



Vagus Nerve Anatomical Assessment with Ultrasonography for Vagus Nerve Stimulation Implantation as Secondary Cervical Surgery: Two Case Reports

Sadahiro H^{1*}, Imoto H^{1,2}, Sugimoto K¹, Fujii N¹, Nomura S^{1,2} and Ishihara H¹

¹Department of Neurosurgery and Clinical Neuroscience, Yamaguchi University School of Medicine, Japan

²Epilepsy Center, Yamaguchi University Hospital, Yamaguchi, Japan

Abstract

Vagus Nerve Stimulation (VNS) is a surgical treatment of epilepsy. When VNS is performed regarding a second surgery, tight adhesion would be disturbing surgical procedure. Ultrasound could preoperatively identify the anatomical assessment of vagus nerve. In this case report, we evaluated preoperative and intraoperative vagus nerve with ultrasound for VNS implantation regarding a second surgery.

Two patients with post left cervical surgery underwent VNS. One case was after cervical lymph node dissection due to metastasis of thyroid cancer. In the second case, the patient developed infection of VNS system, so it was removed, and a new VNS was implanted. Although the vagus nerve tightly adhered to surrounding tissue, intraoperative ultrasound could clearly show the vagus nerve location.

Because tight adhesion happens after first surgery, anatomical assessment of vagus nerve with ultrasound is essential for VNS surgeons.

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*Correspondence:

Hirokazu Sadahiro, Department of Neurosurgery and Clinical Neuroscience, Yamaguchi University School of Medicine, Minami-Kogushi 1-1-1, Ube, Yamaguchi 7558505, Japan, Tel: +81 836222295; Fax: +81 836222294

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Introduction

Vagus Nerve Stimulation (VNS) implantation is a new surgical procedure for the treatment of epilepsy [1,2]. In VNS, the anatomical identification of left vagus nerve is essential. Giovagnorio reported that vagus nerve was identified with ultrasound [3].

If the patients had previous left cervical surgery, vagus nerve adheres to carotid sheath, and be surrounded with thick connective tissue, so that Identification of intraoperative vagus nerve could be difficult. We used ultrasound to identify vagus nerve for a patient after previous cervical surgery and a patient with a second VNS implantation.

Case Presentations

Case 1

A 67 years old female had focal onset seizure and underwent VNS implantation. Ten years ago, she had papillary thyroid cancer with lymph node metastasis, and left wide lymph node dissection was performed. Intraoperative ultrasound showed vagus nerve descended between left Common Carotid Artery (CCA) and left Internal Jugular Vein (IJV) (Figure 1A, 1B). Although the vagus nerve tightly adhered to IJV and deep connective tissue, the vagus nerve could not be identified with ultrasound guidance (Figure 1C).

Case 2

A 11 years old man had had focal onset seizure and underwent VNS implantation. After 5 months, bacterial infection happened along with VNS system, and it was removed. Because VNS was very effective for him, secondary VNS implantation was performed after 1 year from the first surgery. Just before second surgery, ultrasound was used to identify the vagus nerve, then we inserted a needle near the vagus nerve and injected violet pigment (Figure 2A, 2B). we could find the violet pigment and identify tightly adhered vagus nerve (Figure 2C).

Discussion

This is the first report about preoperative vagus nerve anatomical assessment before VNS

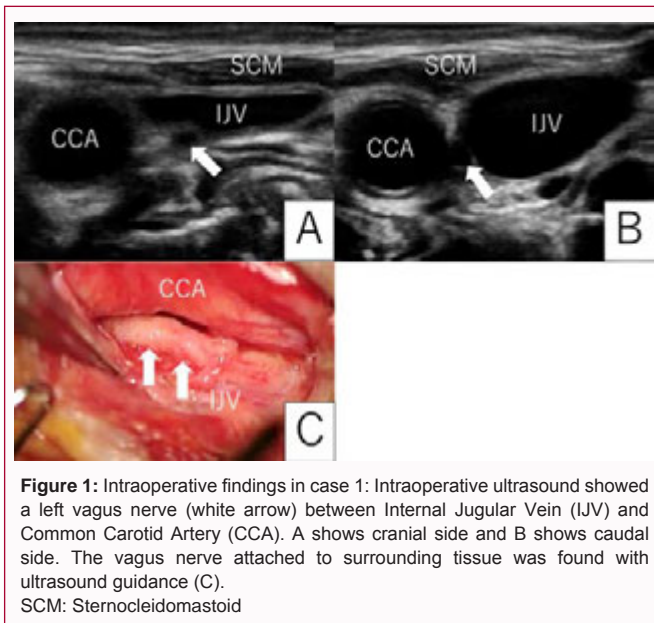


Figure 1: Intraoperative findings in case 1: Intraoperative ultrasound showed a left vagus nerve (white arrow) between Internal Jugular Vein (IJV) and Common Carotid Artery (CCA). A shows cranial side and B shows caudal side. The vagus nerve attached to surrounding tissue was found with ultrasound guidance (C).
SCM: Sternocleidomastoid

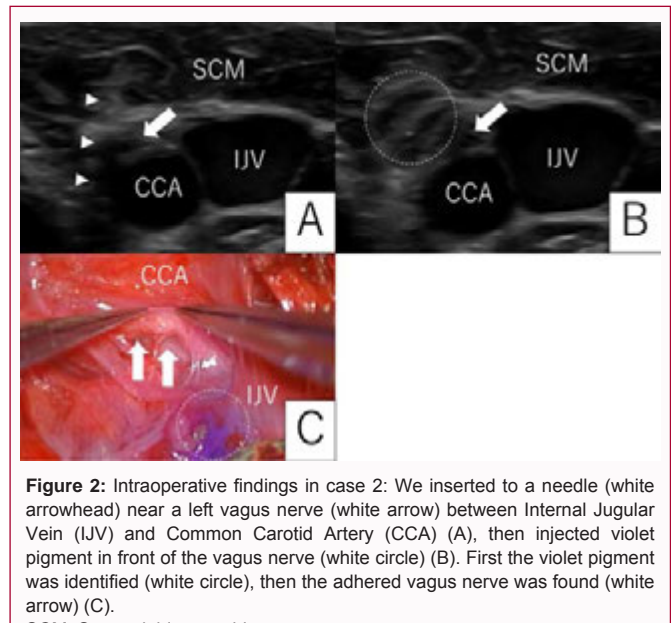


Figure 2: Intraoperative findings in case 2: We inserted a needle (white arrowhead) near a left vagus nerve (white arrow) between Internal Jugular Vein (IJV) and Common Carotid Artery (CCA) (A), then injected violet pigment in front of the vagus nerve (white circle) (B). First the violet pigment was identified (white circle), then the adhered vagus nerve was found (white arrow) (C).
SCM: Sternocleidomastoid

implantation. Only ultrasound can show location of vagus nerve. Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are inadequate. The anatomical assessments are necessary for surgeons.

Giovagnorio already reported ultrasound could identify vagus nerve in 2001 [3]. They described vagus nerve crossed from deep lateral to superficial anterior side at level of middle third of thyroid. Takamizawa reported anatomical relationships among vagus nerve, IJV and CCA, and divided intraoperative vagus nerve position into 5 types. There are individual differences, which might be detected with preoperative ultrasound analysis.

Transcervical noninvasive VNS could be effective for migraine [4], however the effectiveness is still controversial [5]. One possibility of this dilemma could be improper stimulation [6]. When our ultrasound method applies to transcervical noninvasive VNS, the stimulation will be modified to the individual.

Conclusion

This case report showed ultrasound could identify the location of left vagus nerve before VNS regarding a secondary cervical surgery. Preoperative anatomical knowledge of vagus nerve is essential for VNS surgeons. Only ultrasound could analyze location of vagus nerve.

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