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Clinical experience

Intermediate cervical plexus block for carotid endarterectomy in high risk patients

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Abbreviations
Intermediate cervical plexus block – ICB
Superficial cervical plexus block – SCB
Deep cervical plexus block – DCB

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Abstract

Background and Purpose: *Regional anesthesia is the choice for patients undergoing preventive open carotid surgery. Recently intermediate cervical plexus block has been described as a reliable and safe anesthesia technique in comparison with superficial and deep cervical plexus block. The aim of our study was to assess the complications of intermediate cervical plexus block in high risk patients.*

Materials and Method: *The study was performed in 29 ASA III and ASA IV patients with the intermediate cervical plexus block for carotid endarterectomy from January 2006 till November 2008 in the University Hospital Zagreb. The following data were collected: age, sex, ASA status and preoperative disease. Furthermore, intraoperative and postoperative complications associated with intermediate cervical plexus block and carotid endarterectomy were recorded.*

Results: *Median age was 69 years (range, 46 – 82 years). One patient developed Horner's syndrome, three patients developed transitory ischemic attack, one developed stroke intraoperatively and died, seven patients developed transitory hemodynamic instability, one was hypotensive in the postoperative period and required vasoactive support.*

Conclusion: *Intermediate cervical plexus block is safe and effective for carotid endarterectomy in high risk patients.*

INTRODUCTION

Stroke is the main cause of death of cerebrovascular disease. In 2002, 3660 women and 2661 men died of stroke in Croatia *(1)*. The stroke rate of mortality amounted to 142.5 per 100,000 (population) inhabitants for 2002. Open carotid surgery is the gold standard operation for patients with significant carotid artery stenosis *(2, 3, 4)*. This type of procedure has its own risk of perioperative mortality (5–7%) from myocardial infarction or stroke. On the other hand, it is a preventive procedure in a person who might have or might not have a stroke in the future.

Regional anesthesia is the choice for patients undergoing open carotid surgery. However, there is no consensus on which is the best anesthetic technique. Block of C2-C4 cervical nerve is required for carotid endarterectomy. DCB and SCB have a reliable analgesic effect. SCB is associated with low complication rate but ineffectively blocks neck muscles and therefore demands additional local blockade. On the other hand, DCB carries the risk of serious complications such as epidural, subarachnoid or vertebral artery injection and phrenic nerve block.

ICB neck muscles with a low complication rate. Cardiovascular stability and preserved cerebral autoregulation are the main advantages of regional anesthesia in contrast to general anesthesia, especially in high risk patients *(5, 6, 7)*.

Maintenance of adequate cerebral perfusion during the carotid clamping is the cornerstone of success. In the case of cerebral hypoperfusion, the insertion of a shunt has to be performed. The shunt itself carries a great risk of embolic incidents. Regional anesthesia resolves the problem of the cerebral perfusion monitoring, because the procedure can be performed on a conscious patient, enabling real time monitoring *(2, 5)*.

The aim of our study was to describe the complications of ICB in a group of high risk patients and to compare it with other regional techniques according to available literature data. We expected that this technique would be safe for patients with a low rate of complications.

MATERIALS AND METHODS

We conducted a retrospective clinical cohort study which included patients scheduled for carotid endarterectomy from January 2006 till November 2008 with ICB. All patients had signed informed consent of the hospital ethical committee. All patients were »high-risk« patients, ASA III and IV, because they had positive cardiovascular anamnesis of hypertensio arterialis, ischemic heart disease, or atrial fibrillation, and positive neurological anamnesis of cerebrovascular incident or transient ischemic attack with hemiparesis as a consequence in some cases, and vertigo.

They were premedicated with 10 mg of Morphine hydrochloride (MoHCl) intramuscularly 30 minutes before going into the operating theatre. For intraoperative monitoring we used ECG, pulse oxymetry, arterial line and PICC (Peripherally inserted central catheter) inserted through v. brachialis with central venous pressure monitoring.

While performing ICB, the patient's head was facing away from the side to be blocked. The landmarks were the mastoid process, posterior border of the sternocleidomastoideus muscle and Chassaignac's tubercle of C6. The needle was inserted at the posterior border of the sternocleidomastoideus muscle, at the midpoint of the line connecting the mastoid process with Chassaignac's tubercle of C6 transverse process, known as Erb's point or punctum nervosum, 1–1,5 cm perpendicular to the skin until a loss of resistance (past the investing layer of the deep cervical fascia) was obtained. We used the mixture of 30 mL 0,375% levobupivacaine (maximum dosage 2 mg/kg) + 2 mL of epinephrine 1:200 000. 10 mL of the mixture was injected at the insertion site. Next, using a »fan« technique with superior-inferior needle redirections, another 10 mL of the mixture was injected alongside the posterior border of the sternocleidomastoideus muscle 2–3 cm above and below the needle insertion site. Additionally, we performed mandibular branch block with 5 mL of 2% lidocaine (Lidocaine 2%) and a »field« block, consisting of subcutaneous midline injection of 5 ml of 2% lidocaine (Lidocaine 2%) extending from the thyroid cartilage to the suprasternal notch *(12, 13)*.

Intraoperatively any sedation was avoided because of neurological assessment during crossclamping. Real time monitoring of neurological function was performed by assessment of the patient's ability to squeeze a squeaky toy held in the hand during the operation on verbal command. Before clamping of the carotid artery preconditioning was performed by short- term occlusion of the carotid artery (2 minutes). When a transient ischemic attack occurred during crossclamping we applied high oxygen concentration to the patient through the oronasal mask. Hemodynamic instability was treated by volume and vasoactive therapy.

We recorded any new neurological deficit and periods of hemodynamic instability. New neurological deficit was defined as inability to squeeze a toy on verbal command, or as loss of verbal contact and/or consciousness. Hemodynamic instability was defined as a change in mean arterial pressure values by more than 30% and was monitored during clamping period and intensive care unit stay. Statistical analysis was performed using descriptive statistics.

Results are presented as absolute numbers, medians and percentages.

RESULTS

Twenty-nine patients with carotid endarterectomy performed in regional anesthesia were enrolled in this study. Clinical features of patients are presented in Table 1. Median age was 69 years (range 46–82 years). There were 19 men and 10 women. They were generally classified as ASA III (25/29) and 4 as ASA IV. All 29 patients had previous cardiovascular disease: 27/29 had hypertension, 10/29 patient had ischemic cardiac disease, 5/29 had cardiomyopathy, 4/29 had rhythm disturbances and 3/29 had valvular disease. Furthermore, 11/29 patients had stroke and 5/29 had transitional ischemic attack in their history.

Median duration of carotid clamping was 27 minutes (range, 14–38 minutes). Intraoperative and postoperative complications are listed in Table 2. One of patients had Horner's syndrome. Four patients had neurological dysfunction from cerebral ischemia after carotid clamping, in whom immediately shunt was inserted. Three patients developed transitory ischemic attack, which recovered quickly after shunting operated carotid artery and stroke in one patient. The patient with intraoperative stroke also had atrial fibrillation, respiratory insufficiency and died on the 14th day. Seven patients had transient hemodynamic instability during cross clamping that resolved spontaneously. One patient was hypotensive and required vasoactive support for four hours postoperatively.

The median time for intensive care unit stay was 24 hours. The exception was the patient with stroke, who stayed for 14 days.

DISCUSSION

Although regional anesthesia is a well established technique for carotid artery surgery with clear benefit of real time cerebral function monitoring and identification of the patients that need shunt insertion, it can still be associated with serious complications, especially DCB. Inherent intravascular or subarachnoidal injections of local anesthetics during DCB may produce serious complications such as brain stem anesthesia, blockade of phrenic, recurrent laryngeal, vagus nerves and Horner's syndrome. SCB has much less serious complications than DCB but is very frequently performed in conjunction with it because of the better block quality. Recently recognized ICB combined best features of traditional two regional technique: simplicity, reliability and low complication rate.

In our short study ICB proved to be an efficient and safe anesthesia technique in high risk patients. Block was successful and easy to perform in all patients and no patients experienced inadvertent intravascular or subarachnoidal injection. Diffusion of local anesthetics under deep cervical fascia, recently described in the literature, successfully blocks nerve roots and surgeons had satisfactory conditions during operations, with no patient discomfort *(12)*. Horner's syndrome in one patient was a consequence of local anesthetic deep spreading through the nerve roots. Other studies with ICB describe low incidence of Horner's syndrome and is more associated with DCB. In our study Horner's syndrome is probably the result of either injected volume or unusual neck anatomy.

The percentage of new neurological deficit was comparable to other studies in which it varies from 5–7 % *(2, 6)*. Neurological complications are consequences of well-known pathophysiologic events during carotid surgery, well described in the literature *(2, 5)*. One patient experienced stroke with permanent neurological deficit and three patients experienced transient ischemia attack that resolved without consequences after shunt placement. Although clamping of the carotid artery and inadequate collateral circulation can cause cerebral ischemia, almost 60 % of perioperative stroke is related to embolic events during shunt placement *(2)*. Cerebral ischemia in our patients with TIA was probably the consequence of inadequate collateral circulation that could be found in 15% of the patients *(2)*. Because of regional anesthesia technique in the majority of patients we avoided the most frequent cause of cerebral ischemia – embolization *(2)*. In patients with TIA shunt placement returned blood flow and resolved cerebral ischemia. However, in one patient the blood flow through the shunt was probably insufficient, or embolization occurred and the patient developed permanent neurological deficit that is also described in the literature *(2)*.

That particular patient had symptoms of vertigo preoperatively that could have been a sign of impaired vertebrobasillary circulation and bilateral carotid occlusion (left 90% and right 70%). Also the patient suffered from generalized atherosclerosis and cardiomiopathy with atrial fibrillation and experienced transient hemodynamic instability with hypotension after clamp placement. All those factors can impair cerebral perfusion *(2, 5, 6, 11)*. Recent literature has also shown that patients with bilateral occlusion of the carotid artery have indication for regional anesthesia, because of better neurological monitoring than in general anesthesia *(6)*. Controversies exist if the neuroprotection with general anesthetics and decreased cerebral metabolic demand can diminish ischemic damage, and the latest GALA study, failed to show clear benefit of regional versus general anesthesia for carotid surgery *(6)*. In high risk patients, general anesthesia poses a greater risk of cardiovascular and pulmonary function depression and possible, even greater, hemodynamic instability, in comparison to regional anesthesia that is well described in the literature, although larger clinical trials are needed to answer this question *(2, 5)*.

In our study there were no serious cardiovascular complications. This is in compliance with the literature, because regional anesthesia better prevents perioperative stress response, the main cause of cardiovascular complications *(2, 5)*. Temporary hemodynamic instability in seven patients during cross clamping resolved in all patients spontaneously or with a bolus dose of vasoactive drugs, without any consequences. All those patients had significant cardiovascular risk factors preoperatively and blood pressure variation was probably a consequence of mechanical manipulation of carotid baroreceptors by surgeons *(2)*. The patient who required vasoactive therapy for 4 hours postoperativly had generalized peripheral vascular disease and previously operated aortobifemoral bypass, and possibly lower blood pressure values could have been the result of impaired blood pressure autoregulations and local aesthetic absorption, although hemodynamic instability resolved with no adverse consequences. Low cardiovascular complication rate is in

TABLE 1

Clinical features of patients.

Patient characteristics	Number of patients (29)
Age (median, range)	69 (46–82)
Male	19 (65.5%)
Female	10 (34.5%)
Preoperative disease	
Ischemic heart disease	10 (34.5%)
Cardiomyopathy	5 (17.2%)
Valvular disease	3 (10.3%)
Rhythm disturbances	4 (13.8%)
Hypertension	27 (93.1%)
Stroke	11 (37.9%)
TIA	5 (17.2%)
ASA status	
III	25 (86.2%)
IV	4 (13.8%)

TABLE 2

Perioperative complications.

	Number of patients (percent)
Complications	
Horner's syndrome	1 (3.4%)
Stroke	1 (3.4%)
TIA	3 (13,4%)
Transient hemodynamic instability	7 (24.1%)
Hypotension	1 (3.4%)
Conversion to GA	0 (0%)
Shunt	4 (13.8%)
ICU stay (median, range)	24 hours (1–14 days)

compliance with literature date and is mainly the consequence of local anesthetic action and of avoidance of general anesthesia action on the cardiovascular system *(11)*. The limitations of our study were the small number of patients and differences in preoperative risk factors that could influence postoperative complications.

Our study showed that ICB is a safe and efficient regional anesthesia technique, providing good hemodynamic stability with low neurological complication rate in high risk patients.

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