Comparison of Combined (Deep and Superficial) and Intermediate Cervical Plexus Block by Use of Ultrasound Guidance for Carotid Endarterectomy

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Objectives: **Carotid endarterectomy under regional anesthesia may be performed by using superficial, intermediate, deep or combined cervical plexus block. The authors compared the combined and intermediate cervical plexus block by use of ultrasound guidance in patients undergoing carotid endarterectomy.**

Design: **A prospective, randomized, double-blinded trial.**

Setting: **Education and research hospital.**

Participants: **Adult patients undergoing carotid artery surgery.**

Interventions: **Forty-eight patients were randomized to receive either combined cervical plexus block (deep plus superficial) or intermediate cervical plexus block by use of ultrasound guidance for carotid endarterectomy. The primary outcome measure was the amount of supplemental 1% lidocaine used by the surgeon. Secondary outcome measures were the time for the first analgesic requirement after surgery, block-related complications, postoperative visual analog scale score, and patient and surgeon satisfaction.**

Measurements and Main Results: **Intraoperative supplemental lidocaine requirements were 3.0 ± 1.9 mL in the combined-block group and 7.8 ± 3.8 mL in the intermediate block group. These differences were statistically significant. There were no significant differences between the 2 groups in block-related complications and the time between the block completion and the first administration of the first dose of intravenous analgesic. In the combined-block group, maximum visual analog scale score was lower at 3 hours (2.2 [1-5] *v* 5.3 [3-8]), and patient satisfaction score was higher than the intermediate-block group (4.3 [3-5] *v* 3.1 [1-4]). One regional anesthesia procedure was converted to general anesthesia in the combined-block group.**

Conclusions: **Ultrasound-guided combined cervical plexus block compared to intermediate cervical plexus block led to less additional analgesic use, lower visual analog scale score, and higher patient satisfaction.**

KEY WORDS: regional anesthesia, cervical plexus block, carotid endarterectomy, ultrasound guidance

CAROTID ENDARTERECTOMY (CEA) under regional anesthesia requires blockade of the C2-4 cervical nerves. This may be performed by using superficial cervical plexus block (CPB), intermediate CPB, deep CPB, or combined (deep plus superficial) CPB.[1] Deep CPB has been associated with a variety of complications such as injection of local anesthetic (LA) into the vertebral artery, intrathecal injection, and respiratory failure/distress.[2] Intermediate CPB refers to an injection of LA in the space between the superficial and deep cervical fasciae.[3] Theoretically, the intermediate CPB can be expected to reduce the complications of deep CPB.[4] Ultrasound-guided regional anesthesia in CEA is rapidly expanding. The main advantages of ultrasound techniques applied to regional block include a direct view of nerves, LA spreading during injection, reduced volume of LA, avoid inadvertent damage or accidental puncture of vessels, and greater patient satisfaction.[5] Ultrasound-guided intermediate CPB (US-ICPB) may be performed by the anterior or posterior approach. To date, 1 study has described the technique of US-ICPB for carotid surgery using the anterior approach and reported it easier to perform than the posterior approach.[6] Ultrasound-guided deep CPB (US-DCPB) may allow direct spread of the anesthetic injection around the cervical nerve plexus and a reduction of complications due to entrapment of the LA in the paravertebral space.[7] The vertebral artery and the C2-4 spinal nerves are in close anatomic proximity, and mapping of the vertebral artery allows accurate needle placement during deep CPB.[8] No study has described the efficacy of ultrasound-guided combined CPB (deep plus superficial) in the CEA.

The aim of this study was to evaluate the influence of ultrasound-guided regional anesthetic techniques (combined CPB and intermediate CPB) in patients undergoing carotid surgery.

METHODS

This study was prepared through the application of the guidelines of The Declaration of Helsinki and evaluated and approved by the ethics committee of the Education and Research Hospital, Antalya, Turkey (No. 46/14). All patients gave their written informed consent to take part in the study.

The primary aim of this study was to investigate the difference in the amount of supplemental lidocaine used by the surgeon for adequate analgesia in patients who underwent surgery under combined and intermediate CPB. The secondary aim was to investigate the difference of the incidence of adverse events in these groups such as time for the first analgesic requirement, block-related complications (intravascular or intrathecal injection, hoarseness, dysphagia, cough, facial palsy, Horner's syndrome), VAS scores, patients' and surgeons' satisfaction.

Power analysis was performed on use of supplemental lidocaine between the combined and intermediate CPB groups. Considering the previous studies, study size estimation was based on the minimum clinically important difference between two blocks using 40 mg of supplemental lidocaine, more than the block for which less supplemental lidocaine dose is used.[9,10] Therefore, more than 42 participants (21 per group)

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were found to be sufficient for detection of significant difference of observed parameters within the groups with the power of at least 0.80 and a significance level of 0.05. Hence, 24 patients per group were included to replace any dropouts.

Forty-eight adult patients undergoing carotid endarterectomy were randomized into 2 groups by means of draw numbers placed in envelopes: combined CPB and intermediate CPB groups. Patients with contraindications for the blockade (local infection, coagulation disorders) and hypersensitivity to the local anesthetics used were excluded.

Upon the patient's arrival to the operating room, a peripheral venous line was established. Standard monitoring included invasive blood pressure (via 20G catheter in the radial artery of the arm contralateral to the surgery), 5-lead electrocardiograph, and pulse oximetry. Patients were premedicated with 0.015 mg/kg IV bolus of midazolam, 5 minutes before the block. Oxygen therapy was administered with a nasal cannula during all procedures. All cervical plexus blocks were performed by the same anesthesiologist experienced in these techniques. A blunt-end 22-gauge 50-mm needle (Stimuplex® A, B. Braun Melsungen AG, Germany) was used for the blocks. The advantage of using this type of needle was a blunt end and ability to inject with minimal movement of the needle tip. Electrical stimulation was not used for any blocks. The total dose of 0.5% bupivacaine used was designed to be 1.9 mg/kg.

For the deep part of the combined block, skin was cleared with chlorhexidine. Patients were positioned supine and the head rotated to the contralateral side of the blockade. Using an ultrasound machine (Mindray DC-T6 Diagnostic Ultrasound System, Shenzhen, China), the 10-MHz probe with sterile cover was placed along a line joining the mastoid process and Chassaignac's tubercle. Chassaignac's tubercle (transverse process of C6) was palpated at the level of the cricoid cartilage. After obtaining a static sonoanatomic view, the probe was moved caudally from the mastoid process until the vertebral artery loop was visible. Colour Doppler was also used to locate the vertebral vessels, and the second cervical transverse process was identified at the transverse plane. A 22 × 50-mm needle was advanced near 1 mm to 2 mm to the transverse process, and 5 mL of 0.5% bupivacaine was injected after negative aspiration for blood. Afterwards, the probe continued to move caudally, the third and fourth cervical transverse processes were viewed, respectively, and 5 mL of 0.5% bupivacaine was injected in to the transverse processes of the 3rd and 4th cervical vertebrae.

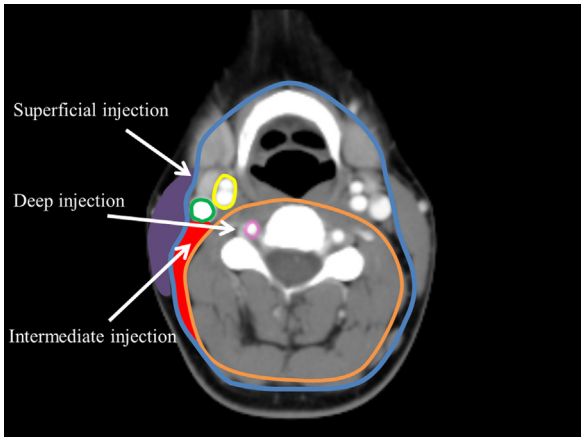

Fig 1. Axial scan of neck. Superficial (investing) layer of the deep cervical fascia (blue line); deep layer of the deep cervical fascia (orange line); sternocleidomastoid muscle (purple area); posterior cervical space (red area); carotid bifurcation (yellow line); internal jugular vein (green line); vertebral artery (pink line).

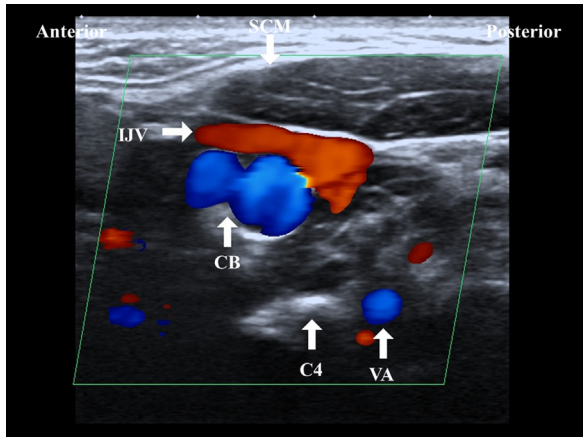

Fig 2. Transverse color Doppler ultrasound image of the neck at the C4 level. SCM, sternocleidomastoid muscle; IJV, internal jugular vein; CB, carotid bifurcation; VA, vertebral artery.

For the superficial part of the combined block the needle was retracted to underneath the muscle at the level of the fourth cervical transverse process, and 10 mL of 0.5% bupivacaine was injected, with clear visualization, under the posterior border of the sternocleidomastoid muscle (Fig 1).

Intermediate CPB was performed using an anterior approach. For this block, the skin was cleaned with chlorhexidine. Patients were positioned supine, and their heads were turned 20° to 30° to the opposite side. The ultrasound probe in the transverse position was positioned just above the clavicle and moved cranially to reveal the carotid bifurcation. Color Doppler was used to verify the location of the carotid bifurcation at the level of the fourth cervical transverse process (Fig 2). At the anterolateral border of the neck, the needle was advanced in-plane through the sternocleidomastoid muscle. After negative aspiration of blood, 10 mL of 0.5% bupivacaine was injected posterolaterally to the carotid bifurcation. Afterwards, the needle was retracted slightly beneath the sternocleidomastoid muscle, and 10 mL of 0.5% bupivacaine was injected. Then, with subcutaneous infiltration of 5 mL of 0.5% bupivacaine along the incision line, the block was completed.

In all patients, sensory loss to pinprick in the C2-4 dermatome distribution was confirmed before the first incision, and the initiation time to surgery after injection was recorded.

All endarterectomy procedures were performed by 3 senior vascular surgeons. Mental status of patients was assessed with verbal questions and answers, whereas motor functions were assessed by squeezing the stress ball that was placed into the hand on the opposite side of the operated side during surgery. Following surgical field dissection, test occlusion of the carotid artery was performed on all the patients. The patients were