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Research Article / Araştırma

Ultrasound-Guided Erector Spinae Plane Block for Carotid Endarterectomy: A Case Series

Karotis Endarterektomisi İçin Ultrason Rehberliğinde Erektor Spina Plan Bloku: Olgu Serisi

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ABSTRACT

Objectives: Erector spinae plane (ESP) block can be used for post-operative analgesia following thoracic, abdominal, and lumbar surgeries. Furthermore, it can provide complete surgical anesthesia in some procedures at cervical or thoracic regions. The case series describes use of ESP block in 12 patients who underwent carotid endarterectomy (CEA).

Methods: Data were analyzed from 12 patients. Patient characteristics, carotid clamping time, duration of surgery, number of patients requiring intraoperative supplemental local anesthetic, amount of additional local anesthetic administered by the surgeon, opioid requirements during the surgery, time to first requirement for analgesia in intensive care unit, pain scores, post-operative analgesic consumption, and hospital stay were recorded from the patients' medical chart.

Results: Nine of 12 patients required intraoperative supplemental 2% lidocaine. The median (interquartile range [IQR] [range]) volume of lidocaine used for supplemental infiltration was 6 (5-9 [3-12]) ml. A total of 10 (83.3%) patients requested analgesia in the first 24 h postoperatively. The median (IQR [range]) time of first analgesic requirement postoperatively was 8 (5-10.5 [1-12]) h. Mean hospital stay was 3.1±0.6 days.

Conclusion: Although erector spina plane block alone cannot provide complete surgical anesthesia in CEA, it can be used as an alternative to other regional anesthesia techniques in combination with relatively low-dose local anesthetic supplementation, as well as contributing to post-operative analgesia.

Keywords: Anesthesia, carotid endarterectomy, erector spinae plane block, post-operative analgesia

ÖZ

Amaç: Erektor spina plan bloku torasik, abdominal ve lomber cerrahiler sonrası postoperatif analjezi amacıyla kullanılabilmektedir. Ayrıca servikal veya torasik bölgelerdeki bazı cerrahi işlemlerde intraoperatif anestezi sağlayabileceği de bildirilmiştir. Bu olgu serisinde, karotis endarterektomisi yapılan hastalarda erektor spina plan bloku uygulaması rapor edilmektedir.

Yöntem: Toplam 12 hastanın verileri analiz edildi. Demografik veriler, karotis klemp süreleri, ameliyat süreleri, intraoperatif ek lokal anestezik gereksinimi olan hasta sayısı, intraoperatif ek lokal anestezik miktarı, opioid gereksinimi, postoperatif ilk analjezik gereksinim zamanı, postoperatif ağrı skorları, postoperatif analjezik tüketimi ve hastanede kalış süreleri kaydedildi.

Bulgular: Verileri analiz edilen 12 hastanın 9'unda (%75) intraoperatif ek lokal anestezik ihtiyacı oldu. İntraoperatif ek lokal anestezik medyan [IQR [min-max)] değeri 6 (5-9 [3-12]) mL olarak tespit edildi. Toplam 10 (%83,3) hastada postoperatif analjezi gerekti. Postoperatif ilk analjezik gereksinimi medyan (IQR [min-max]) süresi 8 (5-10,5 [1-12]) saat olarak tespit edildi. Ortalama hastanede kalış süresi 3,1±0,6 gündü.

Sonuç: Karotis endarterektomisinde erektor spina plan bloku tek başına intraoperatif dönemde tam bir cerrahi anestezi sağlayamasa da postoperatif analjeziye katkısının yanı sıra nispeten düşük doz lokal anestezik takviyesi ile kombinasyon halinde diğer bölgesel anestezi tekniklerine bir alternatif olarak kullanılabilir.

Anahtar sözcükler: Anestezi, erektor spina plan bloku, karotis endarterektomisi, postoperatif analjezi

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Introduction

Although there is no definitive evidence whether regional anesthesia for carotid endarterectomy (CEA) is superior to general anesthesia, regional anesthesia is preferred in many centers because of the advantages of strict monitoring of brain functions, preservation of cerebral and systemic autoregulation, adequate cerebral perfusion pressure, and a lesser need for carotid shunt.[1] Local anesthetic infiltration may be used by the surgeon for this purpose to anesthetize the tissues layer by layer in addition to a formal regional anesthetic technique such as cervical plexus block.

Erector spinae plane (ESP) block has been used effectively for post-operative analgesia following surgery of the thoracic, abdominal, and lumbar regions.[2] It has also been reported that ESP block has provided complete surgery anesthesia at cervical and thoracic levels for procedures such as excising an abscess on the neck,[3] shoulder disarticulation,[4] chest wall,[5] and breast surgery.[6]

We report our experience with the ESP block to manage intraoperative and post-operative pain in patients who underwent CEA.

Methods

The case series included 12 patients who underwent CEA under local anesthesia and received ESP block for intraoperative and post-operative analgesia. Data were obtained from the clinical records of the patients. Ethical approval for the study was provided by the Ethical Committee of Antalya Training and Research Hospital, Antalya, Turkey (approval number 2020-322 18/12). Written informed consent was obtained from all patients. Patients were eligible to receive ESP block if they were aged >18 years and were willing to have regional anesthesia. Patients were not offered ESP block if they had a history of bleeding diathesis, local tissue infection in the block area, local anesthetic allergy, or spinal deformity.

On arrival in the operating room, a peripheral intravenous catheter was inserted. Monitoring included 5-lead electrocardiography, pulse oximetry, invasive blood pressure through a radial artery catheter inserted in the contralateral side to the operation, and frontal regional cerebral oxygen saturation. Oxygen therapy was administered with a nasal cannula during all procedures. Ultrasound-guided ESP blocks were performed at the level of T2. A Mindray DC-T6 ultrasound machine (Diagnostic Ultrasound System, Shenzhen, China) with a 10 MHz linear probe and a blunt-end, 22-gauge, 100 mm needle (Stimuplex A, B. Braun Melsungen AG, Germany) were used for the blocks. After the local anesthetic infiltration of the superficial tissues, the needle was advanced in-plane to the ultrasound beam in a caudal-to-cephalad direction to pass through the trapezius, rhomboid, and erector spinae muscles with the patient in a right or left lateral position (Fig 1a). After confirming the correct position of the needle tip, a total of 20 ml of 0.5% bupivacaine were administered (Fig 1b). Sensory examination was performed with ice to determine a

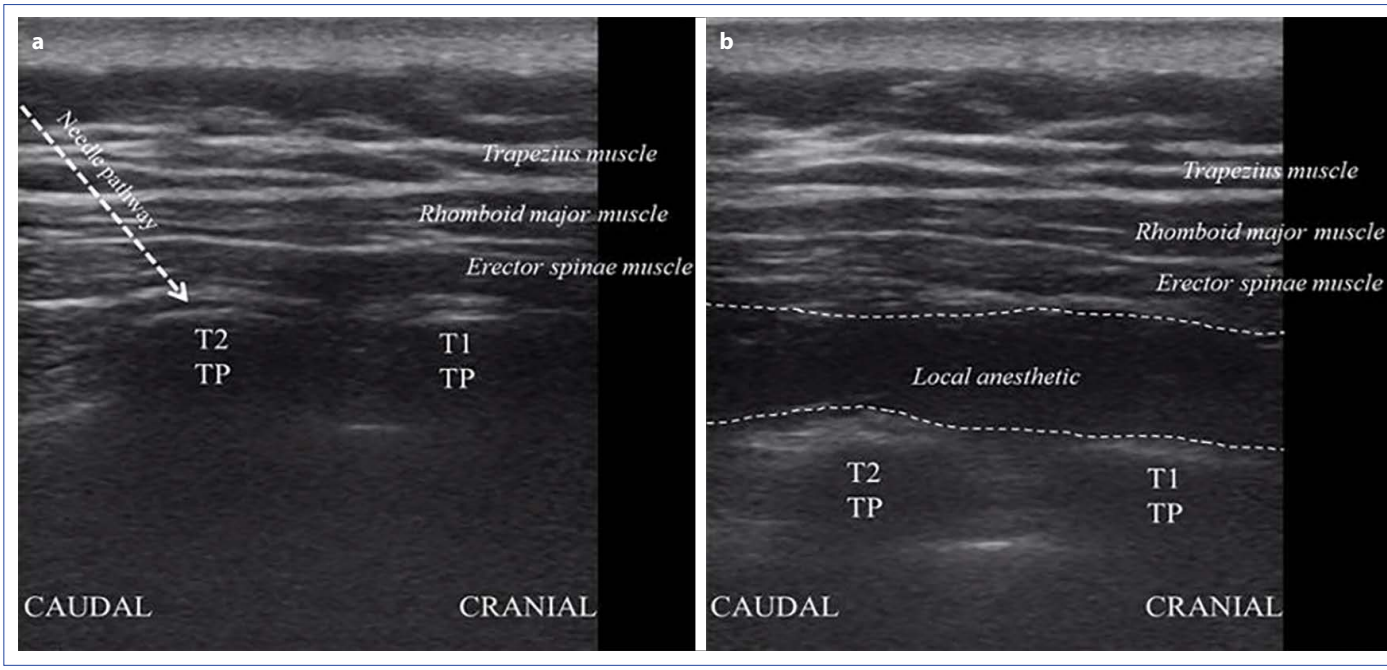

Figure 1. (a) Ultrasound image of the erector spinae plane block. The needle trajectory is illustrated by the dotted line. **(b)** Spread of local anesthetic in the plane between erector spinae muscle and transverse process.

TP: Transverse process.

loss of cold sensation over the C3-4 to T4-5 dermatomes. When the patient reported discomfort and the visual analog scale (VAS) score exceeded 3/10 during the procedure, infiltration of boluses of lidocaine 2% in 1 ml aliquots was administered to the surgical area by the surgeon. If intraoperative pain persisted despite repeated doses of lidocaine, supplemental intravenous (IV) analgesia with fentanyl was given. It was planned to avoid intravenous sedation during the procedure. However, if it was necessary to alleviate anxiety, 0.01-0.03 mg/kg of IV midazolam was given for mild sedation, from which it was easy to awaken the patient.

During the clamping of the carotid artery, a brief neurological assessment was performed to assess the need for shunting. The mental status of the patient was assessed with verbal questions and answers. Motor functions were assessed by having the patient squeeze a stress ball that was placed in the hand contralateral to the operated side during surgery. Surgical treatment was continued without intraluminal shunt if no change was observed in mental status evaluation, including speech, general cognition, and motor functions. After an arteriotomy made between below the plaque in the common carotid artery and normal intima above the plaque in the internal carotid artery, plaque was extracted.

Postoperatively, the patients were transferred to the cardiovascular intensive care unit (ICU) and closely monitored with invasive arterial blood pressure, heart rate, pulse oximetry, and neurological status for the first 24 h. Post-operative pain assessment was performed hourly in the first 24 h. When the VAS score exceeded 3/10, IV tramadol 50 mg was administered.

Statistical Analysis

Data obtained in the case series were analyzed statistically using SPSS version 24 software (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean±standard deviation or median (interquartile range [IQR] [range]) values and categorical data as absolute frequencies and percentages.

Results

Data of a total of 12 patients who underwent CEA and received ESP block were analyzed for this case series. The characteristics of the patients are shown in Table 1. Of the 12 patients, 9 (75%) required intraoperative supplemental 2% lidocaine. The median (IQR [range]) volume of lidocaine used for supplemental infiltration was 6 (5-9 [3-12]) ml. Intraoperative fentanyl was required by 3 (25%) patients, all of whom received intraoperative supplemental lidocaine. These three patients also received midazolam for mild sedation. A total of 10 (83.3%) patients requested analgesia in the first 24 h postoperatively, 3 (25%) patients in the first 6 h postoperatively, and 7 (58.3%) patients after the post-operative 6th h. The amount of post-operative tramadol consumption was at median 50 mg (IQR: 50-100 [range 0-100] mg). No other analgesic was provided to any patient within 24 h. The first post-operative analgesic requirement was at median 8 h (IQR: 5-10.5 [range, 1-12] h). The post-operative pain scores are presented in Figure 2. The mean carotid clamping time was 25±9.8 min and duration of surgery was 85.9±15.1 min. There were no post-operative complications that could be directly associated with the ESP block. No procedure was converted to general anesthesia. No ma-

Table 1. Patient characteristics (values are stated as mean±standard deviation or number and percentage)

Characteristics	n	%
Age (years) (mean±SD)	68.5±10.3	
Gender		
Male	9	75
Female	3	25
Weight, kg, (mean±SD)	76.2±11.1	
Height, cm (mean±SD)	174.2±8.7	
Pre-operative ASA status		
ASA II	4	33.3
ASA III	8	66.7
Side of surgery		
Left	7	58.3
Right	5	41.7
Comorbidities		
Arterial hypertension	10	83.3
Diabetes mellitus	9	75
Coronary artery disease	7	58.3
Chronic obstructive pulmonary disease	3	25

ASA: American Society of Anesthesiologists.

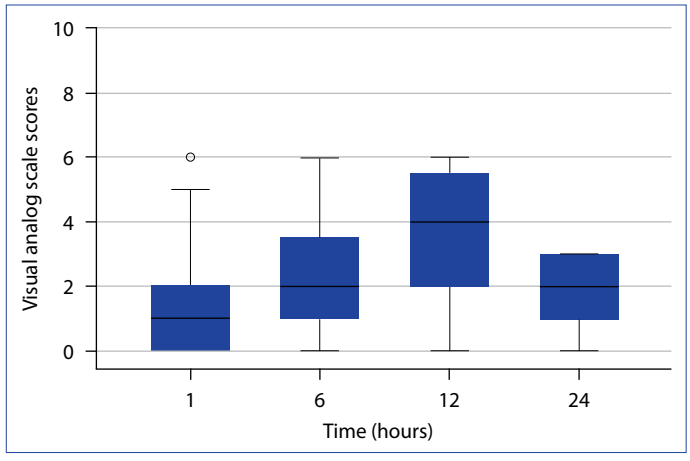

Figure 2. Box plot of post-operative visual analog scale scores.

jor neurological deficits or perioperative mortality were observed in any patient. All patients were discharged to the surgical ward the day after surgery. The mean hospital stay was 3.1±0.6 days.

Discussion

The results of this case series demonstrated that ESP block for CEA could provide effective analgesia for an average of 8 h postoperatively. ESP block alone did not provide complete surgical anesthesia except for a few patients. However, it was observed that it could provide a smooth intraoperative course with relatively low-dose intraoperative local anesthetic supplementation in majority of the patients.

In this case series, while the surgery was completed without the need for supplemental local anesthetic in three of 12 patients, nine of the 12 patients required supplemental local anesthetic. The median (IQR [range]) volume of supplemental 2% lidocaine was 6 (5-9 [3-12]) ml in patients who required additional local anesthetic administered by the surgeon. Although it seems to suggest that this represents a high intervention rate and ESP block alone is not adequate in the majority of patients, there are many studies reporting the use of similar or higher rates or amounts of supplemental local anesthetic during regional techniques for CEA.[7-9] It has been reported that maximum recommended dose for plain solution of lidocaine is 5 mg/kg and with ephedrine 7 mg/kg, for plain solution of bupivacaine is 2 mg/kg and with ephedrine 3 mg/kg. When local anesthetic combinations are used, the dose of each agent should be reduced because of the additive risk for local anesthetic systemic toxicity (LAST).[10] Although only two patients received infiltration of 2% lidocaine administered to the surgical area by the surgeon at a dose as high as 10-12 ml in addition to ESP block, amount of lidocaine and bupivacaine used was less than maximum recommended doses, and no patients were observed a sign of LAST in the current case series.

Sensory loss was observed between C3-4 and T4-5 following ESP block in this case series. The previous studies have reported that if the ESP block is performed at the upper thoracic region, branches of spinal nerves, not only in the thoracic region but also in the cervical region, are anesthetized.[3,11] Ueshima et al.[12] reported two cases where ESP block was used for CEA. In the first of these, a patient who underwent CEA under general anesthesia, post-operative analgesia was not required after ESP block. In the second case, it was reported that ESP block alone, without general anesthesia, provided sufficient intraoperative anesthesia and post-operative analgesia. In both cases, ESP block was performed with 20 ml of local anesthetic and the analgesic range was confirmed from C2-3 to T5. This situation, which is consistent with the results of the present study, may be related to the layers of cervical fascia that both act to support internal structures of the neck and help to compartmentalize structures of the neck, and the spread of local anesthetic between these layers. As it is associated with the structures of the neck, the prevertebral layer is of clinical significance in the ESP block performed at the high thoracic or cervical level. Although there is insufficient evidence about whether local anesthetic reaches the prevertebral layer when the ESP block is performed at the high thoracic level, Elsharkawy et al.[13] showed in a cadaver study that the injectate spreads up to the prevertebral layer after cervical ESP block. Consequently, the possible spread of local anesthetic after ESP block performed at the high thoracic level may affect the cervical plexus, which could explain the efficacy of ESP block in CEA.

There are different opinions about whether there will be paravertebral spread of local anesthetic after ESP block. However the weight of evidence clearly shows that the local anesthetic spreads into the paravertebral space after ESP block.[14] It is possible that local anesthetic enters the paravertebral space through the superior costotransverse ligament, which has an accessory ligament known as the posterior costotransverse ligament. As the posterior costotransverse ligament is absent or rudimentary at the T1-6 levels, the superior costotransverse ligament is more permeable to infiltration above the T6 level.[15] Accordingly, after ESP block performed at T2 level, if diffusion of local anesthetic into the paravertebral space can reach the cervical region, it can also affect the cervical plexus, which is located in the cervical paravertebral space. However, this needs to be confirmed by anatomic or imaging studies.

The current case series has some limitations. First, lack of a comparator group and small sample size limit the value of statistical analysis. Although no complications were observed in this case series, it is not possible to generalize as to whether the ESP block for CEA is reliable due to the limited number of patients. A second limitation was that factors including the position of the patient, injection speed of the local anesthetic, needle gauge, and volume of local anesthetic can theoretically affect the distribution of local anesthetic, and this study was not designed to evaluate the effects of these factors. Finally, some publications have reported that when radiocontrast dye was injected during ESP block performed at T2-T3 level, computed tomography imaging showed the spread of radiocontrast up to the C3 level.[11] As there were no radiocontrast dye injection and imaging technique such as computerized tomography to characterize the spread of the injectate in these cases, whether there was any spread of injectate to the paravertebral or epidural space could not be evaluated.

Conclusion

The results of this case series showed that ESP block can be an alternative to other regional anesthesia techniques for CEA by providing post-operative analgesia as well as a smooth intraoperative course with a relatively low-dose intraoperative local anesthetic supplementation. Nevertheless, further randomized controlled studies are required to confirm the results of this study.

Disclosures

Ethics Committee Approval: The study was approved by The Antalya Training and Research Hospital Clinical Research Ethics Committee (Date: 26/11/2020, No: 2020-322 18/12).

Informed Consent: Written informed consent was obtained from all patients.

Peer-review: Externally peer-reviewed.

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