Vascular Endoscopy — An Adjunct to Carotid Surgery

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SUMMARY Technical advances in optical instrumentation have made vascular endoscopy a useful method for intraoperative evaluation of carotid endarterectomy. A prospective protocol was designed to evaluate the efficacy and practicality of this technique using the Hopkins Optical System in 35 carotid endarterectomies. The external carotid artery was examined after completion of the endarterectomy. The distal internal carotid artery was examined after removal of the shunt with all but 1 cm of the arteriotomy closure completed. Total time required for the procedure was less than 5 minutes in 21 cases and between 5 and 10 minutes in 14. Positive findings were noted in 71% of the external carotid endarterectomies which consisted of intimal flaps in 13 cases and intimal shreds in 25. In 2 patients (6%), internal carotid endoscopy revealed intimal shreds capable of embolizing and probably capable of causing a postoperative neurologic deficit. This technique permits a precise and complete evaluation of the vascular reconstruction.

TECHNICAL ADVANCES in optical instrumentation have made vascular endoscopy a useful method for intraoperative evaluation of carotid endarterectomy sites. Several authors have reported the value of operative endoscopy in biliary and urologic as well as carotid surgery.1-5 To determine the usefulness of this technique a prospective protocol was designed to determine the efficacy and practicality of vascular endoscopy in carotid artery surgery using the Hopkins rod lens system.6

Method

Thirty-five carotid endarterectomies were performed under general anesthesia with systemic heparinization and a temporary inlying bypass shunt. The external carotid artery extension of the atheromatous plaque was removed by a closed avulsion technique. In the internal carotid artery, the intimal break was secured with several 6-0 tacking sutures if it was not firmly adherent to the underlying media. The external carotid artery then was examined with the endoscope prior to closure of the arteriotomy with the shunt in place and with a vascular clamp placed as far distally as possible to prevent back-bleeding (fig. 1). After removing all visualized atheromatous debris and elevated intimal flaps, the arteriotomy was partially closed with a running suture starting distally and extending proximally until a 1 cm defect remained in the carotid bulb. After clamping the common carotid and distal internal carotid artery, the shunt was removed and the endoscope inserted through the arteriotomy. The area was inspected for residual atheromatous debris and blood clots which could embolize when blood flow was restored. The intima at the distal end of the endarterectomy was examined to see that it was tightly adherent. The endoscope was removed and the arteriotomy closure completed. When there was any concern about the adequacy of collateral blood supply to the brain, a partial occlusion clamp was placed across the 1 cm defect in the carotid bulb, allowing immediate restoration of internal carotid blood flow prior to completion of the arteriotomy closure.

In this study the choledochoscope or the arthroscope, utilizing the Hopkins rod lens system, was used. This has a glass rod lens instead of the individual disc lens usually found in endoscopy units. By placing the rod lens in close proximity, light travels a greater distance in glass which results in excellent resolution and light transmission. These units have a fixed focus with a significant depth of field and a viewing angle of 90°, which is much wider than conventional endoscopy units. The choledochoscope is a rigid, right-angled instrument with a 32 cm vertical and a 5 cm horizontal limb (fig. 2). The horizontal limb, which measures 5 x 3.5 mm in cross section, is used for exploration. The arthroscope is a straight instrument, 23 cm long, with a cross sectional diameter of 3.5 mm (fig. 3). A 40 cm right-angle attachment can be added to the arthroscope which avoids contamination during endoscopy. A standard fiberoptic light source and transmission cable are used. The irrigation channel in the endoscope is continuously flushed by lactate Ringers IV solution through gravity flow from a bag hung three feet above the operative field. The endoscope, fiberoptic cable, and IV tubing are gas sterilized. During endoscopy, the eye piece is considered contaminated and not touched. When not in use, the endoscope is wrapped in sterile towels.

Results

The external carotid artery was examined endoscopically after endarterectomy in 35 patients. The duration of the endoscopy was one to five minutes in 21 cases and five to ten minutes in 14. Positive findings were noted in 25 of 35 patients. Raised intimal flaps were present in 13 and intimal shreds and atheromatous debris were observed in all 25 patients.

Thirteen internal carotid arteries were examined after partial closure of the arteriotomy requiring three minutes or less in all examinations. In 2 of 13 patients there were atheromatous shreds in the lumen capable of embolizing to the brain.

The endoscope was too large to insert into the carotid artery in 5 patients and was cumbersome, because of its size, in 3 others.

There were no infections and no apparent vessel injury was produced by insertion or manipulation of the endoscope. One patient had a neurologic deficit resulting from occlusion of the internal and external carotid artery the evening of surgery but inspection of the vessel at re-operation did not reveal any damage from endoscopy.

Discussion

Arterial endoscopy is a useful adjunct to carotid artery surgery, and is safe and easy to perform. The excellent
FIGURE 1. The choledochoscope is inserted into the external carotid artery with the shunt in place. The vascular clamp is placed as far distally as possible on the external carotid artery to permit visualization of the distal extent of the endarterectomy.

FIGURE 2. The choledochoscope. The vertical limb is 32 cm and the horizontal exploring limb is 3 cm long with a $5 \times 3.5$ mm cross-sectional diameter.

FIGURE 3. The arthroscope. The endoscope is 23 cm long with a cross-sectional diameter of 3.5 mm. The endoscope must be inserted into the sheath pictured above which is an irrigating channel. Also, a 40 cm right-angled extension can be added to avoid contamination during endoscopy.

Visualization and magnification of the repair sites by the rod lens system permits more precise vascular reconstruction. During carotid endarterectomy it is difficult to inspect adequately the external carotid artery for atheromatous debris and elevated distal intimal flaps since the distal extent of the endarterectomy is often two to three centimeters beyond the arteriotomy in the common carotid artery. The inadequacy of the external carotid artery endarterectomy was demonstrated by the 71% incidence of positive findings in this study. Although all of the positive findings could not be presumed always to result in occlusion, precise visual inspection of the repair may improve long-term patency rates.

Internal carotid artery endoscopy was done during the last half of the study after the technique was perfected. During endoscopy the adherence of the intima just distal to the endarterectomy was evaluated, the suture line examined, and the lumen searched for any residual atheromatous debris. The atheromatous debris found in the internal carotid artery of two patients was more than 1 mm long and was undoubtedly capable of producing a neurologic deficit by embolization. The time required to perform internal carotid endoscopy did not significantly prolong the time of cerebral ischemia time as endoscopy generally required less than one minute and never more than three minutes.
This technique satisfies three essential criteria necessary for its use in cerebral vascular surgery: absence of neurologic deficit related to the use of the instrument,atraumatic examination of the artery, and no postoperative infections. Although the instrumentation currently available was not designed to meet the specific needs of the vascular surgeon, it did provide an opportunity to establish the feasibility of the technique.

Vascular endoscopy is an alternative to operative arteriography for intraoperative evaluation of vascular repairs. It provides a three dimensional view of the reconstructed segment. It takes less time than arteriography and allows correction of defects prior to the restoration of blood flow. The delicate carotid artery suture line does not have to be reopened to correct residual defects. Endoscopy adds a new dimension to vascular surgery permitting more precise repair which should reduce the morbidity of carotid artery surgery.

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References

Diagnostic Reliability of the Percutaneous Ultrasonic Doppler Technique for Vertebral Arterial Occlusive Diseases

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SUMMARY There is little data on the diagnostic reliability of the ultrasonic Doppler technique for vertebral arterial occlusive lesions. Percutaneous vertebral Doppler examination and the vertebral angiograms were compared to determine the diagnostic reliability of this technique in 64 vertebral arteries of 53 patients with cerebrovascular disease. The percutaneous vertebral Doppler findings were quantitatively analyzed using a sound spectrograph and were classified into three types: no flow signal type, poor flow type and normal flow type. In nine patients with the no flow signal type, the angiograms revealed vertebral occlusion or a missing vertebral artery in six, giving a diagnostic reliability of 67%. In 17 patients with poor flow type the angiograms revealed vertebral occlusion or a missing vertebral artery in five, terminal narrowing of the artery in nine, and hypoplasia in two giving a diagnostic reliability of 94%. For all vertebral arteries examined with this technique, including normal ones, the diagnostic reliability was 92% (59/64). Percutaneous vertebral Doppler examination has clinical usefulness as a screening test for occlusive vertebral arterial diseases.

NUMEROUS REPORTS SHOW that extracranial arterial occlusive or stenotic lesions play an important role in the development of various kinds of ischemic cerebrovascular diseases. The clinical aspects of cerebrovascular disorders for vertebral arterial disease are less well clarified when compared with internal carotid arterial disease. One reason is that the clinical symptoms caused by vertebral arterial occlusions are quite varied; another reason is that the usual diagnostic procedure for disease in this area is vertebral angiography which may have serious complications.

Increasing interest has been focused on the use of the ultrasonic Doppler technique as a noninvasive means for evaluating extracranial arterial occlusive diseases. Recent reports suggest the clinical usefulness of the ultrasonic Doppler technique for the diagnosis of internal carotid artery occlusive lesions. Detection of vertebral blood flow with this technique was successfully reported earlier and was studied from various points of view, but little has been done to test its diagnostic reliability with vertebral arterial occlusive lesions as seen on angiograms. Keller et al reported that errors occurred in studying the arteries using the ultrasonic Doppler technique with a peroral probe. We have found this probe very troublesome and difficult to use because of pharyngeal reflexes.

In the present study we estimated the diagnostic reliability of the percutaneous vertebral Doppler technique in patients with vertebral arterial occlusive lesions by making a comparison between the semi-quantitative analysis of the ultrasonic Doppler findings using the percutaneous probe application technique and the angiographic findings in the vertebral arteries.

Subjects
Fifty-three patients and 64 vertebral arteries were studied. All patients had symptoms of chronic or subacute stages of cerebrovascular disease. Patients with intracerebral hemorrhage or brain edema were eliminated. Thirty-six patients had occlusive cerebrovascular disease with various degrees

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