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Editorial

New alert criteria for intraoperative somatosensory evoked potential monitoring

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Forty years ago, anesthesiologist Betty Grundy and engineer Richard Brown, working with spine surgeon Clyde Nash, began recording somatosensory evoked potentials (SEPs) from the scalp during spine surgery. Their goal was to identify SEP changes in time to avert post-operative neurologic impairment. Their early methods were crude by today's standards. They measured 512 msec long-latency SEPs with filters 1–100 Hz. They followed scalp signals' presence or absence without identifying particular peaks of interest. Disappearance of signals was judged a change. Eventually they decided to call a 50% drop in overall waveform amplitude as a change from baseline for these middle- and long-latency potentials. At their 1977 Cleveland meeting, Clinical Application of Spinal Cord Monitoring for Operative Treatment of Spinal Diseases, Nash presented this 50% rule for alerting for change (Nash, 1977).

Not being satisfied with that noisy long-latency technique, Nuwer and Dawson (1984) set about to refine the technique. Improved signal reproducibility was measured for many technical variations. The modern generation of SEP scalp monitoring technique was derived from these experiments measuring variability and seeking the best reproducibility for short-latency SEP peaks. This search settled on measuring the lower extremity SEP P37 peak, which was found using a 30 Hz low filter and faster stimulation rates. The 50% amplitude reduction alert criterion was brought over from the Cleveland protocol. This technique remains in common use today. Much clinical work has been based on this this short-latency restricted filter with the 50% alert criterion, validating its clinical utility, and confirming prevention of adverse outcome when using that technique and criterion (Nuwer et al., 1995, 2012).

With time, improved alert criteria have been suggested. In this issue of *Clinical Neurophysiology*, MacDonald et al. (2019) propose refining that 50% amplitude reduction criterion. They point out how a more refined criterion may be better at identifying early signs of spinal cord impairment. The new criteria include several points. (1) Baseline amplitudes should be measured after the initial anesthesia "fade", i.e. after the effect of anesthetic causes initially decreased amplitude. Fade is common in the first 20–30 min of general anesthesia, after which a more stable reproducible signal can be followed. (2) Peak reproducibility should be assessed for each patient, and change from stable baseline considered when that stable pattern is exceeded. The more stable reproducible a pattern, the lower the threshold for alerting a change. A very reproducible P37 peak with less than 20% baseline variability could be alerted as changed when a 30% amplitude drop is observed. A less reproducible P37 peak with 30–50% baseline variability could be alerted as changed when a 50% amplitude drop is observed. I would add three more points: (3) At initial data collection, the intraoperative monitoring (IOM) team should scout among various stimulus intensities, filter settings, scalp recording sites, and stimulation rates to find and then use the most reproducible peaks. (4) The measurement of the peak should be for the best reproducible amplitude segment. For some peaks, that is from the flat tracing at 30–35 msec to the nadir of the P37 peak; whereas for other tracings it may be from the P37 nadir to the N45 maximum. Measure the segment that is most stable. (5) Measure more than one channel. If one scalp channel changes and another scalp channel is stable, the change may be a directional change in the generator dipole rather than due to spinal cord impairment. One unchanged cortical channel is good enough to determine spinal cord clinical stability.

Personnel should be well versed in finding their best baseline and alerting for changes in this manner. Appropriate professional supervision of a technologist allows two pair of eyes to scan for changes, and to recognize opportunities to improve the signal reproducibility. Good open clear communication between the IOM team and the surgeon and anesthesiologist based on these principles facilitates the best use of IOM and the greatest safety for the patient.

Given these five guideline principles, IOM teams can improve early alerting for change while avoiding excess false alarms.

Conflict of interest

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