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Case Report

Localization of the cricothyroid muscle under ultrasound guidance for vagal nerve mapping☆,☆☆

Tsui-Fen Yang MD (Associate Professor)[a,b,*], Jia-Chi Wang MD (Fellow in Rehabilitation)[a], Sanford P.C. Hsu MD (Staff Surgeon)[c,d], Cheng-Chia Lee MD (Fellow in Neurosurgery)[c,d], Chun-Fu Lin MD (Staff Surgeon)[c,d], Jan-Wei Chiu MD (Staff in Rehabilitation)[a], Chih-Jou Lai MD (Staff in Rehabilitation)[a], Rai-Chi Chan MD (Chief of Rehabilitation)[a,d], Shinn-Shing Lee MD (Staff in internal medicine)[e]

[a]*Department of Physical Medicine & Rehabilitation, Taipei Veterans General Hospital, Taipei 11217, Taiwan*
[b]*Department of Physical Therapy and Assistive Technology, National Yang-Ming University, Taipei 11217, Taiwan*
[c]*Department of Neurosurgery, Neurological Institute, Taipei Veterans General Hospital, Taipei 11217, Taiwan*
[d]*School of Medicine, National Yang-Ming University, Taipei 11217, Taiwan*
[e]*Department of Internal Medicine, Cheng Hsin General Hospital, Taipei, Taiwan*

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Abstract During surgical removal of tumors of the skull base or cerebellopontine angle with brainstem compression, the vagus nerve is at a high risk for injury that can result in permanent or transient swallowing and speech dysfunction. Intramuscular recording of cricothyroid muscle can be used for vagal nerve mapping during intraoperative neurophysiologic monitoring so as to prevent the above complications. However, it is a small muscle that lies beneath the strap muscles over the anterior neck and is not easily accessible by a blind approach. Here, we present a case in which cricothyroid muscle was identified for precise electrode placement under ultrasound guidance during preparation for intraoperative monitoring. We concluded that localization of the cricothyroid muscle by ultrasonography proved to be a feasible and easy technique, and the compound muscle action potential recorded by this approach is clearly recognizable during intraoperative vagal nerve mapping.

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* Correspondence to: Tsui-Fen Yang, MD, Department of Physical Medicine and Rehabilitation, Taipei Veterans General Hospital, No. 201, Section 2, Shih-Pai Rd, Taipei 11217, Taiwan. Tel.: +886 2 2875 7360; fax: +886 2 2875 7359.
E-mail address: tfyang@vghtpe.gov.tw (T.-F. Yang).

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1. Introduction

During surgical removal of tumors of the skull base or cerebellopontine angle (CPA) with brainstem compression, due to its proximity to or directly involved by the tumor, the vagus nerve is at a high risk for injury that can result in permanent or transient swallowing and speech dysfunction [1]. These 2 functions are so vital that every possible measure should be taken to prevent these complications from ever happening. A surface electrode attached to the endotracheal tube has long been used to record activity of vocal muscles during vagal nerve mapping by most intraoperative neurophysiologic monitoring (IONM) professionals [2]. However, intramuscular recording of cricothyroid muscle (CT) can also be used for a similar purpose during IONM [3]. The latter technique has the advantage of allowing electrode placement closer to the origin of muscle activity, resulting in more distinct signals than those picked up by a surface electrode. However, the CT is a small muscle that lies beneath the strap muscles over the anterior neck, and it is not very easily accessible by a blind approach. Here, we present a case in which CT was identified for precise recording electrode placement under ultrasound guidance during preparation for IONM.

2. Case report

A 54-year-old woman who underwent cyber-knife therapy 3 years ago was admitted for surgical management of a recurrent right-sided CPA tumor. Preoperative brain magnetic resonance imaging demonstrated a 27 × 23 × 23-mm mass in the right CPA with some degree of brainstem compression. The signal from the lesion was isointense on T_1-weighted images and hyperintense on T_2-weighted images, and showed enhancement on postcontrast image after gadolinium administration. The appearance was consistent with that of vestibular schwannoma. Pure tone audiometry revealed low tone and 8-kHz loss, and auditory brainstem response was attainable only at 90 dB. No significant facial asymmetry or other focal neurologic deficits were identified preoperatively. A retrosigmoid approach under IONM was chosen in order to preserve neurologic function during tumor removal. Subdermal needles were placed into the right masseter and orbicularis oculi and oris and the soft palate for monitoring or/and mapping purposes. Surface recording electrodes attached to the endotracheal tube were placed by the anesthesiologist during intubation to record muscle activity of the vocal muscles for vagal nerve mapping and monitoring (Fig. 1A). In addition, a pair of subdermal needles was placed in the right CT muscle under ultrasound guidance during preparation for IONM (Fig. 1B). The CT muscle is the small muscle that lies between the thyroid and cricoid cartilages, with a leaf-shape appearance on ultrasonography (Fig. 2A). Under ultrasound guidance, we knew where to puncture the skin and could gauge the depth of the muscle so that needles could be placed precisely into this particular muscle without safety concerns. When the surgeon stimulated the vagus

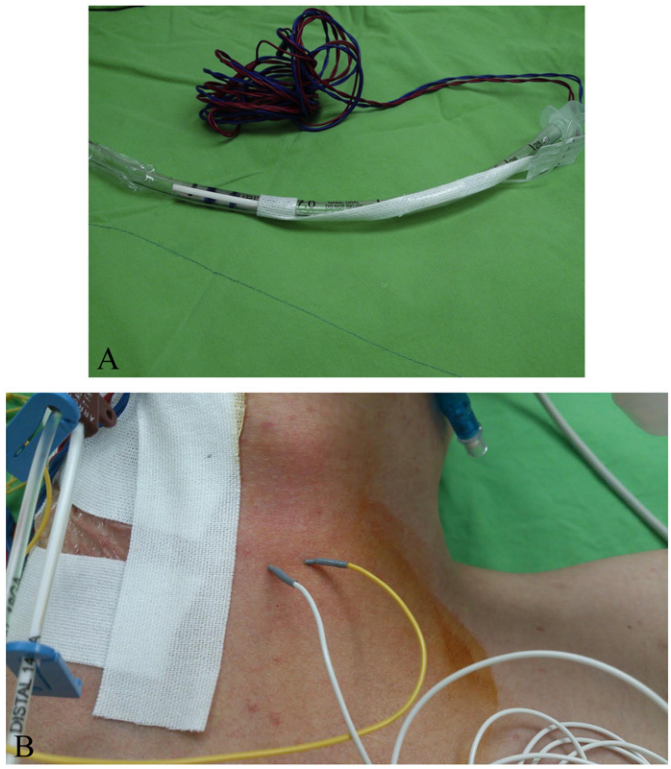

Fig. 1 Surface recording electrodes attached to the endotracheal tube was used to record muscle activity of the vocal muscles for vagal nerve mapping (A), and monitoring (B) a pair of subdermal needles was placed in the right CT muscle under ultrasound guidance.