Editorial

Non-invasive recording during intra-operative neuro-monitoring in thyroid surgery: omitting surface electrode and oversize endotracheal tube

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I have read with interest on the article by Wu *et al.* "*Transcutaneous Recording during Intraoperative Neuromonitoring in Thyroid Surgery*" published in *Thyroid* (1). The article is well written and innovative. It introduced and tested the feasibility of a transcutaneous electrode on recording intra-operative neuro-monitoring (IONM) signal in an *in vivo* study.

IONM has been introduced for thyroid surgery for more than two decades. With advance in technology and improvement of neuro-monitoring systems, IONM have been widely adopted as an important adjunct during thyroid surgery. Though routine application of IONM might not decrease the rate of recurrent laryngeal nerve palsy, its role on identification of recurrent laryngeal nerve (RLN), confirmation of RLN integrity was valuable. Historically, presence of laryngeal twitch during RLN and vagal nerve stimulation confirmed the nerve integrity. However, false twitching was present if laryngeal plexus was stimulated. To decrease the false positivity of laryngeal twitch, insertion of needle electrode into laryngeal muscles was introduced. And later on, surface electrode placed on endotracheal tube (ETT) was developed and became the mostly adopted approach for recording neural signal nowadays. As a receiving electrode, surface electrodes have to be contact with vocal cord to record the neural signal. To enhance the contact, a large size ETT was usually used. However, this oversize ETT could potentially lead to laryngeal trauma and voice change after thyroidectomy (2-4). Instead of insertion of needle electrode, placement of surface electrode in ETT have less disturbance on thyroidectomy. However, position of ETT often shifted and mal-positioned during neck extension or retraction of neck structure during thyroidectomy. It thus led to loss of signal and false positive results.

Wu *et al.* conducted an *in vivo* study evaluating if transcutaneous electrode can be used as an alternative recording electrode. A pair of adhesive pre-gelled electrodes was attached to skin at level of upper border of lateral lamina of thyroid cartilage. The amplitudes and latencies were recorded by transcutaneous electrode and surface electrode on ETT. Despite the level of amplitude was lower, they found that transcutaneous electrodes can accurately record the amplitude and latency and be comparable to surface electrode. The recorded signal was stable during neck extension and elevation of larynx. On induction of RLN traction injury, signal recorded from transcutaneous electrode demonstrated the progressive degrading of electromyographic amplitude as surface electrodes did. Upon release of traction, gradual recovery of neural signal was also demonstrated. Thus, the author concluded that application of transcutaneous electrode is feasible, stable and accurate alternative to record the neural signal during IONM.

By applying these electrodes, the operating surgeons could check with attachment and contact of electrode to the

patients without much disturbance during thyroidectomy. For surface electrode on ETT, the conduction and contact between electrode and vocal cord could only by confirmed with laryngoscopy. On the other hand, for surface electrodes, application of IONM should be decided at the time of ETT insertion. If IONM was used in all thyroidectomy, it has been showed to be not cost-cost-effectives and would not decrease rate of RLN palsy (5,6). Some thyroidectomy, like re-operation, thyroidectomy for malignancy, were expected to be high-risk in RLN injury (7). The decision of application of IONM was less in doubt. However, there were occasions which difficulties in identifications and preservation of RLN were noted during operation. Surface electrode on ETT might not have been placed during intubation. In such condition, surgeons could apply transcutaneous electrode as per needed. By selective use of IONM, it would be much more cost effective.

Theoretically, these transcutaneous electrodes sound promising and have potential role in daily practise. However, there were flaws had to be solved and further revised. There were studies documented that median amplitudes on RLN and vagal nerve stimulation were 622–791 and 448–621 μV respectively (8). In Wu *et al.* study, mean amplitude under RLN and vagal nerve stimulation were 264 and 202 μV only respectively. Signal ≤100 μV upon neural stimulation were usually considered as negative signal (3). With reference to same cutoff, a drop of 50% from baseline on transcutaneous electrode implied absence of signal. From previous study, degree of amplitude drop and absolute value of amplitude have important prognostic value in-terms of early neural recovery at the end of operation and on follow-up (9,10). If transcutaneous electrodes were applied and amplitude was dropped from 264 to 130 μV at the end of operation, there was 50% drop of amplitude on RLN stimulation. Taking 130 μV as the end amplitude, the sensitivity of detecting a vocal cord palsy was 45–54% (11). Taking 50% drop in amplitude, the sensitivity was around 81.8% (10). During bilateral thyroidectomy, prediction of first-side RLN palsy had an important implication on whether second side should proceed, or the operation should be staged. With this variation of sensitivity, normal range of amplitude should be redefined for IONM using transcutaneous electrodes. Though Wu *et al.* showed that the neural signals were stable during neck extension and upward cricoid elevation, in real life, manipulation of neck structure during thyroidectomy were more complicated than simple upward cricoid displacement. While the electrodes were placed at the level of upper edge of thyroid cartilage, development of subplatysmal flap and retraction of strap muscle during dissection of thyroid upper pole might hinder the transmission of neural signal. And the actual recorded EMG signal might be diminished and much lower after dissection of upper pole.

In conclusion, transcutaneous recording of EMG signals sounds promising and easy to apply. It avoided unnecessary over-size ETT insertion and also laryngeal trauma. However, further studies on its application during thyroidectomy would be warranted before adoption as an alternative to surface electrode on ETT.

Acknowledgments

None.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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