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Original contribution

Rapid injection of propofol reduces vascular pain and facilitates Laryngeal Mask Airway insertion

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Abstract

Study Objective: To compare the clinical efficacy of a rapid injection of propofol in regard to pain and ability to facilitate Laryngeal Mask Airway (LMA) insertion.

Design: Randomized, single-blinded, placebo-controlled study.

Setting: University hospital.

Patients: 120 ASA physical status 1 and 2 patients undergoing elective orthopedic surgeries.

Interventions: Patients were randomly allocated to one of 4 groups. Group A patients were pretreated with normal saline followed by propofol 2.0 mg/kg at 3.3 mg/sec. Group B patients were pretreated with lidocaine 0.5 mg/kg followed by propofol 2.0 mg/kg at 3.3 mg/sec. In Group C, patients were pretreated with lidocaine 1.0 mg/kg followed by propofol 2.0 mg/kg at 3.3 mg/sec. In Group D, patients were pretreated with normal saline followed by propofol 2.0 mg/kg at 50 mg/sec.

Measurements: Pain on injection was measured using a 4-point scale. Scale and success rate of smooth LMA insertion also were recorded.

Main Results: Rapid injection was less painful than after pretreatment with lidocaine 0.5 mg/kg, but was similar to slow injection after pretreatment with lidocaine 1.0 mg/kg. Rapid injection facilitated LMA insertion, unlike slow injection with lidocaine 0.5 mg/kg pretreatment, and was similarly successful to slow injection after pretreatment with lidocaine 1.0 mg/kg.

Conclusions: The rapid administration of propofol reduces pain and facilitates LMA insertion versus slow administration of propofol.

1. Introduction

One of the major disadvantages of propofol is pain on injection. Many different methods have been reported to reduce the incidence and degree of this adverse effect [1-8]. In principle, free propofol in the aqueous phase is thought to be responsible for the pain on injection [2]. The speed of injection may influence pain since a slow rate prolongs the contact time with the endothelium, while rapid injection allows the propofol to be cleared from the vein and replaced with blood. However, there are conflicting data regarding the influence of speed of injection on pain, with one study showing no difference [9] and another showing increased pain with slow injection [10]. We previously reported that

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rapid injection decreased pain on injection in 120 female patients [11]. During the study, we had the impression that LMA insertion was facilitated as pain was reduced. Rapid injection also may facilitate LMA insertion [12-14]. We conducted a randomized, prospective, single-blinded, placebo-controlled clinical trial to compare the frequency of pain on injection of propofol using a 4-point scale [15], and the success rate of Laryngeal Mask Airway insertion in groups including both men and women.

2. Materials and methods

All of the procedures were approved by the Institutional Ethics Committee at University of Tsukuba, and informed consent was obtained from each patient. We studied 120 patients (M:F=59:61, aged 16-78 yrs, ASA physical status 1 and 2) undergoing elective orthopedic surgeries. Patients were excluded from the study if they were allergic to propofol, had communication difficulties, had a history of cardiovascular or neurological disease, had body mass index > 28 kg/m^2, or were unsuitable for intravenous (IV) induction.

On arrival in the operating room, patients were randomly allocated to 4 equal-sized groups by sealed envelope assignment. In Group A, patients were pretreated with normal saline 5 mL, then given propofol 2.0 mg/kg at a rate of 3.3 mg/sec delivered by a syringe driver (Terumofusion TE-331S; Terumo, Tokyo, Japan). Group B patients were pretreated with preservative-free lidocaine 0.5 mg/kg adjusted to a volume of 5 mL, then given propofol 2.0 mg/kg at a rate of 3.3 mg/sec. Group C patients were pretreated with preservative-free lidocaine 1.0 mg/kg adjusted to a volume of 5 mL, then given propofol 2.0 mg/kg at a rate of 3.3 mg/sec. In Group D, patients were pretreated with normal saline 5 mL, then given propofol 2.0 mg/kg at a rate of 50 mg/sec.

An 18- or 20-gauge cannula was inserted in the largest visible vein of the radial side of the non-dominant forearm, attached to a three-way tap, and flushed with lactated Ringer's solution. The distance and volume between the three-way tap and cannula were identical in all patients. A 5 mL syringe containing the randomized pretreatment drug at room temperature was attached to one limb of the tap, followed by a propofol infusion at 5°C. The injectate was prepared immediately before use by drawing unmodified propofol (Diprivan 1%, AstraZeneca, Osaka, Japan) without the use of a filter.

A venous tourniquet was applied just above the elbow for two minutes, then released, and the propofol infusion was begun. All patients were informed that the injection of propofol might be painful and instructed to indicate pain at any moment during induction, before losing consciousness. Any verbal response or spontaneous movement of the wrist, elbow, or shoulder was noted. A second anesthesiologist, who was blinded as to the type of pretreatment and rate of propofol infusion administered, evaluated the responses as follows: 0=absolutely without pain; 1=no spontaneous expression of pain, 2=mild spontaneous expression of pain, but on questioning, patient expresses having a mild sensation of pain whether by verbal expression, grimace, or movement of the wrist only; and 3=remarkable expression of pain whether by crying or movement/withdrawal of the involved arm (elbow/shoulder). Any score other than 0 represented pain on injection.

Ninety seconds after completion of the propofol injection, when relaxation of the jaw was confirmed, the LMA was inserted. Patients' response to insertion of the LMA was described as "no movement" or "movement"; and "no movement" was counted as "success". "No movement" was defined as the absence of bucking or gross purposeful muscular movements after insertion or inflation of the LMA until an effective airway was established. "Movement" was defined as difficult mouth opening, gross purposeful muscular movements, coughing, straining, or laryngospasm during any procedures. All anesthetic procedures were conducted by two skilled anesthesiologists. Anesthesia was maintained with 67% nitrous oxide and 1% to 2% sevoflurane in oxygen. Systolic blood pressure (SBP) was measured every minute after completion of the propofol infusion and ephedrine 5 mg was administered if SBP was 30% lower than preinduction baseline values.

Sample size was selected to detect a projected difference of 50% between the groups for a type I error of 0.05 and a power of 0.8. Statistical analysis was performed with StatView software (SAS Institute Inc., Cary, NC, USA). Demographic data were analyzed by analysis of variance (ANOVA). Pain intensity was analyzed by Kruskal-Wallis and Mann-Whitney U tests, and frequency of pain and success rate of LMA insertion were analyzed by χ^2 and Mann-Whitney U tests. *P*-values < 0.05 were considered statistically significant.

3. Results

A total of 120 patients were studied. No significant differences were found among the groups in patient characteristics (Table 1).

The frequency of pain on IV injection of propofol was 63% in Group A. Groups C and D showed significantly less frequency and lower intensity of pain than Group A (P = 0.048 and 0.008, respectively) and Group B (P = 0.045 and 0.008, respectively). No difference in frequency or intensity of pain was found between Groups C and D (Table 2).

The LMA was inserted and placed on the first attempt in all cases if any movement was not considered. There was no case that was technically too difficult to require a repeat of the insertion procedure. Only 50% of the cases were inserted without movement on the first attempt in Groups A and B. Success rates significantly increased to 73% and 83% in Groups C and D, respectively. The *P*-values were 0.004 for Group A versus Group D, 0.02 for Group B versus Group C,