INFLUENCE OF STIMULATION- AND SENSING-ELECTRODES ON SIGNAL-STABILITY AND VALIDITY OF CONTINUOUS INTRAOPERATIVE NEUROMONITORING (CIONM) IN THYROID SURGERY

Rieber, Fabian[1]; Ulmer, Christoph[2]; Heider, Christoph[2]; Steurer, Wolfgang[2]; Lamadé, Wolfram[3]
[1]Robert-Bosch-Krankenhaus Stuttgart, Dept. of General and Visceral Surgery / Dept. of Hematology/Oncology, Stuttgart, BW, Germany; [2]Robert-Bosch-Krankenhaus Stuttgart, Dept. of General and Visceral Surgery, Stuttgart, BW, Germany; [3]Helios-Spital Ueberlingen, Ueberlingen, BW, Germany

Background/Purpose: Stable and noise-free EMG recoding is crucial for CIONM to be clinically meaningful. EMG changes need to be correlated to functional changes of the recurrent-laryngeal-nerve (RLN) in order to prevent nerve-injury and RLN-palsy. The influence of stimulation and sensing electrodes on EMG stability have been widely discussed, but were never quantified. Our goal was to investigate whether the geometry and topology of EMG-electrodes has a systematic and reproducible influence on EMG-signal-stability.
Methods: CIONM through vagus-nerve-stimulation was performed using an endolaryngeal-tube-electrode and an intramuscular needle-electrode simultaneously. The respective EMG signals were recorded an analyzed in MATLAB for characteristic signal-variability (n=12). Previously recorded EMG-signals from thyroid surgeries performed under CIONM with an open vs. closed stimulation-electrode were retrospectively analyzed for characteristic influence on EMG-signal-variability in MATLAB (n=80).
Results: EMG-sensing through an intramuscular needle-electrode provided higher EMG-amplitude compared to the endotracheal surface-electrode. However, the needle-electrode was also associated with a significantly higher signal-variability over the entire operation-course (quartile coefficient-of-dispersion 0.76 vs 0.46, $p<0.01$).
An open-type stimulation electrode resulted in significantly higher short-term signal-variability than the closed-geometry stimulation electrode (60sec-quartile-coefficient-of-dispersion 0,01 vs 0,2, $p<0,001$); the overall variability over the operation-course was not influenced by the stimulation-electrode.
Discussion & Conclusion: Sensing-electrode and stimulation-electrode geometry and topology induce specific EMG-changes in CIONM. The evaluation of short-term signal-change can only be reliably performed using a closed-geometry stimulation-electrode. EMG stability throughout the overall operation-course is highly influenced by the topology of the sensing-electrode. The findings suggest that in order to be able to correlate EMG-changes to actual nerve-function changes, the combination of a closed-geometry stimulation-electrode and an endotracheal sensing-electrode provide the safest and most reliable option.