Thuduvage VS, Daminda DADG, Jayasooriya Y
Preserving vocal cord function: Continuous intraoperative vagusnerve monitoring in total thyroidectomy Volume : 13; Issue1; pp 47-51
DOI: https://doi.org/10.4038/cjo.v13i1.5365

How I do it

Preserving vocal cord function: Continuous intraoperative vagus nerve monitoring in total thyroidectomy

Thuduvage VS[1], *Daminda DADG*[2], *Jayasooriya Y*[3]

[1-]Consultant ENT and Head & Neck Surgeon, University Hospital KDU, Sri Lanka

[2-]Consultant ENT and Head & Neck Surgeon, Portsmouth Hospitals University NHS Trust: Portsmouth, UK

[3-]Research assistant, University Hospital KDU, Sri Lanka

Abstract

A 42-year-old female patient who underwent left hemithyroidectomy for a benign thyroid nodule, was referred for further management, as histology revealed a minimally invasive follicular carcinoma requiring completion thyroidectomy as recommended by Oncologists. She had developed unilateral vocal card palsy following the initial hemithyroidectomy. Pre operatively vocal cord function was evaluated by fibre optic laryngoscopy, which confirmed a left vocal cord palsy. During the completion thyroidectomy, continuous intraoperative nerve monitoring was done using an electrode attached to endotracheal tube. A delta electrode was attached to the Vagus nerve and continuous monitoring of the Vagus nerve was done while performing intermittent monitoring of the Recurrent Laryngeal nerve. Stimulation was performed using a current of 1–2 mA. According to the International Nerve monitoring Study Group (INMSG) guidelines initial amplitude value of at least 500 µV was considered as the normal value.

According to INMSG guide lines, change of EMG signal curve amplitude below 100 µV was considered as loss of signal during the operation. Post-operative period of the patient was uneventful and the right vocal cord function was confirmed as normal by fibre optic endoscopic examination. Even though intraoperative nerve monitoring is a useful procedure for all the thyroidectomy surgeries it is documented to be more beneficial during revision surgeries, thyroid malignancies and pre-operative unilateral nerve palsy patients.

Keywords: vagus nerve, continuous monitoring, thyroidectomy.

Funding: None

Competing interest: None

Correspondence: Dr VS Thuduvage (vasanthikat@kdu.ac.lk)

Accepted Date: 17th January 2024 Published Date: 11th February 2024

p-ISSN : 2012 - 855x, e-ISSN: 2576-2040
Ceylon Journal of Otolaryngology

Introduction

Thyroidectomy is a very common procedure done for thyroid gland related disorders. Thyroidectomy surgery has an inherent risk of damage to recurrent laryngeal nerve (RLN) and external branch of the superior laryngeal nerve (SLN) during surgical procedure due to the anatomical close relationship of the nerve to the thyroid gland. Nerve monitoring during thyroidectomy is a crucial step to prevent nerve palsy and enhance patient safety[1]. It helps to identify both nerves during thyroidectomy and preserve them. Continuous intra operative nerve monitoring further minimizes the risk of nerve injury during surgery, identifying even stretch injury (neuropraxia) during the surgical procedure[2]. Intra operative nerve monitoring enhances surgical accuracy and contributes to better patient outcomes[3].

Case Presentation

A 42-year-old female was referred for completion thyroidectomy who had undergone left hemi thyroidectomy. Her ultra sound scan showed a large solitary nodule over left lobe of thyroid measuring 45mm x 32mm x 24mm and fine needle aspiration was reported as colloid nodule with lymphocytic thyroiditis and Bethesda II classification. She had undergone left hemithyroidectomy and histology suggested minimally invasive follicular carcinoma with complete excision with tumour free extra capsular resection margins. Post operatively, she had developed voice change and confirmed to have left sided vocal cord palsy by fibreoptic laryngoscopic (FOL) examination. Oncology referral was done and confirmed the requirement of completion thyroidectomy. Patient was informed about the possibility of getting a right sided vocal cord palsy during completion thyroidectomy and the need of tracheostomy in such a situation. Consent was taken pre operatively for tracheotomy and the intensive care unit (ICU) was arranged for the post -operative period. Completion thyroidectomy was planned with continuous and intermittent intraoperative nerve monitoring. The patient was anesthetized without using long-acting muscle relaxant. An adhesive electrode was placed around the intubating endotracheal tube covering it facilitating the nerve monitoring. Video laryngoscope examination confirmed the position of the electrodes. During surgery the carotid sheath was exposed and right Vagus nerve was identified. A delta electrode was attached to the right Vagus nerve.

Continuous intraoperative nerve monitoring was done with intermittent stimulation and monitoring using a handheld stimulation probe. A 1–2 mA current was used to stimulate the nerve. Continuous real-time monitoring of the vagus nerve was sustained throughout the completion thyroidectomy, which helped to identify stretch injury to nerve(neuropraxia) early. This was coupled with intermittent monitoring of the right recurrent laryngeal nerve (RLN) and external branch of superior laryngeal nerve with the nerve stimulator. Right recurrent laryngeal nerve and external branch of superior laryngeal nerve was identified physically and preserved. The Patient was extubated on the operating table and observed for stridor. Extubation was uneventful and the patient was observed in the intensive care unit for 24 hours. Clinical voice assessment was done on the day following surgery and postoperative FOL done before discharge confirmed a normally functioning right vocal cord. The Patient was discharged on post-operative day two with the plan of reviewing in the clinic.

Discussion

Vocal cord paralysis is considered as one of the main complications of thyroidectomy. Vocal cord paralysis rates vary from 2 - 26% for transient nerve palsy and 0.3- 6% for permanent forms of palsy according to different studies[5]. The nerve palsy rate for revision thyroid surgeries is reasonably high indicating 14%.[5]. Identification of the recurrent laryngeal nerves during surgical procedure is considered as the gold standard for preventing nerve injury during thyroidectomy. Intraoperative monitoring of nerves are recommended as a useful method of identification of nerves and prevention of nerve injury. This method of nerve monitoring may play an important role especially in revision thyroid surgeries, thyroid cancer surgeries or patients with preexisting vocal cord palsy pre operatively

Nerve monitoring can be done as continuous nerve monitoring and intermittent nerve monitoring[4]. During this type of nerve monitoring an electrode is pasted to the endotracheal tube using its adhesive surface just above the cuff of the tube. This covers the circumference (360^0) of the endotracheal tube and this adhesive electrode comes into contact with both vocal cords. This electrode records the EMG waveform during the surgical procedure.

Figure 01 – Attachment of electrode to the endotracheal tube

An automatic electric current wave of 1-2 mA will be given during the entire operative period and vagus nerve will be stimulated using this current. This will lead to a periodic contraction of vocal cord muscles which will actively convert it to visual and audible signals via the nerve monitor. Real time monitoring of the Vagus nerve during the surgical procedure will allow the surgeon to monitor the nerve and assess the nerve function and detect any imminent injury which will help to take corrective surgical manoeuvres to prevent further injury. A delta electrode is attached to the Vagus nerve after identification of the Vagus nerve within the carotid sheath.

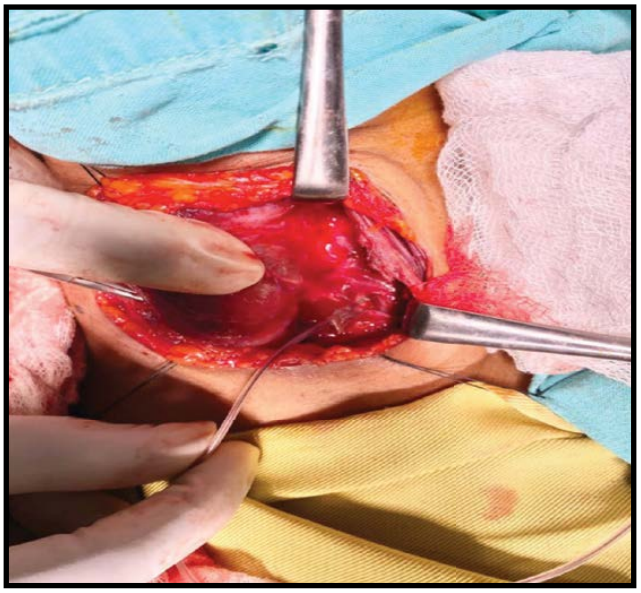

Figure 2 - Attachment of Delta electrode insertion to Vagus nerve

p-ISSN : 2012 - 855x, e-ISSN: 2576-2040
Ceylon Journal of Otolaryngology

After the attachment of the probes, the reference EMG response is taken which will be taken as the baseline reference reading. This will appear as a biphasic wave pattern to the Vagal stimulation which is corresponding to the motor unit action potential of the thyroarytenoid muscles. According to the guideline of International Nerve monitoring Study Group (INMSG), initial response value of a response at least 500 µV is considered as normal[5]. In our patient it was recorded as 1.04 mV which is well above the reference reading.

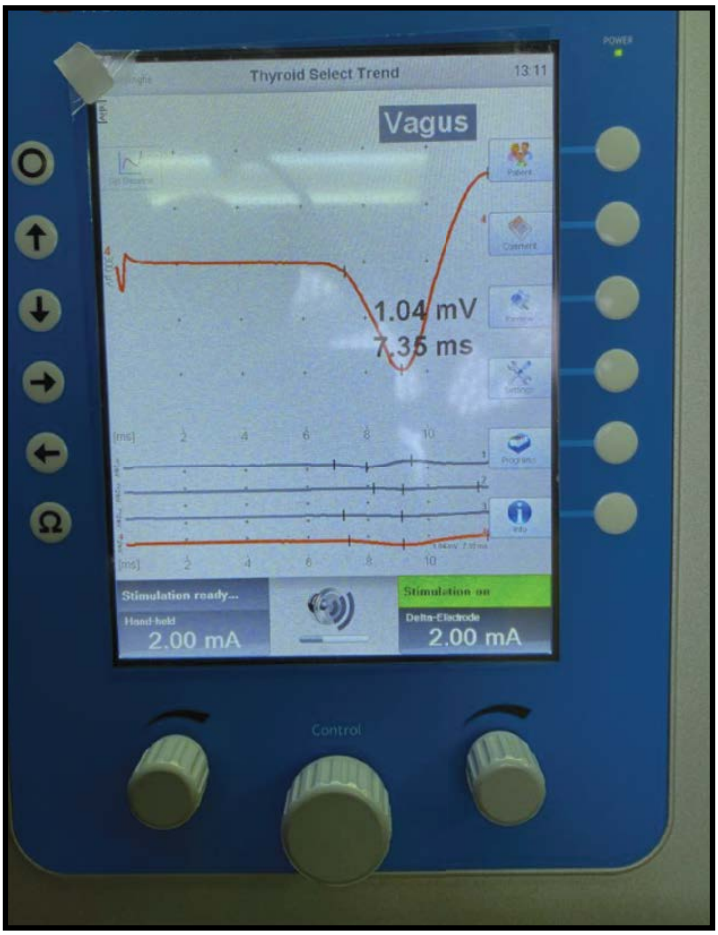

Figure 03 - Waveform detecting the vagus nerve activity

These waves are analysed according to two parameters (the amplitude and the latency of the wave). Amplitude is related to the amount of muscle fibres which are depolarized during the action and this can be vary significantly from patient to patient. The latency is the time gap from stimulation using current to the first muscle response. According to the INMSG guide lines, loss of curve amplitude threshold below the 100 µV is considered as potential nerve damage and advised to take necessary corrective actions aimed to preserve function of the nerve[6]. It is documented that, increase in latency period by 10 % is also considered as a potential injury to the nerve[5]. Therefore, surgeons must have clear understanding of interpretation of nerve responses during intraoperative nerve monitoring.

Intermittent nerve monitoring can be done combined with this continuous intraoperative nerve monitoring using the monopolar electrode probe to detect the nerve function. Usage of intermittent or continuous intraoperative nerve monitoring will facilitate the identification of the recurrent laryngeal nerve[3]. Both intermittent and continuous nerve monitoring are able to detect definitive loss of signal in a one nerve during the surgery but, continuous monitoring has more advantages over intermittent monitoring. Continuous monitoring minimizes the traction injury and thermal injury to the nerve.

At the same time, continuous monitoring helps with 'real time' functional monitoring of the entire recurrent laryngeal nerve and provides detailed EMG documentation [3]. During an event of unilateral loss of nerve signal, the surgeon gets the opportunity of delaying the surgery to a later date after observing for the recovery of the nerve or seek expert help for the contralateral side dissection to minimise bilateral vocal cord palsy risk.

Conclusion

Recurrent laryngeal nerve (RLN) palsy is considered as a dreaded post-operative complication of thyroidectomy. Therefore, intraoperative nerve monitoring, as demonstrated in this case, emerges as a valuable tool for enhancing patient safety during thyroidectomy. The preservation of normal vocal cord function and uneventful postoperative outcomes emphasize the effectiveness of this approach. By minimizing the risk of recurrent laryngeal nerve injury, nerve monitoring contributes to improved surgical outcomes and patient satisfaction.

References

1. *Dralle, H., Sekulla, C., Lorenz, K., Brauckhoff, M., & Machens, A. (2008a). Intraoperative Monitoring of the Recurrent Laryngeal Nerve in Thyroid Surgery. World Journal of Surgery, 32(7), 1358–1366. https://doi.org/10.1007/s00268-008-9483-2*
2. *Sari, S., Erbil, Y., Sümer, A., Agcaoglu, O., Bayraktar, A., Issever, H., & Ozarmagan, S. (2010). Evaluation of recurrent laryngeal nerve monitoring in thyroid surgery. International Journal of Surgery, 8(6), 474–478. https://doi.org/10.1016/J.IJSU.2010.06.009*
3. *Schneider, R., Machens, A., Lorenz, K., & Dralle, H. (2020). Intraoperative nerve monitoring in thyroid surgery–shifting current paradigms. Gland Surgery, 9(S2), S120–S128. https://doi.org/10.21037/gs.2019.11.04*
4. *Thomusch, O., Sekulla, C., Machens, A., Neumann, H.-J., Timmermann, W., & Dralle, H. (2004). Validity of intra-operative neuromonitoring signals in thyroid surgery. Langenbeck's Archives of Surgery, 389(6), 499–503. https://doi.org/10.1007/s00423-003-0444-9*
5. *Mazzone, S., Esposito, A., & Giacomarra, V. (2021). Continuous Intraoperative Nerve Monitoring in Thyroid Surgery: Can Amplitude Be a Standardized Parameter?. Frontiers in endocrinology, 12, 714699. https://doi.org/10.3389/fendo.2021.714699*
6. *Schneider R, Randolph GW, Dionigi G, Wu CW, Barczynski M, Chiang FY, et al.. International Neural Monitoring Study Group Guideline 2018 Part I: Staging Bilateral Thyroid Surgery With Monitoring Loss of Signal. Laryngoscope (2018) 128 Suppl 3:S1–17. https://doi.org/10.1002/lary.27359*