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## Technical note

## Inter-capsular resection of cervical vagus nerve schwannoma

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## ABSTRACT

Cervical vagus nerve schwannoma is rare and its surgical procedure is controversial. The tumor is in general benign and slowly growing without causing symptoms, and therefore it should be advised to remove the tumor while preserving neural function. We operated on two patients with cervical vagus nerve schwannoma with the inter-capsular resection technique proposed by Hashimoto et al. without causing neurological deficits. It is the first time that the plane between the tumor-complex capsule layer (epineurium and perineurium) and true tumor capsule layer was histopathologically proved in this paper. The true tumor capsule layer contained no normal neural fibers, tumor tissues and neural sheath. The inter-capsular resection technique is a safe and reliable method for removing cervical vagus nerve schwannoma.

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## 1. Introduction

Cervical vagus nerve schwannoma originates from schwann cells of the peripheral nerve sheath of the vagus nerve in the neck. The schwannoma is rare and its surgical procedure is uncertain [1–4]. Although the tumor usually presents as a slow-growing, painless, palpable mass in the neck, it has often been removed by sacrificing the nerve of origin without preserving neural function [4,5]. The patients suffer from hoarseness, dysphagia, coughing attacks in the postoperative courses. On the other hand, enucleation technique, that is, removing the tumor inside the tumor capsule, leaves behind the tumor capsule and tumor tissues adherent to it [3,6]. Therefore, this technique could cause tumor recurrence. In order to resolve these problems, Hashimoto et al. proposed “Inter-capsular resection” method as a technique for preserving neural function while achieving total removal of the tumor [7,8].

We operated on two patients with cervical vagus nerve schwannoma with the inter-capsular resection technique without causing neurological deficits and there have been no signs of recurrence. In the literature dealing with this technique, no reports have clearly demonstrated histopathologically the plane between the tumor

complex capsule layer, composed of the epineurium and perineurium, and the true tumor capsule layer. In this paper, we made a histopathological study of the layer of the surgical specimen, and evaluated the safety and the efficacy of the inter-capsular resection technique.

## 2. Case reports

## 2.1 Case 1

A 52-year old woman presented to our hospital, complaining of painless left cervical mass which was growing in size gradually for the preceding 5 years. The MR image revealed a fusiform and boundary clear 50-mm mass in the left side of the neck, which showed low signal intensity on T1-weighted image and high signal intensity on T2-weighted image with heterogeneous gadolinium enhancement. The mass displaced the common carotid artery and internal jugular vein anteriorly. Digital subtraction angiogram demonstrated that there was no vascularity in the tumor. The radiographic studies were considered compatible with cervical schwannoma. The patient requested surgical resection for preventing the mass from causing symptoms.

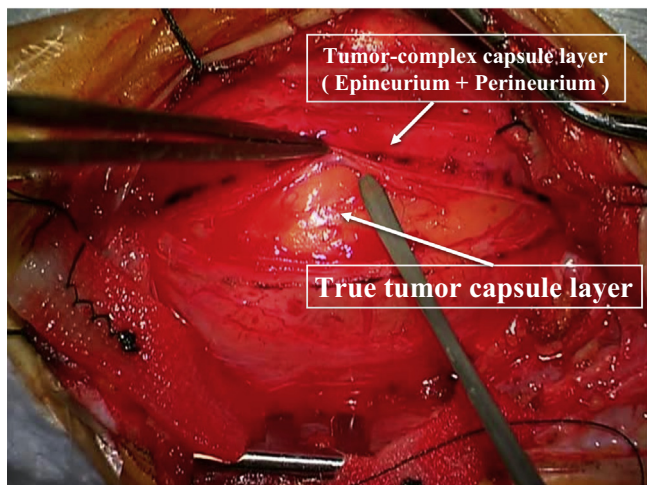
Under general anesthesia, an electromyographic endotracheal tube was used to monitor intraoperative action potential of the vocal cord. The action potential of the soft palate and sternocleidomastoid muscle were also monitored. The tumor-complex capsule

Abbreviation: EMA, epithelial membrane antigen.

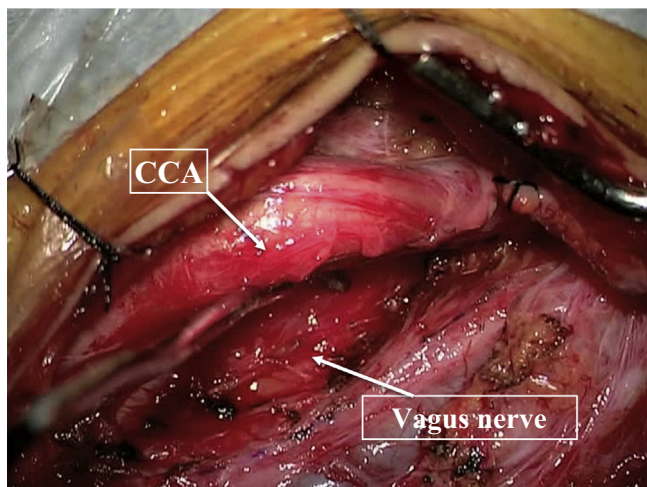
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**Fig. 1.** The operative view showing the dissection between the tumor-complex capsule layer, composed of epineurium and perineurium, and the true tumor capsule layer.



**Fig. 2.** The operative view demonstrating the vagus nerve coursing in the bottom of the tumor removal cavity; it was identified by nerve stimulator.

was found in the carotid sheath. As the sheath was longitudinally cut, the tumor-complex capsule appeared. Electric stimulation of the exposed surface of the tumor-complex did not produce motor responses. As the tumor-complex capsule was sharply cut longitudinally in parallel with the suspected course of the vagus nerve, the true tumor capsule layer appeared (Fig. 1). The layer just overlying the true tumor capsule was dissected to remove the tumor according to the inter-capsular resection technique [7,8]. The dissection of the plane between the tumor-complex capsule layer and the true tumor capsule layer was easily carried out. The tumor was totally removed. The vagus nerve found in the bottom of the removed tumor cavity was identified by nerve stimulation (Fig. 2). The tumor was considered to have originated from a fascicle of the vagus nerve because we observed that the vagus nerve was coursing in close proximity and partly continuous to the tumor, although the tumor-bearing nerve fascicle entering and existing the tumor were not confirmed in the present cases.

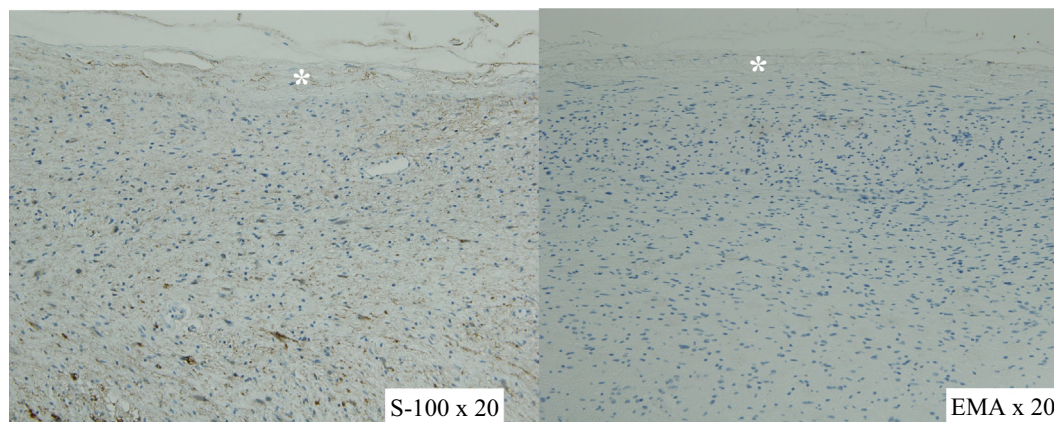
The histopathological examination of the removed tumor tissue revealed spindle cells positive for S-100 protein. No tumor tissues and neural sheath in the true tumor capsule layer stained with S-100 protein and epithelial membrane antigen (EMA), respectively (Fig. 3). These findings histopathologically confirmed that the dissection between the tumor complex capsule layer and true tumor capsule layer was performed.

Postoperative MR images demonstrated total removal of the tumor. The patients left the hospital without neurological deficits. No recurrence has been detected in the follow up studies for 2 years.

## 2.2 Case 2

A 69-year old woman referred to our hospital with a painless left cervical tumor, which was detected by a routine medical examination. The mass was gradually growing over the preceding 2 years. A MR image taken on admission demonstrated a fusiform and boundary clear 30-mm mass in the left side of the neck, which showed low signal intensity on both T1- and T2-weighted images with heterogeneous gadolinium enhancement. A CT angiogram demonstrated the tumor displacing the common carotid artery anteriorly without contrast enhancement. Although asymptomatic, she elected to receive preventive surgery.

Under general anesthesia, action potential monitoring was set up in the same way as in Case 1. The tumor-complex capsule was detected in the carotid sheath. The carotid sheath containing the tumor-complex capsule was cut, exposing its capsule. A cord



**Fig. 3.** Case 1. Histopathological findings of the removed tumor tissue; (Left) showing spindle cells positive for S-100 protein, and (Left and Right) staining no cells in the true tumor capsule layer (\*) with S-100 protein and EMA.

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