A Reliable Technique to Make NIM Tube Work

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Intraoperative identification and functional monitoring of the vagus nerve and its branches, most commonly recurrent laryngeal nerve (RLN), is becoming standard of care during surgery involving brainstem, skull base and especially thyroid and parathyroid gland, where the incidence of RLN compromise may be as high as 13%.[1-6] This is particularly true in the setting where the course of the RLN is aberrant, distorted by masses, postradiation fibrosis of the neck, or involved with scar tissue, as well as in the situations associated with preexisting unilateral vocal cord paralysis.[6-8]

The specialized endotracheal tubes (ETT), such as Xomed and TriVantage Nerve Integrity Monitoring (NIM) ETTs (Medtronic Xomed Inc., Jacksonville, FL USA) allow for RLN identification through continuous intraoperative EMG monitoring of the laryngeal muscles.9 These ETTs incorporate imbedded bilateral stainless steel wire surface electrodes (Xomed ETT) or silver electrode “tabs”, which are exposed above the cuff, and come in direct contact with the vocal cords. **(Figure 1a)** When connected to the NIM-Response 2.0/3.0 system®, **(Figure 1b)** the electrodes continuously track the EMG activity of the laryngeal muscles, thereby providing an immediate audible and visual feedback to the surgeon about the risk of RLN trauma.10 In addition, the system allows the surgeons to use the monopolar and bipolar stimulating probes during the dissection, to allow for early RLN identification and preservation.

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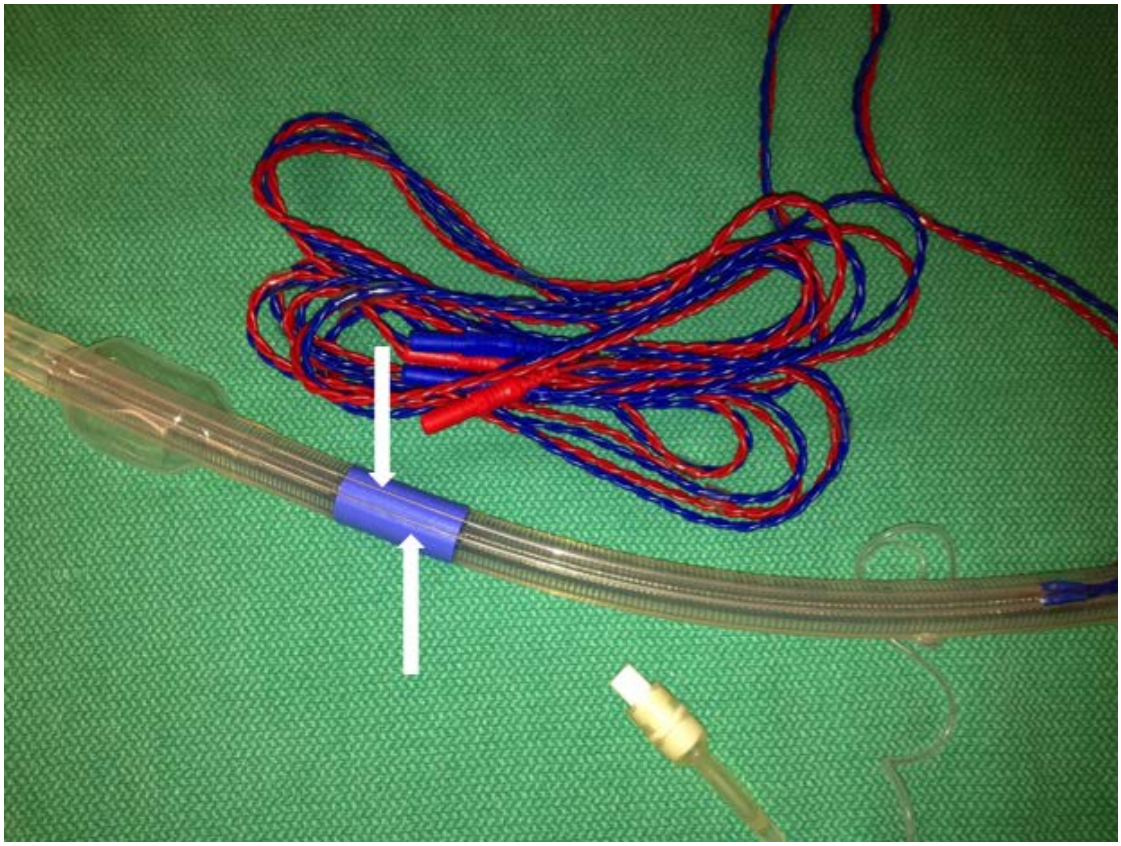

Figure 1a. The Xomed NIM electromyographic (EMG) endotracheal tube (ETT). White arrows indicate the exposed wire electrodes of the Xomned ETT, which come in direct contact with the mucosa of the vocal cords in the blue tab area. There are 4 wires total, 2 on each side of the Xomed ETT.

Figure 1b. The Xomed ETT and NIM-Response 2.0 Nerve Integrity Monitoring (NIM) System (Medtronic Xomed, Inc., Jacksonville, FL USA). The NIM-Response System provides immediate visual and audio alerts of sudden activation of the monitored nerve against the continuously referenced, background EMG activity.

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The key to success of intraoperative RLN monitoring with NIM ETTs and systems, however, rests with the anesthesiologist. The NIM tubes must be properly placed and maintained midline, to assure precise alignment of the surface monitoring electrodes against the medial aspects of the vocal folds **(Figure 2)**. Axial rotation of the ETT or its lateral displacement above or below the level of the glottis will prevent accurate RLN monitoring.[6,9]

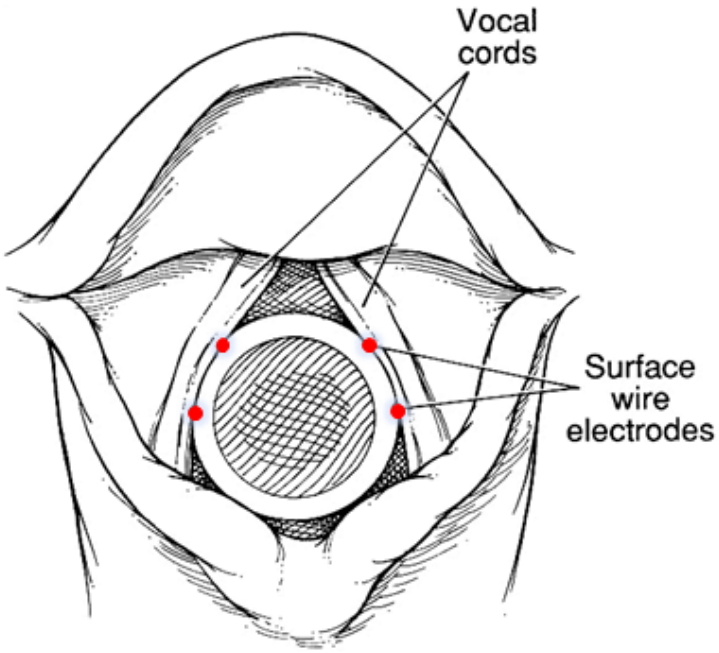

Figure 2. Proper midline positioning of the Xomed endotracheal tube: four wire electrodes are positioned against the medial parts of the vocal cords.

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I wish to describe a simple and reliable technique for facilitating the precise placement of the NIM tubes, and for preserving their midline positioning, using the Xomed ETT as an example. Some of the elements of this technique have been described previously.[10] The technique involves the following steps.

1. Prepare the selected Xomed ETT in a usual manner. Avoid lubrication with Lidocaine containing preparations.

2. Place a heavy hash mark on the left side of the blue tab area, over the exposed electrode wires, to facilitate visualization of the proper ETT placement during video laryngoscopy (see 4., below). For the thyroid surgery, I place a mark approximately ¾ up towards the proximal edge of the blue tab, to account for the ETT pullback caused by head extension during the patient positioning. **(Figure 3)**

Figure 3. A hash mark is placed in the blue tab area ¾ up the proximal edge. The Xomed ETT is used as an example. The TriVantage NIM ETT has an incorporated cross-band to guide placement.

3. Induce general anesthesia and neuromuscular blockade (NMB) to facilitate smooth intubation. A single intubating dose of non-depolarizing NMB (e.g. Rocuronium) is usually inconsequential with regard to intraoperative neuromonitoring.

4. Use a video laryngoscope of choice to guide the Xomed ETT placement. This allows for superior visualization of the hash mark positioning against the left vocal cord. It also provides the opportunity for the surgical team to observe the intubation procedure, and be reassured about the precise ETT placement. I prefer a video laryngoscope with the integrated channel build-in system, such as Airtraq or Pentax AWS **(Figure 4)**. I frequently find steering the bulky, styletted Xomed ETT with the Glidescope or Storz video laryngoscopy systems difficult.

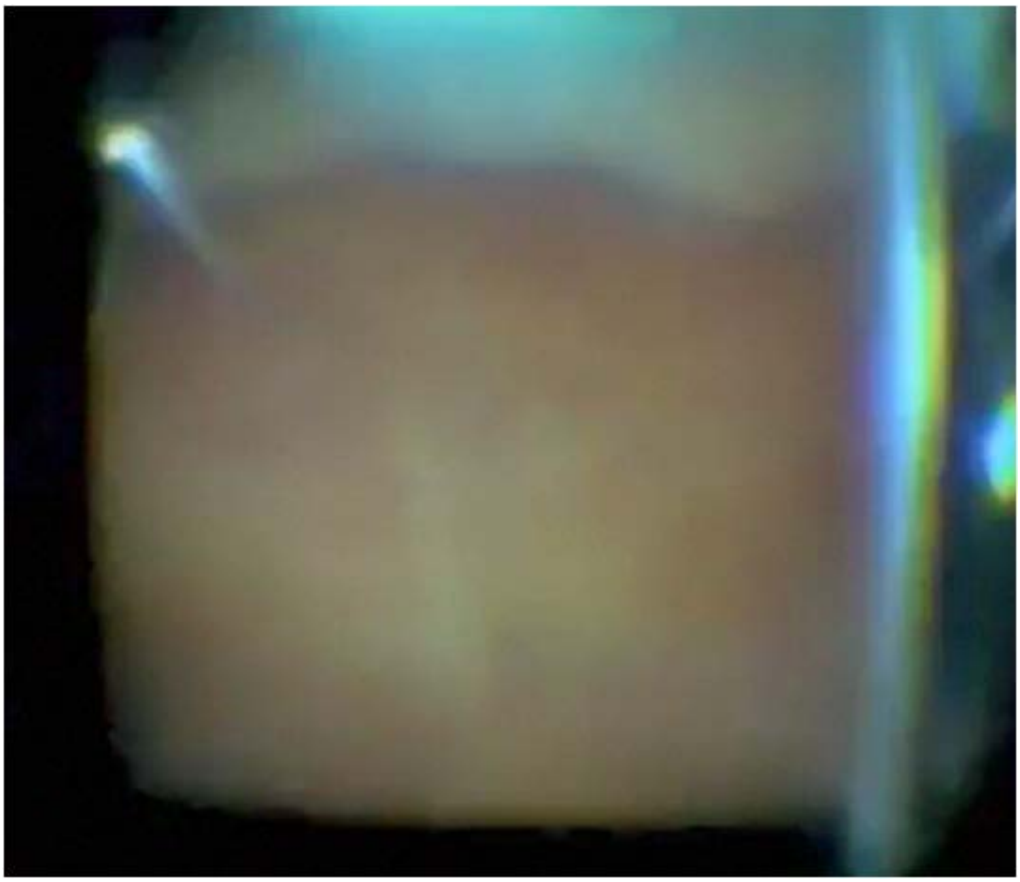
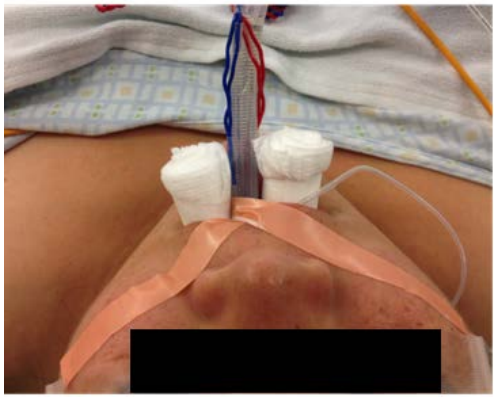


Figure 4. The technique of NIM ETT placement with Airtraq, using the Xomed ETT as an example. Video laryngoscopy allows for superior visualization of the proper ETT placement and positioning. When using the channeled video laryngoscopy technique (e.g. Airtraq), be prepared to facilitate intubation by using the ETT introducer, such as the gum elastic bougie.

(View full video of NIM ETT placement here)

Once the hash mark is placed between the vocal cords, immediately note the depth of NIM ETT placement on the alveolar ridge. Inflate the ETT cuff and confirm tracheal placement in the usual manner.

5. Move the ETT midline with your index finger, maintaining the original depth of ETT placement. Assure absent ETT axial rotation by observing the flat positioning of the color coded ETT wires in the horizontal plane. Using the tongue blade, place 2 small soft bite blocks by the sides of the ETT to stabilize it in the midline position, and tape the tube midline. **(Figure 5a-d)**

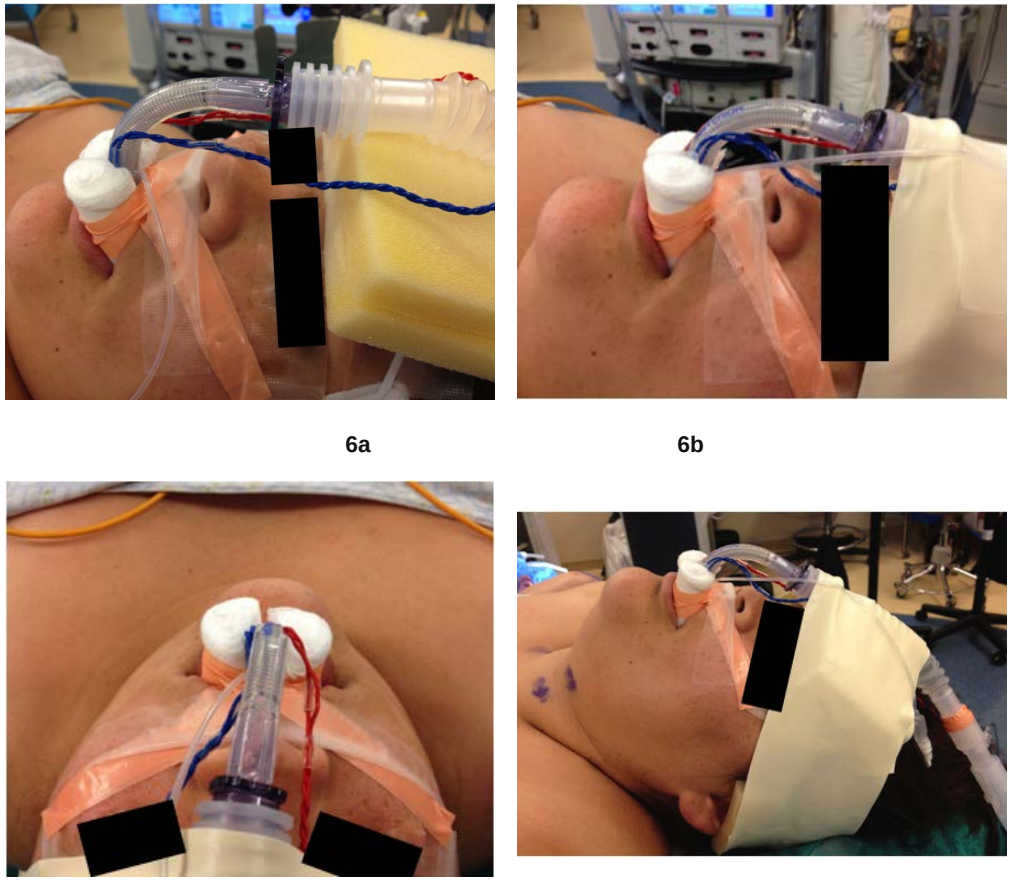


5a 5b

5c 5d

Figure 5a-d. The technique of NIM ETT stabilization, using the Xomed ETT as an example. Each bite block is composed of 3-4 tightly rolled 4 x 4 cm gauzes, covered with tape. The bite blocks should be placed deep inside the mouth, to allow for both posterior and anterior ETT stabilization. The Xomed ETT–bite block assembly is then additionally secured by a larger tape. Note a flat positioning of the color coded electrode wires in the horizontal plane, indicating absent axial rotation of the ETT.

6. Final stabilization of the properly positioned NIM ETT is achieved by taping the tube over the patient's head. **(Figure 6a-d)**



6a 6b

6c 6d

Figure 6a-d. A final step in NIM ETT stabilization, using the Xomed ETT as an example. The NIM ETT is directed over the patient's head, and is supported by several pieces of foam (a self-adhesive foam

is recommended) placed over the patient's forehead. Avoid excessive bending of the TriVantage ETT. A circular wrap with a large tape (I use a foam tape) brought from under the patient's occiput over the head keeps the ETT in place. Consider protecting the patient's ears with the foam to prevent the fold over. Note the extension of the NIM ETT with the combination of the accordion adapter and a straight ETT connector. This assembly prevents inadvertent impingement of the anesthesia circuit against the patient's head, and aids the surgeons' unrestricted position and manipulation at the head of the bed.

The described technique of NIM ETT placement and stabilization has been adopted for routine use by Stanford Head and Neck Anesthesia team and Stanford Otolaryngology-Head and Neck Surgery Department. It provides stable and reliable intraoperative EMG responses, resulting in superior feedback to the surgeon in identification of RLN and preservation of neural integrity.

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