

Comparison of measured versus predicted blood propofol concentration in children undergoing spinal surgery

Background

Propofol anaesthesia is preferred for scoliosis surgery because inhalational agents suppress spinal evoked potentials. We have been concerned over cardiovascular depression during propofol anaesthesia and wished to determine the true (measured) blood propofol levels in our patients receiving target controlled infusions. We wanted to be sure that propofol levels were not excessively high. Also, bed side measurement of blood propofol has become available and we were interested to see if rapid access to propofol assay might help improve the accuracy of predicting blood levels.

Methods

This was an observational study in 20 patients. Anaesthesia management was not affected by the study. Patients were managed with Propofol Target Controlled infusions (TCI). Blood samples (up to 10 per patient) were taken every 30 minutes. The protocol was approved by the hospital Research Adoptions Committee, NRES and MHRA. Parents and children gave informed consent. Data collection took approximately 6 months. Anaesthetists managing the patients were unaware of the measured propofol concentration. Measured (C_m) blood levels were compared with predicted (C_p) blood levels. Blood propofol concentration was measured using Pelorus 1500 (Sphere Medical, UK). Compared with HPLC, the Pelorus propofol estimation in blood has a bias of $0.13 \mu\text{g ml}^{-1}$ and a precision 0.16 to $0.42 \mu\text{g ml}^{-1}$.

Results

The Paedfusor TCI model was used in 16 children of whom 13 weighed <61 kg and were ≤ 18 y old: the 3 others weighed 95, 74 and 66 kg and were 12, 14, and 17y old respectively. The Marsh TCI model was used in 4 children aged 14, 14, 16 and 16 y who weighed 69, 73, 60 and 56 kg respectively. Target propofol concentration was set between 3 and $7 \mu\text{g ml}^{-1}$ during surgery. There were a total of 154 blood propofol measurements. C_m was almost always greater than C_p . Using all data points in all children, mean $C_m - C_p$ was $1.5 \mu\text{g ml}^{-1}$ (95% limits of agreement -1.4 to 4.5). Two children had consistently lower C_m than C_p . Their lowest C_m (s) were 1.74 and $1.96 \mu\text{g ml}^{-1}$ when the C_p was 3mcg ml^{-1} : both had the Paedfusor model and their body weights were 28 and 33 kg. The Median Performance Error (MDPE) $> 50\%$ in 8 children and was not associated with body weight. The estimated blood loss was not accurate enough to justify analysis. The effect of IV fluid infusion on performance was examined. Total IV fluid volume infused was not associated with MDPE. There was no association between increment of IV volume infused and the change in Performance Error ($\text{PE} = (C_m - C_p) / C_p$).

Conclusions

Large differences between C_m and C_p may be foreseen given the variation in the physical and physiological characteristics of children and that the pharmacokinetics of propofol is unknown in children with syndromes associated with scoliosis. Having a reliable, near-

patient blood propofol assay, may allow adjustment of the TCI to achieve the desired blood level. A correction factor has been proposed by Cowley and Clutton-Brock and we have applied it to our data. The correction factor was calculated using a single measurement of C_m after 30 minutes of TCI (Correction factor = C_m at 30 min/ C_p at 30 min; $C_{p(\text{corrected})} = C_p \times \text{correction factor}$) and applied to all subsequent C_p s. Performance was appreciably improved by this adjustment: the means of uncorrected and corrected MDPEs were 41.5% and -9% (mean difference 50.5%, 95% CI 36.4 to 64.6).

Our findings are from a small sample of heterogeneous children having scoliosis surgery and may not reflect the performance of TCI in children generally or in other specific situations. Nevertheless this report may serve as a warning to clinicians that unexpected clinical signs of either excessive or inadequate propofol anaesthesia may occur despite predicted safe and effective TCI doses of propofol.

Publication

Results from this project have been accepted for publication in the Journal *Anesthesia and Analgesia*. Authors: **S. Panchatsharam** (Specialty Registrar, North Central London School of Anaesthesia), **M. Callaghan** (Clinical Fellow, Great Ormond Street Hospital for Children), **R. Day** (Medical Student, Brighton and Sussex Medical School), **M.R.J. Sury** (Consultant Anaesthetist, Great Ormond Street Hospital for Children and Honorary Senior Lecturer, Portex Department of Anaesthesia, Institute of Child Health, University College London)

Funding

Drs Panchatsharam and Sury received support from the NIAA in the form of the Ernest Leach Fund.