ORIGINAL ARTICLE

Effects of catheter orifice configuration (triple-hole versus end-hole) in continuous infraclavicular brachial plexus block on analgesia after upper limb surgery

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ABSTRACT

BACKGROUND: The configuration of a nerve block catheter may affect the local anesthetic spread in epidural analgesia and continuous peripheral nerve blocks. This prospective and randomized study aims to compare the multi-orifice nerve block catheter with an end-hole catheter in ultrasound-guided continuous infraclavicular brachial plexus block (BPB) in terms of providing postoperative analgesia for the orthopedic upper limb surgery below the shoulder. The primary outcome measure was mean pain scores. Secondary outcome measures were the consumption of rescue analgesic and the amount of local anesthetics delivered by a Patient-Controlled Analgesia (PCA) device.

METHODS: A total of 58 adult patients who underwent orthopedic upper limb surgery below the shoulder were randomly assigned into two groups: group end-hole catheter (EHC) (n=31) and group multi-orifice catheter (MOC) (n=27). All patients received a single-shot infraclavicular BPB using 100 mg lidocaine 2% and 75 mg bupivacaine 0.5% administrated through a Tuohy needle. Then, a multi–orifice (triple-hole) nerve catheter was placed in the group MOC and an end-hole (one-hole) catheter in the group EHC at the same location. Bupivacaine 0.125% was infused through the catheters via PCA (infusion rate: 2 mlh^{-1}, automated regular bolus: 5 mlh^{-1}, patient-controlled bolus: 3 ml, lock-out time: 1 hour, 4 hours limit: 40 ml). Pain intensity was evaluated using a visual analogue scale (VAS).

RESULTS: Mean VAS scores were higher in group EHC than group MOC in the first postoperative day (p=0.001). Mean rescue analgesic consumption, the number of bolus demand on PCA, PCA bolus demand dose, and total PCA dose were higher in group EHC than group MOC during the first postoperative day (p<0.05).

CONCLUSION: It is concluded that the use of MHC is more effective than EHC for continuous infraclavicular brachial plexus blocks in providing postoperative pain relief during the first 24 hours.

Keywords: Brachial plexus block; catheter; infraclavicular; postoperative analgesia; ultrasound.

INTRODUCTION

Peripheral nerve blocks (PNBs) are increasingly used as a sole anesthetic technique or as an adjunct to general anesthesia.[1] The introduction of the ultrasonography (US) allows real-time visualization of the target nerve, interfascial planes, as well as the needle, the catheter, and the spread of the local anesthetic (LA) during the procedure.[2] These advantages increase the safety and quality of the postoperative analgesia. Thus, continuous PNBs became a crucial part of the multimodal analgesic regimen in recent years.[1,2]

Like the dose of a LA, its spread around a nerve is important for a successful block. Several factors may affect LA spread, including the configuration of the catheter, the position of the catheter relative to the nerve, and the flow

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rate of the LA through the catheter.[3] The catheter should be positioned, so its orifice(s) is/are close to the nerve and the catheter threading distance, that is, the catheter's length past the tip of the cannula, should avoid displacement and coiling after insertion.[4] There are controversies about the catheter threading distance, but it was reported that a distance between 1–3 cm is optimal and >5 cm increased the risk of catheter coiling.[4]

There are two types of PNB catheters in use: multi-orifice catheter (MOC) and end-hole catheter (EHC). MOCs are found to be superior to the EHCs in epidural analgesia due to a better spread of LA and providing alternative flow channels if one orifice obstruct.[5] However, only three studies exist in the literature that compares catheter configurations regarding postoperative analgesia in continuous PNBs.[4,6,7] In the first study, a MOC was compared with an EHC in continuous supraclavicular blocks and found superior to the EHC, but the catheter threading distances were different between study groups.[4] In the other two studies, no differences in postoperative analgesia were reported between catheters used for supraclavicular and femoral nerve blocks with similar catheter threading distances.[6,7]

Epidural analgesia studies showed that the flow rate affects the LA spread from multi-orifice catheters. They function like end-hole catheters on a flow rate lower than 80 mlh^{-1}. The flow was double or multi-orifice in a flow rate of 100–150 mlh^{-1} and multi-orifice if the flow rate is higher than 400 mlh^{-1}.[8] Since high flow rates cannot be provided with a continuous infusion, automated regular boluses (ARB) with minimum 5ml (flow rate of approximately 100–150 mlh^{-1}) was recommended.[9]

US-guided continuous infraclavicular brachial plexus block (BPB) is generally preferred in our clinic for the upper extremity surgery below the shoulder due to a lower incidence of complications, including pneumothorax, phrenic nerve palsy, and Horner's syndrome.[10] Both MOCs and EHCs are frequently used to provide perioperative anesthesia and analgesia. Similar to the interscalene groove, the posterior, median and lateral cords of the brachial plexus are located around the axillary artery in the infraclavicular region. This allows a sufficient spread of the LAs to the brachial plexus, which results in a rapid onset of the block with a high success rate in single- bolus injection and continuous infusion.[10] The present study aims to compare postoperative analgesia between multi-orifice and end-hole nerve catheters in the continuous infraclavicular brachial plexus blocks in patients undergoing orthopedic upper limb surgery below the shoulder. The primary outcome measure was postoperative pain scores. The secondary outcome measures were the comparison of rescue analgesic consumption, bolus and total doses of local anesthetics administered through the nerve catheter using patient-controlled analgesia (PCA).

MATERIALS AND METHODS

Study Design

This single-center, prospective and randomized study was conducted in the operating theatres of the University of Health Sciences Gülhane Training and Research Hospital between 17.10.2019 and 31.3.2020 after the hospital's ethics committee approval (date: 12.10.2019, protocol no.19/938) and registered with the Clinical Trials.gov (NCT0420569). Written informed consent was obtained from patients. This study followed the Consolidated Standard of Reporting Trials (CONSORT) recommendations for reporting randomised controlled trials.

Inclusion Criteria

American Society of Anesthesiologists physical status 1-2 patients aged between 18-80 years and scheduled for elective unilateral orthopedic upper limb surgery under the care of principal investigator below shoulder were included in this study. A research assistant invited all the patients for the participation, but definitive recruitment was by the principal investigator.

Exclusion Criteria

The exclusion criteria included the patient's refusal, pregnancy, and history of allergy to study drugs, neurological and cognitive disorders, coagulopathy, chronic pain disorder, and infection at the injection site.

Allocation and Randomization

A sealed, opaque envelope containing allocated randomization was opened in the operating room before the block. Patients were allocated in a 1:1 ratio to one of two groups to receive a continuous infraclavicular BPB using a multi-orifice or an end-hole nerve catheter: Group Multi-orifice Catheter (group MOC, n=35) and group End-hole Catheter (Group EHC, n=35).

Infraclavicular Brachial Plexus Block Procedure And Catheter Insertion

After arriving into the operating room, the patients were monitorized with electrocardiogram, pulse oximetry, and non-invasive blood pressure. Midazolam (2–3 mg) and fentanyl (0.05 mg) were administered for sedation and analgesia after establishing an intravenous (IV) access. A single staff anesthesiologist who was experienced in peripheral nerve blocks under the US guidance performed all blocks. The patient was placed supine with the head turned to the contralateral shoulder. The arm was abducted to 90 degrees. Thus, pectoral muscles, brachial plexus chords, and axillary artery could be better visualized. The coracoid process was identified by palpating the bony prominence medial to the shoulder. A linear US probe (ultrasound machine (SonoSite X-Porte, SonoSite, Bothell, WA, USA) was placed in a parasagittal

plane medial to the coracoid process and inferior to the clavicle. By preliminary scanning from medial to lateral, posterior, lateral and medial cords of the brachial plexus were visualized around the axillary artery. A non-stimulating 17-gauge (G) Tuohy needle with a 19 G non–stimulating open-tip, triple hole EHC (Contiplex FX set, CNBFX350C, B.Braun Medical Inc., USA) or with a 19 G non–stimulating closed tip MHC (Contiplex FX set, CNBFX350O, B. Braun Medical Inc., USA) were used in the group EHC and the group MOC, respectively. The triple-hole orifices are located approximately 6, 9 and 12 mm from the MOC tip and radially orientated at 4, 8 and 12 o'clock. All catheters were cut at the proximal end to a length of 25 cm to minimize the flow pressure gradient between each catheter's proximal end and orifice(s).[6]

After sterile preparation and dressing, the US probe was placed in a sterile cover. The Tuohy needle was inserted using an in-plane approach from the cephalic end of the probe with an insertion point inferior to the clavicle after skin infiltration with 2 ml of 2% prilocaine. The needle was passed through pectoral muscles and advanced to the axillary artery. It was placed at the six o'clock position relative to the axillary artery. The location was confirmed by injecting 2 ml of 2% lidocaine after careful aspiration. Eighteen ml of a LA mixture containing 6 ml lidocaine 2% (120 mg) and 14 ml bupivacaine 0.05% (70 mg) was administered to achieve a U-shaped spread of LA around the axillar artery (expected flow rate: 360–550 mlh^{-1}). The catheter was advanced through the needle and placed 4–5 cm beyond the needle tip. The Tuohy needle was removed. Then, the catheter was withdrawn under the US guidance as the catheter threading distance was kept between 1–1.5 cm. The correct position of the catheter was controlled with the US, and the remaining LA (2 ml) was further administered to check its free flow through the catheter. The catheter was tunneled towards the sternoclavicular region to reduce the risk of removal.

A second anesthesiologist who was blinded to the study groups recorded study parameters and managed the patients. The surgical procedure was started after complete sensory and motor block was achieved, which were assessed every five minutes for 30 minutes. The sensory block was assessed with the pinprick sensation at five nerve distributions, including median, radial, ulnar, musculocutaneous, and medial cutaneous nerves of the forearm. The motor block was assessed using the Bromage scale in the hand and arm. Midazolam (1–2 mg) was administered if requested by the patient. If a complete sensory blockade was not achieved, the case was termed as a block failure. In that case, a rescue block for the unblocked nerve (such as an ulnar block at the elbow) or a supplemental LA infiltration was tried. If those interventions failed, general anesthesia was administered.

Follow–up Period

All patients were followed in the post anesthesia care unit until they met the discharge criteria and then they were discharged to the service. The operative arm was kept in a sling during the postoperative period. The patients were received a multimodal analgesic regimen at the postoperative period: paracetamol 1000 mg IV with eight hours intervals, dexketoprofen 50 mg IV with 24 hours intervals, continuous peripheral nerve block-PCA (0.125% bupivacaine; basal rate: 2 mlh^{-1}; automated regular boluse: 5mlh^{-1}; bolus dose on demand: 3 ml, lockout time: 60 min; 4-hours limit: 40 ml).

Postoperative pain was evaluated using a Visual Analogue Scale (VAS; 0–10 cm) before the block, with four hours intervals during the first 24 hours, then with 12 hours intervals until the postoperative 72. hours and recorded. Pethidine 0.5 $mgkg^{-1}$ was IV given as a rescue analgesic if the VAS score was >3. Patients with normal vital parameters were discharged from the hospital on the third postoperative day after removal of the catheter when the VAS score was <3. The patient's satisfaction level was assessed by VAS ranging from not satisfied (score-0) to fully satisfied (score-10) with the treatment outcomes at discharge.

The following criteria were recorded and compared between groups: Demographic data, mean operative times (minutes), VAS scores, time to first rescue analgesic (hour) and rescue analgesic consumption (mg), number of bolus demand via PCA, bolus dose on demand (ml), and total LA consumption (ml) via PCA, patient's satisfaction score, and complications. Complications were defined as complications related to PNB and surgery (nerve damage, LA toxicity, bleeding, infection, catheter removal, and thromboembolism) and to systemic analgesics (respiratory distress, nausea, vomiting, itching, constipation, drowsiness, dizziness, and dry mouth).

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 21 (IBM SPSS Inc., Chicago, IL). The sample size was calculated to detect a minimum clinically important difference of 20% in the VAS scores between two groups. A power analysis indicated that minimum of 50 cases would be needed to achieve 80% power with an alpha error of 0.05, equivalent to an effect size of 0.8. We aimed to enroll a minimum of 70 cases (35 in each arm) to allow 15% through withdrawals or loss to follow up. Descriptive statistics were used as mean, standard deviation, and median for continuous data and frequency and percentage for categorical data. The normal distribution of continuous data was analyzed using the Kolmogorov-Smirnov test. Mean of variables between groups were compared with Student's t-test when data are with normal distribution, and with Mann-Whitney U test when data were without normal distribution. Pearson Chi-square test was used to assess a difference in the distribution of categorical variables between groups. $P<0.05$ was considered as statistically significant.

RESULTS

Of total of 70 patients, 12 patients were excluded from this

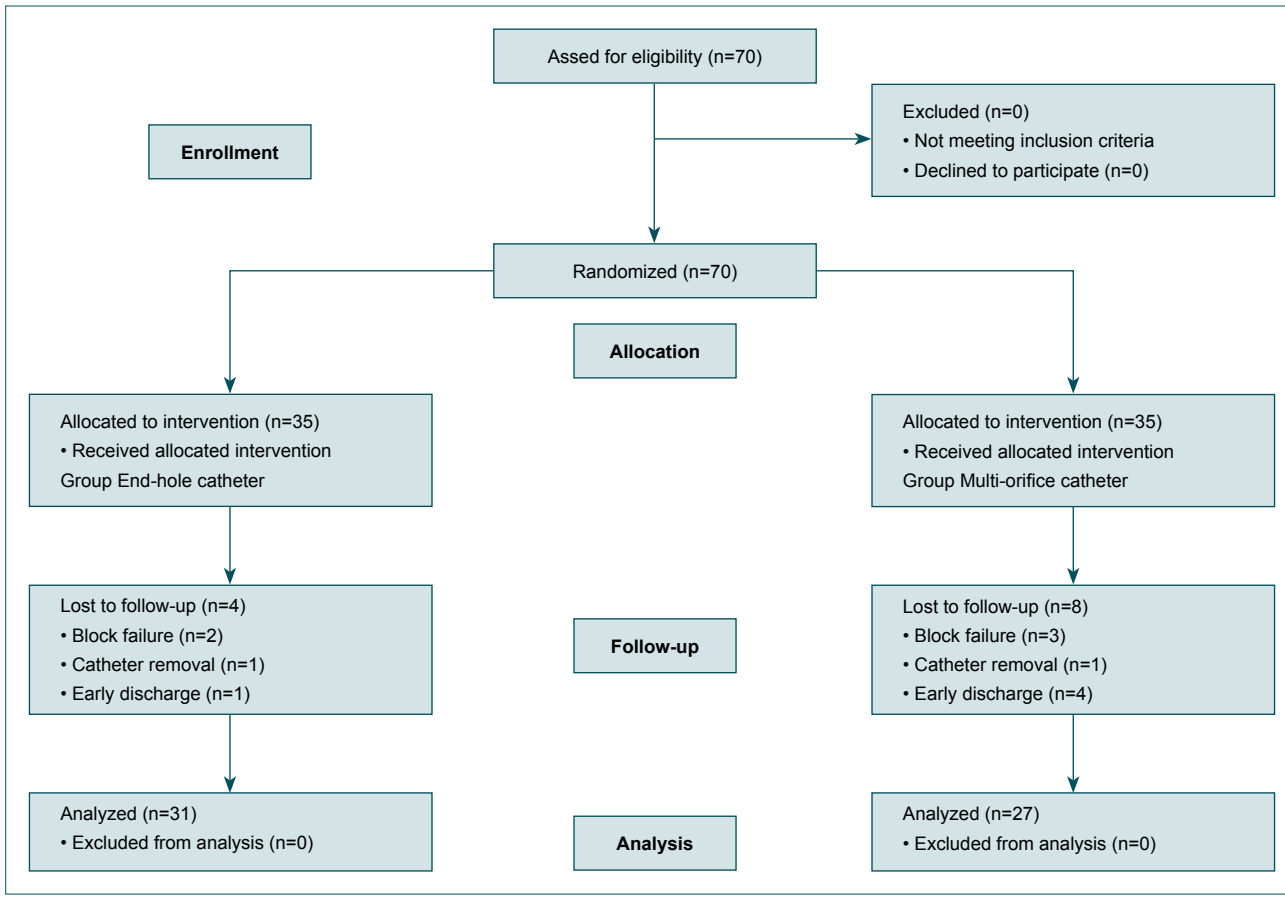

Figure 1. Study flow diagram.

study. The block was failed in five patients (2 in group EHC, three patients in group MOC). These patients were received general anesthesia. The catheter was removed in one patient in both groups in the first postoperative 24 hours, and those patients were received an IV tramadol PCA. Five patients (1 in

Table 1. Comparison of the demographic data between study groups

	Group EHC (n=31)	Group MOC (n=27)	p
Gender, n (%)			
Female	11 (35.5)	11 (40.7)	0.681
Male	20 (64.5)	16 (59.3)	
Age (years)	33.7±10.3	36.0±9.5	0.398
Body mass index (kgm^{-2})	25.4±5.8	25.1±3.3	0.523
ASA status, n (%)			
1	16 (51.6)	14 (51.9)	0.896
2	15 (48.4)	13 (48.1)	
Surgery (ORIF), n (%)			
Distal humerus /elbow	9 (29.0)	8 (29.63)	0.443
Forearm	12 (38.7)	11 (40.74)	0.616
Hand/wrist bones	10 (32.3)	8 (29.63)	0.205

EHC: End-hole catheter; MOC: Multi-orifice catheter; ASA: American Society of Anesthesiologists; ORIF: Open reduction and internal fixation. Values are presented as mean ± standard deviation, numbers and/or proportion (n, %). P<0.05 was considered as statistically significant.

Table 2. Comparison of the Visual Analogue Scale scores between study groups

	Group EHC (n=31)	Group MOC (n=27)	p
VAS Scores (hrs.)			
Preoperative	5.2±1.7	5.3±1.3	0.150
0.	0.5±0.3	0.4±0.2	0.316
4.	1.9±0.5	1.7±0.1	0.150
8.	4.0± 0.8	3.6±0.9	0.150
12.	4.6±0.8	2.7±1.1	0.001
16.	2.9±0.7	2.3±0.7	0.030
20.	1.4± 0.9	1.7±0.9	0.075
24.	0.6±0.9	0.2±0.5	0.136
48.	0.1±0.3	0.0±0.0	0.138
72.	0.0±0.0	0.0±0.0	0.138
Total	1.9±1.9	1.5±1.5	0.008

EHC: End-hole catheter; MOC: Multi-orifice catheter; VAS: Visual Analogue Scale. Values are presented as mean ± standard deviation. P<0.05 was considered as statistically significant.

group EHC and 4 in group MOC) refused to participate in this study in the follow-up period. Of the remaining 58 patients, the EHC group included 31 patients and the MOC group included 27 patients (Fig. 1). Demographic characteristics, surgery, and mean operating times were similar between groups (p>0.05) (Table 1). It was observed that mean VAS scores of the groups reduced to a clinically insignificant level (<1) at the 48. hours and a rescue analgesic was not required after 24. hours. Thus, continuous PNB was stopped and catheters were removed after 48. hours. Oral paracetamol (500 mg) was administered as necessary. A total of 10 VAS measurements (preoperative, at postoperative 4., 8., 12., 16., 20., 24., 48., and 72. hours) and three postoperative pain therapy assessments (0.–12., 12.–24., and 24.–48. hours) were selected out for each case which were recorded at similar times.

Primary Outcome Measure: Mean preoperative VAS scores were 5.2±1.7 in group EHC and 5.3±1.3 in group MHC (p=0.150) (Table 2). Postoperative mean VAS scores were similar and lower than 3 at postoperative 0. and 4. hours but were increased to >3 at 8. hours in both groups (p>0.05). Mean VAS scores were decreased in group MOC at 12. hours but increased to the highest level in group EHC (2.7±1.1 vs. 4.6±2.7; p=0.001). VAS scores gradually decreased in both groups from postoperative 16. hours to the end of the study period, but the difference between groups was significant at 16. hours in favor of the EHC group (2.9±1.1 vs. 2.3±0.7; p=0.030). VAS scores were found to be reduced to a clinically insignificant level (<1) at 48. hours (Fig. 2).

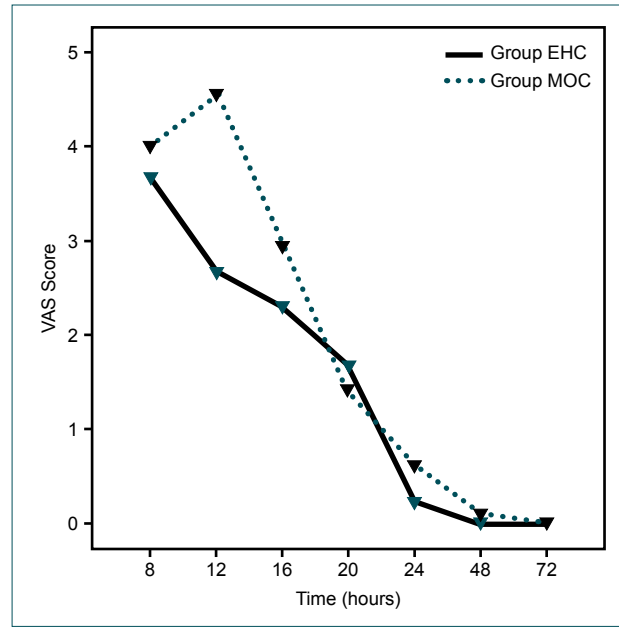

Figure 2. VAS score in groups between postoperative 8.–72. hours. EHC: End-hole catheter; MOC: Multi-orifice catheter; VAS: Visual Analogue Scale.

Secondary Outcome Measures: Time to first rescue analgesic was lower, and mean consumption of the rescue analgesic was higher in the group EHC compared to the group MOC (p<0.05; Table 3). Number of PCA bolus demands, bolus PCA doses, and total PCA doses were higher in

Table 3. Comparing postoperative analgesia between study groups

	Group end-hole catheter (n=31)	Group multi-orifice catheter (n=27)	p
Time to first rescue analgesic (h)	7.13±1.2	7.50±0.7	0.030
Rescue analgesic consumption (mg)			
0.–12. hrs.	16.1±23.8	3.7±13.3	0.017
12.–24. hrs	35.5±26.4	18.5±24.6	0.021
24.–48. hrs.	0±0	0±0	
Patient controlled analgesia bolus on demand (n)			
0.–12. hrs.	6.6±2.4	2.4±2.2	0.001
12.–24. hrs	7.1±1.5	1.8±1.1	0.002
24.–48. hrs.	1.5±1.5	1.4±0.8	0.358
Bolus patient controlled analgesia dose on demand (ml)			
0.–12. hrs.	19.0±6.3	6.9±4.1	0.001
12.–24. hrs	20.9±3.1	5.4±2.3	0.002
24.–48. hrs.	4.2±1.5	4.1±1.0	0.241
Total patient controlled analgesia dose (ml)			
0.–12. hrs.	100.1±4.5	89.9±4.0	0.001
12.–24. hrs	102.8±4.4	89.2±5.1	0.002
24.–48. hrs.	171.2±2.4	170.2±1.9	0.560

Values are presented as mean ± standard deviation. P<0.05 was considered as statistically significant.

group EHC than the group MOC between postoperative 0.–12. hours and 12.–24. hours ($p<0.05$) (Table 3). There were no signs and symptoms related to local anesthetic toxicity observed and similar minor complications were treated in groups ($p>0.05$) Mean patient satisfaction scores were higher in the group MOC than in the group EHC ($p=0.013$).

DISCUSSION

To our knowledge, this is the first prospective and randomized study in the literature which compares nerve catheters with different tip configuration concerning postoperative analgesia in continuous infraclavicular BPBs. In this study, all procedures were performed in a standard fashion. The Tuohy needle was positioned at a six o'clock position under the axillary artery with similar catheter threading distances of 10–15 mm.

It should be noted that the multi-modal analgesic regimen in this study reduced postoperative pain scores in both groups to a minimum level, where rescue analgesics were not required after 24. hours. Mean VAS scores increased to >3 at postoperative 8. hours in both groups that were attributable to the resolution of sensory block. The differences in VAS scores were significant at 12. and 16. hours in favor of the MOC group between groups. The results showed that a continuous infraclavicular BPB using multi-orifice nerve catheter provided superior pain relief than the end-hole catheter in the postoperative first 24 hours. This was supported by the fact that rescue analgesic consumption, number and dose of bolus demand were about 2–3 folds higher in the group EHC than group MOC in the first 24 hours, which decreased the VAS scores in the group EHC to a similar level as in the group MHC. The possible explanation might be due to the better spread of LA through the MOC than the EHC. Automated regular boluses of 5 $ml.h^{-1}$ (flow rate 100–150 $ml.h^{-1}$) might provide sufficient LA spread from all orifices of the MOC, so LA was distributed more efficiently to the cords around the artery compared to the EHC. The result of this current study is consistent with previous studies which have reported that multi-orifice epidural catheters improved analgesia and reduced local anesthetic consumption compared to end-hole catheters.[5,11,12]

The results of this study were in contrast to the previous two studies, which have reported no difference between the end hole and multiple hole nerve catheters concerning postoperative analgesia in continuous peripheral nerve blocks.[6,7]

In the study conducted by Frederickson, an end-hole catheter was compared with a triple-hole and six- hole catheter, which were positioned 3 cm beyond the needle tip lateral to the C5/C6 roots for a continuous interscalene analgesia.[6] The catheters were advanced blindly 5 to 7 cm beyond the needle tip, then, the needle was removed and the catheter was withdrawn until 3 cm remained past the original needle tip position. In addition, 15 ml of ropivacaine 0.375% was administered using the catheter after the induction of the general anesthesia and before the surgery. After the surgery, another 15 ml of lignocaine 1.5% were administered through the catheter in the postanesthesia care unit if the patients reported a numerical rating pain score of more than two. If pain persisted 30 minutes after this bolus, the catheter was replaced with the same catheter type and a further 15 ml of ropivacaine 0.375% was administered. However, the exact position of the catheter relative to the roots was not confirmed under the vision of the US although the catheters were blindly advanced through the catheter and then withdrawn until 3 cm. Also, there was a difference in the difficulty with catheter threading between groups. The catheter was threaded more difficult in the end-hole group compared to the multi-hole groups, which might be contributed to the observed difference in the catheter performance as outlined by the author. Additionally, the flow rate might be effective for a successful spread of LA through catheters, but the dose of the LA using 15 ml might not be an effective dose to achieve a difference in analgesia between catheters in the interscalene block irrespective of the configuration of the catheter which was supported with another two boluses (total 30 ml) after the surgery.

In the second study, 20 ml of 1% lidocaine was administered through a six-hole or an end –hole catheter which was placed between the femoral nerve and the iliopsoas muscle under the US guidance in combination with a single- shot sciatic nerve block before the general anesthesia in patients undergoing total knee arthroplasty.[7] Total local anesthetic consumption, mean pain scores, opiate requirements, patient satisfaction, and technical problems did not differ between groups. The authors of this study stated that this similarity might be due to the trapping of the catheter between the nerve and the muscle and LA is pushed around the nerve irrespective of the number of holes. However, it was not clear

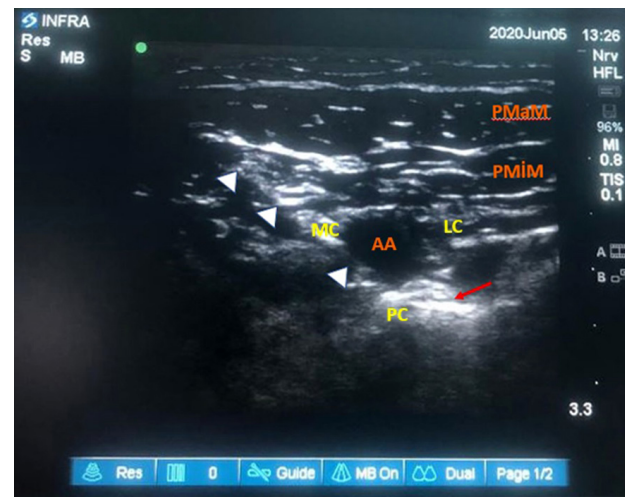

Figure 3. Ultrasound image of infraclavicular catheterization. PMaM: Pectoralis major muscle; PMiM: Pectoralis minor muscle; LC: Lateral cord; MC: Medial cord; PC: Posterior cord; Red arrow: Peripheral nerve catheter; White arrowheads: Needle.

whether the pain after the knee arthroplasty arose from the sensory distribution of the sciatic nerve or the femoral nerve.

There were also several differences between the current and previous studies. First difference is the administration of the bolus LA doses for surgical anesthesia. LA was administrated through the nerve catheter in previous studies.[4,6,7] However, in our study, LA was administrated through the Tuohy needle, and then a nerve catheter was placed (Fig. 3). We preferred this method because the hydrodissection of the surrounding tissue with LA could facilitate the placement of the catheter in the exact position.[13] Also, the high flow rate provided by the bolus administration could gain an advantage to group MHC concerning LA spread from the very beginning of this study, but this study aimed to compare postoperative analgesia. The second difference was the target of LA injection. Since the target was the axillary artery in the infraclavicular blocks, identification of the plexus cords was not necessary as in the supraclavicular block.[13]

Local anesthetic toxicity is a potential problem due to the accumulation of the continuous peripheral nerve blocks. The reported toxic concentration of bupivacaine is 2 $\mu g.ml^{-1}$.[14] In a study, mean plasma bupivacaine level was measured 1.78±0.59 $\mu g.ml^{-1}$ with a bolus dose of 2.5 $mg.kg^{-1}$ bupivacaine followed by a continuous infusion of 0.125% plain bupivacaine at 12 $ml.h^{-1}$ during 48 hours without signs of LA toxicity.[15] In our study, 0.125% bupivacaine was administrated at continuous infusion (2 $ml.h^{-1}$), and 5 ml automated boluses per hour. 3 ml boluses were used on demand with one-hour lockout interval. Although the plasma bupivacaine levels were not measured, the maximum infusion rates were not higher than 10 $ml.h^{-1}$ (3.5–8.5 $ml.h^{-1}$) throughout the study period.

This study has several limitations. Since this study was designed to evaluate postoperative pain relief, the resolution of the sensory and motor blocks was not systematically evaluated. The second limitation was relatively limited numbers of patients that were included in this study. The last limitation was that the measurements for postoperative analgesia that were collected while patients were at rest.

Conclusion

In conclusion, the use of the multi-orifice catheters in continuous infraclavicular BPB provided better postoperative analgesia than the end-hole catheter for the orthopedic upper limb surgery below the shoulder concerning lower VAS scores, reduced consumption of rescue analgesic and local anesthetics, and higher patient's satisfaction scores.

Ethics Committee Approval: Approved by the local ethics committee.

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: M.B.E., A.C.; Design: M.B.E., A.C.; Supervision: M.B.E., A.C.; Fundings: M.B.E., A.C.; Materials: M.B.E., A.C.; Data: M.B.E., A.C.; Analysis: M.B.E., A.C.; Literature search: M.B.E., A.C.; Writing: M.B.E., A.C.; Critical revision: M.B.E., A.C.

Conflict of Interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZET*

Sürekli infraklaviküler brakial pleksus bloğunda kateter ucu konfigürasyonunun (üç delikliye karşı uçtan delikli) üst ekstremite cerrahisi sonrası analjeziye etkisi

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AMAÇ: Sinir bloğu kateterinin konfigürasyonu epidural analjezi ve sürekli periferik sinir bloklarında lokal anestezik yayılımını etkileyebilmektedir. Bu ileriye yönelik ve randomize çalışmanın amacı, omuz seviyesinin altında gerçekleştirilen üst ekstremite cerrahilerinde, ultrason rehberliğinde yapılan sürekli infraklaviküler brakiyal pleksus bloğunda (BPB) üç delikli sinir bloğu kateteri ile tek delikli kateterin ameliyat sonrası analjezik etkinliklerini karşılaştırmaktır. Primer sonuç ölçümleri ortalama ağrı skorlarıydı. Sekonder sonuç ölçümleri, kurtarıcı analjezik tüketimi ve hasta kontrollü analjezi (PCA) cihazı tarafından gönderilen lokal anestezik miktarlarıydı.

GEREÇ VE YÖNTEM: Omuz seviyesinin altında üst ekstremite cerrahisi uygulanan toplam 58 erişkin hasta rastgele iki gruba ayrıldı: Tek delikli kateter (EHC) grubu (n=31) ve çok delikli kateter (MOC) grubu (n=27). Tüm hastalara, Tuohy iğnesi ile 100 mg %2 lidokain and 75 mg %0.5 bupivakain ile tek doz infraklaviküler BPB uygulandı. Daha sonra MOC grubuna çok delikli (üç delikli) bir sinir kateteri ve EHC grubuna aynı seviyeden uçtan delikli (tek delikli) kateter yerleştirildi. PCA yoluyla %0.125 bupivakain, kateterlerden infüzyon edildi (infüzyon hızı: 2 ml/sa, otomatik düzenli bolus: 5 ml/sa, hasta kontrollü bolus: 3 ml, kilitleme süresi: 1 saat, 4 saatlik limit: 40 ml). Ağrı şiddeti görsel analog skala (VAS) kullanılarak değerlendirildi.

BULGULAR: VAS skorları ameliyat sonrası ilk gün grup EHC'de, grup MOC'den daha yüksekti (p=0.001). Ortalama kurtarma analjezik tüketimi, PCA üzerindeki bolus sayısı, PCA bolus dozu ve toplam PCA dozu, grup EHC'de ameliyat sonrası ilk gün grup MOC'dan daha yüksekti (p<0.05).

TARTIŞMA: Infraklavikular sürekli sinir bloğunda MHC kullanımının, ilk 24 saat ameliyat sonrası ağrıyı azaltmada EHC'den daha etkili olduğu sonucuna vardık.

Anahtar sözcükler: Ameliyat sonrası analjezi; brakiyal pleksus bloğu; infraklavikular; kateter; ultrason.

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