Trends in Anaesthesia and Critical Care 50 (2023) 101259

Contents lists available at ScienceDirect

Trends in Anaesthesia and Critical Care

journal homepage: www.elsevier.com/locate/tacc

A case of neural integrity monitor endotracheal tube malfunction: What to blame? Cancelled surgery due to NIM tracheal tube malfunction – a case report

Abdulrahman Dardeer [a], Ahamed Lafir [a], Chitrambika Krishnan [a], Saba Albassam [a], Yasser Hammad [a, b], Majid AlAbdulla [c], Hany Zaki [d], Nabil Shallik [a, b, e, f, *]

[a] Anaesthesia, ICU and Perioperative Medicine Department, Hamad Medical Corporation, Doha, Qatar
[b] Clinical Anaesthesia Department, Weill Cornell Medical College in Qatar, Doha, Qatar
[c] ENT Department, Hamad Medical Corporation, Doha, Qatar
[d] Emergency Department, Hamad Medical Corporation, Doha, Qatar
[e] Clinical Anaesthesia Department, College of Medicine Qatar University, Doha, Qatar
[f] Clinical Anaesthesia and SICU Department, Tanta University, Tanta, Egypt

ARTICLE INFO

Article history:
Received 12 February 2023
Received in revised form
12 April 2023
Accepted 19 April 2023

Handling Editor: Robert Greif

Keywords:
Neural integrity monitor (NIM)
Dental braces
Dental retainer
Equipment malfunction
Thyroid surgery
Recurrent laryngeal nerve

ABSTRACT

Intraoperative neuromonitoring of the recurrent laryngeal nerve (RLN) is becoming the standard of care in surgeries of the brainstem, skull base, thyroid, and parathyroid with the potential risk for RLN damage. The Neural Integrity Monitor (NIM) endotracheal tube is a specialized tube that utilizes electromyography (EMG) for identifying the RLN intraoperatively. Vocal cords movement (if the touched structure is a nerve) is captured and shown on a monitor visually with a distinctive sound to alert the team. We describe a case of recurrent thyroid papillary carcinoma who needed surgical intervention for the third time, in which a NIM tube was used. After careful troubleshooting and failure to solve the issue, the artefacts were attributed to the patient's dental retainers (braces). The surgery was aborted. Subsequently, several tests were done on dental models with and without braces using the very NIM tube used on the patient. Our tests showed no difference in artefacts, suggesting a faulty NIM tube. However, no research, evidence, or manufacturer recommendations exist related to the use of the NIM ETT with dental retainers. There is no evidence suggesting signal interference due to metal braces. The surgery was carried out uneventfully on a subsequent day with a new NIM tube.

1. Introduction

Vocal cord paresis or paralysis due to iatrogenic injury of the recurrent laryngeal nerve (RLN) is a major problem in thyroid and parathyroid surgeries, as well as some other head and neck surgeries, with an incidence between 1.5 and 14%, despite many techniques and tools introduced to prevent it [1]. The injuries may be transient, can last up to 6 months after injury, or permanent. Permanent RLN injuries are fortunately rare (1.1%) [2]. Intraoperative neuromonitoring of the RLN is advised during thyroid surgeries, especially complicated re-do cases with adhesions and distorted anatomy of the neck. NIM tubes can help localize and identify the RLN and to predict the outcome of vocal cord function after resection of the thyroid [3].

2. Case presentation

Our patient was a 44-year-old lady, with a past history of papillary thyroid carcinoma, the classic variant. She had a total thyroidectomy in 2015 followed by radioactive iodine ablative therapy. In early 2021, a suspicious lesion was found in the neck, which was thought to be a lymph node. After a multidisciplinary team meeting, was to do a right-side neck dissection to excise the nodal tissues. In late 2021, she had another recurrence detected and she went again for surgery, this time bilateral neck dissection. Due to the complexity of surgical history and multiple procedures done,

Abbreviations: EMG:, Electromyography; ETT:, Endotracheal tube; NIM ETT:, Endotracheal tube Neural Integrity Monitor; NIM:, Neural Integrity Monitor; RLN:, Recurrent laryngeal nerve.

* Corresponding author. PO Box 3050, Doha, Qatar.;
E-mail address: nabilsholik66@hotmail.com (N. Shallik).

https://doi.org/10.1016/j.tacc.2023.101259

and the nature of the patient's profession, the surgical team decided to use NIM ETT to guide their dissection. The patient was intubated with a size 7.0 mm NIM ETT and properly fixed (Fig. 1: a). When the time came to use it, the monitor showed artefacts (Fig. 1: b). Tube connections were checked but the artefacts persisted. A new monitor was connected to the tube, however, the artefacts were not resolved and therefore another NIM ETT from the same batch was inserted but the artefacts were still present. For example: A new monitor was connected to the tube, however, the artefacts were not resolved and therefore another NIM ETT from the same batch was inserted but the artefacts were still present.As the patient had metal braces, the team thought this might be causing interference. The team decided to abort the procedure, and the patient was advised to remove the retainer if feasible. The tube that was used (ETT-1) was retained, disinfected, and tested to find out what caused the artefacts. Several tests were done on ETT-1 using dental models with and without braces and all of them showed the same artefacts (Fig. 1: c and d). After counselling the patient, she agreed to go for surgery. The last procedure was done using NIM ETT from another batch, and it went smoothly. On another occasion, we had a different patient for a surgical procedure using NIM ETT from another batch but the same manufacturer with her braces on. None of the artefacts described was present, which again proves the hypothesis that braces do not interfere with signals of NIM ETT.

3. Discussion

The EMG NIM endotracheal system is an ETT used to identify and facilitate the protection of the RLN during surgeries [4]. Vocal cords movement is captured and shown on a monitor visually with a distinctive sound to alert the team [5]. Although there is insufficient evidence supporting the routine use of NIM tubes [6], many surgeons still consider it, especially in recurrent re-do cases, as it enables quick and reliable nerve identification [7]. Visual identification and careful dissection remain the standard technique to prevent RLN injury for this challenging procedure [6]. The system of ETT−based surface electrodes is popular 3. The anaesthesiologist should be familiar with the proper positioning of this ETT, as this contributes largely to its function [8,9]. This unique ETT must be positioned so that it's the sensor is appropriately placed between the vocal cords to get the best and maximum signal [9]. Malposition remains to be the main cause of NIM ETT dysfunction [10−12]. The signal detected at the level of vocal cords like all biological signals is subject to interference. As our patient was having dental braces in situ during neuromonitoring, interference had to be excluded. However, no research, evidence, or manufacturer recommendations regarding using the NIM ETT with dental retainers, nor suggesting signal interference due to metal braces. The serial testing of the tube used on the patient against dental models with and without braces verified the fact that vigilance must be exercised at all times and equipment check is of paramount importance. In our patient, the surgery was not cancelled after induction of anaesthesia, but rather after incision and dissection to the point the team needed feedback from NIM ETT. This had a huge negative impact on the patient as she got a fresh scar with zero outcome. It is a matter of debate whether the use of NIM ETT would add benefits that warrant such cancellation in case of malfunction, but from our team's experience having a NIM ETT on board made a great impact on postoperative results of our patients. In some other centres that might not be familiar with the tube, it might be accepted to continue the surgery even if the tube is malfunctioning as they will simply discard the feedback and will depend on the visual identification, but this defies the idea of having such an expensive instrument in the first place. The recall of this exact batch of defective

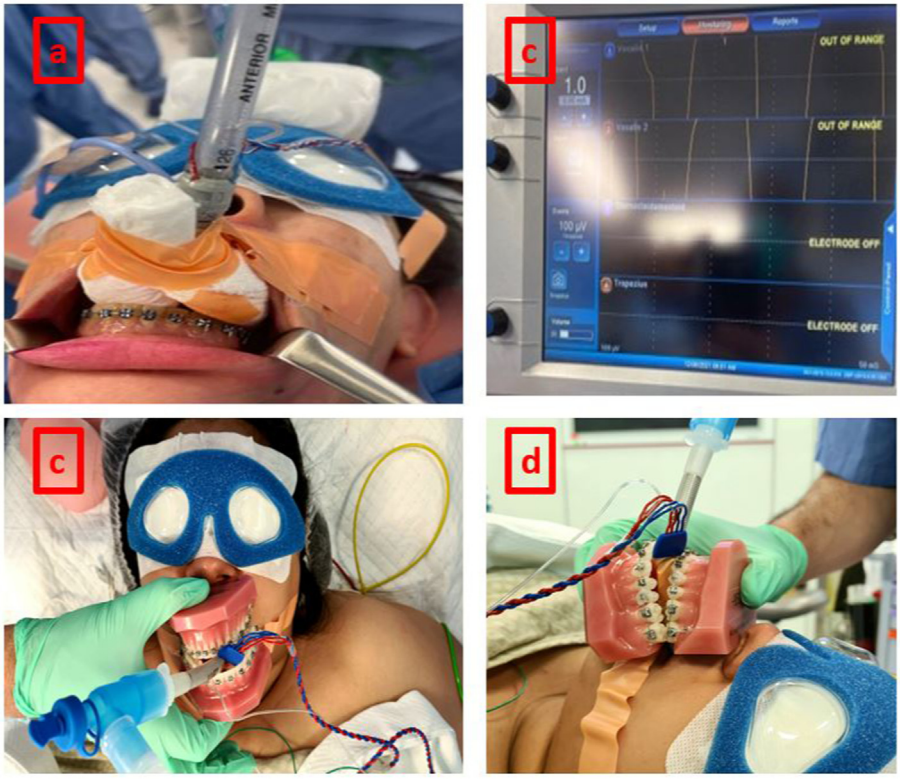

Fig. 1. Figure 1: a) shows the NIM ETT fixed in its position with dental braces. b) NIM monitor with artifacts. c and d) show experiment to test the effect of retainer in another patient without dental braces.

NIM ETTs was done by the manufacturer from other centres but was not communicated with us before using this batch. This again highlights the paramount importance of instrument checks.

4. Conclusion

The artefacts witnessed by our team were extensively studied to eliminate any patient factors (braces) or positioning technique influence. We would like to further highlight the importance of rigorous equipment checks prior to the conduct of anaesthesia to decrease morbidity and mortality.

CRediT authorship contribution statement

Abdulrahman Dardeer: Conceptualization, Methodology, Software. **Ahamed Lafir:** Conceptualization, Methodology, Software. **Chitrambika Krishnan:** Das, Data curation, Writing – original draft, preparation. **Saba Albassam:** Visualization, Investigation. **Yasser Hammad:** Supervision. **Majid AlAbdulla:** Supervision. **Hany Zaki:** Writing – review & editing, and, Writing – original draft. **Nabil Shallik:** Writing – review & editing, and publishing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Open Access funding provided by the Qatar National Library.

References

[1] Zakaria, Recurrent laryngeal nerve injury in thyroid surgery, Oman Med. J. 26 (1) (2011) 34–38, https://doi.org/10.5001/omj.2011.09.
[2] G.R. Joliat, V. Guarnero, N. Demartines, V. Schweizer, M. Matter, Recurrent laryngeal nerve injury after thyroid and parathyroid surgery, Medicine 96 (17) (2017), e6674, https://doi.org/10.1097/MD.0000000000006674.
[3] C.J. Tsai, K.Y. Tseng, F.Y. Wang, et al., Electromyographic endotracheal tube placement during thyroid surgery in neuromonitoring of recurrent laryngeal nerve, Kaohsiung J. Med. Sci. 27 (3) (2011) 96–101, https://doi.org/10.1016/j.kjms.2010.08.002.
[4] A. Engwall, I. Behr, A. Hess, P. Haan, M.K. McLeod, Novel method for confirming appropriate nerve integrity monitor (NIM) endotracheal tube positioning, Am. J. Surg. 221 (2) (2021) 433–434, https://doi.org/10.1016/j.amjsurg.2020.07.019.
[5] G. Atlas, M. Lee, The neural integrity monitor electromyogram tracheal tube: anesthetic considerations, J. Anaesthesiol. Clin. Pharmacol. 29 (3) (2013) 403, https://doi.org/10.4103/0970-9185.117052.
[6] S. Yang, L. Zhou, Z. Lu, B. Ma, Q. Ji, Y. Wang, Systematic review with meta-analysis of intraoperative neuromonitoring during thyroidectomy, Int. J. Surg. 39 (2017) 104–113, https://doi.org/10.1016/j.ijsu.2017.01.086.
[7] G.W. Randolph, H. Dralle, H. Abdullah, et al., Electrophysiologic recurrent laryngeal nerve monitoring during thyroid and parathyroid surgery: international standards guideline statement, Laryngoscope 121 (S1) (2011) S1–S16, https://doi.org/10.1002/lary.21119.
[8] R. Schneider, C. Sekulla, A. Machens, K. Lorenz, P. Nguyen Thanh, H. Dralle, Postoperative vocal fold palsy in patients undergoing thyroid surgery with continuous or intermittent nerve monitoring, Br. J. Surg. 102 (11) (2015) 1380–1387, https://doi.org/10.1002/bjs.9889.
[9] I.C. Lu, K.S. Chu, C.J. Tsai, et al., Optimal depth of NIM EMG endotracheal tube for intraoperative neuromonitoring of the recurrent laryngeal nerve during thyroidectomy, World J. Surg. 32 (9) (2008) 1935–1939, https://doi.org/10.1007/s00268-008-9549-1.
[10] S.K. Snyder, J.C. Hendricks, Intraoperative neurophysiology testing of the recurrent laryngeal nerve: plaudits and pitfalls, Surgery 138 (6) (2005) 1183–1192, https://doi.org/10.1016/j.surg.2005.08.027.
[11] W.F. Chan, C.Y. Lo, Pitfalls of intraoperative neuromonitoring for predicting postoperative recurrent laryngeal nerve function during thyroidectomy, World J. Surg. 30 (5) (2006) 806–812, https://doi.org/10.1007/s00268-005-0355-8.
[12] K. Brauckhoff, R. Vik, L. Sandvik, et al., Impact of EMG changes in continuous vagal nerve monitoring in high-risk endocrine neck surgery, World J. Surg. 40 (3) (2016) 672–680, https://doi.org/10.1007/s00268-015-3368-y.