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Original Article

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ABSTRACT

Objective: We aimed to compare equal doses of bupivacaine and levobupivacaine in terms of efficiency, block quality and side effects on lateral approach to popliteal block in patients who would undergo foot/ankle surgery.

Design: Prospective study

Setting: Goztepe Training and Research Hospital

Subjects: Thirty patients who were planned foot/ankle surgery, were included to the study.

Intervention: After the block was performed mean blood pressure, heart rate, SpO_2 values were recorded at the 1st, 15th, 30th, 45th min and at the end of the operation. Sensory block formation time was tested with pin-prick test in 5 min intervals after completion of block. Time to motor and sensory block durations and time for the first analgesic utilization was recorded.

Main outcome measure: Time to complete sensory blockade/time to complete block duration and administration time of the first analgesic of patients

Results: There were no differences in mean time to complete sensory blockade/time to complete block duration and first analgesic administration times of patients. Total fentanyl doses used in Group L and Group B were 40±38.73 µg and 43.33±37.16 µg, respectively. Sensory block quality formed in dermatome area of sciatic nerve was similar in both groups. Group B was found to be superior in both plantar flexion and dorsal flexion evaluations.

Conclusion: It was concluded that adequate, qualified and safe block could be achieved with bupivacaine and levobupivacaine in lateral popliteal blocks and also that these two drugs provided pain control after the operation and they had no significant difference with regard to side effects.

KEYWORDS: block, bupivacaine, levobupivacaine, nerve

INTRODUCTION

Foot and ankle operations cause severe and prolonged postoperative pain and they require high doses of parenteral opioid frequently. Sciatic nerve block with popliteal approach is an effective method in providing efficient anesthesia and analgesia in foot and ankle surgeries [1-5].

For sciatic nerve block, anterior and lateral approaches have been proposed with the goal of avoiding positioning problems that are common in obese, pregnant or trauma patients [2]. Distal sciatic nerve block (popliteal fossa block) is a relatively simple technique that results in reliable surgical anesthesia of the calf, tibia, fibula, ankle and foot [5]. The sciatic nerve is blocked near the bifurcation of the common peroneal and posterior tibial nerves [6]. The advantage of the lateral approach to popliteal block is that the patient does not need to be positioned in the prone position as with all posterior approaches [5]. And the lateral approach to the block of the sciatic nerve provides analgesia comparable to that obtained with the posterior approach, with a faster onset and longer postoperative duration [7]. Besides the local anesthetic, various factors markedly affect the onset time of peripheral nerve blocks such as the type of evoked motor response [2]. The long acting local anaesthetic agents provide prolonged postoperative analgesia [8], and so we used levobupivacaine (the levorotatory S-enantiomer of racemic bupivacaine) and bupivacaine.

Whereas both the R– and S– enantiomers of bupivacaine have anesthetic activity, previous preclinical studies in animals and volunteers have suggested that levobupivacaine has less cardiovascular system (CVS) and central nervous system (CNS) toxicity than bupivacaine [9-12].

In this study, primary outcome was to compare the efficacy of equal doses of levobupivacaine and bupivacaine in patients to whom lateral approach to popliteal block was performed with the help of peripheral nerve stimulator in foot and ankle surgery.

SUBJECTS AND METHODS

This study was conducted at the Goztepe Training and Research Hospital after approval by the Goztepe Training and Research Hospital Local Ethics Committee (Approval Number: 57/A3).

Forty patients with American Society of Anesthesiologist Physical Status Classification (ASA) I-II who were between 18-70 and and were planned to undergo foot and ankle surgery in the orthopedics clinics with their informed consent, were included to the study. Patients with neurological or neuromuscular diseases, body mass index >30, with acquired or congenital coagulopathy, who were allergic to local anesthesia, who were treated for chronic analgesia and with skin infection in block area who were seven patients were excluded from the study. This study is a prospective double blind randomised controlled trial patients were randomly divided into two groups. Thirty-three patients recieved peripheral nerve blocks for foot and ankle surgery were included respectively to Group L and Group B. Thirty mL 0.5% levobupivacaine was administered to Group L, 30mL 0.5% bupivacaine was administered to group B.

Demographic characteristics (Age, Sex, Weight, Height) of the patients were recorded. Premedication was performed with iv Midazolam 0.03mg kg^{-1}. Initial non-invasive systolic and diastolic blood pressure, mean blood pressure (MBP), heart rate (HR) were monitored with electrocardiogram and peripheral oxygen saturation (SpO_2) was monitored with Petaş PM 150. Nerve block points of application of the patients were determined with the method described by Vloka JD *et al*[13] at supine position. Stimulator (Stimuplex®-HNS11, B.Braun Co. Germany) and 21Ga.x100mm (Stimuplex®-A100, 4inch) block needle were used in the study. Electrode of peripheral nerve stimulator was attached to the foot where block would be performed, stimulator starting current was set to 1.5mA, 0.1ms, 2Hz. After antisepsis is achieved in the region where nerve block would be applied, 100mm stimuplex needle was inserted with an angle of 45° at the needle access point and 1-2mL of local anesthesia was administered to subcutaneous area. Then, the nerve was attempted to be localized by accessing it with block needle. The twitching response of sciatic nerve common peroneal (dorsal flexion) or tibial branch was evaluated as a successful localization.

After the current was reduced to 0.3 mA and stopped motor response, 5 mL injection was performed at the beginning and 30mL 0.5% levobupivacaine (Group L) or 0.5% bupivacaine (Group B) was administered while aspiration tests were performed in every 5 mL. MBP, HR, SpO_2 values were recorded at the 1^{st}, 15^{th}, 30^{th}, 45^{th} minutes after the block was performed and at the end of operation.

After injection, the sensory spread of the block was evaluated by pinprick testing with a hypodermic needle in the sensory territories of tibial and common peroneal nerves in the foot. The end of injection was considered time zero the sensory assessment was conducted at 5 minute intervals for 25 minutes. The localization of the nerve was considered successful when either tibial nerve response or common peroneal

response was obtained. A successful block was defined as a complete sensory block affecting both divisions of the sciatic popliteal nerve within 30 minutes and absence of pain on surgical instrumentation. Surgery proceeded once sensory anesthesia in the surgical field was documented by pinching the skin by the surgeon using a hemostat clamp. When the block was solid, the surgery started.

Sensory blockade was determined by pinprick and graded in accordance with the scale proposed by Hollmèn: 0: Normal sensation of pinprick. 1: Pinprick felt as sharp-pointed but weaker compared with the same area in the other upper extremity. 2: Pinprick recognized as touch with a blunt object. 3: No perception of touch. The gradation of motor blockade was 0: Normal muscular function; 1: Slight depression in muscular function compared with preanesthetic strength; 2: Very weak action persisting in muscles; and 3: Complete block [14].

Additional amounts of fentanyl and midazolam used were recorded. Surgeon satisfaction was evaluated using a 4-point scale at the end of the operation (1: Perfect, 2: Good, 3: Medium, 4: Not acceptable). And patient satisfaction was evaluated with 5 point scale at the end of the operation and at postoperative 24th hour (1: Very satisfied, 2: Satisfied, 3: A little satisfied, 4: Not satisfied, 5. Not at all satisfied). Postoperative motor and sensory block durations and first analgesic administration time was recorded. Complications, hypotension, bradycardia, desaturation, hypoesthesia, neuropathy, prolonged motor block were followed up.

Statistical Analysis: NCSS 2007 package program was used in statistical evaluation. Results were evaluated in $p<0.05$ significance level.

RESULTS

We started the study with 40 patients but seven patients were excluded from the study. As general anesthesia was applied to 2 patients in levobupivacaine group and 1 patient in bupivacaine group due to failed block, these 3 patients also were excluded from the study analysis. The remaining 30 patients, 15 in Group B and 15 in Group L, were included to the study analysis (Figure 1).

Demographic characteristics of 30 patients in the study were similar (Age: 41.25±7.98 (Group L), 40.87±8.64 (Group B). Sex (M/F):7/8 (Group L), 5/10 (Group B). Weight (kg):70.8±10.5 (Group L), 74.07±9.27 (Group B). Height (cm):166.53±7.58 (Group L), 167.6±5.45 (Group B)). No significant statistical difference according to ASA classifications was detected between two groups (ASA I/II: 11/4 (Group L), 10/5 (Group B)).

Time to complete sensory blockade/time to complete block duration and administration time of the first analgesic of patients are shown in Table 1. The end of injection was considered time zero the sensory assessment was conducted at 5-minute intervals for 25 minutes. We defined a successful block as one that allowed the surgery to proceed within 30 minutes after injection. Sensory block quality of patients is shown in Table 2. When plantar flexion (n.tibialis) and dorsal flexion(n.peronealis) motor block quality were evaluated, the number of patients with reduced muscle function and full motor block developed was found higher in bupivacaine group Table 3. Patient and surgeon satisfaction levels are shown in Table 4. MBP, HR and SpO2 measurements are shown in Table 5.

Total fentanyl doses used in Levobupivacaine Group (to 4 patients) and Bupivacaine Group (to 3

patients) were 40 ± 38.73µg and 43.33 ± 37.16µg, respectively. Total midazolam doses used in Levobupivacaine Group and Bupivacaine Group were 0.93 ± 0.46mg and 0.87 ± 0.64mg respectively. No significant difference was detected between groups with regards to total fentanyl or midazolam dose used. In conformity with-additional analgesic application time, patient and surgeon satisfaction after the operation were high and there was no difference between groups. While nausea was encountered in 1 patient in groups, hypotension and hypoesthesia was seen in 1 patient in bupivacaine group. No significant difference was detected between groups with regard to incidence of side effects.

DISCUSSION

The increase observed in the number of outpatient surgery and the number of comorbid patient and the increase in complication risk related to central neuroaxial blocks in patients using anticoagulants maximize the importance of peripheral nerve blocks gradually in lower extremity surgery [1-3, 8, 15]. Among the different peripheral nerve block techniques used for forefoot surgery, sciatic nerve block at popliteal fossa provides safe and effective analgesia reducing the doses of local anesthetic, opioids and minimizing the risk of complications [16]. Distal sciatic nerve (popliteal) block is more advantageous than proximal sciatic nerve blocks and it is easier to perform because this technique allows the protection of knee functions of the patients and enables them to move with supports [6]. In our study popliteal block was performed with lateral approach to thirty patients that would undergo foot and ankle surgery. Lateral approach to popliteal block was preferred because it presented various advantages when compared with posterior approach [7].

The block can be formed in the area belonging to two branches by administering the drug with single needle after detecting one of the peroneal or tibial nerves [17]. In our study one of the branches of sciatic nerves was detected with peripheral nerve stimulator and block process was performed by administering all of the local anesthetic at a time. In all the block performed cases sensory and motor block in various levels were obtained in areas appropriate to both branches of sciatic nerves (lateral cutaneus sural, sural, superficial peroneal, deep peroneal).

In the study conducted by Urbanek *et al* [11], when 20mL doses of 0.5%, bupivacaine, 0.5% levobupivacaine and 0.25% levobupivacaine were compared in femoral block applications, it was reported that time to sensory blockade/total block times of bupivacaine and levobupivacaine (27min/1053min, 24min/1001min) were similar and time to sensory blockade of 0.25% levobupivacaine (30min/707min) was higher and total block time was shorter. In our study, time to complete sensory blockade/time to complete block duration for levobupivacaine and bupivacaine were detected respectively as 21.66min/9.87hours and 21.8min/10.07hours which were compatible with the studies in the literature.

While in the study performed by Liisanantti *et al* [18] on axillary block, motor total block formation percentages for ropivacaine, bupivacaine and levobupicaine were reported respectively as 67%, 47%, 30%, in the study conducted by Connoly *et al* [8] on distal sciatic nerve block with posterior approach this percentage for 7.5mg mL^{-1} ropivacaine and 5mg mL^{-1} bupivacaine was reported respectively as 75% and 58%. In the study conducted by de Leeuw *et al* [19] on psoas compartment and sciatic block, no significant difference was reported with regards to sensory block quality between bupivacaine, levobupivacaine and

ropivacaine groups. However, in our study while no significant difference was detected between bupivacaine and levobupivacaine with regards to sensory block quality, the incidence of reduced muscle function and full motor block in bupivacaine group was significantly higher than the incidence in levobupivacaine group.

In femoral nerve block performed by Urbanek *et al* [11], no difference was reported between levobupivacaine and bupivacaine in terms of analgesic efficiency and it was stated that these two drugs provided effective pain control. In study performed by de Leeuw *et al* [19] on psoas compartment and sciatic nerve block, it was reported that levobupivacaine, bupivacaine and ropivacaine provided an efficient postoperative analgesic effect and there was no significant difference between these drugs with regards to analgesic effect.

In the study performed by McLeod *et al* [20] with 20mL 0.5% bupivacaine, postoperative first analgesic requirement was reported as 18 hours on average in lateral popliteal block performed patients. In another study on distal sciatic block, postoperative first analgesic requirement time for 0.5% levobupivacaine, 0.75% levobupivacaine and 0.75% ropivacaine was reported respectively as 16 hours, 18 hours and 13 hours [21]. In our study postoperative first analgesic requirement time was detected as 11.8 hours for levobupivacaine group and 10.57 hours for bupivacaine group and no significant difference was found between the groups. In literature, in different studies, it is detected that there are differences between postoperative first analgesic requirement periods [18, 20, 21]. It is considered that this difference may depend on local anesthetics doses used, whether the local anesthetics are diluted, type of surgical intervention applied and variability of pain sensitivity of the patients.

In study performed by Mcleod *et al* [20] on the lateral popliteal block using 20mL 0.5% bupivacaine, it was reported that a high level of patient satisfaction was reached and 95 % of the patients was satisfied with this method. In our study very satisfied and satisfied patient percentages in levobupivacaine and bupivacaine groups were respectively 93.3 and 93.4%.

Hadzic *et al* [22] classified the potential complications for lower extremity peripheral nerve blocks as local anesthetic systemic toxicity, hemorrhagic, infectious and neurological. There is convincing evidence that the probability of an adverse event related to the CNS and CVS toxicity of local anesthetics can be reduced when levobupivacaine is used instead of bupivacaine [23]. This arises primarily from the higher toxicity of the R(+)-stereoisomer of bupivacaine [11, 23]. So levobupivacaine is presented as a suitable alternative for bupivacaine [11]. Systemic toxicity related to local anesthetics was not detected in any group. Peripheral nerve blocks are associated with minimal haemodynamic disturbance [24]. In the study conducted by Urbanek *et al* [11], HR, noninvasive blood pressure, and SpO_2 showed no statistically significant inter- or intragroup differences during the entire study period. Also in that clinical trial, no signs of CVS or CNS toxicity were observed. In our study no significant changes in MBP, HR, and SpO2 were encountered in any of the groups. No toxic effect on CVS or CNS was detected.

Limitation of this study was that the efficacy of levobupivacaine and bupivacaine was compared only in lateral approach to popliteal sciatic nerve blocks. Besides, if this study was performed with ultrasonography, doses used and complication risk could decrease.

CONCLUSION

In line with the similar studies in literature and with the findings of our study it was determined that both 0.5 % concentrated 30 mL bupivacaine and 0.5 % concentrated 30 mL levobupivacaine used in lateral popliteal nerve block for foot and ankle surgery were sufficient to perform the block and provided sufficient anesthesia quality. Although bupivacaine group was statistically more efficient in terms of motor block quality, there were no differences between two drugs with regard to sensory block quality and side effect. Patient and surgeon satisfaction was found to be high and no difference was found between two drugs. Levobupivacaine or bupivacaine can be used in lateral approach to popliteal block for foot and ankle surgery because of both of these agents similar anesthesia quality, patient/surgeon satisfaction and side effects.

ACKNOWLEDGMENT

I and all authors have no conflict of interest

Author contribution:

Ozkan ORHAN; Study design, literature review, article writing.
Melek GURA; Study control, study design.
Ali Nadir OZCEKIC; Surgical examination and literature review.
Namik Kemal OZKAN; Surgical examination and literature review.
Sevgi KESICI; Literature review and, article writing.

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Table 1: Time to complete sensory blockade/time to complete block duration and administration time of first analgesic of patients.

Time	Group L	Group B	Mann Whitney	p
Time to sensory blockade (minute)	21.66±5.23	21.80±6.74	106.5	0.799
Time to block duration (hour)	9.87±1.73	10.07±3.26	101.0	0.629
Administration time of first analgesic (hour)	11.80±2.7	10.57±2.06	75.5	0.194

Data are presented as mean ± SD

Table 2: The gradation of sensory blockade of total patients

Sensory blockade		Group L		Group B		p
		n	%	n	%	
Lateral sural cutaneous	**Felt as sharp-pointed but weaker**	1	6.7	4	26.7	
	Recognized as touch with a blunt object	11	73.3	11	73.3	χ^2:4.8
	No perception of touch	3	20.0	0	0.0	p=0.091
Sural	**Felt as sharp-pointed but weaker**	1	6.7	3	20.0	
	Recognized as touch with a blunt object	10	66.7	12	80.0	χ^2:5.18
	No perception of touch	4	26.7	0	0.0	p=0.075
Superficial Peroneal	**Felt as sharp-pointed but weaker**	0	0.0	3	20.0	
	Recognized as touch with a blunt object	12	80.0	8	53.3	χ^2:3.94
	No perception of touch	3	20.0	4	26.7	p=0.139
Deep Peroneal	**Felt as sharp-pointed but weaker**	1	6.7	4	26.7	
	Recognized as touch with a blunt object	11	73.3	7	46.7	χ^2:2.83
	No perception of touch	3	20.0	4	26.7	p=0.243

Data are presented as no. and % of total patients.

Table 3: The gradation of motor blockade of total patients

Motor Blockade		Group L		Group B		p
		n	%	n	%	
	Normal muscular function	1	6.7	0	0.0	
	Slight depression in muscular function	10	66.7	2	13.3	
Plantar	**Very weak action persisting in muscles**	4	26.7	9	60.0	**χ^2:12.2**
Flexion	**Complete block**	0	0.0	4	26.7	**p=0.007**
	Normal muscular function	1	6.7	0	0.0	
	Slight depression in muscular function	9	60.0	2	13.3	
Dorsal	**Very weak action persisting in muscles**	5	33.3	9	60.0	**χ^2:10.6**
Fleion	**Complete block**	0	0.0	4	26.7	**p=0.014**

Data are presented as no. and % of total patients.

Table 4: Patient and surgeon satisfaction levels.

Satisfaction levels		Group L		Group B		p
		n	%	n	%	
	Very satisfied	11	73.3	10	66.7	
	Satisfied	3	20.0	4	26.7	
	A little					
Postoperative Patient	**satisfied**	1	6.7	0	0.0	χ^2:2.2
satisfaction	**Not satisfied**	0	0.0	1	6.7	p=0.534
Patient satisfaction	**Very satisfied**	14	93.3	13	86.6	χ^2:0.37
Postoperative 24th						
hour	**Satisfied**	1	6.7	2	13.4	p=0.500
Postoperative	**Perfect**	12	80.0	11	63.6	χ^2:0.18
Surgeon satisfaction	**Good**	3	20.0	4	36.4	p=0.500

Data are presented as no. and % of total patients.

Table 5. Changes in MBP, HR and SpO_2 at various specified timings in two groups

Vital Parameters	Time	Group L	Group B	Mann Whitney	p
MBP	**Start**	91.87±10.72	94.40±10.91	95.5	0.480
	Block	91.00±9.76	96.67±12.09	80.5	0.182
	1st min	88.87±12.05	94.80±12.41	82.5	0.212
	15th min	94.13±11.90	93.47±15.21	109.0	0.884
	30th min	94.13±10.55	93.67±15.24	109.0	0.884
	45th min	92.47±8.18	92.27±9.09	106.5	0.803
	End of surgery	93.40±9.69	92.00±9.53	103.0	0.692
	Friedman p	0,004	0,006		
HR	**Start**	73.47±8.33	79.53±8.70	67.5	0.061
	Block	74.27±8.20	77.73±8.89	80.0	0.176
	1st min	70.87±7.82	74.73±5.02	79.5	0.170
	15th min	71.67±7.35	76.20±9.96	80.0	0.176
	30th min	75.07±6.70	75.20±8.50	111.5	0.967
	45th min	74.67±8.07	75.13±8.22	99.0	0.575
	End of surgery	75.00±8.82	75.67±7.08	102.0	0.663
	Friedman p	0,339	0,463		
SpO_2	**Start**	98.07±0.96	97.93±0.59*	91.0	0.310
	Block	98.13±1.06	98.33±0.62	107.5	0.818
	1st min	98.20±0.68	98.53±0.64	81.5	0.155
	15th min	98.20±0.77	98.33±0.72	102.0	0.637
	30th min	98.33±0.62	98.33±0.72	110.0	0.909
	45th min	98.60±0.63	98.60±0.63	112.5	0.999
	End of surgery	98.67±0.62	98.87±0.35*	96.5	0.340
	Friedman p	0,004	**0,000***		

Data are presented as mean ± SD

MBP: Mean blood pressure; HR: Heart Rate; SpO_2:Peripheral oxygen saturation

Figure 1. CONSORT Flow Diagram