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EDITORIAL

Unconventional monitoring methods: can BIS® predict airway obstruction?

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Anesthesia depth assessment is still under discussion despite several monitors available to this day (BIS®, Entropia®, SED-line®, NarcoTrend® etc.). Since manufacturer introduced the BIS device in 1994, a huge debate raised about its real usefulness in monitoring anesthesia depth and preventing awareness. Just to mention the main studies that have been published about BIS, in 2004 the "B-Aware Trial" showed better outcomes for adult patients at high risk of awareness[1]; in 2008 the "B-Unaware Trial" demonstrated no differences in awareness incidence when BIS is compared to end-tidal anesthetic gas (ETAG) measurement.[2] In 2007, Manyam discussed the need to maintain BIS reading below 60, demonstrating how BIS values are minimally influenced by the addition of opioids to general anaesthetics.[3] In 2011, the BAG-RECALL Research Group was unable to prove superiority of BIS-guided anesthesia versus ETAG-guided anaesthesia.[4] More recently, Mashour *et al.* found no differences in the incidence of awareness in a study with more than 21,000 patients.[5] A 2014 Cochrane review confirmed the previous trend, finding inconclusive evidence of intraoperative awareness protection.[6] In addition, in 2015, the BJA released a special issue about memory and awareness, from which two studies are worth mentioning: a study by Schuller, in which BIS monitor was used in awake volunteers receiving neuromuscular blocking agents, showing unreliable values,[7] and a review on "controversies and non-controversies" in intraoperative awareness.[8]

In the last eight years a number of neural mechanisms of consciousness, including surprising genetic and anatomical details, were discovered. Friedman described "neural inertia" for the first time in 2010, presenting a hysteresis-based model.[9] In 2013 the same research group was able to demonstrate how four different genes are involved in sleep homeostasis, and how these genes can control waking and unconscious states in distinct anatomical circuits.[10] In 2012 Långsjö *et al.* demonstrated how different areas of the brain, including subcortical and limbic regions, have a key role in awakening from unconsciousness.[11] As clearly stated by Scheinin *et al.* in 2013, while consciousness depends on activation of deep, primitive brain structures, BIS is based on electroencephalographic measurement of neocortical activity.[12] In the same paper, the Authors state that no scientific evidence supports the "therapeutic window" of 40-60.[12] All these studies indicate that BIS is able to detect changes in a limited region of the cerebral cortex, while consciousness and anesthesia depth depend on complicated interactions between different areas of the brain.

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Regarding mortality, in 2005 Monk *et al.* demonstrated a direct association between cumulative deep hypnotic time and one-year mortality after noncardiac surgery.[13] Their results were confirmed by a study by Kertai in 2010,[14] while in 2012 Sessler *et al.* found increased mortality when hypotension and low minimal alveolar concentration were combined with low BIS ("triple-low").[15] Interestingly, another study by Kertai in 2014 stated that "triple low" was not associated with increased mortality.[16] Again, two papers in the last three years found an association between low BIS and mortality, opening a new debate about the real weight of low BIS in daily practice.[17, 18]

According to scientific literature, evidence to support BIS use to prevent awareness is weak. Differences between awareness and wakefulness must be taken into account when evaluating patients scheduled for sedation in outpatient settings.[19] In this scenario, alternative uses of BIS monitor could lead to interesting conclusions. In this issue of *Minerva Anestesiologica*, Sabouri *et al.* present an observational prospective study showing an association between BIS and airway obstruction during sedation for third molar extraction.[20] According to the results presented, a clinical-based BIS value of 74 was proposed as a target to avoid airway obstruction. From this perspective, BIS could "improve safety, assure adequate recovery of the patient in outpatient setting and could increase practitioner comfort".[20] Considering low incidence of awareness compared to high incidence of other clinical events like airway obstruction during sedation, it is clearly easier to demonstrate BIS usefulness in daily clinical practice correlating BIS values with frequent clinical events. The study by Sabouri is a good example of a trial designed to find new applications for a twenty-five-year-old technology, looking for clinical correlations beyond awareness prevention. At this point of the scientific debate, anaesthesiologists should use BIS in daily practice as an aid to clinical evaluation. Sabouri shows a valid way to use BIS in clinical practice in order to increase safety and to manage adverse clinical events in a selected setting. In conclusion, being aware of the limits of a device besides its strengths is the best way to benefit from its value.

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