

Title: THE EFFECT OF BUPIVACAINE SCALP INFILTRATION ON THE HEMODYNAMIC RESPONSE TO CRANIOTOMY UNDER GENERAL ANESTHESIA

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INTRODUCTION: Skin incision for craniotomy under general anesthesia may be associated with significant increases in mean arterial blood pressure (MAP) and heart rate (HR). These increases may be expected to contribute to a higher incidence of morbidity and mortality, especially in the presence of cerebral vascular malformations and/or elevated intracranial pressure^{1,2}. We studied the effectiveness of local anesthetic infiltration of the scalp as a means of attenuating the hemodynamic response to craniotomy under general anesthesia.

METHODS: In accordance with institutional ethics and informed consent standards, forty two patients presenting for elective craniotomy for tumor within the cranial vault were studied. A standard narcotic/relaxant anesthetic technique was used with dose of agents determined by weight. ECG, HR, arterial wave form, and MAP were continuously recorded from induction of anesthesia to dural incision. Scalp infiltration was performed approximately five minutes prior to skin incision. Half of the patients received normal saline and half received 0.5% bupivacaine (plain) in a double blind randomized fashion. Elevations in MAP or HR of 20% or more over baseline were treated with additional narcotic, thiopental, or hydralazine. Eight events were identified for the purpose of comparison: 1-pre induction; 2-post intubation; 3-pre infiltration; 4-post infiltration; 5-post incision; 6-post scalp reflection; 7-craniotomy; 8-dural incision. MAP and HR data for each event was extracted from the polygraph tracings using a digital plotter and microcomputer to average the data over a period of one to three minutes. Statistical comparison between the study groups at each event was made using an unpaired t-test.

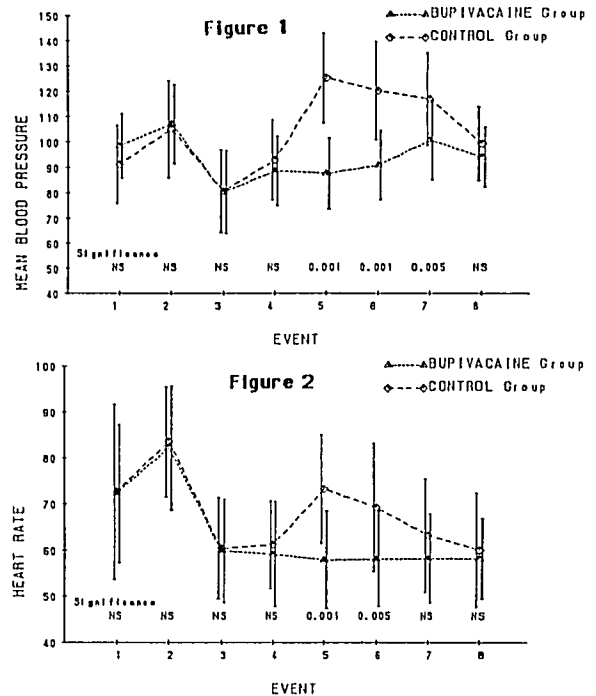
RESULTS: The two groups were well matched for age, weight, sex, and type of craniotomy. In the bupivacaine group 6.3 ± 3.2(SD) minutes elapsed between infiltration and incision and 16.4 ± 5.0(SD) ml of bupivacaine were infiltrated. MAP and HR data are shown in figures 1 and 2. No significant difference in MAP or HR occurred between the study groups from induction of general anesthesia through scalp infiltration. During scalp incision a marked difference developed between the saline group where hypertension and tachycardia occurred, and the bupivacaine group where there was little change in these parameters ($p < 0.001$). The differences in MAP ($p < 0.001$) and HR ($p < 0.005$) persisted during scalp reflection. Differences in MAP remained apparent during craniotomy ($p < 0.005$). There was no statistical difference between the groups at the time of dural incision. Eleven patients in the saline group, while none in the bupivacaine group, required supplemental opiate, thiopental, or hydralazine.

DISCUSSION: The notable cardiovascular stability seen in the bupivacaine group indicates that local scalp analgesia prior to craniotomy minimizes hemodynamic responses to skin incision. This stability is particularly advantageous in the management of patients with cerebral arterial aneurysms or arterial venous malformations who risk rupture and hemorrhage with abrupt changes in blood pressure and vessel wall tension. Attenuation of hemodynamic responses would also benefit patients with impaired cerebral autoregulation where intracranial pressure

tends to passively follow MAP. Other potential benefits include a decrease in surgical blood loss and a better oxygen supply/demand ratio in patients with coronary artery disease. The prevention of tachycardia and hypertension circumvents the need for antihypertensive treatments which may transiently produce hypotension and decrease cerebral perfusion pressure or disturb cerebral autoregulation. We conclude that local anesthetic infiltration of the scalp results in significantly enhanced cardiovascular stability during craniotomy under general anesthesia. Because it involves minimal effort, time, expense, or risk to the patient³, we recommend that it be undertaken prior to any operation within the cranial vault.

REFERENCES:

1. Lassen NA, Christensen HS: Physiology of cerebral blood flow. *Br J Anaesth* 40:719-34, 1976.
2. Shapiro HM: Intracranial hypertension: therapeutic and anesthetic considerations. *Anesth* 43:445-71, 1975.
3. Colley PS, Heavner JE: Blood levels of bupivacaine after injection into the scalp with and without epinephrine. *Anesth* 54: 81-4, 1981.



Figures 1 and 2 -- MAP (mmHg) and HR (min⁻¹) from induction of anesthesia to dural incision in the bupivacaine and saline (control) groups. Bars indicate ± one standard deviation.

Events: 1-pre induction; 2-post intubation; 3-pre infiltration; 4-post infiltration; 5-post incision; 6-scalp reflection; 7-craniotomy; 8-dural incision