

Surgical Management and Outcome of Carotid Body Tumours

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Abstract

Introduction: Carotid body tumours are rare but are interesting in their manner of presentation and challenging with respect to surgical extirpation. They may present as a neck mass from which a bloody aspirate is obtained on fine needle aspiration. They are occasionally diagnosed only at the time of surgery, when one encounters the vascular tumour mass. **Methods:** We reviewed the results of 8 cases operated in our department over a 10-year period from 1989 to 1999. We evaluated in-hospital mortality and morbidity, as well as the long-term outcome especially with regards to functional disability. **Results:** Preoperative evaluation included angiography, computed tomography (CT) or magnetic resonance angiography. Operative technique involves good exposure, vascular control, identification and preservation of neurovascular structures and subadventitial tumour dissection. In all cases the vagus nerve was preserved, except in 1 case who had a malignant tumour and resection of the vagus nerve together with the accessory nerve and sympathetic chain. Two patients had unexpected hoarseness of voice postoperatively, 1 was due to permanent vagus nerve palsy and the other to transient vagus nerve palsy. One of them needed vocal cord medialisation and long-term tube feeding. One patient had bilateral tumours and developed a stroke after an operation on the second tumour. No patients exhibited local or metastatic disease during follow-up. There was no mortality in all cases. **Conclusion:** Although resection of the carotid body tumour is safe in experienced hands, long-term morbidity is still a significant problem and can be debilitating to the patient.

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Introduction

The carotid body was first described by von Haller in 1743.¹ It is often a small ovoid or irregular mass composed of compact pinkish tan tissue and has an average size of 6 x 4 x 2 mm.² It is located bilaterally at the bifurcation of the common carotid artery, usually resting against the medial aspect of the vessel adventitia. Tumours of the carotid body are rare and have an incidence of 0.012% in one series.³ The aetiology is unknown, but there has been association with living at high altitudes and in patients with chronic obstructive pulmonary disease.³ Malignancy of the tumour is difficult to ascertain histologically but is usually based on the presence of metastatic disease. The quoted incidence of malignancy is 2% to 30%.⁴ The most common sites of metastasis are the regional lymph nodes, but metastases to the brain, lungs and kidneys have been reported.⁵⁻⁸

The first attempt at surgical excision of a carotid body tumour by Reigner in 1880 resulted in the death of the patient. In 1886, Maydl performed the first successful resection with postoperative hemiplegia and aphasia.⁹

This report describes our experience with 8 carotid body tumours in 7 patients.

Patients and Methods

Over a 10-year period from 1989 to 1999, a total of 8 carotid body tumours were resected from 7 patients in the Department of General Surgery, Singapore General Hospital (Tables I and II). There were 5 women and 2 men with a mean age of 43 (range 32 to 54) years. Four patients had right-sided tumours, one had a left-sided tumour and 2 had bilateral tumours. All patients presented with self-discovered neck masses, 6 of whom were asymptomatic and 1 had pain and hoarseness of voice.

One patient presented with a neck lump and fine needle aspirate cytology showed malignant cells associated with metastatic carcinoma.

Biopsies of the posterior nasopharyngeal space, base of tongue and tonsils did not reveal any malignancy.

The size of the tumours ranged from 2 to 6 cm in diameter (mean 4.3 cm). Two out of 7 patients had bruits on

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TABLE I: CHARACTERISTICS OF 8 CAROTID BODY TUMOURS

Average age at treatment (range)	43 y (32 to 54 y)
Duration of mass before treatment (range)	5 y (1 mo to 18 y)
Bilateral tumour	2 (29%)
Malignant tumour	1 (14%)
Female-to-male ratio	5:2

examination. The time from the discovery of the tumour to operation was 1 month to 18 years (mean 5 years).

There was no family history or a history of high altitude living in all patients. The patients had no co-morbidities except 1 who had thyrotoxicosis treated with radioiodine.

The patient with malignant disease had preoperative evaluation with angiography, computed tomographic (CT) scan and magnetic resonance imaging (MRI). Three had both angiography and CT scan, and 2 had MRI only. One patient underwent surgery without preoperative evaluation.

Angiographic embolisation was performed for 1 patient with bilateral tumours and in another with a unilateral tumour. Twenty-four hour urine vanillylmandelic acid assessment was done in 3 patients, of whom 1 had bilateral tumours and were found to be normal.

In all patients, we used the surgical technique as mentioned by Sykes.¹⁰ He proposed wide surgical exposure of the tumour followed by proximal and distal vascular control. The identification and preservation of neurovascular structures was essential to prevent and reduce mortality and morbidity. The tumour was then dissected in a sub-adventitial plane from the common to the internal and external carotid arteries in a cephalad direction. During this stage, absolute hemostasis with electrodesiccation should be employed. Ligation of the external carotid artery was

performed when necessary as it made it easier to approach the posterior surface of the bifurcation where the tumour originates. In cases where vascular injury or difficulty in dissection made it necessary, vascular shunting and grafting would be performed.

Results

In our series, exposure for resection only required a cervical skin crease, lazy-S incision or a vertical incision anterior to the sternocleidomastoid muscle. Further exposure in the form of mandibulotomy was not necessary.

Ligation of the external carotid artery (ECA) was performed in 4 patients. The vagus nerve, spinal accessory and sympathetic chain was sacrificed intentionally in 1 patient who had malignant disease. The vagus nerve was preserved in all other patients.

The mean time of operation was 233 (range 135 to 315) minutes. The mean intraoperative blood loss was 760 (range 500 to 1000) mL. Five cases required blood transfusion with a mean of 582 (range 340 to 730) mL. The 3 cases which underwent angiographic embolisation of feeding vessels received intraoperative blood transfusion of 340 mL, 730 mL and 770 mL each. Three cases did not require blood transfusion. The mean postoperative hospitalisation was 8 (range 3 to 15) days.

One patient was found to have a tumour encircling the carotid arteries intraoperatively. She presented with a 6-cm tumour which she had for several years. The tumour was painful and caused neck stiffness, giddiness and hoarseness of voice. The operative time was 315 min, with estimated intraoperative blood loss of 700 mL and intraoperative transfusion requirement of 340 mL.

TABLE II: PATIENTS TREATED BY CAROTID BODY TUMOUR RESECTION

Initials	Sex	Year of operation	Age	Side	Bilateral	CT scan	MRI	Angiogram	Embolisation	Operation	Complications
KMT	F	1989	40	R	No	No	No	No	No	Resection	Nil
MBD	F	1995	50	L	Yes	Yes	No	Yes	Yes	Resection	XII palsy permanent
MBD	F	1995	50	R	Yes	Yes	No	Yes	Yes	Resection	Left CVA
TGO	M	1996	32	L	No	No	No	Yes	Yes	Resection	XII nerve palsy 2 months
FTK	M	1998	39	R	No	Yes	Yes	Yes	No	Resection	Malignant, X,XI, Sympathetic chain sacrifice
VDM	F	1999	54	R	No	Yes	No	Yes	No	Resection	X palsy
TSK	F	1999	36	R	Yes	Yes	Yes	No	No	Resection	Nil
OBN	F	1999	52	R	No	No	Yes	No	No	Resection	XII palsy transient 2 months X palsy transient permanent

CT: computed tomographic; CVA: cerebrovascular accident; MRI: magnetic resonance imaging

Vagus nerve palsy was observed in 3 patients, 1 of whom mentioned earlier was due to tumour involvement with nerve sacrifice. In the remaining 2, 1 had permanent palsy and the other had transient palsy which resolved after 9 months. Two patients were treated with vocal cord medialisation; 1 had intentional vagus nerve sacrifice and the other had an intact nerve intraoperatively. The latter patient also experienced significant dysphagia which required long-term tube feeding. The hypoglossal nerve was affected in 3 patients, 2 of whom recovered after 2 months and 1 of whom was permanent.

One patient developed a dense right hemiplegia from a left frontoparietal intraparenchymal haematoma on the first postoperative day after resection of a right-sided tumour. This patient had a tumour on the left side of the neck resected 5 months prior to this with preoperative embolisation done and ligation of the external carotid artery. She recovered well with physiotherapy and power on the right limbs returned to 4/5 after a month.

Histology showed the tumours to be benign in 6 patients and malignant in 1. Malignancy was confirmed with findings of angioinvasion and tumour emboli.

The length of follow-up ranged from 5 days to 2 years 9 months. Three of the patients were referrals from a neighbouring country and returned to their respective countries for postoperative follow-up. The patient with malignant carotid body tumour received a course of adjuvant radiotherapy. There were no cases of local recurrence or metastatic disease in all patients. There was no mortality in all cases operated upon.

Discussion

The carotid body tumour remains a diagnostic, therapeutic and operative challenge. The differential diagnosis of a carotid body tumour must always be considered in a patient with a lump in the anterior triangle of the neck. The lump must be carefully assessed for pulsatility. It is mobile laterally but not vertically. The common carotid pulse can also be felt to shift in a similar direction when the tumour is displaced laterally.

A suspicion of a carotid body tumour should preclude percutaneous needle or incisional biopsy. Subsequent methods of investigation include ultrasonography, and scintigraphy. Ultrasonography is useful to exclude differential diagnoses of branchial or thyroid cysts, lymph nodes and carotid aneurysms. Scintigraphy using ^{99m}Tc is inexpensive and minimally invasive but it is unable to define the origin of tumescence and extension of the tumour exactly.

CT scan is useful not only to assess the extension of the tumour but also to assess its relationship with adjacent structures and the carotid bifurcation. The other non-

invasive investigation is MRI. It shows the mass through multiplanar cross-sectional images (axial, sagittal and coronal planes) and does not involve ionising radiation or the use of contrast medium. The tumour has an inhomogeneously hyperintense aspect since the mass presents highly vascularised parts with a fast flow.

The most important invasive study is digital angiography. Pathognomonic radiological features include a “lyre-like” or goblet-shaped splaying of the carotid bifurcation pushing the internal carotid artery posterolaterally and displacing the external carotid artery anterolaterally. It is also useful to identify feeding vessels for preoperative embolisation. Angio-embolisation may be effective in decreasing blood supply to the tumour. However, in our patients, transfusion requirements were still high and not significantly different from patients without preoperative embolisation. The embolisation must be done 24 hours before the surgery to reduce effects of neovascularisation. However, embolisation is not favoured by our team as the particles could potentially embolise into the internal carotid arterial tree.

Alternatively, a CT scan with contrast or magnetic

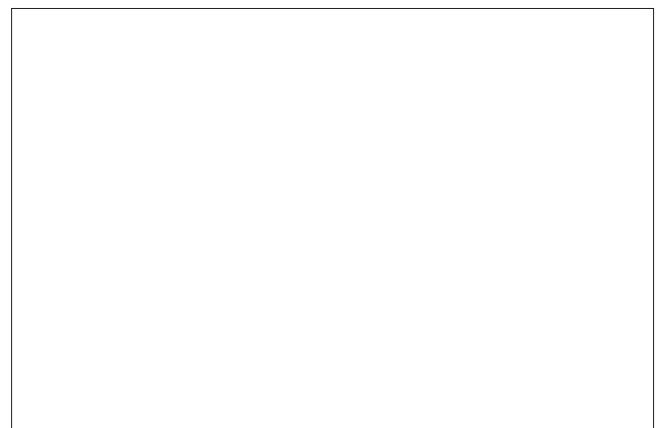


Fig. 1. Carotid body tumour in an axial view of an MRI of the neck showing splaying of the internal and external carotid arteries.

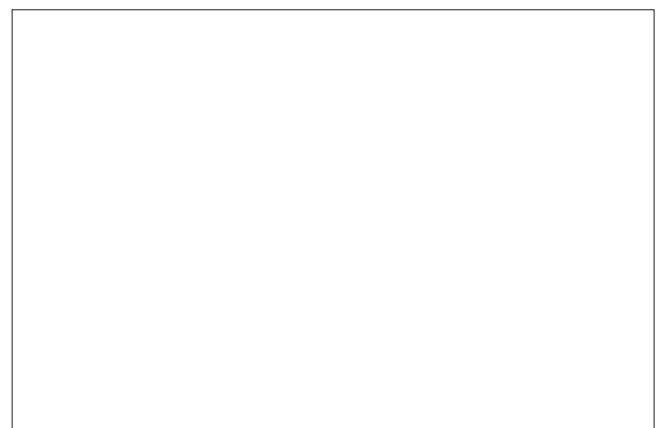


Fig. 2. Carotid body tumour in a coronal view of an MRI of the neck

resonance angiogram can provide less invasive and comparable information (Figs. 1 & 2). It is important to image both sides of the neck because bilateral tumours are reported in 5% to 10% of cases.¹¹⁻¹³

The management options include surgical resection, observation, radiotherapy and embolisation. Factors influencing the choice of treatment are the patient's age, symptoms, the size of the tumour, the rate of growth, the presence of a glomus tumour elsewhere and the side of the dominant hemisphere. When the tumour is on the side of the dominant hemisphere, a hemiplegia from surgery will involve loss of speech.

Surgical excision is the treatment of choice in patients under the age of 50,¹⁴ but in the older patient, non-surgical treatment may be advised, especially when the tumour is slow-growing and the patient is asymptomatic.

Carotid body tumours are in general not considered to be radiosensitive and radiotherapy is of little benefit.¹⁵ However, radiotherapy is considered the treatment of choice for glomus tumours of the ear and jugular bulb because complete surgical excision is rarely possible.

In our series, operative technique has been as described above. The ligation of the external carotid artery did not result in any permanent morbidity in our study, and may be safely performed.¹⁴ However, we think that ligation of the external carotid artery should not be routine. It should be restricted to cases where the tumour is inseparable from the artery, or where it may aid in access to a difficult tumour.¹⁶

Shamblin² divided tumours into 3 groups: localised tumours, adherent tumours which partially surround the carotid vessels and lastly, tumours which intimately surround the carotid vessels. This classification is useful in determining the ease of respectability and morbidity especially if the extent of local invasion is known preoperatively. We did have 1 case of a carotid body tumour which encircled the carotid arteries, but this case did not have a significantly increased blood loss or longer

operative time probably because of preoperative angiographic embolisation.

The neurovascular structures should be preserved in all cases unless there is gross tumour involvement. However, even with documented preservation, 1 patient still suffered long-term disability with vagus nerve injury.

Although the immediate outcomes show no mortality and low morbidity, long-term postoperative functional disability may still be a problem despite meticulous efforts at preservation of neurovascular structures.

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