

Carotid Body Paragangliomas

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ABSTRACT

The aim of this study is to review our experience in the management of carotid body tumors in the National Cancer Institute. This retrospective and prospective review was carried out at NCI Department of Surgical Oncology. Eleven patients with carotid body tumors were identified from January 1997 to December 2000. All of them were submitted to surgery after preoperative clinical and radiological diagnosis. None of them underwent preoperative embolization. Two patients died from severe blood loss during surgery. Neurological deficits were noted in 3 patients immediately after surgery. In one patient the deficit was permanent. Conclusive surgical resection is the treatment of choice for carotid body tumors. In our series, the risk of post surgical cranial nerve deficits was small. Simple observation of these tumors is not recommended, as the treatment of choice, because progressive growth is associated with increased risk of neurological deficits.

Key Words: *Carotid body tumors - (C.B.T.)*

INTRODUCTION

Paragangliomas arising from the carotid bodies are generally rare tumors but comprise the majority of head and neck paragangliomas (60-70%). They are closely related histologically to other paragangliomas (glomus jugulare, glomus tympanicum, intravagal and laryngeal paragangliomas) and to pheochromocytomas of the adrenal medulla. Both familial and sporadic forms have been documented [3].

The mean age of diagnosis is 40-50 years; however, carotid paragangliomas may occur at any age. The term paraganglia was first used by Kohn in the early twentieth century and is the most appropriate nomenclature from an embryological standpoint [9]. These nests of cells appear to originate from neural crest cells that have migrated in close association with the autonomic nervous system ganglion cells.

The carotid body was first described by Von Haller in 1743 and is a round, reddish-brown to tan structure found in the adventitia of the common carotid artery [2]. It is located on the posteromedial wall of the vessel at its bifurcation and is attached by "Mayer's ligament" through which the feeding vessels run (primarily from the external carotid). The normal carotid body measures 3-5 mm in diameter but is often larger in people living at higher altitudes. Afferent innervation is provided through the glossopharyngeal nerve.

The histologic appearance of the carotid body is identical to other paraganglia and includes two types of cells: Type I (chief) cells: are APUD type cells with copious cytoplasm and large round or oval nuclei [5]. Their cytoplasm contains dense core granules that store and release catecholamines. Chief cells are divided into three types: progenitor cells, light and dark (mature) cells. It is the hyperplasia of the dark chief cells that leads to enlargement of the paraganglia during chronic hypoxia [11]. Type II (Sustentacular cells): are elongated cells that closely resemble Schwann cells. Their function is not entirely clear [4]. These cells are arranged into clusters with a core of chief cells surrounded by sustentacular cells embedded in a fibrous stroma [8].

Grossly, the carotid paraganglioma is dark tan to purple in color and is usually fairly well circumscribed although there may be only a very thin fibrous capsule. They tend to splay the carotid bifurcation as they enlarge and can extend along the internal carotid to skull base. Histologically, the paraganglioma is similar to the normal carotid body except that clusters tend to be larger (Zellballen formation). Also,

there are often areas of spindle-shaped cells (sarcomatoid foci) and highly vascular areas that may resemble an angioma [16]. Nuclear pleomorphism and cellular hyperchromatism are common and should not be considered evidence of malignancy. In fact, there are no clear histological characteristics of malignancy. This diagnosis should be reserved for the presence of local, regional or distant metastases. Carotid paragangliomas also resemble pheochromocytomas but are often less chemically active than their adrenal counterpart [6].

The sporadic form of carotid body paraganglioma is more common than the inherited variety and tends to occur slightly more often in women. It is seen more frequently in people living at high altitudes and is multicentric in approximately 10% of cases with bilateral carotid body lesions being the most common combination [3]. Malignancy occurs in 6-12.5% of cases, which ranks carotid body paragangliomas as the most frequent malignant head and neck paraganglioma [14].

The hereditary form occurs in 7-9% of cases and is more frequently multicentric (30-40%). These are seen with equal frequency in both sexes and the inheritance pattern is autosomal dominant, modified by genomic imprinting. Although the allele can be passed from either parent, only those from the father will lead to the paraganglioma phenotype in the children. It is thought that this occurs because the allele is only activated during spermatogenesis and not during oogenesis [14]. Since treatment of smaller tumors carries a much lower risk of morbidity and mortality and because of the autosomal dominant pattern of inheritance, routine examination and screening with MRI every two years for at risk individuals older than 16 to 18 years of age is recommended [9]. This costly approach may be eliminated in the future if a reliable genetic screening test can be developed.

PATIENTS AND METHODS

This is a prospective study performed of all patients treated by junior and senior authors from January 1997 to December 2000. Eleven patients were identified who had presented with C.B.T. The data of each patient was analyzed for preoperative deficits, operative details and postoperative neural loss and other postoperative sequela. Follow-up was available for 8 patients; this follow-up information was obtained

from the patients or from the medical records.

All the patients with carotid body paragangliomas presented with slowly enlarging, non-tender neck masses located just anterior to the sternocleidomastoid muscle at the level of the hyoid bone (Fig. 1). Two masses transmitted the carotid pulse and one mass transmitted a thrill. One patient presented with dysphagia, hoarseness and three cases presented with odynophagia.

Carotid angiography was done to eight patients. This modality can establish the diagnosis, demonstrate multiple lesions, determine the size and vascularity and evaluate the tumor blood supply. This information is extremely important in preoperative planning and counseling of the patient as to the relative risk of surgery. The classic, pathognomonic finding on arteriogram is widening of the carotid bifurcation by a well-defined tumor blush (lyre sign) (Fig. 9). It should be emphasized that angiography of both carotid systems is required to rule out bilateral tumors. MRI with GAD (that can detect tumors as small as 5 mm) and contrast CT (Figs. 6,7,8,10,11) are also effective imaging modalities in this area and are non-invasive [12].

Biopsy, including fine needle aspiration is unnecessary, dangerous and even contraindicated in the evaluation of paragangliomas.

We had only four patients who had incisional biopsy outside NCI beforehand, as they were erroneously diagnosed as cervical lymph nodes. Routine screening for urinary metanephrines and VMA and serum catecholamines is probably only indicated for multiple or familial paragangliomas or in the presence of catecholamine related symptoms [7]. The treatment of choice for most carotid body paragangliomas is surgical excision. However, because of their location in close approximation to important vessels and nerves, there is a very high risk of morbidity (mainly cranial nerve X-XII deficits and vascular injuries) which was estimated as 3-9% [8,12]. Tumor size was identified as the most important factor for such morbidity. Tumors greater than 5 cm in diameter had a complication rate of 67% compared to 15% for tumors < 5 cm [9]. A classification system based on size and difficulty of resection has been developed [13]. Group I tumors are small and easily dissected away from the vessels (three patients). Group II includes paragangliomas of medium

size that are intimately associated with the vessels but are separable with careful subadventitial dissection (4 patients). Group III tumors are large and typically encase the carotid requiring partial or complete vessel resection and replacement (4 patients).

An extensive and complete preoperative work up is essential for safe resection of carotid body paragangliomas.

Although some earlier articles recommend angiographic embolization preoperatively, other authors discourage this because it seems to be associated with an inflammatory phase that makes subadventitial dissection more difficult [10].

In our series none of the patients had been treated with preoperative embolization.

The usual approach was transcervical. No patient in our series required the skull base approach. Wide exposure was a must for meticulous hemostasis. Early control of the proximal and distal vessels was then accomplished with vessel loops. Important neurovascular structures were identified and appropriately retracted. The tumor was then carefully dissected from the common carotid in a subadventitial plane (Fig. 2). This dissection was carried out superiorly, making every effort to protect the internal carotid. If necessary, the external carotid can be sacrificed (Fig. 3). If the common or internal carotid was encased in the tumor or it was damaged during resection, immediate repair/replacement should be performed [15]. Again, the preoperative work up should indicate the likelihood of vascular involvement and give some indication as to how well the patient will tolerate temporary internal carotid compromise [1].

RESULTS

From January 1997 to December 2000, eleven patients presented with unilateral neck mass, 7 on the right side and 4 on the left side.

Four of them had previous incisional biopsy as they were erroneously diagnosed as cervical lymph nodes. There were 7 females and four males. The age range of the group extended from 20 to 63 years. Two patients died intraoperatively from severe blood loss due to uncontrollable hemorrhage. The tumor ranged in size from 0.5 cm to 8 cm. Three patients having tu-

mors 3.0 cm or less in size were symptom-free and were identified incidentally during imaging evaluations for some other reasons all presenting as a neck mass (8 patients). Most tumors could be dissected away from the carotid system with no damage to either internal or external system. In two patients with tumors about 5.0 cms, they needed venous patch graft. The carotid artery was resected in one patient (with tumor 8 cms).

One patient presented with preoperative cranial nerve involvement. She presented with vagal paresis. Postoperatively, there were 3 patients with paresis of cranial nerves improved after surgery.

Two patients sustained only loss of superior laryngeal nerve and one patient in whom the vagus nerve was shaved away from the tumor with minimal damage leading to postoperative paralysis of the ipsilateral vocal fold. Only one patient presented with nodal in metastatic spread in cervical nodes.

There has been no recurrence of any of the resected C.B.T., however it will take for longer follow-up to validate the adequacy of the resections.



Fig. (1): CBT common presentation with cervical mass.

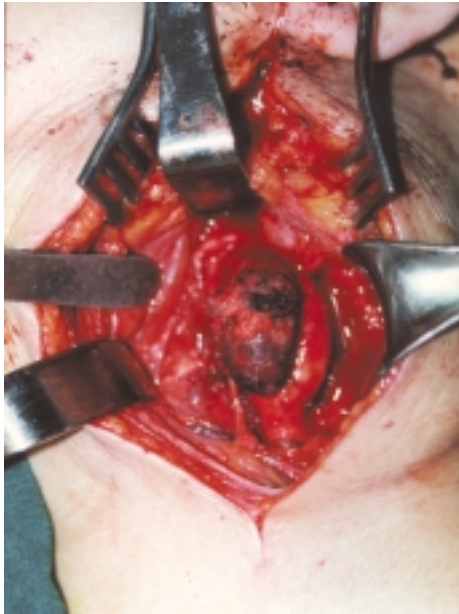


Fig. (2): Transcervical exposure of Rt CBT.

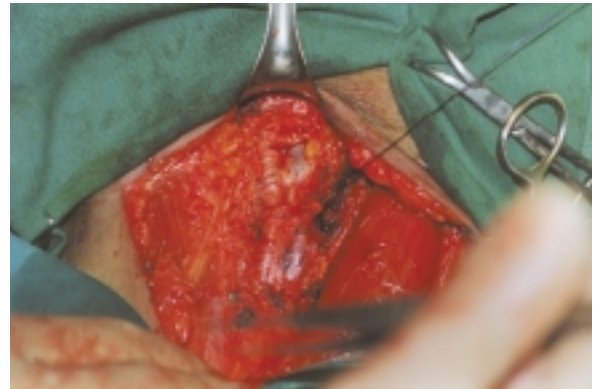


Fig. (3): CBT exposure to ICA and ligation of ECA.

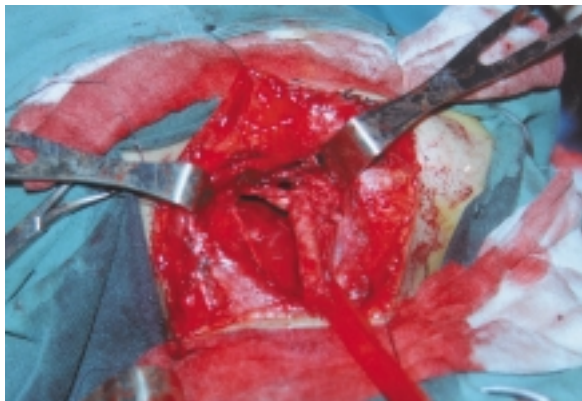


Fig. (4): Operative Field after complete dissection of CBT and immediately before extirpation.

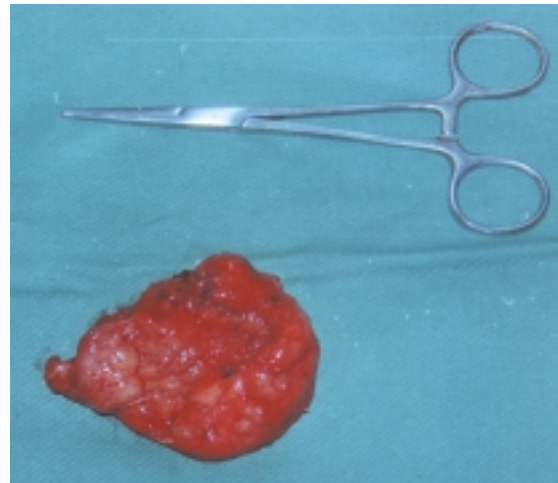


Fig. (5): Postoperative specimen (7 cm x 4 cm).

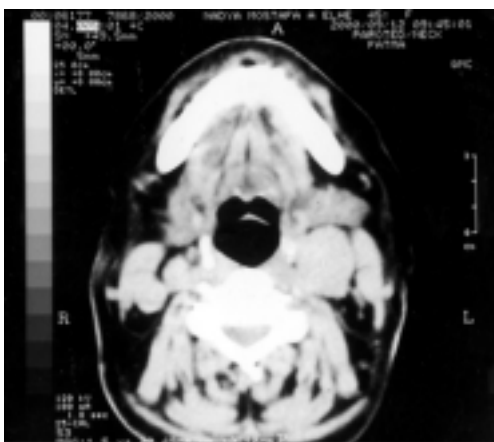


Fig. (6): CT of the left CBT.



Fig. (7): Coronal CT of right CBT.

The major morbidity is cranial nerve injury. McCaffrey et al. [9], reviewed the incidence of cranial nerve injury in 8 recent series including their own report.

The nerve palsy rate ranged from 17 to 57% with a mean value of 40% for the entire group. It is difficult to compare these results with ours as they had different thresholds for defining nerve palsy or loss. Following the resection plan, permanent nerve palsy was seen in one patient, however two patients sustained only loss of the superior laryngeal nerve.

Radiotherapy, either alone or in conjunction with surgery, is a second consideration and an area of some controversy. Historically, paragangliomas were considered radioresistant. Some authors believe this radioresistance was false and based on past experience where only large, recurrent or inoperable tumors were treated with this modality [17].

Several more recent studies indicate good responses to supervoltage radiation including some complete responses. They report only minimal acute complications (skin changes) and no long-term complications. However, other studies have demonstrated persistence of disease in lesions whose growth was stabilized by radiotherapy. Most authors still recommend XRT only for very large tumors, recurrent tumors or for those patients who are poor surgical candidates [16].

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