Comparison of Spinal, Low-Dose Spinal and Epidural Anesthesia With Ropivacaine Plus Fentanyl for Transurethral Surgical Procedures

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The aim of this study was to compare spinal, low-dose spinal, and epidural anesthesia using ropivacaine and fentanyl combinations for transurethral surgical procedures. Sixty patients with American Society of Anesthesiologists scores of I–III were allocated into three groups. After preloading with 5 mL/kg normal saline, patients in the spinal anesthesia group (Group S) received 15 mg of hyperbaric ropivacaine plus 25 μg of fentanyl intrathecally; patients in the epidural anesthesia group (Group E) received 112.5 mg of ropivacaine plus 25 μg of fentanyl epidurally *via* an epidural catheter; and patients in the low-dose spinal anesthesia group (Group L) received 10 mg of hyperbaric ropivacaine plus 25 μg of fentanyl intrathecally. Blood pressure, heart rate, peripheral oxygen saturation, time to onset of thoracic (T)-10 dermatome, two-segment sensorial block regression time, full recovery of sensorial block, maximum motor blockade levels, motor blockade regression time, additional analgesic administration, patient comfort, and complications were recorded. The time to the onset of T10 dermatome level was shortest in Group S and longest in Group E ($p < 0.001$). The sensorial blockade time and motor blockade regression time were shorted in Group L ($p < 0.001$). The two-segment sensorial block regression time in Group E exceeded that in the other groups. Additional analgesic administration was not needed in any group. No complications or adverse effects were observed in any patient. We conclude that all three anesthetic techniques may be used safely and are appropriate for transurethral surgical procedures. However, low-dose spinal anesthesia with ropivacaine plus fentanyl may be preferable in transurethral surgery because we reach an adequate sensorial level with less motor blockade.

Key Words: epidural anesthesia, low-dose spinal anesthesia, ropivacaine, transurethral surgery
(*Kaohsiung J Med Sci* 2010;26:167–74)

Transurethral procedures are frequently used in geriatric subjects. Patients in this age group may experience accompanying health problems such as atherosclerotic cardiovascular diseases, chronic obstructive lung disease, renal function disorders, hypertension, or diabetes mellitus. Therefore, the choice of anesthetic method is crucial in transurethral procedures. Priority should be given to the use of an anesthetic method

Received: Apr 29, 2009 Accepted: Oct 30, 2009
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This study was presented at ESRA 2007 as an oral presentation.

that has the least effect on cardiovascular stability and hemodynamics [1].

Regional anesthetic methods are commonly preferred in transurethral procedures because of their advantages such as less postoperative pain, less nausea and vomiting, early patient mobilization, and shorter hospital stay. This technique can be performed with the use of local anesthetics alone in different doses and intensity, or by combining local anesthetics with adjuncts such as opioids to obtain an adequate level of anesthesia together with more stable hemodynamics [2]. Bupivacaine is commonly used in spinal anesthesia. However, its prolonged effects may lead to a delay in motor block resolution, urinary retention, and a prolonged hospital stay. These problems limit the use of bupivacaine in day-case settings [3]. Alternatively, agents with a short effect such as lidocaine are associated with transient neurological symptoms [4]. Therefore, the search continues for a local anesthetic that offers a low motor blockade rate and short term effects, but without transient neurological symptoms.

Ropivacaine is a local anesthetic with similar effects and a greater safety margin than bupivacaine [5–7]. Intrathecal ropivacaine has been shown to cause equal sensory block, less motor block, and rapid regression of sensory block than bupivacaine at similar doses [8]. However, very few studies have evaluated the effect of ropivacaine and fentanyl at different doses during epidural and spinal anesthesia in transurethral procedures.

In this prospective randomized study, we compared the anesthesia quality, patient comfort, and complications between three groups of patients who underwent a transurethral procedure. The first two groups received a standard (15 mg; Group S) or low dose (10 mg; Group L) of hyperbaric ropivacaine plus 25 μg of fentanyl by spinal anesthesia, and a third group received an epidural combination of 15 mL of 7.5 mg/mL ropivacaine plus 25 μg of fentanyl (Group E).

Material and Methods

Patients

This prospective randomized study protocol was approved by the Local Ethics Committee of Pamukkale University, Medical Faculty Hospital, and written informed consent was obtained from each patient. We randomly selected a total of 60 patients with American Society of Anesthesiologists scores of I–III. The patients weighed 60–100 kg, were more than 1.60 m tall, and were scheduled for transurethral surgical procedures [e.g. transurethral resection of the prostate (TUR-P) and transurethral resection of bladder tumors]. Patients with serious central nervous system or peripheral nervous system disorders, organ failure, severe anemia, shock, severe systemic infection or infection at the injection site, coagulation defects, history of allergy to any type of local anesthetics, and syndromes precluding intrathecal drug administration (e.g. kyphosis, scoliosis, and previous operations) were excluded from the study. We did not include patients who did not volunteer for the technique. The patients were allocated into three groups using a random samples table (20 patients/group).

Anesthesia and operation procedure

In the operating room, all patients were administered oxygen at 2–4 L/min via a nasal cannula. Electrocardiography, non-invasive arterial blood pressure (BP), heart rate (HR), peripheral oxygen saturation (SpO_2) and respiration rate (RR) were monitored and recorded. An 18-G cannula was used for peripheral intravenous access, and 0.9% NaCl solution (5 mL/kg) was preloaded. Throughout the procedure, 0.9% NaCl infusion was maintained at a rate of 6 mL/kg/hr.

Hyperbaric ropivacaine solution was prepared by adding 2 mL of 20% dextrose to 4 mL of 7.5 mg/mL ropivacaine solution (0.75%; Naropin®; Astra Zeneca, Södertälje, Sweden); the final concentration of hyperbaric ropivacaine was 5 mg/mL. All three regional anesthesia techniques were applied to the patients in the right lateral position.

After skin antisepsis procedures in the Group S and Group L, a 25-G Quinke needle (Spinocan, Braun Melsungen AG, Melsungen, Germany) was advanced from the lumbar (L) L2–L3 or L3–L4 interspinous space, parallel to the dura fibers. Once cerebrospinal fluid appeared in the needle, the needle tip was rotated to the cephalad direction. If the cerebrospinal fluid remained clear, it was confirmed that the tip of the needle was completely placed in the subarachnoid cavity. In Group S, 15 mg of hyperbaric ropivacaine and 25 μg of fentanyl citrate (50 μg/mL; Abbott Labs, Chicago, IL, USA) were injected intrathecally within 30 seconds. In Group L, 10 mg of hyperbaric ropivacaine and 25 μg of fentanyl were injected intrathecally within 30 seconds.

In Group E, after the skin antisepsis, 0.1–0.2 mL of prilocaine was injected subcutaneously at the planned

injection site. To identify the epidural space, we used the loss of resistance technique by administering saline via an 18-G Tuohy needle at L2–L3 or L3–L4. The epidural catheter (Perifix®, Braun, Melsungen AG, Melsungen, Germany) was advanced by 3–4 cm and inserted into the epidural space. The catheter was fixed from the waist and back to the shoulders. The patient was then placed into the supine position and the test dose of 3 mL of 2% lidocaine was infused from the tip of the catheter over 3 minutes. Once the epidural space was confirmed, 15 mL of 7.5 mg/mL ropivacaine and 25 μg of fentanyl were injected epidurally within 30 seconds.

After the injection, the patients in all groups were quickly placed into the supine position. The sensory anesthesia level was assessed on the midclavicular line with the bilateral pinprick test using a 27-G blunt needle. The time to onset of analgesia was defined as the time to the onset of sensory block at any spinal segment level. The motor block level was assessed using the modified Bromage scale (0 = no motor block, the patient is able to partially bend knees while lying supine; 1 = partial motor blockade, the patient is able to move knees; 2 = almost complete motor blockade, the patient is able only to move feet; and 3 = complete motor blockade, inability to flex ankle joints). The time to onset time of thoracic (T)-10 dermatome, sensorial block two-segment regression time, time to full recovery from sensorial block, highest motor blockade levels, and motor blockade regression time were recorded.

Mean arterial BP, HR, and SpO_2 values were measured by an anesthesia monitor (ADU Cardiocap 5, Datex Ohmeda, Helsinki, Finland). Requirement for additional analgesia and adverse effects such as nausea, vomiting, and itching were also recorded. Patient comfort was assessed using a four-point scale (1 = very good, no discomfort; 2 = good, weak discomfort, no opioid requirement; 3 = middle, pain present, opioids required; 4 = insufficient, severe pain, general anesthesia required).

Intraoperative hypotension was defined as a 20% decrease from baseline or a systolic BP < 90 mmHg. In the event of intraoperative hypotension, 5 mg of ephedrine HCl (Biosel, Istanbul, Turkey) was administered intravenously. Furthermore, 0.5 mg of atropine sulfate (Haver, Istanbul, Turkey) was administered intravenously if HR fell below 55 beats/min. The total amount of ephedrine and atropine used was recorded. A RR of < 10 breaths/min and SpO_2 < 92% were considered to indicate respiratory depression.

Sufficiency of surgical anesthesia, the patient's subjective response to surgery, the need for additional analgesics or general anesthesia were recorded. If sufficient anesthesia could not be obtained, 50 mg of meperidine was administered intravenously. General anesthesia was used if the patient had repeated complaints of pain.

Post operation, patients with a modified Aldrete score of 9 were taken to their respective wards. Because a Foley catheter was inserted at this time, the development of urine retention could not be assessed.

Statistical analysis

All data were analyzed using SPSS version 10.0 (SPSS Inc. Chicago, IL. USA). One-way analysis of variance (ANOVA) was used to assess the following: demographic data, duration of operation, time to reach the T-10 dermatome, time to reach maximum sensory level, sensorial block two-segment regression time, motor block regression time, time to full recovery from sensorial block, maximum motor block level, amount of ephedrine used, and the first dose of analgesic needed. Tukey's *post hoc* test was used to identify differences between groups for parameters that were found to be significant with ANOVA ($p < 0.05$). Repeated-measures ANOVA was used to assess preoperative and postoperative mean BPs and HR. Data are reported as mean ± standard deviation. Side effects such as nausea, vomiting, itching, local anesthetic agent toxicity findings, and patient comfort were assessed with Pearson's χ^2 test. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Demographic characteristics

The demographic characteristics were similar for all groups, with no statistical differences between the groups in terms of age, height, weight, American Society of Anesthesiologists physical condition, and the transurethral procedures performed (Table 1).

Characteristics of the operation and anesthesia

No significant difference was found between the three groups with respect to the operation times. There was

Table 1. Characteristics of the 60 patients with different transurethral procedures*

	Group S ($n=20$)	Group L ($n=20$)	Group E ($n=20$)	p
Age (yr)	69.0±3.2	71.0±2.6	70.0±4.9	0.2
Weight (kg)	73.5±6.8	73.0±6.5	76.05±11.9	0.5
Height (cm)	172.6±4.1	172.8±3.1	167.8±12.7	0.1
ASA I/II/III (n)	1/19/0	1/15/4	5/13/2	0.2
Duration of surgery (min)	122.8±3.4	122.7±4.4	122.8±4.8	0.8
TUR-P/TUR-B	15 (75)/5 (25)	14 (70)/6 (30)	14 (70)/6 (30)	0.8

*Data presented as mean±standard deviation, n or n (%). Groups=Spinal anesthesia group; Group L=low dose spinal anesthesia group; Group E=epidural anesthesia group; ASA=American Society of Anesthesiologists risk class; TUR-P=transurethral resection of prostate procedure; TUR-B=transurethral resection of bladder tumors procedure.

Table 2. Characteristics of regional anesthesia techniques*

	Group S ($n=20$)	Group L ($n=20$)	Group E ($n=20$)	p
Sensory block				
Onset time of T10 level block (min)	5.7±1.3†§	12.0±2.9†‡	25.1±6.5‡§	0.001
Time to reach maximum sensory level (min)	8.0±1.4†§	11.9±5.2†‡	25.9±5.7‡§	0.001
Time to two-segment regression (min)	91.0±8.2†§	79.5±7.9†‡	124.0±5.9‡§	0.001
Time to full recovery (min)	182.8±15.1†	125.0±9.3†‡	187.8±7.7‡	0.001
Motor block‖				0.001
BS 0	0	9 (45)	7 (35)	
BS 1	0	4 (20)	3 (15)	
BS 2	1 (5)	4 (20)	3 (15)	
BS 3	19 (95)	3 (15)	7 (35)	
Time to full recovery (min)	157.0±9.8†	97.1±21.9†‡	138.3±18.9‡	0.001
Adverse events				
Nausea	6 (30)	0	0	0.001
Vomiting	0	0	0	NS
Itching	4 (20)	0	0	NS
Local anesthetic toxicity	0	0	0	NS
Ephedrine usage	5 (25)	0	0	0.004
PDPH	3 (15)	3 (15)	0	0.189
Patient comfort				NS
Very good	13 (65)	16 (80)	17 (85)	
Good	7 (35)	4 (20)	3 (15)	

*Data presented as mean±standard deviation, n or n (%); †$p<0.05$ between Group S and Group L; ‡$p<0.05$ between Group E and Group L; §$p<0.05$ between Group S and Group E; ‖0: no motor block, 1: partial motor blockade, 2: almost complete motor blockade, 3: complete motor blockade. BS=Bromage scale; PDPH=post dural puncture headache; Group S=spinal anesthesia group; Group L=low dose spinal anesthesia group; Group E=epidural anesthesia group; NS=not significant.

a significant difference between Groups S and E ($p<0.001$), Groups S and L ($p<0.05$) and Groups E and L ($p<0.001$) for the time to reach maximum sensory level. In addition, the time to reach the T-10 dermatome level was significantly different between Groups S and E, Groups E and L, and Groups S and L (all: $p<0.001$; Table 2). The time to full recovery from sensorial block was similar in Groups S and E, but shorter in Group L than in Groups S and E (both: $p<0.001$). No significant difference was observed between Groups S and E for motor block regression time. The motor block regression time in Group L was significantly shorter than that in Groups S and E (both: $p<0.001$). There was a statistically significant difference between the two-segment regression times ($p<0.001$) and was significantly longer in Group E than in Groups S and L (both: $p<0.001$).

At minute 3, a block was obtained at T12 (thoracic 12th vertebral level spinal anesthesia) more quickly in Group S than in Groups E and L ($p<0.05$). None of the groups showed a block at T7, but the desired block at T10 was reached in all groups (Figure 1).

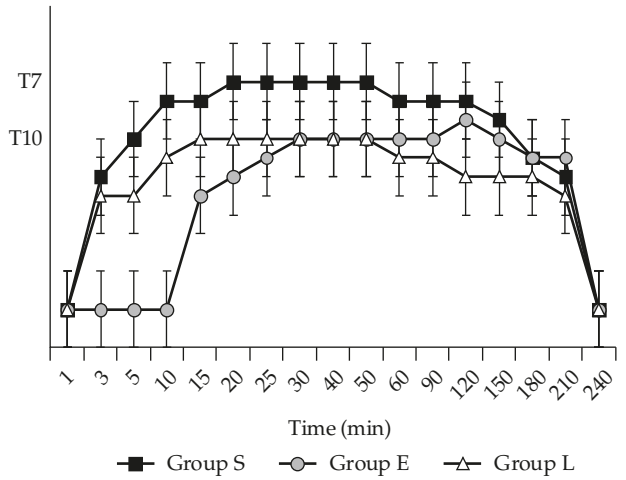

Figure 1. *Changes in sensory block over time. S = Spinal anesthesia; L = low-dose spinal anesthesia; E = epidural anesthesia; T = thoracic.*

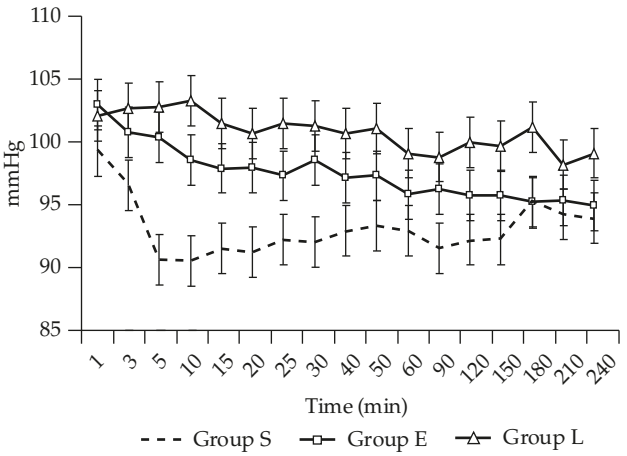

Figure 2. *Changes in mean blood pressure over time. S = Spinal anesthesia; L = low-dose spinal anesthesia; E = epidural anesthesia; T = thoracic.*

There were significant differences in the frequency of motor block between Groups S and E, Groups E and L, and Groups S and L (all: $p < 0.001$; Table 2). However, there were no differences in the visual analog scale scores between any groups ($p > 0.05$). Additional analgesic agents were not needed in any group. Similarly, RR and SpO_2 were comparable in all three groups.

Intraoperative and postoperative hemodynamic changes

There were no significant difference in mean arterial BPs and changes in HRs between the three groups (Figures 2 and 3).

Complications and patient comfort

Nausea was observed in six patients (30%) in Group S versus none in Groups E and L ($p < 0.005$). Vomiting was not observed in any of the three groups. Only four patients in Group S experienced itching versus none in Groups L and E. Unilateral block and local anesthetic agent toxicity did not occur in any patients of the all group. Ephedrine was used in five patients in Group S versus none in Groups L and E ($p < 0.05$). There were no differences between groups in terms of post dural puncture headache and patient comfort (Table 2).

Power analysis

Sensory block end times, two-segment regression times, and full recovery of motor block times were considered in the power analysis. The α error was defined as 0.05. Thus, the power of the study was > 98% [9].

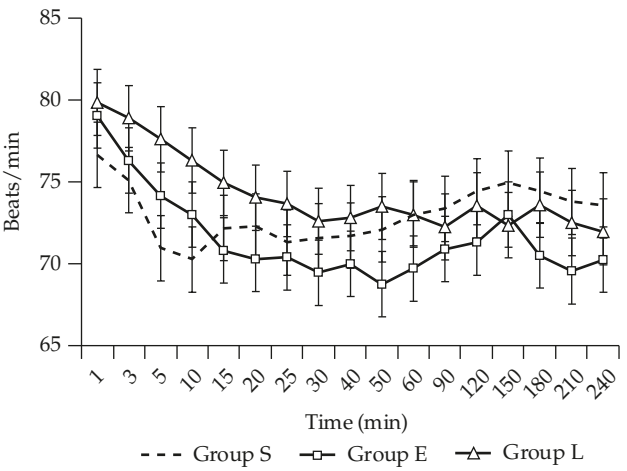

Figure 3. *Changes in heart rate over time. S = Spinal anesthesia; L = low-dose spinal anesthesia; E = epidural anesthesia.*

DISCUSSION

It has been reported that hyperbaric ropivacaine provides significantly shorter motor block duration, faster regression of sensory block, and faster mobilization than an equivalent dose of hyperbaric bupivacaine and levobupivacaine [8]. Luck et al also reported that hyperbaric ropivacaine may be preferred because of its shorter motor block and duration of effect, particularly for patients requiring fast mobilization. Casati et al [10] concluded that levobupivacaine or ropivacaine may be used as alternatives to bupivacaine in spinal anesthesia.

In the study by Malinovsky et al [11], patients undergoing TUR-P or transurethral resection of bladder

tumors were intrathecally administered with 15 mg ropivacaine and the results seemed to suggest the motor and hemodynamic effects were similar to 10 mg bupivacaine. In another study, the 50% effective dose of hyperbaric ropivacaine in spinal anesthesia for cesarean section was 10.37 mg and the 95% effective dose was 15.39 mg [12]. In our study, we used 15 mg of hyperbaric ropivacaine in Group S and 10 mg in Group L.

Fettes et al [13] compared the plain and hyperbaric formulations of ropivacaine for spinal anesthesia. They concluded that the block starting time and block regression speed were both greater for hyperbaric ropivacaine, which is prepared by adding glucose to ropivacaine. The authors emphasized that, in surgery above the L1 dermatome, plain solutions were less safe. Kallio et al [14] also reported that motor and sensory block regression times and the duration of hospital stay were shorter with spinal anesthesia induced by 15 mg hyperbaric ropivacaine than with plain ropivacaine for lower extremity surgery. Thus, the results in our study are consistent with the above findings, and we obtained earlier mobilization with the use of hyperbaric ropivacaine solutions for spinal anesthesia.

Combining fentanyl with bupivacaine has been reported to increase the quality of spinal anesthesia, and enhance anesthesia without extending sensory or motor recovery times or length of hospital stay [15]. In a study comparing the intrathecal administration of 10 mg of hyperbaric ropivacaine with 7.5 mg of hyperbaric bupivacaine in patients undergoing TUR-P, no significant difference was found between the groups for the time to reach the T10 dermatomal level. Motor block time was 57 minutes in the ropivacaine group versus 82.4 minutes in the bupivacaine group. The sensory block regression time was 86.5 minutes with ropivacaine versus 92.5 minutes with bupivacaine. It was subsequently reported that different doses of ropivacaine may be needed relative to bupivacaine in TUR-P patients because it causes shorter motor block times [16]. Our results agree with these earlier studies. We obtained a shorter motor block and a longer analgesia time for spinal anesthesia by combining 10 mg of hyperbaric ropivacaine with 25 μg of fentanyl.

Kallio et al [17] compared intrathecal administration of 10 mg of hyperbaric ropivacaine plus 20 μg of fentanyl versus 15 mg of hyperbaric ropivacaine. They concluded that the group given 10 mg of hyperbaric ropivacaine displayed earlier mobilization, but there were no differences in terms of time to onset and duration of analgesia. Another study compared the effectiveness of 10 mg of hyperbaric ropivacaine in combination with 5 μg of sufentanil versus 15 mg of hyperbaric ropivacaine alone for spinal anesthesia in patients undergoing cesarean section [18]. The combination was observed to cause significantly less hypotension, nausea, shivering, shortened motor block time, and longer analgesia than 15 mg of ropivacaine. In a study comparing the combinations of ropivacaine plus fentanyl and bupivacaine plus fentanyl for spinal anesthesia in transurethral procedures, Lee et al [19] used isobaric solutions and the sensory block level was similar in both groups, while the motor block time was shorter with ropivacaine plus fentanyl and all patients displayed full motor block. In our study, we found that hyperbaric ropivacaine plus fentanyl elicited short-term motor block; and full motor block did not even occur in some patients in the low-dose spinal group. The results obtained in Group L are consistent with those obtained by Kallio et al [17] in patients given a combination of 10 mg of hyperbaric ropivacaine plus 20 μg of fentanyl for spinal anesthesia in day surgeries.

Previous studies have emphasized the importance of the concentration of ropivacaine. In a study comparing the epidural administration of 20 mL of 0.75% ropivacaine versus 100 μg of fentanyl in combination with 0.5% bupivacaine in patients undergoing elective cesarean section, there were no differences in sensory block time, or the time to reach the T4 and S1 levels between the two groups. However, ropivacaine elicited deeper and longer motor block. The authors reported that 0.75% ropivacaine used epidurally without opioids may offer an alternative to 0.5% bupivacaine in combination with fentanyl [20]. Similar to our study, Cederholm et al [21] reported that 20 mL of ropivacaine given epidurally at a concentration of 0.5% or 0.75% with and without epinephrine. They stated that although 0.75% ropivacaine solution provided more rapid onset of analgesia and longer duration of sensory block than 0.5% ropivacanine solution, they both provided adequate sensory level and motor block in transurethral surgery. They also concluded that the addition of epinephrine did not significantly prolong sensory or motor block, or affect sympathetic block. In our study, more rapid onset, adequate and effective sensory block, and faster recovery were observed with epidural and low-dose spinal anesthesia. The mean

time to reach the maximum sensory level was 8 minutes in Group S, 26 minutes in Group E and 12 minutes in Group L. The T10 dermatome level was reached most quickly in Group S and most slowly in Group E. However, the motor block emergence rates were 95% in Group S (19 patients), 35% in Group L (7 patients), and 15% in Group E (3 patients).

All of our groups experienced adequate anesthesia, recovery and early mobilization after the transurethral procedures. We believe that the higher dose administered may be responsible for the longer duration of analgesia, the shorter time to reach maximum sensory level, and the more frequent motor block development in the Group S (15 mg of hyperbaric ropivacaine, intrathecal) than in Group L (10 mg of hyperbaric ropivacaine). There was a significant difference in the time to reach maximum motor block and two-segment block regression, and the time to full recovery of motor block. The two-segment regression time was significantly longer in Group E than in the other groups. We believe that the epidural anesthesia method used can affect the duration of anesthesia due to anatomical and physiological changes, particularly in elderly patients, as permeability of and sensitivity to local anesthetics increase with age.

Hypotension is a frequent adverse effect that occurs in approximately 30% of patients during spinal anesthesia [22]. The nerve block (T6–L1) causes accumulation of blood in the capacitance veins in the splanchnic bed, which contributes to the development of hypotension induced by high levels of anesthesia. Other factors triggering this include a reduction in cardiac reserve with increasing age, structural changes in arterioles, and changes in the autonomous nervous system [23]. No clinically significant changes occurred in any of our patients in terms of HR, BP, RR and SpO_2. However, some patients in Group S displayed a slight decrease in mean arterial BP, meaning that when 5 mg of ephedrine was administered in five patients, positive responses were achieved in all five patients. We believe that the slight fall in BP may have been due to decreased peripheral vascular resistance because spinal anesthesia causes faster onset of sympathetic block than epidural anesthesia. Previous studies have also shown that low-dose bupivacaine alone or in combination with low doses of fentanyl dramatically reduces the risk of hypotension [24]. In our study, we believe that the lower dose of ropivacaine used in Group L was responsible for the absence of ephedrine administration in that group compared with that in Group S.

Although no significant difference was observed in any of the three groups in terms of HR, a slight decrease was seen in Groups S and E during the first 15 minutes. We believe that the changes in HR and systolic BP during the early phase of the surgery can be explained by the doses of anesthetics and the anesthesia method applied.

The hemodynamic data for Group E are not consistent with those reported by Wolff et al [25], who reported frequent bradycardia and hypotension after administration of 20 mL of 0.75% or 20 mL of 1% ropivacaine for lumbar epidural anesthesia in elderly patients undergoing hip surgery. We attribute this to the lower dose used in our study. In a study comparing the use of administration of 7.5 mg/mL hyperbaric ropivacaine and 7.5 mg/mL hyperbaric levobupivacaine for spinal anesthesia for knee arthroscopy, ropivacaine was associated with less frequent hypotension and bradycardia [26].

We suggest that the lack of hemodynamic changes could have occurred due to intravascular absorption of the irrigation solution into the bladder after starting surgery in our study because the operation time was not extended in any group.

After sensory block disappeared, additional analgesics were not required in any group. This could be because the patients experienced considerably less pain during endoscopic transurethral procedures than during open surgeries.

Intrathecal lipophilic opioids may exert adverse effects such as nausea, vomiting, urinary retention, itching, and dose-dependent respiratory depression. However, even in elderly patients, intrathecal administration of 25 μg of fentanyl has been shown to provide effective preoperative analgesia without causing respiratory depression [27]. In a study using intrathecal administration of hyperbaric ropivacaine plus fentanyl for TUR-P, patients given 18 mg of hyperbaric ropivacaine plus 25 μg of fentanyl did not experience any nausea or vomiting [16]. In our study, only six patients in Group S reported nausea, although this may be related to the slight fall in mean arterial BP.

Itching was reported by four patients in Group S as well. However, this was of short duration and weak intensity, and did not require medication. Nausea, vomiting, and itching were not reported by patients in the other groups. Local anesthetic toxicity, postural

headache, and temporary neurological symptoms were not reported in any group.

In conclusion, an adequate sensory level can be reached without episodes of serious hypotension using ropivacaine in combination with fentanyl. Epidural administration of 15 mL of plain ropivacaine plus 25 μg of fentanyl was associated with less motor block than the other groups. Adequate operative anesthesia without any major side effects can be elicited with low-dose intrathecal administration of 10 mg of hyperbaric ropivacaine in combination with 25 μg of fentanyl.

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