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Comparison of unilateral spinal anesthesia and L_1 paravertebral block combined with psoas compartment and sciatic nerve block in patients to undergo partial hip prosthesis

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Abstract. – OBJECTIVES: Just as hip prosthesis, most of the patients undergoing orthopedic lower extremity surgery (OLES) belong to the advanced age group. Sciatic nerve block combined with psoas compartment block is used as a technique alternative to central neuraxial block and GA. In geriatric patients that will undergo partial hip prosthesis, the effects of the methods of unilateral spinal anesthesia (SA) and L_1 paravertebral block combined with psoas compartment block (PCB) and sciatic nerve block (PCSL) on peroperative hemodynamic parameters and the duration of need for postoperative analgesia were studied.

PATIENTS AND METHODS: Fifty patients from the ASA III-IV group were randomly divided into two groups. Group SA was administered spinal anesthesia with hyperbaric bupivacaine (2 ml, 0.5%) from the selected intervertebral distance (L4-L5 or L3-L4) in lateral position. Group PCSL was administered L1 paravertebral block combined with PCB and sciatic nerve block with bupivacaine hydrochloride (total 35 ml). Hemodynamic parameters (HR: heart rate and MAP: mean artery pressure) were recorded in pre- and post-intervention 5-minute intervals. The initial time of the need for analgesia of patients were evaluated postoperatively.

RESULTS: Any failure in methods implemented on patients in either group was not observed. Times of anesthesia and surgical preparation of patients were observed to have significantly prolonged in the PCSL compared to Group SA ($p < 0.005$). Hundred and 5th and 110th min. mean arterial pressures of patients was found to be significantly higher in Group SA compared to Group PCSL ($p < 0.05$). The initial time of the need for analgesia was observed to be significantly prolonged in Group PCSL (432.80 ± 236.77 min) compared to Group SA (185.40 ± 171.40 min) ($p < 0.001$).

CONCLUSIONS: Unilateral SA conducted with bupivacaine hydrochloride and PCSL block technique provided a hemodynamically similar activity in the perioperative period in patients that underwent partial hip operation. However, PCSL block implementation extended the initial time of the need for analgesia in postoperative period. PCSL method could be selected in cases belonging to such group of patients. PCSL block can be a alternative anesthetic tecniques in patients that underwent partial hip operation.

Key Words:
Partial hip prosthesis, Unilateral spinal anesthesia, Lumbar plexus block, Sciatic nerve block, Hemodynamic effects.

Introduction

Just as hip prosthesis, most of the patients undergoing orthopedic lower extremity surgery (OLES) belong to the advanced age group. In these patients, the fact that cardiac, endocrine, renal, cerebral, and respiratory tract diseases accompany the current surgical pathology increases the risk of morbidity at the time or following the operation[1]. In high-risk geriatric patients, postoperative pain treatment also poses an issue for anesthesiologists due to co-morbid diseases[2]. Approach to anesthesia for such patients generally includes general anesthesia (GA), central neuraxial block, and use of systemic analgesics for postoperative pain treatment. Spinal anesthesia (SA) is the most commonly used method of regional anesthesia (RA) in OLES and seems to be more advantageous compared to epidural and GA. Hemodynamic effects of spinal anesthesia varies depending on sympathetic block induced by anesthesia, preoperative cardiac performance, and the condition of intravascular volume of the patient[3,4].

Psoas compartment block (PCB) is an alternative approach used to overcome side effects related with GA and central neuraxial block tech-

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niques. Sciatic nerve block combined with psoas compartment block (PCSL) causes a unilateral lower extremity anesthesia. Nowadays, PCSL is used as a technique alternative to central neuraxial block and GA. Through psoas compartment block, femoral, lateral femoral cutaneous and obturator nerves are blocked simultaneously[5]. However, blockage of subcostal nerve derived from T_{12} and posterior rami from L_1 may not be possible with PCB in some individuals. Therefore, a combination method of paravertebral T_{12}-L_1 nerve blockage, psoas compartment and sciatic nerve blockage should be used in order to provide a complete nerve block in the surgical area in hip prosthesis operations. When local anesthetic (~5 ml) is administered to T_{12}-L_1 paravertebral region, it is spread and can easily create blockage in subcostal and posterior rami[6].

In our study, we aimed to study times of anesthesia and surgical preparation, hemodynamic parameters, and effects of unilateral SA and T_{12}-L_1 paravertebral block combined with PCB and sciatic nerve block (PCSL) techniques on postoperative analgesia in anesthesia administration of patients to undergo partial hip prosthesis.

Patients and Methods

Following obtaining the approval of Faculty Ethics Committee and Australian New Zeeland Clinical Trials Registry (ANZCTR, ANZCTR number is 12613001186741), 50 patients (26 female/24 male) at ages ranging from 68 to 98 belonging to ASA III-IV group that were planned to be operated by RA method and to undergo partial hip prosthesis were included in the study. Patients that were allergic to local anesthesia, with neurological diseases, infection in the intervention area, with whom cooperation could not be established, and that did not accept the procedure were excluded from the study. After informed consent form was obtained, patients were randomly divided into two groups by closed envelope method as Group SA: spinal anesthesia group (n = 25) and Group PCSL: T_{12}-L_1 paravertebral block combined with psoas compartment block and sciatic nerve block group (n = 25). All patients taken to the operation table were monitored by noninvasive arterial blood pressure, heart rate (HR), and peripheral oxygen saturation (SpO_2). Before performing the block, peripheral vascular access was provided by 18G cannula on patients and 500 mL 0.9% NaCl solution was infused in 20 minutes. Hemodynamic parameters were recorded in 5 minute intervals till the end of preoperative and perioperative operation times. Patients in each group were administered 50 µgr fentanyl IV before the procedure. Patients into Group SA were administered 2 mL hyperbaric bupivacaine hydrochloride (Marcain Heavy 0.5%, Astra-Zeneca®) with 25G Quincke spinal needle (Braun®) from the selected intervertebral distance (L_4-L_5 or L_3-L_4) following local sterilization in lateral decubitus position. Following the procedure, patients left in this position for 15 minutes were positioned in lateral position so that the surgical side is on top. After observing dorsal and plantar flexion on feet with the help of a nerve stimulator (Multiplex, Pajunk®, Geisingen, Germany) by using a 10 cm long block needle by Labat technique[7], sciatic nerve block was then obtained on patients in Group PCSL with 15 mL bupivacaine hydrochloride (by mixing 5 mg/mL Marcaine, Astra-Zeneca® and 10 mL 0.9% NaCl, making a total volume of 25 mL) following negative aspiration technique. Then, when observed lumbar plexus stimulation (quadriceps muscle fasciculation) with the help of nerve stimulator by Winnie technique[7], psoas compartment block was obtained with 15 mL bupivacaine hydrochloride (by mixing 5 mg/mL Marcaine, AstraZeneca® and 10 mL 0.9% NaCl, making a total volume of 25 mL) following negative aspiration technique. Later on, L_1 paravertebral block was obtained with 5 mL bupivacaine hydrochloride (by mixing 5 mg/mL Marcaine, Astra-Zeneca® and 5 mL 0.9% NaCl, making a total volume of 10 mL) by using the technique of Moore[8]. Implementation time of both techniques, anesthesia preparation time, and the period until the beginning of surgical intervention were recorded as surgical preparation period. Level of analgesia was evaluated with pinprick test and motor block degree was assessed by modified Bromage scale (0: No block, 1: hip flexion blocked while knee is in extension, 2: knee flexion blocked, 3: complete motor block); following the administration of drug, sensory and motor block were evaluated with the measurement of hemodynamic parameters in 5 minute intervals. After a complete motor block was developed, surgical intervention was initiated. The time from the beginning of surgical incision up to the completion of procedure was recorded as the operation time. A decrease of 25% and above in basal mean arterial pressure was accepted to be hypotension, and in

Table I. Demographic data of patients.

	Group SA	Group PCSL	*p*
Age (year)	81 ± 7.54	78.80 ±5.90	NS
Gender F/M	13/12	13/12	NS
ASA III/IV	18/7	17/8	NS
Operation time (min)	93.80 ± 17.63	100.60 ± 26.54	NS

NS: No significant.

that case, 5 mg ephedrine IV and an additional 5 mL/kg crystalloid fluid were administered. Heart rate reduced to 50/min was accepted as bradycardia and 0.5 mg atropine IV was administered. The entire patients were given 3 L/min O_2 with mask and 5 mL/kg/hour maintenance crystalloid fluid at the time of operation. Motor block return time and initial time of the need for analgesia were recorded.

Statistical Analysis

SPSS 15.00 (Statistical Packages for the Social Sciences, SPPS Inc., Chicago, IL, USA) software pack was used for statistical analysis. Parametric values were taken as mean ± SD, and nonparametric values were taken as median (min ± max). For the inter-group comparison of parametric tests, their distributions were established and Student's *t* test was implemented. Mann-Whitney U test was applied in nonparametric measurements. Paired-*t* test and Wilcoxon's test were carried out for the evaluation of in-group repeated measurements. $p < 0.05$ was accepted to be statistically significant.

Results

A significant difference was not observed between the groups in demographic data of patients included in the study (Table I).

Anesthesia preparation time was established to be significantly longer in Group PCSL (15.60 ± 5.06 min) compared to Group SA (7.40 ± 3.57 min) ($p < 0.005$). While the period from the beginning of RA preparation till the beginning of surgical intervention was found to be significantly longer in Group PCSL (30.60 ± 3.57 min) compared to Group SA (27.40 ± 3.57 min) ($p < 0.005$), motor block time was established to be significantly longer in Group PCSL (436.00 ± 236.01 min) compared to Group SA (197.00 ± 131.21 min) (p 0.001) (Figure 1).

When evaluated the heart rates of patients, a significant difference was not observed. At 105th and 110th min measurement times of patients, MAP was established to be significantly higher in Group SA compared to Group PCSL ($p < 0.05$) (Figure 2).

Initial time of the need for analgesia was found to be significantly longer in Group PCSL (432.80 ± 236.77 min) compared to Group SA (185.40 ± 171.40 min) ($p < 0.001$) (Figure 3).

Discussion

In patients that will undergo lower extremity orthopedic surgical intervention, RA techniques are frequently implemented. Administered with posterior approach for lumbar plexus block, PCB possesses significant advantages over perivascular approach (femoral nerve block or "3-in-1 block"). Blockage of obturator nerves with posterior approach (for the anteromedial aspect innervating

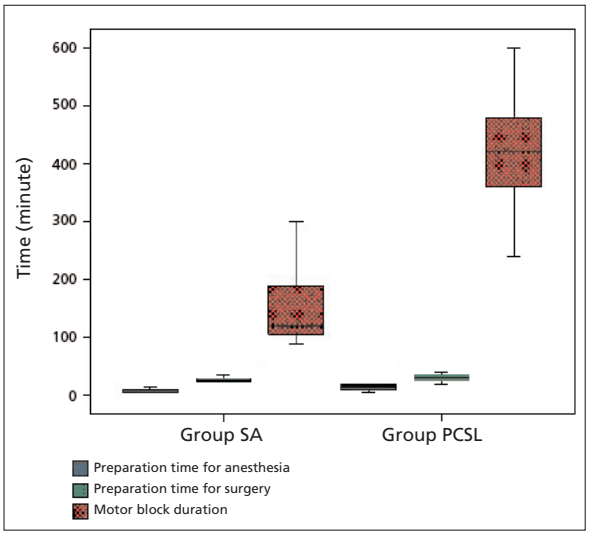

Figure 1. Preparation time for anesthesia and surgery, and motor block duration.

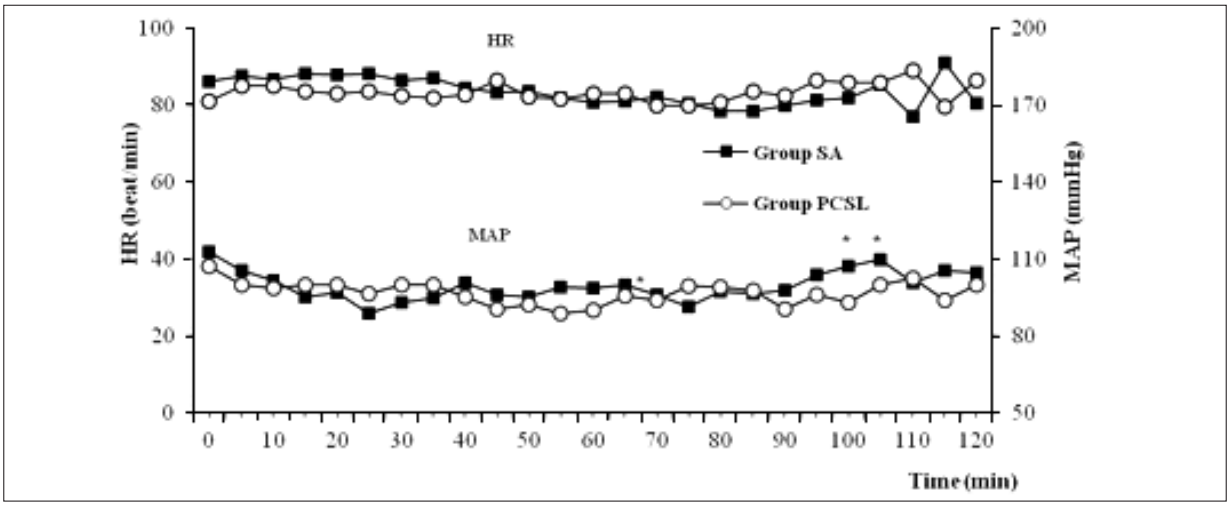

Figure 2. Heart rate and mean arterial pressure of the patients. *$p < 0.05$ when Group SA compared to Group PCSL.

the articular branches of hip joint capsule) provides a more effective blockage[9]. Since posteromedial aspect of hip joint capsule is innervated by sciatic nerve branches[10], PCB and "high" sciatic nerve block should be obtained together in order to establish anesthesia for the entire leg and hip[11]. Mannion et al[12] reported that one of the reasons for PCB being insufficient for hip prosthesis surgical intervention could result from the variations of dermatomes from T_{12}-L_1 within the surgical area. De Leeuw et al[13] argued that L_1 paravertebral block implementation in addition to PCB would be efficient in providing an effective anesthesia for hip prosthesis surgery. In such surgical interventions, the combination of PCB and sacral plexus block that accompany perioperative sedation were reported to be an efficient alternative to general anesthesia[14]. We observed in our study that L_1 paravertebral block that we combined with PCB and sciatic nerve block established a sufficient level of anesthesia in our patients.

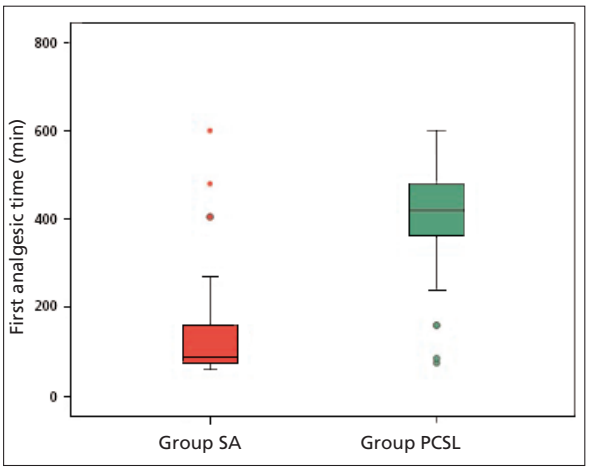

Figure 3. First time of analgesic needed of patients.

PCB and sciatic nerve block applications have a significant place in postoperative analgesia following hip surgery. Postoperative opioid consumption of patients that undergo PCB was demonstrated to decrease considerably[15,16].

It was established that the patients that were administered general anesthesia along with PCB had lower pain scores in postoperative period compared to patients that did not undergo PCB[17]. In a meta-analysis, PCB block procedure with catheter technique could provide 8 hour and above analgesia compared to opioids[18].

Both techniques of spinal anesthesia with bupivacaine and sciatic nerve block combined with PCB were reported to provide sufficient amount of anesthesia in patients, and in postoperative period, that sciatic nerve block combined with PCB significantly extended the initial time of the need for analgesia more[19].

We established in our study that the initial time of the need for analgesia was significantly longer in postoperative period in PCSL block.

While, in hip prosthesis surgery, mean arterial pressure of 38% of geriatric patients that were administered spinal block with hyperbaric bupivacaine was observed to have decreased, mean arterial pressure of 27% of patients that underwent combined lumbar and sacral block was established to have reduced; however, such a change was not found to be significant compared to basal values[19].

Peripheral nerve block techniques have limited hemodynamic effects compared to central RA techniques. Among the reasons are regional blood flow and less affected sympathetic nerves[20,21]. Naja et al[22] established in combined sciatic-paravertebral nerve block practice that hypotension observed during the operation was lower compared to general anesthesia and that it significantly reduced the need for intensive care in postoperative period.

In our study, a significant difference was not observed between the groups in terms of hemodynamic changes in perioperative period. In addition, MAP at 105th and 110th measurement times were found to be significantly higher in Group SA compared to Group PCSL. We believe that this was due to a decrease in post-spinal block sensory block effect.

While in geriatric patients to undergo partial hip prosthesis operation spinal anesthesia is frequently used, hypotension is observed at a high rate in such patients during spinal anesthesia[23-25]. In addition, risk of coronary ischemia secondary to hypotension also increases in such patients due to high risk of ischemic heart disease[26]. Unilateral SA technique implemented in lateral position creates less sympathetic denervation compared to supine position and causes more limited hemodynamic changes[27].

In our study, the fact that a significant difference between perioperative and postoperative hemodynamic changes in two techniques was nonexistent suggests that it was due to the implementation of unilateral spinal method.

Casati et al[28] did not find any difference in terms of the quality of anesthesia and analgesia although combined sciatic-femoral nerve (25 ml mepivacaine) block application time (14 ± 5 min and 15 ± 6 min for spinal and sciatic-femoral group) was longer compared to the preparation stage (SA 5 ± 2.1 min, sciatic-femoral block 8 ± 2.7 min) when compared to SA (8 mg hyperbaric bupivacaine) for same-day knee surgery. Sansone et al[29] did not establish a significant difference in terms of application time in patients they administered spinal anesthesia and combined sciatic-femoral block. In another work, while SA procedure time was 12 min on average in elderly patients to undergo hip prosthesis operation, combined lumbar and sacral block procedure time was found to be 18 min on average[19].

In patients included in our study, anesthesia and surgical preparation times were established to be significantly longer in Group PCSL (15.60 ± 5.06, 30.60.45 ± 5.46 min) compared Group SA (7.40 ± 3.57, 27.40 ± 3.57 min). When considered as well the co-morbidities of patients at advanced ages that will undergo hip prosthesis procedure, reliability of such an anesthesia method shows that the waste of time disadvantage could be ignored.

Peripheral nerve blocks are implemented with success in OLES[30,31]. Peripheral nerve block techniques provide less postoperative nausea and vomiting, shorter hospital days, and better postoperative analgesia and early mobilization for patients that undergo orthopedic surgery. In addition, these techniques reduce the postoperative need for intensive care and total hospital day, and they are more economical[32]. Sufficient, comprehensive, and multicenter studies are yet to exist in literature to be able to recommend the use of PCSL instead of GA or central neuraxial block in perioperative period in hip operations.

Conclusions

We observed that unilateral spinal anesthesia technique and PCSL block technique provide similar perioperative hemodynamic efficiency in hip operations for high-risk geriatric patients, and that PCSL block technique extended postoperative time of the need for analgesia. We believe that PCSL block technique can be implemented with ease in such cases and further researches are needed in order to put forth its efficiency.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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