

of AVM of the spinal cord were just like that of the brain and composed of feeding arteries, intramedullary nidus and draining vessels. Only one case of arteriovenous shunt type (so-called single coiled vessel type after Doppman et al) was found. By angioma racemosum venosum, the authors mean an angioma composed of abnormal tortuous vessels without definite feeding arteries. Telangiectasis is understood as single or several thin serpentine vessels without noticeable draining vessels.

2) Treatment of angiomas of angioma racemosum arteriovenosum type: By means of microsurgery, it was not so difficult to remove totally these angiomas of the spinal cord other than angioma of AVM type. There are some opinions that AVM of the spinal cord is different from that of the brain and occlusion of the feeding arteries are sufficient to treat AVM of the spinal cord. The authors, however, suppose that the intramedullary nidus should be also removed as much as possible to prevent development of new feeding arteries. Removal of nidus is not always easy and is indicated when the nidus is small or there is sharp cleavage between nidus and cord tissue after bleeding from the nidus.

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### **B-53. External Carotid Artery Steal: Complication of Neurosurgical Procedures and Evaluation Using Common Carotid Artery Blood Flow Measurement**

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External carotid artery steal has not been received attention until recently. Steal indicates reversal and diversion of blood flow and is noted through two major pathways. Most of the cases reported were vertebral-external carotid artery steal which shows diversion of blood flow from the extracranial vertebral artery to the external carotid artery through normally existing anastomosis or pathological blood vessels. (Barnett, 1970; Kohlmeyer, 1966; Azzolini, 1968; Thierry, 1970). Internal carotid-external carotid artery steal which presents retrograde filling of the external carotid artery through the intracranial portion of the internal carotid artery has been reported less frequently. (Barnett, 1970). This is the first report of the internal carotid-external carotid artery steal furnished with clinical histories and laboratory findings.

Case 1 The patient is 65 year old male who had a carotid endarterectomy for transient ischemic attacks due to severe stenosis in the left carotid bifurcation. Post operatively, patient did well until one month after surgery when patient's family noticed deterioration of his mental function and daily activities. Neuropsychological

test (Halsted-Reitan) showed significant deterioration compared with preoperative evaluation. A cerebral angiogram showed retrograde filling of the internal maxillary artery through the intracranial portion of the internal carotid artery while the internal carotid artery at the operative site was widely patent. Radioisotopic angiogram with  $Tc^{99m}$  was abnormal showing delayed isotopic uptake in the left hemisphere. Background activity of an EEG showed diffuse slow activities after five minutes of chewing. The patient was followed in the clinic and remain symptomatic.

**Case 2** A 36 year-old male had recurrent meningioma in the left middle cerebral fossa which was removed totally again after the left external carotid artery was ligated. The patient was discharged from the hospital without any neurological deficit. Three months postoperatively, the patient was readmitted because of weakness of the right extremities. A cerebral angiogram showed opacification of the peripheral external carotid arteries through the intracranial portion of the internal carotid artery. Main branch of the external carotid artery remained occluded at its origin. There was no signs of tumor recurrence nor other pathological process to explain his neurological deficits.

*Discussion:* We have postulated that patients with external carotid artery steal become symptomatic when interruption of significant collateral circulation through the external carotid artery occurred after surgical procedure and aggravated by steal of blood flow down to the preexisting collateral channels. Blood flow from the contralateral external carotid artery may not reach the area needed because of generalized atherosclerosis or stenosis of the contralateral external artery or other causes. This was supported by a clinical case which became symptomatic after a carotid endarterectomy with the occluded external carotid artery at the operative site demonstrated in a postoperative angiogram. Blood flow study with electromagnetic flow meter during carotid endarterectomy showed Type 1 of blood flow change. (Ono, 1968) which indicates presence of significant collateral circulation through the external carotid artery. Ligation of the external carotid artery is not quite safe procedure as described previously. Before interruption of the artery, blood flow study with special attention to the external carotid collateral circulation should be performed to prevent this avoidable complication.

*Summary:* Two cases of external carotid artery steal were presented with clinical data. Evaluation of collateral circulation through the external carotid artery using electromagnetic flow meter was emphasized to prevent this complication.

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## **B-54. Experiment on Angiotactic Surgery for Cerebro-Vascular Diseases**

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Angiotactic surgery is proposed for the treatment of vascular lesions. The authors