It has recently been suggested that unilateral internal carotid arterial occlusion may be an indication for surgical intervention in patients with cerebral thrombosis and, in normal subjects. Ann Intern Med 59: 180-185, 1963


**Unilateral Internal Carotid Arterial Occlusion: Special Considerations**

**CHARLES A. ANDERSEN, M.D., LTC M.C. U.S.A.,**

**NORMAN M. RICH, M.D., F.A.C.S., COL M.C. U.S.A.,**

**GEORGE J. COLLINS, JR., M.D., LTC M.C. U.S.A.,**

**PAUL T. MCDONALD, M.D., LTC M.C. U.S.A.,**

**AND STEPHEN C. BOONE, M.D., LTC M.C. U.S.A.**

**SUMMARY** Cases of patients with unilateral internal carotid arterial occlusion and contralateral internal carotid arterial stenosis are reviewed. Forty-two percent presented with a fixed neurological deficit. The deficit was referable to the side of occlusion in 92% and to the side of stenosis in 8%. Eleven percent had a neurological complication following carotid endarterectomy on the side of the stenotic lesion. The neurological complication was referable to the side of stenosis in 67% and to the side of occlusion in 33%. Patients have been followed for an average of 19 months and have not developed any additional TIA's or strokes in the followup period. There may be a role for an extracranial-intracranial bypass (ECIC) on the occluded side prior to an endarterectomy on the stenotic side if a poor collateral situation exists. An ECIC should be done in patients who remain symptomatic following carotid endarterectomy on the stenotic side. These data do not support doing ECIC in asymptomatic patients with unilateral carotid arterial occlusion.

IT HAS RECENTLY been suggested that unilateral internal carotid arterial occlusion may be an indication for superficial temporal to middle cerebral arterial bypass. It has also been suggested that extracranial-intracranial bypass (ECIC) should be done on the side of a unilateral internal carotid arterial occlusion prior to performing carotid endarterectomy for stenosis of the contralateral internal carotid artery. Also, Fields and Lemak, in a recent review of data obtained by the joint study of extracranial arterial occlusion, suggested that medical therapy is superior to surgical therapy in patients with unilateral carotid arterial occlusion and contralateral carotid arterial stenosis.4 Because of the emergence of these new and controversial concepts, we reviewed our recent operative experience in patients with unilateral carotid arterial occlusion and contralateral stenosis.

**Methods**

Between January 1974 and December 1976, 189 carotid endarterectomies were performed on 154 patients at Walter Reed Army Medical Center. Twenty-eight of the 154 patients (18%) presented with a unilateral internal carotid arterial occlusion and a contralateral significant (greater than 50% as demonstrated arteriographically) internal carotid arterial stenosis. An analysis of these 28 cases forms the basis of this report. There were 24 males and 4 females ranging in age from 26 to 73 years with an average age of 56 years. Twelve of the 28 patients (43%) had a fixed neurological deficit at the time of initial evaluation. In 11 of the 12 patients (92%), the deficit was referable to the side of the occlusion; however, in one patient, it was referable to the side of the stenosis.

The indications for surgery in these 28 patients were transient ischemic attacks (TIA's) in 15 (54%); fixed neurological deficit with TIA's in 6 (21%); fixed neurological deficit without TIA's in 6, (21%); and as prophylaxis prior to major surgery in 1, (4%). An analysis of the 21 patients having TIA's showed the TIA's to be referable to the side of the occlusion in 6 patients, (29%), referable to the side of stenosis in 9 patients, (43%), and non-localizing or bilateral in 6 patients (29%).

All 28 patients had a carotid endarterectomy performed on the side of the stenotic lesion. In none of the patients was an attempt made to open the occluded internal carotid artery. No patients were operated on during the acute phase of a stroke. Following a stroke, patients were stabilized for at least six weeks or until the static portion of the brain scan returned to normal before an operation was performed. Also, no arteriograms were performed during the acute...
phase of a stroke. The carotid endarterectomies were performed using general anesthesia with an indwelling shunt. The procedures were performed as part of a teaching program with the surgery being done by a chief general surgery resident, a peripheral vascular surgery fellow, or a staff member of the Peripheral Vascular Surgery Service. Although our current policy is to use an indwelling shunt in all patients, stump pressures were measured. The stump pressures in these 28 patients ranged from 28 to 80 mm Hg. The average stump pressure was 44 mm Hg. Only five patients (18%) had stump pressures above 50 mm Hg.

Two patients had a superficial temporal to middle cerebral arterial bypass performed. In one patient, ECIC was performed on the side of an internal carotid arterial occlusion prior to endarterectomy on the side of an internal carotid arterial stenosis. In the second patient, the ECIC was done on the side of internal carotid arterial occlusion following carotid endarterectomy of the contralateral stenotic internal carotid artery because of persistent symptoms. All ECIC procedures were done on the Neurosurgery Service by one of the authors (S.B.).

Results

There was no operative mortality. Three of 28 patients (11%) developed a neurological complication following carotid endarterectomy. All of these were fixed neurological deficits lasting longer than 24 hours. In one patient, the deficit was referable to the occluded side, however in the other two patients the deficit was referable to the side of the stenotic internal carotid arterial lesion. One of these strokes resulted from a subintimal injection of contrast material during an intra-operative arteriogram. Neither patient who had ECIC performed developed neurological complications.

All patients have been followed in the Peripheral Vascular Surgery Registry and Clinic, with an average follow-up period of 19 months. In the 12 patients who initially presented with a fixed neurological deficit, one has been lost to follow up. One died from complications related to an occluded infrarenal abdominal aorta. Three patients have significant residual hemiparesis limiting their ability to work or care for their personal needs. Four patients have mild, non-limiting residual deficits. Three patients are asymptomatic with no residual neurological deficits. None of these patients has developed additional TIA's or strokes in the follow up period.

In the 16 patients with no neurological deficit at the initial evaluation, one has been lost to follow up. The one patient in this group that had a neurological complication at the time of surgery continues to have a mild hemiparesis. Fourteen of 16 patients (88%) in this group are completely asymptomatic. No patient in this sub-group has developed further TIA's or strokes in the follow up period.

Discussion

These cases demonstrate that a sizable percentage of patients can occlude an internal carotid artery without developing a neurological deficit. On the other hand, 12 of the 28 patients, (43%), presented with a fixed neurological deficit. Fields and Lemak, in the joint study of extracranial arterial occlusion, reported that 72% of patients with unilateral carotid arterial occlusion presented with some degree of neurological deficit. Dycan and associates demonstrated a 3% incidence of asymptomatic unilateral carotid arterial occlusions in hospital patients over 50 years of age. In the patients presenting with a fixed neurological deficit, it was usually referable to the side of occlusion. In the present series, 11 of 12 patients, (92%), had the deficit referable to the side of the occlusion.

In patients with unilateral carotid arterial occlusion and contralateral stenosis, transient ischemic symptoms can be referable to either hemisphere or be non-localizing. Symptoms referable to the occluded side suggest a low flow state, although embolization from the stump of an occluded internal carotid artery has been reported. Symptoms referable to the stenotic side can be due to either embolization or decreased perfusion.

In considering operative intervention, several authors have suggested that patients with unilateral carotid arterial occlusion and contralateral stenosis are at an increased risk of mortality and neurological morbidity during and following a carotid endarterectomy. Fields and Lemak reported that 43% of patients in this category either expired or had a stroke as the result of surgical intervention. They reported that among randomized patients with unilateral carotid occlusion and contralateral carotid stenosis, 63% of medically treated patients were alive at the end of a 66 month follow-up, whereas only 34% of surgically treated patients were still living. Analysis of their high mortality, however, shows that most of the deaths occurred in patients in whom disobliteration of an occluded internal carotid artery had been tried or in patients operated upon during the acute phase of a stroke. As pointed out previously, we have abandoned both of these procedures. Other authors have reported a low rate of complications in this group of patients. Thompson reported no increase in morbidity or mortality in this select group of patients, but points out that they present special problems since they are at a higher than normal risk. Patterson recently reported on 23 patients with unilateral carotid arterial stenosis and contralateral occlusion. He reported no mortality or morbidity following carotid endarterectomy. In the present series, there was no mortality but an 11% incidence of postoperative strokes. However, as we have become more aware of the high risks in these types of patients, the incidence of neurological deficits has decreased. The last 11 patients have been done with no neurological complications.

Following carotid endarterectomy, 20 of 21 patients were relieved of their transient ischemic symptoms. This suggests that in most cases symptoms can be relieved by increasing total cerebral perfusion via well developed intra-cerebral collateral pathways. Without good collateral pathways, symptoms may persist even after carotid endarterectomy. The one patient in our series who continued to have symptoms after carotid endarterectomy had an ECIC performed on the side of occlusion with good relief of symptoms.

In the follow up period, the patients have not developed any further TIA's or strokes. This suggests that with at least one patent carotid artery and good collateral pathways, these patients are not at a high risk of developing future strokes. This is in contra-distinction to the group of medically treated patients that Fields and Lemak reported in which 23% of patients developed strokes during a
month average follow up period. Fifty percent of these strokes were fatal.

The role of ECIC in patients such as those described above remains undefined. Patients with symptoms referable to the side of the occluded internal carotid artery with poor collateral pathways may benefit from an ECIC on the side of the occlusion prior to doing the carotid endarterectomy on the side of the stenosis. This sequence of operations was suggested by Andersen and co-workers\(^1\) in 1974. They reported doing an ECIC on the side of a totally occluded internal carotid artery prior to doing an endarterectomy of the contralateral stenotic artery. Their patient had no post-operative neurological complications. Our policy in these types of patients is to preoperatively evaluate the competency of the anterior and posterior communicating branches of the circle of Willis and the patency of the vertebral arteries in an attempt to evaluate angiographically the adequacy of the collateral circulation. Also, the stump pressure on the side of the occlusion is measured using the Gee OPG. If a poor collateral situation exists then an ECIC is done on the side of occlusion prior to doing the carotid endarterectomy on the side of stenosis. The one patient in this series that had this sequence of operations did not have any neurological complications and has remained asymptomatic.

An ECIC may also be indicated in patients following carotid endarterectomy on the stenotic side if they continue to have symptoms referable to the side of occlusion. One patient in this series had this sequence of operations and has remained asymptomatic following ECIC. This approach is supported by the work of Samson and co-workers\(^12\) who followed a group of symptomatic patients with unilateral carotid arterial occlusion who refused an ECIC. Twenty-nine percent of their patients developed strokes.

Whether or not patients with a unilateral carotid arterial occlusion are at increased risk for developing neurological symptoms in the future, thus warranting prophylactic ECIC on the side of the occlusion remains in question. This problem has previously been addressed by Grillo and Patterson.\(^13\) They reviewed the cases of 44 patients with unilateral internal carotid arterial occlusion. Five patients developed strokes in the follow up period. However, all strokes occurred in the cerebral hemisphere opposite the occlusion. Based on our current limited study where no patients became symptomatic in the follow up period and based on the work of Grillo and Patterson, it is difficult to justify doing an ECIC on the side of an occluded internal carotid artery in an asymptomatic patient. As pointed out as early as 1970 by Yasargil and co-workers,\(^14\) it may be impossible to solve the complex issues without the benefit of randomized, prospective trials.

### References

Unilateral internal carotid arterial occlusion: special considerations.
C A Andersen, N M Rich, G J Collins, Jr, P T McDonald and S C Boone

Stroke. 1977;8:669-671
doi: 10.1161/01.STR.8.6.669
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1977 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/8/6/669

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/