

# Neurological Complications in Surgical Management of Carotid Body Paragangliomas

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## Abstract

**Introduction:** Carotid body tumors are rare neoplasm and must be considered in the evaluation of all lateral neck masses. Though surgical excision of carotid body tumor is a challenge to the surgeon, early surgical excision is considered. Cranial nerve injuries are common because of its proximity to the carotid body tumor.

**Methods:** Fifteen carotid body tumors operated on 14 patients over ten year period from July 2003 to June 2013 were retrospectively reviewed. Six (42.9%) of the patients were male and eight (57.1%) were female. The average age was 41.9 years (23 to 70 years). Physical examination, radiological evaluation, method of treatment and postoperative complications were studied. Four cases belonged to Shamblin class II and 11 to Shamblin class III. Six (40%) cases were operated with carotid shunt and four (26.7%) with clamping of carotid artery. Division of external carotid artery was required in five (33.3%) cases. Polytetrafluoroethylene graft was used to maintain continuity of internal carotid artery in three (20%) cases and external carotid artery was transposed to internal carotid artery in one (6.7%) case.

**Results:** Complete resection was possible in all cases. Cranial nerve palsies were noted in five (33.3%) cases. Two of them had complete recovery whereas three (20%) had permanent palsy. No stroke and mortality occurred.

**Conclusion:** Carotid body tumor has higher risk of cranial nerve paresis which requires good surgical skills to ensure complete removal. Vascular excision with continuity to internal carotid artery may be required while undertaking complete carotid body tumor excision.

**Keywords:** carotid body tumor, carotid paraganglioma, cranial nerves, Shamblin classification

## Introduction

Tumors arising from the carotid body are interchangeably called carotid body tumors, paragangliomas, chemodectomas and glomus tumors. Carotid paragangliomas is the current general term used.<sup>1</sup> Carotid body tumors are both unusual and highly vascular, arising from paraganglion cells of the carotid body. They usually present with asymptomatic lateral neck mass. While these are usually benign, resection of large tumors can be complicated by high incidence of cranial nerve (CN) injury due to direct involvement or because of its close proximity.<sup>2,3</sup>

Involvement of carotid artery can occasionally necessitate carotid artery reconstruction.<sup>4</sup> At present, uncomplicated resection of these tumors is usually feasible as a result of careful preoperative planning and the use of several adjuncts, including use of bipolar cautery,<sup>5</sup> selective carotid shunting<sup>6</sup> and carotid artery reconstruction when deemed necessary.<sup>7</sup> Availability of adjuncts minimize neurovascular complications.

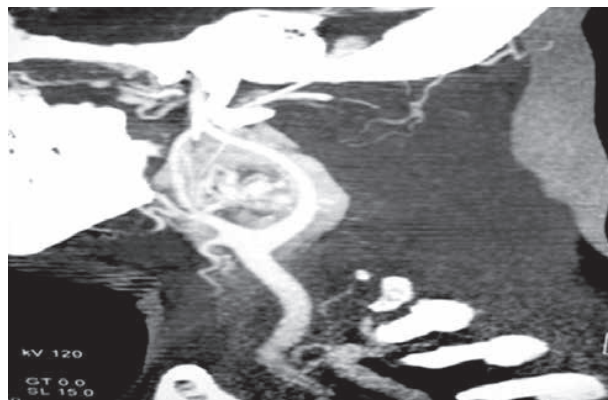
## Methods

A retrospective review of the medical records of the patients diagnosed with carotid body tumor during the period of July 2003 and June 2013 was performed. Six (42.9%) of these patients were male and eight (57.1%) were female. Eight (53%) had the tumor on left side and six (40%) on right side. One male patient had bilateral carotid body tumor (7%). The age of patients ranged between 23 to 70 years and the average age was 41.9 years. Four (26.7%) patients had Shamblin type II tumor and 11 (73.3%) had type III.

The main symptom was a slowly growing lateral neck mass. The patients did not have neurological deficits. The most common finding on physical examination was a pulsatile, hard rubbery mass located below the mandibular angle that was palpable on the carotid arterial trace; mobile in horizontal plane and immobile in the vertical plane. The minimum and maximum sizes of the tumors were 3 cm x 3 cm and 5 cm x 7 cm, respectively.

Before being referred to our center, five (33.3%) patients had undergone fine needle aspiration cytology (FNAC). This did not help in diagnosis. We generally avoid FNAC as this tumor is highly vascular and may lead to potential complication. To confirm diagnosis all patients underwent doppler ultrasound aided by computed tomography (CT). CT angiogram in these patients assisted us in delineating clear picture of tumor and its close relation to carotid arteries (Fig 1).

**Fig 1: CT angiogram showing splaying of carotid artery with highly vascular carotid body tumor.**



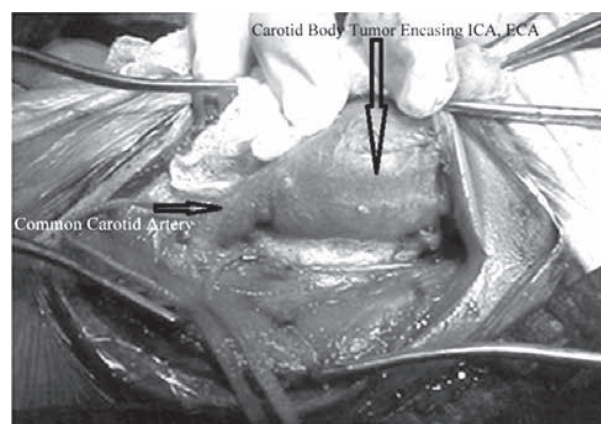
Patients were operated under general anesthesia. Based on tumor location as shown by preoperative imaging, excision was performed through a standard anterior sternocleidomastoid incision. Common carotid artery and branches were explored. Dissection was typically directed to achieve control on common carotid artery proximally

and internal as well as external carotid arteries distally before attempting tumor mobilization. Despite the majority of the patients having Shamblin III tumors (Fig 2) none underwent pre-operative embolization as this potentially entails complications like transient ischemic attack (TIA) and stroke.<sup>8</sup> To minimize CN injury, bipolar cautery was used; adjacent non-involved CNs were protected and mobilized off the tumor as required. The intraoperative data is shown in Table 1.

**Table 1: Intraoperative data.**

Surgical approach	N (%)
Complete resection	15 (100%)
ICA clamping	4 (26.7%)
Carotid shunt	6 (40%)
Division of ECA	5 (33%)
PTFE graft	3 (20%)
Transposition of ECA to ICA	1 (6.7%)

**Figure 2: Operative picture showing carotid body tumor encasing both internal and external carotid arteries (Shamblin Class III)**



Four (28.6%) patients with Shamblin class III had adequate internal carotid artery systolic stump pressure (more than 50 mmHg) and we could safely clamp common carotid and internal carotid for safe dissection. In six (40%) cases we used Pruitt-Inahara outlying carotid shunt. In three patients internal carotid arteries had to be excised which were replaced by 6 mm Polytetrafluoroethylene (PTFE) graft. In one case we transposed external carotid artery to internal carotid artery keeping continuity with common carotid artery. In two cases we had to divide external carotid artery and sew. In all cases tumors were resected completely. For

the patient with bilateral carotid body tumor the second tumor was resected after six weeks' interval.

## Results

All 15 carotid body tumors were completely removed. The post-operative data are shown in Table 2. Postoperative complications included deviation of angle of mouth on clenching teeth, deviation of tongue contralateral to operated side on protruding and coughing when drinking. One patient had permanent vocal cord palsy required speech therapy for voice improvement. Most patients had temporary palsy but one with mouth deviation and one with hypoglossal nerve injury were permanent. This constitutes three (20%) patients with irreversible nerve damage. There was no incidence of stroke or operative mortality. No one had cerebral infarction and nobody died from surgery. The post-operative hospital stay ranged from 3 to 7 days (mean 4.7 days).

**Table 2: Postoperative data.**

Complications	N (%)
Mouth deviation on clenching teeth	4 (26.7%)
Deviation of tongue on protrusion	3 (20%)
Coughing when drinking	3 (20%)
Permanent vocal cord palsy	1 (6.7%)
Cerebral infarction	0
Death	0
<b>Postoperative hospital stays (days)</b>	<b>3-7(mean 4.7)</b>

All tumors were confirmed as paragangliomas by histopathological analysis. Only one was reported as malignant as the lymph-node resected was shown positive. After two and half years of follow-up she has no recurrence. No evidence of local or distant metastasis was seen at the follow-up checks in other patients. Follow up duration ranged from 6 months to 3 years (mean 1.6 years).

## Discussion

Carotid body tumors are rare, asymptomatic and most of them present with lateral neck mass. They are benign most of the time. Only 3-12.5% of them are malignant. Malignancy is identified by regional or distant metastasis of these tumors. Local lymph-nodes are the most common site for metastasis.<sup>9</sup> Bilateral tumor is seen in 10% of cases<sup>10</sup>. Early surgical treatment is advised as when they grow, they may invade or compress adjacent vascular and neural tissues. Most of the patients in our study were diagnosed with larger size tumors; no patient was in

Shamblin class I. Eleven (73.3%) were in Shamblin class III. This may be a result of patients coming from remote areas to get treatment. In spite of its larger size of tumors we did not subject patients for pre-operative embolization as it carries risk of transient ischemic attack (TIA) and stroke<sup>8</sup>. For these large tumors we used adjuncts like measuring internal carotid artery (ICA) stump pressure and clamping or keeping internal carotid (IC) shunt. This made our dissection easier as blood circulation to tumor is cut-off during time of surgery.

A correct diagnosis is important to minimize unnecessary FNAC, neck exploration and/or biopsies.<sup>11</sup> Five (33.3%) cases referred to our center had undergone FNAC. All other cases we examined were diagnosed with color doppler study, CT neck and/or CT angiogram. Cross sectional imaging modalities have significantly improved preoperative planning.

The Shamblin classification scheme reliably predicts the need for ICA reconstruction. Carotid reconstruction to resect advanced tumor that encases the ICA was performed in three (20%) of our cases. Similar rates of carotid reconstruction, in the range of 6% to 33%, have been reported by others.<sup>12,13</sup>

Post-operative stroke is associated with carotid reconstruction or ICA injury and thrombosis, and has been reported to occur in 0-16% of patients.<sup>14,15</sup> We did not observe stroke/death in our patients. To prevent stroke related to temporary carotid clamping, selective carotid shunting has been used in most series.<sup>16</sup> We used Pruitt Inahara outlying carotid shunt in six cases (40%) where tumor dissection from carotids were difficult and ICA systolic stump pressure was lower than 50 mmHg.

The incidence of post-operative CN dysfunction in this study was in five (33.3%) patients, three (20%) of them were permanent. CN injury is not uncommon in carotid surgery. Most series of carotid body tumors report a 40% incidence of CN injury,<sup>15,17</sup> although rates lower than 20% or as high as 50%<sup>10,18</sup> have also been documented. The malignancy rate was 6.7% in this series and has been reported to vary from 4% to 14% in the literature.<sup>3,12,13,19</sup>

## Conclusion

Carotid body tumors are slow growing and mostly asymptomatic masses. Doppler USG, CT and CT angiogram play important roles in diagnosis. Complete and safer surgical excision is possible even in larger tumors with special adjuncts, including use of carotid shunts which allows for easier excision with minimal CN injuries.

## Conflict of interest

The authors declare that there is no conflict of interest associated with the study.

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