Common Carotid Ligation for Intracranial Aneurysms*

Results in 26 Cases

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In spite of the emphasis in recent years on the direct approach to intracranial aneurysms, cervical carotid ligation remains an effective method of treating these lesions. This is especially true when the aneurysms are manifest in the elderly, or when they arise from the internal carotid artery and are not amenable to direct attack. Dukes, et al., have indicated that sometimes cervical carotid ligation may be effective in treating aneurysms arising from the anterior communicating artery.

The reported morbidity from this procedure, usually caused by ischemia in the territory of the occluded cervical carotid artery, has been significant. Such complications have been lessened by ligating the common rather than the cervical internal carotid artery and by gradual occlusion using the Crutchfield or Selverstone clamp. Defective collateral circulation across the circle of Willis has been emphasized as a major cause of ischemic complications following cervical carotid ligation, and has been considered a contraindication to this procedure. Moreover, attempts to predict intolerances to cervical carotid artery ligation are unreliable.

We have not considered a positive Matas test or arteriographic evidence of the absence of cross-collateral circulation contraindications to common carotid ligation. In fact, we believe that this kind of incompetence of the circle of Willis should enhance the effectiveness of the procedure. This has previously been suggested by Odom and his co-workers. In these cases, ischemic complications should be reduced by extending the period of gradual occlusion to as long as 3 weeks if necessary and by careful monitoring of the effects of graded occlusion.

Method

At this clinic, patients with subarachnoid hemorrhage are kept at strict bed rest until their neurological deficiencies become minimal or absent. Unless an intracerebral hematoma is suspected, arteriography is deferred during this period. Until recently, bilateral carotid arteriography was initially carried out, reserving vertebrobasilar studies for those patients in whom carotid arteriograms were negative. For the past 3 years, retrograde femoral arteriography has been employed, with visualization of both the anterior and posterior intracranial circulation. Assessment of collateral circulation is attempted in all cases. As a matter of fact, this technique is also used in all patients with occlusive cerebrovascular disease, with only one serious complication in the entire series which includes many older patients. This may be due to the fact that one of us (LB) does all of the procedures himself. In 292 such studies carried out for the sole purpose of opacifying selectively the intracranial circulation, the following complications have occurred: one patient developed a persistent left hemiparesis. Another had a transient worsening of her previous hemiparesis. A third patient developed cortical blindness which lasted 12 hours. Transient confusion occurred in 10 to 15 demented patients, lasting less than 24 hours. Two patients on anticoagulants bled from the groin. There has been no mortality.

Operation is usually carried out on the following day. Under general endotracheal anesthesia, the Crutchfield clamp is applied to the common carotid artery and the handle

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brought out through a stab wound. For the past 3 years, mean and pulsatile blood flow have been recorded by the Dennison-Spencer square-wave electromagnetic flowmeter,\textsuperscript{20} with the probe implanted around the internal carotid artery.\textsuperscript{18,21} Common carotid pressures upstream to the clamp and cervical internal carotid pressures are recorded at the time of surgery through No. 20 gauge needles connected to Statham strain gauges. Graded common carotid occlusion is carried out, noting the number of turns producing complete occlusion together with the effects of occlusion on arterial pressures and flow. Such studies are useful in estimating effective collateral circulation. The clamp is turned down to the point at which internal carotid flow first decreases. Pressure recordings are discontinued and the wound closed around the Crutchfield clamp and the implanted flowmeter probe.

Graded occlusion of the common carotid artery is continued over several days. Each increment of occlusion is monitored by internal carotid flow determinations and by serial retinal artery pressures\textsuperscript{6,17} in addition to repeated neurological assessments. Should neurological changes occur, the clamp is reopened one-quarter to one turn depending upon the effect on internal carotid blood flow. Once the patient's condition has stabilized, graded occlusion is resumed. If total occlusion is tolerated for 24 hours, the patient is returned to the operating room. The common carotid artery is doubly ligated and the Crutchfield clamp together with the electromagnetic flowmeter probe removed. In Figs. 1 and 2 the effects on two patients of acute turn-down at surgery and of gradual common carotid occlusion postoperatively are compared with respect to mean and pulsatile blood flow in the cervical internal carotid artery. Serial retinal artery pressures were also recorded during the course of postoperative turn-down.

Clinical Material

Twenty-six patients comprised this series (Table 1). Their ages ranged between 20 and 74 years at the time of operation; 88\% were older than 50 and 30\% were over 70. All but four of these presented subarachnoid hemorrhage. Two patients had carotid-cavernous sinus fistulas and two others had giant aneurysms of the internal carotid artery producing, primarily, visual field impairment. Neurological defects were minimal to absent in most cases at the time of surgery, which took place from 72 hours to 31 days after the hemorrhage. Common carotid occlusion was accomplished over periods ranging from 3 to 22 days.

Seventeen patients had aneurysms arising from the internal carotid artery. In only two of them was cross-filling absent during contralateral carotid compression at the time of arteriography. In four cases, however, the status of collateral circulation was not determined. Nine patients had aneurysms arising from the anterior communicating artery. No cross-filling could be demonstrated in six of them and, as suggested by Odom,\textsuperscript{15} the contralateral proximal anterior cerebral artery was clipped in two others.

Results

Twenty-one patients, 80\% of this series, were able to resume their usual activities and are considered good results. In five cases, however, the postoperative period was not uncomplicated. One patient developed dysphasia and a right hemiparesis during the course of graded carotid occlusion which took 23 days to accomplish. She was 71 years old, with an internal carotid aneurysm without cross-collateral circulation, but recovered within 3 months after operation. One other patient had a vagal paralysis which cleared 5 months after surgery.

In three patients, common carotid ligation was incomplete. In one, arteriography 6 months after carotid ligation showed enlargement of her internal carotid aneurysm, cervical views showed patency of the common carotid artery and the Crutchfield clamp completely open. She has done well since religation. Since this case, we routinely remove the clamp after doubly ligating the common carotid artery 24 hours after occlusion is complete. Another patient experienced rebleeding from her internal carotid aneurysm 1 month after surgery, she is well 6 months after religation. In the third case, Doppler studies demonstrated flow in the common carotid artery 5 days after ligation, she also had a cervical bruit and a rise in the ipsilateral retinal artery pressure. She is now doing well 7 months after religation.

Two patients had late sequelae. A 73-year-old man with extensive peripheral vas-