



# Finding the Wanderer Nerve: A Novel Use of ETT Surface Electrodes in Vagal Nerve Stimulator Insertion Surgery

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## Abstract

### Keywords

- vagus nerve
- endotracheal tube surface electrodes
- neuromonitoring
- vagal nerve stimulation

Endotracheal tube (ETT) surface electrodes have been in vogue for vagal nerve identification and monitoring for a while. They have been used in thyroid surgeries as well as neurosurgical procedures involving the skull base or brain stem. These electrodes have been proved vital in preventing inadvertent vagal nerve injury and damage during such procedures. However, ETT surface electrodes have not yet been used in vagal nerve stimulator insertion surgeries. Here, we report the first such case of vagal nerve stimulator insertion surgery wherein ETT surface electrodes were successfully used for vagal nerve identification.

## Introduction

Intraoperative identification and functional neuromonitoring of the vagus nerve have been used in brain stem and skull base surgery. The use of endotracheal tube (ETT) surface electrodes for vagal nerve monitoring opened new avenues for intraoperative neuromonitoring in thyroid surgeries as well as neurosurgical cases operating in close proximity to the vagal nerve nucleus or roots. This is the first reported case of use of ETT surface electrodes for vagal nerve identification during vagal nerve stimulation procedure.

## Case Report

A 10-year-old boy weighing 26 kg presented with a history of medically refractory seizures and drop attacks for 6 months. He had a history of hypoxic injury leading to bilateral

temporal gliosis. The patient was planned for vagal nerve stimulation and was posted for electrode and stimulator placement under general anesthesia with endotracheal intubation.

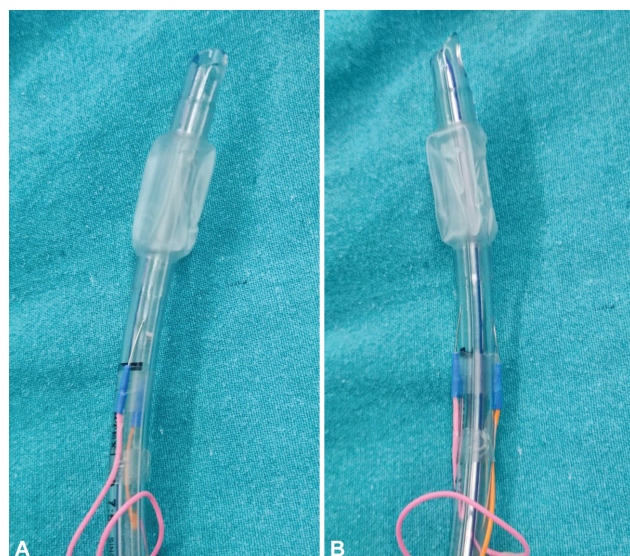
Anesthesia was induced with intravenous fentanyl 2 µg/kg and propofol 2mg/kg. Intravenous atracurium 0.5mg/kg was given after confirmation of adequacy of ventilation. Child was intubated with 6 mm ID cuffed ETT and fixed at 16 cm at the level of incisors. To enable easy vagal nerve identification, we planned for ETT surface electrode monitoring of electromyography (EMG) activity of vocalis muscle. Due to unavailability of NIM-EMG ETT (nerve integrity monitoring electromyography ETT) at our institute, we prepared the ETT surface electrodes by placing two single needle electrodes at the level of the vocal cord guide (► **Fig. 1A**). These were precisely fixed to the ETT with a sterile adhesive transparent tape ensuring that the needle tips are covered and

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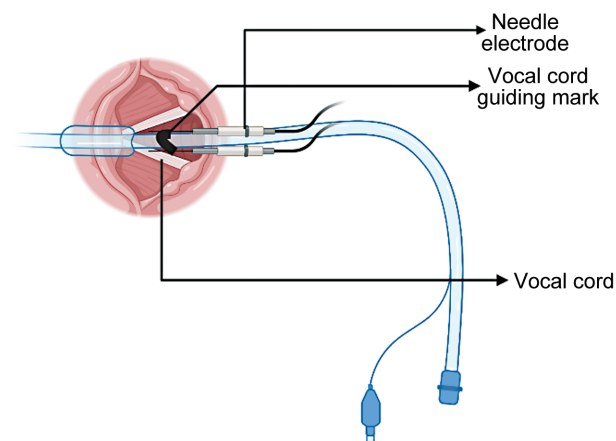
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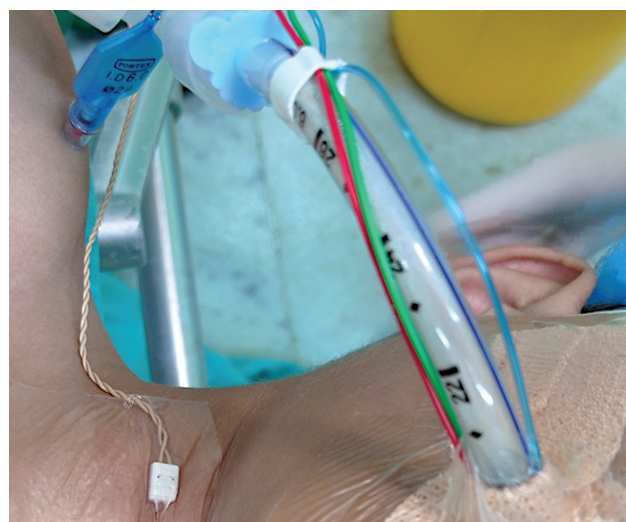
**Fig. 1** (A) Photograph representing the needle electrodes attached to endotracheal tube (ETT). (B) Photograph representing the needle electrodes attached as ETT surface electrodes.

atraumatic (► **Fig. 1B**). During intubation, the ETT was meticulously placed such that the electrodes are in contact with the vocal cords (► **Fig. 2**). A paired electrode was also placed in the cricothyroid muscle to monitor the muscle activity (► **Fig. 3**). Ground electrodes were placed over the acromion process. The triggered EMG activity of vocalis and cricothyroid muscle was monitored using nerve integrity monitor (NIM-Neuro 3.0) using a 1 mA stimulation current. Anesthesia was maintained using total intravenous anesthesia with fentanyl and target control infusion of propofol (target plasma concentration of 1.5–2 µg/mL). Further doses of neuromuscular blockers and inhalational agents were avoided.

During surgical neck dissection, the left vagus nerve was identified by a sinusoidal wave with an audible signal on NIM-Neuro 3.0 (► **Fig. 4**). The vagal nerve stimulator electrodes were anchored to the nerve. A repeat stimulation of the left vagus nerve confirmed the functional integrity at the end



**Fig. 2** Diagrammatic representation of endotracheal tube surface electrodes placed in contact with the vocal cords. (Created with BioRender.com).

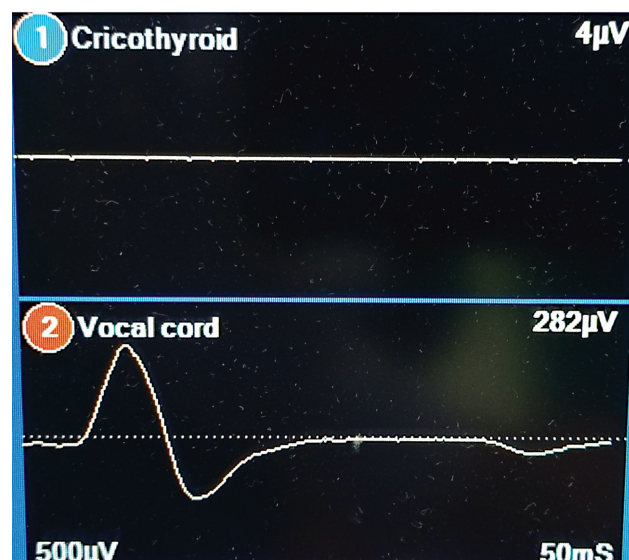


**Fig. 3** Photograph showing endotracheal tube surface electrodes and paired electrode in cricothyroid muscle.

of the procedure. The child was extubated on table without any new focal neurological deficits

## Discussion

ETT surface electrode has been in use for recurrent laryngeal nerve monitoring during thyroidectomy and parathyroid surgeries to predict postoperative vocal cord mobility.<sup>1</sup> It has been recently used for vagal nerve mapping and evaluation of functional status intraoperatively in several neurosurgical procedures like skull base surgeries and surgeries involving brain stem. Such electrophysiological monitoring of vagus nerve perioperatively had two goals; one was to identify the vagal nerve rootlets and nucleus intraoperatively especially when the anatomy is distorted by space-occupying lesion. The other goal is evaluation of functional status.<sup>1</sup>



**Fig. 4** Photograph of the recorded sinusoidal wave during vagus nerve identification.

A prospective study done by Julien et al found that use of surface electrodes is as sensitive as monitoring by intramuscular electrodes and was helpful for nerve identification and nerve integrity testing perioperatively. They concluded that it was a simple, noninvasive and effective method with stimulation thresholds similar to those reported with the use of intramuscular electrodes.<sup>2</sup> Mikuni et al found that the placement of the ETT surface electrodes on the bilateral vocal cords could be easily performed under direct vision (direct laryngoscopy). Also, when there occurred a change in tube positioning during surgery, re-establishing electrode contact was relatively easy with the guidance of impedance and X-ray images.<sup>1</sup> Ito et al found that use of ETT surface electrodes along with transcranial electrical stimulation enables continuous real-time monitoring of nerve integrity in brain stem or skull base surgeries.<sup>3</sup>

## Conclusion

Hence, a noninvasive ETT surface monitor for vagal nerve identification and evaluation of functional status can be used

during vagal nerve stimulation procedure. This would be useful in identification of the nerve in patients with altered neck anatomy due to previous radiation therapy or burns contracture. The electrical identification in conjunction with visual assessment would help prevent inadvertent damage to the nerve during neck dissection.

## Conflict of Interest

None declared.

## References

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