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Addition of lidocaine to bupivacaine for spinal anaesthesia compared with bupivacaine spinal anaesthesia and local infiltration anaesthesia

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Background: Two spinal anaesthesia techniques were compared with local infiltration anaesthesia (LIA) to test the hypothesis that the addition of lidocaine to bupivacaine would decrease the spinal block's duration and provide shorter recovery to discharge.
Methods: Ninety-three patients undergoing outpatient herniorrhaphy were randomised into three groups. Spinal anaesthesia: the BL Group (bupivacaine-lidocaine) received 2 ml hyperbaric bupivacaine (10 mg) + 0.6 ml 1% lidocaine (6 mg), the BS Group (bupivacaine-saline) received 2 ml hyperbaric bupivacaine (10 mg) + 0.6 ml saline. LIA: the LIA group received plain bupivacaine + lidocaine. Resolution of the nerve blocks were compared between spinal anaesthesia groups, and postoperative pain scores, analgesic requirements, post-anaesthesia care unit (PACU) time, and discharge time were compared among all groups.
Results: Spinal block resolved faster in the BL group vs. the BS group: 194.8 [standard deviation (SD) 29.2] min vs. 236.8 (SD 36.5) min ($P = 0.000$). PACU and discharge time were shortest in the LIA group [PACU time: 108.7 (SD 27.6) min vs. 113.0 (SD 39.4) min and 151.9 (SD 43.7) min in the BL and BS groups ($P = 0.000$), and discharge time 108.5 (SD 29.5) min vs. 145.8 (SD 37.3) min and 177.1 (SD 32.0) min in the BL and BS groups, respectively ($P = 0.000$)]. Pain scores and analgesic consumption were lower, with the time to first analgesic intake being longer in the LIA group.
Conclusion: Addition of lidocaine to bupivacaine reduced the duration of the spinal block and was associated with shorter recovery times. However, LIA provided the fastest recovery to discharge after outpatient inguinal herniorrhaphy.

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The number of patients operated in the outpatient setting has increased.[1] The guidelines for hernia repair suggests that more widespread use of day surgery is desirable, and the indication from The Royal College of Surgeons of England that approximately 30% of inguinal hernias should repaired as outpatient cases is valid.[2]

Existing evidence favours local infiltration anaesthesia (LIA) for outpatient inguinal herniorrhaphy in terms of efficacy and time to discharge,[3,4] although an ideal anaesthesia method remains a topic of debate.[5–7] Anaesthesiologists are encouraged to use spinal anaesthesia in outpatient settings;[8] however, discharge delay is considered as the main drawback.[9]

The addition of lidocaine to hyperbaric bupivacaine shortens the duration of the bupivacaine spinal block. It provides more rapid recovery and may offer advantages in outpatient spinal anaesthesia.[10]

This prospective randomised, controlled trial tested the hypothesis that adding lidocaine to bupivacaine would decrease the duration of the spinal block and provide faster discharge compared with LIA after outpatient inguinal hernia repair. We compared two types of spinal anaesthesia and LIA. The main outcome measures were the duration of the spinal block in related groups and time to discharge in all three groups.

Methods

Patients and anaesthesia procedures

Ninety-three patients who underwent unilateral inguinal herniorrhaphy at the Ankara Diskapi

Teaching and Research Hospital were prospectively enrolled between March 2012 and July 2012. All patients provided informed consent. Ethical approval had been provided by the Ministry of Health Ataturk Teaching and Research Hospital Ethical Committee, Ankara, Turkey on June 30, 2009 (Clinical trial registration NCT01548794). Patients with contraindications for outpatient surgery and spinal anaesthesia, those on anticholinergic medications, or with previous voiding issues and recurrent hernias, or emergency cases were excluded.

Age, body mass index, concomitant diseases, and the American Society of Anesthesiologist's physiological state were recorded.

Simple randomisation was accomplished with a computer-generated sequence of numbers, and sealed envelopes were used to allocate patients into three groups.

Heart rate (HR), peripheral oxygen saturation (SpO_2), systolic arterial pressure (SAP), diastolic arterial pressure, and mean arterial pressure (MAP) were monitored. Baseline values were recorded. Patients were not pre-medicated. Ringer's lactate was infused at 15 ml/kg/h during surgery and 2 ml/kg/h during post-anaesthesia care unit (PACU) stay.

The patients in the BL Group (bupivacaine-lidocaine) ($n = 31$) received 2 ml of 0.5% 10 mg hyperbaric bupivacaine (Marcaine Heavy® 5 mg/ml, Abbott Laboratories, Elverum, Norway) + 0.6 ml of 1% 6 mg lidocaine (Lidokain® 1%, Deva Ilac, Kocaeli, Turkey) (total, 2.6 ml). The patients in the BS Group (bupivacaine-saline) ($n = 31$) received 2 ml of 0.5% 10 mg hyperbaric bupivacaine + saline (100 ml 0.9 % Izotonik Sodium Klorur®, Turktıpsan, Ankara, Turkey) in the same volume. Spinal anaesthetic solutions were aseptically prepared immediately before the injection. Spinal anaesthesia was performed at the L4–5 intervertebral spaces, with the patient placed in the lateral decubitus position; a midline approach was used with a 25-G Quincke needle. After verifying free flow of clear cerebrospinal fluid, the prepared anaesthetic solution was injected into the intrathecal space over 30 s, and the patients were placed supine after the injection.

Patients in the LIA group ($n = 31$) received plain bupivacaine (Marcaine® 5 mg/ml, Abbott Laboratories) and lidocaine. The surgeon applied LIA by using the step-by-step infiltration method of the Lichtenstein Hernia Institute.[11] This technique commences with intradermal and subdermal injection of the local anaesthetic solution. Subcutaneous tissues are gradually infiltrated as dissection deepens. A bolus dose of 6–8 ml of the solution is given under the external oblique aponeurosis before it is incised, and additional small doses are given at the root of the spermatic cord, the pubic corner, and the internal oblique aponeurosis lateral to the internal inguinal ring. The surgeon tested the anaesthesia adequacy with the pinprick test.

The spinal anaesthesia groups were both patient- and observer-blinded. The LIA group was observer-blinded; patient blinding was unlikely in this group. The observer had no access to anaesthesia records. Intraoperative and post-operative data were recorded by independent residents.

Intraoperative course

Sensory block was measured at the midclavicular line with a pinprick test, using a 22-gauge hypodermic needle at 1-min intervals until the maximum block was achieved and at 15-min intervals thereafter. Motor block was evaluated using a modified Bromage scale (0: no motor block; 1: hip blocked; 2: hip and knee blocked; 3: hip, knee, and ankle blocked). Block at the L1 dermatome was considered as onset of spinal anaesthesia, and block at the T10 dermatome indicated readiness for surgery.

Time of subarachnoid injection, onset of the sensory block, readiness for surgery, and maximum block level were recorded. Patients in the LIA group received additional local anaesthetic when they experienced pain. Total local anaesthetic dose was recorded at the end of surgery. Amounts of fentanyl, midazolam, and propofol administered intraoperatively for rescue analgesia and sedation were also recorded.

Hypotension (≥ 30% decrease in SAP in comparison with baseline values, or SAP < 80 mmHg) was treated with a 250-ml crystalloid fluid bolus or 5-mg intravenous ephedrine. Total amount of intravenous fluid was recorded. Bradycardia (HR ≤ 50 beats/min) was treated with 0.5-mg intravenous atropine. Periods of desaturation ($SpO_2 < 95$) and additional analgesia or sedation requirements were recorded. Duration of surgery was defined as the time between surgical incision and wound closure. Time spent in the operating room was also noted.

Post-operative course

Patients were transferred to the PACU after surgery. Block duration was defined as time to resolution of the sensory block at the S3 dermatome. Resolution of spinal anaesthesia was assessed with the time to two-segment, T10, L1, and S3 regression of the sensory block. Patients could resume oral fluids in

the PACU. Pain was measured with a visual analogue scale (VAS) score of 0–10 (0 = no pain and 10 = worst imaginable pain). VAS scores were recorded at rest and during mobilisation. Ability to sit, stand, walk, and urinate was evaluated at 15-min intervals. Times to ambulation without assistance and urination, with the corresponding VAS scores at each time, were recorded. Post-operative analgesia was provided as needed with paracetamol (Parol® 10 mg/ml vial and Parol® 500 mg tablet, Atabay Kimya, Istanbul, Turkey), and on discharge, patients were asked to take 500 mg three times a day as needed. Paracetamol was first administered when the pain score was > 3. Rescue analgesia of 50 mg oral tramadol (Contramal® tablet 50 mg, Abdi Ibrahim Ilac, Istanbul, Turkey) was provided if pain scores > 3 persisted. Time to first analgesic intake and total analgesic consumption in the PACU were recorded. Patients were asked about their recall of intraoperative pain during their PACU stay with a questionnaire. Patients with post-anaesthesia score ≥ 9 were cleared to leave the PACU, and duration of PACU stay was recorded.[12]

Post-operative urinary retention was evaluated. Bladder volumes were measured by ultrasonography when leaving the PACU and then at hourly intervals in the ward. Urinary catheterisation was planned, if bladder volume exceeded 500 ml, and the patient was unable to spontaneously void. Discharge time was defined as the time from the end of surgery until patients reached a post-anaesthesia discharge score of ≥ 9, the sensory block to S3 dermatome resolved, and the patient voided.

Adverse events before discharge were registered: post-operative nausea and vomiting, hematoma, femoral nerve palsy, and voiding difficulty. All patients who were discharged were called the next day and questioned about pain, headache, analgesic use, and complaints of transient neurological symptoms (TNS; including pain, dysaesthesia, or both, in the buttocks and lower extremities). During a hospital follow-up visit on the third day after surgery, patients completed a questionnaire about headache, transient neurological symptoms, and overall satisfaction with anaesthetic method (unsatisfied/satisfied/very satisfied).

Statistical analysis

Statistical analysis was performed with the Statistical Package for Social Sciences (SPSS) software version 18 (SPSS, Inc., Chicago, IL, USA). Kruskal–Wallis was used to test the normality of distribution. The homogeneity of groups was assessed with Levene's test. Results were expressed as mean [standard deviation (SD)], median (range, minimum–maximum), or numbers of occurrences. Mean duration of the sensory block, PACU stay, and time to discharge were compared using an unpaired *t*-test. Mann–Whitney *U*-test was applied for comparisons of non-parametric and non-normally distributed data. Nominal data were analysed by Pearson chi-square or Fisher's exact test where appropriate. Repeated-measure analysis of variance was applied for evaluation of haemodynamic assessment with a Bonferroni post-hoc test. P values < 0.05 were considered statistically significant in each test.

The sample size of 31 patients in each group was determined with a pilot study of 33 patients, which achieved 92% power with $\alpha = 0.05$ (The BL group mean 145.20 [1.47] min, the BS group mean 172.30 [25.63] min, and the LIA group mean 122.50 [24.17]min for PACU stay).

The primary outcome variable was the difference in the duration of nerve block between the two spinal groups, as determined by duration of the sensory block at S3. Other outcome variables were differences between PACU times and time to discharge, VAS pain scores, time to first analgesic intake, total analgesic consumption, haemodynamic parameters, and adverse events in all three groups.

Results

Ninety-three male patients were included. Groups were similar with respect to patient characteristics (Table 1). All operations were completed with the planned anaesthesia method, and no conversions to general anaesthesia occurred. All cases were assessed for the primary and secondary outcome variables (Fig. 1).

Onset of spinal block

Onset of sensory block was similar in the spinal anaesthesia groups (in terms of time to L1 block, time to T10 block, and time to reach maximum block). The mean highest level of sensory block was at the T9 dermatome in both groups (min T10, max T5). The intensity of the motor block at the time of maximum blockade was also similar (Table2).

Intraoperative course

MAP was higher in the LIA group at 30 min intraoperatively ($P = 0.002$). One patient in each group experienced hypotension, requiring treatment with intravascular volume expansion and ephedrine, and one patient in the BL group experi-

Table 1

Patient characteristics.

	Group BL ($n = 31$)	Group BS ($n = 31$)	Group LIA ($n = 31$)
Age (years)	55.8 (SD 15.6)	59.3 (SD 12.8)	54.7 (SD 16.7)
Weight (kg)	75.4 (SD 12.8)	75.6 (SD 9.8)	80 (SD 15)
Height (m)	1.72 (SD 0.06)	1.71 (SD 0.04)	1.71 (SD 0.04)
BMI (kg/m^2)	25.5 (SD 4.3)	25.8 (SD 3.1)	27.4 (SD 5.3)
Duration of surgery (min)*	58.2 (SD 22.6)	53.9 (SD 15.1)	69.6 (SD 22.2)
Time in operating room (min)	75.8 (SD 24.2)	68.5 (SD 13.2)	79.7 (SD 22.6)

*Significantly longer in Group LIA, $P = 0.012$.
Values are mean standard deviation (SD).
BL, bupivacaine-lidocaine; BMI, body mass index; BS, bupivacaine-saline; LIA, local infiltration anaesthesia.

Table 2

Onset and recovery of the spinal block.

	Group BL ($n = 31$)	Group BS ($n = 31$)	P
Onset profile			
Block onset: time to L1 block (min)	2.0 (SD 1.1)	2.2 (SD 1.3)	0.575
Time to readiness for surgery: T10 block (min)	6.3 (SD 3.57)	7.1 (SD 4.19)	0.436
Highest level of sensory block	T9 (10–4)	T9 (10–4)	–
Recovery profile			
Time to two-level regression (min)	81.1 (SD 30,5)	81.1 (SD 28)	0.990
Time to T10 regression (min)	89.2 (SD 36.1)	108.7 (SD 36.7)	0.039
Time to L1 regression (min)	131.8 (SD 32.4)	160.2 (SD 40.1)	0.003
Time to S3 regression (min)	194.8 (SD 29.2)	236.8 (SD 36.5)	0.000

Values are mean standard deviation (SD), except the peak sensory block levels described with median (min– max).
BL, bupivacaine-lidocaine; BS, bupivacaine-saline.

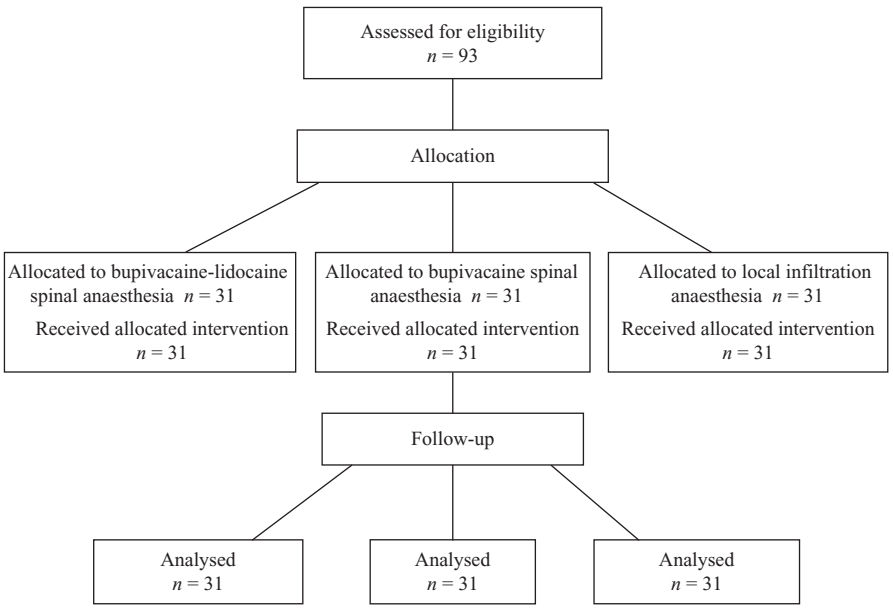

Fig. 1. Consort diagram.

enced bradycardia requiring atropine treatment. Results were similar in terms of intraoperative adverse events and treatments, except that the incidence of periods of desaturation necessitating supplemental oxygen therapy was higher in the LIA group ($n = 8$) ($P = 0.000$). Two patients in the BL group and one patient in the BS group needed additional analgesia during surgery (maximum fentanyl

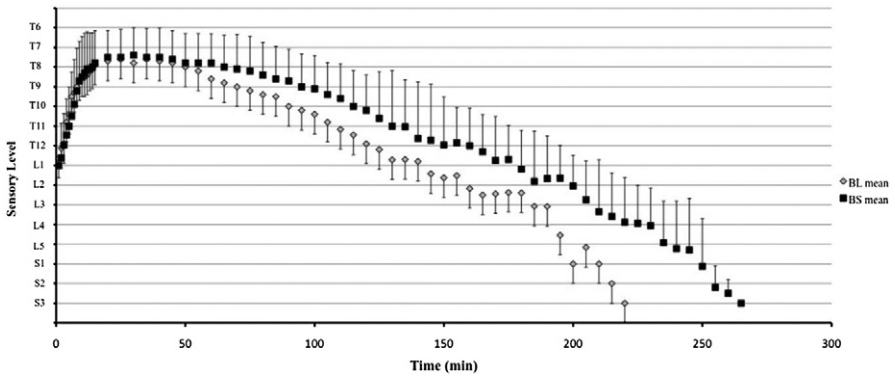

Fig. 2. Onset and resolution of the sensory block. BL, bupivacaine-lidocaine; BS, bupivacaine-saline.

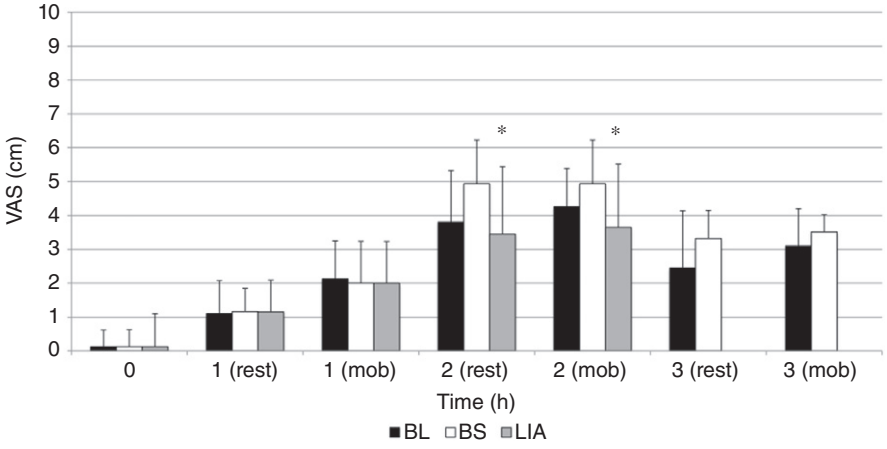

Fig. 3. Post-operative visual analogue pain scale (VAS) (0–10) scores, at rest and during mobilisation. Significant difference between groups at 2 and 3 h. LIA group was discharged at 3 h; no data obtained. BL, bupivacaine-lidocaine; BS, bupivacaine-saline; LIA, local infiltration anaesthesia.

dose was 150 mcg), and one patient in each spinal anaesthesia group needed additional sedation. The maximum midazolam dose was 5 mg in these patients. Eight patients in the LIA group needed additional sedation, with the maximum midazolam dose at 10 mg. The duration of surgery was longer in the LIA group ($P = 0.012$). Mean total local anaesthetic doses were 40 (10) mg bupivacaine and 200 (40) mg lidocaine.

Resolution of the spinal block

Times to regression of sensory block at T10, L1, and S3 were significantly shorter in the BL group compared with the BS group ($P = 0.039$, $P = 0.003$, and $P = 0.000$, respectively) (Table 2 and Fig. 2). The motor block resolved in both groups when the sensory block was resolved to the S3 dermatome. PACU time was significantly longer in the BS group, while the BL and LIA groups showed similar results. Mean time to discharge from the PACU was 113 (SD 38.4) min in the BL group, 151.9 (SD 42.6) min in the BS group, and 106.6 (SD 27.5) min in the LIA group ($P = 0.000$). Time to sit, stand, and walk without assistance were shortest in the LIA group. None of the patients had bladder volumes exceeding 500 ml upon leaving the PACU. Mean time to discharge was 145 (SD 37.3) min in the BL group, 177.1 (SD 32.0) min in the BS group, and 108.5 (SD 29.5) min in the LIA group ($P = 0.000$).

Post-operative course

Post-operative VAS pain scores and total analgesic consumption were lower ($P = 0.000$) in the LIA group, and time to first analgesic intake was longer ($P = 0.000$) in this group compared with BL and BS groups. The LIA group had the most patients who reported intraoperative pain when questioned post-operatively ($P = 0.0047$) (Fig. 3 and Table 3). There were three patients in each spinal anaesthesia group with urinary retention, requiring bladder scanning in the ward, but none required urinary catheterisation. Time to spontaneous voiding was significantly reduced in the BL group compared with the BS group and was lowest in the LIA group [mean 170.3 (SD 30.8) min, 141.4 (SD 41.0) min, and 108.4 (SD 29.4) min, respectively; $P = 0.000$].

Table 3

Length of PACU stay, time to discharge, pain scores, analgesic requirements, and patient satisfaction.

	Group BL ($n = 31$)	Group BS ($n = 31$)	Group LIA ($n = 31$)	*P*-value
PACU stay (min)	113.0 (SD 39.4)	151.9 (SD 43.7)	108.7 (SD 27.6)	0.000
Time to discharge (min)	145.8 (SD 37.3)	177.1 (SD 32.0)	108.5 (SD 29.5)	0.000
1 h VAS median (min–max)				
Rest	2.0 (0–2.0)	2.0 (0–2.0)	2.0 (0–2.0)	0.965
Mobilisation	3.0 (0–3.0)	3.0 (0–3.0)	3.0 (0–3.0)	0.422
2 h VAS median (min–max)				
Rest	5.0 (0–5.0)	6.0 (2.0–6.0)	3.0 (0–3.0)	0.000
Mobilisation	5.0 (0–5.0)	6.0 (2.0–6.0)	3.0 (0–3.0)	0.000
3 h VAS median (min–max)				
Rest	4.0 (0–4.0)	4.0 (1.0–4.0)	-	0.052
Mobilisation	4.0 (1.0–4.0)	4.0 (3.0–4.0)	-	0.017
Recall of intraoperative pain* (*n*)	0	0	8	0.0047
Time to first analgesia request (min)	112.5 (SD 30.3)	126.3 (SD 21.4)	272.5 (SD 63.8)	0.01
Required first dose of post-operative analgesia before discharge (*n*)	29	30	0	
Required rescue analgesia before discharge (*n*)	2	2	0	
Patient satisfaction* (satisfied/very satisfied/unsatisfied) (*n*)	16/15/0	17/14/0	18/13/0	0.878

*Subjective reporting by patient questionnaire.
Values for PACU stay, time to discharge and time to first analgesic request are standard deviation (SD).
BL, bupivacaine-lidocaine; BS, bupivacaine-saline; LIA, local infiltration anaesthesia; PACU, post-anaesthesia care unit; VAS, visual analogue scale score.

Patient satisfaction with the anaesthetic technique was similar between groups. Fifteen patients in the BL group, 14 patients in the BS group and 13 patients in the LIA group were very satisfied with their anaesthetic technique, and none rated their experience as unsatisfactory ($P = 0.878$) (Table 3). The three groups also had similar results in terms of post-operative adverse events: none reported nausea or vomiting, one patient in the BS group reported headache, and none in either spinal anaesthesia group reported transient neurological symptoms at the 3-day follow-up examinations.

Discussion

We found that the addition of low-dose (6 mg) 1% lidocaine to bupivacaine for spinal anaesthesia reduced the duration of the spinal block. This resulted in a shorter PACU stay and discharge time compared with spinal anaesthesia with bupivacaine alone, although time to discharge with the LIA technique remained the shortest.

Improved recovery after spinal anaesthesia has been the focus of many studies. The use of lower doses of long-acting anaesthetics was associated with inadequate anaesthesia.[13] The combination of low-dose local anaesthetics with opioids was also studied in outpatient spinal anaesthesia,[14] and urinary retention was reported as a restriction. The use of articaine as a short-acting agent was associated with higher incidence of hypotension compared with a bupivacaine-fentanyl combination, and in the same study, the time to onset and extent of spinal block with the bupivacaine-fentanyl combination was unpredictable.[15] Another short-acting local anaesthetic, chloroprocaine, was associated with short times to ambulation after spinal anaesthesia, but there are concerns related to neurological injury.[16] Unilateral spinal anaesthesia has been used to restrict the block to the operative side and optimise recovery. This technique requires patients to rest in the lateral position for 15 min after intrathecal injection.[17,18] According to our results, the addition of lidocaine reduced the duration of spinal anaesthesia without affecting the quality or stability of the block.

Another recent study could not confirm that the addition of lidocaine to bupivacaine would reduce the duration of the spinal block.[19] The method was similar to ours, except that their patients waited for 3 min in the lateral decubitus position after intrathecal injection, and the definition of total regression of sensory block was unclear.

Low-dose lidocaine has vasodilator properties that increase the clearance rate of bupivacaine from the intrathecal space, as shown in animal models via a microdialysis technique in rabbits. This mechanism may explain why increasing the total local anaesthetic dose did not increase the duration.[20]

Restricted mobilisation because of motor block can prolong discharge.[9] Post-operative pain can also

delay discharge;[21] we observed that resolution of sensory and motor blockade did not predict readiness for discharge in spinal anaesthesia groups. These patients had higher post-operative pain scores, especially during mobilisation. Earlier perception of post-operative pain after resolution of a spinal block might contribute to differences in discharge times between spinal anaesthesia and LIA.

In this study, the time gained by adding lidocaine to bupivacaine for spinal anaesthesia was 40 min in terms of resolution of the block and 45 min in terms of PACU time. A hypothetical model showed that decreased time to discharge from the PACU by ≥ 10% can decrease PACU congestion by 20%. Reducing time in the PACU can reduce the costs and increase the number of patients served while also increasing quality of care and reducing risk of post-anaesthesia complications.[22]

LIA techniques and ilioinguinal, iliohypogastric nerve blocks require multiple injections, with special training and experience. Surgeons are reluctant to rely only on local anaesthesia in inguinal hernia repair, preferring to perform this complex procedure under general or spinal anaesthesia monitored by skilled anaesthetists. Furthermore, higher doses of anaesthetic agents are needed for local anaesthesia than spinal anaesthesia.[23] The mean doses of local anaesthetic used in our LIA group were high compared with spinal anaesthesia, but the difference complied with previous reports.[24] Spinal anaesthesia techniques can be easily learned and performed with a single injection, and required anaesthetic doses are lower than those for LIA.

MAP was higher at certain intraoperative periods in the LIA group, which corresponded to the manipulation of peritoneal sac (the tissue most sensitive to tension during inguinal herniorrhaphy). This group had the highest number of patients who recalled experiencing intraoperative pain. The LIA techniques require additional local anaesthetic injections during peritoneal sac manipulation, which might contribute to longer operative times and intraoperative pain. Patients receiving LIA alone may require more sedation during peritoneal sac manipulation, which may elicit respiratory depression and supplemental oxygen thereafter. The incidence of insufficient local anaesthesia requiring extended supplementary sedation is reported at about 8% during herniorrhaphy with local anaesthesia. Surgeon's lack of experience in administering local anaesthesia may be responsible for insufficient anaesthesia, and further improvement in intraoperative analgesia is required.[25]

To date, local and spinal anaesthesia for outpatient inguinal herniorrhaphy have rarely been compared. In one study, local anaesthesia was associated with shorter time to discharge, while additional local anaesthesia was required intraoperatively in 80% of patients. However, the patients were not questioned whether they recalled having pain during surgery. In that study, time to discharge after spinal anaesthesia was longer than our BL group, although our patients received lower bupivacaine doses.[7]

Besides prolonged motor block and early onset of post-operative pain, nausea and vomiting, or urinary retention can also delay discharge after spinal anaesthesia.[12] Moreover, inguinal hernia repair with spinal anaesthesia is among the procedures associated with a high risk of urinary retention. Urination before discharge is recommended;[26] as such, we carefully monitored all patients in this study for spontaneous urination. Patients also emptied their bladders prior to surgery to reduce risk of post-operative urinary retention.[27] No patients in this study experienced post-operative nausea or vomiting possibly because of avoidance of opioids.

The limitation of this study is that our study was not powered to make a definitive statement concerning the difference between post-operative urinary retention, transient neurological symptoms (TNS) or nausea and vomiting. In addition, the dose-related efficacy of bupivacaine was not examined. The bupivacaine dose was determined according to the practice in our institution. The probability of block failure with lower doses of bupivacaine was excluded; however, this issue has to be studied.

Despite the limitations of our study, we find that reducing the duration of the spinal block by the addition of lidocaine to bupivacaine is a good alternative to LIA for outpatient herniorrhaphy. This spinal anaesthesia technique did not affect the quality or stability of the spinal block and is easy to perform; in contrast, LIA was associated with intraoperative pain and needs special training. To our knowledge, this is the first study to evaluate a BL mixture for outpatient herniorrhaphy.

We conclude that the addition of low-dose lidocaine to bupivacaine as an alternative spinal anaesthesia technique shortened the duration of the bupivacaine spinal block and decreased the PACU stay and discharge time. Compared with spinal anaesthesia, LIA allows earlier hospital discharge and lower post-operative pain scores after outpatient inguinal herniorrhaphy; conversely, patient

reports of intraoperative pain may be a disadvantage of the technique.

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References

1. De Lange DH, Kreeft M, van Ramshorst GH, Aufenacker TJ, Rauwerda JA, Simons MP. Inguinal hernia surgery in the Netherlands: are patients treated according to the guidelines? Hernia 2010; 14: 143–8.
2. Metzger J, Lutz N, Laidlaw I. Guidelines for inguinal hernia repair in everyday practice. Ann R Coll Surg Engl 2001; 83: 209–14.
3. Kehlet H, Nielsen MB. Anaesthetic practice for groin hernia repair- a nation-wide study in Denmark 1998–2003. Acta Anesthesiol Scand 2005; 49: 143–6.
4. Ruben VN, Mahabier C, Dawson I, Hop CW, Kok FMN, Lange FJ, Jeekel J. Spinal or local anesthesia in Lichtenstein hernia repair a randomized controlled trial. Ann Surg 2008; 247: 428–33.
5. Bhattacharya P, Mandal MC, Mukhopadhyay S, Das S, Pal PP, Basu SR. Unilateral paravertebral block: an alternative to conventional spinal anesthesia for inguinal hernia repair. Acta Anesthesiol Scand 2010; 54: 245–51.
6. Toivonen J, Permi J, Rosenberg PH. Analgesia and discharge following preincisional ilioinguinal and iliohypogastric nerve block combined with general or spinal anesthesia for inguinal herniorrhaphy. Acta Anaesthesiol Scand 2004; 48: 480–5.
7. Poli M, Biscione R, Bacchilega I, Saravo L, Trombetti P, Amelio G, Rossi G. Subarachnoid anesthesia vs monitored anesthesia care for outpatient unilateral inguinal herniorrhaphy. Minerva Anestesiol 2009; 75: 435–42.
8. Wulf H. New perspectives for day-case spinals! Old drugs for an ancient technique? Acta Anesthesiol Scand 2011; 55: 257–8.
9. Song D, Greilich N, White P, Wachta MF, Tongier K. Recovery profiles and costs of anesthesia for outpatient unilateral inguinal herniorraphy. Anest Analg 2009; 91: 876–81.
10. Lee SJ, Bai SJ, Lee JS, Kim WO, Shin YS, Lee KY. The duration of intrathecal bupivacaine mixed with lidocaine. Anesth Analg 2008; 107: 824–7.
11. Amid PK, Shulman AG, Lichtestein IL. Local anesthesia for inguinal hernia repair step-by-step procedure. Ann Surg 1994; 220: 735–7.
12. Marshall SI, Chung F. Discharge criteria and complications ambulatory surgery. Anesth Analg 1999; 88: 508–17.
13. Arzola C, Wieczorek PM. Efficacy of low-dose bupivacaine in spinal anesthesia for Caesarean delivery: systematic review and meta-analysis. Br J Anaesth 2011; 107: 308–18.
14. Gupta A, Axelsson K, Thörn SE, Matthiessen P, Larsson LG, Holmström B, Wattwil M. 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: 13–9.
15. Bachmann M, Pere P, Kairaluoma PH, Kallio H. Randomised comparison of hyperbaric articaine and hyperbaric low-dose bupivacaine along with fentanyl in spinal anesthesia for day-case inguinal herniorrhaphy. Eur J Anaesthesiol 2012; 29: 22–7.
16. Förster JG, Rosenberg PH. Revival of old local anesthetics for spinal anesthesia in ambulatory surgery. Curr Opin Anaesthesiol 2011; 24: 633–7.
17. Borghi B, Stagni F, Bugamelli S, Paini MB, Nepoti ML, Montebugnoli M, Casati A. Unilateral spinal block for outpatient knee arthroscopy: a dose-finding study. J Clin Anesth 2003; 15: 351–6.
18. Casati A, Moizo E, Marchetti C, Vinciguerra F. A prospective, randomized, double-blind comparison of unilateral spinal anesthesia with hyperbaric bupivacaine, ropivacaine, or levobupivacaine for inguinal herniorrhapy. Anesth Analg 2004; 99: 1387–92.
19. Jacobsen J, Husum B, Staffelt H, Qvist T, Jensen PE, Kledal S. The addition of lidocaine to bupivacaine does not shorten the duration of spinal anesthesia: a randomized, double blinded study of patients undergoing knee arthroscopy. Anesth Analg 2011; 113: 1272–5.
20. Clement R, Malinovsky JM, Corre P, Dollo G, Chevanne F, Verge R. Spinal biopharmaceutics of bupivacaine and lidocaine by microdialysis after their simultaneous administration in rabbits. Int J Pharm 2000; 203: 227–34.
21. Pavlin DJ, Rapp S, Polissar NL, Malmgren JA, Koerschgen M, Keyes H. Factors affecting discharge time in adult outpatients. Anesth Analg 1998; 87: 816–26.
22. Dexter F, Tinker JH. Analysis of strategies to decrease postanesthesia care unit costs. Anesthesiology 1995; 82: 94–101.
23. Seker G, Kulacoglu H. The acceptance rate of local anesthesia for elective inguinal hernia repair among the surgeons working in a teaching hospital. J Coll Physicians Surg Pak 2012; 22: 126–7.
24. Kulacoglu H, Ozyaylali I, Yazicioglu D. Factors determining the doses of local anesthetic agents in unilateral inguinal hernia repair. Hernia 2009; 13: 511–6.
25. Callesen T, Bech K, Kehlet H. One thousand consecutive inguinal hernia repairs under unmonitored local anesthesia. Anest Analg 2001; 93: 1373–6.
26. Baldini G, Bagry H, Aprikian A, Carli F, Phill M. Postoperative urinary retention. Anesthesiology 2009; 110: 1139–57.
27. Petros JG, Rimm EB, Robillard RJ, Argy O. Factors influencing postoperative urinary retention in patients undergoing elective inguinal herniorrhaphy. Am J Surg 1991; 161: 431–4.

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