Additive use of continues subcortical stimulation for resection of motor eloquent lesions

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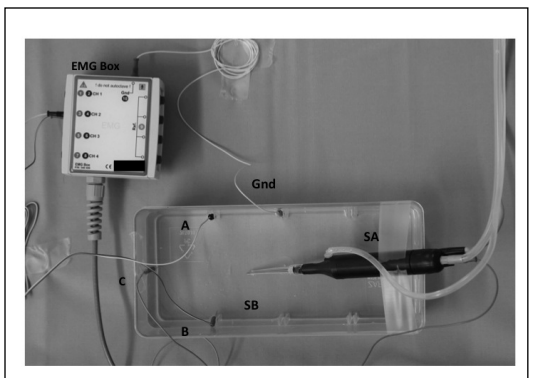
Introduction

Resection of motor eloquent lesions has become safer due to intraoperative neuromonitoring (IOM). Subcortical stimulation of motor evoked potentials (scMEP) is increasingly used to increase patients´ safety even further. So far, scMEP is performed intermittently during resection of eloquently located lesions. The present study assessed the possibility to use a resection instrument for continuous stimulation of scMEP.

Methods

An ultrasonic surgical aspirator (SA) was attached to the IOM stimulator and was used as a monopolar subcortical stimulation probe. The influence of SA usage at different ultrasound power levels (0, 25, 50, 75 and 100 %) on stimulation intensity was examined in a saline bath.



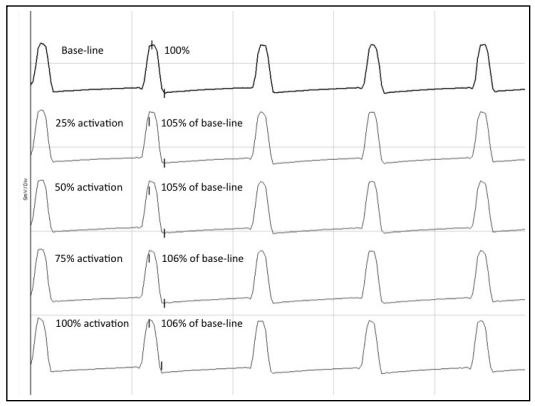
The ultrasonic surgical aspirator (SA) is connected to an IOM stimulator through an adapter cable (E). Electrical stimulation voltage is detected through the needles (A & B) in a saline bath (SB). Anodal pole for the monopolar stimulation (C) and ground electrode (Gnd).

Thereafter monopolar stimulation with the SA was used during the resection of subcortical lesions in the near vicinity of the corticospinal tract (CST) in 14 cases in comparison to scMEP via a standard stimulation electrode. During resection, the stimulation current at which an MEP response was still measurable with SCS using the SA was compared to the corresponding stimulation current needed using standard monopolar subcortical stimulation probe (MP) at the same location of stimulation.

Results

Influence of the surgical aspirator (SA) on the monopolar stimulation

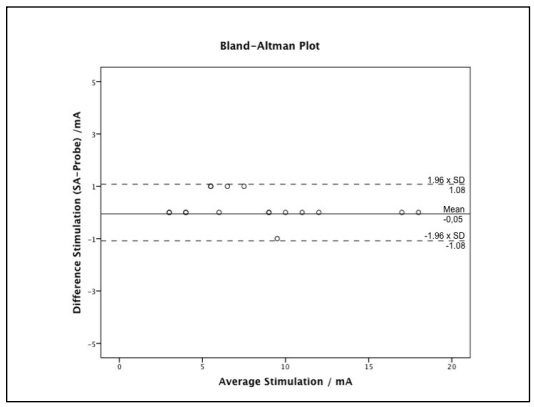
Activation of the SA increased the stimulation intensity to 105.7% ± 7.9% at 25% SA activation level, 105.8% ± 3.6% at 50% SA activation level, 106.5% ± 8.1% at 75% SA activation level and 106.9% ± 13.9% at 100% SA activation level (mean ± SD) compared to baseline (without SA activation)



Influence of SA activation on electrical stimulation voltage in the saline bath.

Correlation of subcortical stimulation with SA and the monopolar hand-held probe

Subcortical stimulations with the hand-held probe and the SA were successful in all cases. Stimulation intensities of both methods were almost identical for electing the lowest motor threshold from the same stimulation site in all cases ($r2 = 0.994$, $p < 0.0001$). A 1 mA difference between both stimulation devices was regarded as clinically insignificant.



Bland-Altman plot illustrating motor mapping thresholds measured with the hand-held monopolar probe and the surgical aspirator. The variability of the different methods was evaluated and visualized by a Bland-Altman plot. The limits of agreement during Bland-Altman analysis were the average difference ± 1.96 standard deviation of the difference

Correlation of electrophysiological findings to postoperative clinical outcome

scMEP motor threshold (MT) ranged from 3 – 18 mA in both stimulation modalities. One patient developed a high-grade paresis following surgery. In this case cortical cMEP were permanently lost. Transient new postoperative paresis or temporary exacerbation of preoperative paresis was observed in 28% (4/14) of cases . In all these cases MT was 4 – 8 mA stimulation intensity at 300 ms pulse duration.

Gross total resection was achieved in 57% (8/14) and subtotal resection (>80% of tumor mass) in 35% (5/14) of cases.

Conclusions

Continuous motor mapping using subcortical stimulation via SA is a feasible and safe method withou any disadvantages in comparison to the sequential use of the standard monopolar stimulation probe. In comparison to the standard probe it offers continuous information on the distance to the corticospinal tract.