A simple technique is described for extracranial vertebral artery vein bypass grafting, utilizing an internal shunt that avoids prohibitively dangerous vertebral artery cross-clamping. This procedure was carried out successfully in a patient with vertebrobasilar insufficiency.

Key Words: vertebrobasilar insufficiency • vertebral stenosis • vein graft • vertebral artery

Cerebrovascular insufficiency of the posterior circulation has been an area of increasing interest during the past few years. Direct attack on extracranial vertebral disease has been limited to those patients who could tolerate vertebral cross-clamping for either endarterectomy, 1 vein grafting, 2 or external carotid to vertebral artery anastomosis. 3, 12 The risk of cross-clamping a solitary vertebral artery with or without angiographically demonstrated flow via the posterior communicating arteries is prohibitively high. 3, 10 We would like to report a technique for extracranial revascularization of the posterior circulation at any level. This procedure does not interfere with vertebral artery flow during the anastomosis placement.

Case Report

This 58-year-old right-handed woman presented with almost daily episodes of gait ataxia, bilateral facial numbness, severe vertigo, and bilateral macular visual loss.

Examination. Her blood pressure was 140/85 mm Hg, and she demonstrated no orthostatic changes. Angiography demonstrated right vertebral artery occlusion, 95% stenosis of the left vertebral artery at about the C-6 level, and normal carotid arteries (Fig. 1). There were bilaterally hypoplastic (or absent) posterior communicating arteries. Maximum medical therapy had failed to alter her symptomatology. Neurological examination was completely normal. Computed tomography (CT), electroencephalography (EEG), radioisotope studies of the blood flow in the anterior circulation, and ophthalmoplalstamography (OPG) analysis were also normal. It was believed that symptoms were due to hemodynamic insufficiency of the upper brain stem, and that an occipital to posterior inferior cerebellar artery bypass would not likely provide enough distal flow to the brain stem. 7, 11, 13 It was considered to be far too great a risk to undertake an external carotid to vertebral artery anastomosis or a direct vein graft, 4, 5, 6 as vertebral artery cross-clamping would leave her brain stem almost without blood supply for 1 to 2 hours. 9, 12

Operation. An incision was made along the anterior border of the sternocleidomastoid muscle, and dissection as far as the prevertebral space was performed as in an anterior cervical discectomy. Manual retraction exposed both the longus colli and the more lateral longus capitis muscles. Subperiosteal dissection was then carried out to elevate the longus colli muscle medially, and the longus capitis muscle laterally, and both muscles were held with Cloward retractors. Under low-power magnification, the anterior wall of the foramen transversarium and the anterior tubercle were removed at two adjacent levels with the aid of a diamond drill. 9 By drilling bone both medial and lateral to the vertebral artery, approximately three-fourths of the circumference of the vessel could be exposed. The circumferential venous plexus was painstakingly removed with bipolar forceps. Then, 2-0 silk ligatures were passed around the vertebral artery at...
the proximal and distal limits of the exposure, and passed through a short red rubber catheter.

A fresh saphenous vein graft was harvested from the left thigh. The left subclavian artery was exposed in the supraclavicular portion by dividing both the scalenus anticus and sternocleidomastoid muscles.

![Image](image_url)

FIG. 1. Left: Arch aortogram showing high-grade stenosis of the left vertebral artery (arrow). Right: Vertebral arteriogram showing a normal intracranial vertebrobasilar system.

The exposed and elevated portions of the subclavian artery were encircled with tapes and tourniquets at three places (Fig. 2). The harvested saphenous vein was further prepared by making a 0.5-cm venotomy at approximately its midportion. Horizontal purse-string sutures were placed but not tightened, and the proximal end of the internal shunt brought out through this incision. (The internal shunt used was a No. 10 French argyl catheter with the bubble flow at the proximal (subclavian) end and a taper at the distal (vertebral) end.) The patient was fully heparinized, and the subclavian artery clamped distally; then both proximal tourniquets were closed. The proximal end of the internal shunt was then inserted through an arteriotomy between the distal tourniquet and distal clamp and passed proximally beyond the first tourniquet (Fig. 2). Then the shunt could conduct blood from a location proximal to the first tourniquet to the distal end of the vein graft. Stay sutures were placed in the vertebral artery, which was then momentarily cross-clamped. An arteriotomy was made in the vertebral artery, and the distal end of the internal shunt inserted past the distal vertebral tourniquet, and vertebral flow was restored. The vertebral artery was cross-clamped for only 8 seconds. The end-to-side distal anastomosis was performed at leisure with interrupted 9-0 Ethicon sutures, followed by the proximal anastomosis to the subclavian artery with running 6-0 Prolene sutures. The internal shunt was withdrawn through the graft venotomy and the distal subclavian arteriotomy, and the previously placed venotomy su-

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FIG. 2. Schematic illustration of use of the internal shunt as described in the text.
Subclavian-vertebral artery bypass


...tightened. The distal arteriotomy in the subclavian artery was repaired at leisure with the vein graft now functioning normally. Drains were placed and the wounds were closed anatomically after heparin reversal.

**Postoperative Course.** The patient awoke with no neurological deficit in the vertebrobasilar distribution, but with a mild left C-5 root motor and sensory loss, which rapidly cleared. An incomplete left Horner’s syndrome is still present. Postoperative arteriography on the 4th day after surgery showed excellent flow through the graft (Fig. 3). There have been no symptoms of vertebrobasilar insufficiency in the 6-month follow-up period despite their daily occurrence preoperatively.

**Discussion**

Corkill, *et al.*, reported two cases of external carotid to vertebral artery anastomosis for extracranial vertebral stenosis. They strongly cautioned, based on both cases, that only with retrograde flow down the vertebral artery (demonstrated by angiography and by intraoperative back-flow intraluminal pressure measurements) could a venous or arterial bypass procedure be performed. Pritz, *et al.*, reported on three cases of extracranial vertebral artery augmentation. All three of their cases had contralateral patent vertebral arteries, and two had good flow via the posterior communicating arteries to the distal brain stem. They also stated that temporary occlusion of a solitary vertebral artery was too dangerous, and clearly warned that extracranial vertebral artery reconstruction is possible only if the other vertebral artery perfuses the brain stem.

Our technique is unique in several respects. Flow through a solitary vertebral artery is interrupted only for the 5 to 10 seconds necessary to insert an internal shunt. The anastomosis is not rushed and in fact, during graft placement, a greater flow to the brain stem is maintained than was present preoperatively. Removal of the internal shunt through prepared separate vascular incisions does not traumatize either the proximal or the distal anastomosis sites. Exposure of the vertebral artery in the foramen transversarium is not technically difficult, but does require tedious bipolar coagulation of the surrounding venous plexus. The distal anastomosis is performed under the microscope with 8-0 or 9-0 Ethicon sutures, and is easier than the standard superficial temporal artery to middle cerebral artery bypass. Injury to the sympathetic chain is usually unavoidable, but care should be taken not to mechanically or thermally injure the C-5 or C-6 root, which lies just behind the exposed vertebral artery.

Both the complete immediate cessation of our patient’s frequent transient ischemic attacks and the postoperative angiogram speak for themselves. Although only an initial report, we feel this technique merits consideration in patients with extracranial vertebral occlusive disease when adequate collateral flow to the brain stem is not available.
References


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