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## Trends in Anaesthesia and Critical Care

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## The meaning and impact of interpreting the EEG when using EEG derived ‘depth of anaesthesia’ indices

In this issue of Trends in Anaesthesia and Critical Care (TACC), Dr. Honorato and her colleague present an inspiring review on the use of processed electroencephalogram (pEEG) monitors to better guide intraoperative administration of anaesthetics. Most importantly, they emphasize their technical and clinical drawbacks – with intriguing clinical case descriptions – and deliver necessary basic knowledge about signal recording & processing to definitely improve the readers understanding to use pEEG – and especially the density spectral array (DSA) of the EEG – as a central adjunct in the OR or ICU to improve patient care. Thereafter, they put this elegantly into clinical context [1].

It is a fortunate coincidence that important EEG signatures of unconsciousness – especially the anteriorization of the alpha waves – originate from the frontal part of the brain, and so can be easily recorded during most surgical interventions [2]. As described by the authors, the DSA of anaesthesia induced EEG changes is much more than just an additional display on the widely used pEEG monitors. Unfortunately, to date DSA displays are available only on the standalone monitors, and are not part of the modules that deliver pEEG data to standard anaesthesia monitors. A crucial question now naturally arises: how much longer are we happy to trust the index numbers of those pEEG monitors that lack adequate integration & interpretation of age, and were not designed to handle co-administration of non-GABAergic anaesthetics like ketamine or dexmedetomidine? [3–5].

Furthermore, analgesia or pain is not reflected with widely used pEEG monitors and the mentioned qNOX monitor (Quantum Medical, Mataró, Spain) is still far from being highly validated. But evidence exists that pain or inadequate analgesia can induce so-called alpha drop outs in the EEG during anaesthesia or “delta arousal” pattern (also termed “paradoxical arousal”) as an unexpected *increase* in slow-wave or delta EEG amplitude [6–8]. This also is effortlessly recognizable on a DSA trace.

So, at the end of the manuscript you might find yourself asking why those monitors have failed to invade every OR in the world, when we do have some evidence now that a more personalized (medicine) anaesthesia decreases the risk of awareness (in TIVA) and delirium? [9,10].

The problem is of course multifactorial and discussed in depth in a recent “open mind” publication in Anesthesia & Analgesia [5].

1) The major challenges could be the cost effectiveness of monitors (20.000 EUR) or especially the sensors (10–15 EUR/sensor, or even more) and total expenses, which easily reach the level of a full year salary of an attending anaesthesiologist for a

department. The reason for those high prices is essentially due to the integrated proprietary algorithms.

- 2) There is still a lot of (valid) scepticism about what those algorithms (the “black box”) exactly do? This could be avoided by the companies themselves publishing detailed information of the processing involved to create the index number.
- 3) Unfortunately, we as a specialty have failed so far to deeply incorporate knowledge in EEG in the training of our residents. Just imagine a cardiologist without knowledge in ECG or a neurologist in EEG!

We think the time has come for intraoperative EEG and specifically the DSA to become the standard means of monitoring the target organ of anaesthesia – the brain – and for adequately educating ourselves & future anaesthesiologists in using the EEG to deliver a more personalized anaesthesia. In parallel, we do need more research on the intraoperative use of the DSA to titrate anaesthesia. For every novice to using EEG during anaesthesia: this is an excellent article for getting a grip on this essential topic.

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