Intrathecal prilocaine, 2-chloroprocaine and bupivacaine for ambulatory abdominal wall herniorrhaphy: a prospective observational study

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Abstract

Objectives: Considering fast-track principles, an ideal spinal anesthetic should have minimal complications and above all fast recovery so reducing in-hospital stay.

Methods: Between 1/8/2015 and 1/1/2016, a total of 101 patients with an umbilical or unilateral inguinal hernia were enrolled in this observational study. 10.5mg bupivacaine (B-group), 40mg 2-chloroprocaine (C-group) or 60mg prilocaine (P-group), each with added sufentanil (2µg) was used as spinal anaesthetic. Full regression of sensory and motor block and time to independent micturition (>200ml) were defined as clinical endpoints.

Results: 33 patients were injected with bupivacaine (B-group), 33 patients with 2-chloroprocaine (C-group) and 35 patients with prilocaine (P-group). Pain during surgery was predominantly seen in the C and P-group (5 and 1 patient(s) with the need for general anaesthesia in 2 patients (1 in the C-group, 1 in the P-group). Mean time to full regression of sensory and motor block was 5,3; 2,8; 3,9 hours and 3,1; 1,8; 2,2 hours for respectively the B, C and P-group. Time to independent micturition (>200ml) was similar in all groups: 6,9 (B); 5,1 (C); 5,6 (P) hours. Only in the B-group, postoperative urinary retention with the need for catheterisation (4 patients) and overnight stay was encountered.

Conclusions: Bupivacaine has a rather slow recovery with a risk of urinary retention. 2-chloroprocaine has a faster motor and sensory block regression as compared to prilocaine.

Keywords: Ambulatory surgery, hernia, abdominal, umbilical, intrathecal, prilocaine, bupivacaine, 2-chloroprocaine, ambulation, discharge, fast-track.

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Introduction

Open inguinal and umbilical hernia repair are two of the most performed surgical interventions in day-care surgery. Fast-track surgery implies a short acting anesthesic with few side-effects.

Spinal anesthesia has proven to be a safe method to ensure adequate analgesia for patients undergoing elective open abdominal wall surgery. During many years, a variety of intrathecal products alongside a plethora of adjuvants have been evaluated. Three different types of spinal anesthetic products already used in routine care were compared for feasibility and efficiency: 2-chloroprocaïne (Ampres®, Nordic Pharma), bupivacaine (Marcaine®, AstraZeneca) and prilocaine (Tachipri®, Nordic Pharma).

Methods

We conducted a prospective five month observational study on patients undergoing day-care surgery for an umbilical or unilateral inguinal hernia. Local ethical committee approval (EC0G099 - AZ Sint Dimpna, Geel, Belgium – 8/2015) and individual written informed consent was obtained. Surgical procedures were performed by two surgeons (TL and TG). The hernia was diagnosed clinically and/or by ultrasonography. Patients were preoperatively informed about the details concerning surgery and anesthesiology. This study was registered retrospectively at ClinicalTrials.gov (NCT02813382).

All patients were hospitalized on the day of surgery following standard preoperative instructions. Spinal anesthesia was performed by six different anesthesiologists. Patients with contraindications for spinal anesthesia were excluded: INR (International Normalized Ratio) > 1.2, thrombocytopenia (<75.000/µl), symptomatic neurological disease and/or an allergy for local anesthetics.

Patient's baseline features were listed: gender, age, Body Mass Index (BMI), Anesthesiologists Physical Status classification (ASA classification), the patient's position at the moment of intrathecal injection (sitting up or in dorsolateral decubitus) and type and length of surgery. Open inguinal herniorrhaphy was performed following the Liechtenstein technique as described by Chastan [1,2]. For the treatment of an umbilical hernia, a polypropylene-ePTFE hernia patch (Ventralex™, BARD®) was used [3] .

Patients were injected with 10.5mg bupivacaine (B-group), 40.0mg of 2-chloroprocaïne (C-group) or 60.0mg prilocaine (P-group), each in combination with sufentanil (2.0µg). The choice of the product was based on the decision of the anesthesiologist.

All patients were administered 5mg of ephedrine and 0.2mg of glycopyrronium bromide IV after injection of the spinal anesthetic. A crystalloid solution was started at 200 ml/hr. Standard monitoring was used during the procedure: blood pressure monitoring, pulse oximetry and three lead electrocardiogram. Parameters were continuously recorded by a patient data management system (GE Ohmeda Health Care Aisys and Chipsoft). Hemodynamic anomalies were listed: hypotension (systolic pressure <75% of baseline value), bradycardia (pulse <60/min) and desaturation (SpO_2<92%).

The skin of the lower back was anesthetized with 3–5 ml of 1% lidocaine under aseptic conditions. Spinal anesthesia was performed at the L2-L3 interspace using a 27 G x 3 1/2 inch BD™ Whitacre needle pencil point needle. This procedure was performed sitting-

up or in dorsolateral decubitus (in inguinal hernia repair lying on the ipsilateral side when using prilocaine or bupivacaine and on the contralateral side when using 2-chloroprocaine). Patients in the sitting up position were instantly put in the dorsolateral position after the injection (side again depending on the product and type of surgery as described above). Regardless of these proceedings, all patients receiving 2-chloroprocaine were put in the reverse Trendelenburg position (approximately 20°) for 1–2 minutes immediately after infusion.

After injection, sensory and motor block assessment was performed and listed on predetermined time intervals: 1, 3, 30 minutes after infusion and from then on every 15 minutes until spontaneous voiding (>200ml) was achieved. Sensory block was evaluated by assessing the peak level dermatome (using the loss of thermoalgesia assessed by evaporation of ether starting at the L2 dermatome). Motor block was assessed using the Bromage scale.

During surgery, hypotension (systolic pressure <75% of baseline value) was treated with ephedrine and bradycardia with atropine and/or ephedrine. Patients experiencing desaturation (blood oxygen saturation <92%) received oxygen through a standard face mask starting at 2l/min. Intravenous (IV) fentanyl (25µg) was given as an escape drug. If insufficient analgesia was achieved (insufficient sensory block height), general anesthesia was initiated.

Postoperatively, all patients were transferred to the Post-Anesthesia Care Unit (PACU), where they received IV paracetamol (1g) and ketorolac (30mg). Postoperative nausea and vomiting (PONV) was treated with alizapride (50mg), if needed followed by ondansetron (5mg). After a minimum stay of 90 minutes, signs of regression of the motor block (Bromage scale) and normal hemodynamic parameters, patients were transferred to the day-care hospital for further recovery.

Full regression of sensory (defined as regression to the S2 dermatome) and motor block (Bromage 0) and time to independent micturition (>200ml) were defined as clinical endpoints. Pain experienced at the day-care hospital was managed with oral paracetamol (500mg) and ibuprofen (600mg), after determination of a Visual Analog Scale for Pain (VAS).

All data was analyzed using IBM SPSS statistical software version 23 and Microsoft Excel 2010. Comparison of continuous variables was performed using the F-test and posthoc analysis. Categorical variables were compared by means of a chi-square test. A p-value < 0.05 was considered statistically significant.

Results

A total of 101 patients were included. 33 patients were injected with bupivacaine (B-group), 33 patients with 2-chloroprocaine (C-group) and 35 patients with prilocaine (P-group). Mean age at surgery was 62.8 years (range 20.9 - 91.7) with a mean BMI of 26.3 kg/m² (range 17.9–39.4). 72 patients underwent unilateral open inguinal hernia repair and 29 umbilical hernia repair. ASA classification was ranked "1" for 93, "2" for 7 and "3" for 1 patient(s). Analysis of baseline demographic data did not show any significant differences between groups, besides from the ASA- classification (Table 1). Mean time

Table 1 Baseline demographic data (Mean + Range).

		B-group (n=33)		C-group (n=33)		P-group (n=35)		P-value
Patients (n)		33	32.7%	33	32.7%	35	34.7%	0.942
	male/female ratio	10.0		32.0		6.0		0.265
	age	67.2	(35.4 – 91.7)	57.9	(24.0 – 82.7)	63,4	(20.9 – 90.6)	0.053
	BMI	26.6	(17.9 – 39.4)	25.3	(18.7 – 30.1)	26.9	(20.3 – 38.6)	0.252
ASA*								
	1	27		33		33		0.020
	2	6		0		1		0.009
	3	0		0		1		0.386
	4	0		0		0		-
Position during spinal injection								
	Sitting up	1		6		2		0.069
	Lateral decubitus	32		27		33		0.069
Duration of surgery (min)		36	(14 – 63)	31	(14 – 48)	35	(12 – 56)	0.094
Type of surgery								
	inguinal hernia	25		22		25		0.717
	direct	13	52.0%	10	45.5%	10	40.0%	0.695
	indirect	15	60.0%	15	68.2%	19	76.0%	0.479
	combination	3	12.0%	3	13.6%	4	16.0%	0.919
umbilical hernia		8		11		10		0.717
	mesh	8	100%	10	90.9%	10	100%	0.429
	primary	0	0%	1	9.1%	0	0%	0.429

ASA: Anesthesiologists Physical Status classification

until spontaneous micturition was 6.9 ± 2.0 hours (B-group), 5.1 ± 1.9 hours (C-group) and 5.6 ± 1.3 hours (P-group). There was no significant difference between groups. Mean time until complete sensory recuperation was 5.3 ± 2.2 hours (B-group), 2.8 ± 1.6 hours (C-group) and 3.9 ± 2.0 hours (P-group). Mean time until complete motor regression was 3.1 ± 1.7 hours (B-group), 1.8 ± 0.8 hours (C-group) and 2.2 ± 0.8 hours (P-group). Both were significantly faster in the C-group (as compared to the P and B-group). Details concerning the regression of sensory and motor blocks are displayed in Table 2.

In the C-group, four patients (p=0.077) experienced significant pain during surgery which was successfully managed using IV fentanyl. Intraoperative hypotension was only encountered in the C and P-group (p=0.001), as was pain requiring conversion to general anesthesia (one patient in each group). Postoperative pain (VAS 4-6) was encountered significantly more in the C-group (p=0.041). Need for an overnight stay (due to prolonged PONV and/or urinary retention requiring indwelling catheter) was only seen in the B-group (P=0.042). Intra- and postoperative hemodynamic data, symptoms and need for analgesia are displayed in Table 3.

Discussion

In this study, a significantly faster regression of motor and sensory block was seen for intrathecal 40mg of 2-chloroprocaine (2-CP) as compared to 60mg of prilocaine, both with 2.0µg of added sufentanil. Time to independent micturition however, was comparable. Both products were ineffective requiring general anesthesia in one patient each.

Because of the recorded neurotoxicity when administered in large doses [4] and potential high incidence of transient neurological symptoms (TNS) [5], the use of 2-CP for spinal anesthesia was unpopular in the past. It was finally approved in Europe in 2013 [6] after extensive testing. In a study of over 4000 patients, Goldblum et al [7] described 5 possible cases of TNS and 1 regressive incomplete cauda equine syndrome. Valth et al [8] did research concerning the effects of added fentanyl (20µg) and concluded an average time to void of 104±7 min with a prolonged surgical block, but without significantly delaying discharge. Furthermore, a somewhat longer time to complete sensory and motor block regression was seen in comparison with other studies using plain 40mg 2-CP [9, 10, 11]. We recorded a significantly longer average time to independent micturition when using 40mg 2-CP ranging from 96 to 271min [12, 13]. In those studies however, a plain product was used (without added sufentanil). Unfortunately, few comparable articles studying the effects of added sufentanil are available at this time. Maes et al [14] recorded a time to complete motor block regression of 73 min (41–114 min) using 40mg of 2-CP with sufentanil (1µg) for caesarean sections (n=18). In literature, encountered intraoperative hypotension ranges from 4.5 to 54% [15, 16, 17].

Dahlgren et al [18] recorded a comparable sensory peak block height (T4 versus T3 in our study) when using 12.5mg of bupivacaine with 2.5µg of sufentanil in patients undergoing C-section. Furthermore, in this randomized, double-blind fashion study (n=20) they recorded a similar motor block regression (177min versus 168min in our study). In a randomized controlled clinical trial involving 90 patients undergoing lower limb surgery, Hassani et al [19] concluded that the use of added sufentanil (2.5µg) resulted in a longer complete and effective analgesia as compared to intrathecal fentanyl and placebo. Also, they did not notice any significant difference in motor block. Overall, postoperative urinary retention after intrathecal infusion of bupivacaine with added sufentanil is encountered in 2.7–40% of patients [20, 21].

2-CP is suggested to be used for ultra-short and short ambulatory surgery (up to 45min). Prilocaine should be suitable for somewhat longer surgical interventions [22]. Few studies regarding the use of intrathecal prilocaine with added sufentanil are currently available. In a randomized, clinical trial comparing the efficacy of 40 and 60 mg of hyperbaric versus 60 mg of plain 2% prilocaine, Camponovo et al [23] described a faster sensory block regression (163 min), faster spontaneous micturition (336 min) and slower motor block regression (157min to Bromage 0) in a younger population (47 years old on average) as compared to our results (using plain prilocaine). Akcaboy et al [24] also noticed a significantly higher incidence of intraoperative bradycardia and hypotension (23.3%) after prilocaine 50mg with 25 µg fentanyl in a male population (70 years old on average) undergoing TURP. Other authors confirmed these observations [25, 26].

Table 2 Post injection sensory and motor block clinical data (mean values and range).

	B-group (n=33)	C-group (n=33)	P-group (n=35)
Time to independent micturition (h)	6.9 (2.0-11.3)	5.1 (2.4-9.7)	5.6 (2.4-8.2)
In hospital time (h)	8.5 (4.0-10.9)	8.0 (4.2-10.8)	8.1 (5.2-9.4)
Time to complete sensory regression (h)	5.3 (1.7-9.2)	2.8 (1.0-8.1)	3.9 (1.3-9.3)
Time to complete motor regression (Bromage 0) (h)	3.1 (1.3-9.2)	1.8 (0.8-4.3)	2.2 (0.7-4.2)
Time from spinal anesthesia to ready-to-cut (min)	3.4 (1.0-19.0)	2.8 (1.0-15.0)	3.7 (1.0-22.0)
Time from spinal anesthesia to start of surgery (min)	11.1 (2.0-20.0)	10.8 (3.0-24.0)	11.5 (1.0-22.0)
Time to T6 (min)	8.1 (1.0-20.0)	12.1 (1.0-68.0)	10.8 (1.0-63.0)
Time to T10 (min)	2.8 (1.0-19.0)	1.5 (1.0-15.0)	3.1 (1.0-22.0)
Peak sensory level time to onset (min)	36.3 (1.0-70.0)	28.3 (1.2-69.0)	26.3 (1.0-67.0)
Peak sensory level (dermatome)	T3 (T1-T9)	T4 (T3-T9)	T5 (T2-T9)

*P-values are calculated between C-group and P-group.

**P-values show significant faster sensory and motor block recuperation in the C-group.

time to complete sensory recuperation was defined as complete regression to the S2 dermatome

Table 3 Intra- and postoperative hemodynamic data and clinical symptoms.

	B-group (n=33)		C-group (n=33)		P-group (n=35)		p-value
Intraoperative period							
Hypotension (systolic blood pressure ≤ 75% of baseline value)	0	0%	7	21.2%	12	34.3%	0.001
Bradycardia (pulse < 60bpm)	6	18.2%	4	12.1%	3	8.6%	0.491
Desaturation (SpO2 < 92%)	1	3.0%	5	15.2%	4	11.4%	0.240
Pain	1	3.0%	5	15.2%	1	2.9%	0.077
Pain requiring general anesthesia	0	0%	1	3.0%	1	2.9%	0.609
Nausea	2	6.1%	4	12.1%	4	11.4%	0.664
Postoperative period							
PONV*	2	6.1%	4	12.1%	4	11.4%	0.664
Pain	3	9.1%	7	21.2%	3	8.6%	0.218
VAS** (0-3)	3	9.1%	3	9.1%	3	8.6%	0.996
VAS** (4-6)	0	0%	3	9.1%	0	0%	0.041
VAS** (7-10)	0	0%	1	3.0%	0	0%	0.353
Postoperative urinary retention (requiring catheterization)	4	12.1%	0	0%	0	0%	0.014
Need for overnight stay	3	9.1%	0	0%	0	0%	0.042
Due to need for urinary catheterisation	2	6.1%	0	0%	0	0%	0.122
Due to prolonged PONV*	1	3.0%	0	0%	0	0%	0.353

*PONV = Postoperative Nausea and Vomiting (in the hospital)

**VAS = Visual Analogue Scale for Pain

Limitations of this study are obviously the non-randomization and small sample size in each group. Specifically for abdominal wall surgery, relatively few articles seem to exist concerning the efficacy of different products with added sufentanil.

To conclude we can state that in the setting of elective ambulatory abdominal wall surgery (open unilateral inguinal and umbilical hernia repair), bupivacaine offers long-time adequate analgesia but carries a rather high risk of postoperative urinary retention. 2-CP is associated with the fastest sensory and motor block regression, however one should be aware that some degree of intraoperative (refractory) pain is possible and conversion to general anesthesia might be needed. The latter remark together with a slightly higher incidence of hypotension also holds true for prilocaine.

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