Clinical Neurology and Neurosurgery 154 (2017) 98–103

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

Which one is more effective for analgesia in infratentorial craniotomy? The scalp block or local anesthetic infiltration☆

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ARTICLE INFO

Article history:
Received 10 December 2016
Received in revised form 24 January 2017
Accepted 27 January 2017
Available online 30 January 2017

Keywords:
Scalp block
Local anesthetic infiltration
Infratentorial craniotomy
Postcraniotomy pain
Bupivacaine
Opioid related side effects

ABSTRACT

Objectives: The most painful stages of craniotomy are the placement of the pin head holder and the skin incision. The primary aim of the present study is to compare the effects of the scalp block and the local anesthetic infiltration with bupivacaine 0.5% on the hemodynamic response during the pin head holder application and the skin incision in infratentorial craniotomies. The secondary aims are the effects on pain scores and morphine consumption during the postoperative 24 h.
Methods: This prospective, randomized and placebo controlled study included forty seven patients (ASA I, II and III). The scalp block was performed in the Group S, the local anesthetic infiltration was performed in the Group I and the control group (Group C) only received remifentanil as an analgesic during the intraoperative period. The hemodynamic response to the pin head holder application and the skin incision, as well as postoperative pain intensity, cumulative morphine consumption and opioid related side effects were compared.
Results: The scalp block reduced the hemodynamic response to the pin head holder application and the skin incision in infratentorial craniotomies. The local anesthetic infiltration reduced the hemodynamic response to the skin incision. As well as both scalp block and local anesthetic infiltration reduced the cumulative morphine consumption in postoperative 24 h. Moreover, the pain intensity was lower after scalp block in the early postoperative period.
Conclusion: The scalp block may provide better analgesia in infratentorial craniotomies than local anesthetic infiltration.

1. Introduction

Optimal pain treatment reduces intra and postoperative surgical stress response, therefore provides hemodynamic stability in craniotomies [1]. Pain following craniotomies has been largely investigated and reported that it could be moderate or severe during postoperative period [2–4].

Postoperative pain treatment might help to prevent rise in intracranial pressure as well as reduce the risk of intracerebral hemorrhage [5,6]. For this purpose, pain control has become a priority in neurosurgery [2].

The aim of multimodal pain treatment is to provide analgesia by different neurophysiological pathways [7]. The combination of systemic analgesics and local anesthetics might reduce the amount of systemic opioids, thereby lower the incidence of opioids adverse effects, such as sedation, miosis, respiratory depression, nausea and vomiting [8,9]. For this purpose; scalp block and local anesthetic infiltration have been used with systemic opoid administration [2,3,10].

The most painful stages of craniotomy are the placement of the pin head holder and the skin incision. Therefore, it is necessary to increase the depth of anesthesia by additional analgesic to prevent hemodynamic response such as tachycardia and hypertension during these stages [11].

It has been known that postoperative pain may be more severe following infratentorial craniotomies than supratentorials [12–14]. As far as we know, the efficacy of the scalp block has not been investigated yet in the infratentorial craniotomies.

Thus the primary aim of this prospective, randomized and placebo controlled study is to compare the effects of the scalp block

☆ This study's abstract is submitted to Euroanesthesia 2017 Congress.

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http://dx.doi.org/10.1016/j.clineuro.2017.01.018
0303-8467/

and local anesthetic infiltration with bupivacaine 0.5% on the hemodynamic response during the pin head holder application and the skin incision in infratentorial craniotomies. The secondary aims are the effects on pain scores and morphine consumption during the postoperative 24 h.

2. Materials and methods

The study registered to Clinical Trials.gov (NCT 02852382). This prospective, randomized and placebo controlled study was performed between May 2014 to December 2016. After approval from the Ethics Committee of Cerrahpasa School of Medicine (Ethical Committee No: 83045809/604/02-6015; 4 March 2014) and patient written informed consent, 47 American Society of Anesthesiologists (ASA) physical status class I–III patients aged between 18 and 70 years scheduled for elective infratentorial craniotomy were included in the study. Patients presenting with allergy to bupivacaine or opioids, chronic hypertension, coronary artery disease, arrhythmia, coagulopathy, cerebrovascular disease, raised intracranial pressure, trigeminal neuralgia and previous craniotomy were excluded from the study.

Patients were sedated with intravenous (IV) midazolam ($0.05\,mg\,kg^{-1}$) before the surgery. In the operating room, after routine monitoring, anesthesia was induced with propofol ($1.5–2\,mg\,kg^{-1}$), rocuronium ($0.5\,mg\,kg^{-1}$), remifentanil ($0.15\,\mu g\,kg^{-1}\,min^{-1}$), 0.7 FiO_2 oxygen-air and maintained with sevoflurane 0.5–0.8 MAC in oxygen/air ($FiO_2 = 0.40$), remifentanil ($0.05–0.1\,\mu g\,kg^{-1}\,min^{-1}$) and rocuronium ($0.03\,mg\,kg^{-1}\,min^{-1}$) infusions. After orotracheal intubation; nasogastric tube, right radial artery and urinary catheters were inserted.

Patients were randomized to one of three groups using a closed envelope technique. The scalp nerve block was performed in the Group S, the local anesthetic infiltration was performed in the Group I and the control group (Group C) only received remifentanil as an analgesic during the intraoperative period.

The scalp block was performed 10 min before the pin head holder application (PHHA) by the anesthesiologist with using the Pinosky's et al. [11] method. The supraorbital and supratrochlear nerves were blocked bilaterally with 6 mL bupivacaine 0.5% injected above the midline of the eyebrow, perpendicular to the skin. The auriculotemporal nerves were blocked bilaterally with 4 mL bupivacaine 0.5% injected to 1.5 cm anterior of the ear at the level of tragus, the needle was introduced perpendicular to the skin and injection was performed deeply to fascia and superficially as the needle was withdrawn. The postauricular branches of the greater auricular nerves were blocked bilaterally with 2 mL bupivacaine 0.5% injected to 1 cm posterior to the ear at the level of tragus, between bone and skin. The greater, lesser and third occipital nerves were blocked bilaterally with 8 mL bupivacaine 0.5% injected along the superior nuchal line, approximately halfway between the occipital protuberance and mastoid process.

In the Group I, the PHHA points and the surgical incision sites were infiltrated with 20 mL of bupivacaine 0.5% 10 min before the PHHA.

In the Group C, IV bolus 50 μg remifentanil was administered 10 s before the PHHA and the skin incision.

Additional remifentanil 50 μg IV was administered if the mean arterial pressure (MAP) and hearth rate increased above the 20% of the baseline in all groups.

Intraoperative analgesia was maintained with remifentanil alone. Sugammadex ($2\,mg\,kg^{-1}$) was used to reverse residual muscle relaxation at the end of surgery. Ondansetron (8 mg IV) administered as an antiemetic prophylaxis. All patients were extubated at the end of the surgery and admitted in the neurosurgical-intensive care unit for postoperative 24 h.

All patients received IV morphine using a patient controlled analgesia (PCA) pumps (Abbott Provider®, Chicago, USA) for postoperative 24 h. The PCA solution contained 100 mg morphine in 100 mL normal saline. The PCA was set to administer a bolus dose of 1 mg on demand with a lockout period of 10 min and maximum 25 mg for 4 h. Pain was evaluated with visual analogue scale (VAS) scores from 0 to 10 (0 = no pain 10 = worst pain). Two mg IV morphine was administered every 20 min in addition to PCA delivery, until the pain score decrease below 4.

The incision types are midline, paramedian and hockey stick incision. The midline and the paramedian incisions are linear. The midline incision extends from 6 cm above the inion to the C2 spinous process; paramedian incision (also referred to as a retrosigmoid approach) begins 5 mm medial to the mastoid notch and extends 4–6 cm above and below the notch. The "hockey-stick" incisions are curved and begin in the midline at the C2 spinous process, extend superiorly to just above the inion, and then laterally to mastoid tip with a terminal caudal curve.

The corticosteroid administration, the type of the surgery, the type and the size of the surgical incision, duration of the surgery, cumulative remifentanil administration in first 15 min, cumulative intraoperative remifentanil administration were recorded.

The heart rates and MAPs were recorded before induction of anesthesia (Baseline), before the PHHA, during the PHHA, 5 min after the PHHA, 10 min after the PHHA and during the skin incision as well as postoperative 10th min, 1th h, 2nd h, 6th h, 12th and 24th h.

The pain scores and postoperative cumulative morphine consumption as well as morphine related side effects such as nausea, vomiting, pruritus and rash were recorded at postoperative 10th min, 1th h, 2nd h, 6th h, 12th and 24th h and defined by a scale with 0 = absent and 1 = present.

The patient and the anesthesiologist who recorded postoperative pain scores were blinded in every case. But the anesthesiologist who applied the scalp block and followed the hemodynamic response to pin fixation and skin incision were sometimes same person.

The primary endpoint of the present study is to compare the effects of the scalp block and the local anesthetic infiltration with bupivacaine on the hemodynamic response to pin head holder application and to skin incision in infratentorial craniotomies. The secondary endpoints are the effects on pain scores and morphine consumption during the postoperative 24 h.

2.1. Statistical analysis

On the basis of previous study [5] and the assumption that a difference of 20% on MAP is clinically relevant, setting α equal to 0.005 and β equal to 0.9, we calculated a sample size of 15 patients per group. To compensate for dropouts the study included 47 patients. Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) for Windows 15.0. The determination of the normality and homogenity of the data distribution was performed with Shapiro–Wilkinson test. The data determined one out of the normal distribution were analyzed with Kruskal–Wallis test. Differences among the groups were analyzed by using one-way analysis of variance (ANOVA) with the post hoc Tukey analysis for patient characteristics, surgical incision size, duration of surgery, cumulative remifentanil administration in first 15 min, cumulative intraoperative remifentanil administration, heart rates, MAPs and the VAS scores. Postoperative cumulative morphine consumption was analyzed with repeated measures of ANOVA. The differences in gender, ASA physical status, corticosteroid administration, the