Induction characteristics of 2% propofol in children

A. BORGEAT, T. FUCHS AND E. TASSONYI

Summary
We have conducted a prospective, randomized study to evaluate the characteristics of induction of anaesthesia in children with 2% propofol. Children were allocated to receive propofol 3 mg kg\(^{-1}\) (group A), 4 mg kg\(^{-1}\) (group B) or 5 mg kg\(^{-1}\) (group C) of the 2% formulation. We observed a high incidence of spontaneous movements (90%) in group A and an incidence of coughing of 70% in group C. Induction in group B was characterized by a short induction time, low incidence of spontaneous movements (20%), pain on injection (10%) and excellent conditions for manual ventilation. (Br. J. Anaesth. 1997; 78: 433–435).

Key words

Propofol 1% is an i.v. anaesthetic agent which is now used routinely in paediatric anaesthesia.\(^1\) Spontaneous movement is one of the side effects observed during induction of anaesthesia with 1% propofol.\(^2\) It was demonstrated that increasing the loading dose from 3 to 5 mg kg\(^{-1}\) resulted in a significant decrease in these movements.\(^2\) However, the volume needed to be administered may be quite large and the required time to infuse such a volume through a 22-gauge or smaller catheter may be prolonged. It has been shown that slow injection is associated with more frequent and intense pain on injection,\(^3\) an especially troublesome side effect in children.

A new formulation containing 2% propofol has been prepared recently; this reduces by half the volume and fat load. The 2% solution was prepared mainly for intensive care sedation, but the use of smaller volumes may be advantageous in children. We undertook this study to evaluate and assess the clinical tolerance and quality of induction of anaesthesia in children with this new formulation.

Methods and results
After obtaining parental informed consent and institutional Ethics Committee approval, we studied 45 ASA I children, aged 5–12 yr. All children were undergoing elective ear, nose and throat (ENT) procedures of short duration. Exclusion criteria were known allergy to propofol or lignocaine, mental disorders or a previous problem with general anaesthesia.

EMLA emulsion cream (lignocaine 25 mg g\(^{-1}\) and prilocaine 25 mg g\(^{-1}\)) was applied to the dorsum of both hands and covered with an impervious dressing approximately 1 h before operation. No sedatives were given before induction of anaesthesia. On arrival in the anaesthetic room, heart rate and arterial pressure were recorded with an automatic device (Cardiocap, Datex, Helsinki). Other monitors included a pulse oximeter (Cardiocap, Datex, Helsinki) and a precordial stethoscope. A 22-gauge catheter was inserted into a vein on the dorsum of the hand. Children were allocated prospectively to group A (2% propofol 5 mg kg\(^{-1}\)), group B (2% propofol 4 mg kg\(^{-1}\)) or group C (2% propofol 3 mg kg\(^{-1}\)) according to a computer randomized table. Propofol was premixed with lignocaine in a ratio of 10:1 (10 mg of propofol for 1 mg of lignocaine).

Children’s lungs were preoxygenated for 1 min with oxygen (\(F_\text{O}_2\), 1.0). The induction bolus was given within 5–10 s. Two minutes later continuous infusion of propofol 0.2 mg kg\(^{-1}\) min\(^{-1}\) was started via an automatic pump (IVAC 711, San Diego, CA, USA). At this time children received alfentanil 20 mg kg\(^{-1}\) and vecuronium 0.1 mg kg\(^{-1}\).

A nurse was responsible for preparing and administering the propofol injection. At the end of the induction bolus, an independent investigator, unaware of the child’s group assignment, observed and communicated with the child during induction and assessed the presence of pain on injection according to the following scale: (a) verbal complaints without withdrawal of the arm, (b) withdrawal of the arm with or without verbal complaints. The appearance of spontaneous movements was assessed according to the following classification: (a) movements of the hand and fingers, (b) movements of the arm, (c) movements of the arm and shoulder. Other variables assessed were induction time, defined as the time between end of propofol administration and loss of the eyelash reflex, arterial pressure and heart rate changes, erythema or cutaneous rash and cough/hiccup. Ease of ventilation of the lungs was assessed as excellent, smooth or unsatisfactory.
Patients were similar in the three groups. All groups were comparable in induction times, incidence of pain on injection and appearance of a rash or erythema.

A high incidence of spontaneous movements (90%) was observed in the 3-mg kg\(^{-1}\) group which resulted in poor induction. In the 5-mg kg\(^{-1}\) group, a high incidence of coughing (70%) was noted which rendered the management of ventilation unpleasant. In contrast, the 4-mg kg\(^{-1}\) dose produced a rapid and smooth induction with few side effects (table 1).

Haemodynamic changes were comparable in all three groups, with a mean decrease in arterial pressure of 5–15% from basal values 1 min after injection, a decrease of 10–15%, 2 min and 15–20%, 3 min after administration of the propofol bolus. Changes in heart rate were also similar between groups, ranging from a mean decrease of 5% to an increase of 15%, 1, 2 and 3 min after induction.

**Comment**

We have assessed the quality of induction of anaesthesia in children with the new formulation of 2% propofol and found that the induction dose of 3 mg kg\(^{-1}\) was inadequate as we observed a high incidence of spontaneous movements. A dose of 5 mg kg\(^{-1}\) was associated with a high incidence of coughing which interfered with manual ventilation. In contrast, a dose of 2% propofol 4 mg kg\(^{-1}\) allowed rapid and smooth induction with few side effects. The ease of performing manual ventilation was particularly striking.

Induction time, that is interval between the end of drug administration and loss of the eyelash reflex, was 12 (3) s in the 4-mg kg\(^{-1}\) group. Puttick and Rosen\(^4\) using the same criteria, found an induction time of 21 (3) s in children aged 2–11 yr who received 1% propofol 3.5 mg kg\(^{-1}\). It is conceivable that a higher brain drug concentration is reached faster with the 2% formulation, thus explaining the very short induction time. A short induction time has advantages in young children, especially in those who have reduced pulmonary function.

One of the striking features of induction with 2% propofol 4 mg kg\(^{-1}\) was the ease of performing manual ventilation. Manual ventilation was assessed as very easy and comfortable in 88% of children. Propofol 1% is also known to provide excellent intubating conditions; Pedersen\(^5\) observed that sedation with 1% propofol in patients with hyperactive airway disease provided marked bronchodilatation.

Spontaneous movements limited to the finger and hand were observed in 15% of children and those involving the arm in 5%. The movements were, as described previously,\(^2\) dystonic in nature. The incidence of spontaneous movements was similar to that reported by Purcell-Jones and colleagues\(^6\) after a bolus of 1% propofol 2.5 mg kg\(^{-1}\). The appearance of these movements decreased when the initial dose of 1% propofol was increased to 5 mg kg\(^{-1}\),\(^2\) but was also reported to be high when the induction dose was 3 mg kg\(^{-1}\).\(^2\) The trend in observing more severe and frequent spontaneous movements with a lower dose of 2% propofol is similar to that observed with 1% propofol.

Pain on injection was noted in 10% of children receiving 2% propofol pre-mixed with 1% lignocaine (in a ratio of 2% propofol 10 mg : lignocaine 1 mg). Pre-mixing 1% lignocaine with 1% propofol appeared to be the most efficient means of reducing pain on injection. The incidence observed in this study was similar to the results obtained with a mixture of 1% propofol–lignocaine.\(^7\) The more concentrated formula of 2% propofol does not appear to increase the incidence of pain on injection when pre-mixed with lignocaine.

Other excitatory events such as cough and hiccup were rare in the 4-mg kg\(^{-1}\) group. These results are comparable with those observed with 1% propofol.\(^2\) We believe that the high incidence of cough observed with 2% propofol 5 mg kg\(^{-1}\) may be explained by a sudden high propofol brain concentration leading to some excitatory effects on the cough centre.

Haemodynamic changes (arterial pressure and heart rate) did not differ from values observed after induction with the 1% formulation.

We have found that the new formulation of 2% propofol, at a dose of 4 mg kg\(^{-1}\), provided induction characteristics in children similar to those observed with 1% propofol in terms of haemodynamic stability, pain on injection and spontaneous movements. However, the 2% formulation had the advantage of reducing the time of injection and volume of drug, of providing a short induction time and offering excellent conditions for manual ventilation.

**References**


