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Entropy as a Measure of Hypnosis during Intravenous Anesthesia in Children

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Aim of the Study

To validate Spectral Entropy as a marker of the level of hypnosis and hypnotic drug effect during total intravenous anesthesia in children.

Introduction

Monitoring the depth of hypnosis (DoH) may be even more important in children than in adults, because awareness is more common in children (*1*). Spectral Entropy (*2*) provides two indices, Response Entropy (RE) and State Entropy (SE), and has been previously studied in children only during inhalation anesthesia. DoH monitors must be validated with different anesthetics and age groups. We hypothetized that Entropy would have inverse correlations with the University of Michigan Sedation Scale (UMSS) (*3*) and the target controlled infusion (TCI) of propofol.

Methods

Sixty healthy children (3-16 yr; 15-61 kg) undergoing elective surgery under general anesthesia were enrolled. After premedication and iv. cannulation, the anesthesia was induced slowly with TCI propofol (Kataria pharmacokinetic model) in three 8-minute steps targeting at 1, 2 and 3 µg/ml plasma concentration. After this the patient was intubated. During surgery, anesthesia was maintained with stable remifentanil 0.3 µg/kg/min infusion and varying TCI-propofol steered by the attending anesthesiologist blinded to Entropy. No muscle relaxants or regional anesthesia were used. The Entropy indices were correlated during the induction with: 1) UMSS sedation scale and 2) pseudo stable effect site concentarion of propofol (C_{eff}; i.e. TCI plasma concentration stable for at least 7 minutes > 4 x $T½k_{e0}$) (*4*), and during the maintenance with the C_{eff}. The patients were divided into and analyzed in three age groups. As a measure of correspondence the Prediction Probability (P_k)(*5*) was used.

Results

Table 1: Demographic data.[table2]Table 2: The P_k analyses. Since Entropy (RE, SE) and UMSS and C_{eff} change in opposite directions, results are presented as 1-P_k. A value of 1 indicates perfect concordance between variables, a value of 0.5 indicates a concordance not better than chance.[table1]**Conclusions**

The correlations of Entropy vs both the UMSS and the C_{eff} were good.

Spectral Entropy seems to measure the level of hypnosis and the anesthestic drug effect during TCI propofol - remifentanil based total intravenous anesthesia in children.

References

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2.Viertiö-Oja H et al. Acta Anaesthesiol Scan 48:154

3.Malviya S et al. BJA 88:241

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Relationship between RE, SE, UMSS and C_{eff} (Standard Error)

Age group	3-6 yr	7-11 yr	12-16 yr
Induction			
RE vs UMSS	0.87 (0.01)	0.87 (0.01)	0.93 (0.01)
SE vs UMSS	0.86 (0.01)	0.87 (0.01)	0.93 (0.01)
RE vs C_{eff}	0.89 (0.03)	0.94 (0.02)	0.94 (0.02)
SE vs C_{eff}	0.87 (0.03)	0.93 (0.03)	0.95 (0.02)
Maintenance			
RE vs C_{eff}	0.86 (0.02)	0.75 (0.03)	0.81 (0.02)
SE vs C_{eff}	0.86 (0.02)	0.75 (0.03)	0.81 (0.02)

Demographic data

Age group	3-6 yr	7-11 yr	12-16 yr
Number of patients	20	20	20
Male/female ratio	13/7	11/9	12/8
Age, yr (SD)	4.8± 0.9	9.5 ± 1.5	13.7 ± 1.1
Weight, kg (SD)	21.4 ± 3.4	37.4 ± 9.3	51.2 ± 6.2