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Original Article

A comparison of ankle block and spinal anesthesia for foot surgery

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Abstract: Regional anesthesia methods in the lower extremity include central blocks where spinal and epidural anesthesia are performed as well as peripheral nerve blocks, which are performed by injecting anesthetics locally to nerves. The study aimed to provide a retrospective comparison of unilateral spinal block and ankle block methods in foot operations. Some 60 ASA I-III patients who underwent operation under regional anesthesia were retrospectively examined. Two groups, known as the Unilateral Spinal Block Group (Group S) (n=30) and the Ankle Block Group (Group A) (n=30), were designed. Average blood pressure (ABP), heart rate (HR), block formation time (BFT), time for being ready for operation (TBRFO), total operation duration (TOD), visual analogue scale (VAS), first analgesic need time (FANT) and any complications were all recorded. The BFTs were longer in Group A than Group S, while the FANTs were longer in Group A postoperatively. When these decreases in Group A and Group S were compared with the basal values before the block, all decreases in Group S following the block were considered statistically significant ($P<0.05$), while the decreases in Group A in the 5th and 15th minutes were not considered statistically significant. The VASs measured postoperatively at the 6th, 12th and 24th hours of Group A were lower than those of Group S ($P\leq 0.05$). Despite the longer block formation, the ankle block is safer when compared to the spinal anesthesia, which involves risky hemodynamic changes in patients with associated diseases.

Keywords: Ankle block, unilateral spinal block, foot operations, visual analog scale

Introduction

Today, regional anesthesia in the lower extremities is considered preferable to general anesthesia. Postoperative recovery is faster in cases involving regional anesthesia and the hospital costs are lower [1, 2]. Additionally, the limitations in movement, operational stress, and other similar problems are better controlled in regional anesthesia methods. Further, depression stemming from opioids, drowsiness, and side effects such as nausea-vomiting are less frequently observed [1] when compared to general anesthesia.

Regional anesthesia methods in the lower extremity include central blocks where spinal and epidural anesthesia are performed, peripheral nerve blocks where anesthetics are injected locally to nerves and plexus, and area blocks involving injecting anesthetics locally around the operational area. Among these, the spinal anesthesia method is most commonly used in lower extremity operations [3]. The most significant advantage of peripheral nerve blocks over the other regional anesthesia methods is such blocks being limited to the area innerved by the nerve [4]. In a study by Mineo et al., it was reported that the local anesthetic level, which was checked in the venous blood in the 90th minute following the ankle block, reached its peak level at what was still a very low level [5]. Therefore, it is expected that the complication rate will be much lower in peripheral nerve blocks when compared to the other methods. When the literature was examined, it was observed that many studies reported the incidence of cardiovascular and neurological side effects to be considerably lower in peripheral blocks when compared with general and spinal anesthesia [6, 7]. Furthermore, another advantage of peripheral nerve blocks in the lower extremities is that they provide longer analgesia during the postoperative period and so decrease the use of additional analgesic. Previous studies have shown that long-term analgesia was ensured with femoral-sciatic blocks, popliteal blocks, ankle blocks, and similar methods that were applied to provide anesthesia during lower extremity operations [8, 10].

Foot operations (hallux valgus, debridement, traumatic and non-traumatic amputation, pulling out of nails, etc.) are performed for many reasons. The patients at the plastic surgery clinic in our hospital mainly fell within the ASA (American Society of Anesthesiologists) I-III risk group and most of them had additional diseases (diabetes mellitus, cardiovascular system diseases, neurologic diseases, etc.) as well as open wounds to the foot, debridement, and toe amputation. For these reasons, the anesthesia method used for such patients must be one that will be both safe and efficient. No other study in the literature has directly compared these two methods in terms of the hemodynamic and postoperative analgesic effects. Peripheral blocks in the lower extremity that also include an ankle block were compared with spinal and general anesthesia in one study [9]. In other studies, peripheral blocks in the lower extremity without an ankle block were compared with spinal and general anesthesia methods [10-12]. The current study aimed to provide a retrospective comparison of the unilateral spinal block and ankle block methods in foot operations performed at our plastic surgery clinic in cases involving open wounds to the foot, debridement, and toe amputation.

Methods

After the study protocol was approved by the Ethics Committee, the files of some 60 patients who had previously undergone operations due to open wounds to the foot and who received regional anesthesia were retrospectively examined in our plastic surgery clinic and included in the ASA I-III risk group. The information concerning these patients was first obtained from the computer registers, and then their files were procured from the archives and examined. Any patients who received regional anesthesia and then later required general anesthesia, as well as any patients who were classified with greater than ASA III risk, were excluded from the study. The patients included in the study were divided into two groups: patients who received a unilateral spinal block (Group S) (n=30) and patients who received an ankle block (Group A) (n=30). The demographic data concerning the patients (age, gender, height, weight, anesthesia risk group, etc.), average blood pressure (ABP) values taken non-invasively from the operation registries in the patient files, and the heart rate (HR) parameters before and after the spinal block and ankle block in the 5th, 15th, 30th, 45th, and 60th minutes were recorded. The duration of anesthesia, the time for being ready for operation (TBRFO) and the operation time were also recorded from the registers. The visual analogue scale (VAS), which was postoperatively requested from the patients and recorded. The VAS scale is a numerical scale in which having no pain is coded as 0 and having the most extreme unbearable pain is coded as 10. The first analgesic need time (FANT) written in the service orders and the complications (if any) were also recorded.

All patients who received regional anesthesia were administered 0.02 mg/kg of midazolam IV sedation prior to the process. The unilateral spinal block was applied as follows: First, the extremity to be operated on was placed in the lateral decubitus position with the medium line approach. Next, the subarachnoid space was entered with a 25-gauge Quincke needle from the L 4-5 intervertebral area. Finally, after the free BOS flow was observed, 10 mg of 0.5% hyperbaric bupivacaine was administered. The patients were left in this position for 10 minutes and then placed in the supine position.

The ankle block was applied as follows: First, the patient was placed in the supine position and then a cushion was placed under the ankle to enable access to all nerves and to make it easy to position the foot. Next, the entry point was marked on the foot and then disinfection was applied. The entry was performed from the gap in the extensor hallucis longus tendon lateral, which was marked and made clear by dorsiflexion of the toes in advance for deep peroneal nerve blockage with a 4 cm 25-gauge needle until the needle reaches the bone. Then,

Table 1. Demographic values

	Group S	Group A	P
Age (Year)	39.57±15.71	49.03±21.21	P<0.05*
Height (cm)	167±9.8	170.5±8.7	P=0.864
Weight (kg)	50.43±4.56	49.33±4.58	P=0.892
Gender (F/M)	12/18	8/22	P=0.321

*This difference was found to be statistically significant (P≤0.05).

Table 2. Block formation time (BFT)-Time for Being ready for operation (TBRFO); Total Operation Duration (TOD)-First Analgesic Need Time (FANT)

	Group S	Group A	P
BFT (min)	6.53±1.52	13.07±1.94	P<0.05*
TBRFO (min)	14.70±2.03	16.80±2.10	P=0.315
TOD (min)	50.43±4.56	49.33±4.58	P=0.966
FANT (min)	289±87.5	616±155.7	P<0.05*

*This difference was found to be statistically significant (P≤0.05).

the needle was withdrawn 1-2 mm and 2 ml of 0.5% bupivacaine was administered. The same procedure was repeated twice and a total of 5 ml local anesthetics was given in the shape of a fan in different points. Next, the posterior tibial nerve block (the other deep nerve) was performed. To do this, the posterior tibial artery, which was marked in advance, was palpated just behind the medial malleoli. Then the entry in the lateral position of the artery was entered with the needle and forwarded until the bone, just as in the deep peroneal nerve, then withdrawn 1-2 mm. A total of 5 ml of 0.5% bupivacaine was administered in the shape of a fan. Since the superficial peroneal nerve, sural nerve, and saphenous nerve are located just under the skin, the entry was performed in a circular line with a suture needle 2-3 cm over the malleoli level. Some 5 ml of 0.5% bupivacaine was administered for each nerve and thus the blockage was performed. For the saphenous nerve, the needle was forwarded until it was between the medial malleoli and the Achilles tendon; for the superficial peroneal nerve, it was forwarded until it was between the tibial bulge and lateral malleoli; and for the sural nerve, it was forwarded until it was between the lateral malleoli and the Achilles tendon. The local anesthetic was administered in these locations to form a puff under the skin.

Statistical analysis was performed with the Statistical Package for Social Sciences (SPSS, Inc., Chicago, IL), version 20.0. Means and standard deviations were used to describe the numerical variables. In the comparison of the measurable parameters, the t-test (independent samples test) was utilized, while in the comparison of the non-measurable parameters, Pearson's chi-square test was used. Data were examined at 95% confidence interval and a value of $P<0.05$ was accepted as statistically significant.

Results

The parameters were similar in both groups in terms of the patients' demographic data, except for the age parameters. The ages of the ankle block group (Group A) were higher than the ages of the spinal anesthesia group (Group S). This difference was found to be statistically significant (P<0.05) (**Table 1**).

While the total operation durations (TOD) were similar between the groups, the block formation times (BFT) and the times for being ready for operation (TBRFO) were longer in Group A. However, these difference was not found to be statistically significant on TBRFO (P=0.315). It was also found that patients in neither group required additional analgesics to the intraoperative analgesics. When we evaluated the first analgesic need times (FANT) among groups, they were obviously longer in Group A. This difference was found to be statistically significant (P≤0.05) (**Table 2**).

When the hemodynamic data concerning the patients was examined, it was observed that the average blood pressure (ABP) and the heart rate (HR) values decreased in both Group A and Group S. The average blood pressure (ABP) and the heart rate (HR) values in Group S decreased more noticeably when compared to those in Group A; however, this was not statistically significant (P≤0.05) (**Tables 3**, **4**). When these decreases in Group A and Group S were compared with the basal values before the block, all decreases in Group S following the block were considered statistically significant (P≤0.05), while the decreases in Group A in the 5^{th} and 15^{th} minutes were not considered statistically significant (P≤0.05).

Moreover, when we considered whether intraoperatively there was a vasopressor requirement or not, it was observed that 10 mg ephedrine HCL was intravenously administered to

Table 3. Average Blood Pressure Values of the Cases (mm-Hg)

	Group S	Group A	P
Before the block[a]	106.63±26.48**,****	105.50±12.47***	P=0.932
After the block 5th (min)[b]	92.33±14.01	105.03±11.62	P=0.643
After the block 15th (min)[c]	88.37±13.13	104.10±12.53	P=0.548
After the block 30th (min)[d]	86.87±12.50	102.80±12.61	P=0.405
After the block 45th (min)[e]	84.57±11.66	102.33±12.61	P=0.466
After the block 60th (min)[f]	82.43±10.43	101.20±12.91	P=0.454

*This difference was found to be statistically significant (P≤0.05); **a compared with b, c, d, e, f in Group S: (P<0.05); ***a compared with b, c in Group A: (P<0.05); ****a compared with d, e, f in Group S: (P<0.05).

Table 4. Heart Rates (HR) of the Cases (beat/min)

	Group S	Group A	P
Before the block[a]	90.60±12.73**,****	91.27±15.06***	P=0.932
After the block 5th (min)[b]	81.50±12.68	89.83±12.71	P=0.899
After the block 15th (min)[c]	77.10±12.88	87.60±12.97	P=0.673
After the block 30th (min)[d]	73.57±11.66	86±12.98	P=0.476
After the block 45th (min)[e]	72.50±11.41	85.07±11.74	P=0.354
After the block 60th (min)[f]	70.10±11.02	82.93±11.14	P=0.433

*This difference was found to be statistically significant (P≤0.05); **a compared with b, c, d, e, f in Group S: (P≤0.05); ***a compared with b, c in Group A: (P≤0.05); ****a compared with d, e, f in Group S: (P≤0.05).

Table 5. Post-operative VAS Scores of the Cases (Average ± SD)

	Group S	Group A	P
Post-operative 6th (hour)	3.67±1.70	0.33±0.08	P<0.05*
Post-operative 12th (hour)	5.03±1.24	2.67±1.15	P<0.05*
Post-operative 24th (hour)	2.37±1.27	1.20±0.48	P<0.05*

*This difference was found to be statistically significant (P≤0.05).

seven patients in Group S after the spinal block, although no patients required it in Group A. The visual analogue scale (VAS) values, which were checked at the 6th, 12th and 24th postoperative hours, were clearly lower in Group A when compared to Group S. This difference was found to be statistically significant (P≤0.05) (**Table 5**). When the files were examined in terms of postoperative complications in Group S, one patient experienced postoperative backache, one patient had urine retention and two patients complained of nausea, vomiting, and headache on the second day after the operation and so required anesthesia consultation. There were no postoperative complications in Group A.

Discussion

Peripheral nerve blocks decrease the patient's need for general anesthesia by providing area-specific anesthesia. Indeed, in postoperative pain treatment, they contribute to the anesthesia management by diffusing the analgesic duration to the postoperative period in addition to their intraoperative anesthesia effects [13, 14]. Despite these positive properties, peripheral nerve blocks are generally used less when compared to other methods. The reasons for this include the fact that anesthesiologists' skills vary regarding this anesthesia technique, it requires additional time, the anesthesia effect time is later, and its safety is variable [15].

We assessed the two anesthesia methods that we applied in our plastic surgery clinic to patients who were mainly diabetics and who received surgical treatment for open wounds to the feet in terms of BFT, TBRFO, FANT, hemodynamic variables, and pain scores. Although BFT (the time from the cleaning of the skin until the block formation) and TBRFO were shorter in the spinal anesthesia group (Group S) when compared with the ankle block group (Group A). While there are no other studies in the literature directly comparing spinal anesthesia with ankle block in terms of these durations, there are some studies that compare other peripheral nerve blocks with the spinal anesthesia method applied in lower extremity operations. Cappelleri et al. found that the being ready for operation durations were similar in both groups when they compared one-day unilateral spinal block and combined femoral sciatic block applications in patients who underwent knee arthroscopy [16]. Özhan et al. reported that in one-day lower extremity operations, the peripheral block durations and being ready for operation durations were significantly longer when compared with the general and spinal anesthesia methods and different peripheral nerve blocks (ankle, femoral-sciatic, and popliteal-saphenous) [9]. In our study, block formation time (BFT) was statistically significantly higher in Group A; however, although total time for being ready for operation (TBRFO) was higher in Group A, unlike the study by Özhan et al. the difference did not reach statistical significance. Statistically insignificant difference between TBRFOs despite higher BFTs in favour of Group A were thought to be resulted from the surgeons not to pay attention sufficiently to the onset time of operation in the patients in both groups.

It was reported in a widespread study of the complications of regional anesthesia methods that cardiovascular (cardiac arrest) and neurological complications (radiculopathy, cauda equina syndrome, paraplegia) were rarely observed in regional anesthesia applications; the rate was the highest in spinal anesthesia methods and the lowest in peripheral nerve blocks [17]. In our study, we observed that the ankle block application was a safe and efficient method in foot operations [18]. It ensured long-term analgesia and had lower neurological and cardiac side-effects when compared to the spinal and general anesthesia [7]. Another study by Rudkin et al. reported that no complications were observed in bilateral ankle blocks applied to patients undergoing foot operations, and that this method was thus a safe method that could be applied in foot operations when accompanied by proper sedation [19]. In our study of ankle block and spinal anesthesia patients, we performed measurements to assess the hemodynamic changes. We observed that the average blood pressure and heart beat rate decreased in both Group A and Group S after the block application; however, this decrease was clearer in Group S. When compared with the pre-block basal values in particular, it was observed that, although there was not a significant decrease in Group A in the first 15 minutes following the block, all decreases in all durations in Group S were at a significant level. Furthermore, it was also observed that some patients in Group S intraoperatively required vasopressor. In our study, the majority of the patients who underwent operations due to open wounds to the foot also suffered from diabetes and cardiac-associated diseases. Therefore, it is suggested that in such patients spinal anesthesia might affect the hemodynamic values more than ankle block and so pose a greater risk. For this reason, the ankle block method is preferable.

Again, many studies have stated that the ankle block, as well as other lower extremity blocks, ensured intraoperative anesthesia and long-term analgesia during the postoperative period [7, 11, 19]. Özkan et al. reported that when spinal and general anesthesia were compared with peripheral nerve blocks, the first analgesic requirement time was longer and the total analgesic consumption decreased considerably [9]. Similarly, in our study the first analgesic requirement time was relatively longer when compared with the spinal anesthesia group (in Group S 289 minutes; in Group A 616 minutes). Moreover, the VAS scores that were checked postoperatively were considerably lower in Group A.

Despite similar demographic data in the patients in both groups, lack of a homogeneous distribution particularly in terms of age may be specified as an imperfect aspect of our study. This may be caused by the ankle block considered more reliable than the spinal anesthesia in the management of selected anesthesia in the elderly patients and those with additional diseases who were predicted to be at higher risk, as a general procedure implemented in our clinic. Preference of an anesthetic method that would not create risk as much as possible and result in less hemodynamic alterations in the case of foot surgery which doesn't require a very high level of block, can be regarded as a more convenient and reliable anesthetic approach. Indeed, more vasopressor agent requirements and postoperative complications were seen in Group S, supporting this notion.

Consequently, we conclude that although there might be a longer block formation in the ankle block, it is still preferable, especially for elderly patients and patients with associated diseases, due to its prolonged postoperative analgesic effect. It is also preferred due to its being generally safer than spinal anesthesia, in which certain complications may be observed.

Disclosure of conflict of interest

None.

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