

# Sub-adventitial carotid body resection: How we do it to avoid complications? A Step-by-Step Surgical Technique

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## Abstract

Carotid body tumors are rare, typically benign neoplasms located at the carotid bifurcation. Complete surgical resection is the only definitive cure, but can be associated with significant morbidity due to the tumor's intimate relationship with cranial nerves and carotid arteries. This article outlines the key steps of our technique for Sub-adventitial tumor dissection to minimize complications.

**Keywords:** Carotid body tumor, Sub-Adventitial, Resection

## Introduction

Carotid body tumors, while uncommon, are the most frequently encountered head and neck paraganglioma. The carotid body contains specialized chemoreceptors that help maintain homeostasis by increasing ventilation in response to hypoxia, hypercapnia, and acidosis [1]. Carotid body is derived from both mesodermal and neuroectodermal embryonic origins [1].

Carotid body tumors are generally well-circumscribed and splay the carotid bifurcation. They are located under the adventitial layer of the artery, adhering closely. These highly vascular tumors have oxygen consumption exceeding even the heart and brain. Their blood supply runs through a thin strand of adventitia called the Meyer's ligament [2].

Patients typically present with an asymptomatic anterior neck mass. Tumors are palpable when >3 cm, felt as a non-compressible, rubbery lump that moves laterally but not vertically in the anterior cervical triangle. Cranial nerve deficits indicate an associated cervical paraganglioma or malignant tumor [1].

In general, all carotid body tumors in healthy patients should be resected as surgical resection provides the only reliable cure; however, surgery risks cranial nerve injury in up to 17% of cases [3], which can cause permanent deficit in 5-9%. Injury occurs during dissection, especially in a bloody field. The marginal mandibular branch of the facial nerve, hypoglossal nerve, superior laryngeal nerve, cervical sympathetic

chain, vagus, and glossopharyngeal nerves are at risk. Another major risk is stroke, declining from 25% prior to 1965 to 1% currently. Most strokes are associated with vascular injury during resection of large tumors which requires vascular repair or replacement [2].

Controversy exists regarding the optimal technique to resect carotid body tumors while minimizing hemorrhage and neurovascular complications. Approaches such as preoperative internal carotid artery stenting [4], external carotid ligation, and craniocaudal dissection [5] have been described. The goal of our technique is complete tumor removal without neurovascular compromise.

## Technique

### *Patient positioning and Anesthesia*

Induce the patient under general anesthesia with endotracheal intubation. Position the patient in a semi-sitting position with a roll placed under the upper thoracic spine between the scapulae; similar to a carotid endarterectomy. Rotate the face away from the operative side as much as possible. After prepping the patient and using head drape proceed to incision.

### *Surgical approach and exposure*

Make an anterior cervical incision along the sternocleidomastoid border up to the mastoid process. The lower end of the incision can be located at the upper cervical crease, from where one may choose to deviate the incision towards the midline for better

cosmetic results. By neurolysis of the greater auricular get adequate exposure without cutting this nerve. Retract the sternocleidomastoid muscle laterally to expose the carotid sheath, allowing for localization of the internal jugular vein and, underneath it, the carotid artery. Place self-retracting device to optimize exposure. Identify the facial vein and then ligate it. Retract the jugular vein from the carotid artery. Dissect away areolar tissue around the carotid sheath.

### *Tumor excision*

Now if dilated tumor fed veins are evident on the common carotid artery the diagnosis of carotid body tumor is confirmed. It is essential to identify the fine connective tissue capsule covering the carotid artery here in order to proceed with the operation. This tissue is separated with the surgeon's index finger way up to the base of skull. This will separate the tumor from all the surrounding nerves and one can proceed the operation with impunity. Early proximal common carotid control is crucial in identifying this capsule, particularly when dealing with large carotid body tumors. Start dissecting the large vessels over the common carotid artery toward internal carotid artery and separate all feeding vessels with a LigaSure™ Small Jaw Open Sealer/Divider handle (Covidien) up to the base of the skull. So the most important structure which is internal carotid artery now is dissected free from carotid body tumor. After reaching to the top of tumor from here come down to the bifurcation ligate all the vessels traversing this layer of dissection. The tumor must then be dissected from the external carotid artery in the same way, paying particular attention to the bifurcation or first few millimeters of external carotid artery where the tumor receives its major blood supply. It is important to localize this vessel with a fine tip hemostat clamp, being careful not to point the tip towards the carotid bifurcation. Go parallel to bifurcation and properly ligate this vessel. From now the rest of the operation is relatively simple.

After dissecting the tumor from both the internal and external carotid arteries in front, use an Alice clamp to lift the tumor at the bifurcation and dissect it off the aforementioned arteries and subsequently from the areolar tissue which separates the tumor from sympathetic nerve behind. This can be accomplished by implementation of a LigaSure™ Small Jaw Open Sealer/Divider handle (Covidien). By utilizing this

technique, the tumor is devascularized prior to resection.

It is essential to note that if a tumor is exceptionally hard upon palpation and is severely adherent to internal and external carotid arteries, it is presumed to be malignant. In these cases, we abort the surgery. Fortunately, these patients can be well managed by radiation therapy.

### *Hemostasis and closure*

Achieve hemostasis and irrigate the surgical field before closure. Close platysma and skin in separate layers. Apply a sterile dressing.

## **Results**

With this technique almost all benign carotid body tumors can be resected with minimal bleeding. This technique avoids cranial nerve injury.

## **Discussion**

Surgical resection of carotid body tumors represents a special challenge to the surgeon because of the complex anatomical location of the tumor, including close relationship with the cranial nerves, involvement of the carotid vessels and large vascularization of the tumor.

Various methods have been described to reduce complications during carotid body tumor resection.

Preoperative interventions such as internal carotid artery stenting, external carotid and its branches ligation [4], or selective CBT branch artery embolization [6] are reported.

Intra operatively again there are several techniques available. One approach involves working in a craniocaudal fashion from the skull base to the carotid bifurcation [5].

When resecting carotid body tumors, either the tumor-adventitial or subadventitial plane can be utilized. Some studies suggest that a tumor-adventitial plane of dissection could be safer when the carotid artery is densely involved. However, other studies propose that subadventitial excision, executed meticulously, allows for complete tumor resection with minimal morbidity and no surgical mortalities. Notably, there have been no reports of tumor recurrence when using the subadventitial plane of dissection [6, 7].

As overall subadventitial resection is a safer technique for treating of carotid body tumors.

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