The use of extended release bupivacaine with transversus abdominis plane and subcostal anterior quadratus lumborum catheters: A retrospective analysis of a novel technique

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Abstract

Background and Aims: Liposomal bupivacaine (LB) is a formulation of local anesthetic that may exert analgesia over a prolonged period. Anecdotal use of LB suggests benefit and prolonged analgesia when used to supplement infiltration blocks. Our aim was to test the effect of a bolus of LB delivered through a nerve catheter in two types of interfascial plane blocks (transversus abdominis plane and anterior subcostal quadratus lumborum). The effect was evaluated through patient self-reporting of postsurgical pain up to 48 postoperative hours.

Material and Methods: Medical records of adult postoperative patients who received LB in a peripheral nerve catheter were followed retrospectively and analysed for pain scores and spread of dermatomal numbness over 48 h following the postoperative dose. A chart review of patients who qualified between June 2015 and March 2017 was performed, and clinical data were obtained from the institutional Perioperative Health Documentation System.

Results: Pain scores decreased following LB bolus, and all patients reported efficient block analgesia after bolus injection. Dermatomal numbness decreased gradually and was minimal by 48 h following bolus.

Conclusion: LB can be injected through a peripheral nerve catheter to prolong analgesia after catheter removal.

Keywords: Liposomal bupivacaine, nerve block catheters, postoperative pain, quadratus lumborum block, transversus abdominis plane block

Introduction

Postoperative pain remains a concern following surgery and is a source of morbidity, increased hospital stay, and dissatisfaction.[1-5] Peripheral nerve catheters are currently being used in transversus abdominis plane (TAP) blocks and quadratus lumborum (QL) blocks.[1,4,6,7]

Liposomal bupivacaine (LB) has been used to increase the duration of postoperative analgesia.[8-10] However, published data are insufficient,[11,12] and current experience is limited to surgical site infiltration and single-injection nerve blocks.[2,9,13,14] To date, LB has not been used in nerve catheters. We have conducted a retrospective review of analgesia and dermatomal distribution after LB injection in TAP or QL catheters prior to removal.

Material and Methods

The institutional review board at our institution approved

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the study and waived the requirement for written informed consent. The procedures followed were in accordance with the ethical standards of the institution and with the Declaration of Helsinki of 1975, as revised in 2000. We reviewed the charts of all adult patients (≥18 years of age) who received LB injected in peripheral nerve catheters (TAP or QL) between June 2015 and March 2017. Clinical data were obtained from the electronic medical records in the institutional Perioperative Health Documentation System. As this was a retrospective chart review without a control group, no formal statistical power analysis was performed. The medical records of all patients receiving LB through peripheral nerve catheters during this period were included in an LB registry and reviewed in detail. Data were collected by obtaining notes by surgeons, pain team physicians, and ward nurses, as well as electronically uploaded vital signs. Collected data included patient demographics, surgical details (type of procedure, type of peripheral nerve catheter), and catheter insertion details (time of catheter initiation, completion, discontinuation, time of LB bolus). Data were as de-identified and stored in an electronic spreadsheet where simple descriptive statistics were calculated (median, range, percentage) and reported as tables and column charts.

The techniques for TAP block, QL block, and catheter insertions have been described elsewhere.[15-17] Local anaesthetic spread was confirmed on ultrasound imaging in all patients [Figure 1]. All catheters were confirmed to be functional at the time of insertion by observing analgesia and a corresponding dermatomal decreased sensation (T10–T12 for TAP blocks and T8–L1 for QL blocks).

On the day of anticipated catheter removal, the ropivacaine infusion was stopped and patients were observed for 4 h to determine their pain levels and need for further analgesic management. At the end of this observation period, if a patient reported a pain score of 5 or more on the visual analog scale (VAS), they were selected to receive LB through the catheter(s). For patients who received QL catheters, a normal motor examination (hip and knee flexion and extension) was documented prior to LB injection to minimize the risk of falls after discharge. The catheters were first flushed with 10 mL of normal saline to wash out any residual ropivacaine and prevent solution mixing, and then LB was injected once just before removal. For unilateral catheters, 20 mL of LB was injected corresponding to 266 mg (Exparel; Pacira Pharmaceuticals, Parsippany, NJ, USA) diluted with normal saline for a total volume of 30 mL. For bilateral catheters, each side received 10 mL of LB corresponding to 133 mg diluted with normal saline to a total volume of 20 mL. The patients were then observed for at least 4 h prior to hospital discharge and received phone follow-up 24 and 48 h after hospital discharge. This follow-up period was chosen to minimize phone calls to patients (one phone call per day over 2 days) and because it was anticipated that the majority of patients would have experienced their most severe pain within that period.

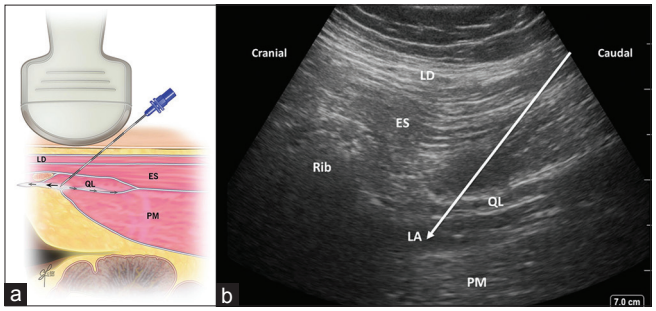

Figure 1: Ultrasound-guided subcostal anterior QL block. (a) Schematic representation of the ultrasound-guided anterior subcostal approach to the QL nerve catheter insertion. (b) Ultrasound image showing the spread of local anaesthetic. The white arrow represents the needle path. LD = latissimus dorsi, ES = erector spinae, QL = quadratus lumborum, PM = psoas muscle, LA = local anaesthetic

The pain scores prior to and following LB injection through the catheter (for 48 h after LB) were reported by patients on a 10-point standard pain scale (where 0 indicates no pain, 5 indicates moderate pain, and 10 indicates severe pain).

We asked each patient to report the degree of numbness in the dermatome blocked by the catheter starting from the time of LB injection and over the following 48 h. Patients scored the dermatomal spread at 100% on the day of LB injection, corresponding to maximal analgesic effect and block coverage. We maintained the same method of subjective reporting by patients throughout the study period.

Pain tolerance was another subjective measure that was collected over the study period. Pain tolerance was defined as the comfort of each patient with their pain at predefined intervals: prior to the LB bolus, within 1 h after LB bolus, at 24 h, and at 48 h. An experienced provider from the acute pain team ensured proper removal of all catheters.

Results

We included a total of 10 patients in this cohort [Table 1], 7 of whom received TAP blocks (5 unilateral and 2 bilateral) and 3 received QL blocks (1 unilateral and 2 bilateral). Catheters were infused with ropivacaine (0.1% or 0.2%) for the duration of their placement. Each of the peripheral nerve catheters was used for a period of at least 2 days (median 3, range 2–10) depending on the surgical procedure and the status of the patient [Table 2].

Figure 2 shows the baseline median VAS pain scores preceding the bolus injection. All patients reported a decrease in pain on

the bolus day within 1 h of the bolus injection (roughly two points on the VAS scale). Pain scores remained below the baseline levels throughout the study period (48 h following the bolus).

Subjective pain tolerance as described by patients is reported in Table 3. All patients reported being comfortable with their analgesia on the bolus day and at least 24 h later. Some of the patients had acceptable analgesic effect till 48 h after the bolus.

Figure 3 shows the presence of dermatomal numbness as reported by patients. Maximal dermatomal spread was rated at 100% on the day of bolus injection, indicating the patient could feel the numbness in the intended dermatomal distribution.

No patient experienced untoward side effects or complications while in the hospital or after discharge.

Discussion

This novel application of LB and its effects on postoperative pain could complement peripheral nerve catheters and affect patient recovery after catheter removal and discharge.

Table 1: Patient demographics

ID	Gender	BMI	Age (years)	Height (cm)	Weight (kg)
1	Female	22.4	58	157.5	59.0
2	Male	22.0	23	190.5	80.0
3	Female	34.2	57	162.6	90.4
4	Male	24.9	68	170.2	72.1
5	Female	27.9	44	167.6	78.4
6	Male	21.5	76	165.0	58.6
7	Female	36.2	44	157.5	89.8
8	Female	29.7	46	156.8	73.1
9	Female	24.3	52	163.8	65.3
10	Male	28.0	55	179.0	89.8

BMI=Body mass index

The catheters were flushed with normal saline prior to LB injection to avoid a possible rapid release of bupivacaine from the liposomes due to solvent mixing and interactions.[18] As such, it has been recommended to space the two medications over 20–30 min to avoid this interaction and to avoid the use of bupivacaine HCl for several days afterward due to the prolonged half-life of LB.[19]

The available data in this cohort, while not extensive, indicate a trend toward decreasing pain in the 2 days following catheter removal. Patients are typically titrated to a "comfortable" level of analgesia before catheter removal, at which time they are being prepared for hospital discharge.

The heterogeneity of our case series and the absence of a control group preclude firm conclusions, but all our patients

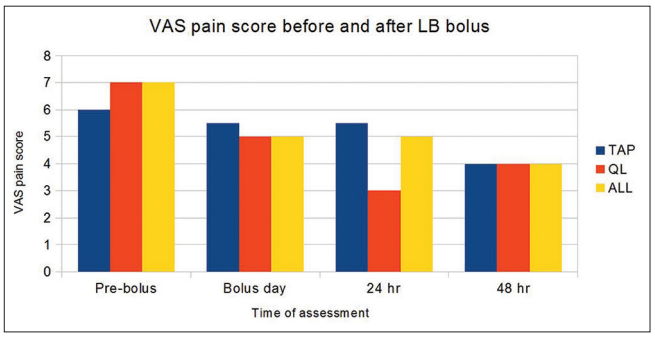

Figure 2: Median pain scores over the 48 h after LB bolus injection compared with pre-bolus levels. Median VAS pain scores (where 0 indicates no pain and 10 indicates the most severe pain) as reported by patients prior to and following LB bolus injection through the peripheral nerve catheter. All patients reported decreased pain at the time of LB bolus injection. All pain scores were maintained below pre-bolus levels over the following 48 h. VAS = visual analog scale, LB = liposomal bupivacaine, Bil = bilateral, Uni = unilateral, TAP = transversus abdominis plane, QL = quadratus lumborum

	Pre-bolus	Bolus day	24 h	48 h
TAP	6	5.5	5.5	4
QL	7	5	3	4
ALL	7	5	5	4

Table 2: Block-related demographics

ID	BMI	Procedure	Chronic pain*	Block type	Catheter drug†	Catheter discontinued (POD)‡
1	22.4	Laparotomy	Y	Bilateral TAP	Ropivacaine 0.2%	10
2	22.0	Proctectomy	N	Bilateral QL	Ropivacaine 0.2%	3
3	34.2	Laparotomy	Y	Bilateral QL	Ropivacaine 0.2%	6
4	24.9	Nephrectomy	N	Unilateral TAP	Ropivacaine 0.2%	2
5	27.9	Gastrectomy	Y	Bilateral TAP	Ropivacaine 0.1%	5
6	21.5	Kidney transplant	N	Unilateral TAP	Ropivacaine 0.1%	3
7	36.2	Kidney transplant	N	Unilateral TAP	Ropivacaine 0.2%	2
8	29.7	Gastric bypass	Y	Unilateral TAP	Ropivacaine 0.2%	7
9	24.3	Unilateral hip replacement	Y	Unilateral QL	Ropivacaine 0.2%	2
10	28.0	Laparoscopy	Y	Unilateral TAP	Ropivacaine 0.2%	2

*BMI=body mass index, TAP=transversus abdominis plane, QL=quadratus lumborum, POD=postoperative day. *Chronic pain: diagnosis present on admission. †TAP catheters are typically infused at 8-12 mL/h; QL catheters are typically infused at 6-8 mL/h. ‡On the day the peripheral nerve catheter was discontinued, a bolus dose of LP (Exparel; Pacira Pharmaceuticals) was delivered as follows: For unilateral catheters, 266 mg Exparel in 30 mL normal saline. For bilateral catheters, 133 mg Exparel in 20 mL normal saline per side*

Table 3: Patient-reported pain tolerance over 48 h following LB bolus

Patient	Evaluation within 1 h following LB bolus	24-h follow-up	48-h follow-up
1	Pain well-tolerated	Pain well-tolerated	Pain increased at 36 h
2	Pain well-tolerated	Pain well-tolerated	Pain increased at 48 h
3	Pain well-tolerated	Pain well-tolerated	Pain increased at 36 h
4	Pain well-tolerated	Pain well-tolerated	Pain increased at 48 h
5	Pain well-tolerated	Pain well-tolerated	Pain increased at 48 h
6	Pain well-tolerated	Pain well-tolerated	Pain increased at 48 h
7	Pain well-tolerated	Pain well-tolerated	Pain increased at 36 h
8	Pain well-tolerated	Pain well-tolerated	Pain increased at 48 h
9	Pain well-tolerated	Pain well-tolerated	Pain increased at 48 h
10	Pain well-tolerated	Pain well-tolerated	Pain increased at 36 h

LB=Liposomal bupivacaine. Pain tolerance was defined as the comfort of each patient with their pain at predefined study intervals (subjective reporting, qualitative measure). Patients were discharged home following a 4-h observation period after the LB bolus. Follow-up phone calls were made over the 2 days following the LB bolus

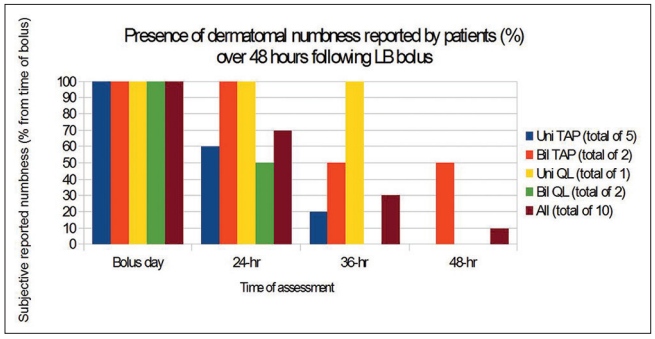

Figure 3: Presence of dermatomal numbness (decreasing from 100%) as reported by patients starting from LB bolus and over the following 48 h. Analgesic effect differed by type and laterality of block. Most patients reported nonsignificant numbness (20% or less) at 48 h after the LB bolus. LB = liposomal bupivacaine, Bil = bilateral, Uni = unilateral, TAP = transversus abdominis plane, QL = quadratus lumborum

Block type	Numbness present (decreasing from 100)			
	Bolus day	24 h	36 h	48 h
Uni TAP (total of 5)	100	60	20	0
Bil TAP (total of 2)	100	100	50	50
Uni QL (total of 1)	100	100	100	0
Bil QL (total of 2)	100	50	0	0
All (total of 10)	100	70	30	10

reported good pain control on the day of LB bolus and throughout the next day.

The use of LB in QL blocks is novel, with the first case report published in 2016 and describing an anterior QL block achieving sensory blockade for 2 days.[20] Three later reports described reduced postoperative pain, enhanced ambulation, and decreased overall cost with the use of LB postoperatively. However, these reports consisted of two case series with no control[13,21] and a retrospective analysis with propensity matching.[22]

Indwelling catheters are neither without complications nor without risks. Two recent reviews[23,24] have discussed the complications of peripheral nerve catheters including infection, secondary block failure, catheter migration, obstruction, kinking, infusion pump malfunction, and inadvertent catheter removal. Application of LB in peripheral nerve catheters may prove helpful for procedures with short hospital stay where patients can have significant pain at the time of scheduled discharge, or in cases where anticoagulation needs to be resumed in the early postoperative period precluding the ability to keep a catheter in place.

QL blocks can be associated with muscle weakness. A recent report mentions unilateral hip flexion and knee extension weakness for 18 h following lateral QL block with 20 mL of levobupivacaine 0.25%.[25] It is probable that the weakness resulted from local anaesthetic spread to the L1, L2, and branches of the lumbar plexus. We did not find any muscle weakness in our patients, whether before or after the LB injection.

The cost of liposome bupivacaine is one factor that deters hospitals from using it routinely.[26] The overall cost of prolonged hospitalization and readmission secondary to pain and opioid-related complications, however, may exceed the cost for patients receiving LB.[19,26] This cost should also take into account the requirement to follow-up with patients for up to 3 days postoperatively and assess their pain and possible adverse effects. A cost-effectiveness analysis needs to be conducted.

A formal prospective, randomized, blinded controlled trial with placebo and/or plain bupivacaine is necessary to define the real value of the technique.

LB can thus be injected through a peripheral nerve catheter to prolong analgesia after catheter removal.

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Nil.

Conflicts of interest
Dr. Elsharkawy has received unrestricted educational funding from PAJUNK Medical Systems (Norcross, GA,

USA), and is a consultant for PACIRA Pharmaceuticals (San Diego, CA, USA). Those companies had no input into any aspect of the present project design or manuscript preparation.

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