The Carotid Body Tumor

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Carotid body tumors (CBTs) initially were termed chemodectomas, but are now more commonly referred to as paragangliomas. These very rare tumors arise at the bifurcation of the carotid artery. They are situated between the branches of the internal and external carotid arteries (Figure 1). Most CBTs are benign, although approximately 10% are malignant, and 10% are bilateral.

Histologic description of carotid body tumors was first reported by Marchand in 1891. CBTs are characterized by their extreme vascularity and intimate relationship with major blood vessels and cranial nerves. They can receive their vascular supply from the external carotid artery or thyrocervical trunk.

Initially, surgical removal of carotid paragangliomas was fraught with high morbidity and mortality, but with improvements in anesthesia, blood replacement, and surgical techniques, such as tumor embolization, the removal of these tumors is a relatively safe procedure with low morbidity.

Due to the nontender, slow-growing nature of this tumor, it could go unnoticed until its increase in size involves the vagus, hypoglossal, and glossopharyngeal nerves. If the tumor is large enough, the patient may present with a chief complaint of dysphagia or hoarseness because of nerve compression.

Tumor Etiology and Diagnosis
The etiology of CBTs is unknown; however, there is an association between chronic hypoxemia and carotid body hyperplasia and tumors. The tumors grow in the adventitial plane between the internal and external carotid arteries, causing the characteristic splaying of the arteries. The tumors are composed of nests of epithelioid cells with finely granular eosinophilic cytoplasm and small oval or round nuclei. The tumors are encapsulated and extremely vascular. Their vascularity is supplied by the branches of the external carotid artery and the vasa vasorum.

A carotid body tumor may be suspected by family history and/or palpation of a slow-growing, nontender neck mass. It is confirmed by radiologic evaluation. Computed tomography (CT) and magnetic resonance imaging (MRI) can provide information on the degree of invasion into surrounding structures. The location of the tumors and their tendency to surround neurovascular structures makes resection potentially hazardous. Early studies reported such high rates of morbidity and mortality that a nonsurgical approach was recommended.

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One of the unique characteristics specific to a CBT is that upon palpation, the growth will move anterior-posteriorly, but not superior-inferiorly. A needle should never be introduced for biopsy due to the extreme vascular supply of these neoplasms; a severe hemorrhage could result, and a hematoma may make an excision impossible. Angiography may be pathognomonic for these tumors. A carotid arteriogram will reveal the size and shape of a tumor, its location, and its involvement with the great vessels.

Surgical Planning and Preparation
The planning for the resection of a CBT involves a team approach. Once a diagnosis has been made from an arteriogram, a surgical team consisting of a neuroradiologist, a vascular surgeon, as well as a general surgeon knowledgeable in head and neck procedures, will work together in preparation for this complex surgical procedure. The technique of embolizing these vascular tumors preoperatively has proven to be an effective tool in conjunction with surgery. This involves the introduction of either a piece of absorbable gelatin foam, radiopaque silicone spheres, or the injection of a silicone glue. This concept works to contain the embolic phenomenon within a specific region and to lessen its ramifications in the neoplasm. This procedure reduces the vascularity of the tumor by embolizing the blood supply. The procedure of embolizing these vascular tumors is performed a day or two prior to surgery. This technique is an uncomfortable procedure for the patient and is not without risk: the embolic material could dislodge and travel directly to the brain, resulting in cerebrovascular accident (CVA), blindness, or death.

Despite the preoperative risk, embolization is considered necessary for the safe evacuation of the tumor in the operating room.

Instrumentation
A regular dissecting set is used for this case in combination with a vascular set. The surgeon may request additional clamps such as ring handled bull dogs and finger grasping bull dogs. A Detrich right-angle clamp is needed for passing vessel loops and ties. A Fogarty clamp may also be placed on the table for partial or complete vessel occlusion. Hartman clamps used with shods should be available for anastomosis. Red rubber catheters with wire made into tourniquets should be on the table; they are used with No. 5 silk ties to obtain proximal and distal control of
the vessel. Fine Metzenbaum scissors or endarterectomy scissors are used for the fine dissection. DeBakey or Potts-Smith forceps are available for grasping the fine tissue during the dissection and fine gold forceps, with or without teeth, are used for grasping the vessel.

The surgical technologist may also wish to add the following retractors to the setup: Gelpi (self-retaining), Weitlaner (self-retaining), Green thyroid (hand-held), Vein retractor (hand-held).

The surgical technologist should be aware that when the carotid trunk is being compromised during this type of surgery, the patient may experience bradycardia. As a result, the surgeon may wish to inject 1% lidocaine into the surgical area to treat this condition. The scrub person should request that the circulator have this medication available. Various-sized shunts should also be in the room for this case. The surgeon may wish to use a shunt if the surgery requires the use of a carotid patch or graft.

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**Resection of the CBT**

The patient arrives in the operating room suite and is greeted by a team of surgeons, including a general surgeon who specializes in head and neck procedures, and a vascular surgeon, who will scrub on the case and stand by in the event that assistance is required. The surgeon explains that if there is too much involvement with the cranial nerves, the procedure will be aborted. The normal protocol of the anesthesiologist for administering general anesthesia is followed. The patient is sedated and intubated and an arterial line is inserted so that the patient’s blood pressure can be carefully monitored. The surgeons prep the patient’s left leg as well as the affected side of the neck for the possible harvest of the saphenous vein. This vein may be used later if a resection of the carotid artery with reconstruction using a vein graft is necessary. The continuity of the common internal carotid artery must be preserved; however, if need be, the external carotid artery can be sacrificed.

An incision is made following the anterior border of the sternocleidomastoid muscle. Care is taken while making the incision to prevent any injury to the underlying nerves. After the incision is completed, the vagus and hypoglossal nerves are dissected free and will remain well isolated throughout the procedure. The lymph nodes are dissected free from the internal jugular vein and sent with the pathologist for frozen section examination. Proximal and distal control of the carotid artery is obtained. The tumor is then dissected free from the vessel by remaining in a subadventitial plane. Electrocautery is not chosen for the coagulation of vessels in this intimate dissection. Instead, silk suture 4-0 free ties are used to ligate vessels.

Using fine Metzenbaum scissors and DeBakey forceps, the slow dissection of the tumor progresses. The surgeon must at all times be aware of the vagus and hypoglossal nerves. The branches of the external carotid artery are sacrificed if necessary. The external carotid artery can be completely removed without complications. In 85% of these neoplasms, there is cranial nerve involvement. A cautious and meticulous dissection must be performed. Once the tumor has been excised, the pathologist is called. The tumor is examined to ensure that its margins are clearly identified. CBTs have a fine capsule surrounding...
them. The pathologist will confirm that the resected tumor’s capsule is intact and that the surgeon has left no part of the mass behind.

Blood typing and crossmatching was performed for the patient for four units of blood; however, blood loss may not be substantial enough to necessitate transfusion. A hemovac drain is inserted to prevent a hematoma. The surgeon closes the incision with a subcuticular stitch using a 4-0 undyed, uncoated monofilament polyglactin 910 on a P3 needle. Sterile strips are applied, and a large soft dressing is lightly taped around the patient’s neck.

Postoperative Care
Morphine is administered for postoperative pain. After an approximately 5-hour stay in the postanesthesia care unit (PACU), the patient is transported to the intensive care unit (ICU).

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The following day, the hemovac drain is removed if there is minimal drainage. The patient may be discharged within 48 hours of admission. The surgeon may prescribe acetaminophen with codeine for discomfort. Restrictions include lifting, driving, and strenuous physical activities. The patient may resume his or her normal activities within approximately 2 weeks.

Summary
A carotid body tumor is an extremely rare lesion of the carotid artery. These tumors range in size from 1 cm to 7 cm. In the past, excising a tumor of this magnitude was very difficult. With the modern technique of embolization, resection is much safer and considerably less traumatic. It has been shown to cause less nerve damage and less blood loss. A small percentage of CBTs are malignant and have the capability to metastasize. It is not uncommon to see a patient with bilateral carotid body tumors. If a mass is found to be unresectable, it is most often treated with radiation. Δ

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