Effect of Scalp Infiltration on Postoperative Pain Relief in Elective Supratentorial Craniotomy with 0.5% Bupivacaine with Adrenaline 1:400,000

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Objective: *Determine the effect of scalp infiltration on postoperative craniotomy pain with 0.5% bupivacaine with adrenaline 1:400,000.*

Material and Method: *A prospective randomized double blind control trial was conducted on 50 patients (18-65 years), who were ASA physical status I to III, and scheduled for elective intracranial surgery at Maharaj Nakorn Chiang Mai Hospital, Thailand between October 2006 and December 2007. The patients received wound infiltration before skin closure by either 0.5% bupivacaine with adrenaline 1:400,000 (group B), or normal saline with adrenaline 1:400,000 (group S).*

Results: *The median pain score in the first 12 hours trended to be lower in the bupivacaine group than in the control, but the differences were not statistically significant apart from the score in the first hour (median pain score = 2, IQR = 3; p = 0.031). There were more pain-free patients in the bupivacaine group than in the control group at all time intervals during the first 12 hours. However, the difference was significant in the first hour (7 vs. 1; p = 0.034). Although the median (range) time interval between the end of surgery and first administration of tramadol was longer in the bupivacaine group, when compared to the control group, it was not statistically significant.*

Conclusion: *Surgical wound infiltration, before skin closure, with 0.5% bupivacaine with adrenaline decreased the incidence and severity of postoperative pain in patients undergoing supratentorial craniotomy, but only for the first hour after surgery.*

Keywords: *Craniotomy, Pain, Scalp infiltration, 0.5% bupivacaine with adrenaline, Tramadol*

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There have been several reviews of post-operative pain in neurosurgical patients, but no large-scale studies determined effective treatment and side effects. While pain may be less severe in this than in other operations, there is a growing consensus that it has been undertreated[1-3]. The overall incidence of pain in the study of Giuseppina M. was 24%, and severe pain was not a persistent problem in craniotomy because adequate pain relief was achieved in most patients with only 2 doses of ketolorac (30 mg)[4]. Other studies reported a higher incidence of pain after craniotomy, varying from 40-84%, with the maximum incidence occurring 12 hours after surgery[3,5]. Patients undergoing craniotomies have traditionally received opiates for the management of their postoperative pain. The use of narcotics alone can have several side effects. Scalp infiltration with local anesthetic is another technique that has been studied for post-operative pain after craniotomy. One study showed that although preincision scalp infiltration with bupivacaine did not have any significant effect on postcraniotomy pain and analgesic requirement, it delayed the need for analgesic[6]. In the authors' institute, the duration of craniotomy last usually 3-4 hours.

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Therefore, the authors decided to determine the effect of scalp infiltration, before skin closure, on pain relief with 0.5% bupivacaine with adrenaline 1:400,000.

Material and Method

After approval by the institutional ethics committee and written informed consent, 50 patients (18-65 years), with ASA physical status I to III, and scheduled for elective supratentorial craniotomy at Maharaj Nakorn Chiang Mai Hospital, Thailand between October, 2006 and September, 2007, were enrolled. The exclusion criteria comprised a preoperative decrease in the level of consciousness (Glasgow Coma Scale < 15); complication occurring during surgery such as unanticipated brain swelling, injury to the cranial nerves, massive blood loss or unstable vital signs, allergy to bupivacaine, difficulty in communicating, and no plan to extubate. All patients were visited preoperatively and introduced by verbal numeric scale (VNS) for pain assessment, grading a 10 baseline VNS with 0 = no pain and 10 = the worst possible pain.

Infiltration by 0.5% lidocaine with adrenaline 1:100,000 was done as usual by a neurosurgeon before craniotomy. Anesthetic management depended on the judgment of the attending anesthesiologist and was not influenced or intentionally altered as a result of participation in the present study. Demographic and anesthetic data (perioperative medications, duration of anesthesia, and time to awakening) were recorded. Before skin closure, patients were randomly allocated into two groups using a computer generated random number chart. Group B received wound infiltration by 20 ml of 0.5% bupivacaine with adrenaline 1:400,000, whereas group S received infiltration by 20 ml of normal saline with adrenaline 1:400,000. Both solutions were prepared by the scrub nurse, who did not participate in the postoperative pain assessment. The neurosurgeon performing the infiltration, anesthesiologist and patient were blinded to the drug being administered. Furthermore, location and length of surgical wound were recorded for each patient. After extubation, all patients were monitored in the post anesthesia care unit (PACU) and then transferred to the intensive care unit (ICU) for at least 24 hours. Pain was assessed by blinded nurses using VNS at 30 minutes and 1, 2, 4, 6, 8, and 12 hours, postoperatively. The incidence of pain requiring rescue medication (VNS > 4) was recorded and treated with tramadol at 50-mg i.v., but not more than 400 mg/day. The second rescue analgesic was paracetamol at 500-1,000 mg I.M. or intraorally. Total doses and the frequency of rescue analgesic administered, including times from the end of the operation to the first requirement of analgesic, were noted. Sedation was assessed using four-point scale: i.e. 1) awake and communicative; 2) asleep, but responding to normal speech; 3) asleep, but responding to shaking; and 4) deeply sedated[7]. The incidence of nausea/vomiting (0 = no nausea or vomiting; 1 = nausea but no vomiting; 2 = retching but no vomiting; and 3 = vomiting) was recorded for each patient.

The sample size of 22 patients in each group was determined, based on the assumption that scalp infiltration will decrease the incidence of moderate to severe postoperative pain (VNS > 4) by 50% (from 80 to 40%), with α of 0.05 and power of 80%[8]. However, 25 patients per group were chosen by the authors to compensate for 10% missing subjects.

Pain score, sedation score and all time intervals were compared by using the Mann Whitney U test. The number of pain free patients at different time intervals was compared using the chi square test or Fisher's exact test. Dose requirement of tramadol was compared using the Mann Whitney U test. Correlation between location and length of the surgical wound, and pain score were tested with Spearman's and Pearson's correlation coefficient, respectively. Discrete categorical data were presented as frequency (percent); and continuous data were presented as mean $\pm$ SD. All data were analyzed by the Statistical Package for Social Science program (SPSS for Windows, version 10.0). Statistical significance was determined at a p-value of less than 0.05.

Results

Fifty patients were enrolled in the present study, at 25 in each group. Only one patient in the bupivacaine group was excluded, due to inability to assess the pain score from alteration of consciousness. There were no differences between either group in demographic characteristics, duration of surgery, total amount of fentanyl used intraoperatively, and duration from the last dose of fentanyl to recovery (Table 1). Locations of surgical incision are shown in Table 2. Analysis of correlation between surgical site (Spearman's correlation coefficient), length of surgical incision (Pearson's correlation coefficient) and pain scores in both groups revealed that there were no correlations between the variables.

The median pain score was significantly lower in only the first postoperative hour in the bupivacaine group (median pain score = 2, IQR = 3; p = 0.031). Although median pain scores during the first 12

Table 1. Demographic and characteristic data

	Group S (n = 25)	Group B (n = 24)
Age (years, mean ± SD)	49.12 ± 10.97	49.33 ± 13.56
Weight (kg, mean ± SD)	55.56 ± 8.84	56.85 ± 10.76
Sex ratio (M/F)	9/16	13/11
ASA (I/II/III)	5/13/7	2/16/6
Glasgow Coma Score	15	15
Duration of surgery [min, median(range)]	210 (140-360)	240 (100-360)
Total amount of fentanyl (μg, mean ± SD)	165.20 ± 49.25	157.50 ± 61.37
Time from the last dose of fentanyl to recovery [min, median(range)]	60 (10-180)	67.5 (15-200)

Table 2. Location of surgical incision: data presented as frequency

Location	Group S (n = 25)	Group B (n = 24)	Total (n = 49)
Frontal	6	8	14
Parietal	2	-	2
Temporal	2	3	5
Fronto-parietal	1	2	3
Fronto-temporal	9	6	15
Parieto-temporal	-	1	1
Parieto-occipital	5	2	7
Suboccipital	-	1	1
Retrosigmoid	-	1	1

Table 3. Postoperative pain scores: values presented as median and interquartile range (IQR)

Time interval	Control group (n = 25)	Bupivacaine group (n = 24)	p-value[a]
Hours	Median (IQR)	Median (IQR)	
0.5	3 (3)	2 (3.75)	0.196
1	3 (3)	2 (3)	0.031*
2	3 (3)	2 (4.5)	0.352
4	3 (3)	3.5 (4.75)	0.379
6	3 (4)	3 (2.75)	0.983
8	3.5 (3)	2.5 (3.75)	0.318
12	3 (3)	3 (3.5)	0.738

[a] p-value obtained from the Mann Whitney U test
* Statistically significant

hours tended to be lower in the bupivacaine group than in the saline group, the differences were not statistically significant except for the score in the first hour (Table 3). There were more pain-free patients in the bupivacaine group when compared to controls at all time intervals during the first 12 hours. However, the difference was significant in only the first hour (7 vs. 1; p = 0.034) (Table 4).

Although the median (range) time interval between the end of surgery and the first administration of tramadol was longer in the bupivacaine group when compared to the saline group, it was not statistically significant [90 (30-600) vs. 60 (30-720) min, p = 0.442]. There was no statistically significant difference in the total amount of tramadol in the first 6 to 12 hours or the number of other rescue drug doses between the groups (Table 5).

Most of the patients were easily aroused during the immediate postoperative period and extubated on the operating table once they could follow verbal commands. Five patients (2 in the saline group and 3 in the bupivacaine group) were extubated in ICU a few hours after the operation. Sedation scores, which were compared between the groups at all time intervals, revealed no statistical difference. Almost no

Table 4. Number of patients remaining pain free: data presented as frequency and (percent)

Time interval (Hours)	Group S (n = 25)	Group B (n = 24)	p-value[a]
0.5	4 (16)	8 (33)	0.248
1	1 (4)	7 (29)	0.034*
2	1 (4)	6 (25)	0.059
4	1 (4)	4 (17)	0.180
6	1 (4)	2 (8)	0.564
8	-	1 (4)	-
12	-	1 (4)	-

[a] p-value obtained from the chi-square test or Fisher's exact test
* Statistically significant

Table 5. Postoperative rescue analgesia

	Group S (n = 25)	Group B (n = 24)	p-value[a]
Time of first request for rescue analgesia [min, median(range)]	60 (30-720)	90 (30-600)	0.442
Total amount of tramadol at the first 6 hrs [mg, median(range)]	50 (0-100)	50 (0-100)	0.351
Total amount of tramadol at the first 12 hrs [mg, median(range)]	100 (0-150)	100 (50-150)	0.132
Total number of other rescue drug doses (%)	2 (8)	3 (12.5)	0.640

[a] p-value obtained from the Mann Whitney U test

patients experienced postoperative nausea and/or vomiting. Only five patients had nausea and/or vomiting symptoms 24 hours postoperatively (3 vs. 2 in the controls and bupivacaine group, respectively). No arrhythmia or hypotension was observed when lidocaine and bupivacaine solutions were infiltrated during scalp incision and before skin closure, respectively.

Discussion

Some previous studies dealt with scalp block or infiltration for pain control after craniotomy. The study of Bala I. demonstrated that scalp block using 0.5% bupivacaine with adrenaline 1:400,000 decreased both the incidence and severity of postoperative pain in patients undergoing supratentorial craniotomy[8]. They observed that the duration of pain relief corresponded with the duration of action of bupivacaine. However, Nguyen et al reported the unexpected long duration of 0.75% ropivacaine in pain relief after scalp nerve block, the analgesic effect seemed to persist for at least 48 hours postoperatively[9]. In contrast to the result of scalp infiltration, one study reported that wound infiltration with 0.25% bupivacaine with adrenaline 1:200,000 decreased pain scores on admission to the PACU for up to one hour[3]. Scalp infiltration using 0.375% bupivacaine with adrenaline 1:200,000, or 0.75% ropivacaine, decreased postoperative pain scores and morphine consumption, but only for the first two hours after surgery[10]. The present study is another that indicated that scalp infiltration with 0.5% bupivacaine with adrenaline 1:400,000 decreased pain scores and analgesic consumption, but in the first hour after supratentorial craniotomy. Therefore, the duration of pain relief did not correspond with the expected duration of bupivacaine with adrenaline action. Although the median (range) time interval between the end of surgery and the first administration of tramadol was longer in the bupivacaine group, when compared to the control group, it was not statistically significant. In addition, the frequencies and the total doses of rescue analgesia were not significantly lower in the bupivacaine group.

There were no significant differences in the severity of pain or frequency of nausea based on the craniotomy site[11]. In contrast, women and any patients undergoing infratentorial surgery were reported to be at particular risk of nausea and vomiting[12]. In addition, a previous study concluded that infratentorial craniotomy was associated with a higher early requirement for immediate postoperative pain control than supratentorial craniotomy, when local anesthetic infiltration was not used[1]. Thus, the authors excluded infratentorial craniotomy cases from the present study. Analysis of correlation between surgical sites, length of surgical incision and pain scores in both groups revealed that there was no correlation between the variables. Tramadol was chosen as the first rescue analgesic and paracetamol the second, based on the traditional regimen prescribed by neurosurgeons. Tramadol has some side effects similar to those from narcotic medications, including nausea, somnolence, and respiratory depression[13], and it has been shown as less effective when compared to opioid[14]. However, the present study showed adequate pain relief from tramadol as the first rescue analgesic, with no significant side effects in postcraniotomy patients.

Bupivacaine with adrenaline for scalp infiltration has been reported to have no accompanying blood pressure or unusual heart rate[15]. In contrast, adrenaline-containing lidocaine solution can elicit temporary but significant hemodynamic changes including hypotension[16]. In the present study, there was no incidence of arrhythmia or hypotension observed when adrenaline-containing lidocaine and adrenaline-containing bupivacaine solutions were infiltrated during scalp incision and before skin closure, respectively. From the results of the study, the authors implied that surgical wound infiltration with 0.5% bupivacaine with adrenaline 1:400,000, before skin

closure, decreases the incidence and severity of post-operative pain in patients undergoing supratentorial craniotomy in the first hour after surgery, but does not delay the need or decrease the consumption of rescue analgesia.

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ผลการฉีดยาที่หนังศีรษะต่อความเจ็บปวดหลังการผ่าตัดเปิดกะโหลกด้วย 0.5% บิวพิวาเคนที่มีอะดรีนาลีน 1:400,000

อานันท์ชนก ศฤงคารินกุล, เศรษฐพงษ์ บุญศรี

วัตถุประสงค์*: เพื่อศึกษาผลการฉีดยาที่หนังศีรษะต่อความเจ็บปวดหลังการผ่าตัดเปิดกะโหลกด้วย 0.5% บิวพิวาเคนที่มีอะดรีนาลีน 1:400,000*

วัสดุและวิธีการ*: เป็นการศึกษาไปข้างหน้าแบบ randomized double blind control โดยเก็บข้อมูลในผู้ป่วย 50 คน อายุระหว่าง 18-65 ปี ASA physical status I to III นัดมาผ่าตัดเปิดกะโหลกศีรษะ ที่ โรงพยาบาลมหาราชนครเชียงใหม่ ตั้งแต่เดือนตุลาคม พ.ศ. 2549 ถึง เดือนธันวาคม พ.ศ. 2550 ผู้ป่วยได้รับการฉีดยาชาที่แผลผ่าตัดก่อนการเย็บปิดด้วย 0.5% บิวพิวาเคนที่มีอะดรีนาลีน 1:400,000 (กลุ่ม B) หรือน้ำเกลือที่มีอะดรีนาลีน 1:400,000 (กลุ่ม S)*

ผลการศึกษา*: ค่ากลางความเจ็บปวดในช่วง 12 ชั่วโมงแรกมีแนวโน้มที่ ค่าในกลุ่มบิวพิวาเคนจะต่ำกว่าค่าในกลุ่มควบคุม แต่ไม่มีนัยสำคัญทางสถิติยกเว้นค่าความเจ็บปวดในชั่วโมงแรก (ค่ากลางความเจ็บปวดเท่ากับ 2, IQR = 3; p = 0.031) จำนวนผู้ป่วยที่ไม่มีความเจ็บปวด ในกลุ่มบิวพิวาเคนมากกว่าผู้ป่วยกลุ่มควบคุม ทุกช่วงเวลาใน 12 ชั่วโมงแรก อย่างไรก็ตามพบความแตกต่างอย่างมีนัยสำคัญทางสถิติในชั่วโมงแรกเท่านั้น (7 vs. 1; p = 0.034) ถึงแม้ค่ากลางของช่วงเวลาระหว่างสิ้นสุดการผ่าตัดและการให้ยา tramadol ครั้งแรกจะยาวนานกว่า ในกลุ่มบิวพิวาเคนเทียบกับกลุ่มควบคุม แต่ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติ*

สรุป*: การฉีดแผลผ่าตัดก่อนการเย็บปิดด้วย 0.5% บิวพิวาเคนที่มีอะดรีนาลีน 1:400,000 ช่วยลดอุบัติการณ์ และความรุนแรงของความเจ็บปวดในผู้ป่วยที่ได้รับการผ่าตัดเปิดกะโหลกศีรษะที่บริเวณ supratentorial แต่อยู่ในช่วง 1 ชั่วโมงแรกหลังการผ่าตัดเท่านั้น*