Editorial

Safety of continuous vagal neuromonitoring in thyroid surgery from gastrointestinal point of view

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Continuous intraoperative neuromonitoring (c-IONM) via the vagal nerve has been recently introduced to the surgical armamentarium for thyroid surgery in order to prevent the recurrent laryngeal nerve (RLN) injury (1-4). Automatic periodic stimulation of the vagal nerve with the electric current at frequency of 0.2–2.0 Hz allows for almost real time monitoring of the functional integrity of the entire RLN during thyroid operation. When compared to the current standard of visual identification of the RLN even with use of intermittent IONM (i-IONM) allowing for improved anatomical identification of the nerve this novel concept of functional preservation is considered to be a quantum leap in nerve protection with a potential of preventing nerve injury (1). As shown in many previous studies the majority of the RLN injuries are non-anatomical and traction related injuries caused by surgical manipulation during thyroid dissection (5,6). The impending neural injury can be recognized by the c-IONM system intraoperatively and the surgeon can be alerted as soon as a series of severe combined events (sCE) occur in intraoperative electromyography (EMG) of the vocalis muscles during the case. Most commonly the sCE is defined as decrease in amplitude of more than 50% from baseline with a simultaneous increase in amplitude of the EMG signal of more than 10% when compared to the initial baseline (3,4). What is extremely important is the fact that sCEs usually are reversible in the majority of cases and that loss of signal—an EMG event which is hardly reversible and highly predictive of neural injury—is most commonly preceded by the occurrence of sCEs (3,4). Hence, once the surgeon is alerted by the c-IONM system the surgical maneuvers should be stopped for a while until the recovery of the EMG parameters is observed (1). In this way surgical manipulation and dissection during thyroidectomy can be done in a much safer way for the RLN implying not only anatomical but also functional nerve preservation. Schneider *et al.* published recently encouraging data comparing prevalence of RLN injury with c-IONM versus i-IONM in a large cohort of 1,526 patients, 788 of whom (1,314 nerves at risk) underwent thyroid surgery using c-IONM and 738 (965 nerves at risk) had i-IONM. Operation with c-IONM resulted in fewer permanent vocal fold palsies compared with i-IONM after thyroid surgery in patients with benign disease (0.0% *vs.* 0.4%, P=0.019) (2).

Despite growing body of evidence based on prospective cohort studies, including large cohorts of patients that c-IONM with a repetitive vagal nerve stimulation is safe (1-4,7), there are three anecdotal reports of local and cardiac complications during thyroid operations with c-IONM in a very few patients (8-10). Hence, some surgeons expressed their concern that this technology designed to prevent harm to the RLN during thyroid dissection may carry its own risk and should not be recommended to the low-volume thyroid surgeons (8). However, it has been repeatedly shown that gentle vagal nerve handling and meticulous RLN dissection makes no harm to the nerve (2,7). In addition, the electrical current of 1–2 mA used during thyroid operation with c-IONM has no potential to activate thin demyelinated C-fibers responsible for the majority of the autonomic effects (11). The stimulation with 1 mA is supramaximal for only the efferent motor A fibers and myelinated autonomic B fibers. Moreover, low-level

vagal nerve stimulation at frequencies less than 30 Hz (most commonly frequency used for c-IONM is between 0.5 and 2.0 Hz) has not been associated with subsequent adverse vagal effects. Furthermore, the 1 mA stimulation current used for c-IONM is not believed to initiate any adverse vagal effect leading to central (headache, numbness), cardiac (arrhythmias, bradycardia), pulmonary (bronchospasm), or gastrointestinal (nausea, vomiting) symptoms (1).

Thus, it is of utmost importance to realize that surgeons willing to utilize the c-IONM technology safe should be aware of the standardized approach to the neural monitoring of the RLNs and strictly adhere to some basic rules outlined by the International Neural Monitoring Study Group in the field (12). To make this procedure even safer we certainly need more studies focused on safety issues. Hence, Xiaoli *et al.* should be congratulated for undertaking in their most recent research the changes in gastric acid secretion and gastrin release during thyroidectomy with c-IONM as the primary outcome measure (13). The vagus nerves are very well-known to play a pivotal role in the regulation of gastric acid secretion and Gastrin release (14). Xiaoli *et al.* examined 58 patients undergoing thyroid surgery with c-IONM and compared gastric acid and serum gastrin at five time points during the operation: (I) before skin incision; (II) after baseline calibration of c-IONM probe; (III) at 20 min from baseline; (IV) before probe removal; and (V) after extubation. Gastric pH was assessed by transnasal placement of a sensor in the stomach by the anesthesiologist. Gastrin hormone level was determined with a commercially available radioimmunoassay kit. Non-significant differences in mean gastric pH values were observed at all time points of the operation. Comparisons of pH monitoring parameters revealed no significant differences if stratified to age, gender, side of c-IONM (left *vs.* right), sequence of c-IONM, or duration of c-IONM. Gastrin values were normal in sequential determinations and did not significantly differ at any time points. Hence, authors concluded that c-IONM performed via repeated vagal nerve stimulation during total thyroidectomy in healthy patients did not influence gastrin secretion and gastric pH (13).

To date, there is no concern about safety of c-IONM during thyroid surgery from gastrointestinal point of view as any alimentary tract associated severe adverse effects of a repetitive stimulation of the vagal nerves have not been reported so far. From practical point of view, the clinical benefit of utilization of c-IONM during thyroid surgery seems to far overweight the minimal risk of the procedure related problems. Prevalence of permanent vocal fold palsy is lower with c-IONM and accuracy in predicting early postoperative vocal cord function is superior to the i-IONM technique.

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Footnote

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