Selective spinal anesthesia for inguinal herniorrhaphy

Yasar Pala, MD, Murat Ozcan, MD, Gulten Dikmeer, MD, Vildan Taspinar, MD, Dilsen Ornek, MD, Levent Ozdogan, MD, Aydin Selcuk, MD, Bayazit Dikmen, MD.

ABSTRACT

الأهداف: تحديد الخصائص المميزة لمحلولين تخدير شوكي ناقصان الثقل عند إستعمالهما في التخدير الشوكي الإنتقائي في عمليات رقو الفتق الأُرْبِيّ الجراحية.

الطريقة: تم القيام بهذه الدراسة في مستشفى أنقرة نمونة للأبحاث و التدريب، قسم التخدير في غرفة عمليات تقويم العظام في فترة ما بين شهر مايو و شهر مايو 2005، باستعمال الطريقة العشوائية المنظورة و اختبار التعمية المزدوجة. تم عشوائياً تقسيم مجموع 61 حالة مرضية (I–III) لمرضى ASA المقرر إخضاعهم لعملية رقو الفتق الأُرْبِيّ إلى مجموعتين. تم بطريقة التخدير الشوكي الفوق الجافي المشترك تطبيق روبيفاكاين 7.5 ملغم على المجموعة R، وبوبيفاكاين 5 ملغم على المجموعة B، في كلا المجموعتين تم إضافة 25 ميكروغرام من الفنتانيل. تم تخفيف المحاليل بمقدار 1.5 مللتر من الماء المعقم. تم غرز إبرة بورتكس 18/27 أو 16/27 من خلال L1-2 أو L2-3 على المرضى وهم في وضعية الجلوس، حيث تم البدء بالعملية الجراحية بعد وصول تخدير الحواس إلى العضلة T6. تم تقييم الخصائص الحسية و القوى المحركة، بيانات الدينميات الدموية، الأعراض الجانبية، وقت الشفاء، توقيت بداية الألم والمشي.

النتائج: فترة تخدير القوى الحركية كانت أقل في المجموعة R 36.1±56.1 دقيقة و 23.3±72.5 دقيقة (p=0.013). كانت فترة التخدير الكامل للقوى الحركية أقل في المجموعة R. فيما عدا ذلك لم يكن هناك فرق آخر بين المجموعتين. تشير تحاليل المجموعة الداخلية أن معطيات الدينميات الدموية التي تم الحصول عليها بعد التأثير التخديري أقل من القيم الأولية.

خاتمة: على الرغم من أن النتائج تشير إلى تشابه تأثير التخدير الحسي للروبيفاكاين و البوبيفاكاين مضافاً إليهما الفنتانيل، إلا أن التأثير التخديري الحسي للروبيفاكاين أقل من نظيره عند تطبيقه في عمليات رقو الفتق الأُرْبِيّ الجراحية. علاوة على ذلك، نحن نؤمن بضرورة مراقبة وضعية الدينميات الدموية بدقة أثناء العملية الجراحية.

Objectives: To determine the characteristic profiles of 2 hypobaric spinal anesthetic solutions for selective spinal anesthesia in inguinal herniorrhaphy.

Methods: The study took place in the general surgery room of Anesthesia Department, Ankara Numune Research and Training Hospital between May and July 2005 as a prospective, randomized and double-blind trial. Sixty-one ASA I-III patients scheduled for inguinal herniorrhaphy were randomly divided into 2 groups. Group R received combined spinal epidural anesthesia with ropivacaine 7.5 mg and group B received bupivacaine 5 mg; in both groups 25 µg of fentanyl was added. Solutions were diluted with 1.5 ml of sterile water. A Portex 18/27 or 16/27 needle was inserted at L1-2 or L2-3 with patients sitting upright; surgery began after the sensory block reached the T6 dermatome. Sensory and motor block characteristics, hemodynamic data, side effects, recovery time, the timing of the onset of pain, and the walkout were assessed.

Results: Motor block duration was shorter in Group R (56.1±36.1 minutes versus 72.5±23.3 minutes) (p=0.013). Complete motor block duration was shorter in Group R. There was no difference between the 2 groups. Intra-group analysis showed that hemodynamic values after anesthesia induction were lower than initial values.

Conclusion: Ropivacaine plus fentanyl provided similar sensory anesthesia, but with a shorter duration of motor block than bupivacaine plus fentanyl when used for selective spinal anesthesia in herniorrhaphy surgery. Furthermore, we suggest that hemodynamic should be carefully monitored during surgery.

Saudi Med J 2009; Vol. 30 (11): 1444-1449

From the Department of Anesthesiology and Reanimation, Ankara Numune Training & Research Hospital, Ankara, Turkey.

Received 3rd August 2009. Accepted 30th September 2009.

Address correspondence and reprint request to: Dr. Dilsen Ornek, Department of Anesthesiology and Reanimation, Ankara Numune Training & Research Hospital, Ankara 06810, Turkey. Tel. +90 (312) 5084229. Fax. +90 (312) 3111121. E-mail: dilsenpinar@yahoo.com

Spinal anesthesia is the most common regional anesthesia technique. Infections, limited duration, possible neurotoxicity, and post-dural puncture headache are possible, but technological advances have reduced the complication rate. In recent years, efforts have focused on spinal anesthetic techniques for ambulatory surgery by reducing the dose of local anesthetics and introducing the use of additional spinal opioids to improve pain relief. Walk-in, walkout spinals with an extremely low dose of lidocaine and opioids for gynecological laparoscopy created the concept of selective spinal anesthesia (SSA);[1] however, spinal anesthesia for hernia repair is more complicated. A higher level of sensory block is required, but increasing the dose of long-acting local anesthetics may produce extensive sensory and motor blocks, as well as arterial hypotension, which might result in delayed discharge.[2] Early studies reported that ropivacaine causes the same sensorial block, but less motor block than bupivacaine, which might be advantageous for regional anesthesia for short procedures. Ropivacaine in low doses may produce better differential block analgesia, with minimal block. For inguinal hernia repair, low-dose spinal bupivacaine in combination with fentanyl has been evaluated; however, no comparative data are available on the use of low-dose ropivacaine with fentanyl. Therefore, the present study aimed to compare hypobaric ropivacaine 7.5 mg to hypobaric bupivacaine 5 mg, both with fentanyl 25 μg and 1.5 ml of sterile water for SSA in ambulatory inguinal herniorrhaphy.

Methods. This study took place in the Anesthesia Department at general surgery room of Ankara Numune Research and Training Hospital, Ankara, Turkey between 04 May 2005 and 04 July 2005. The prospective, randomized, double blind study included 61 ASA physical status I-III patients aged 18-70 years that were scheduled for elective inguinal hernia repair under combined spinal epidural anesthesia. The hospital's Ethical Committee approved the study protocol and written informed consent was obtained from all the patients. Exclusionary criteria included neurological or neuromuscular diseases, infection at the intended site of spinal needle insertion, and hypersensitivity to amide local anesthetic, fentanyl, or sufentanil, severe cardiac disease, abnormal coagulation profiles and if the patient would not accept local anaesthesia. All the participants received oxygen (4 $L \cdot min^{-1}$) via a facemask and an intravenous bolus dose of lactated Ringer's solution 10 ml kg^{-1} was administered over the course of 30-45 min Standard monitorization, including non-invasive blood pressure, pulse oximetry, and electrocardiography (Peta, KMA275, Ankara, Turkey) was performed. Baseline arterial blood pressure was recorded at the end of volume expansion, before inducing spinal block.All patients were placed in an upright sitting position. Then, an 18/27 or 16/27 Tuohy needle (Portex Ltd, Hythe, UK) was inserted into the epidural space at the L1-L2 or L2-3 inter-space via a loss-of-resistance technique. The dura was punctured using a 27-gauge pencil-point needle Boriented with the orifice facing cephalad. After confirming the free flow of cerebrospinal fluid, 3 ml of spinal solution was injected over the course of approximately 3 min and a multi-orifice epidural catheter was inserted 3 cm into the epidural space. Patients were then placed in a semi-sitting position (30°-45°), and surgery began 15 minutes later. As determined by a table of random numbers, patients received one of the following intrathecal (i.t.) solutions: ropivacaine 7.5 mg (group R, n=31) or bupivacaine 5 mg (group B, n=30). In each group, fentanyl 25 μg was added to the local anesthetic. The study drugs were diluted to 1.5 ml with distilled water and were prepared by an anesthetist not involved with subsequent patient assessments. Patients were judged ready for surgery when complete loss of pinprick sensation at T6 was confirmed. The time at which the injection of spinal anesthetic began was considered to be zero. If the level of the epidural anesthesia was insufficient for the probability of additional dose, the catheter left in its place until the end of the operation.

Clinically relevant hypotension (decrease in systolic arterial blood pressure >30% of baseline) was initially treated with a rapid infusion of 200 ml of normal saline over 10 minutes, if this was ineffective, 5 mg of ephedrine was given intravenously. Bradycardia (decrease in heart rate to <45 bpm) was treated with 0.5 mg of atropine intravenously. Propofol sedation was provided (continuous infusion of 2-3 $mg \cdot kg^{-1} \cdot h^{-1}$) when required by the patient. We assessed the quality of spinal anesthesia testing for sensory and motor blockade as previously described by Girgin et al.[2] Sensory and motor blocks were measured at 1, 3, and 5 minutes, and then at 5 minutes intervals for the first 20 minutes, then every 15 minutes until the completion of surgery. At the same time, cardiovascular variables were also recorded. Sensory block was assessed by complete loss of pain during a pinprick (22-gauge hypodermic needle). The motor block was quantified using a modified Bromage scale by asking the patients to flex their limb at the hip, knee, and ankle joints (0 = no motor block, 1 = hip blocked, 2 = hip and knee blocked, and 3 = hip, knee, and ankle blocked). The inability to obtain sensory block at T6 within 30 minutes of spinal injection was considered a technical block failure, and the patient was excluded from further analysis.

The occurrence of adverse events, including nausea, vomiting, and pruritus was also recorded. Postoperative

analgesia consisted of 10 mg of oral ketorolac as requested. The ability to achieve 'walkout' criteria was determined at the end of surgery while patients were in the operating room by asking them to perform a 'straight leg raise' and a 'deep knee bend'; further assessments were performed in the post-anesthesia care unit, upon arrival and at 30, 45, 60, 75, and 90 minutes. Full sensory assessment was also performed in all patients upon arrival in the PACU and at 15-minutes intervals thereafter. A follow-up evaluation was performed the day after surgery by asking patients on the occurrence of pain, post-dural puncture headache, and dysesthesia in the lower limbs or buttocks.

Data regarding the time from the beginning of spinal injection to readiness for surgery (onset time), the highest dermatomal level of sensory blockade, Bromage scale score for motor blockade, time to peak level, time to 2-segment regression, time to S2 regression, time for complete regression of spinal block, time to the first analgesic request, and time to ability to walk and void spontaneously were recorded following surgery.

In this study, the statistical analysis was performed by SPSS version 12. Frequencies and percentiles of the variables were specified. Inter-catagoric dependences were analyzed using Fisher's exact and Pearson Chi-square tests. For variables, which did not show normal distribution comparisons in double groups were assessed using the Mann-Whitney U test. Intra-group comparisons were analyzed using Wilcoxen sign test. Theoretical power for this study was assumed as 0.8 and the power realized measured as 0.78. G-power 3.1 package program was used to measure power. A p value <0.05 were considered significant.

Table 1 - Patient demographic data.

Demographic data	Group R (n=31)	Group B (n=30)	*P*-value
Age (years)	47 ± 15.5	50 ± 14.0	>0.05
Weight (kg)	74.6 ± 11.2	72.2 ± 8.9	>0.05
Height (cm)	169.3 ± 9.1	171.1 ± 6.5	>0.05
Duration of surgery (min)	71.5 ± 21.5	79.8 ± 33.8	>0.05
Gender (male/female)	27/4	29/1	>0.05
ASA (n)			>0.05
I	10	8	
II	21	20	
III	0	2	

Data are shown as mean ± SD.

Results. Sixty-one patients were enrolled and randomized into 2 treatment groups. No patient was excluded from the statistical analysis due to incomplete data collection. The 2 groups were comparable with the age, gender, weight, height, ASA and duration of surgery (**Table 1**). All blocks were performed successfully in 2 groups. There were no significant differences between the 2 groups in terms of spinal block, sensorial block time, motor block time, time to reach the T6 dermatome, maximum motor block level, sensorial block regression time, S2 regression time, post-surgery

Table 2 - Characteristics of spinal anesthesia and postoperative analgesia times.

Characteristics	Group R (n=31)	Group B (n=30)	*P*-value
Sensory block			
Onset time (min)	1.94 ± 2.91	2.04 ± 2.81	>0.05
Time to T6 (min)	4.19 ± 1.3	3.70 ± 1.08	>0.05
Time to two-segment regression (min)	63.2 ± 16.8	69.6 ± 16.6	>0.05
Time to S2 regression (min)	82.7 ± 30.7	91.6 ± 25.8	>0.05
Motor block			
Time to complete block (min)	5.64 ± 4.0	5.10 ± 3.9	>0.05
Complete block at T5 (%)	4.19 ± 1.3	3.7 ± 1.0	>0.05
Time to complete recovery (min)	56.1 ± 36*	72.5 ± 23.3	<0.05*
Time to first analgesic	272.0 ± 108.1	263.3 ± 79	>0.05
Maximum level (range)	T3-T4 (29 - 2)	T3-T4 (29 - 1)	>0.05
Bromage scale score (n)			>0.05
0	6	1	
1	13	7	
2	9	14	
3	2	8	
Walkout (n)			>0.05
Yes	18	13	
No	13	17	

Data were expressed as mean±SD. *p<0.05 is statistically significant

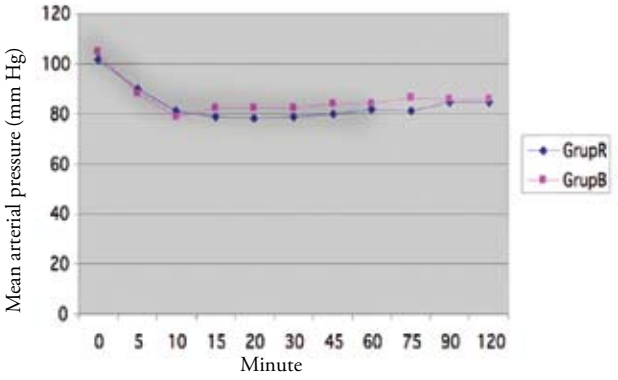

Figure 1 - Mean arterial pressure.

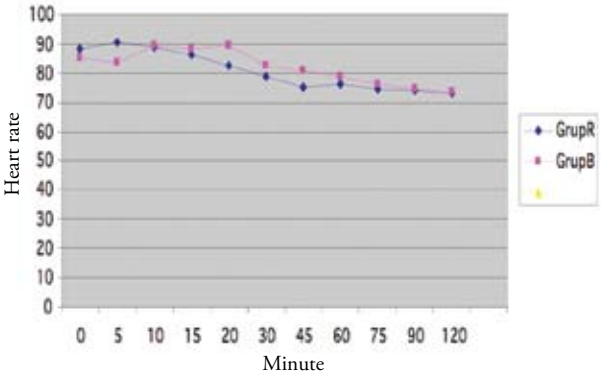

Figure 2 - Heart rate.

Table 3 - Side-effects.

Side-effects	Group R (n=31)	Group B (n=30)	*P*-value
Hypotension	7	12	>0.05
Bradycardia	2	9	>0.05
Nausea-Vomiting	3	8	>0.05
Shivering	0	0	>0.05
Respiratory depression	0	0	>0.05
Pruritus	0	0	>0.05

There were no significant differences between the groups.

walkout time, or first analgesic request (**Table 2**). Motor block regression time was statistically different between the 2 groups (p=0.04; group R = 56.1 ± 36.1 minutes, group B = 72.5 ± 23.3 minutes) (**Table 2**). Heart rate and blood pressure were similar in both groups, but when comparing time '0' and all other times, significant differences were observed (**Figures 1 & 2**). Anti-emetic requirement was similar in the 2 groups. In all, 3 patients in group R and 8 patients in group B needed anti-emetics. Bradycardia was observed in 2 patients in group R and 9 patients in group B (HR <50) and was treated with atropine. In total, 7 patients in group R and 12 patients in group B developed hypotension, which was treated with ephedrine. Antiemetic, atropine, and ephedrine requirements were similar in both groups (**Table 3**).

Discussion. Results of the present study show that low-dose SSA can be achieved with 5 mg of hypobaric bupivacaine or 7.5 mg of hypobaric ropivacaine, when mixed with 25 µg of fentanyl and 1.5 ml of distilled water for inguinal hernia repair. This spinal anesthetic technique and local anesthetics provided effective anesthesia for outpatient inguinal herniorrhaphy. Operating conditions were good and most patients had minimal motor block, preserved light touch, and proprioception; yet, the technique was associated with faster recovery of pinprick analgesia and many of the patients were able to achieve 'walkout' criteria upon arrival in the recovery room. The choice of anesthetic technique for inguinal hernia repair depends on several factors, including patient and surgeon preferences, feasibility of the technique, intra-and postoperative pain control, recovery time and monitoring requirements, postoperative morbidity, and cost.[2] In this context, spinal anesthesia for hernia repair has attained widespread popularity due to the advantages of an awake patient, and minimal drug and equipment costs.[1] However to produce spinal anesthesia for ambulatory surgery is more complicated. Because of the higher sensory block is required for abdominal surgery and lower doses of local anesthetics for fast recovery may cause problems of operation level and time. In this case, opioid usage in addition to local anesthetics were suggested, and avoidance of side effects by lowering local anesthetics for ambulatory surgery was aimed. In this study, adequate surgical time and level were aimed by reducing local anesthetic dose and baricity with the help of fentanyl and distill water added to local aesthetics. Furthermore, our study demonstrates that adequate surgical relaxation of the abdominal wall was achieved with 2 spinal solutions and that low-dose local anesthetics were associated with fewer side effects and rapid recovery.

Selective spinal anesthesia has been confirmed as a reliable anesthetic technique that offers a satisfactory alternative to general anesthesia (GA) for outpatient surgical procedures. Selective spinal anesthesia has the advantage of using minimal doses of conventional intrathecal anesthetic to obtain anesthesia of specific nerve roots and selective modalities. It provides selective pinprick anesthesia without affecting the motor functions, and maintains the integrity of the dorsal columns. Due to these reasons, SSA attain selective short-duration spinal anesthesia and facilitates ambulation at

the completion of the surgical procedure.[3] On the other hand, selectivity is related to local anesthetics (LAs). The effect of anesthetics on nerve fibers is related to the size of nerve fibers, whether or not they contain a myelin sheath, and concentration and duration. These are the basics of differentiation phenomena.[4-8] All nerve fibers are affected by LAs, but their effect is greater in small and myelinated fibers. Accordingly, there is a minimum concentration that inhibits nerve transmission and pH. The Ca ion concentration and stimulus rate are also action potential generation and transmission is formed in the nodes of Ranvier and factors affecting this transmission also affect the nodes of Ranvier. The internodal space is different for each fiber. This feature explains differential block; if the entire nerve is contact by the LA all the fibers will be blocked, but if the smaller part contact by LA, fibers with long internodal spaces are not affected, while fibers with short internodal spaces are affected. Considering the selectivity and differential block phenomena reported by some studies with the use of low doses and adequate baricity, and appropriate patient positioning, only dermatomes of the surgical space are blocked, allowing the procedure to proceed.[4-6]

Liew et al[9] and Ganapathy[10] used 25 mg of 0.5% lidocaine (hypobaric) for outpatient gynecological surgery with motor blocks that resolved within one hour. Buckenmaier et al[11] described the use of doses of ropivacaine as low as 4 mg with the addition of 20 μg of fentanyl for anorectal surgery in an ambulatory setting, and observed complete regression of spinal block after <2 hours, with patient discharge occurring nearly 3 hours after spinal injection. Nonetheless, anorectal procedures require a lower level of spinal anesthesia than inguinal hernia repair, and this can account for the acceptable success rate reported by Buckenmaier et al,[11] when using such small doses of ropivacaine. Some authors recommended the use of lidocaine 2% or mepivacaine 2% at doses <50 mg associated with fentanyl 12.5 μg as a reference practice for ambulatory spinal anesthesia[15] to obtain shorter recovery time; however, the risk of transient neurological symptoms (TNS) frequently associated with lidocaine and mepivacaine should be considered. Our study demonstrates that the shorter recovery achieved with such anesthetic drugs such as ropivacaine and bupivacaine that are seldom associated with TNS. In one study, a low dose of ropivacaine (12 mg), bupivacaine (8 mg) and levobupivacaine (8 mg) resulted in a reliable block for inguinal hernia repair.[13] Motor recovery was significantly faster after levobupivacaine and ropivacaine.[12] In another study, unilateral block was produced with low dose bupivacaine[6,7] (5mg) in combination with 25 μg fentanyl, but the overall need for catheterization was 18%[14] and in that study motor block onset and regression times were measured. In the present study, the motor block onset time was 5.1 ± 3.9 minutes in group R and 5.6 ± 4 minutes in group B, and motor block regression time was 5.6 ± 36.1 minutes and 72.5 ± 23.3 minutes. Motor block regression time was shorter in group R, but the difference was not statistically significant. Motor block onset and regression times in the present study are different than those of other studies; we think that this is due to differences in the baricity and concentration of the solutions. Nevertheless, regression time was shorter in group R if it is used in equipotent doses. Despite the physicochemical similarities of these 2 solutions, the differences may have arisen due to the lipid solubility of bupivacaine. Additional studies with smaller doses of ropivacaine should be performed to accurately evaluate the clinical profile of this drug for inguinal hernia repair.[10] Gupta et al[14] used 6 mg and 7.5 mg of ropivacaine in inguinal hernia repair; sensorial onset time and regression times were similar, and sacral regression was 190 ± 61 minutes and 206 ± 56 minutes. In the present study, the sensorial block onset time was 3.24 minutes in group R and 3.40 minutes in group B, regression time was 63.2 minutes in group R and 69.6 minutes in group B, and sacral regression was 82.7 ± 30.7 minutes in group R and 91.6 ± 25.8 minutes in group B; the differences in values between the 2 groups were not statistically significant. Concentration and baricity differences may explain these results.

Vaghadia et al[3] reported that low-dose SSA could be achieved with 20 mg of lidocaine + 25 μg of fentanyl, with 20 mg of lidocaine + 10 μg of sufentanil, and with 10 mg of lidocaine + 10 μg of sufentanil in gynecologic laparoscopic procedures.[3] They administered 3 ml of solution at the rate of 0.5 ml s^{-1} in the L2-3 or L3-4 interspace with patients in the upright sitting position using a 27 G Whitacre needle and the orifice of the needle directed cephalad; when the block reached the T6 dermatome patients were placed in the Trendelenburg position. They reported that 10 mg of lidocaine mixed + 10 μg of sufentanil was associated with faster recovery of pinprick analgesia and 80% of patients were able to achieve 'walkout' criteria upon arrival in the PACU.[3] In the present study, 3 ml of LA was administered over the course of 3 minutes with patients in a semi-sitting position (30°-45°), which was maintained until the surgery was completed. In the study by Vaghadia et al[3] the Trendelenburg position may have directed the LA molecules caudally and increased block depth, whereas in the present study the semi-sitting position may have directed the LA cephalad and decreased sacral bloc dept. In the present study sacral regression was shortened. Increasing the concentration of LA solution may result in increased duration of anesthesia and recovery.[8] The

use of continuous techniques may provide valuable anesthetic titration, as small doses of spinal anesthetics may produce highly variable results. Intrathecal fentanyl may prolong surgical anesthesia without prolonging recovery. Ambulatory spinal anesthesia may be optimized by selection of dose, concentration, and baricity of the LA used. Use of a continuous technique or an intrathecal adjunct may also be valuable means of optimizing spinal anesthesia for ambulatory surgery. A slow bolus of low-dose, small-volume LA has been used to produce segmental analgesia to relieve intractable angina with implantable pumps while retaining the capacity to ambulate.[6] Because of the baricity of the drugs and patient positioning, sympathetic cardio-accelerator fibers were affected and sudden bradycardia, hypotension, and nausea were observed; the difference between the 2 groups in terms of these side-effects were not significant. In addition, Girgin at al[2] reported that the most frequent side effect of fentanyl plus local anesthetics used in hernia operations was pruritis. In our study, no pruritus necessitated treatment was observed.[2]

In conclusion, the present study shows that outpatient inguinal herniorrhaphy was possible with low-dose selective spinal anesthesia, and that a majority of the patients had preserved light touch and proprioception during and after surgery. In addition, most of the patients were able to achieve 'walkout' criteria at the conclusion of surgery; yet, 5mg of bupivacaine or 7.5 mg ropivacaine with 25 µg of fentanyl and 1.5 ml of distilled water was associated with faster recovery of pinprick analgesia. Thus, future studies using this method should assess the discharge criteria, since we cannot assess the clinical discharge criteria.

Acknowledgment. *The authors would like to thanks Ahmet Gül,MS Expert Statisticion,Turkish Statistical Institue, and Diamed Presentation Center, Ankara for his valuable contributions to this study.*

References

1. Korhonen AM. Use of spinal anaesthesia in day surgery. ***Curr Opin Anaesthesiol*** 2006; 19: 612-616.
2. Girgin NK, Gurbet A, Turker T, Bulut T, Demir S, Kılıç N, et al. The combination of low dose levobupivacaine and fentanyl for spinal anaesthesia in ambulatory inguinal herniorrhaphy.J ***Int Med Res*** 2008; 36: 1287-1292.
3. Lennox PH, Vaghadia H, Henderson C, Martin L, Mitchell GW. Small-dose selective spinal anesthesia for short-duration outpatient laparoscopy: recovery characteristics compared with desflurane anesthesia. ***Anesth Analg*** 2002; 94: 346-350.
4. Kayhan Z. Central Blocks. In: Kayhan Z. Clinic Anaesthesiology 3rd ed. Turkey: The Logos Companies; 1997. p. 482-485.
5. Morgan Jr GE, Mikhail MS. Klinik Anesteziyoloji. In: Morgan Jr GE, Michail MS. Spinal, epidural and caudal blocks. 3rd ed. USA: Mac Graw-Hill Companies; 2004. p. 253-281.
6. Cousins MJ, Veering BT, Spinal Neural Blockade. In: Cousins MJ. Neural Blockade. 3rd ed. Philadelphia (PA): Lippincolt-Raven 1998. p. 203-239.
7. Miller RD. Local anesthetics. 5th ed. NewYork (NY): Churchill Livingstone; 2000. p. 491-522.
8. Liu SS. Optimizing spinal anesthesia for ambulatory surgery. ***Reg Anesth*** 1997; 22: 500-510.
9. Liew QY, Tay DH, Thomas E. Lignocaine 0.5% for spinal anaesthesia in gynaecological day surgery. ***Anaesthesia*** 1994; 49: 633-636.
10. Ganapathy S. Walking spinals: a myth or reality? ***Can J Anaesth*** 2001; 48: 222-224.
11. Buckenmaier CC 3rd, Nielsen KC, Pietrobon R, Klein SM, Martin AH, Greengrass RA, et al. Small-dose intrathecal lidocaine versus ropivacaine for anorectal surgery in an ambulatory setting. ***Anesth Analg*** 2002; 95: 1253-1257.
12. Urmey WF. Spinal anaesthesia for outpatients surgery. ***Best Pract Res Clin Anaesthesiol*** 2003; 17: 335-346.
13. Casati A, Moizo E, Marchetti C. A prospective, randomized, double blind comparison of unilateral spinal anaesthesia with hyperbaric bupivacaine, ropivacaine, or levobupivacaine for inguinal herniorrhaphy. ***Anesth Analg*** 2004; 99: 1387-1392.
14. Gupta A, Axelsson K, Thörn SE, Matthiessen P, Larsson LG, Holmström B, et al. Low-dose bupivacaine plus fentanyl for spinal anesthesia during ambulatory inguinal herniorrhaphy: a comparison between 6 mg and 7.5 mg of bupivacaine. ***Acta Anaesthesiol Scand*** 2003; 47: 13-19.

Related topics

Siddiqui AK. Airway management for cervical spine injury. ***Saudi Med J*** 2009; 30: 1133-117.

Sivaci R, Balci C, Maralcan G, Kuru I. Management of difficult airway in a child with arthrogryposis multiplex congenita during general anesthesia. ***Saudi Med J*** 2005; 26: 1657-1659.

Morais RJ, Kotsev SN, Hana SJ. Modified retrograde intubation in a patient with difficult airway. ***Saudi Med J*** 2000; 21: 490-492.