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Scalp block for hemodynamic stability during neurosurgery

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Abstract

Background and Purpose: *For elective neurosurgery procedures maintaining perioperative hemodynamic stability and optimal cerebral perfusion is of outmost importance. Beside numerous anesthetics techniques, risk of hemodynamic instability is still very high.*

Materials and Methods: *We retrospectively analyzed perioperative values of heart rate and arterial blood pressure in 39 patients who underwent neurosurgery. We combined general anesthesia with scalp block. We blocked the supraorbital, supratrochlear, zygomaticotemporal, auriculotemporal, greater occipital, and lesser occipital nerves with 0,5% chirocaine, including 5 μg/mL of epinephrine that was performed after general anesthesia induction, before pin placement. Heart rate and blood pressure values were measured before anesthesia induction, after induction, after pins placement, after craniotomy and at the end of surgery. Changes of heart rate and blood pressure values less than 20% after painful stimuli was considered as a good hemodynamic stability of applied anesthetic technique.*

Result: *Scalp block was successfully performed in all patients without complications. Measured values of heart rate and blood pressure before and after anesthesia induction compered to values after painful stimuli were within the 20% change.*

Conclusion: *Scalp block, combined with general anesthesia provide good hemodynamic stability during neurosurgery.*

INTRODUCTION

For elective neurosurgery procedures maintaining perioperative hemodynamic stability and optimal cerebral perfusion is of outmost importance. Especially in patients with elevated intracranial pressure or scheduled for aneurysm repair. Although numerous anesthetics techniques are available the risk of hemodynamic instability at the very beginning of neurosurgical procedure during the placement of cranial pins of the head holder, craniotomy and dural incision is still very high *(1)*. Changes in blood pressure and heart rate could have adverse effect on patient cardiovascular system, intracranial pressure decreasing cerebral perfusion pressure and also could increase risk of aneurysm rupture *(2)*. One solution is high opioids techniques that could provide stress free anesthesia but has numerous drawbacks such as delayed emergence and incapability of early neurological evaluation after surgery. Combining regional anesthesia technique of scalp block just after induction of general anesthesia offers several advantages for most patients. Blocking the nerves that sensory innervates crania helps to blunt the hemodynamic response to noxious stimuli stabilizing intraoperative hemodynamics, decrease the amount of opioids and decrease postoperative pain allowing smooth and fast emergence with lower incidence of chronic pain *(3)*.

Scalp block is easily performed by direct local anesthetics infiltration at the typical anatomical places and most proximal points where nerves that sensory innervate scalp and forehead (supraorbital nerve, the supratrochlear nerve, the zygomaticotemporal nerve, the auriculotemporal nerve, greater and lesser occipital nerves) emerges from scull *(1)*. Preferably long acting local anesthetics such as ropivacaine 0.75% or levobupivacaine 0.5% are used supplemented with 5 µcg/ml epinephrine for reducing systemic resorption and to elongate the duration of block *(4)*. Scalp blocks proved useful during awake craniotomy and for supplementation of general anesthesia for other forms of craniotomy *(1, 5)*.

Adverse effects of scalp block are rare and include unintentionally motor nerve infiltration with extension of the anesthesia to the motor nerves, unintentionally intravascular injection systemic toxicity and unintentionally intrarticular and intramuscular injection of the pterygoid muscles that can block temporomadibulary joint with limited oral opening and trismus *(1, 2)*.

MATERIAL AND METHODS

In observational study we retrospectively analyzed perioperative values of heart rate and arterial blood pressure in 39 patients who underwent neurosurgery procedure in whom we combined general anesthesia with scalp block. We included patients who underwent elective neurosurgery for intracranial mass lesion and aneurysm or AV fistula repair, ASA I to III. All patients preoperatively signed informed consent and agreed with scalp block procedure. Exclusion criteria were previously cardiovascular medication, including beta blocker or antihypertensive therapy with previously known local anesthetics allergy. After patients arrived in operating theater standard neuroanesthesiamonitoring were placed (ECG, invasive arterial blood pressure under local anesthesia, pulse oximetry) and peripheral intravenous line was introduced. All patients underwent same anesthetics technique. Anesthesia induction was done with fentanyl and propofol. Endotracheal intubation was facilitated with vecuronium. Scalp block was performed according to modern technique described in literature after anesthesia induction because of better patients' comfort *(1)*. We blocked six sensory nerves at the typical anatomical places where they emerge from skull with direct infiltration of local anesthetic.

Supraorbital nerve was blocked as it emerges from the orbit. After identification of supraorbital notch the needle was inserted along the upper orbital margin perpendicular to the skin 1 cm medial to the supraorbital foramen. Supratrochlear nerve was blocked as it emerges from the superiomedial angle of the orbit finger's breadth medial to supraorbital nerve.

Auriculotemporal nerve was blocked over zygomatic process 1 to1.5 cm anterior to the ear at the level of the tragus. Before injection superficial temporal artery was identified anterior to the auriculotemporal nerve at the level of the tragus to avoid intravascular injection.

The zygomaticotemporal nerve emerges from scull above zygoma between supraorbital and auriculotempoal nerves. Nerve was blocked with infiltration from the supraorbital margin to the posterior part of the zygomatic arch with deep and superficial injection of local anesthetics because of its ramifying. The greater occipital nerve was blocked by infiltration of local anesthetic 2.5 cm lateral to the nuchal median line, halfway between the occipital protuberance and the mastoid process. Lesser Occipital Nerve was blocked by infiltration along the superior nuchal line, 2.5 cm lateral to the greater occipital nerve block.

As a local anesthetic, we used 0,5% chirocaine with addition of with 5 µcg/ml epinephrine. During each infiltration 2–5 ml was injected with previously checking for unintentionally intravascular injection. For anesthesia maintenance we used TIVA technique with propofoland fentanyl. Anesthesia depth was monitored with entropy. Scalp block effectiveness was evaluated through maintained hemodynamic stability during painful stimuli of surgery (pinsplacement and craniotomy). Heart rate and blood pressure values were measured for five times: Before anesthesia induction (T1), immediately after anesthesia induction (T2), after scalp block (T3), after placement of head pins (T3) after craniotomy (T4) and at the end of operation (T5). Changes in heart rate and blood pressure values before painful stimuli (T1 and T2) of more than 20% in contrast to values after painful stimuli (T3 and T4) was considered as hemodynamic instability and inadequate scalp block effectiveness for analgesia during painful stimuli. Data are presented as average and median values in tables and figure.

RESULT

Demographic data are shown in table 1. In all patients planned scalp block was successfully performed after anesthesia induction and before painful stimuli. Average fentanyl dose during surgery was 0, 21 mg. Scalp block 0,5% chirocaine dose was 20 ml in all patients. In all patients measured values of heart rate and blood pressure before (T1) and after (T2) anesthesia induction compered to values after painful stimuli (T3 and T4) were almost the same with minimal variation that not exceed 20% change (Table 2 , Figure 1). There were no complications associated with scalp block in any patients.

TABLE 1
Demographic data.

Patients number	39
Female	21
Male	18
Age (years)	46
Intracranial mass lesion	30
Vascular pathology	9

TABLE 2
Average (median) values of heart rate and arterial blood pressure.

Measurement	Heart rate (beats/min)	Blood pressure (mmHg)
T1 before anesthesia induction	70 (75)	124/68 (125/65)
T2 after anesthesia induction	68 (65)	123/68 (130/63)
T3 after pins placement	66 (68)	124/67 (110/65)
T4 after carniotomy	66 (68)	121/67 (113/65)
T5 at the end of surgery	67 (68)	119/67 (1110755)

DISCUSSION

Optimal neuroanesthesia technique for craniotomy should enabled intraoperative hemodynamic stability with good perioperative pain control to avoid acute or chronic postcraniotomy headache. The main cause of pain arises from the insertion of scull pins into the periosteum and craniotomy. Systemic application of opioids could blunt the stress responsebut used in high dose couldhave adverse effect of lowering blood pressure and delayed emergence *(2)*. Regional anesthesia techniques, as a supplement to general anesthesia, could offer advantages such as lower stress response, better hemodynamic stability and lower postoperative pain *(3, 5)*. Most commonly used is scalp block and local infiltration of local anesthetic at the wound and the site of pins insertion. Several papers have described the use of scalp block to limit the neuroendocrine and hemodynamic response *(2)*. Cardiovascular stability as well as pain control has shown positive findings in outcome of neurosurgical patients *(2, 4)*. In our study, we follow the systolic and diastolic blood pressure, heart rate and consumption of opioid in patients that underwent craniotomy in general anesthesia with scalp block. Scalp block is sensory blockade of scalp and forehead. According literature, scalp block is effective, simple to use, easy to learn, with known but rare side-effects *(1, 3)*. Various local anesthetics such as lidocaine, bupivacaine, ropivacaine, with or without adrenaline, could be used. Papers reports application of block preoperatively or postoperatively after wound closure *(1, 3, 5)*. Moderate to severe postcraniotomy pain is present in more than 50% of patient after craniotomy *(5)*. According meta-analysis from 2013, scull block is associated with reduced postoperative pain in the first 12 hours and also reduced requirements of analgetics in the first 24 hours *(3)*. On the other hand, use of analgetics in the neurosurgery is limited by their side effects. Guilfoyle et al discuss the advantages of blocks over the use of opioids (nausea, vomiting) and NSAID (often parallel use of steroids) *(3)*. They conclude that poor treatment of postoperative pain in neurosurgery patients can be overcome with scalp blocks.Local wound infiltration is another alternative to scalp block. Geze et al carried out prospective, randomized, placebo-controlled study (2). Authors compared scalp block, infiltration block, and routine anesthesia in craniotomy on hemodynamic (mean arterial pressure, heart rate) and stress response (cortisol and adrenocorticotropic hormone). They reported that scalp block had better results compared to local infiltration of each skull-pin insertion point or routine anesthesia *(2)*. It is easy to explain because scalp block provide much superior sensoryblockade of scalp and forehead while local wound infiltration provide only short lived analgesia of wound area. Our data showed excellent hemodynamic stability in all patients with combined regional anesthesia scalp block and general anesthesia. Almost identical measured values of heartrate and blood pressure could be explained with carefully titrated anesthetics dose with TIVA, selected group of patients withoutsignificant cardiovascular morbidity and excellent suppression of painful stimuli of pins placement and craniotomy with previously done scalp block thatblunt stressresponse. These results were found

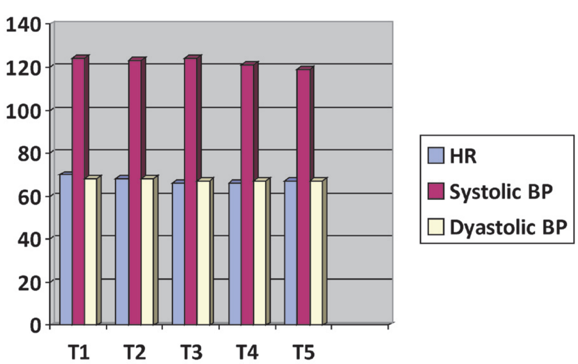

Figure 1. *Average heart rate (HR), systolic and diastolic blood pressure (BP) values.*

to be consistent with the results of other studies. In our study *(2, 4)* there were no complications associated with the block. According different authors, side effects of scalp block are rare *(1, 5).* The main problem can result from the fact that local anesthetics should be given in relatively high amount in very vascularized area. Thus, it cannot beemphasize enoughthe importance of carefully administration of local anesthetics, and caution about maximum doses. Our study also has several potential limitations. First, the small sample size with only descriptive comparison of results, but it was conceived as pilot study and it should be confirmed on larger number of patients with proper statistical analysis. Second, biological different sensation of pain among patients could influence measured values so in the future studies some preoperative evaluation of pain potency sensation could be appropriate.. And third, because of small group of patients, incidence of complication can be under-recognized. In conclusion, in our study scull block as adjunct to general anesthesia provided neurosurgical patients with excellent hemodynamic stability. Dose of 20 ml of chirocaine for blockade of sensory cranial nerves was required for adequate scalp block. With regular precautionary measures throughoutthe blockadministration, scalp block was safe for patients, Scalp block prior painful stimuli, combined with general anesthesia, and couldbe anesthesia technique of choice for maintaining optimal perioperative hemodynamic in neurosurgery.

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