

Anastomosis of Occipital Artery to Anterior Inferior Cerebellar Artery With Interposition of Superficial Temporal Artery. Case Report

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A 56-year-old man with vertebrobasilar insufficiency and associated findings including quadripareisis, dysarthria, cerebellar ataxia, nystagmus, and somnolence underwent left occipital artery (OA) to anterior inferior cerebellar artery (AICA) anastomosis with interposition of a superficial temporal artery (STA) graft. This procedure was chosen because cerebral angiograms demonstrated occlusion of the right vertebral artery (V3) and severe stenosis of the V4 segment of the left vertebral artery, with perfusion of the territory of the left posterior inferior cerebellar artery via the ipsilateral AICA, and because dissection of the OA is a relatively difficult and time-consuming procedure. Dissection of the STA, on the other hand, is much easier. Preoperative measurements of local cerebral blood flow in the vertebrobasilar circulation before and after intravenous administration of acetazolamide (500 mg) were obtained, and demonstrated low flow and hemodynamic compromise in the posterior circulation. The patient's hemodynamic and neurological status improved following surgery. In this report, we present a new and simplified method of OA-AICA anastomosis with interposition of STA graft.

KEY WORDS: Vertebrobasilar insufficiency; Occipital artery; Anterior inferior cerebellar artery; Superficial temporal artery; Anastomosis; Cerebral blood flow

Transient ischemic attacks (TIAs) affecting the vertebrobasilar arterial circulation, such as those of the carotid arterial system, have been associated with a risk of stroke

(25–35%) for a period of up to five years when diagnosed using strict criteria [4,10]. Anti-coagulation therapy has been recommended, but many patients with symptomatic posterior circulatory disease continue to have TIAs despite its institution [15]. The first extracranial-to-intracranial anastomosis for vertebrobasilar revascularization was performed by Ausman et al [2] in 1976. Since then, surgical treatment for vertebrobasilar revascularization has been studied because of continuing debate concerning the type of therapy currently employed; to this end, specific anesthetic and surgical techniques have been reported [6,12,18,24,25].

In this report, a new and simplified surgical approach to the treatment of severe stenosis of the intracranial vertebral artery (V4) is described. The technique of anastomosis of the occipital artery (OA) to the anterior inferior cerebellar artery (AICA), combined with interposition of the superficial temporal artery (STA) is described.

Case Report

A 56-year-old man was admitted to Osaka Neurological Institute on December 14, 1991 with quadripareisis (3/5), dysarthria, and somnolence. Sixteen days prior to admission, the patient had experienced episodes of vertigo and dizziness, which subsequently worsened and came to be associated with the findings noted above. Past medical treatment had included daily oral ingestion of 100 mg of aspirin prophylactically following cerebral infarction, the signs of which included right hemiparesis which had occurred two years prior to admission. Neurological examination disclosed quadripareisis, dysarthria, nystagmus, bilateral limb ataxia, and somnolence. A computed tomographic study revealed that a region of relatively low density was present in the brainstem and the right cerebellar hemisphere (Figure 3).

Cerebral angiography was conducted on admission, and demonstrated occlusion of the right vertebral artery

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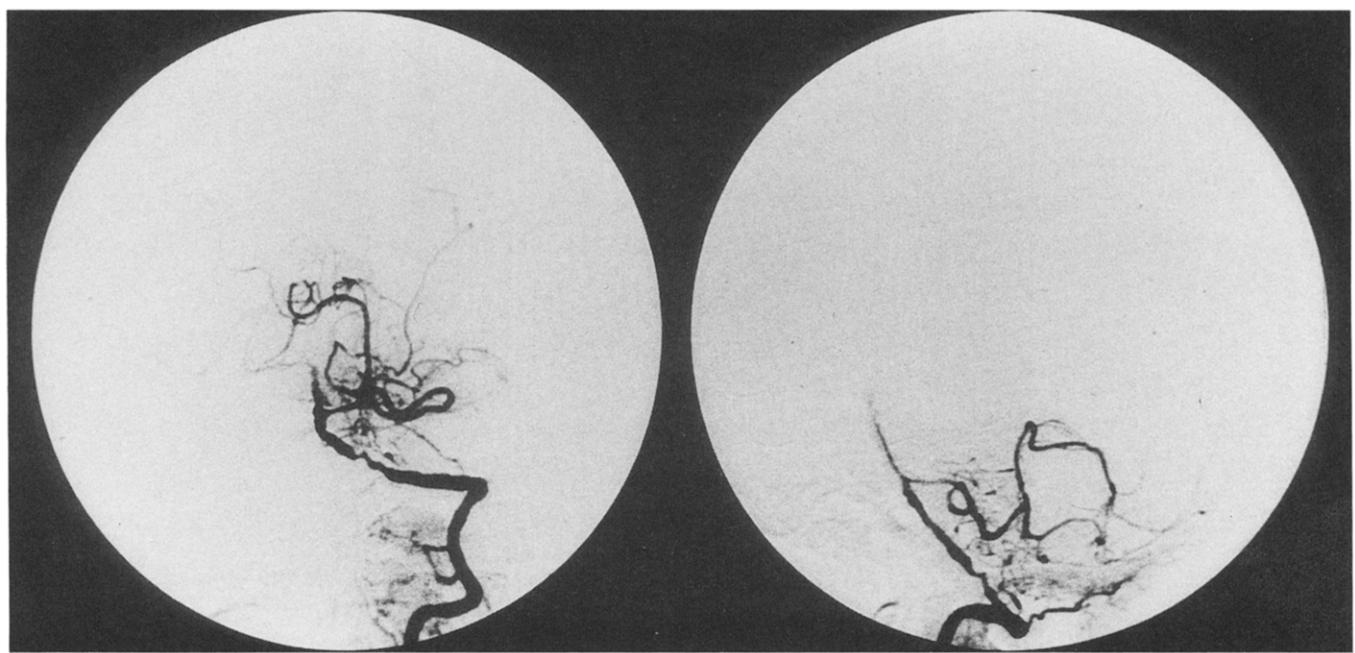


Figure 1. Angiograms of the left vertebral artery disclosed that severe stenosis was present in the V4 segment and that the territory of the left posterior inferior cerebellar artery was perfused via the ipsilateral anterior inferior cerebellar artery. Left: anteroposterior view; right: lateral view.

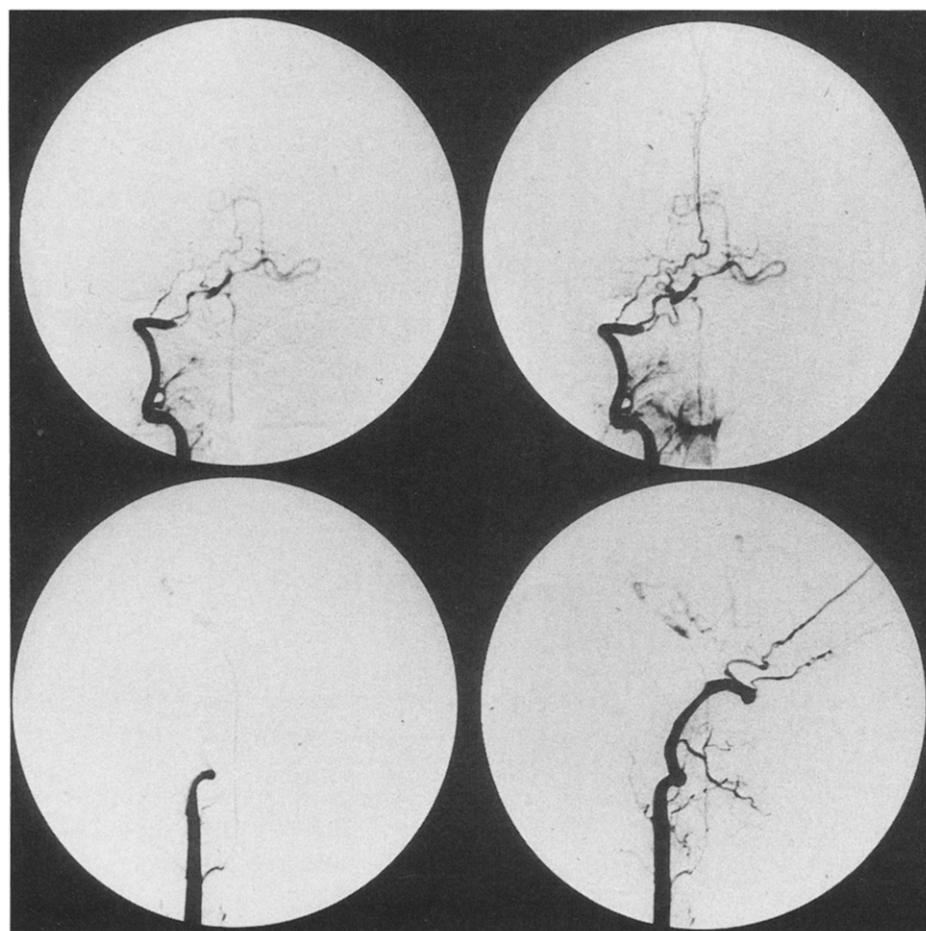


Figure 2. Angiograms of the right vertebral artery demonstrated its occlusion; in addition, a portion of the basilar artery was visualized via the anterior spinal artery, which originated from the extracranial right vertebral artery. Upper: anteroposterior views; lower: lateral views.

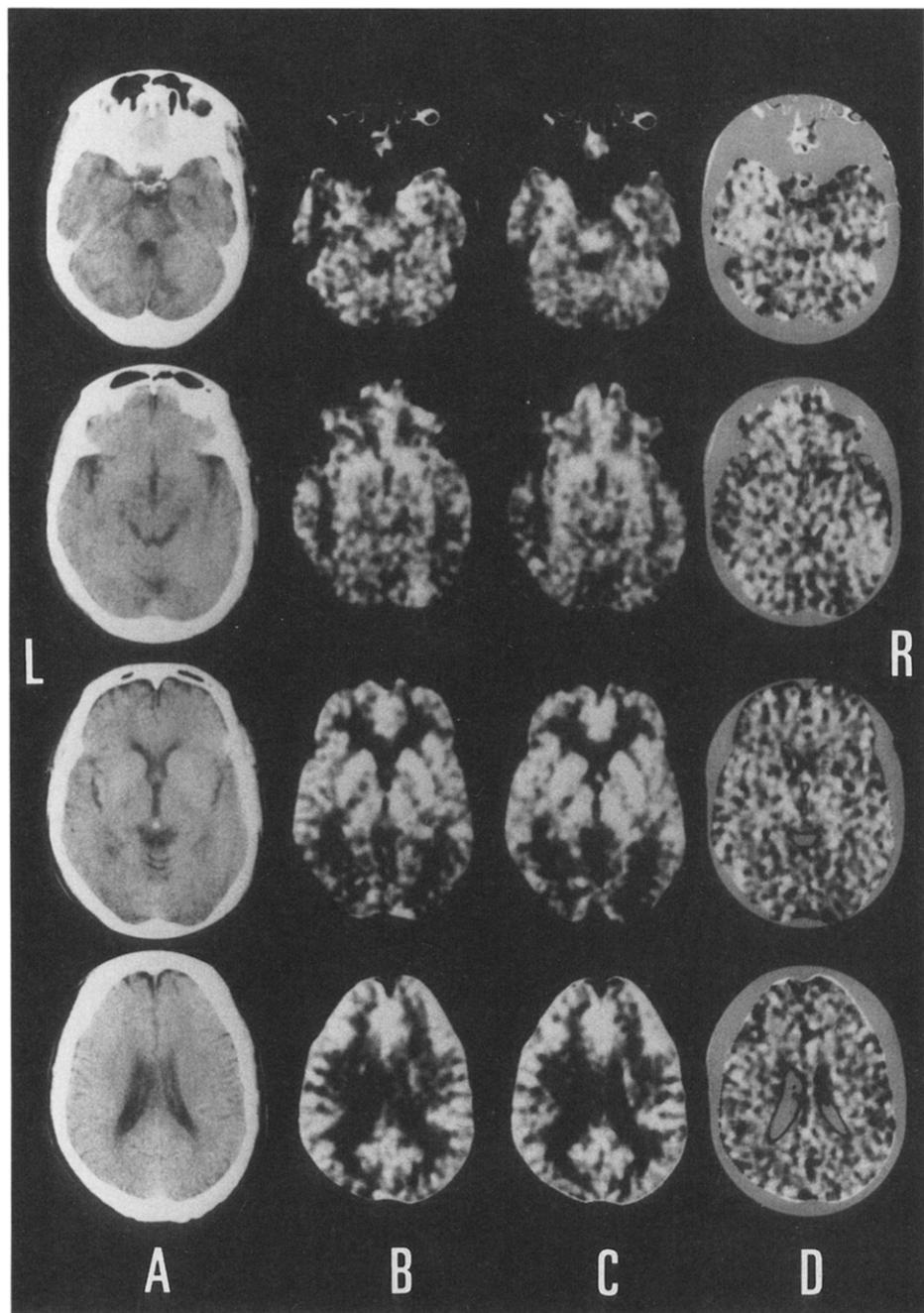


Figure 3. Preoperative measurement of local cerebral blood flow (LCBF). (A) Computed tomography scans. (B) LCBF maps for the resting state. (C) LCBF maps following administration of acetazolamide. (D) Δ LCBF maps, illustrating the difference between LCBF before and after administration of acetazolamide.

(V3), as well as severe stenosis of the left vertebral artery (V4) with resulting perfusion by the AICA of the territories of both the AICA and the posterior inferior cerebellar artery (PICA) (Figure 1). Visualization of collateral channels indicated that a portion of the basilar artery was supplied by the anterior spinal artery, which itself originated from the extracranial right vertebral artery (Figure 2). And the upper portion of the basilar artery, in addition to the bilateral posterior cerebral arteries, were supplied by the posterior communicating arteries

and a leptomeningeal anastomoses via the branches of each middle cerebral artery.

Measurement of local cerebral blood flow (LCBF) using inhalation of stable xenon and computed tomography (Xe^8 CT-CBF study) [21] was carried out and disclosed a low perfusion area in the both cerebellar hemispheres ($28 \text{ ml}/100 \text{ g} \cdot \text{min}$), bilaterally in the thalamus ($40 \text{ ml}/100 \text{ g} \cdot \text{min}$), and in the left occipital lobe ($26 \text{ ml}/100 \text{ g} \cdot \text{min}$) in the resting state (Figure 3B). LCBF was markedly decreased and hemodynamic compromise

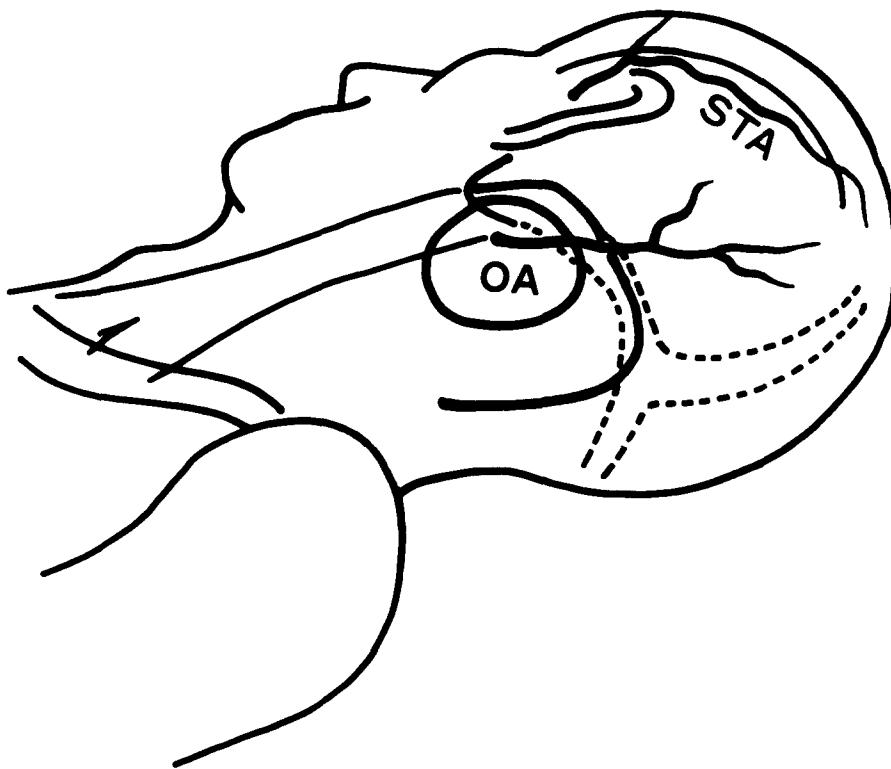


Figure 4. A new and simplified technique for occipital artery (OA) to anterior inferior cerebellar artery (AICA) anastomosis with interposition of superficial temporal artery (STA) graft. An 8 cm STA graft was prepared and anastomosed to the ipsilateral OA, and the OA was cut distal to the anastomotic site. The other end of the STA graft was then anastomosed to the segment of AICA distal to the meatal loop.

was therefore present in the cerebellar hemispheres, bilaterally in the occipital lobes, and in the right temporal lobe (Figure 3C and 3D) following intravenous administration of 500 mg acetazolamide [9,23]. The difference between LCBF in the resting state and that following administration of acetazolamide (Δ LCBF) is demonstrated in Figure 3D.

In spite of daily oral ingestion of 100 mg aspirin and of hypervolemia induced by transfusion of packed red cells and administration of low molecular dextran following admission, the patient's neurological state deteriorated. He was taken to surgery, and a left OA-AICA anastomosis was performed, with interposition of a parietal branch of the ipsilateral superficial temporal artery graft.

He was placed in the lateral decubitus position with his right side down. His head was secured in the Mayfield three-point-fixation head rest and a spinal drain was inserted. The course of the parietal branch of the left STA was marked out on the scalp, and a left unilateral suboccipital horseshoe-shaped skin incision was made. This was followed by a unilateral suboccipital craniectomy to the sigmoid sinus, the transverse sinus, medially to approximately 1.5 cm from the midline, and inferiorly to just above the foramen magnum. The parietal branch of the left STA was dissected free to a length of 8 cm. An approximately 2 cm length of the OA, which is located in the retromastoid region, was identified and dissected

(Figure 4). The graft was anastomosed end-to-side to the dissected portion of the OA. The OA was then cut distal to the anastomosis. With careful retraction of the cerebellum, the vestibulocochlear and facial nerves were identified, and the distal segment of the AICA just distal to the branching of its meatal loop was selected for anastomosis with the other end of the STA graft. The end was cleaned of adventitia and brought to the site of the anastomosis. The anastomosis was completed with eight interrupted 10-0 nylon sutures. The time required for anastomosis was 52 minutes. The dura matter was then closed, and closure of the incision was made in the usual manner.

Immediately after the operation, the patient's neurological condition improved; his right hemiparesis appeared clinically to improve (3-4/5), but he transiently developed difficulty in swallowing and was therefore not extubated until four days after the initial surgery. At extubation, he experienced no difficulties with swallowing. CT scans obtained five days after operation disclosed evidence of hemorrhagic infarction, but the patient's condition nevertheless underwent no deterioration. He became somnolent 10 days after operation, and evidence of obstructive hydrocephalus was noted on CT scans. Following the institution of right lateral ventricular drainage, his level of consciousness appeared to recover. The drainage tube was removed five days after the drainage. He no longer had findings

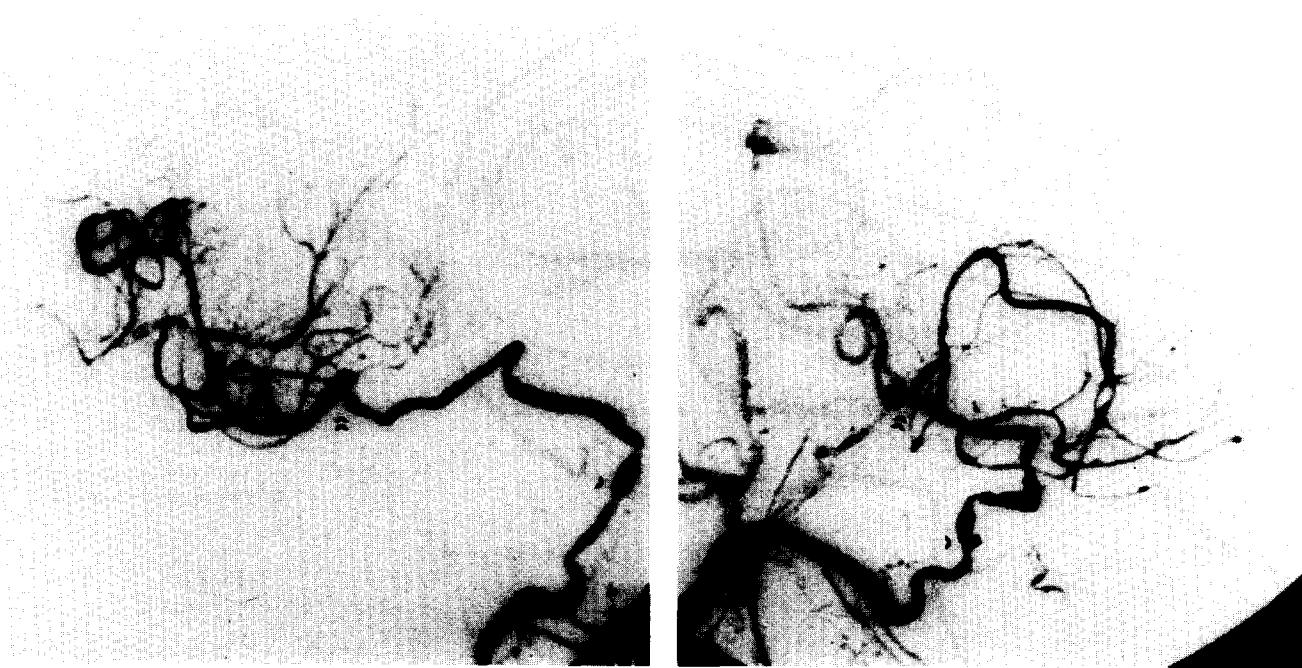


Figure 5. Postoperative angiograms of the left occipital artery (OA). These demonstrated that the basilar artery and the anterior inferior cerebellar artery (AICA) could be visualized well via the superficial temporal artery (STA) graft. The proximal anastomotic site between the OA and STA is shown by the single arrowhead; the distal anastomotic site between the STA and AICA is just distal to the meatal loop (double arrowheads). Left: anteroposterior view; right: lateral view.

of hydrocephalus. He underwent no subsequent neurological deterioration, and was able to sit in bed on February 16, 1992.

Postoperative left occipital artery angiograms obtained 20 days after performance of the anastomosis demonstrated that both the ipsilateral AICA and the basilar artery could be visualized via the anastomotic channel (Figure 5).

A Xe^{s} CT-CBF study obtained 22 days after the first operation demonstrated that cerebral blood flow had increased postsurgically in both cerebellar hemispheres (36 ml/100 g · min), in both temporal lobes (40 ml/100 g · min), bilaterally in the thalamus (62 ml/100 g · min), and bilaterally in the occipital lobes (34 ml/100 g · min) in the resting state (Figure 6A). LCBF increased markedly (Figure 6B) and hemodynamic reserve was improved (Figure 6C) in these regions following administration of acetazolamide. Postsurgical maps of Δ LCBF are shown in Figure 6C.

Discussion

Atherosclerotic disease in the vertebrobasilar system is commonly detected in the extracranial portion of the

vertebral artery. However, the majority of symptomatic lesions are located in the intracranial segments of the vertebral artery and/or in the basilar artery. The reason for this discrepancy is thought to be the presence of a rich supply of collateral circulation from other branches to the upper vertebral artery precluding the development of symptoms in association with vascular disease in the vertebral arterial system [5,7,8,18]. Cartlidge et al [4] and Heyman et al [10] reported that transient ischemic attacks (TIAs) affecting the posterior circulation led to infarction at a rate similar to that associated with anterior circulation TIAs. Each of these types of TIAs has an associated 25–35% risk of infarction within five years of occurrence.

Naritomi et al [16] reported a significantly greater reduction in local cerebral blood flow in the posterior circulation induced by postural hypotension in patients with vertebrobasilar insufficiency than in normal controls. Dysautoregulation was detected in the patients with vertebrobasilar insufficiency. Hemodynamic factors and dysautoregulation appear to play roles in the pathogenesis of vertebrobasilar insufficiency.

Revascularization of the vertebrobasilar arterial system is a subject that has received considerable attention in past years. The surgical approach to be used in an individual patient is determined by the location of the steno-occlusive lesion(s), the pathophysiology responsible for symptoms of ischemia, and the degree of intracranial collateral circulation [1,11,13,14,17,19,22]. OA-to-PICA bypass has been performed for treatment of significant steno-occlusive lesions in the fourth segment

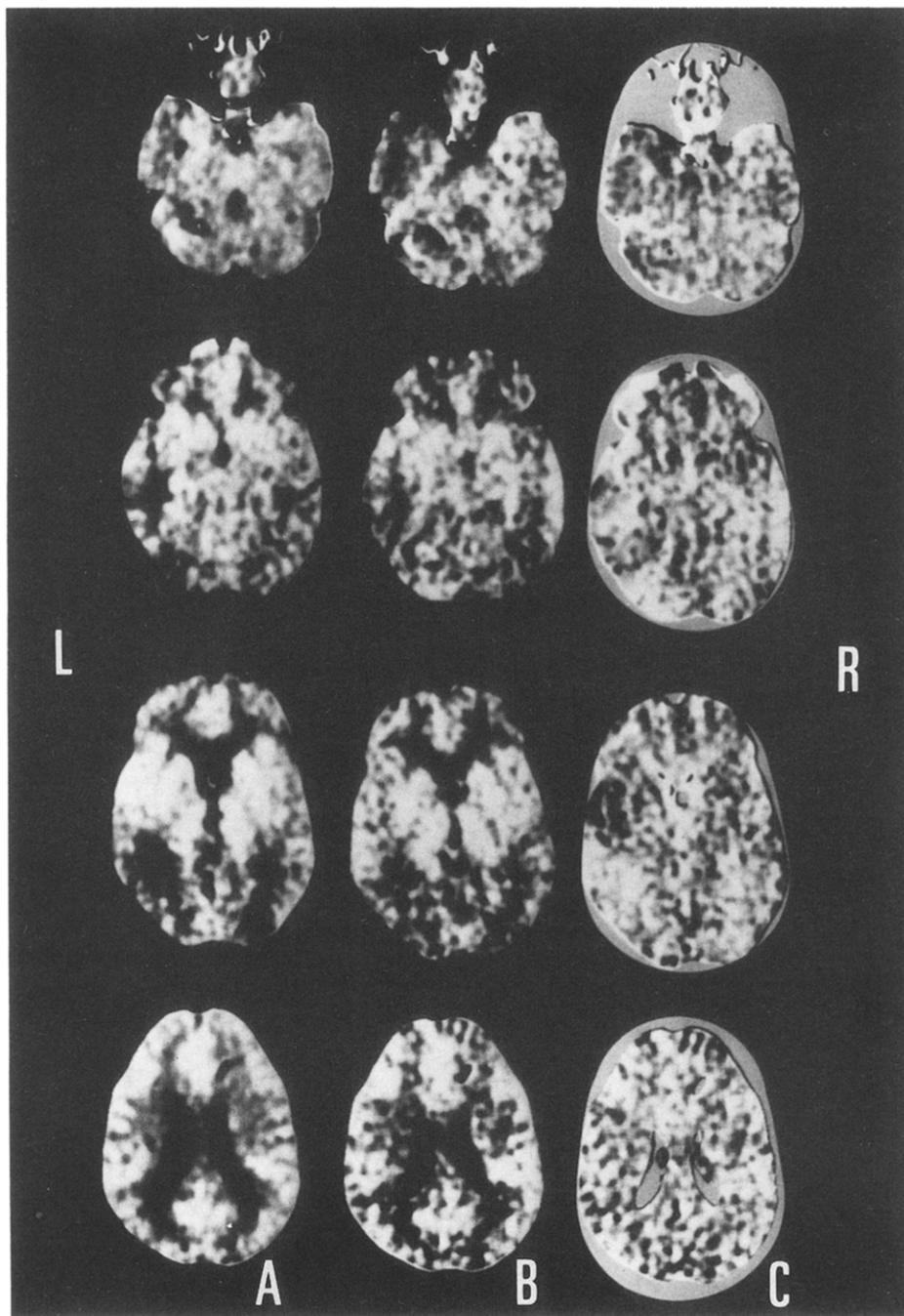


Figure 6. Postoperative measurement of local cerebral flow (LCBF). (A) LCBF maps for the resting state. (B) LCBF maps following administration of acetazolamide. (C) Δ LCBF maps, illustrating the difference between LCBF before and after administration of acetazolamide.

of the vertebral artery. The surgical procedure is directed at the lesions proximal to the origin of the PICA, which are responsible for the distal hemodynamic insufficiency. Sundt et al [20] reported that interposition of a vein graft may be employed when extracranial carotid artery vessels are inadequate or unavailable to serve as donor vessels.

On the other hand, occlusive lesion(s) of the vertebrobasilar arterial system distal to the PICA require for

treatment extracranial-intracranial vascular anastomosis distal to the PICA; potential anastomoses include STA-superior cerebellar artery anastomosis, STA-posterior cerebral artery anastomosis, and OA-AICA anastomosis.

The OA-AICA anastomosis has been referred to in a few reports, and is thought to be relatively difficult to perform [3,12,19]. Moreover, dissection of the OA is relatively difficult and time-consuming compared with that of the STA, due to the complicated three-dimen-

sional course of the former [3,12,19]. Due to the fact that in the patient considered here severe stenosis was present in the V4 segment, and the ipsilateral AICA therefore perfused territories of both the AICA and PICA, a decision was made to attempt anastomosis of the OA to the AICA with interposition of STA graft. Obtaining the STA graft and dissection of an approximately 2 cm portion of the OA are much easier than dissection of the OA to a length of 8 to 10 cm. This procedure is thought to be very simple and may be substituted for OA-AICA anastomosis.

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