Common carotid to intracranial internal carotid bypass venous graft

Technical note

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A 54-year-old woman was admitted with a complete occlusion of the right internal carotid artery and a 25% stenosis of the left internal carotid artery. Intracranial circulation on the right side was restored by taking a vein from the leg and anastomosing the vein of the intracranial carotid artery just distal to the anterior clinoid process. Prior to insertion the vein was turned inside out, the valves removed and then reinverted allowing the distal end of the vein to be anastomosed to the intracranial internal carotid artery. The blood flow was therefore reversed in the vein. The proximal end of the vein was anastomosed to the common carotid artery. Upon completion there was excellent circulation in the bypass graft and internal carotid artery.

KEY WORDS: cerebral revascularization • venous bypass graft • carotid artery occlusion

FREQUENTLY in carotid artery disease, one is faced with a totally occluded internal carotid artery that cannot be reopened. However, many of these cases have sufficient collateral circulation from the opposite carotid artery to nourish the affected hemisphere. It is not uncommon, though, to meet the situation where the carotid artery on the contralateral side is stenosed and this stenotic artery must supply both hemispheres. In such a situation, endarterectomy on the stenosed side carries with it a considerable risk. In the following case we attempted to avoid this risk by repairing the occluded side with a venous bypass graft from the common carotid artery in the neck to the intracranial carotid just distal to the anterior clinoid process.

Case Report

A 54-year-old woman was admitted to the Toronto General Hospital on November 24, 1969, because of 2-min episodes of left homonymous hemianopsia recurring during the last 6 weeks. In November, 1968, she had suffered a stroke which had left her with mild left-sided weakness; the right internal carotid artery was repaired at that time by a standard endarterectomy in the neck. A good retrograde flow was established but she was not given anticoagulants postoperatively as has been our custom.

Examination. At the time of the present admission the patient had weakness of the left side of her face and clumsiness and weakness of the left hand. Angiography demonstrated complete occlusion of the right
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internal carotid artery at the previous endarterectomy site (Fig. 1 left), and an 80% stenosis of the left internal carotid artery at its origin. There was also a 20% stenosis of the right vertebral artery. The angiograms demonstrated filling of the right middle cerebral and right anterior cerebral arteries through the anterior communicating artery. There was also faint filling of the intracranial portion of the internal carotid artery on the right side as far as the clinoid process, and this artery looked very small indeed. Also a small amount of contrast medium could be faintly made out passing from the ophthalmic artery into the internal carotid artery (Fig. 1 right).

Operation. A vein graft was taken from the left leg, extending from just below the knee to the dorsum of the foot. This was a tedious procedure as this obese patient had rather poor veins. In spite of this, the vein was traced throughout its course in the leg and all the small branches arising from it were carefully ligated with 5-0 silk sutures. Great care was taken to preserve many side branches of the vein on the dorsum of the foot so as to give a choice of various sizes of lumen which might be anastomosed to the intracranial carotid artery. The vein was turned inside out and the valves removed. When this was completed, the vein was reinverted and blown up with a heparin and saline solution to break down the spasm and to check for small leaks, which were then closed with 5-0 silk ligatures.

The common carotid, internal, and external carotid arteries in the right side of the neck were exposed through a right sternomastoid incision. The common and external carotid arteries were patent, pulsed well, and were free of atheroma. The internal carotid artery was a solid, firm, fibrous cord that could not be opened. No retrograde flow was therefore obtained. A right frontotemporal bone flap was then turned down, the dura opened, and the frontal and temporal lobes retracted so as to expose the internal carotid artery from the anterior clinoid process to its bifurcation.

The internal carotid artery was quite short, measuring 1 cm in length, and only 3 mm in diameter; a yellow calcium plaque could be visualized on the first 3 mm, but terminated abruptly at the site where the posterior communicating artery joined the internal carotid. Beyond this point the artery wall looked quite healthy. It was possible to demonstrate the posterior communicating artery and the anterior choroidal artery, which also appeared to be healthy. The anterior clinoid process was resected using a small angled Cloward-Harper cervical punch to gain a little more room to apply the temporary clamps (Kerr clips). The patient's body temperature was cooled to 30°C to further protect the brain while the clamps were

![Fig. 1. Preoperative lateral arteriogram showing (left) complete occlusion at the origin of the internal carotid artery, and (right) the lack of intracranial filling.](image-url)
FIG. 2. Operative drawings showing the optic nerve at the top above the rongeured portion of the anterior clinoid process. **Top:** The three temporary clips are in place. The dotted line represents the area to be resected in the lateral aspect of the carotid artery. **Center:** The vein graft is sutured to the internal carotid artery. **Bottom:** The suture line is completed and the temporary clips are removed.

In spite of this it left little working room between the two clips (about 5 mm).

The small end (distal end) of the vein graft was then brought into the head along the line of the lesser wing of the sphenoid. An appropriately sized branch of this graft was chosen and tailored to fit in an end-to-side fashion with the internal carotid artery. When this had been completed, an ellipse was cut out of the lateral aspect of the internal carotid artery wall between the occluding clamps (Fig. 2 top). This ellipse measured 3 × 4 mm. The vein graft was then sewn by two interrupted sutures to the ends of the ellipse, and using a continuous running 8–0 silk suture, the inferior and superior lines of anastomosis were completed (Fig. 2 center and bottom). The vein was then brought along the sphenoidal wing, over the temporal lobe, through a slit in the dura, and through a prepared opening in the temporal muscle and thence subcutaneously down a tunnel in front of the tragus of the ear into the neck wound. The vein was adjusted for appropriate tension, cut on the bias, and joined to the common carotid artery in an end-to-side type of anastomosis (Fig. 3). Before this anastomosis was completed, all the air was evacuated from the vein graft by allowing retrograde bleeding to occur.

The clamps were then opened on the common carotid artery and the proximal end of the graft, and the Kerr clips were removed from the posterior communicating and from the proximal and distal ends of the intracranial internal carotid artery. Immediately upon releasing the clips there was an excellent pulse in the vein graft; the internal carotid artery, which had appeared small, became several millimeters larger with an excellent pulse. One could see that the branches of the middle cerebral artery in the Sylvian fissure were now well filled with blood and that there was a much better perfusion of the right hemisphere. The bone flap was replaced leaving a craniectomy in the lower portion to allow the graft adequate room.

**Postoperative Course.** Angiograms performed after the closure of the wound showed excellent filling of the internal carotid artery, and the middle cerebral and anterior cerebral arteries on that side (Fig. 4). The patient made a satisfactory recovery.
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from the anesthesia; she had two seizures postoperatively which came quickly under control. She had been on Dicoumarol before the operation, with a prothrombin level of 25 sec and control of 12. This had caused no difficulty in carrying out the surgery, but on her 2nd postoperative day the prothrombin time rose to 32 sec with a control of 11, necessitating the administration of Aquamephyton.

Her subsequent course has been uneventful. The neurological deficit has not changed from that noted preoperatively.

Discussion

This type of venous bypass has been attempted twice before in this center, but in both instances the amount of atheroma present in the intracranial internal carotid artery prevented completion. We would now be prepared to do an endarterectomy on the atheromatous segment of the intracranial carotid artery since this is not difficult and allows a satisfactory anastomosis to be completed. This operation is a long and tedious one and, of course, would only be applicable in cases where the simpler method of endarterectomy in the neck is not possible, or in

![Fig. 3. Diagram shows final position of graft.](image)

![Fig. 4. Left: Angiogram demonstrates early filling of the graft from just below the occluded stump of the internal carotid artery to the anterior clinoid process. Right: A later phase angiogram indicates the site of anastomosis to the internal carotid artery and the subsequent excellent filling of the middle cerebral vascular tree.](image)
cases in which both hemispheres might be jeopardized by bilateral disease. We have also carried out the alternative method of connecting the superficial temporal artery into the middle cerebral artery, as described by Yasargil, but this does not supply as much blood as the larger bypass directly into the internal carotid artery.

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Reference


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