Carotid Endarterectomy with Contralateral Carotid Occlusion: Is Shunting Necessary?

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Abstract

Keywords

- carotid endarterectomy
- cerebral protection
- contralateral occlusion
- carotid shunting

Background Controversy exists about the effect of contralateral carotid stenosis on the perioperative risks of carotid endarterectomy (CEA). Despite increased perioperative risk, the long-term outcome is improved in patients who undergo ipsilateral CEA with significant contralateral carotid stenosis. Traditionally, this involved shunting the ipsilateral carotid artery during the procedure. It was believed that this minimized the risk for cerebral ischemia. We believe selective shunting can be employed while still avoiding cerebral ischemia. This requires a reliable method of monitoring for ischemia. Intraoperative EEG monitoring has been proven to be a reliable method for monitoring for ischemic changes during a case.

Methods A standard operative technique involving continuous EEG monitoring was used. We reviewed the records of carotid endarterectomies in the past 3 years. We present a series of 8 cases of CEA with contralateral occlusion in which shunting was selective based on EEG.

Results Of eight patients, seven (87.5%) tolerated the procedure without EEG changes and thus did not requiring intraluminal shunting. There were no long-term complications in our series of patients.

Conclusion We found that intraluminal carotid shunting during CEA with contralateral occlusion is not mandatory but neuroprotection methods need to be added to the operative procedure to ensure safety.

Controversy exists about the effect of contralateral carotid stenosis on the perioperative risks of carotid endarterectomy (CEA).^{1,2} The Asymptomatic Carotid Atherosclerosis Study (ACAS) and the North American Symptomatic Carotid Endarterectomy Trial (NASCET) both showed worse perioperative morbidity of CEA with severe contralateral stenosis versus those without contralateral stenosis.^{3–6} Others report results that show near equal perioperative risk.^{7,8} Despite the perception of increased perioperative risk, the long-term outcome is improved in patients who undergo ipsilateral CEA with significant contralateral carotid stenosis.⁶

The traditional technique for CEA in patients undergoing CEA for ipsilateral carotid stenosis with contralateral occlusion involves shunting the ipsilateral internal carotid artery during the procedure. Some surgeons believe it is necessary to shunt all patients undergoing CEA with contralateral carotid occlusion, although there is no conclusive evidence that a shunt improves outcomes.^{9,10} The use of an intraluminal shunt during CEA is not without complications.^{11,12} We reviewed our experience with this group of patients to examine the neuroprotection used in this challenging group of patients. We found that intraluminal carotid shunting is not mandatory but multiple other

neuroprotection methods need to be added to the operative procedure.

Methods

Neuroprotection During CEA

As part of long-standing interest and experience with patients requiring operative intervention for extracranial carotid stenosis, we adopted multiple interventions aimed at providing neuroprotection during carotid clamping. These interventions include (1) maintenance of adequate systolic blood pressure at or slightly above awake baseline, (2) continuous EEG monitoring under general anesthesia during the procedure, (3) short period of clamping with direct closure of the arteriotomy without patching such that clamp times are predictably less than 20 minutes, and (4) selective intraluminal shunting based on EEG monitoring trends, regardless of presence of contralateral carotid stenosis or occlusion.

Operative Technique

The operative technique in all patients was as follows. Under general endotracheal anesthesia, each patient has a standard longitudinal neck incision for exposure of the common carotid, internal carotid, and external carotid arteries. After administration of 5000 units of heparin, and before clamping, phenylephrine induced slight hypertension. Their mean blood pressure was maintained at 95 to 105 mm Hg. Clamps are then applied to the internal, followed by the common and external carotid arteries to avoid embolization of plaque. Careful monitoring of the patient's EEG ensures neuroprotection during clamping. Incision begins on the anterior surface of the common carotid artery and then extending into the internal carotid artery. Standard endarterectomy is performed with a Penfield dissector. The plaque is sharply divided in the common carotid artery. Eversion technique is used for endarterectomy in the external carotid artery. Direct feathering technique is used in the internal carotid artery. After removal of all fragments and thrombogenic material, the arteriotomy is closed using running 6-0 Prolene suture. The clamps are removed and the wound irrigated and inspected for hemostasis. We then use intraoperative ultrasonography to ensure patency of the artery. Once satisfied with the results of the ultrasound, the wound is closed in normal fashion. Routine drains are not used.

Study Group

After obtaining Institutional Review Board approval, we reviewed the records of carotid endarterectomies in the past 3 years. We found eight cases of severe ipsilateral carotid stenosis with a contralateral carotid occlusion. These patients make up the study group.

The study group was composed of 6 men and 2 women, the average age being 62.1 years. Of these patients, two patients were asymptomatic. The clinical characteristics of each patient are summarized in ►Table 1.

Table 1 Clinical characteristics of patients

Patient description	Indication for surgery	Carotid stenosis		Procedure	Shunt yes/no	Clamp time, min	Patch yes/no	Complications
		Right	Left					
49-year-old woman	Carotid bruit on examination, asymptomatic	85%	Complete occlusion	Right primary CEA	No	19	No	None
60-year-old man	Recent stroke, multiple TIA's	Complete occlusion	75%	Left primary CEA	No	15	No	None
63-year-old man	Hx of stroke, current asymptomatic	Complete occlusion	80%	Left primary CEA	No	16	No	None
62-year-old man	Chin/arm numbness, dizziness, Hx of stroke	85%	Complete occlusion	Right primary CEA	No	13	No	None
70-year-old woman	Multiple TIAs	Complete occlusion	75%	Left primary CEA	Yes		No	EEG changes requiring shunt
68-year-old man	Recent stroke	80%	Complete occlusion	Right primary CEA	No	30	No	None
57-year-old man	Recent stroke	75%	Complete occlusion	Right primary CEA	No	14	No	None
68-year-old man	Visual changes, left eye	80%	Complete occlusion	Right primary CEA	No	33	No	None

Abbreviations: CEA, carotid endarterectomy; EEG, electroencephalography; TIA, transient ischemic attack.

Results

Of eight patients, seven (87.5%) tolerated the procedure without EEG changes and thus did not require intraluminal shunting. A shunt rate of approximately 12.5% is very comparable with other studies using EEG to direct shunt placement.^{9,13} Average clamp time of patients who had CEA without shunt was 20 minutes with a median of 16 minutes. There were no long-term complications in our series of patients. In one patient, 3 seconds after clamp placement, there was a decrease in background wave activity. The clamp was immediately removed and EEG waves returned to patient baseline. The procedure was then performed using a shunt without further complication. At present, on long-term follow-up, there has been no stroke, death, return of symptoms, or restenosis in any of the patients presented.

Discussion

Our belief is that patients undergoing CEA for significant ipsilateral carotid artery stenosis with contralateral occlusion do not require routine intraoperative shunting during their procedure. We present a series of eight cases in which patients underwent CEA for significant ipsilateral carotid artery stenosis with severe contralateral stenosis using selective use of a shunt. These patients were monitored intraoperatively using EEG to direct shunt placement. If evidence of EEG slowing occurs during carotid clamping, then a shunt was immediately placed.

It has been shown that the most effective treatment for ipsilateral carotid artery stenosis is CEA, whether symptomatic or asymptomatic (ACAS and NASCET). In patients with significant stenosis in a carotid artery who also have contralateral carotid artery stenosis, CEA appears to be effective in reducing long-term morbidity and mortality. In our institution, we have experience in performing CEA in patients with contralateral carotid occlusion using selective shunt placement. It is our belief that the important steps in performing this safely are using a reliable monitor for cerebral ischemia and minimizing clamp time.

The main concern in performing a CEA without shunting is the increased risks of cerebral ischemia. To study and prevent this, we need to use a reliable method to monitor for cerebral ischemia. There are several suggested methods for monitoring for cerebral ischemia intraoperatively. These include EEG monitoring, transcranial Doppler monitoring, cerebral oxygen monitoring, and carotid stump pressure monitoring.

Intraoperative EEG monitoring has been proven to be a reliable method for monitoring for ischemic changes during a case. It has been shown by using EEG, that patients with contralateral stenosis do have more need for shunting. There is still a significant number of CEAs performed in patients with contralateral stenosis who did not have EEG changes. Most patients undergoing CEA with contralateral occlusion tolerate the procedure without EEG changes. In our experiences, this was true for seven of eight patients. In one patient with EEG changes, a shunt was placed and the procedure was tolerated without complication.

Shunting for all cases presents increased risks to the patient. The risks of using an intraoperative shunt include atheromatous emboli from distal carotid plaques, air emboli, intimal dissection, acute occlusion, lengthening time of procedure, and the shunt limits plaque exposure.^{10,14}

Conclusion

It is our belief that CEA with a contralateral carotid occlusion can be routinely performed safely and effectively with the selective use of a shunt. EEG monitoring is a reliable method to direct shunt placement. By using a shunt selectively, we minimize the risk to the patient by preventing complications associated with shunt placement.

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