International Journal of Nursing Studies 61 (2016) 209–218

Contents lists available at ScienceDirect

International Journal of Nursing Studies

journal homepage: www.elsevier.com/ijns

Comparison of the effects of lidocaine pre-administration and local warming of the intravenous access site on propofol injection pain: Randomized, double-blind controlled trial

Meejeong Jeong [a], Haesang Yoon [b,*]

[a] Department of Nursing, National Cancer Center, South Korea
[b] College of Nursing, Gachon University, South Korea

ARTICLE INFO

Article history:
Received 12 November 2015
Received in revised form 17 June 2016
Accepted 22 June 2016

Keywords:
Lidocaine
Local hyperthermia
Noticeptive pain
Pain management
Propofol

ABSTRACT

Background: Lidocaine reduces pain that occurs upon the intravenous injection of propofol. But, there are few non-pharmacological nursing interventions to reduce propofol injection pain.
Objective: To compare the effects of lidocaine pre-administration and local warming of the intravenous access site on propofol injection pain.
Design: Prospective, double-blind, randomized controlled trial.
Setting: The 555 bed, non-teaching National Cancer Center in Kyunggido, South Korea.
Participants: A total of 96 patients who underwent thyroidectomy under total intravenous general anesthesia with propofol were randomly allocated to the control, lidocaine pre-administration (LA) or local warming (LW) group.
Methods: All three groups received 2% propofol with an effect-site target at 3 μg/mL for induction dose. The control group received 2% propofol with no intervention. The lidocaine pre-administration group received 2% propofol 30 s after 1% lidocaine 30 mg. The local warming group received 2% propofol after warming of the intravenous access site for 1 min using 43 °C forced air. Propofol injection pain was assessed by four-point verbal categorial scoring (VCS), numerical rating scale (NRS) and surgical pleth index (SPI).
Results: Pain VCS of the LA group (mean ± SD, 1.11 ± 0.45) was significantly reduced ($U = -3.92$, $p < .001$) compared to the control group (mean ± SD, 1.71 ± 0.74). Pain VCS of the LW group (mean ± SD, 0.76 ± 0.44) was significantly reduced ($U = -5.17$, $p < .001$) compared to the control group (mean ± SD, 1.71 ± 0.74). Pain VCS of the LW group was significantly reduced compared to the LA group ($U = -3.33$, $p = .001$]. Pain NRS of the LA group (mean ± SD, 4.31 ± 2.32) was significantly reduced (mean difference, 1.82; 95% CI, 0.63–3.00; $p = .003$) compared to the control group (mean ± SD, 6.13 ± 2.39). Pain NRS of the LW group (mean ± SD, 3.06 ± 2.37) was significantly reduced (mean difference, 3.07; 95% CI, 1.63–4.51; $p < .009$) compared to the control group. There were significant differences in pain NRS between the LA group and the LW group (mean difference, 1.25; 95% CI, 0.09–2.42; $p = .035$). SPI of the LA group (mean ± SD, 64.1 ± 16.3) was significantly reduced (mean difference control versus LA, 8.36; 95% CI, 1.64–15.1; $p = .016$) compared to the control group (mean ± SD, 72.5 ± 9.56). SPI of the LW group (mean ± SD, 55.0 ± 16.2) was significantly reduced (mean difference control versus LW, 17.4; 95% CI, 10.8–24.0; $p < .001$) compared to the control group. There was a significant difference in SPI between the LA group and LW group (mean difference, 9.06; 95% CI, 1.02–17.1; $p = .028$).

* Corresponding author at: College of Nursing, Gachon University, Younsoodong 534-2, Younsoogu, 406-812, South Korea. Tel.: +82 032 820 4212; fax: +82 032 820 4201.
E-mail addresses: yoonhs@gachon.ac.kr, haesyoon@hanmail.net (H. Yoon).

http://dx.doi.org/10.1016/j.ijnurstu.2016.06.012

Conclusion: Local warming of the intravenous access site by 43 °C forced air for 1 min is slightly more effective in reducing propofol injection pain compared to lidocaine pre-administration.

What is already known about the topic?

- Propofol causes intravenous injection pain. Lidocaine effectively reduces intravenous pain associated with the injection of propofol.
- Local warming of intravenous access site may reduce propofol injection pain. Little is known about the effect of local warming on propofol injection pain.
- There are few studies to compare the effect of lidocaine administration and local warming on propofol injection pain.

What this paper adds

- This prospective, double-blind, randomized controlled trial compared propofol injection pain of surgical patients under total intravenous anesthesia propofol with control, lidocaine pre-administration and local warming groups.
- A 1-min local warming of the intravenous access site using forced air at 43 °C is as effective in reducing propofol injection pain as lidocaine pre-administration.

1. Introduction

Propofol is an intravenous anesthetic that features a rapid onset and emergence, but which causes intravenous injection pain (Doenicke et al., 1996; Euasobhon et al., 2016). This pain is a perioperative discomfort to surgical patients and anesthetic personnel (Macario et al., 1999). The majority (70–80%) of patients who receive intravenous propofol application experience propofol injection pain (Jeon, 2012; Picard and Tramèr, 2000).

The cause of propofol injection pain is likely the lipid solvent in the preparation, which irritates the intima of the involved vein (Doenicke et al., 1996). Solvent-mediated activation of the plasma kinin system leads to the production of bradykinin, in turn leading to injection site pain (Nakane and Iwama, 1999). Younger, female or Asian patients are more sensitive to propofol injection pain compared to older, male or Caucasian patients (Chan et al., 1996; Kang et al., 2010).

Lidocaine and nitroglycerin reportedly reduce propofol injection pain (Derakhshan et al., 2015; Jeon, 2012; Picard and Tramèr, 2000). Lidocaine acts as a local anesthetic on the vein, thereby stabilizing the kinin system and decreasing propofol injection pain. Injection of lidocaine into a vein, either mixed with propofol or followed by propofol, is effective in reducing the incidence and intensity of propofol injection-related pain (Euasobhon et al., 2016). Less common lidocaine treatment-related adverse effects include redness or swelling at the intravenous access site (Ahmad et al., 2013). Lidocaine pre-administration with or without venous occlusion is comparably efficacious (Picard and Tramèr, 2000).

Vein dilation by nitroglycerin increases blood flow, dilutes propofol concentration and diminishes irritation of vein intima and propofol injection pain (Derakhshan et al., 2015). Local warming of the skin dilates veins under the skin and increases blood flow (Savage and Brengelmann, 1994; Taylor et al., 1984). Biophysical effects in heat therapy require a 3–4 °C increase in skin temperature (Kankaanpää et al., 1999) and local warming of arm at 42 °C vasodilatates the cutaneous arterior smooth muscle (Taylor et al., 1984). Local warming seems to reduce the incidence of rocuronium injection or propofol injection pain with no evident adverse effects (Mahajan et al., 2010; Park et al., 2002). On the basis of the previous findings, vein dilation by local warming can increase blood flow, dilute propofol concentration and decrease propofol injection pain.

Even though both lidocaine and local warming seem to reduce propofol injection pain, development of a non-pharmacological nursing intervention requires further considerations. The use of lidocaine to reduce propofol injection pain can lead to adverse effects, such as cardiovascular and hemodynamic influence and swelling at the intravenous access site, and can cause confusion regarding the required propofol dose for induction (Ahmad et al., 2013; Kim et al., 2011; Le Guen et al., 2014). Few studies have compared propofol injection pain between lidocaine administration and local warming. Most prior studies used four-point verbal categorial scoring (VCS) because of time constraints; pain assessment should be completed within 10–15 s after propofol injection (Ahmad et al., 2013; Euasobhon et al., 2016; Jeon, 2012). As average, standard deviation and mean difference are usually meaningless in ordinary-level data such as four-point VCS, which cannot precisely evaluate the differences between comparison groups. The final limitation is the lack of knowledge of the heating temperature and the warming duration for reduction of propofol injection pain, or the change of skin temperature after warming.

As local warming is simple and non-invasive, and does not affect systemic hemodynamics, it is worth exploring as a non-pharmacological nursing intervention to reduce propofol injection pain. This prospective, double-blind, randomized controlled trial compared propofol injection pain among control, lidocaine pre-administration and local warming groups. Propofol injection pain as a primary outcome variable was assessed by an 11-point pain numerical rating scale (NRS) and the Surgical Pleth Index (SPI) based on heart beat and the plethysmographic pulse. Also, the change of skin temperature by local warming was assessed with the aim of improving nursing practice related to propofol injection pain.