Control of Postoperative Pain after Awake Craniotomy with Local Intradermal Analgesia and Metamizol

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Abstract

Background: Pain following brain surgery is a significant problem. Infiltration of the scalp with local intradermal anesthetics was suggested for postoperative pain control but was assessed only in the first hour postoperatively.

Objectives: To evaluate wound infiltration with a single dose of metamizol (dipyrone) for postoperative pain control in patients undergoing awake craniotomy.

Methods: This open, prospective, non-randomized observational study, conducted in anesthesiology and neurosurgical departments of a teaching hospital, included 40 patients undergoing awake craniotomy for the removal of brain tumor. Intraoperative anesthesia included wound infiltration with lidocaine and bupivacaine, conscious sedation using remifentanil and propofol, and a single dose of metamizol (dipyrone) for postoperative pain control. Outcome was assessed by the Numerical Pain Scale on arrival at the postoperative care unit, and 2, 4 and 12 hours after the end of surgery.

Results: On arrival at the postoperative care unit, patients reported NPS scores of 1.2 ± 1.1 in a scale of 0–10 (mean ± SD) (median = 1, range 0–4). The scores were 0.8 ± 0.9, 0.9 ± 0.9 and 1 ± 0.9 at 2 hours, 4 hours and 12 hours after the end of surgery, respectively. Based on patients' complaints and NPS lower than 3, 27 patients did not require *any* supplementary analgesia during the first 12 postoperative hours, 11 patients required a single dose of oral metamizol or intramuscular diclofenac, one patient was given 2 mg of intravenous morphine, and one patient required two separate doses of metamizol.

Conclusions: Although the clinical setup prevents the use of placebo local analgesia as a control group, the results suggest the possible role of local intradermal infiltration of the scalp combined with a single dose of metamizol to control postoperative pain in patients undergoing craniotomy.

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Pain in the first 24 hours after brain surgery is a significant problem, with 60% to 80% of patients experiencing moderate to severe pain [1-3]. Various protocols to control postoperative pain were suggested, including infiltration of the scalp with intradermal local anesthetics. These include blunting the hemodynamic response to scalp incision using 0.5% bupivacaine [4], and wound infiltration with 0.25% bupivacaine with epinephrine (1:200,000), which lowered the pain score assessed in the first hour after surgery [5].

Local intradermal analgesia combined with monitored conscious sedation is used also for the resection of tumors located near the eloquent cortex ("awake craniotomy"). During surgery anesthesia must provide adequate sedation and analgesia, allow respiratory and hemodynamic control, and maintain the patient in an awake and cooperative state for neurological evaluation [6]. Postoperatively, patients need to be kept comfortable and with minimal pain to allow for neurological monitoring and hemodynamic stability. Numerous protocols enabling the safe performance of awake craniotomy have been proposed, and some surgeons even offered to perform the procedure as day surgery [7]. However, no data are available on postoperative pain in patients undergoing awake craniotomy.

In this open, prospective, non-randomized observational study, we assessed the efficacy of wound infiltration with lidocaine and bupivacaine and a single dose of metamizol combined with intraoperative conscious sedation, using remifentanil and propofol for the control of postoperative pain in patients undergoing awake craniotomy.

Patients and Methods

The study group consisted of 40 consecutive patients who underwent awake craniotomy for removal of brain tumors with intraoperative cortical mapping. Patients were included if they were oriented to person, place and time, with a Glasgow Coma Score of at least 14 (eye-opening in response to speech). Patients were excluded if they were unable to understand the use of the Numerical Pain Scale. The same surgeon (Z.R.) and anesthesiologist (H.B.) treated all patients. Approval for the study was obtained from the Institutional Review Board and patients signed a consent form.

Anesthesia protocol

Anesthesia was administered in conjunction with the surgery as follows: skull fixation with head holder, scalp incision, craniotomy, cortical and sub-cortical mapping, tumor resection, and closure. All patients were monitored via an arterial line, blood pressure cuff, electrocardiogram, pulse oximeter, and end-tidal CO_2 using a nasal probe. The anesthesia protocol was standardized for all patients. Patients were premedicated orally with clonidine 2–3 µg/kg 1 hour before arrival at the operating room. Intravenous propofol at an initial dose of 50 µg/kg/min was started on arrival at the operating room. Three to five minutes

NPS = Numerical Pain Scale

before placement of the head holder, remifentanil at an initial dose of 0.05 µg/kg/min was administered. The scalp in the pin insertion sites was injected with 3–5 ml of 2% lidocaine and epinephrine 1:200,000. The infusion of remifentanil was reduced to 0.01 µg/kg/min after placement of the head holder, and both infusions were adjusted by 25% increments to achieve a sedation score of 2 and a respiratory rate higher than 8 breaths/min. After marking the necessary skin incision and flap site, the scalp was anesthetized with local intradermal anesthesia infiltration of bupivacaine 0.5% and lidocaine 2% in a 1:1 mixture. Remifentanil and propofol were discontinued after opening of the dura in order to maintain the patient fully awake and cooperative during the stimulation, functional testing, and tumor resection. Propofol was resumed upon closure of the dura, at a dose of 15 µg/kg/min. If the patient required more than 25 µg/kg/min of propofol, remifentanil was added at a dose of 0.01 µg/kg/min. Labetalol, in boluses of 5–10 mg, was used to maintain systolic arterial pressure below 150 mmHg, while stabilizing the heart rate above 50 beats/min. Following surgery, all patients were monitored for at least 2 hours in the post-anesthesia care unit and then for at least 12 hours in the same unit or in the neurosurgical intensive care unit.

Pain control

Additional 2% lidocaine and epinephrine 1:200,000 were infiltrated to the scalp and dura mater according to the patient's report during surgery and during closure of the skin flap. Supra-orbital nerve block was performed, when appropriate, in the frontal skin flap. Metamizol (dipyrone), 1 g, was given intramuscularly to all patients 30 minutes before the end of surgery. Patients with known or suspected sensitivity to metamizol were given 75 mg of diclofenac intramuscularly. In the postoperative period, dipyrone was administered orally if the Numerical Pain Scale was ≥ 3 in a scale of 10. If pain (NPS ≥ 3) was reported less than 6 hours after the previous dipyrone dose, intramuscular diclofenac was provided. If the pain was still not controlled, intravenous morphine in 1 mg increments was administered.

Parameters

Pain scores were assessed upon arrival at the postoperative care unit and then 2, 4 and 12 hours after surgery using the Numerical Pain Scale, where zero was defined as no pain at all and 10 as maximal pain. One investigator performed all assessments.

The incidence of nausea and vomiting were recorded. Intravenous labetalol and hydralazine were administered for the control of systolic arterial pressure, after pain was excluded as the cause for elevated blood pressure.

Results

All 40 patients completed the study protocol. The overall stay in the operating room was 245 ± 55 minutes and operating time was 202 ± 45 minutes (mean ± SD).

The initial dose of propofol was 50 µg/kg/min, and the majority of the patients (30/40) needed only 25–50 µg/kg/min for most of the procedure. Remifentanil, which was started 3–5 minutes before placement of the head frame at a dose of 0.05 µg/kg/min, was reduced to 0.01 µg/kg/min after the frame placement, and was discontinued shortly thereafter in the majority of the patients (29/40). The infusion was reinstituted only before skin incision, at a dose of 0.01–0.02 µg/kg/min. For closure of the dura, cranium and scalp, propofol was given at a dose of 15–25 µg/kg/min to all patients, and remifentanil to only 18/40 at a dose of 0.01–0.02 µg/kg/min.

NPS measured on arrival at the postoperative care unit was 1.2 ± 1.1 (mean ± SD) (median 1, range 0–4). Mean values were 0.8 ± 0.9, 0.9 ± 0.9, and 1 ± 0.9, 2 hours, 4 hours, and 12 hours after the end of surgery, respectively.

During the first 12 postoperative hours, 27 patients did not require any supplementary analgesia besides the local intradermal anesthesia performed during surgery and the single dose of metamizol (dipyrone) or diclofenac administered before the end of surgery (22 and 5 patients respectively). With regard to the other 13 patients, 11 were given a single dose of metamizol (dipyrone) or diclofenac (3 patients received the treatment 2–4 hours after the end of surgery, 4 patients 4–8 hours after the end of surgery, and 4 patients 8–12 hours after the end of surgery); one patient was given 2 mg of morphine besides diclofenac in the first hour after arriving at the post-anesthesia care unit, and one patient required two separate doses of metamizol (dipyrone).

Five of the 40 patients were treated with labetalol and 2 with hydralazine after the exclusion of pain as a cause for elevated arterial pressure. Neither nausea nor vomiting was recorded for any of the patients during the study period.

Discussion

The data presented in this study demonstrate low levels of pain in patients during the first 12 hours after brain surgery performed with clonidine premedication, local intradermal analgesia, conscious sedation using the short-acting medications propofol and remifentanil, and a single dose of metamizol (dipyrone).

Our findings are in contrast to those reported by De Benedittis and colleagues [2] and Quiney et al. [3] who found that 60–84% of patients, evaluated prospectively, reported moderate to severe pain during the first 24 hours post-intracranial surgery. In another retrospective report, limited to the immediate arrival at the post-operative care unit, Dunbar and co-workers [8] reported that 55% of patients undergoing intracranial procedures felt postoperative pain. Moreover, patients undergoing intracranial surgery were less likely to experience moderate to severe pain compared with patients undergoing facial bone or spine surgery. Nguyen et al. [1] who studied the effects of scalp block on postoperative pain reported that in the control group of patients who received only saline, moderate intensity of pain occurred in 70% of the patients, 48 hours postoperatively.

Others have used wound infiltration with local anesthetic as a technique to reduce postoperative pain. Hillman and team [4] blunted the hemodynamic response to scalp incision using 0.5% bupivacaine without epinephrine. Bloomfield et al. [5] demonstrated that wound infiltration with 0.25% bupivacaine with epinephrine (1:200,000) lowered the pain score assessed

at admission to the post-anesthesia care unit and 60 minutes later when compared to patients who underwent placebo infiltration. However, the study was limited to the immediate 1 hour postoperative period, unlike the results of the present study demonstrating a beneficial effect 12 hours postoperatively.

In the postoperative period, metamizol (dipyrone) was used as a supplement to the regional analgesia because of its index of safety. Metamizol is a non-opioid analgesic, similar in strength to ketoprofen and ketorolac [9,10], lacks any sedative effect, does not increase the bleeding tendency, and its analgesic effect lasts for at least 3–4 hours.

Other analgesics have been used for control of post-craniotomy pain, but each is associated with specific disadvantages. Opioids may cause nausea, vomiting, and depressed respiration leading to increased cerebral blood flow and raised intracranial pressure, especially when intracranial compliance is reduced. [11]. Patient-controlled analgesia with opioids, widely used for pain relief after general surgery, is considered to be inadequate after craniotomy because of the various disadvantages of opioids mentioned above. Intramuscular codeine provides insufficient pain relief after craniotomy, and non-steroidal anti-inflammatory drugs are associated with an increased risk of intracranial bleeding [11]. In this study we administered diclofenac only after dipyrone failed to provide sufficient analgesia or in patients with suspected sensitivity to dipyrone.

None of our patients complained of nausea or vomiting in the perioperative period. In a recent study the incidence of nausea and vomiting after awake craniotomy was 4% and 0%, respectively. The incidence of both was lower in comparison to similar operations performed under general anesthesia [12].

Study limitations

The main limitation of this study is that the protocol was open and no control group was used. However, this limitation is inherent to the procedure performed, and any attempt to use placebo instead of local intradermal anesthetic for local infiltration could cause uncontrolled pain, need for higher doses of intravenous propofol and remifentanil, and increased risk for severe respiratory and neurological consequences. Another limitation of the study was that the follow-up was limited to the first 12 hours after surgery.

Conclusions

This study demonstrated that following intraoperative local intradermal infiltration of the scalp with bupivacaine and lidocaine, combined with postoperative use of dipyrone, patients reported low levels of pain in the first 12 hours after surgery. This protocol may contribute not only to the well-being of patients but also to their hemodynamic stability, which could possibly permit their early discharge [7].

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I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I
I took the one less traveled by,
And that has made all the difference

Robert Frost (1874-1963), U.S. poet and four-time Pulitzer Prize laureate. He used the setting of rural New England to explore complex social and philosophical themes.