Effects Of Intramuscular Administration Of Lidocaine In Hynotic Effect And On Induction And Maintenance Doses Of Propofol

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Citation

Abstract

Background. In a prospective, randomized, double-blind study we tested whether local anaesthetic administered i.m. potentiates the hypnotic effect of propofol. Methods. Sixty patients (two groups, n=30) undergoing lower abdominal surgery with total i.v. propofol anaesthesia were investigated. Patients in Group Lidocaine (Group L) received i.m. 100 mg and patients in Group Control (Group C) received i.m. saline 5 ml before the operation. Hypnosis was measured with responses to verbal commands. Results. In Group L, the time required for failure to open the eyes in response to verbal command, and the time and dose for achieving hypnosis were significantly shorter than Group C. The induction, and the maintenance doses of propofol were significantly less in Group L compared with the control group. Induction doses were 1.52 and 2.05 mg kg^{-1} respectively; p<.0001. Maintenance doses were 7.28 and 9.93 mg kg^{-1} respectively in the first hour; p<.0001. Conclusion. I.M. administered local anaesthetics are associated with a decrease in both the induction and maintenance doses of propofol during total i.v. anaesthesia and a reduction in haemodynamic responses.

INTRODUCTION

The growing interest in combining local and general anaesthesia has led to studies investigating possible interactions between general anaesthetics and local anaesthetics administered via different route (1).

In previous studies it has been shown that i.m. administration of either lidocaine or bupivacaine enhances the hypnotic effects of i.v. thiopental (2) and propofol. However, these studies concluded that local anaesthetics administered i.m. can reduce the induction dose of i.v. general anaesthetics, no evaluation of the effect of systemically used local anaesthetics on the maintenance dose of the general anaesthetic was carried out.

In a prospective, randomized, double blind study, we investigated whether lidocaine administered i.m. reduces the induction and the maintenance dose of propofol total i.v. anaesthesia (TIVA).

METHODS

With informed patient consent and approval from the local ethical committee, we studied 60 patients, aged 20–50 yr, ASA I or II, weighing 50–80 kg, undergoing minor elective lower abdominal surgery expected to last ≥1 h. To detect a decrease of 0.35 mg kg^{-1} of the induction dose of propofol (accepting an alpha error of 5% and a beta error of 10%), the required study size was 16 patients per group. Patients taking cardiovascular medication, with known hypersensitivity to local anaesthetics, neurological disorders, hypertension, baseline systolic arterial pressure (SAP) <100 mm Hg, heart rate (HR) <55 beat min^{-1}, or any serious medical conditions that would interfere with cardiovascular response assessment were excluded.

The patients did not receive premedication. They were prehydrated with NaCl 0.9% 500 ml solution and were connected to an electrocardiograph monitor, automatic arterial pressure cuff and a pulse oximeter. The patients were then allocated randomly to two groups according to a sealed envelope technique in a double-blind manner. In Group L, 20 patients received i.m. lidocaine 100 mg, administered into the gluteus muscle 10 min before induction of anaesthesia. In Group C, 20 patients served as controls and received i.m. saline 5 ml into the gluteus muscle 10 min before induction of anaesthesia. All i.m. injections were performed by an independent practitioner. HR, mean arterial pressure (MAP)

were recorded at D0 (before i.m. administration), D1 (before induction of anaesthesia), D2 (after induction of anaesthesia) and D3 (after intubation).

After a bolus dose of fentanyl 1.5 µg kg^{-1} i.v., a physician, who was blinded to the dose or type of local anaesthetic (or saline) administered earlier, injected propofol 10 mg (1 ml) in 5 s every 15 s until the response to verbal commands was evaluated, intubation was accomplished after administration of vecuronium 0.5 mg kg^{-1}. Volume controlled ventilation was started with 10 ml kg^{-1} tidal volume and ventilatory frequency was adjusted to maintain endtidal carbon dioxide tension 30–35 mm Hg. Lungs were ventilated with 50% oxygen/50% air.

After intubation, infusion of propofol 10 mg kg^{-1} h^{-1} and remifentanil 0.25 µg kg^{-1} min^{-1} was started. The dose of propofol was titrated to keep hemodynamia. The dose of propofol was changed by 1 mg kg^{-1} h^{-1} every 20 s. The total maintenance dose of propofol during the first hour of anaesthesia was recorded in mg kg^{-1} h^{-1}.

Inadequate analgesia was defined as response to surgical stimuli by hypertension (SAP >20% above preoperative baseline value for >5 min) or tachycardia (HR >20% above preoperative baseline value) and patients were given bolus doses of remifentanil 0.5 µg kg^{-1}. If this treatment was unsuccessful, the remifentanil infusion rate was doubled.

Bradycardia was defined as HR <40 beat min^{-1} and hypotension as a decrease in SAP >20% of the baseline value. Hypotension was treated by infusion of lactated Ringer's solution 3–5 ml kg^{-1}, and if necessary, with ephedrine 5 mg i.v. Bradycardia was treated with atropine 0.5 mg i.v. The frequency of hypotension, bradycardia and inadequate analgesia and supplemental remifentanil doses was recorded.

To assess intraoperative awareness, a number was repetitively recited to each patient four times during anaesthesia at 5, 10, 15 and 20 min. The patients were specifically questioned for recall of this number.

Analysis of variance (ANOVA) was used to evaluate the differences in patient characteristics, HR, MAP values, and propofol doses for induction and maintenance between the groups. Data at different times within the groups were compared with a repeated measures ANOVA (GraphPad InStat™, GraphPad Software V2.02). The alterations in HR and MAP after the induction and intubation were also compared in the groups. To compare the frequency of hypotension, bradycardia and inadequate analgesia, an appropriate χ^2test was used. P<0.05 was regarded as statistically significant.

RESULTS

There were no statistically significant differences with respect to patient characteristics between the groups. Propofol doses required for the induction of anaesthesia were significantly less in patients in Groups L compared with the control group (P<0.0001; 1.52 and 2.05 mg kg^{-1}, respectively). The maintenance doses for the first hour of surgery were also significantly less in these patients (P<0.0001; 7.28 and 9.93 mg kg^{-1} h^{-1} respectively)

HR was decreased after induction by 14.0 , 14.5 % in patients receiving prilocaine and saline, respectively (no statistically significant differences). The increase in HR after intubation was statistically different between the groups (P=0.0003; 16.7 and 23.5 % in Groups P and C, respectively)

In Group L, the time required for failure to open the eyes in response to verbal command, and the time and dose for achieving hypnosis were significantly shorter than Group C (p<0.05, p<0.05, p<0.05) (Table 1). Table 3: The difference between groups in regards of the time required for failure to open the eyes, to achieve hypnosis and the dose for achieving hypnosis

Figure 1

	The time required for failure to open the eyes(sec) (mean± SD)	the time for achieving hypnosis (sec) (mean± SD)	the dose for achieving hypnosis(mg) (mean± SD)
Group C	69 ± 5,67	79 ± 4,97	193,5 ± 10,05
Group L	41 ± 6,99	61,5 ± 19,72	138 ± 19,7

Regarding the MAP, the decrease after induction and increase after intubation were both groups. There were no differences between the groups.

At the end of the induction period, no response to verbal commands was observed. Awareness or inadequate analgesia was observed in no patients. Except for the hypotension in two patients in each group, haemodynamic complications were not seen. No signs of local anaesthetic toxicity or side effects were observed in any patient.

DISCUSSION

The effects of i.m. administration of lidocaine and bupivacaine on the induction doses of thiopental and propofol have been described.(2,4) The results of these studies and the present study are similar. However, there is one difference. In our study, not only the induction, but also the maintenance doses of propofol were investigated.

There are some mechanisms that may explain the interaction of local anesthetics and general anesthetics. Most local anesthetics bind to sodium channels in the inactivated state, preventing subsequent channel activation and the large transient sodium infuz associated with membrane depolarization (5). General anesthetics are known to have some effects on the central nervous system which are like local anesthetics. Both volatile anesthetics and barbiturates have been shown to block sodium channels and prevent action potential formation in central neurons. Immobilization of the gating charge caused by the general anesthetics has also been implicated in local anesthetic action. Some studies show that general anesthetics increase the proportion of channels in the closed inactive state (6,7). Propofol also faciliates GABAergic currents which faciliates inhibitory neurotransmission in neurones (13). Propofol at clinically relevant concentrations inhibit some GABA uptake process in vitro in striatal nerve terminals (8). Local anesthetics potentiate GABA mediated Cl currents by inhibiting GABA uptake (9). These similar mechanisms of general and local anesthetics might explain how administration of i.m. prilocaine enhances the hypnotic effect of i.v. propofol. We administered i.m. lidocaine 10 min before i.v. administration of propofol because, at these times, blood concentrations reach a peak(10).Changes in haemodynamic values were not the primary variable in our study. But our findings are similar to former studies. We did not observe any signs of local anaesthetic toxicity or side effects. The highest doses of local anaesthetics administered in our study were less than half the recommended maximum clinical doses (10,11).

In conclusion, our study showed that i.m. administration of lidocaine lead to a reduction in both the induction and maintenance doses of propofol.

Further studies are necessary to evaluate the effects of different doses of local anesthetics on the doses of general anaesthestics after i.m. administration.

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