Università degli Studi di Trieste
Archivio della ricerca – postprint

Correlation between Bispectral Index and EEG

Monitoring the depth of anesthesia plays a pivotal role during surgery and sedation. In a pediatric setting it becomes even more important due to the increased risk of intraoperative awareness and of both underdosing and overdosing of anesthetic drugs.[1] Bispectral Index (BIS) is an EEG-derived algorithm used for monitoring the depth of anesthesia which converts four features of the EEG to a dimensionless number that ranges from 0 (cortical silence) to 100 (awake). Although its effectiveness has been demonstrated for adult patients,[2, 3] limited data are available in pediatrics. First of all, because its realization had been achieved from the study of adult-only EEG.

We conducted a prospective study, enrolling 17 children (mean age 14.1 y.o., ranging from 2 to 18) undergoing anesthesia for scoliosis surgical correction, with the aim to investigate a possible correlation between BIS Index and the power of the main EEG frequency bands (α, β, γ, θ and δ) during induction and maintenance of anesthesia. Total intravenous anesthesia (TIVA) was induced by a target-controlled infusion (TCI) system with propofol and remifentanil. We also performed hemodynamic monitoring, which detected Cardiac Output Index (CI), central venous pressure (CVP), systemic vascular resistance index (SVRI), arterial elastance (Ea), and pulse pressure variation (PPV).

We detected a statistically significant inverse correlation between BIS Index, δ and θ waves power from the frontal and parietal regions during anesthesia induction: this means that as the minutes passed, there was a decrease of BIS Index accompanied by a contextual increase of slow θ and δ waves in the frontal and parietal regions ($P=0.007$ and $P=0.02$, respectively) (Figure 1). Moreover, our analysis showed a statistically significant reverse correlation between BIS data and frontal δ waves during the maintenance phase, suggesting the BIS ability to reflect anesthesia's depth, particularly in the frontal area. The above-mentioned correlation appears less reliable in the presence of confounding factors, such as muscle activity or the use of electric bistoury.

A possible limitation of some previous studies was the lack of data on hemodynamic stability, which interfere with the BIS lecture, as BIS parameters are influenced by blood loss and cerebral hypoperfusion.[4] Remarkably, in our study, most hemodynamic parameters during the maintenance phase remained stable, allowing BIS data objective evaluation.

Our study has some limitations: we did not define the *a-priori* power target to reach a validation for the BIS Index using a convenience sample. Moreover, the broad age range (2 to 18 y.o. patients) could represent a selection bias, due to the known high variability of EEG patterns in pediatric population until the age of 14.

Despite these considerations, this pediatric case series is the first investigation confirming a significant correlation between BIS and EEG in children by mean of a quantitative approach (strengthening what Riguozzo *et al.* first qualitatively described in 2019)[5] and including hemodynamic stability data. Further studies are needed to confirm our findings and to definitely validate BIS as an effective device for monitoring pediatric anesthesia.

Angela PITTALIS [1], Marianna CAVINATO [2], Sara ROMANO [3], Pierandrea ELEFANTE [3] *, Giulia TINTI [3], Egidio BARBI [1, 3], Raffaella SAGREDINI [1]

[1]Institute for Maternal and Child Health, IRCCS Burlo Garofolo, Trieste, Italy; [2]San Camillo IRCCS, Venezia, Italy; [3]Department of Medicine, Surgery, and Health Sciences, University of Trieste, Trieste, Italy

*Corresponding author: Pierandrea Elefante, Department of Medicine, Surgery, and Health Sciences, University of Trieste, Via dell'Istria 65/1, 34137 Trieste, Italy.
E-mail: pier.elefante@gmail.com

References

1. Uezono S, Mio Y. Monitoring consciousness in the pediatric patient: not just a small adult. Best Pract Res Clin Anaesthesiol 2006;20:201–10.

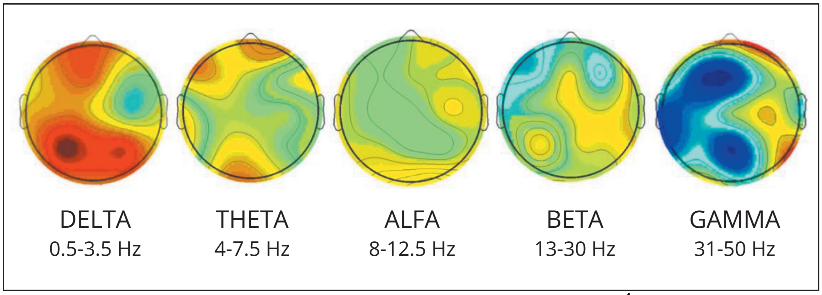

Figure 1.—Significance maps of EEG powers distribution from induction phase to maintenance phase.
Dark gray areas (red in the online version) indicate a significant power increase. Black areas (blue in the online version) indicate a significant power reduction. In light gray areas (green in the online version) a statistically significant difference is not verified.

2. Delfino AE, Cortinez LI, Fierro CV, Muñoz HR. Propofol consumption and recovery times after bispectral index or cerebral state index guidance of anaesthesia. Br J Anaesth 2009;103:255–9.

3. Myles PS, Leslie K, McNeil J, Forbes A, Chan MT. Bispectral index monitoring to prevent awareness during anaesthesia: the B-Aware randomised controlled trial. Lancet 2004;363:1757–63.

4. England MR. The changes in bispectral index during a hypovolemic cardiac arrest. Anesthesiology 1999;91:1947–9.

5. Rigouzzo A, Khoy-Ear L, Laude D, Louvet N, Moutard ML, Sabourdin N, *et al.* EEG profiles during general anesthesia in children: A comparative study between sevoflurane and propofol. Paediatr Anaesth 2019;29:250–7.

Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Authors' contributions.—All authors read and approved the final version of the manuscript.

Acknowledgements.—The authors acknowledge Martina Bradaschia for the English revision of the manuscript.

History.—Article first published online: April 14, 2021. - Manuscript accepted: March 23, 2021. - Manuscript received: March 6, 2021.

(*Cite this article as:* Pittalis A, Cavinato M, Romano S, Elefante P, Tinti G, Barbi E, *et al.* Correlation between Bispectral Index and EEG. Minerva Anestesiol 2021;87:1056-7. DOI: 10.23736/S0375-9393.21.15703-7)