Carotid Endarterectomy under Regional Anesthesia

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Abstract

Regional anesthesia for carotid endarterectomy is a simple, reliable, and virtually complication-free technique. We began to perform a series of carotid endarterectomy under regional anesthesia at our institution in May 1990. This report describes our experience with 180 operated patients from May 1990 till December 1995, with regional anesthesia. All patients were operated with microsurgery and we utilized the deeply cervical plexus block at the C-4 level associated with superficial block, along the posterior border of the externocleidomastoid muscle. The main advantage of this technique of anesthesia is that it is the only exact method of assessing the need of a shunt by using the neurological status of the awaken patient during trial carotid cross-clamping. The regional anesthesia allows carotid endarterectomy to be safely performed on patients with advanced cardiac disease or severe chronic obstructive pulmonary disease who were not good candidates for general anesthesia. In this 180 patients we performed 198 consecutive endarterectomies (10% bilateral) with a total morbidity-mortality rate of 2.0%.

Key words: endarterectomy, carotid artery, regional anesthesia

Introduction

Carotid endarterectomy was successfully performed for the first time in 1953 and since then refinements in all aspects of this operation have taken place. During this period of time, many controversies have been aroused and only after the publication of the result of the various cooperative studies it became an accepted and unquestionable prophylactic procedure for cerebral ischemic disease.

We believe that carotid endarterectomy is a safe and very effective method of prevention of brain ischemia and also that it could be optimized when attention is directed to several technical aspects such as: correct selection of patients, anesthesia, surgical technique, and postoperative care.

The regional anesthesia is very useful in order to select the few patients that really need a shunt during the period of carotid cross-clamping. Using the neurological evaluation during the procedure we can precisely determine the cases that develop symptoms of ischemia and also identify with accuracy the probable cause and the time of an intraoperative stroke, thus permitting immediate institution of corrective measures.

This paper focuses on surgical management of internal carotid artery (ICA) stenosis by reviewing the indications, regional anesthesia, and operative technique for carotid endarterectomy.

Materials and Methods

We began our experience with carotid endarterectomy at our institution in 1977 utilizing general anesthesia. In May 1990, we decided to change the anesthetic technique, from general anesthesia to regional anesthesia. We did that mainly because of the difficulties in monitoring all the patients and also for we believe that regional anesthesia has many other advantages that will be discussed in the following.

I. Anesthesia

Superficial and deep cervical plexus block were utilized in all patients. The deep cervical block was done at the C-4 level with 20 ml of bupivacaine chloride (Marcaine 5%; Astra, São Paulo, Brazil). For the superficial block another 20 ml of Marcaine 5% were injected along the posterior border of the sternocleidomastoid muscle. If this superficial block is not done, the patient will complain of pain and discomfort while the dissection is being done in the upper cervical region. If the patient complains of pain during the procedure, small amounts of anesthetic could be injected in the surgical field.
The use of neurolept sedation must be restricted to small doses so as not to interfere with the monitoring of the verbal, visual, and motor function testing during the cross-clamping period. The patients were monitored during the surgery by intra-arterial pressure, digital oximetry, and electrocardiography.

In order to determine the necessity of the use of a shunt during the cross-clamping period, we made a test of tolerance by clipping the ICA for 3 minutes. If the patient tolerates the occlusion for this period of time, a shunt will not be needed. If the patients tolerate the test for 3 minutes, in at least 90% of the cases they will tolerate it for the time needed for the surgery. If a neurological deficit is shown by the test, we take out the clip and wait for the regression of the neurological deficit, which usually happens in a few minutes. Before the cross-clamping to install the shunt, we give D-mannitol (Mannitol; Aster, São Paulo, Brazil) 1 g/kg, for it has an effect of brain protection and usually allows the installation of the shunt without development of neurological deficits.

The use of regional anesthesia with mild sedation for carotid endarterectomy permits effective cerebral monitoring and is a cost-effective method.

II. Surgical technique

With the patient in the supine position, the head is turned 30° away from the side of the operation and the neck slightly extended. The incision is outlined along the anterior border of the sternocleidomastoid muscle with an anterior curve in the inferior border and a posterior curve, in the direction of the tip of the mastoid process (Fig. 1).

After the skin and subcutaneous incision has been completed, dissection is carried out through the platysma and along the anterior border of the sternocleidomastoid muscle. The common carotid artery is exposed in the lower part of the incision and followed superiorly thus identifying the bifurcation and exposing the proximal 3 to 4 cm of the ICA. The origin of the external carotid and superior thyroid arteries are then isolated.

Manipulation during the dissection of the carotid bifurcation and proximal ICA are kept to a minimum so as to avoid dislodgment of embolic material from the atherosclerotic plaque. Prior to the cross-clamping of the carotid artery, heparin (70 U/kg) is administered intravenously as a bolus to all patients. After heparinization, a test of tolerance of flow interruption is done by clipping the ICA for 3 minutes. When the patient develops a neurological deficit during this test, the clip is taken out and the deficit is usually reversed in minutes. Those patients will need a shunt during the endarterectomy. Before the cross-clamping for installation of the shunt, mannitol (1 g/kg) is administered intravenously and the anesthesiologist is asked to induce mild hypertension (20 to 30 mmHg) for brain protection. This usually permits to install the shunt before the patient develops symptoms of brain ischemia again. When the occlusion of the ICA is tolerated for 3 minutes without any neurological deficit the shunt will not be needed.

We prefer to use temporary aneurysm clips for the occlusion of all arteries except for the common carotid artery, which, because of its size, requires a vascular clamp. Just before clipping the vessels, the operating microscope with 300 mm lens is brought into the field. Increased magnification combined with coaxial illumination makes the operating microscope a very useful tool in this procedure.

The arteriotomy starts in the common carotid artery and extends superiorly to the ICA beyond the end of the atherosclerotic plaque. The dissection of the plaque is done utilizing a Penfield dissector, beginning in the common carotid artery and distally on to the ICA. Finally, the plaque is freed from the external carotid artery. The artery is closed using 6-0 monofilament sutures and starting at both ends of the arteriotomy. Before final closure, backbleeding

Fig. 1 The incision is outlined over the medial border of the sternocleidomastoid muscle, with an anterior curve at the inferior end for better cosmetic results, and a posterior curve in the direction of the mastoid tip in case we need to expose a very high carotid bifurcation.
Fig. 2 After finishing the arteriotomy closure, the deoxygenation of the arteries is accomplished in a manner that expels any air or debris to the external carotid artery. A: The clip on the superior thyroid artery has been removed just before the last sutures to maintain the lumen full of blood and expel air bubbles. B: The external carotid artery is opened. C: The common carotid artery is opened allowing blood and debris to flow out to the external carotid artery. D: The common carotid artery is again occluded and the internal carotid artery opened allowing any debris to be washed back to the external carotid artery. E: The internal carotid artery is clipped again and the common carotid artery is opened. Finally, about one minute later, the internal carotid artery is reopened.

from all the vessels is done in order to eliminate air and debris from the lumen.

The clips are removed in a specific sequence (Fig. 2) so as to reduce the risk of embolic stroke. Finally, the surgical field is carefully inspected for hemostasis and after that the wound is closed in two layers using interrupted sutures. The heparin is not reversed at the end of the procedure.

Some surgeons advocate the use of carotid patch angioplasty as a routine in carotid endarterectomy to avoid local stenosis.\textsuperscript{6,7} Using microsurgical technique, primary closure can be done without stenosis in the great majority of cases.\textsuperscript{27,28} We indicate patch angioplasty when the surgery is being done for recurrent stenosis or in the very rare cases of ICA with a diameter smaller than 4 mm.

Results

From May 1990 to December 1995, we performed 198 endarterectomies in 180 patients (10% bilateral). In this series, the shunt was made necessary in only eight surgeries (4%), on patients that developed symptoms of ischemia during the test of occlusion of the ICA. After reopening the ICA, the neurological deficit was cleared in minutes in all patients. Before the new interruption of the blood flow to install the intraluminal shunt, mannitol (1 g/kg) was given associated with induced hypertension for brain protection.

The age of the patients ranged from 0.37 to 89, the average being 66.5. Most of the patients were symptomatic (89%), with transient ischemic attacks or strokes. There were two postoperative deaths (mortality of 1.0%), the first one secondary to a heart attack 1 week after the surgery, and the second one secondary to a brain stroke. There was only one postoperative stroke with full recovery in a few weeks. Tables 1 and 2 represent the incidence of nonischemic and ischemic complications.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Transient nonischemic postoperative complications in 198 endarterectomies under regional anesthesia</th>
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<tbody>
<tr>
<td>Complications</td>
<td>No. of cases</td>
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<tr>
<td>Recurrent laryngeal palsy</td>
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<tr>
<td>Wound hematoma</td>
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<tr>
<td>Wound infection</td>
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<tr>
<td>12th cranial nerve paresis</td>
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<tr>
<td>7th cranial nerve palsy</td>
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<td>Total</td>
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<th>Table 2</th>
<th>Morbidity and mortality in 198 carotid endarterectomies</th>
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<tr>
<td>Complications</td>
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<tr>
<td>Transient ischemic neurological deficits</td>
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<tr>
<td>Stroke</td>
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<tr>
<td>Death</td>
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<tr>
<td>Total</td>
<td>4</td>
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Discussion

Carotid endarterectomy is a useful and efficient procedure in the prevention of brain ischemia and the anesthetic technique does not make the results any different.1,3,17,22,23)

There is no doubt that the regional anesthesia is much better for high risk patients.2,9,20,26) The awaken patient during surgery is at the same time the best and simplest way to monitor brain functions.10,12,26,29) The other existing monitoring procedures are expensive because they require high technology equipment and they sometimes fail as well.4,14)

The use of a shunt under regional anesthesia is less frequent than that under general anesthesia (4% in this series). That is important for it is well known the shunt can make the surgery more difficult and also make the risk of cerebral embolism higher.14,30) Several clinical studies have shown that regional anesthesia is better for high risk patients and that the chance of myocardial infarction is lower under this kind of anesthesia.18,19,23)

The time of hospitalization is shorter with regional anesthesia (an average of 3.5 days in our series) and as a consequence the final costs are lower.

References

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