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CASE REPORT

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Use of intermediate cervical plexus block in carotid endarterectomy –an alternative to deep cervical plexus block: a case series

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Abstract

Introduction Carotid endarterectomy is performed for patients with symptomatic carotid artery occlusions. Surgery can be performed under general and regional anesthesia. Traditionally, surgery is performed under deep cervical plexus block which is technically difficult to perform and can cause serious complications. This case series describes 5 cases in which an intermediate cervical plexus block was used in combination with a superficial cervical plexus block for Carotid endarterectomy surgery.

Methods Five patients who were classified as American Society of Anesthesiologists 2–3 were scheduled for Carotid endarterectomy due to symptoms and more than 70% occlusion of the carotid arteries. The procedures were carried out in the University Teaching Hospital- Peradeniya, Sri Lanka. All patients were given superficial cervical plexus block followed by intermediate cervical plexus block using 2% lignocaine and 0.5% plain bupivacaine.

Results Adequate anesthesia was achieved in 4 patients, and local infiltration was necessary in 1 patient. Two patients developed hoarseness of the voice, which settled 2 h after surgery. Hemodynamic fluctuations were observed in all 5 patients. No serious complications were observed. All 5 patients had uneventful recoveries.

Discussions Regional anesthesia for CEA is preferable in patients who are medically complicated to undergo anesthesia or in patients for whom cerebral monitoring is not available. Intermediate cervical plexus block is described for thyroid surgeries in literature, but not much details on its use for carotid surgeries. Deep cervical plexus blocks has few serious complications which is not there with the use of ICPB making it a good alternative for CEA surgeries .

Conclusions Superficial cervical plexus block and intermediate cervical plexus block can be used effectively for providing anesthesia for patients undergoing Carotid endarterectomy. It is safe and easier to conduct than deep cervical plexus block and enables monitoring of cerebral function.

Keywords Intermediate cervical plexus block, Carotid endarterectomy, Superficial cervical plexus block

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Background

Stroke ranks as the fifth most common cause of mortality globally. Approximately 10–20% of strokes are caused by carotid artery disease [1]. Because of the predominant turbulent flow at the level, atheromatic plaques develop at the bifurcation of the internal and external carotid arteries [2]. The underlying cause of the symptoms of cerebral ischemia is severe stenosis, embolism, or thrombosis, which will give rise to a clinical picture of stroke and transient ischemic attacks in the territory of the middle cerebral artery and momentary mono-occular blindness or complete blindness in the territory of the ocular artery [1, 2].

Carotid endarterectomy (CEA) is indicated for symptomatic patients. This surgery can be performed under regional anesthesia or general anesthesia. The GALA trial, which compared general anesthesia and regional anesthesia, showed no difference in primary or secondary outcomes following CEA [3]. Therefore, the choice of anesthesia should be individualized according to the patient.

Regional anesthesia for carotid endarterectomy (CEA) provides the advantage of monitoring cerebral functions during surgery. Traditionally, deep cervical plexus blocks have been used for this purpose. This block is technically difficult and can have complications. In contrast, an intermediate cervical plexus block is a technically easy block to perform with fewer complications [4]. The block has been widely used for neck surgeries such as thyroidectomies but rarely described for CEA [5]. We report successful use of ultrasound-guided intermediate cervical plexus block combined with superficial cervical plexus block for CEA with possible complications.

Materials and methods

This case series included 5 patients who underwent CEA at the University Teaching Hospital, Peradeniya, Sri Lanka from 1st of June 2023 to 31st of March 2024. The procedure, advantages and risks of the procedure were explained to all 5 patients, and written informed consent was obtained. All patients belong to ASA 2 category where well controlled co-morbid diseases were present. Patients were educated about the intraoperative assessment of memory, speech, and motor functions. All the patients were kept nil orally for 6 h before surgery, and anxiolytic premedication was performed with oral diazepam. The data collection was done prospectively at each stage of the surgery.

In the theatre, intravenous access was established, and standard monitoring commenced. Arterial blood pressure monitoring was commenced using radial arterial catheters. Cervical plexus blocks were performed by a consultant anesthetist experienced in the technique. For both blocks, patients were positioned in the lateral position with the operative side up. Ultrasound-guided superficial cervical plexus block (SCB) was performed in all patients as the first block using a linear high-frequency probe (6–14 MHz) with 2 ml of 2% Lignocaine and 2 ml of 0.5% plain bupivacaine. Local anesthetics were deposited underneath the tapering end of the sternocleidomastoid. Three to five minutes later, an intermediate cervical plexus block was performed on the same patient. The SCB was performed first for the comfort of the patient allowing anaesthesia on the region of needling site of the ICB. The transducer probe was placed transversely at the Cricoid cartilage level, and the block needle was advanced in the plane beneath the sternocleidomastoid muscle toward the carotid sheath. C4 level was avoided as inadvertent punctures may occur at the site of carotid bifurcation which is the commonest site for atheroma formation. After confirming negative aspiration, 8 ml of 0.5% plain bupivacaine and 5 ml of 2% lignocaine were injected beneath the mid-bulk of the sternocleidomastoid after piercing the investing layer. Figure 1 shows ultra sound anatomy related to deposition of local anaesthetics.

Surgeries were commenced 10–20 min after the completion of the intermediate cervical plexus block. Patients were placed in a supine position for surgery, and standard intraoperative monitoring and monitoring for complications were performed. Higher functions were assessed using pre prepared questions to assess memory, and commands were given to assess the motor functions of contralateral upper limb. Surgery was abandoned if any of the motor or higher functions were affected. All patients could understand the commands and responded appropriately.

Continuous intra arterial blood pressure monitoring was done in all patients. Systolic, diastolic and mean arterial pressures were monitored. A change in blood pressure more than 30% from baseline is regarded as a significant fluctuation. Blood pressure fluctuations were observed in all 5 patients intraoperatively, and patient 3 required IV labetalol 5 mg to 20 mg for blood pressure control. IV labetalol was used according to unit protocol to reduce blood pressure and prevent tachycardia. All patients were observed in the high dependency unit (HDU) during the immediate postoperative period, and no complications were noted. Two patients who developed hoarseness regained their normal voice within 1–2 h after surgery. All 5 patients were discharged from the HDU after 24 h.

Results

Table 1 summarizes the characteristics of the patients, pathology results, block characteristics and complications in the intraoperative period.

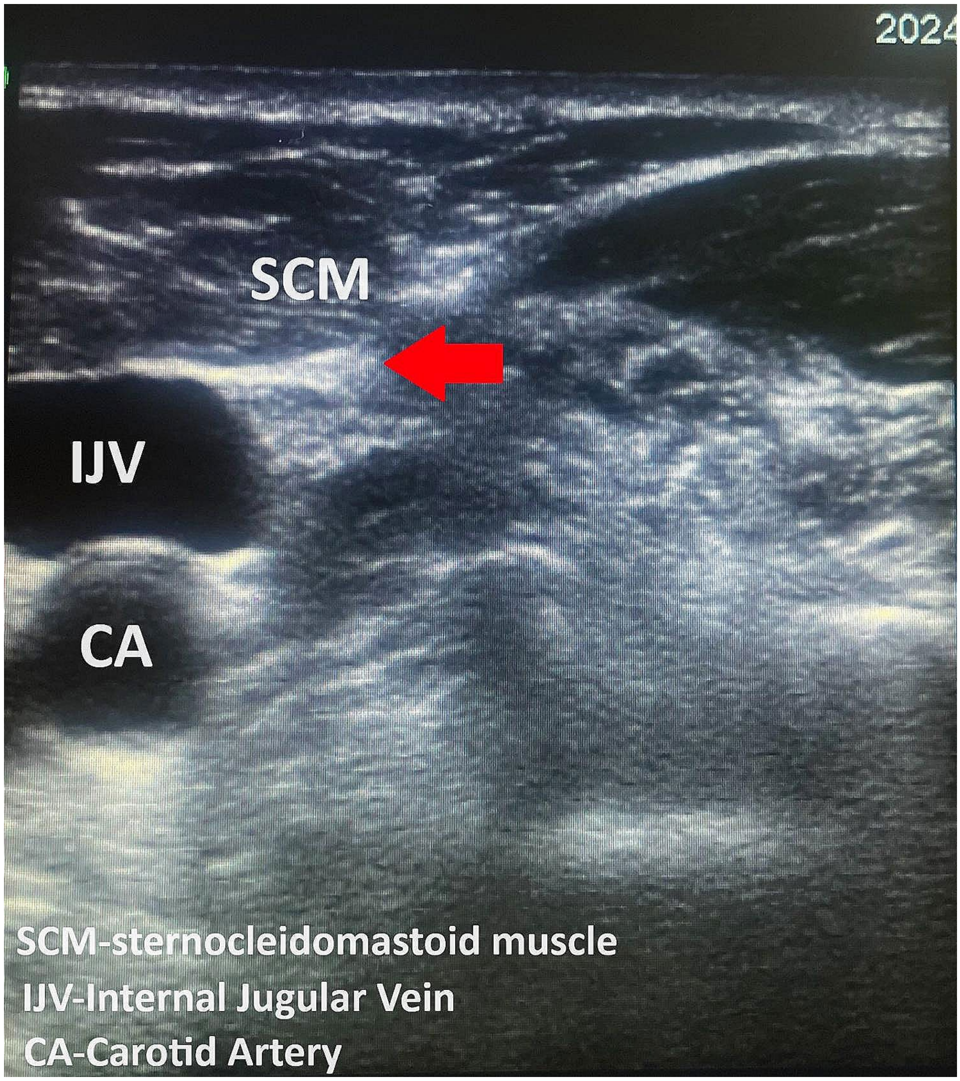

Fig. 1 The red arrow shows the area of local anaesthetic deposition

Table 1 Characteristics of the patients, pathology results, block characteristics and complications in the intraoperative period

Patient number	Carotid duplex finding	Comorbidities	Complications due to block	Supplementation of local anesthetics of IV sedation needed	Total clamp time	Duration of surgery (In mins)
Patient 1	70% stenosis of L/ICA	Hypertension IHD	Hoarseness of voice	None	29 min	65 min
Patient 2	80% stenosis of L/ICA	Hypertension	None	IV Fentanyl 100 µg	15 min	45 min
Patient 3	70% stenosis of LCA	Hypertension IHD- PCI done	Hoarseness of voice	None	23 min	60 min
Patient 4	70% stenosis of LCA	Hypertension	None	IV Fentanyl 100 µg	20 min	55 min
Patient 5	70% stenosis of RCA	Hypertension	Inadequate requiring additional supplemental local anesthesia	IV Fentanyl 100 µg	20 min	65 min

The results of our case series point out several key observations. Two patients (40%), both with 70% stenosis of the left carotid arteries and similar comorbidities including hypertension and ischemic heart disease (IHD), experienced hoarseness of voice as a postoperative complication, despite not requiring additional anesthesia beyond the intermediate cervical block.

In contrast, other three patients(60%), each with hypertension, did not develop hoarseness postoperatively despite receiving IV Fentanyl supplementation along with local anesthetics. Duration of surgery, ranges from 45 to 65 min, while total clamp time ranges from 15 to 30 min.

Discussion and conclusions

Carotid endarterectomy is performed to prevent embolic strokes in patients with significant carotid stenosis. The North American Symptomatic Endarterectomy Trial (NASCET) and the European Carotid Surgery Trial (ECST) are two large, randomized trials that compared surgery with best medical management [6, 7]. Combined, the data from both studies revealed 16% and 4.6% reductions in the absolute risk of stroke for more than 5 years when carotid occlusion was >70% and >50%, respectively. NASCET indicates surgery once the occlusion is >50%, and ECST indicates surgery when the occlusion is >70%. Both criteria suggest performing surgery within two weeks of symptom onset for greatest risk reduction. Five patients included in this case series had symptomatic carotid obstructions of more than 70%, making them suitable for carotid endarterectomy.

CEA can be performed under general anesthesia (GA) or regional anesthesia (RA). The GALA trial, which compared GA vs. RA, showed no difference in primary or secondary outcomes following CEA [3]. Therefore, the choice of anesthesia should be individualized according to the patient. Most centers utilize GA for this procedure [8]. The advantages of GA over RA include better control of CO_2 and hemodynamic parameters [3, 9]. Patients who are unable to lie flat or who have chronic cough cannot undergo RA for CEA. GA is indicated for these patients.

RA has the advantages of enabling continuous neurological monitoring during surgery and being able to be performed in patients who are not fit for GA. Poor patient compliance, movement of the surgical site due to patient movement, inability to proceed in claustrophobic patients and patients with respiratory symptoms/cough, anxiety-related effects (tachycardia, hypertension, myocardial ischemia, elevated cerebral metabolic rate), risk of conversion to GA and risks associated with regional block are the disadvantages associated with RA [10, 11]. In contrast, GA reduces the cerebral metabolic rate, hence reducing oxygen consumption. However, other means of monitoring cerebral perfusion, such as electroencephalogram, jugular venous oxygen tension, transcranial Doppler and carotid artery stump pressure, are needed. Most centers may not have the facilities to monitor these functions, and they will not detect subtle changes in consciousness. Therefore, the choice of GA vs. RA has to be individualized.

The available methods for accessing the RA are cervical epidural, posterior cervical paravertebral block and cervical plexus blocks. The first two are not commonly used due to their significant side effects [12]. Common choices for cervical plexus blocks for CEA are superficial blocks alone or a combination of superficial and deep blocks. These are supplemented by direct infiltration of tissue planes by the surgeon as they dissect. Studies have shown that there is no significant difference between the two types of blocks with regard to the amount of local anesthetic supplementation.

The anatomy of the cervical plexus and fascial sheaths in the neck is complex, but it is important to study when disease spread, infection and regional anesthesia are considered [13]. The cervical plexus is situated between the longus capitis and the middle scalene muscles. Two nerve loops, formed by the union of the anterior spinal nerves from C2 to C4, give off four superficial sensory branches: the lesser occipital (C2, C3), great auricular (C2, C3), transverse cervical (C2, C3), and supraclavicular nerves (C3, C4); these branches initially run posteriorly and soon pierce the prevertebral fascia [14, 15]. These nerves pass through the prevertebral muscles and reach the skin at the posterior border of the sternocleidomastoid muscle. The deposition of local anesthetics at this point is considered a superficial cervical plexus block (SCB) that provides adequate analgesia in most neck surgeries.

A deep cervical plexus block (DCB) is performed at the paravertebral space targeting the C2-C3 nerve roots. This can be performed as a single shot or three different injections [13, 16]. Despite providing adequate analgesia, this block can cause serious complications. Phrenic nerve palsy, intravascular injections to major neck vessels, and epidural and subarachnoid injections are among these complications. The use of ultrasound can minimize some of these complications [17].

Intermediate cervical plexus blocks (ICPB) are relatively underused for neck surgeries. It was first described in 2004 by Telford and Stoneham [18]. The ICPB is the area where the deep cervical plexus penetrates the prevertebral fascia and branches deep to the sternocleidomastoid muscle to migrate to the superficial cervical plexus. This block has been widely used in patients undergoing thyroidecyomy for postoperative pain relief [16]. Few cases of its use for CEA have been reported [4, 5]. The ultrasound technique can be used as an anterior approach or a posterior approach. There are studies describing the use of the posterior approach and anterior approach of ICPB for carotid surgery [4, 5]. We used the posterior approach, keeping the patient in the lateral position and allowing free space for mobilization of the needle. Traditionally ICPB is performed at the level of C4. But we performed at the level of C6, that is at the level of the cricoid cartilage. This level was selected to avoid the C4 level as most carotid plaques occur at the level of carotid bifurcation, which is located at C4 and in case of inadvertent arterial puncture, we could disturb the plaque. However with the use of 8 ml of anaesthetic solution, we could see the adequate spread up to C4 level.

In contrast to the literature, we used a combination of superficial and deep cervical plexus blocks for carotid surgeries. On some occasions, the ICPB may not cover the area supplied by the marginal mandibular nerve, which can cause discomfort to the patient due to the use of retractors during surgery. The SCBPs cover this area. None of our patients complained of pain due to the use of retractors.

The operative field of the CEA lies inside the carotid sheath. The carotid sheath is composed of a tight fibrous band that is less penetrative to substances, particularly infections [9]. However, it has been shown that local anesthetics penetrate through the sheath to provide anesthesia. This makes RA a favorable option for CEA. ICPB deposits local anesthetics close to the carotid sheath, enabling adequate anesthetics.

In comparison to DCPB, ICPB is relatively easy block to perform and can be done with single injection whereas DCPB may require 3 injections at different levels. The ICPB is not associated with sinister complications like epidural or subarachnoid injections or accidental vertebral artery injection which may affect the continuation of surgical procedure. Considering these factors ICPB is a safe and easy option than DCPB.

We observed fluctuations in hemodynamics during surgery in all patients. A randomized controlled trial will show whether these changes are significant in comparison to those in GA. This would be a good area to explore in further studies.

The aim of this case series is to show the adequacy of combination of SCPB and ICPB to perform CEA and to analyse the potential complications associated with it. In conclusion, ICPB in combination with SCPB provides adequate anesthesia for CEA surgeries and can be used safely in compromised patients who do not withstand GA or in situations where cerebral monitoring is not available. The SCPB is relatively easy to perform and is not associated with serious complications like intra cranial spread or phrenic nerve palsy as in DCPB. However, further studies are needed to compare the hemodynamic effects and complications of the block compared to those of GA and DCPB.

Abbreviations

CEA	Endarterectomy
HDU	High dependency unit
NASCET	North American Symptomatic Endarterectomy Trial
ECST	European Carotid Surgery Trial
GA	General anesthesia
RA	Regional anesthesia
ICPB	Intermediate cervical plexus blocks
SCPB	Superficial cervical plexus block
DSPB	Deep cervical plexus block

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A.R., A.A., B.S., J.R., S.S., R.P. analyzed and interpreted the patient data and A.R. and C.B. were the main contributors in writing the manuscript. All authors read and approved the final manuscript.

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Data is provided within the manuscript.

Declarations

Consent to participate
Written informed consent has taken before participation.

Consent for publication
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Competing interests
The authors declare no competing interests.

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