DEVELOPMENT AND VALIDATION OF AN EARLY-WARNING-SYSTEM FOR RECURRENT LARYNGEAL NERVE PROTECTION IN THYROID SURGERY

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Background/Purpose: Despite intraoperative nerve-localisation through visualization and electrical stimulation, recurrent-laryngeal-nerve-palsy (RLN-palsy) is still a relevant complication in thyroid surgery, especially in complex procedures e.g. thyroid-cancer surgery. Transsection and clipping of the nerve has been reduced through these methods, but indirect nerve trauma by physical stress e.g. pressure and strain cannot be safely prevented. Electromyography (EMG)-based continuous-intraoperative neuromonitoring (CIONM) in thyroid surgery has shown potential to overcome these limitations. However, currently available CIONM-systems comprise no reliable automatic signal-analysis and intuitive, non-distracting information display to the surgeon. Our goal was to develop an early-warning-system for intraoperative nerve-trauma.

Methods:
2. Experimental assessment of the correlation between physical stress and EMG-changes (in-vivo experiment, n=3).
4. Implementation & validation of the results in a realtime-system.
5. Intraoperative proof-of-concept (pilot-study, n=12).

Results: Empirical automatic classification of EMG signals provided 97,1% sensitivity and 98,1% specificity. Changes in EMG amplitude and latency highly correlated to physical nerve strain even before nerve trauma was induced (p>0.00001, Fig. 2a+b).

Synthetic auditory display allowed for 50% earlier detection of EMG-changes than currently available analog EMG display (Fig. 3).

The realtime system SAFE (signal-analysis-and-feedback) correctly detected 99,1% of intraoperative motor-potentials. In 5/12 cases, the surgical strategy was altered based on the detection of the SAFE early-warning system.
Discussion & Conclusion: Fully-automatic EMG analysis in CIONM is feasible in realtime. Changes in motor-nerve function preceding indirect nerve-damage can be reliably displayed to the surgeon without distraction from the procedure.