



Comparison between ultrasound-guided sciatic–femoral nerve block and unilateral spinal anaesthesia for outpatient knee arthroscopy

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Abstract

Objective: To compare unilateral spinal anaesthesia (USA) and ultrasound-guided combined sciatic–femoral nerve block (USFB) in ambulatory arthroscopic knee surgeries in terms of haemodynamic stability, nerve block quality, bladder function, adverse events and time-to-readiness for discharge (TRD).

Methods: Patients undergoing ambulatory arthroscopic knee surgery were randomly assigned to one of two groups. The USA group received 2 ml (10 mg) of 0.5% levobupivacaine and the USFB group received a 25 ml mixture consisting of 10 ml of 2.0% lidocaine, 10 ml of 0.5% levobupivacaine and 5 ml of saline (15 ml for the femoral and 10 ml for the sciatic nerve block). Preparation time (PT), surgical anaesthesia time (SAT), operation time, total anaesthesia time, time-to-first spontaneous urination, time-to-first analgesia, TRD, adverse events and patient satisfaction were recorded.

Results: A total of 40 patients were enrolled in the study ($n = 20$ per group). PT, SAT, total anaesthesia time and time-to-first analgesia were significantly shorter in the USA group than the USFB group; time-to-first spontaneous urination and TRD were significantly longer in the USA group than the USFB group.

Conclusions: USFB provided sufficient duration of sensory blockade and it reduced the TRD and the rate of adverse events.

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Introduction

Ambulatory orthopaedic procedures have become increasingly common due to the effectiveness of the anaesthesia techniques that facilitate rapid and safe discharge.^{1,2} Regional anaesthesia techniques are used as an alternative to general anaesthesia in these procedures.³ It is generally accepted that both peripheral nerve blocks and spinal anaesthesia provide sufficient anaesthesia, and better postoperative analgesia and satisfaction than general anaesthesia, in addition to being minimally invasive and using less resources.^{3,4}

Unilateral spinal anaesthesia (USA) is particularly preferred by patients undergoing unilateral lower limb surgery due to the fact that only the desired region undergoes nerve blockade, which results in early mobilization and good patient satisfaction.^{2,3,5} In addition, USA is known to provide haemodynamic stability.^{2,3,5}

Combined sciatic–femoral nerve block (SFNB) is also used for unilateral lower limb surgery, but it remains a less frequently used technique because it takes a longer time to perform, requires a higher dosage of local anaesthetic and causes paraesthesia.^{3,4} Ultrasound-guided sciatic–femoral nerve block (USFB) is the preferred technique because it avoids SFNB-related side-effects and is associated with a number of benefits such as less needle insertion, improved block quality, short administration time, decreased dosage of local anaesthetic and a rapid onset of nerve blockade.^{6,7}

The present randomized study compared USA and USFB in patients undergoing ambulatory arthroscopic knee surgery in

terms of the stability of haemodynamic parameters, the quality of the nerve block, bladder function, adverse events and readiness for discharge from hospital.

Patients and methods***Patient population***

This randomized study enrolled consecutive patients aged 18–65 years with American Society of Anesthesiologists (ASA) physical status I–II,⁸ who were scheduled to undergo elective arthroscopic knee surgery including selective meniscectomy, chondroplasty, loose body removal, synovectomy and subchondral bone drilling in the Department of Orthopaedics and Traumatology, Faculty of Medicine, Mustafa Kemal University, Hatay, Turkey, between January 2011 and December 2011. Exclusion criteria included: allergies, bleeding disorders, localized infections, neurological disease, anatomical abnormalities of the spinal column, respiratory or cardiac disease, morbid obesity, chronic analgesic therapy, diabetes mellitus, peripheral neuropathy or anterior cruciate ligament surgery.

Patients were randomized using a computer-generated randomization table into two groups: the USA group and the USFB group. Demographic and clinical data including age, sex, weight, height, ASA physical status scores and type of surgery were recorded for all patients. The study was approved by the Ethics Committee of Mustafa Kemal University Medical School, Hatay, Turkey (no. MKU-2011). All patients provided written informed consent.

Surgical and anaesthetic procedure

All patients received premedication with 0.05 mg/kg midazolam intravenous injection following 7 ml/kg normal saline infusion before the surgical procedure.

In the USA group, spinal anaesthesia was achieved by injecting 2 ml (10 mg) of 0.5% levobupivacaine (Chirocaine®; Nycomed Pharma, Elverum, Norway) at the lumbar L3–L4 level through a 27-gauge Ballpen spinal needle (Rüsch, Kern, Germany) in the left or right lateral decubitus position, as appropriate, for 15 min.

In the USFB group, the sciatic and femoral nerve blocks were achieved using a 25 ml mixture consisting of 10 ml of 2.0% lidocaine (Biologici Italia Laboratories, Masate, Italy), 10 ml of 0.5% levobupivacaine (Chirocaine®; Nycomed Pharma) and 5 ml of saline (15 ml for the femoral and 10 ml for the sciatic nerve block) with the aid of a nerve stimulator (Stimuplex® HNS 11; B Braun, Melsungen, Germany) under ultrasound guidance using a Vivid *e* ultrasound scanner (GE Healthcare, Piscataway, NJ, USA) as previously described.^{9,10}

All nerve blocks were performed by the same anaesthetist (I.D.) and the surgical procedures were undertaken by the same orthopaedic surgeon (R.O.).

Outcome assessments

In the USA group, time-to-achieve surgical anaesthesia (surgical anaesthesia time [SAT]) was defined as complete sensorial loss at the thoracic 12 level with complete motor blockade. In the USFB group, SAT was defined as the presence of sensorial block at the distribution of the sciatic and femoral nerves with immobility or inability to move the ankle and knee of the operated leg. Routine clinical monitoring was undertaken using a Datex-Ohmeda Cardiacap/5® monitor (GE Healthcare). Haemodynamic changes were measured at baseline, at 5-min

intervals during the first 30 min after initiation of nerve block, and at 15-min intervals until completion of the surgery.

Time from skin preparation of the application site to the end of the local anaesthetic injection was recorded as the preparation time (PT). Nerve block quality was determined according to the need for additional anaesthesia and sedation as follows: (i) adequate nerve block when neither sedation nor analgesics were required; (ii) inadequate nerve block when additional analgesia was required; (iii) failed nerve block when general anaesthesia was required.

The intraoperative free movement of the knee joint was classified as excellent, sufficient or insufficient. Pain was assessed by a 10-cm visual analogue scale (VAS) (0, no pain; 10, worst pain imaginable) at the pre-operative period (baseline) and at 15-min intervals during the first 2 h, and at 4, 6 and 24 h after surgery.

Total anaesthesia time (TAT) was defined as the time from last local anaesthetic injection to complete resolution of sensorial and motor blockade. Time-to-readiness for discharge (TRD) was defined as the interval that began at the end of surgery and ended when the patient's status was recorded as alert, with stable vital signs, able to void urine and ambulate, and nausea and pain were controllable by oral medication.

Data regarding duration of surgery, time-to-first spontaneous urination, time-to-first analgesia need, adverse events and complications, patient satisfaction (excellent, good, sufficient, insufficient) and whether or not the patient would prefer the same procedure again were recorded by investigators that were blinded to the randomization group.

Postoperative evaluations were performed by telephone interview at 24 h and 1 week after surgery. Patients were questioned about postoperative pain, nausea, headache, lower back pain and transient neurological symptoms including pain or dysaesthesia in the buttocks, thighs or lower limbs.

In addition, patient satisfaction was assessed at 24 h after surgery by a telephone interview in which the patients were asked to rate their level of satisfaction as excellent, good, satisfactory or unsatisfactory.

Sample size estimation and power calculation

Sample size estimates were based on TRD. It was estimated that a sample size of 16 per group would provide 90% power to detect a clinically significant difference of 40 min (within-group SD, 39 min) at an α significance level of 0.05.

Statistical analyses

All statistical analyses were performed using the SPSS[®] statistical package, version 15.0 (SPSS Inc., Chicago, IL, USA) for Windows[®]. Pearson's χ^2 -test and Fisher's exact test were used for comparisons between categorical variables. For continuous variables, Mann–Whitney *U*-test was

used. A *P*-value < 0.05 was considered statistically significant.

Results

This randomized study enrolled 40 patients scheduled to undergo ambulatory arthroscopic knee surgery to one of two groups: USA group (*n* = 20) and USFB group (*n* = 20). There were no significant differences observed between the two groups in terms of demographic characteristics and ASA physical status (Table 1). The power calculation for this study was based on the mean $\pm$ SD TRD, which was 257.57 ± 16.50 min in the USA group and 200.75 ± 5.68 min in the USFB group. As there were 20 patients in each group at the completion of the study, the study had 100% power to detect a clinically significant difference of 40 min (within-group SD, 39 min) at an α significance level of 0.05.

The mean PT was 4.85 min in the USA group (Table 2), but then the patients were required to wait in the lateral decubitis

Table 1. Demographic characteristics of patients (*n* = 40) who were scheduled to undergo arthroscopic knee surgery and who participated in a randomized study to compare unilateral spinal anaesthesia (USA group) and ultrasound-guided sciatic–femoral nerve block (USFB group).

Characteristic	USA group <i>n</i> = 20	USFB group <i>n</i> = 20
Age, ^a years	48.50 $\pm$ 13.39	39.85 $\pm$ 13.27
Sex ^b		
Male (%)	14 (70)	12 (60)
Female (%)	6 (30)	8 (40)
Weight, ^a kg	78.40 $\pm$ 12.17	77.40 $\pm$ 13.32
Height, ^a cm	169.55 $\pm$ 5.86	168.75 $\pm$ 6.41
ASA physical status ^c		
I	16 (80)	15 (75)
II	4 (20)	5 (25)

Data presented as mean $\pm$ SD or number of patients (%).

^aMann–Whitney *U*-test.

^bPearson's χ^2 -test.

^cFisher's exact test.

No statistically significant between-group differences (*P* $\geq$ 0.05).

ASA, American Society of Anesthesiologists.

position on the blockade side for 15 min; so the mean total time before the initiation of surgery was 19.85 min. In the USFB group, the mean PT for the sciatic–femoral block was 11.20 min followed by a mean of 15.65 min before the nerve blockade was achieved; thus the mean total time before the initiation of surgery was 26.85 min. When the two groups were compared, there was a 7-min delay prior to surgery in the USFB group.

The surgery, anaesthesia and postoperative duration data in the USA and USFB groups are shown in Table 2. The mean PT, SAT and duration of surgery were significantly shorter in the USA group than the USFB group ($P=0.0001$ for all comparisons). The mean time-to-first analgesia need was significantly shorter in the USA group than the USFB group ($P=0.0001$). The mean TAT was significantly shorter in the USA group than the USFB group ($P=0.0001$). The mean time-to-first spontaneous urination was significantly longer in the USA group than the USFB group ($P=0.0001$). The mean TRD was significantly longer in the USA group than the USFB group ($P=0.0001$).

The mean VAS pain scores at 4, 6 and 24 h after the end of surgery were

significantly lower in the USFB group than the USA group ($P<0.05$ for all comparisons) (Figure 1). Pain was observed in seven patients at 24 h after the end of surgery in the USA group. Postoperative pain relief was considered as sufficient in the USFB group. Only one patient (5%) in both groups required additional analgesia to complete surgery. No patients required general anaesthesia. No serious intraoperative complications were observed. In the USA group, hypotension developed in one patient that required vasopressor administration in addition to fluid replacement. No significant differences were observed in heart rate between the two groups (data not shown).

Intraoperative free motion of the knee joint was recorded as excellent in 18 (90%) and sufficient in 2 (10%) patients in the USA group; in the USFB group it was found to be excellent in 19 (95%) patients and sufficient in one (5%) patient. Contralateral blockade was detected in four (20%) patients in the USA group. In the USA group, grade 3 motor blockade was observed in 19 patients (95%). The motor blockade level was grade 3 in 14 patients (70%) and grade 2 in six (30%) patients in the USFB group. The difference between the two groups in terms of motor blockade was significant

Table 2. Surgery, anaesthesia and postoperative duration data for patients ($n=40$) who were scheduled to undergo arthroscopic knee surgery and who participated in a randomized study to compare unilateral spinal anaesthesia (USA group) and ultrasound-guided sciatic–femoral nerve block (USFB group).

Variable	USA group $n=20$	USFB group $n=20$	Statistical significance ^a
Preparation time, min	4.85 ± 0.58	11.20 ± 0.61	$P=0.0001$
Surgical anaesthesia time, min	7.75 ± 1.99	15.65 ± 1.95	$P=0.0001$
Duration of surgery, min	42.75 ± 13.05	44.75 ± 5.72	$P=0.0001$
Total anaesthetic time, min	180.15 ± 23.67	410.50 ± 75.32	$P=0.0001$
Time-to-first spontaneous urination, min	244.40 ± 38.33	170.05 ± 21.07	$P=0.0001$
Time-to-first analgesic need, min	190.60 ± 36.27	412.15 ± 69.19	$P=0.0001$
Time-to-readiness for discharge, min	257.75 ± 16.50	200.75 ± 5.68	$P=0.0001$

Data presented as mean $\pm$ SD.

^aMann–Whitney *U*-test.

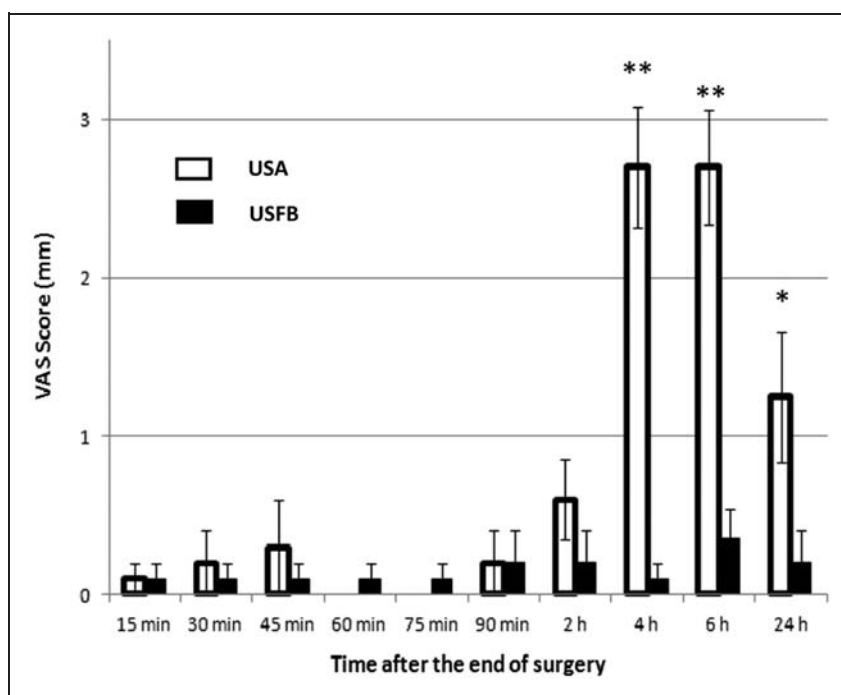


Figure 1. Postoperative visual analogue scale (VAS) scores for pain in patients ($n = 40$) who were scheduled to undergo arthroscopic knee surgery and who participated in a randomized study to compare unilateral spinal anaesthesia (USA group) and ultrasound-guided sciatic–femoral nerve block (USFB group). Data are shown as mean $\pm$ SEM. * $P < 0.05$ versus the USFB group; ** $P < 0.0001$ versus the USFB group; Mann–Whitney U -test.

($P < 0.05$). In the USFB group, 14 patients still had grade 2 motor blockade at 4 h after the end of surgery, while none of the patients in the USA group had motor blockade at the same time-point. Motor blockade was completely resolved in the USFB group by 7 h after the end of surgery. The quality of motor blockade was similar in both groups. In the postoperative period, additional analgesia was needed in 15 patients after a mean of 190.60 min in the USA group, while in the USFB group it was needed in only one patient after 412.15 min.

During the postoperative period, there was no headache, nausea, vomiting, motor deficit or dysaesthesia reported by any patient in either study group. In the USA group, there was lower back pain reported by three patients at 24 h after the end of

surgery, while one patient reported lower back pain at 1 week after the end of surgery. Although patient satisfaction was better in the USFB group compared with the USA group, there was no significant difference between the two groups (data not shown). All patients reported that they would prefer the same anaesthesia technique in the future, if required.

Discussion

Although there are several studies comparing USA with combined SFNB in outpatient knee arthroscopy in the literature, this present study is the first to investigate the use of combined SFNB with ultrasound guidance. The present study demonstrated that USFB provided some advantages compared with

USA including prolonged TAT and delayed time-to-first requirement for analgesia, earlier spontaneous urination and a shorter time-to-readiness for discharge from hospital; USFB, however, had a significantly longer PT and SAT compared with USA. Previous research demonstrated that SFNB with ultrasound guidance increased the success rate resulting in improved block quality compared with a neurostimulator alone.⁶

In the present study, the PT for USFB was significantly longer than that for USA. This could be due to the fact that the technique was blocking more than one nerve, which required two distinct positions. Similar differences were reported in other studies.^{4,11,12} In our opinion, the difference observed for USFB compared with the USA group in the present study was caused by a lack of experience in the use of ultrasound guidance. This was one of the limitations of the present study.

The SAT was significantly lower in the USA group compared with the USFB group in the present study. However, there was only a 7-min delay before beginning the surgery in the USFB when the 15 min waiting time after performing USA was taken into consideration. Consistent with these current results, Imbelloni et al.¹² compared sciatic-femoral block and USA and found that there was only a 5-min delay before the beginning of surgery in the combined sciatic-femoral block group.

In the USFB group, the SAT was similar to values reported in studies using mepivacaine despite the use of an agent with a longer onset time of action such as levobupivacaine.^{2,11} The time-to-initiation of surgery was reported to be 31 min when using 20 ml of levobupivacaine via nerve stimulator alone.¹³ In the present study, ultrasound guidance provided an advantage and a lower SAT was obtained compared with values reported previously.¹³ The time-to-onset of nerve block was decreased in sonography-guided groups.⁷

In this present study, the TAT was found to be similar to values obtained in studies using 10 mg hypobaric and 7.5 mg hyperbaric levobupivacaine.^{14,15} In the present study, the TAT in the USFB group was decreased by 50% compared with values reported previously.¹³ In this present study, the TAT with low-dose USFB was sufficient and it was significantly prolonged compared with the USA group.

In two studies, 4% of patients failed to achieve acceptable anaesthesia when SFNB was used.^{4,16} The failure rate after spinal anaesthesia varies between 3% and 6%.^{15,17,18} The rate of inadequate nerve block was 5% (one patient in each group required additional analgesia) in the present study and this was consistent with the literature.^{15,17,18}

The presence of sufficient postoperative analgesia is essential to facilitate rehabilitation after knee arthroscopy.⁴ In spinal anaesthesia, the presence of pain after regression of the nerve block is one of the factors that limit its use. In the present study, USFB provided significantly more effective analgesia than USA at 4, 6 and 24 h after surgery. Montes et al.⁴ reported that SFNB provided more effective analgesia than spinal anaesthesia, particularly at 6 h after surgery. Another study found that analgesics were needed after 230 min in the spinal anaesthesia group compared with after 310 min in the SFNB group.³ In the present study, there was a significant difference in the time-to-first analgesia need between the two groups. In the postoperative period, additional analgesia was needed in 15 patients after a mean of 190.60 min in the USA group, while it was needed in only one patient after 412.15 min in the USFB group.

The selection of the anaesthesia technique and the anaesthetic agents are important as the adverse events and complications affect discharge time in ambulatory cases.¹⁹ In the USA group in the present study, lower back

pain was reported by three patients at 24 h after the end of surgery, while one patient reported lower back pain at 1 week after the end of surgery. No adverse events were observed in the USFB group.

Another limiting factor for discharge from hospital is urinary retention, which is related to neuraxial blockade and is a commonly observed adverse event. In previously reported studies, return of spontaneous urination was the most limiting factor that determined time of discharge.^{15,20} Return of spontaneous urination was used in the present study as one of the criteria used to determine readiness for discharge from hospital. Two previous studies suggested that SFNB was as effective and safe as spinal anaesthesia without causing urinary retention.^{11,20} In the present study, time-to-first spontaneous urination was significantly longer in the USA group despite rapid resolution of the nerve block compared with the USFB group. Thus, the TRD was significantly shorter in the USFB group compared with the USA group.

Clinicians have concerns about discharge of patients who have undergone peripheral nerve block with longer times of action for lower extremity procedures due to loss of pain sensation, which is considered to be a sensorial and protective reflex.⁴ However, a previous study showed that this was a safe and effective procedure for this patient group.²¹ In the present study, there were no adverse events observed after discharge, in agreement with the literature.²¹

In conclusion, the preferential selection and successful use of a nerve block is based on it not only having a short PT and rapid onset of action, but also on it providing lower rates of complications and adverse events, a longer duration of analgesia, good patient satisfaction and optimal patient discharge compared with other available agents. In our opinion, it should be possible to achieve PTs and SATs with USFB that are as short as those achieved with USA in

patients undergoing ambulatory procedures of the lower extremities by increasing the experience of the surgical team of using ultrasound guidance. Taking these current findings into consideration, USFB appears to be a good alternative for USA in ambulatory arthroscopic knee surgery.

Declaration of conflicting interest

The authors declare that there are no conflicts of interest.

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