

Iontophoretically applied lidocaine reduces pain on propofol injection[†]

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We have compared iontophoretically and locally applied lidocaine for relief of pain on propofol injection. Pain was assessed on insertion of a 20-gauge i.v. cannula and at 10-s intervals for 30 s after injection of propofol. Pain scores on cannulation were significantly less in the iontophoresis group (median 1.1) than in the sham (control) group (median 2.8) ($P<0.005$). Pain after injection of propofol was significantly reduced at 10 ($P<0.002$), 20 ($P<0.001$) and 30 s ($P<0.001$). We conclude that iontophoretically applied lidocaine decreased the pain of cannulation and propofol injection.

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Propofol has become the induction agent of choice for elective surgery in many countries. Pain on injection is a recognized complication and several methods are used to reduce its incidence and severity.^{1,2} Iontophoretically applied local anaesthetic has been compared with EMLA cream and shown to reduce the pain of inserting an i.v. cannula and injection of i.v. hypertonic saline.³ However, it has not been used to treat the pain of propofol injection.

Iontophoresis is the facilitated transport of ionic drugs through body tissues under the influence of an electric current. It has been used for administration of several drugs, including local anaesthetics,⁴ tap water or glycopyrrolate for the treatment of hyperhidrosis.⁵ Deeper tissue penetration of iontophoretically applied local anaesthetic compared with that of topical local anaesthetic³ makes it a suitable method for anaesthetizing the skin and immediately underlying structures.⁶ It is acceptable to patients as it does not involve injection.⁴

The aim of this study was to measure the effect of iontophoretically applied lidocaine on the pain of injection of propofol.

Method and results

After obtaining approval from the Local Ethics Committee and written informed consent, we studied 40 ASA I and II patients undergoing day-case surgery. Exclusion criteria were: concomitant sedative or analgesic medication; chronic pain syndromes; cardiac pacemaker; sensitivity to lidocaine or propofol; indications for rapid sequence induction; and a rash at the proposed site of electrode placement.

The study was double-blind, prospective and randomized. Using sealed envelopes, patients were allocated randomly to either the iontophoresis or sham (control)

group. The sham group was treated in a similar manner to the iontophoresis group, except no current was passed through the electrodes. Electrophoresis electrodes were applied as shown in Figure 1; the skin was first cleaned with alcohol.

The negative electrode containing 4% lidocaine 1.5 ml in a hydrogel was placed on the dorsum of the hand over the site for insertion of the cannula. The positive electrode was placed 10 cm proximally. All patients were connected to the current generator (Iomed phoresor II auto, RDG medical, Croydon, UK). Accurate negative electrode placement over the site of the expected painful stimulus is important as the documented depth of tissue penetration (up to 8 mm) is limited with this method.³ In the iontophoresis group, 40 mA min⁻¹ was applied with a peak of 3.5 mA (duration 11.4 min). In the sham group, no current was applied. The conducted current and size of the negative electrode gave a current density of 0.68 mA cm⁻¹ in the iontophoresis group. This is below the threshold level (1 mA cm⁻¹) above which pain has been documented previously.⁶ All patients were warned that they may feel tingling under the electrodes and were asked to report any discomfort.

When completed, the electrodes were removed and a second investigator, unaware of previous events, entered the anaesthetic room and inserted a 20-gauge i.v. cannula at the indicated site. All cannulations took place within 15 min of removal of the electrodes. The patient completed a 10-cm visual analogue scale (VAS) to indicate the pain of cannulation. Propofol was then injected at a rate of 2 ml per 5 s. The patient was asked to describe, at 10-s intervals

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Table 1 Pain on injection of propofol. *n*=Number of patients

	Iontophoresis group			Sham iontophoresis group		
	Time (s) 10	20	30	Time (s) 10	20	30
No pain (<i>n</i> (%))	20 (100)	15 (75)	15 (75)	12 (60)	4 (20)	5 (25)
Mild (<i>n</i> (%))	0	5 (25)	5 (25)	3 (15)	8 (40)	5 (25)
Moderate (<i>n</i> (%))	0	0	0	3 (15)	3 (15)	4 (20)
Severe (<i>n</i> (%))	0	0	0	2 (10)	5 (25)	6 (30)

for 30 s, any pain or discomfort in the arm (no, mild, moderate or severe pain). Matching of the groups for age and sex was assessed using Student's *t* test and chi-square test, respectively. Pain scores for cannulation and injection were analysed using the Mann-Whitney *U* test. $P < 0.05$ was considered statistically significant.

The groups were well matched, with mean age and male:female ratio in the iontophoresis group 36.1 (range 19–66) yr and 7:13, and 40.1 (19–73) yr and 8:12 in the sham group. Pain on insertion of the i.v. cannula was significantly decreased in the iontophoresis group ($P < 0.005$) compared with the sham group, with median scores of 1.1 (range 0–3.8) and 2.8 (0–8.6) respectively. All patients were cannulated successfully at the first attempt. The frequency and severity of pain after propofol injection are shown in Table 1. There was significantly less pain in the iontophoresis group at 10 s ($P < 0.002$), 20 s ($P < 0.001$) and 30 s ($P < 0.001$).

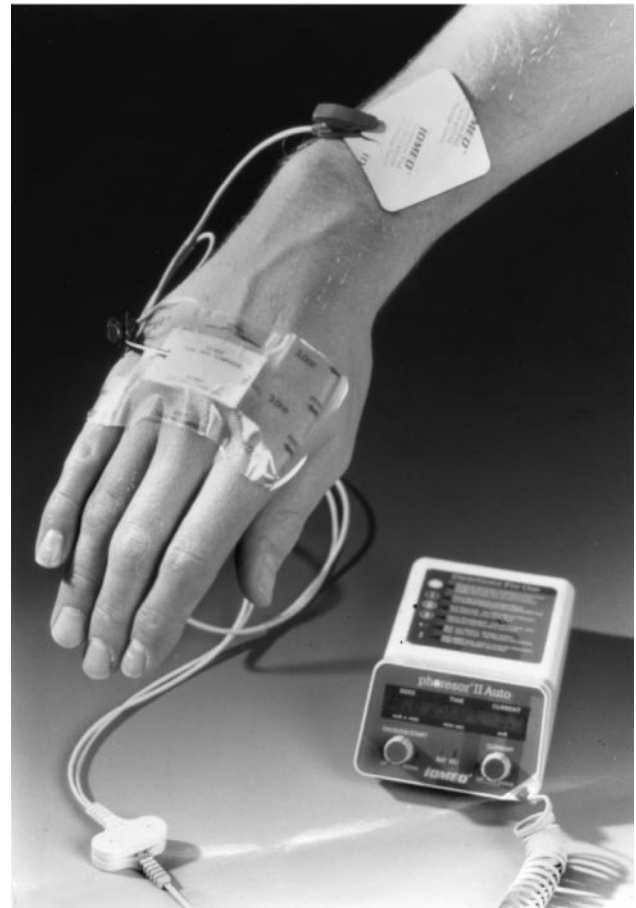
The only side effect noted was erythema at the site of the negative electrode, lasting up to 1 h after removal of the electrode. This appeared more obvious in the iontophoresis group. All 20 patients in the iontophoresis group and 13 in the sham group experienced tingling at the site of the negative electrode. However, no patient reported discomfort.

Comment

We have shown that the pain of injection of propofol was a significant problem, with 50% of patients in the sham group experiencing moderate or severe pain. Iontophoretically applied lidocaine was successful, with 75% of this group having no pain and 25% only mild pain.

All patients in the iontophoresis group and the majority in the sham group experienced tingling under the negative electrode. Therefore, we feel that this did not interfere with the blinding of the study. The control group did not receive an electrical current but no analgesic effect has been reported with the amplitude and duration of current we used.

Local anaesthetics are known to decrease the pain of propofol injection,² although the mechanism is still unclear. Possible modes of action for iontophoretically applied lidocaine include penetration of the drug into the vessel wall and vasodilatation. Erythema at the site of the negative electrode in the iontophoretic group would support the second theory.

**Fig 1** Positioning of the iontophoresis electrodes.

In summary, iontophoretically applied lidocaine reduced the pain of propofol injection with the added benefit of decreased pain of cannulation. We found it acceptable to patients, but the time taken for application may effect its acceptability over currently used methods. We are now comparing it with premixed lidocaine and propofol in a new series of studies.

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