

Anesthetic Management of Carotid Body Tumor: Case Series

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ABSTRACT

Carotid body tumors are nonchromaffin paragangliomas that arise near carotid bifurcation, derived from embryonic neural crest within the gloms cells. The estimated incidence of CBT being 1/1000000 to 7.5/1000000. The only proven cure being complete surgical removal. In this case series, we present our experience of carotid body tumor effects on cerebral protection and hemodynamic fluctuations.

Keywords: Carotid Body Tumor, Paragangliomas, Cerebral Protection, Hemodynamic Fluctuation.

INTRODUCTION

Primary tumors arising at carotid bifurcation includes paraganglioma, schwannoma and lymphoma. The primary tumor, paraganglioma arising at carotid bifurcation is known as carotid body tumor [1]. CBTs are very uncommon neoplasms constituting < 0.5% of all body tumors. The incidence of CBTs may increase proportionally with chronic hypoxia stimulus being due to altitude, that causes hyperplasia in the chemodectomas. The differential diagnosis of this tumor includes meningioma, medullary thyroid carcinoma, middle ear adenoma and neuroendocrine carcinoma. Three-group classification system by Shambling is used for risk stratification before surgical procedure for CBTs [2,3]. Surgical excision being the main treatment of choice poses several anaesthetic and perioperative challenges as these tumors are highly vascular and chances of cranial nerve injury during tumor excision [4-6].

CASE 1

A 43-year-old female patient, weighing 65 kg presented with a painless soft swelling over the angle of mandible on the left side of neck since 3 years. The swelling was soft, painless, non-pulsatile, non-collapsible with no bruit heard over it. There was no history of difficulty in deglutition, hoarseness of voice, numbness, fever, cough, and history of trauma. Known case of hypertension on regular medications for 3 years with no other comorbid illness.

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Figure 1. Swelling Under the Left Angle of Mandible.

On examination, lump was below the angle of mandible measuring 4cm X 3cm. General physical examination, Airway assessment and systemic examination was within normal limits. Computerized tomography confirmed the diagnosis of highly vascular carotid body tumor measuring 4 x 5cms for which an elective excision procedure was planned.

Indirect laryngoscopy showed bilateral vocal cords mobile and documented. All routine hematological investigations were performed and are as mentioned in the table below. Electrocardiogram and chest x ray were normal. 2D Echocardiography showed normal LV systolic function with EF of 56%, no regional wall motion abnormalities.

Blood Test	Test Results	Reference Range
Hemoglobin	13	12-15g/dl
Packed cell volume	45	40-50%
White blood cells	5,500	4000-11000
Prothrombin time	12	10-16
INR	1.5	
Activated prothrombin time	23	22-40
Sodium	138	135-145mmol/L
Potassium	4.0	3.5-5.5mmol/L
Chloride	99	98-107mmol/L
Serum Creatinine	1.0	0.7-1.2 mg/dl
Blood urea	26.4	19-44mg/dl
TSH	3.5	0.4-4.5mIU/L
T 3	110	80-200ng/dl
T 4	7	5-12mcg/dl

The case was discussed with the surgeon regarding the plan and care of this Shamblin's type II tumor, nasal intubation was requested by the surgeons for the extra length of internal carotid artery during dissection, hence excision of left sided CBTs under general anesthesia with nasal intubation was confirmed. Preoperatively adequate blood and post operative intensive care unit with ventilator was reserved. The patient and attenders were counselled regarding the complications associated with the procedure and high-risk consent was taken. On the day of surgery, the patient was asked to continue antihypertensives medications. Preoperatively, Xylometazoline nasal drops instilled in both the nostrils 30 minutes prior to surgery.

The operating room was kept ready and emergency drugs was arranged. In the operation theatre standard ASA monitors was attached and 18G cannula secured and normal saline infusion was started. The patient was preoxygenated with 100% oxygen for 3 minutes. Premedicated with

injection Fentanyl 2mcg/kg, induced with injection Thiopentone 5mg/kg and Tracheal intubation was facilitated by inj Atracurium 0.1mg/kg. Nasal intubation was done with flexometallic endotracheal tube 7.5mm fixed at 26cms after confirming with the EtCo₂ and bilateral air entry. Left Radial artery cannulation was done for invasive arterial pressure monitoring and central line secured over right internal jugular vein for central venous pressure was monitored. Intraoperatively, Neuromonitoring of cerebral oxygenation was done with near infrared spectrophotometer. A cerebral oximetry sensor was applied to the bilateral skin over forehead maintaining cerebral oxygen saturation between 60- 80%. Patient was in a head up position, to reduce venous pooling and risk of air embolism. Intra operatively, the mean arterial pressure was maintained above 65mmhg with a relatively low systolic blood pressure during periods of blood loss and a high systolic pressure during carotid clamping. Maintenance of normocarbida and normothermia with EtCO₂ 30-35mmhg and around 37degree Celsius respectively.

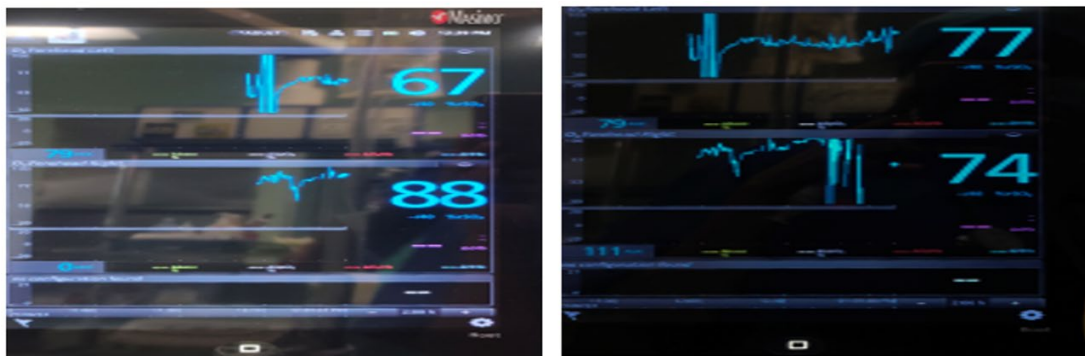


Figure 2. Intraoperative Cerebral Regional Oxygen Saturation.

SURGICAL TECHNIQUE

Tumor were approached transcervical through transverse incision made on the sternocleidomastoid muscle. Following exploration of common carotid artery, dissection was started advanced up to the tumor and dissected totally. There was no vascular or nerve injury. There were 2 episodes of hypotension during tumor handling, surgeon was informed about lowering of oximetry value of 50%, managed by injection Ephedrine 5mg boluses and local infiltration of injection Lignocaine 2%, further improvement in blood pressure was noted after release of pressure by surgeon. The total duration of surgery was 4 hours with total blood loss of around 300ml. Post surgery the patient was extubated with neuromuscular reversal agents and shifted to ICU. Post operatively the patient was hemodynamically stable with no neurological deficits.

CASE 2

A 52-year-old female presented to the vascular surgery OPD with a history of painless swelling over her left neck, gradually progressing since 3 years. Patient also complained of some difficulty in swallowing. Known case of hypertension for 5 years on regular medication. With no other positive medical or past surgical history.

CT scan revealed a soft tissue mass lesion measuring 2.8 x 2.5 cm seen at bifurcation of left common carotid artery causing splaying of internal and external carotid arteries with Shamblin type II tumor. An elective surgical excision of carotid body tumor was planned under General Anesthesia. 2D ECHO and Indirect laryngoscopy was normal with bilateral mobile vocal cords. Routine blood investigation is mentioned below.

Blood Test	Test Results	Reference Range
Hemoglobin	12	12-15g/dl
Packed cell volume	42	40-50%
White blood cells	5,000	4000-11000
Prothrombin time	13	10-16
INR	1.2	
Activated prothrombin time	26	22-40
Sodium	135	135-145mmol/L
Potassium	3.8	3.5-5.5mmol/L
Chloride	102	98-107mmol/L
Serum Creatinine	0.8	0.7-1.2 mg/dl
Blood urea	22	19-44mg/dl
TSH	2.5	0.4-4.5mIU/L
T 3	100	80-200ng/dl
T 4	9	5-12mcg/dl

In the operation theatre, standard ASA monitors was attached and intravenous fluid was started. Preoxygenated, induced and oral intubation done with 7.5 mm size tube and fixed at 20cms after. The right internal jugular vein

was cannulated and Arterial line secured. Neuromonitoring of cerebral oxygenation was done with near infrared spectrophotometer.

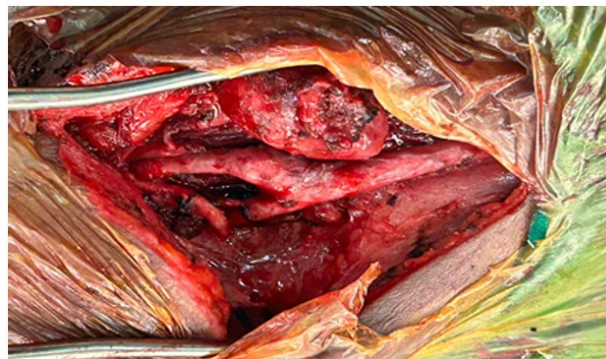


Figure 3. CCA, ICA, ECA Skeltonised with Excised Tumor.

As the surgery proceeded, Internal carotid artery identified, and tumor was tried to dissect but the tumor was adherent and partially encasing the Internal carotid artery. During clamping of common carotid artery there was an episode of bradycardia (heart rate of 40bpm) which was reverted once the artery was unclamped and infiltration with 3ml of inj lidocaine 1% and IV Atropine 0.6mg. Heart rate after unclamping was 82bpm. Total surgical duration was about 4hrs, and tumor was dissected safely and blood loss was about 450ml. The patient was extubated and shifted to ICU for observation. The patient was assessed for neurologic deficits and developed hoarseness of voice post operatively. The patient was shifted to wards on postoperative day 2.

CASE 3

A 33-year-old female patient, presented with a swelling over left side of neck for 1 years. The swelling was soft, painless, non-pulsatile, non-collapsible with no bruit. Patient denied any negative history with no surgical history or any comorbid illness.

General physical examination, systemic examination and airway assessment were within normal limit. CT confirmed the diagnosis of highly vascular carotid body tumor measuring 4x 4 cm with splaying of internal carotid artery. Indirect laryngoscopy and 2D ECHO was within normal. Routine investigations are as mentioned below.

Blood Test	Test Results	Reference Range
Hemoglobin	11.5	12-15g/dl
Packed cell volume	40	40-50%
White blood cells	6000	4000-11000
Prothrombin time	11	10-16
INR	1.3	
Activated prothrombin time	25	22-40
Sodium	135	135-145mmol/L
Potassium	3.5	3.5-5.5mmol/L
Chloride	101	98-107mmol/L
Serum Creatinine	0.9	0.7-1.2 mg/dl
Blood urea	27	19-44mg/dl
TSH	2.3	0.4-4.5mIU/L
T3	100	80-200ng/dl
T4	9	5-12mcg/dl

The case was discussed with the surgeon, General anesthesia with nasal intubation was planned as it was Shamblin type III. Xylometazoline nasal drops were instilled preoperatively.

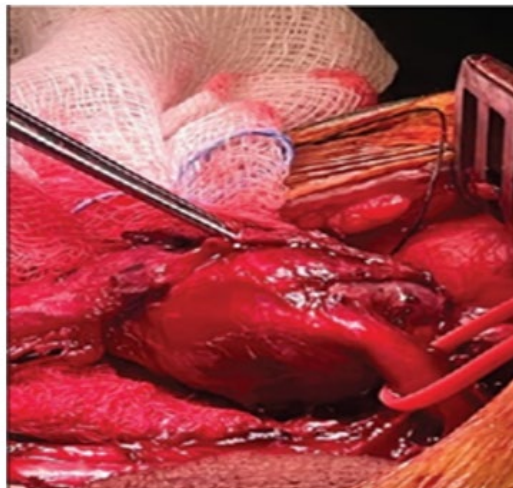


Figure 4. Intraoperative Shamblin Type 3 CBT.

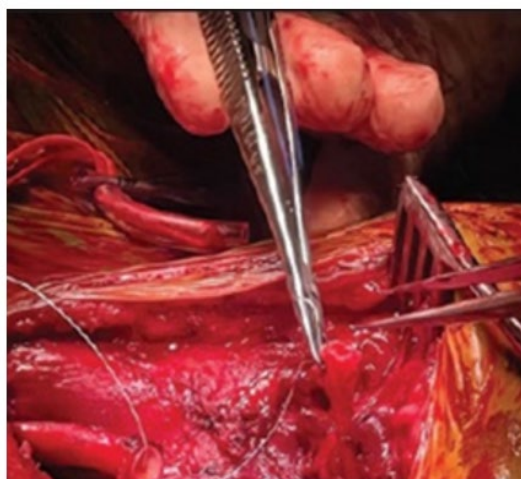


Figure 5. Primary End-End Repair of ICA.

In the theatre, ASA monitoring was attached and infusion was started. The patient was intubated with flexometallic endotracheal tube. As in the above 2 cases, central line and arterial line was secured intraoperatively, Neuromonitoring of cerebral oxygenation was done. The surgery was started, 3ml of injection 1% Lignocaine was infiltrated before resection of tumor. The surgeon informed the need of extensive vascular resection and reconstruction as the tumor was tightly adherent to the adventitia of ICA requiring carotid shunt to maintain cerebral blood flow, during this procedure there was 600ml blood loss, 1-pint red blood cells was started. The cerebral oxygen saturation was maintenance between 60- 80%. The patient was stable and was extubated and shifted to ICU. Post operatively the patient was hemodynamically stable with no neurological deficits.

DISCUSSION

CBTs are the commonest form of cervicocranial paragangliomas with neural crest origin. In the head and neck, they originate from neuroendocrine tissue that lies along the carotid artery forming the branchiomic paragangliomas [7,8]. Catecholamine production by paragangliomas is proportionately low for head and neck region [9].

Pre-operative diagnosis of carotid body tumors is primarily achieved through radiological imaging modalities. These include color Doppler, ultrasound imaging, computed tomography and MRI.

Contrast-enhanced computed tomography (CT) is effective in detecting paragangliomas; typically, a carotid body tumor appears as a homogeneously and vividly enhancing soft tissue mass at the carotid bifurcation, often causing splaying of the internal and external carotid arteries. Computed tomography angiography further enables visualization of tumor vascularization via branches of the external carotid artery. However, the requirement for contrast media and exposure to radiation limits the utility of CT in long-term follow-up.

Magnetic resonance imaging (MRI) is considered superior to CT, as it avoids ionizing radiation and offers precise delineation of soft tissue involvement. Larger tumors may demonstrate the characteristic "salt and pepper" appearance on both T1- and T2-weighted images. The classic splaying and displacement of the carotid bifurcation, known as the 'Goblet deformity' is seen on MRI.

Digital subtraction angiography (DSA) is the gold standard for diagnosis of CBT, it provides the most detailed assessment of the tumor's vascular supply. Early arterial and venous

phase angiography is crucial for evaluating tumor perfusion, hemodynamics, and major vessel displacement.

In our study, patients did not have any symptoms suggestive of catecholamine secretion, hence such tests were not done. Continuous cervical plexus block and general anesthesia are the preferred anaesthetic management options for CBTs [10].

Anesthetic management goals for carotid body tumor excision include protection of the heart and brain from ischemic injury, heart rate and arterial blood pressure maintenance, followed by ablating pain and stress response of surgery. The main goal is to have an awake patient by the end of procedure for neurological examination. Neuroprotection, Normocapnia and maintaining a MAP ensures adequate cerebral perfusion. The main advantages of regional Anaesthesia technique being regular neurological assessment, hemodynamic stability, a decrease in adverse events like stroke. Carotid artery surgery with a complication arising from bleeding from the hyper vascular tumor mass, as it is located at the bifurcation of the carotid artery is the reason we preferred general anesthesia. The main aim was to reduce anxiousness of surgeon by maintaining optimal cerebral perfusion and better operating condition for the surgeons by regular update of oximetry values.

Surgical manipulation causes activation of baroreceptors at the carotid sinus leading to abrupt bradycardia and hypotension [11]. The main stay of treatment being cessation of surgical manipulation and infiltration of the carotid bifurcation with 1% lidocaine prevents further episodes. The other options for reflex bradycardia and hypotension is External cardiac pacing if not responding to pharmacological treatment. The surges in BP occurring during induction of anesthesia and surgical manipulation can be prevented by the administration of alpha blockers preoperatively and beta blockers intraoperatively.

Neuroprotection and cranial nerve deficits: prevention of hypoxia and cerebral oedema to maintain the intracranial pressure. Induction agent thiopentone is neuroprotective as it causes constriction of cerebral vasculature thereby decreases cerebral blood flow, cerebral blood volume, Intracranial pressure and cerebral oxygen consumption. Volatile anesthetics like isoflurane, have the advantage of decreasing cerebral metabolic rate [12].

CONCLUSION

Anesthesiologists have a pivotal role in successful management of detailed preoperative, intraoperative and

postoperative evaluation with a high degree of suspicion of possible complications made in the period of perioperative. Increased awareness of these scenarios with appropriate management and timely intervention ensures minimization of perioperative adverse events.

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None.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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