JNI Jurnal Neuroanestesi Indonesia

Original Article

The Comparison of the Effectiveness of Additional Scalp Block Bupivacaine 0,125% with Bupivacaine 0,25% on Hemodynamic Responses in Patients Undergoing Craniotomy

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Received: Desember 12, 2025; Accepted: September 10, 2025; Publish: October 21, 2025

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Abstract

Introduction: Scalp block is one of the regional blocks that can be combined with neuroanesthesia in craniotomy of tumor resection (CTR) surgery. The advantages of scalp block can blunt the stress response during CTR, maintain hemodynamic stability, and reduce the use of opioid drugs during the operation.

Subject and Method: This study is a double-blinded randomized controlled trial. The subjects consisted of 28 samples aged 18-65 years, GCS 15, ASA II-III physical status, with a diagnosis of intracranial tumor who underwent CTR at Mohammad Hoesin Hospital, Palembang. The samples were divided into two treatment groups using general anesthesia techniques with the addition of a scalp block using bupivacaine 0.125% and bupivacaine 0.25%. Patients who were allergic to bupivacaine, those in hemorrhagic shock, or those had undergone surgery lasting more than 6 hours were excluded from data collection. Data analysis was conducted by assessing hemodynamic changes, namely systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR). The data analysis methods used were the general linear model, specifically repeated measures ANOVA, paired t-test, and independent t-test with SPSS version 28.

Results: There is no significance difference between two group in the hemodynamic changes of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean atrial pressure (MAP), and heart rate (HR) over time between the two groups using bupivacaine 0.125% and bupivacaine 0.25% with the independent t-test ($p>0.05$). The presence of significant hemodynamic changes in each treatment group over time with repeated-ANOVA and paired-t-test statistical tests ($p<0.05$). No side effects are observed. There is no significant proportional difference in the addition of fentanyl doses between the two groups ($p>0.05$).

Conclusion: The addition of a scalp block with 0.125% bupivacaine is equally effective as 0.25% bupivacaine in maintaining hemodynamic stability during tumor resection craniotomy surgery. The need for opioids during the intraoperative period can be reduced.

Keywords: buvipacaine, hemodynamic, neuroanesthesia, scalp block, tumor removal craniotomy

J. neuroanestesi Indones 2025;14(3): 53–63

Introduction

The incidence rate for brain tumors worldwide based on world population standard figures is 3.4 per 100,000 population with a mortality rate of 4.25 per 100,000 per year. Of all primary tumors in the central nervous system, astrocytomas and glioblastomas account for about 38% of the total and meioma and other mesenchymal tumors account for about 27%. The rest consists

doi: https://doi.org/10.24244/jni.v14i3.647
ISSN (Print): 2088-9674 ISSN (Online): 2460-2302

JNI is accredited as Sinta 2 Journal: https://sinta.kemdikbud.go.id/journals/profile/796

How to cite: Afprimadhona, et al, "The Comparison of Effectiveness of Additioning Scalp Block Bupivacaine 0,125% with Bupivacaine 0,25% on Hemodynamic Responses in Patients Undergoing Craniotomy".

of various brain tumors including pituitary, schwannoma, central nervous system lymphoma and others.[1] One of the brain tumor management actions related to neuroanesthesia is craniotomy tumor removal (CTR). Different stimulations during the tumor removal craniotomy procedure include pin placement, skin incision, craniotomy, contact with the periosteum, manipulation of the dura, bone and brain which can cause a sudden increase in blood pressure and heart rate. This can cause an increase in intracranial pressure.[2.3] The regional anesthesia technique, namely the scalp block, was first developed by Harvey Cushing and George Crile in the early 1900s. The scalp block is an alternative option that can be combined with general anesthesia.[2] This technique can be used in all craniotomy procedures. The addition of scalp block is one of the efforts to maintain hemodynamic stability during intraoperatively and achieve better postoperative analgesic effects, and the use of fewer anesthetic drugs during surgery.[3]

The combination of local anesthetics with 0.125% bupivacaine or 0.25% bupivacaine can provide more optimal results in patients because the pharmacology of local anesthetics inhibits voltage-gated sodium channels, thereby preventing channel activation and sodium influx related to membrane depolarization.[4] Buvipacaine has dose-related risks, including cardiotoxity and neurotoxicity, eventhough scalp block uses relatively small volumes, higher concentrations (0.25% and above) may carry greater systemic absorption risks, especially in highly vascular areas like the scalp. Although bupivacaine 0.25% is commonly used for scalp block, concerns remain regarding potential systemic toxicity due to the scalp's rich vascularization and the additive effects of anesthetic agents used during craniotomy. A lower concentration such as 0.125% may offer adequate analgesia and hemodynamic stability while minimizing the risks of toxicity and reducing the overall anesthetic load. However, evidence directly comparing the efficacy and safety of 0.125% versus 0.25% bupivacaine in scalp block remains limited. Therefore, this study aimed to compare the effectiveness between the addition of local anesthesia 0.125% versus 0.25% buvipacaine in the scalp block technique, especially in terms of maintaining hemodynamic stability during intraoperatively in general anesthesia.

Method

This study was a double-blinded randomized controlled trial conducted in the Neurosurgery Operating Room (20.08), Central Surgery Installation, Mohammad Hoesin Hospital, Palembang from September to October 2024. The aim was to compare effectiveness of the addition of 0.125% bupivacaine scalp block and 0.25% bupivacaine on hemodynamic responses in neurosurgery patients undergoing craniotomy surgery at Mohammad Hoesin Hospital Palembang. A total of 28 patients were enrolled and randomly assigned into two groups: one receiving 0.125% bupivacaine scalp block and the other receiving 0.25% bupivacaine.

The inclusion criteria used in this study were: 1) Patients aged 18-65 years; 2) Patients who underwent craniotomy tumor removal (CTR) surgery at Mohammad Hoesin Hospital Palembang from September 2024 to October 2024; 3) Patients with any Body Mass Index (BMI) were eligible for inclusion;[6]
4) Patients with American Society of Anesthesiologist (ASA) physical status II-III.
The exclusion criteria used in this study were: 1) Patients who were unwilling to sign the informed consent; 2) Allergies to thiopental and/or bupivacaine and/or fentanyl; 3) History of craniectomy surgery; 4) Patients with comorbid endocrine diseases (hyperthyroidism, hypothyroidism) that affect hemodynamics, congenital heart disease or other heart diseases related to hemodynamics; 5) Patients with severe mental illness.

The drop-out criteria in this study were 1) Patients with LAST (Local Anesthetic Systemic Toxicity); 2) Allergic reactions to local anesthetic drugs; 3) Intraoperative emergencies where brain tumor patients experienced complications during surgery in the form of hemodynamic instability during observation and intervention requiring vasoconstrictors; 4) Intraoperative hemorrhagic shock; 5) Duration of surgery >6 hours. Sampling and distribution were conducted by block randomization. Block randomization was conducted by a predetermined assistant using a computerized method without the researcher's knowledge. Computer randomization was conducted by entering sequences into the website http://www.random.org/lists/. The treatment group was divided into two groups, namely group 1 and group 2. Group 1 was the group that received general anesthesia and scalp block using 0.25% bupivacaine while group 2 was the group that received general anesthesia plus scalp block using 0.125% bupivacaine. The scalp block action will be performed by researchers who have been provided with prior training. The research subjects and the research data recorders did not know the scalp block action performed using 0.125% bupivacaine or 0.25% bupivacaine.

Scalp Block Procedure

Scalp block injection was performed on patients before incision and after induction of general anesthesia. The scalp block fluid given would be adjusted to the patient group. The method of administering the scalp block followed the technique previously reported by researcher.[2,5,7,15,16,20] The supraorbital nerve and supratrochlear nerve blocks were performed with an injection volume of 2 ml in the orbit using a 23 G needle inserted perpendicular to the eyebrow at the tragus level. The auriculotemporal nerve was blocked using an injection volume of 3 ml 1.5 cm anterior to the ear at the tragus level. Infiltration of 1.5 ml using a syringe was performed into the deep fascia and 1.5 ml was inserted into the superficial part. The post-auricular nerve branch of the greater auricular nerve was blocked using an injection volume of 2 ml with a syringe introduction 1.5 cm posterior to the ear at the tragus level. The greater occipital nerve, lesser occipital nerve, and greater auricular nerve were blocked using an injection volume of 5 ml with infiltration following the superior nuchal line and approximately in the middle of the occipital protuberance and mastoid process.

After the procedure was completed, the patient's systolic blood pressure, diastolic blood pressure, MAP, and heart rate (HR) were recorded 1 minute after the head pin was inserted, 1 minute after the skin incision, 1 minute after the dura mater incision, and after the surgical wound was covered with gauze.[8]

Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) ver 28.0. Normality test using Shapiro-Wilk test, normally distributed data ($p>0.05$) are presented in mean ± standard deviation (SD) while non-normally distributed data ($p<0.05$) are presented in median ± interquartile range (IQR). Assessment of hemodynamic changes was assessed from the value of each hemodynamic variable (SBP, DBP, MAP, HR) at each measurement time, where in this study 6 measurements were carried out. The data analysis was used to see whether there were significant changes at many measurement times (>2) is the general linear model, namely repeated measures ANOVA. This test can be used to compare changes in the value of a variable at each different time period. The test was then continued with a paired t-test to compare the difference in value between two different times. The requirement of this test is that the data analyzed must meet the requirements of the parametric test, namely normally distributed. For data that is not normally distributed or that has a p-value <0.05 in the Shapiro-Wilk test, a non-parametric test is carried out, namely the Friedman test as a substitute for the general linear model repeated measures test and the Wilcoxon test as a substitute for the paired t-test. The difference in effectiveness between treatment groups was done by comparing hemodynamic values at each measurement time. The test performed for this was the independent t test on normally distributed data or the Mann Whitney test on non-normally distributed data.

Results

The results of the study showed that the age in group 1 had an average of 44.78 ± 10.72 years,

Table1. Characteristics of Research Subjects

Variables	Group		P
	1 (Bupivacaine 0.25%) Mean±SD	2 (Bupivacaine 0.125%) Mean±SD	
Age (years)	44.78±10.72	45.78±11.45	0.813a
Gender, n (%)			0.430b
Man	4(28.57%)	6(42.85%)	
Woman	10(71.43%)	8(57.15%)	
Physical status, n (%)			0.541b
ASA II	12 (85.71%)	13(92.86%)	
ASA III	2 (14.29%)	1 (7.14%)	
Height (cm)	159.21±3.35	162.14±8.32	0.233a
Body weight (kg)	56.07±6.59	61.42±10.52	0.119a
BMI (kg/m2)	22.09±2.13	23.30±3.19	0.248a
TDS (mmHg)	131.35±4.10	132.35±4.25	0.532a
BP (mmHg)	79.50±6.88	79.57±5.43	0.976a
MAP (mmHg)	96.67±5.29	96.83±4.11	0.976a
Heart Rate(x/minute)	84.14±9.54	84.71±5.06	0.845a
Operation duration (minutes)	175±45.36	174±26.05	0.980a
Amount of bleeding (mL)	460.71±73.84	457.14±108.9	0.920 a

Description: $p > 0.05$ is not statistically significant, a) parametric test of unpaired group differences of numeric data (independent t test).; b) test of unpaired group differences of categorical data (chi-square).

Table 2. Comparison of Systolic Blood Pressure (SBP) by time (T0-T5)

SDP	Group		P Value
	1 (Bupivacaine 0.25%) Mean±SD	2 (Bupivacaine 0.125%) Mean±SD	
T0 (Baseline)	79.50±6.88	79.57±5.43	0.976a
T0 vs T1	0.000θ*	0.000θ*	
T1	75.78±5.56	76.64±4.79	0.666a
T1 vs T2	0.000θ*	0.001θ*	
T2	73 ±6.87	73.14±6.63	0.956a
T2 vs T3	0.021θ*	0.010θ*	
T3	70.35±6.14	71±4.47	0.754a
T3 vs T4	0.504θ	0.280θ	
T4	70±5.53	70.21±3.26	0.902a
T4 vs T5	0.000θ*	0.000θ*	
T5	66.71±5.22	67.14±3.37	0.799b

Information : a) Independent t test; b) Repeated ANOVA; θ) Paired t-test; *) is significant if $p < 0.05$. T0: Measurement time before induction of anesthesia; T1: Measurement time 40 minutes after scalp block; T2: Measurement time 1 minute after Mayfield head pin insertion; T3: Measurement time 1 minute after skin incision; T4: Measurement time 1 minute after dura mater incision; T5: Measurement time after the surgical wound is covered with gauze

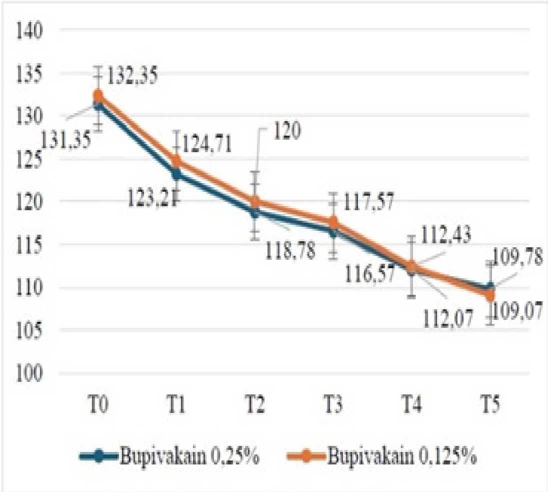

Figure.1 TDS monitoring graph

while in group 2 it had an average of 45.78 ± 11.45 years and there was no significant difference between the two (p = 0.813). There was no significant difference in other subject characteristics (p> 0.05). In the initial value (baseline) of hemodynamic variables, there was also no significant difference (p> 0.05) (Table 1). Difference in Systolic Blood Pressure (SBP between the 0.25% Bupivacaine Group and the 0.125% Bupivacaine Group. In both groups, there was a decrease in SBP values from T0 to T5. The results of the repeated ANOVA test in group 1 found a change in the mean SBP value with a p value = 0.002. The SBP value experienced a significant change T0 vs T1, T1 vs T2, T2 vs T3 and T4 vs T5 (p value <0.05). While in group 2, the results of the repeated ANOVA test found a significant change in the mean SBP value at each measurement time (p value = 0.002). The SBP value experienced a significant change at T0 vs T1, T1 vs T2, T2 vs T3 and T4 vs T5 in each group (p value <0.05). (Table 2)

Difference Diastolic Blood Pressure (DBP) between 0.25% Bupivacaine Group and 0.125% Bupivacaine Group

In both groups, there was a decrease in DBP values from T0 to T5. The results of the repeated ANOVA test in group 1 found a change in the mean DBP value with a p value = 0.002. The DBP value experienced a significant change T0 vs T1, T1 vs T2, T2 vs T3 and T4 vs T5 (p value <0.05). While in group 2, the results of the

Table 3. Comparison of Diastolic Blood Pressure (DBP) by time (T0-T5)

DBP	Group		P value
	1 (Bupivacaine 0.25%) Mean±SD	2 (Bupivacaine 0.125%) Mean±SD	
T0 (Baseline)	79.50±6.88	79.57±5.43	0.976a
T0 vs T1	0.000θ*	0.000θ*	
T1	75.78±5.56	76.64±4.79	0.666a
T1 vs T2	0.000θ*	0.001θ*	
T2	73 ±6.87	73.14±6.63	0.956a
T2 vs T3	0.021θ*	0.010θ*	
T3	70.35±6.14	71±4.47	0.754a
T3 vs T4	0.504θ	0.280θ	
T4	70±5.53	70.21±3.26	0.902a
T4 vs T5	0.000θ*	0.000θ*	
T5	66.71±5.22	67.14±3.37	0.799b
P Value	0.002b	0.002b	

Information: a) Independent t test; b) Repeated ANOV; θ) Paired t-test; *) is significant if p < 0.05.
T0: Measurement time before induction of anesthesia; T1: Measurement time 40 minutes after scalp block; T2: Measurement time 1 minute after Mayfield head pin insertion; T3: Measurement time 1 minute after skin incision; T4: Measurement time 1 minute after dura mater incision; T5: Measurement time after the surgical wound is covered with gauze.

Table 4 Comparison of Mean Arterial Pressure (MAP) by time (T0-T5)

MAP	Group		P Value
	1 (Bupivacaine 0.25%) Mean±SD	2 (Bupivacaine 0.125%) Mean±SD	
T0 (Baseline)	96.67±5.29	96.83±4.11	0.976a
T0 vs T1	0.017θ*	0.000θ*	
T1	91.35±4.71	92±3.68	0.691a
T1 vs T2	0.000θ*	0.000θ*	
T2	88±5.34	88.24 ±4.62	0.901a
T2 vs T3	0.008θ*	0.003θ*	
T3	85.59±4.99	86.02±3.19	0.789a
T3 vs T4	0.002θ*	0.001 θ*	
T4	83.78±4.84	83.66±2.43	0.935a
T4 vs T5	0.000θ*	0.000θ*	
T5	81.07±4.12	81.12 ±2.40	0.97a
P Value	0.004b	0.004b	

Information: a) Independent t test; b) Repeated ANOVA θ) Paired-t-test; *) is significant if p<0.05.
T0: Measurement time before induction of anesthesia; T1: Measurement time 40 minutes after scalp block; T2: Measurement time 1 minute after Mayfield head pin insertion; T3: Measurement time 1 minute after skin incision; T4: Measurement time 1 minute after dura mater incision; T5: Measurement time after the surgical wound is covered with gauze.

repeated ANOVA test found a significant change in the mean DBP value at each measurement time (p value = 0.002). The DBP value experienced a significant change at T0 vs T1, T1 vs T2, T2 vs T3 and T4 vs T5 in each group (p value <0.05). (Table 3)

Difference in Mean Arterial Pressure (MAP) between the 0.25% Bupivacaine Group and the 0.125% Bupivacaine Group

In both groups, there was a decrease in MAP values from T0 to T5. The results of the repeated ANOVA test in group 1 found that there was a change in the MAP value with a p value = 0.004. The MAP value experienced significant changes at T0 vs T1, T1 vs T2, T2 vs T3, T3 vs T4 and T4 vs T5 (p value <0.05). While in group 2, the results of the repeated ANOVA test found that there was a significant change in the MAP value at each measurement time (p value = 0.004). The MAP value experienced significant changes at T0 vs T1, T1 vs T2, T2 vs T3, T3 vs T4 and T4 vs T5.

Difference in Heart Rate between 0.25% Bupivacaine Group and 0.125% Bupivacaine Group

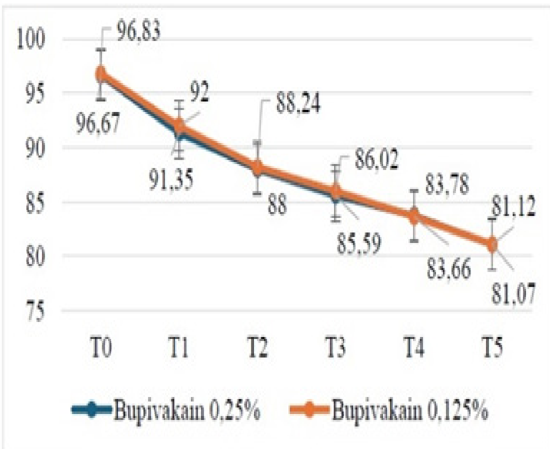

Figure 3 MAP monitoring graph

The results of the repeated ANOVA test in both groups found that there was a significant change in the mean HR value at each measurement time (p value = 0.045). In group 1, the results of the paired-t-test HR value experienced a significant decrease at T0 vs T1, T1 vs T2, T3 vs T4 and T4 vs T5 (p < 0.05). In group 2, the HR value

Table 5. Heart Rate (HR) Comparison by Time (T0-T5)

HR	Group		
	1 (Bupivacaine 0.25%) Mean±SD	2 (Bupivacaine 0.125%) Mean±SD	P value
T0 (Baseline)	84.14±9.54	84.71±5.06	0.845a
T0 vs T1	0.001θ*	0.000θ*	
T1	78.85±6.17	79.14±3.71	0.883a
T1 vs T2	0.001θ*	0.007θ*	
T2	74.78 ±6.97	75.43±4.58	0.776a
T2 vs T3	0.359θ	0.000θ*	
T3	74 ±7.36	72 ± 4.91	0.406a
T3 vs T4	0.000θ*	0.000θ*	
T4	70.71 ± 8.94	68.93±4.69	0.514a
T4 vs T5	0.021θ*	0.649θ	
T5	67.50± 8.19	68.43±4.29	0.710a
P Value	0.045b*	0.045b*	

Information: a) Independent t test; b) Repeated ANOVA θ) Paired-t-test; *)meaningful if p<0.05.
T0: Measurement time before induction of anesthesia; T1: Measurement time 40 minutes after scalp block; T2: Measurement time 1 minute after Mayfield head pin insertion; T3: Measurement time 1 minute after skin incision; T4: Measurement time 1 minute after dura mater incision; T5: Measurement time after the surgical wound is covered with gauze.

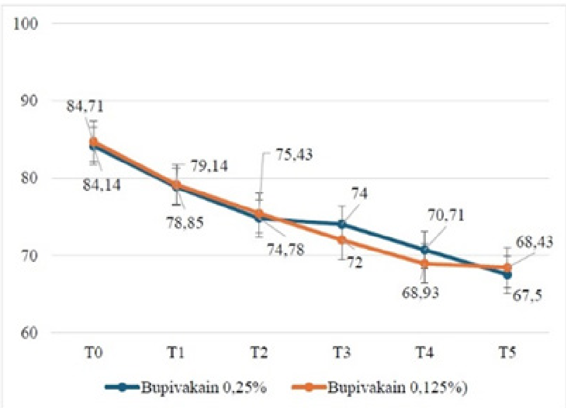

Figure 4 Monitoring graph *heart rate (HR)*

experienced a significant change at T0 vs T1, T1 vs T2, T2 vs T3, and T3 vs T4 (p < 0.05). (Table 5)

Analysis of Differences in Side Effects between the 0.25% Bupivacaine Group and the 0.125% Bupivacaine Group

In the study, no side effects were found from the local anesthetic buvipacaine between group 1 (buvipacaine 0.25%) and group 2 (buvipacaine 0.125%).

Analysis of Differences in Fentanyl Use between the 0.25% Bupivacaine Group and the 0.125% Bupivacaine Group

Determination of the cut-off value for the need for fentanyl use in both groups was analyzed using ROC curve analysis. it is obtained that the cut-off value of fentanyl is ≤ 300 as the proportion of the fentanyl divider in the 0.125% buvipacaine scalp block group with 0.25% buvipacaine in subjects undergoing craniotomy surgery to remove tumors with an area under the curve (AUC) of 0.582 (p = 0.393). Comparative test between group 1 (buvipacaine 0.25%0 and group 2 (buvipacaine 0.125%) showed all subjects (100%) in group 1 received fentanyl ≤ 300 mcg, while in group 2, 2 subjects (14.28%) received fentanyl > 300 mcg and 12 subjects (85.72%) received fentanyl ≤ 300 mcg. The results of the difference test obtained a p value> 0.05 with a relative risk (RR) of 0.462 (95% CI: 0.305-0.699).

Discussion

Overall, the characteristics of the subjects in this study included general characteristics of patients undergoing craniotomy surgery. There were no significant differences in characteristics between each group so that further analysis could be carried out in hemodynamic parameters. Hemodynamic changes that occur during craniotomy surgery are the main reason for this study. The characteristics of the subjects in this study were not much different from the characteristics of the subjects which examined the effect of scalp block between bupivacaine and levobupivacaine on hemodynamic responses during craniotomy.[6] In the study involving 90 subjects, the average age was in the range of 30–65 years (average 47–49 years), the number of men was 41%, the average body weight was 70–80 kg, the average height was 163–170 cm, and the average duration of surgery was 180–210 minutes. Study7 in 40 subjects who underwent craniotomy at the Mohammad Husein Hospital, Palembang, the characteristics were not much different, where 72.5% of patients who underwent craniotomy were in the 41–60 year age range, 72.5% of patients were women, 97.5% of patients were in the normoweight BMI category and 90% had a duration of surgery <4 hours.[7]

The incidence of hemodynamic instability during intraoperative is very high in both neurosurgery and gynecology. A study concluded that prolonged surgical procedures can affect hemodynamic instability. There is a correlation between the duration of surgery, patients who undergo surgical procedures for 4 hours or more are 3.8 times more likely to experience hemodynamic instability. Patients are exposed to anesthetic drugs, hypothermia, intraoperative blood loss, fluid loss and tissue stress during the surgical procedure. In neurosurgery, both trauma and emergency, the risk of increased intracranial pressure is very significant in patients with unstable hemodynamics. In intracranial tumor surgery, scalp block aims to prevent hemodynamic changes during scalp incision. The potential for morbidity that occurs with hemodynamic changes due to stress responses such as increased blood pressure and heart rate which have the effect of increasing the amount of blood flow to the brain which increases intracranial pressure (ICP).[8,9] The results of this study showed no significant difference in systolic and diastolic blood pressure (p>0.05). This result is in line with research before, which compared 0.25% bupivacaine scalp block and 0.125% bupivacaine scalp block with control (saline), where bupivacaine infiltration inhibited the hemodynamic response to craniotomy. A concentration of 0.125% bupivacaine epinephrine was as effective as 0.25% bupivacaine epinephrine in reducing the hemodynamic response to craniotomy.[10]

In this study, systolic blood pressure and diastolic blood pressure values were found to have significant values in measurements after scalp block was performed followed by head pin insertion (T2) and skin incision, then decreased significantly after the wound was covered with gauze (T5). These results are in line with study research before which administering a scalp block with buvipacaine can blunt the hemodynamic response in craniotomy surgery starting from the installation of the head pin.[5] In intracranial tumor surgery, scalp block aims to prevent hemodynamic changes during scalp incision.[5.10, 15,16]

In this study, the mean arterial pressure (MAP) and heart rate values experienced a significant decrease in measurements after scalp block was performed followed by head pin insertion (T2) and skin incision, then experienced a significant decrease after the wound was covered with gauze (T5). These results are in line with the research of before, which administration of scalp block with buvipacaine can blunt the hemodynamic response in craniotomy surgery starting from the installation of the head pin and shows a statistically significant decrease in MAP and heart rate in the control group during the period between scalp incision and dural reflection ($p < 0.05$).[5,10,15,16] Both 0.25% bupivacaine and 0.125% buvipacaine groups prevented the increase. MAP and heart rate during scalp incision and scalp reflex were significantly higher in the control group than in both bupivacaine groups ($P < 0.05$).[10] The increase during this time period is due to the insertion action of the noxious stimulus. The stimulus induces peripheral afferents responsible for transmitting pain (including A-delta and C- nerve fibers, as well as free nerve endings) throughout the nervous system of an organism. The stimulus then activates the autonomic nervous system, causing an increase in blood pressure and heart rate.[11–14]

The incidence of hemodynamic instability during intraoperative is very high in the field of neurosurgery. A study concluded that prolonged surgical procedures can affect hemodynamic instability. There is a correlation between the duration of surgery, patients who undergo surgical procedures for 4 hours or more are 3.8 times more likely to experience hemodynamic instability.[4,15] Patients are exposed to longer periods of anesthesia, hypothermia, intraoperative blood loss, fluid loss and tissue stress during the surgical procedure. In both trauma and emergency neurosurgery, the risk of increased intracranial pressure is significant in patients with unstable hemodynamics.[4,5,15,16] In this study, there were no side effects of seizures, hypotension, tachycardia or allergies to the addition of buvipacaine scalp block in each group of 0.125% bupivacaine and 0.25% buvipacaine during intraoperatively. Monitoring of hemodynamic changes was carried out as in general neurosurgical procedures that are measurable and directed and see changes in cardiotoxic, neurotoxic, allergic effects to local anesthetic drugs and the possibility of systemic toxicity from local anesthetic drugs or local anesthetic systemic toxicity (LAST).[17]

The side effects of the local anesthetic drug buvipacaine are influenced by several factors, such as in general the toxicity of local anesthetic use can be caused by systemic absorption, direct intravascular injection, shunting or inadvertent administration into certain places such as skull defects must be considered.[6.15] The plasma concentration of local anesthetics will increase according to the amount of vascularization of the head area compared to other neuronal block techniques, so that signs of local anesthetic toxicity can be seen immediately within the first

15 minutes after injection (absorption-related toxicity). This local anesthetic toxicity can be seen as seizures, hemodynamic instability causing cardiac arrest so that consideration must be given to the potential for nerve damage in intraneural injection due to pressure when administering local anesthetic drugs.[17–19]

In Thailand it is showed that the procedure of head pin placement in craniotomy is the most painful part, with the combination of general anesthesia and scalp block providing significant results in reducing opioid consumption and hemodynamic changes.16 The stress response to surgery is characterized by increased pituitary hormone secretion and activation of the sympathetic nervous system. Changes in pituitary secretion have secondary effects on hormone secretion from target organs. Hypothalamic activation of the sympathetic autonomic nervous system causes increased catecholamine secretion from the adrenal medulla and the release of norepinephrine from presynaptic nerve terminals. The main function of norepinephrine is as a neurotransmitter, but some is released from nerve terminals into the circulation. The effects of increased sympathetic nervous system activity and the release of some norepinephrine into the circulation will produce cardiovascular effects such as tachycardia and hypertension. These cardiovascular changes can cause increased intracranial pressure.[3,16,20]

The use of large doses of opioids has been shown to be effective in blocking stimulation in head incisions but has undesirable effects. Scalp block is an alternative option that can be combined with general anesthesia. Scalp block itself can blunt the stress response caused by craniotomy and can maintain unexpected hemodynamic stability. The addition of this scalp block can minimize the hemodynamic response to surgical stimulation, can reduce the use of intraoperative anesthetic drugs, and can reduce postoperative pain and postoperative opioid use so that postoperative recovery care is shorter with minimal side effects.[3,20] In theory, the multimodal analgesia technique approach to overcome post-craniotomy pain has been proven to be better. Injection of local anesthetic into the scalp can also block the conduction of sensory nerve impulses, prevent responses to head pin and incision insertion, reduce pain levels in the first hour after craniotomy, and provide better intra- and postoperative hemodynamic stability.[3,5,16] Overall, the evidence suggests that scalp block with 0.25% or 0.125% bupivacaine can attenuate hemodynamic responses. The results obtained from this study have been supported by existing evidence and literature. The weakness of this study is that this study only involved one hospital (single-centered) so it cannot be generalized to all populations. In addition, this study did not involve a control (placebo) as a comparison to the two treatment groups. Finally, this study did not follow up hemodynamic assessments of postoperative research subjects in the ICU.

Conclusion

This study shows that scalp block with bupivacaine either 0.25% or 0.125% provides good effectiveness in preventing hemodynamic responses caused by craniotomy tumor removal. Longitudinal studies involving a larger sample size are needed to represent the population and see the long-term effects of scalp block administration.

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