

CASE REPORT

Analgesia nociception index for early detection of vagal stimulation during carotid body tumor resection: A case report

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Abstract

ANI can be used for early detection of parasympathetic signals before the occurrence of bradycardia or to locate unidentified carotid structures in the head and neck region.

KEYWORDS

analgesia nociception index, carotid body tumor, complication, head and neck surgery, nerve monitoring

1 | INTRODUCTION

Carotid body tumor (CBT) resection is a complicated otolaryngological surgery, which may be complicated with hemodynamic instability, such as bradycardia or bleeding. Neuronal and vascular structures are difficult to identify and also cause neurological complications. Here, we report a 46-year-old patient who underwent CBT resection with intraoperative parasympathetic activity monitoring of analgesia nociception index (ANI). The operation was successful with early detection of vagal stimulation and no bradycardia events. The patient's hospital course and recovery time were shorter than usual without nerve injury. A mini-narrative review of the device was discussed.

Carotid body tumor is an uncommon type of head and neck tumor arising from chemoreceptor tissue. Anatomical structures around the tumor consist of major arteries and cranial nerves. Tumor resection with preoperative embolization

is one treatment option. However, there is some controversy regarding the benefits of tumor embolization before surgery.¹ The major complications of resection are bleeding and cranial nerve injury. Higher Shamblin classification grade, greater tumor distance from the base of the skull, and greater mean tumor volume were considered to associated with higher complication risk.² High-frequency heart rate variability monitoring has been proposed to assess the balance between the parasympathetic and sympathetic nervous systems, especially during the intraoperative period to monitor the level of analgesia.³ It is crucial to administer a sufficient amount of analgesia without overdosing to ensure patient safety. We applied the basic concept of ANI to surgical anesthesia in head and neck surgery. A case of advanced CBT treated with a simple intraoperative indirect vagus nerve monitoring technique is presented. This case report was approved by the institutional review board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand.

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2 | CASE REPORT

A 46-year-old man with a history of hypertension presented with a palpable neck mass that had progressed over a period of 4 years. Magnetic resonance imaging (MRI) revealed a well-defined lobulated mass measuring 6.0 cm × 4.6 cm × 7.3 cm with heterogeneous enhancement. Mass effects were detected on adjacent structures, including the right internal jugular vein, right submandibular gland, and tongue base. No intraluminal stenosis was detected. (Figure 1) Transcervical tumor removal was performed by an otolaryngologist and vascular surgeons after preoperative embolization. General anesthesia was administered with special monitoring including bilateral regional cerebral saturation to detect inadvertent intraoperative cerebral ischemia, depth of anesthesia, and the level of nociception (Analgesia Nociception Index® [ANI]; MDoloris Medical Systems) to monitor parasympathetic–sympathetic activity. Analgesics were administered according to the clinical judgment of the attending anesthesiologist. The ANI score increased when surgeons manipulated the tumor and stretched the vessels, particularly while the vascular surgeon repaired a small tear at the carotid bifurcation. (Figure 2) The anesthesiologist communicated with the surgeons when the ANI score increased suddenly, to withhold carotid manipulation before bradycardia occurred. In this case, no bradycardia (heart rate < 60 beats/min) occurred throughout the operation. At the end of the surgery, the tumor was dissected completely and adjacent structures were preserved. The operation time was about 6 hours. The estimated blood loss was 300 mL. The patient was extubated in the operating room and was discharged without complications on postoperative day 4.

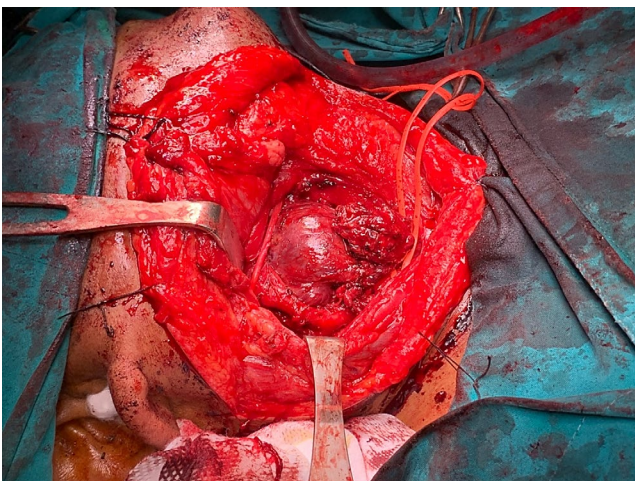


FIGURE 1 Intraoperative findings: mass with circumferentially encasement of right internal carotid artery and external carotid artery

3 | DISCUSSION

Transcervical CBT resection is a complex surgery involving the risk of cranial nerve and major vascular injury, and therefore requires meticulous surgical skill. To our knowledge, this is the first case report of the monitoring of parasympathetic activity during CBT or neck dissection. Carotid manipulation during parapharyngeal space tumor surgery or interventional treatment causes carotid body stimulation, bradycardia, and subsequent hypotension. Previous reports have described variations in surgical outcomes of treatment in terms of hospital stay, readmission, and long-term complications with multifactorial causes.⁴

Analgesia nociception index is a noninvasive index derived from heart rate variability analysis, which analyses, primarily, the influence of ventilation on RR interval from electrocardiography after real-time wave series transformation.⁵ Changes in ANI reflect parasympathetic and sympathetic outflow, which fluctuate during the inspiration and expiration phases. The ANI score presented on the monitor screen was divided into instantaneous (i) and mean (m) ANI. These scores represent parasympathetic activity at that time but are different in time frame calculation. A higher score reflects greater parasympathetic tone.⁶ The ANI-guided technique during general anesthesia is aimed at monitoring intraoperative nociception, to titrate the dose of analgesics, and also to predict hemodynamic changes after noxious stimuli. Variations in ANI score have been shown to allow the early prediction of risk of spinal anesthesia-related maternal hypotension in cesarean section.⁷ Moreover, some studies showed that ANI decreased the amount of opioid consumption⁸ and was associated with better recovery in the postanesthetic care unit.⁹ Similar to the present case report, a lower dose of opioid use and appropriate adjunct analgesics facilitated early patient recovery. However, further meta-analysis or stronger evidence is needed to confirm whether these benefits are clinically relevant.^{6,10} ANI monitoring has limitations in patients with



FIGURE 2 The point in time when the vascular surgeon repaired and intermittently compressed carotid artery shown as *

cardiac arrhythmia or using medications that influence the autonomic nervous system.

The role of ANI to detect inadvertent vagal stimulation during surgery was first demonstrated in 2013.¹¹ Therefore, application of this practical and noninvasive type of monitoring in otolaryngology could be useful to confirm or identify the carotid artery in cases with limited surgical field visualization in addition to conventional anatomical identification techniques, such as parapharyngeal space tumor resection or endoscopic nasopharyngectomy.¹²

4 | CONCLUSION

Analgesia nociception index can be used, or parasympathetic tract manipulation during CBT resection, to allow the early detection of vagal stimulation and prevent bradycardia. We reported use of ANI to improve the safety of anesthesia and quality of patient care. Other benefits in otolaryngology should be investigated in future studies.

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CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

PL: involved in conception. PL and NT: involved in manuscript and photography. Both authors involved in review and approval of the final version of manuscript.

ETHICAL APPROVAL

This case report was approved by the institutional review board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand. The informed consent was obtained from the patient before publishing.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analyzed in this report.

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