

## Carotid Body Tumor Excision with *In Vivo* Optical Spectroscopy (INVOS®) Cerebral Regional Oxygen Saturation Monitoring under Anesthesia

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### Abstract

Carotid body tumor excisions pose significant morbidity, even mortality due to autonomic dysfunction, anatomical relations and prior radiotherapy, chemotherapy and surgery. Close excision proximity to the carotid artery may potentially compromise cerebral perfusion; hence a real-time monitoring system while the patient is under anaesthesia would be beneficial. Our case report describes the use of the *In Vivo* Optical Spectroscopy (INVOS®) cerebral oximeter as a surrogate for cerebral perfusion monitoring in a patient who underwent a successful excision of a recurrent carotid body tumor under general anaesthesia with prior history of contralateral carotid body tumor excision. Intraoperative real-time regional oxygen saturation (rSO<sub>2</sub>) readings were compared to her baseline values and pharmacological agents were titrated accordingly. INVOS® cerebral oximeter provides a real-time, non-invasive monitor of cerebral perfusion especially valuable in conditions with potential cerebral vascular compromise.

**Keywords:** Cerebral regional oxygen saturation; Carotid body tumor

### Introduction

Carotid body tumors are the most common paragangliomas of the head and neck region [1]. They form about 60 percent of the head and neck paragangliomas, rare tumors of neural crest origin associated with autonomic ganglia [2].

Since the tumors were first reported by Von Luschka in 1862, they have typically presented as painless, gradually enlarging masses situated in the upper part of the neck below the angle of the mandible [3]. Occasionally, mass effect on autonomic nerves may cause voice hoarseness and Horner's Syndrome. Management of such tumors includes surgical resection, chemotherapy and radiation therapy.

Excision of carotid body tumors poses potentially life threatening anesthetic risk due to their innate characteristics, anatomical associations and prior management. Carotid body tumors are known to secrete neuropeptides and catecholamines. Their highly vascular supply, proximity to major vessels and the peripheral chemoreceptors, as well as possible prior radiation therapy and surgery to the neck pose significant challenges to the unwary anesthetist.

The following case report describes the use of *In Vivo* Optical Spectroscopy (INVOS®) used as a surrogate for cerebral perfusion monitoring in a patient with high risk of neurovascular compromise, who had undergone an excision of a recurrent carotid body tumor with prior contralateral carotid body tumor excision.

### Case Report

A 47-year-old lady, weighing 47 kg, presented with an enlarging right neck swelling over four years associated with pain only in the recent four months. There was no mass effect such as hoarseness of voice, dysphagia or orthopnea. She denied any chest pain, dyspnea, palpitations or gastro esophageal reflux symptoms. Her only significant medical history was a previous left neck tumour that had been excised abroad as a teenager.

On examination, she was afebrile; her blood pressure was 104/80 and heart rate 88 beats/min. There was a 4 cm×3 cm tender mass on her right neck with no overlying skin changes. Cardiorespiratory, abdominal and neurological examinations were normal.

Her electrocardiogram showed a normal sinus rhythm and her blood chemistry was within normal limits. No catecholamine or metanephrine assays were done.

A preoperative 4-vessel angiogram showed a large arterial enhancing tumor with epicenter straddling the internal and external carotid artery measuring 2.1×2.5×3.4 cm, with a cuff of tumour seen around the proximal internal and external carotid arteries. It appeared to be supplied by a branch of the right external carotid artery, probably the ascending pharyngeal branch arising medially. The right common, internal and external still enhanced normally with good caliber. There was also heavy calcification at the proximal left internal carotid artery with suggestion of focal loss of enhancement and high grade stenosis (although the presence of heavy calcification may overestimate the degree of stenosis). The visualized Circle of Willis and bilateral vertebral arteries enhanced well with no focal stenosis detected. Visualized paranasal sinuses were normally aerated. The neck nodes were not abnormally enlarged. No destructive bone lesion was detected. Distally the left internal carotid artery enhanced well with good caliber, possibly supplied by the right side.

A preliminary diagnosis of an enlarging hypervascular paraganglioma was made and she was admitted for an elective resection of the right carotid body tumor.

Before anaesthetic induction, the INVOS® cerebral oximeter SomaSensor adhesive optode pads were placed over each fronto-

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temporal area and her peri-induction baseline regional oxygen saturation (rSO<sub>2</sub>) readings were measured, 66% and 62% for left and right respectively while she was resting quietly for a minute and the values had stabilized.

Her heart rate and rhythm were continuously monitored using a lead II of a 3 lead ECG while her blood pressure was continuously monitored via an intra-arterial line.

After induction with IV 200 mg of propofol with target-controlled infusion (TCI) remifentanyl at 3ng/ml and atracurium 40 mg via a 16G IV cannula, she was intubated with a 6.5-mm internal diameter preformed North Rae nasotracheal tube uneventfully. Nasotracheal intubation was chosen in the event of any intraoral work required and to reduce aspiration risk, associated with delayed gastric emptying. She was ventilated with an oxygen/air mixture on desflurane maintained 4-5% with concurrent TCI remifentanyl between 1-2.5 ng/ml to maintain at least a cerebral oximetry reading above her respective baseline values bilaterally by maintaining mean arterial pressure between 60-80 mmHg from induction until after extubation. End tidal CO<sub>2</sub> was maintained between 32-36 cm H<sub>2</sub>O.

During dissection of the tumor, a single 20 mg bolus of IV esmolol was required in addition to the TCI remifentanyl when the blood pressure rose to 150/90 with a heart rate of 90bpm, without any additional need for hypotensive agents. There was no episode of bradycardia intraoperatively.

Operative findings showed a 2.1×2.5×3.4 cm right carotid body tumor at the common carotid bifurcation without vascular encasement. A Level II pigmented cervical lymph node was sent for frozen section intraoperatively which yielded no malignancy IV morphine 3 mg was given before the end of operation and she was extubated. Post extubation, she was monitored in recovery and was able to obey commands to move all of her limbs without neurological deficit. She started normal consistency diet of choice on the first post operative day and was able to swallow with ease with no odynophagia. During the post anesthesia review the following day, she had normal speech and no neurological deficit. She had her neck drain removed on the second postoperative day and was discharged from hospital on her third postoperative day.

## Discussion

Anesthetic management in carotid artery surgery aims to optimize cerebral perfusion and operating conditions to maximize surgical benefit. Patient factors, such as anxiety or refusal of regional anesthesia and surgical factors including, surgeon preference and incomplete analgesic coverage, form but a few of the many reasons to administer a general anesthetic for carotid artery surgery. However, intraoperative neurological monitoring under general anesthesia becomes imperative to provide early detection of cerebral insult, which could potentially be reversible. Options include specialized tests to detect electrical integrity (electroencephalogram (EEG), somatosensory-evoked potential (SSEP), auditory evoked potentials), flow velocities (transcranial Doppler) and perfusion (jugular vein oxygenation, stump pressure and cerebral oximetry) [4].

The *In Vivo* Optical Spectroscopy (INVOS®) Somanetics cerebral oximetry is a non-invasive, site specific measure regional perfusion used in paediatric and adult patients internationally. It uses near-infrared spectroscopy (NIRS) to measure the relative amount of oxygen saturated haemoglobin in the brain, referred to as regional oxygen saturation (rSO<sub>2</sub>), to detect ischemic threats with the aim to administer timely intervention to reduce or prevent patient morbidity. The major

organ morbidity includes stroke [5], post-operative cognitive decline, respiratory failure, ventilator time [6], adverse surgical events [7], coma [8] and even mortality [9]. The usefulness of intraoperative rSO<sub>2</sub> monitoring has been shown during cardiac, vascular and even a hepatic phase of orthotopic liver transplantation surgeries [10-13].

Additionally, the monitoring system often provides an earlier indication of oxygen imbalance than conventional measures such as mean arterial pressure, pulse oximetry, arterial blood gases and lactates [14]. An indication of compromise would allow early administration of routine interventions to rectify ischemic threats, reported to be successful 80-94% of the time [8,9].

In a patient with a previous operation to her right cerebral perfusion, a contralateral carotid surgery portends a high risk for permanent cerebral insult. A non-invasive modality was chosen as a surrogate to monitor the patient's cerebral perfusion, where her previously operated right side, had a lower baseline rSO<sub>2</sub> (62%) than her current contralateral operation site. The system allows one to tailor decisions to the patient's unique physiology and co-morbidities for optimal care with aims similar to Austin et al. [15], who reported that active interventions based on a multimodal neurophysiologic monitoring, including cerebral oximetry, decreased the incidence of postoperative neurological sequelae with marked reduction of hospital stay and costs.

The INVOS® cerebral oximetry has potential to provide a continuous, noninvasive, bedside cerebral perfusion monitoring tailored to the baseline rSO<sub>2</sub> on each side of patients under general anesthesia. The reference to an individualized baseline reference point provides a useful safety monitoring tool for an anesthetist without in-depth training in electroencephalogram interpretations and complexity of device attachments.

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