Anastomosis of the superficial temporal artery to the distal anterior cerebral artery with interposed cephalic vein graft

Case report

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A newly modified cerebral revascularization procedure for ischemia in the territory of the anterior cerebral artery in moyamoya disease is reported. The approach involves interposition of a cephalic vein graft between the superficial temporal artery and the distal anterior cerebral artery (callosomarginal artery) in combination with bilateral routine superficial temporal artery to middle cerebral artery anastomosis. The surgical technique and the possible role of this procedure are discussed.

KEY WORDS arterial anastomosis □9 vein graft □9 superficial temporal artery □9 moyamoya disease □9 revascularization

DONAGHY and Yaşargil first performed a microvascular anastomosis between the superficial temporal artery (STA) and a cortical branch of the middle cerebral artery (MCA) in 1967 (unpublished data). Since then, a number of new procedures of extracranial-intracranial arterial anastomosis have been increasingly used as a method to create a collateral circulation capable of restoring normal circulatory capacity and preventing further cerebral ischemia. We report our experience with an interposed cephalic vein graft between the STA and the distal anterior cerebral artery (ACA) for ACA occlusion in moyamoya disease. It is our purpose to focus attention on the technical aspects of this bypass procedure and discuss the possible role of this procedure.

Case Report

This 30-year-old woman experienced weakness and numbness in the left arm on November 24, 1981, but these improved quickly. A second attack occurred about 6 hours later, and left hemiparesis persisted. She was admitted to Suibarago Hospital.

Preoperative Course. Examination revealed left hemiparesis and hemihypesthesia, and café au lait spots on the whole body. Computerized tomography (CT) performed 7 days later revealed several small low-density areas in the territory of the right MCA. Arteriography, performed on November 26 and December 4, demonstrated multiple occlusive lesions of the cerebral arteries, including stenosis of the bilateral internal carotid artery (ICA), both ACA's at the proximal portion (A1), and the right posterior cerebral artery (PCA), and occlusion of the bilateral MCA. Abnormal vascular networks at the base of the brain, which irrigated the ACA and MCA territories, were also demonstrated without apparent evidence of transdural anastomosis.

On January 23, 1981, the patient suddenly developed moderately severe paresis of the left leg and mental deterioration. An CT scan on January 27 suggested a large infarction in the territory of the right ACA. Repeat angiography (Fig. 1) demonstrated occlusion of the right ICA just before its bifurcation, topped by a blush of hypertrophied vessels. There was no filling of the right ACA. The vascular supply to
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FIG. 1. Preoperative arteriograms, frontal projection. Left: Right internal carotid angiography demonstrating occlusion of the right internal carotid artery just before its bifurcation, topped by a blush of hypertrophied vessels. There is no filling of the right anterior cerebral artery (ACA). Right: Left internal carotid angiography demonstrating occlusion of the left middle cerebral artery and marked stenosis of the left ACA. The vascular supply to the left distal ACA was mainly from the left posterior cerebral artery in retrograde fashion, and from the markedly stenotic A1 portion in anterograde fashion.

the left distal ACA was mainly from the PCA in retrograde fashion (Fig. 2), and from the markedly stenotic A1 portion in anterograde fashion. There was slight improvement in the degree of paresis of the left leg. The patient was referred to Niigata University Hospital for further treatment on March 3.

Because, in our opinion, the patient had a high risk of a further major cerebral infarction in the territory of both MCA's and the left ACA, a cerebral revascularization procedure was planned. The optimal approach to provide additional circulation to the territories mentioned above could be achieved by anastomosis between the right STA and left distal ACA, in combination with bilateral routine STA-MCA anastomosis. It was decided to use the cephalic vein for interposition between the parietal branch of the right STA (Fig. 3), which had a large enough caliber for anastomosis, and the left callosomarginal artery.

Operative Procedure. On March 25, 1982, the patient underwent a revascularization procedure. She was placed in the supine position. Normotensive and normocarbic anesthesia was used. A large bifrontal and right temporoparietal scalp flap was turned. Two small craniotomies were performed in the bifrontal and right temporoparietal regions for the anastomosis between the right STA and left distal ACA, and for the routine STA-MCA anastomosis, respectively. Then, both the frontal and parietal branches of the right STA were dissected. The lumina were thoroughly irrigated with heparinized saline after they had been mobilized. Anastomosis between the frontal branch of the STA and the angular artery of the MCA was performed in the usual manner. During these procedures, the cephalic vein of the forearm, which had been thought to be suitable because of its diameter and the thickness of its wall, was harvested by exposing a segment 15 cm in length. The branches were ligated with 6-0 sutures and divided. No attempt was made to remove the valves. The isolated vein was perfused with heparinized saline in order to prevent shrinkage during preparation.

After the STA-MCA anastomosis had been finished, the distal end of the parietal branch of the STA was transected obliquely and then incised longitudinally on one surface to splay open the end of the STA, equal in length to the lumen of the vein graft which had been cut obliquely. The anastomosis was then performed end to end, using running 8-0 Prolene sutures as follows: corner stay-sutures were placed at
STA-ACA anastomosis with vein graft

FIG. 3. Preoperative right external carotid angiogram. Both branches of the right superficial temporal artery were used for the anastomoses.

Fro. 2. Preoperative left vertebral angiogram showing that the vascular supply to the left distal anterior cerebral artery was derived mainly from the left posterior cerebral artery in retrograde fashion.

either end of the orifice with the suture cut to a length of approximately 4 cm. The final tie in the suture line of one side was completed between the cut stump end of the first knot and the free end of the running suture. The same procedure was performed in the other suture line. The self-retaining retractor was then placed on the medial surface of the left frontal lobe after intravenous administration of 100 gm of mannitol. The bridging veins draining to the superior sagittal sinus were visualized but not divided. A 1-cm segment of the callosomarginal artery was exposed just distal to the junction. Two tiny perforating branches were divided after coagulation. Acland clips were placed proximally and distally, after a rubber strip was passed beneath the artery. The artery was then opened with microscissors equal in length to the vein graft which had been brought down to the interhemispheric fissure and cut obliquely. The incision was long enough to match the length of the gap without the risk of kinking or tension. An end-to-side anastomosis was performed, using running 10-0 Prolene sutures, just as performed for the end-to-end anastomosis between the STA and vein graft. This anastomosis was completed in 35 minutes. Good pulsation of the callosomarginal artery and the vein graft was seen after removing the clips (Fig. 4). The dura mater was then partially closed and the bone flap was replaced, leaving a hole for the vein graft to enter inferiorly. The scalp was closed in the usual manner. Systemic heparinization was not employed during the operation.

Postoperative Course. Postoperatively, the patient’s neurological status was unchanged. The pulsating graft was palpable in its subcutaneous position. Angiography 4 weeks postoperatively revealed excellent patency of the vein graft and STA-MCA anastomosis with enlargement of the STA, and perfusion in the distribution of the ACA and MCA (Fig. 5). There was
excellent filling of the left ACA through the vein graft, with extension across the anterior communicating artery into the right ACA, and irrigation of the MCA territory in retrograde fashion. Excellent filling of the right MCA through the STA-MCA anastomosis was also demonstrated. The abnormal vascular networks in the base of the brain did not appear as dilated or extensive as they were preoperatively.

On May 14, STA-MCA anastomosis was performed on the left side in the usual manner.

Discussion

This is the first report of a bypass procedure from the STA to the ACA territory using an interposed cephalic vein graft for occlusion of the ACA in moyamoya disease. This disease is characterized by the chronic progressive stenosis or occlusion of the carotid artery with well developed collateral anastomotic pathways in the base of the brain. As the disease progresses, it produces focal neurological deficits due to cerebral infarction. Lately, surgical procedures, such as STA-MCA anastomosis and encephalomyosynangiosis, have been successfully used as an alternative procedure to conservative treatment for this disease of unknown pathogenesis.4,6

In this patient, as the normal anatomical pathways that irrigated the territory of the ACA and MCA were almost totally obstructed and other sources of collateral circulation were sparse, the patient had the risk of a further major cerebral infarction in the territory of both the arteries. Therefore, we believed that the optimal approach to provide additional circulation to these areas would be achieved by the following revascularization procedures: an interposed cephalic vein graft between the STA and the callosomarginal artery, in combination with bilateral routine STA-MCA anastomosis.

Ito3 reported a technique of intracranial anastomosis between the distal ACA's, and suggested the usefulness of this procedure in the treatment of ischemia in the territory of the ACA. This inter-ACA anastomosis was performed in two patients with anterior communicating artery aneurysms and three patients with spontaneous occlusion of one ACA. In our patient, however, this procedure was not indicated, because not only was the right A1 segment totally occluded but the left A1 segment was markedly stenotic. It was decided to use the cephalic vein for interposition between the callosomarginal artery and the parietal branch of the right STA, which was of sufficient caliber, but in fact did not provide a suitable length for grafting directly to the ACA.
STA-ACA anastomosis with vein graft

In 1971, Lougheed, et al., reported a technique of a long bypass from the extracranial to the intracranial circulation, using an interposed vein graft, in a patient with complete occlusion of the ICA. Since then, several reports have described the indications for such an interposed graft involving vein, artery, or even a synthetic tube, to increase collateral blood supply in problems of occlusive cerebrovascular disease. It seems to us that this method is an attractive means of carrying blood from extracranial arteries to the ischemic cortex when branches of extracranial arteries are unavailable for direct artery-to-artery anastomosis; however, this technique has not received wide acceptance. The most important factor must be patency of the vein graft, especially over a protracted period. The saphenous veins have been used for grafts in coronary bypass surgery, and experience has shown that the patency rate in that setting is approximately 70% to 90% over 5 years. Similar patency rates may presumably apply to the vein graft used in this patient as well. However, the results obtained with the shorter segments used in coronary bypass surgery may not apply to the much longer vein graft used here. A point of greater importance than the length of the graft relates to the size discrepancy. Tew stated that if the internal diameter of the donor vessels exceeds that of the recipient vessel by a factor of 2.5, the turbulence at the site of anastomosis is great and the risk of thrombosis is enhanced. Because of these reasons, in our patient we used the smaller and more delicate cephalic vein of the forearm for a graft from the parietal branch of the STA to the distal ACA.

Postoperative arteriography revealed that the ACA territory is perfused extensively through this cephalic vein graft, although the ultimate outcome with respect to graft patency is still unknown. This preliminary report with a limited follow-up period presents an alternative surgical approach to a patient with ischemia in the territory of the ACA.

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References


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