Distal Internal Carotid Thrombo-Embolectomy Using a Fogarty Catheter in Total Occlusion

Technical Note

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INVALUABLE information concerning the problems of carotid occlusive disease has been published.1-3,6,7,9,12,13,15-17,20 Yet, in general, the results of surgical treatment of total occlusions of the cervical internal carotid artery have been disappointing. Surgical intervention has rarely produced neurological benefits either in the presence or absence of neurological deficit. We are reporting the use of a special intravascular catheter which has facilitated the extraction of distal thrombi in patients with totally occluded carotid arteries.

Some of the uncertainties associated with this lesion relate to the duration of occlusion, peripheral embolization to the cerebral vessels, proximal and distal propagation of the thrombus from the site of occlusion, and stenotic lesions in the region of the carotid siphon. Fisher1 reported a 45% incidence of severe neurological deficit in a series of 45 autopsies in which total occlusion of a carotid artery was present. In 31% of the cases with deficit, there was extension or emboli to vessels beyond the circle of Willis. This incidence of cerebral propagation corresponds to a 35% and 46% incidence reported by Luesenhop14 and Hultquist15 respectively.

Murphey and Maccubin16 reported that 80 of 194 patients operated on for carotid occlusive disease had totally occluded vessels; arterial back flow and circulation were restored in 35 of these cases. These authors found an indirect correlation between the duration of the occlusion and the number of arteries in which flow could be re-established. From 0–2 days, 90% of the arteries could be opened; in 3–7 days, 56%; in 8–11 days, 27%; and in 12–14 days, 4%. They concluded from their study that “the results suggest that there is probably little to be gained by operating on an occluded artery, even in patients without severe deficit when the contralateral vessel is not significantly stenosed. However, until this matter is settled by further experience, we shall no doubt continue to operate upon these individuals without profound deficit when the occlusion is thought to be of recent onset.” They also advocated surgical intervention in those patients with bilateral carotid occlusions.

Techniques for the extraction of thrombi from the distal internal carotid artery, such as the insertion of small sucker tips and rubber catheters, have met with varying results, usually unfavorable. Among these have been the retrograde “milking technique” of Keeley and Rooney,19 retrograde flushing of the artery as described by Lerman, et al.,21 and the use of various endarterectomy instruments and guides such as a corkscrew device advocated by Shaw.19 None of these techniques is applicable to the extraction of thrombi in the distal portion of the internal carotid artery.

In 1963, Fogarty8 described a special intravascular catheter with an inflatable balloon applied to the tip for extraction of thrombi in peripheral arteries (Fig. 1). The catheter is made of pliable rubber, 80 cm in length, and is available in several diameters from 1 to 3 mm. The catheter is threaded into the artery to pass through a soft thrombus or between the thrombus and the arterial wall to a point distal to the thrombus. The balloon is inflated with fluid and the catheter gently and firmly withdrawn, extracting the thrombus or embolus ahead of the balloon.

The rubber inflatable balloon is 1 cm long and constructed as a small jacket so that maximal inflation occurs in the middle of the jacket. Increased resistance encountered by small alterations in the intraluminal dia-
unsuccessful in October, 1964, and further study was refused at that time. Twelve days before admission, he developed pneumonia and a right hemiparesis.

Examination. The patient was mute and did not respond to commands. There was conjugate gaze of the eyes with the pupils equal and reactive, and a right hemiparesis with a spastic paralysis of the left leg. A retrograde right arteriogram revealed bilateral internal carotid artery occlusions with good filling of both vertebral arteries (Fig. 2). There was very minimal delayed retrograde filling of the left middle cerebral and left anterior cerebral arteries, by way of the posterior circulation.

Operation. A left carotid endarterectomy was undertaken, even though the prognosis was poor. Arteriotomy was performed over the carotid bifurcation revealing total occlusion of the left internal carotid artery by thick, yellowish, ulcerating, hard atheromatous plaque. There was no soft thrombus and no "back or retrograde bleeding" from the internal carotid.

A Fogarty catheter (No. 4, 1 mm) was inserted into the proximal internal carotid as far as possible (13 cm) from the carotid bifurcation. The balloon was filled with 1 cc of 50% Hypaque, and a semilateral skull film was obtained, showing the distal catheter to be within the carotid siphon (Fig. 3 A).

The catheter was withdrawn without back bleeding, and a lateral x-ray was obtained during injection of 5 cc of Hypaque into the common carotid artery. There was filling of the internal carotid artery to the supraclinoid level without filling of the intracranial cerebral arteries (Fig. 3 B). However, there was filling of the cavernous sinus and internal jugular vein almost immediately, indicating that a traumatic carotid cavernous fistula had formed (Fig. 3 B).

The patient’s condition deteriorated immediately, and he died 18 hours after surgery.

Postmortem examination. Attempts to inject the carotid and vertebral arteries at their origin indicated no flow (intracranially) from either the carotid arteries or the left vertebral artery. The carotid arteries were removed, and examination revealed total occlusion of both internal carotids by an old, completely fibrous, thrombotic process. The

meter or by atherosclerotic plaque causes displacement of the fluid within the balloon, allowing the catheter to glide past, supposedly without undue trauma to the vessel. The circumference of the balloon can be altered according to the size of the vessel and the area of constriction by increasing or decreasing the volume of liquid in the balloon.

We are reporting two cases of total carotid occlusions at the bifurcation in which we used the Fogarty catheter; the balloon was filled with 0.5 to 1 cc of 50% Hypaque for radiographic visualization of the distal catheter. The first case illustrates a complication of the technique, and the second illustrates its usefulness.

Case Reports

Case 1. A 48-year-old white man with a 19-month history of intermittent carotid insufficiency with known bilateral reduction of retinal artery pressures was admitted to the Cochran Veterans Hospital in May, 1963. He had previously developed a left hemiparesis with a residual spastic paresis of the left leg. A retrograde femoral aortogram was

Fig. 1. Fogarty catheter (No. 6) illustrating uninflated distal bulb in top photograph and inflated bulb in lower photograph.
left internal carotid was partially occluded in the petrous portion. Two areas of the right internal carotid were totally occluded just above the bifurcation in the petrous portion. The left vertebral artery was occluded at its origin. The definite site of communication between the internal carotid artery and the cavernous sinus was not determined.

There was infarction of both frontal lobes, the left caudate region, and the left cerebellar hemisphere, and thrombotic occlusions of the left common iliac and right internal iliac arteries.

Case 2. A 56-year-old white man had a sudden onset of left hemiparesis progressing to a left hemiplegia with a left homonymous hemianopsia, left hypalgesia, and lethargy. A right common carotid arteriogram taken 40 hours later showed a total occlusion of the right internal carotid artery at the bifurcation (Fig. 4 A and B).

Operation. A carotid endarterectomy and a thrombectomy were performed immediately. Upon visualization of the carotid bifurcation, there was a bluish discoloration of the internal carotid artery and no pulsation. A thick, firm, circumferential atheromatous plaque was present at the carotid bifurcation ex-
tending into the external carotid and totally occluding the internal carotid artery. This was removed and a 5½ cm thrombus extracted from the internal carotid artery without retrograde bleeding. A rubber catheter and sucker tip were inserted into the internal carotid artery without benefit.

A No. 4 Fogarty catheter was inserted for approximately 18 cm from the carotid bifurcation, the balloon filled with 1 cc of 50% Hypaque, and a skull film obtained. This showed the distal catheter to be located in the carotid siphon (Fig. 4 C). Upon withdrawal of the inflated catheter bulb a large amount of soft thrombus was extracted ahead of the balloon, followed by good retrograde bleeding. A diamond-shaped Dacron patch graft was applied.

**Postoperative course.** There was no immediate improvement until 2 weeks postoperatively when the patient regained some leg function followed by progressive gradual improvement. At the time of discharge he could walk with the aid of a cane and was able to care for himself. He had a hemiparesis, more pronounced in the arm, no dysphasia, and no sensory defect. On the 19th postoperative day, a right common carotid arteriogram revealed excellent flow through the carotid bifurcation, the internal carotid, and filling of the right anterior and middle cerebral arteries (Fig. 5).

**Discussion**

Case 1 illustrates a complication that may occur when the Fogarty catheter is used for extraction of a thrombus from the intracranial portion of the internal carotid. This complication, a rupture or tear of the arterial wall leading to arteriovenous fistula, may result from the overdistention of the balloon or from the overzealous manipulation of the catheter during its withdrawal through the artery.

Other possible complications are intimal and medial tear with delayed dissection, or formation of intracavernous or intracranial extradural aneurysm, or a complete tearing of the internal carotid artery. The catheter might be forced through the internal carotid bifurcation, causing intracranial hemorrhage.

Case 2 illustrates the value of this technique in the treatment of a patient with sudden or rapid total carotid occlusion and soft thrombus in the proximal portion of the internal carotid artery where routine application of gentle traction or suction has failed to remove the thrombus and establish retrograde flow.

In this particular patient, who was operated on within 48 hours, excellent re-establishment of circulation was obtained with the Fogarty catheter. We cannot be certain, however, that this technique altered the na-

![Fig. 3. Angiograms, Case 1. A. The Fogarty catheter with the inflatable balloon filled with 1 cc of Hypaque is shown in the siphon portion of the left internal carotid artery. B. Post-thrombectomy angiogram of the same artery shows patency to the suprachoroidal level. Contrast material in the cavernous sinus and internal jugular vein denotes the post-traumatic carotid cavernous fistula.]
tural course. Had surgery been performed during the first 12 to 24 hours while he was hemiparetic, before the hemiplegia, the severe neurological deficit might have been prevented. However, the thrombus at that time might have been confined to the carotid bifurcation region and not have propagated distally, in which case the use of the Fogarty catheter would not have been necessary.

We are fully aware of the poor results obtained in surgical intervention in totally occluded carotid arteries as opposed to stenotic lesion with transient neurological deficits. However, if one is to embark on operative intervention in these lesions with total occlusions, we feel that the Fogarty catheter technique may have merit and occasionally be useful.

Insertion of this catheter via the cervical internal carotid artery in patients without occlusive carotid disease at autopsy revealed that this catheter will enter the proximal middle cerebral artery and less often the anterior cerebral artery.

Summary

We have described the use of an intravascular arterial catheter with a distally located

Fig. 4. Case 2. A. and B. Total occlusion of the right internal carotid artery is shown at the level of the bifurcation. C. Hypaque-filled balloon is visualized within the cavernous portion of the right internal carotid artery.
inflatable balloon for extraction of thrombi from the proximal internal carotid artery. This device was first described by Fogarty and previously used in peripheral arteries. We have reported a case in which it was successfully used to remove a thrombus from the region of the carotid siphon, with re-establishment of intracranial blood flow. We have also discussed a second case in which a carotid-cavernous arterial venous fistula developed as a complication of this technique.

References

5. Fogarty, R. J., Cranley, J. J., Krause, R. J., Strasser, E. S., and Hafner, C. D. A method for extraction of arterial emboli and thrombi.
13. Lyons, C., Clark, L. C., Jr., McDowell, H., and

Fig. 5. Postoperative arteriograms, Case 2. The patency of the internal carotid artery and the filling of the anterior and middle cerebral arteries are demonstrated.
Fogarty Catheter for Carotid Thrombo-Embolectomy


