the left side).

treatment for vascular dementia. Accordingly, the authors think that among cases of vascular dementia caused by hypoperfusion, some would be curable by surgery such as carotid endarterectomy and STA-MCA bypass. In all of present patients, preoperative r-CBF study showed diffuse hypoperfusion in both hemispheres, and within 1 week to six months after the STA-MCA bypass, cognitive function and its tests showed marked improvement with increased CBF.

Our results thus supported El-Fiki's hypothesis that some cases of vascular dementia might be caused by chronic hypoperfusion in the brain, and also provide proof of effective treatment for vascular dementia.

Based on our present results, the STA-MCA bypass would be indicated in cases of vascular dementia that fulfilled the following criteria : 1) diffuse hypoperfusion revealed by CBF study, 2) occlusive disease of the MCA or IC without a large infarct on CT or

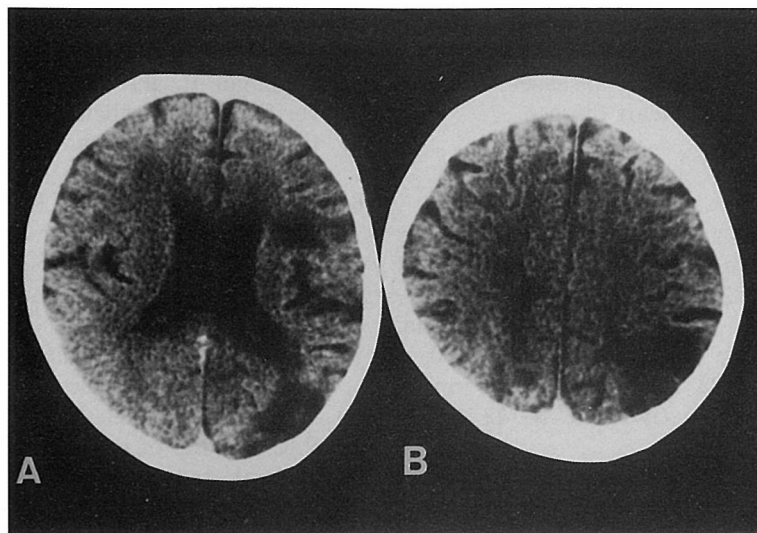


Fig. 5 Computerized tomography (CT) scans in case 3. Plain CT (A and B) shows multiple infarcts in the right frontal, parietooccipital and the left parietal lobe.

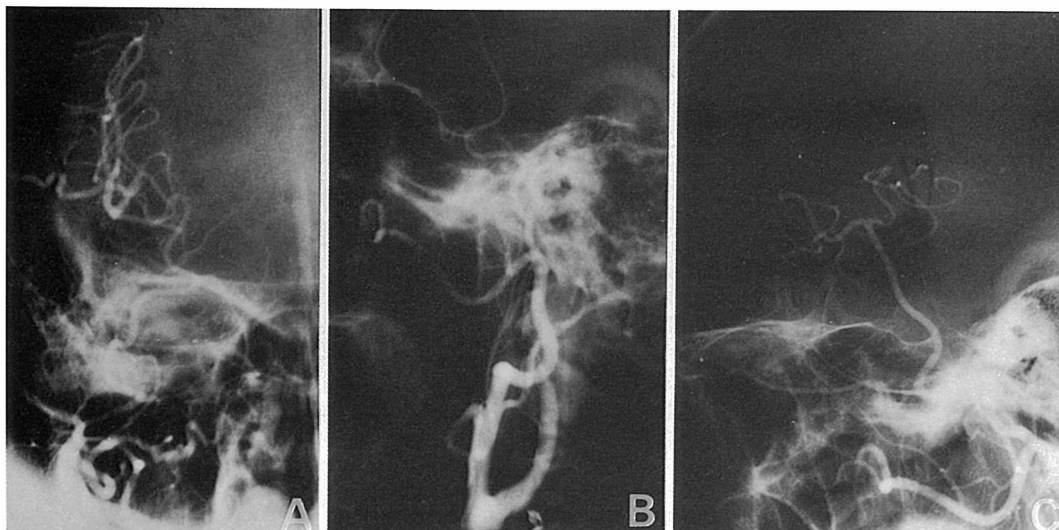


Fig. 6 Angiograms in case 3. Angiogram of the right external carotid artery (A:anteroposterior view) shows a patent bypass with good filling of the branches of the right MCA. Angiogram of the left common carotid artery (B:lateral view) shows occlusion of the left internal carotid artery at the C2 level. Postoperative angiogram of the left external carotid artery (C:lateral view) shows a patent bypass with good filling of the branches of the left MCA.