Original Article

Analgesic sparing effect of dexamethasone with levobupivacaine in quadratus lumborum block in patients undergoing unilateral inguinal hernia repair: A prospective randomised controlled trial

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ABSTRACT

Background: Quadratus lumborum block (QLB) provides somatic and visceral analgesia to the lower thoracic and abdominal wall. The aim was to investigate the analgesic effect of dexamethasone with levobupivacaine in QLB in patients undergoing unilateral inguinal hernia repair surgery. **Methods:** A total of 90 patients of American Society of Anaesthesiologists (ASA) I/II were randomly divided into two groups. Group L received 0.25% levobupivacaine (20 ml) + normal saline (1 ml) and group D received 0.25% levobupivacaine (20 ml) + 4 mg dexamethasone (1 ml) in QL plane on the operated side using ultrasound, after completion of surgery under spinal anaesthesia. The primary objective was to compare time for first rescue analgesia. The secondary objectives were total rescue analgesic consumption and numeric rating scale (NRS) in the first 24 h. **Results:** The demographic data age, sex, height, weight and ASA were comparable in both groups. The mean time to request for first rescue analgesia was longer in group D compared to group L (1016.02 ± 205.97 min versus 640 ± 132.96 min; $P < 0.0001$). The mean total tramadol consumption in the first 24 h was lower in group D compared to group L (233.55 ± 86.92 mg versus 328.22 ± 78.74 mg; $P < 0.0001$). Patients in group D had significantly lower NRS scores at rest and on movement as compared to group L. **Conclusions:** The addition of dexamethasone to levobupivacaine in QLB results in prolonged duration of postoperative analgesia, less rescue analgesic requirements and better quality of analgesia as compared to levobupivacaine in unilateral inguinal hernia repair surgery.

Key words: Dexamethasone, inguinal hernia repair surgery, levobupivacaine, quadratus lumborum block

INTRODUCTION

Inguinal hernioplasty is the third most commonly performed surgery in adults after appendicitis and proctologic disorders.[1] Various modalities like intravenous nonsteroidal anti-inflammatory drugs (NSAIDs), opioid analgesics, regional anaesthetic techniques like epidural and truncal blocks are used for the treatment of post-operative pain. Among them, regional anaesthetic techniques are preferred as they provide effective control of pain, reduced requirement

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of opioids, earlier mobilisation and better patient satisfaction.[2]

Quadratus lumborum block (QLB) is an abdominal interfascial plane block, which was first described by Blanco R as a variant of the TAP block in 2007.[3] The peculiar feature of this block is that it not only blocks sensory nerves but also the visceral nerves.[4] The QLB has been shown to provide effective postoperative analgesia in abdominal surgery, laparoscopic surgery and caeserean deliveries.[5-12] Several approaches have been described for the QLB. Lateral QLB (QLB-1) where local anaesthetic (LA) is injected at the anterolateral border of the QL muscle, posterior QLB (QLB-2) where LA is injected at the junction of QL muscle with the transversalis fascia and transmuscular QLB (QLB-3), where the needle is advanced through the QL muscle, penetrating the ventral proper fascia of the QL muscle and LA is finally injected between the QL muscle and psoas major (PM) muscle.[2,4,10]

Levobupivacaine is the LA agent with a higher threshold for systemic toxicity and with lesser cardiac and central nervous system side effects.[13] Single-shot regional anaesthesia using levobupivacaine has a limited duration of analgesia. Continuous research is being done to identify the effect of various adjuvants in improving the quality and increase the duration of the LA action in different peripheral nerve block techniques.[2] Dexamethasone is a very potent and highly selective glucocorticoid, which has been used as an adjuvant to LA in various nerve blocks.[2,14] There is still no consensus on the effect of dexamethasone on the duration of peripheral nerve blocks. The recent meta-analyses indicate that perineurally administered dexamethasone prolongs the duration of the peripheral block and potentiates analgesia.[15-17] The literature is scant on comparison of dexamethasone as an adjuvant to levobupivacaine for postoperative analgesia in ultrasound (US)-guided QLB in open inguinal hernia repair surgery. We hypothesised that the addition of dexamethasone to levobupivacaine in QLB would prolong the duration of analgesia in patients undergoing unilateral inguinal hernia repair.

METHODS

This prospective, randomised, double-blinded study was approved by the Institutional Ethical Committee (F.1/Acad/MC/JU/18 / 5156) and Clinical Trial Registry India (CTRI/2018 / 07/014866). This study followed the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 2013. Written informed consent was obtained from all participants. The manuscript adheres to the applicable CONSORT guidelines. The study was performed between July 2018 and December 2018.

A total of 90 American Society of Anesthesiologists (ASA) physical status I/II patients, aged 18–60 years, of either sex scheduled for elective unilateral inguinal hernia repair surgery under spinal anaesthesia were recruited in the study. Patient's refusal, known hypersensitivity to LA, infection at the local site, body mass index ≥35 kg/m^2, history of opioid addiction, any chronic systemic illness, bleeding diathesis, renal and hepatic dysfunctions, pregnancy and failure of the spinal block were the exclusion criteria for the study. The randomisation was carried out with the computer-generated random number table and group allocation was done with the sealed envelope method after completion of surgery. Patients were assigned to one of the two groups of 45 each, group L (levobupivacaine and normal saline) and group D (levobupivacaine and dexamethasone). QLB was performed by an experienced anaesthesiologist after completion of surgery.

A detailed preoperative check-up was carried out one day before surgery. The patients were explained in detail about the anaesthesia procedure and numeric rating score (NRS) for pain. The patients were kept fasting as per institutional protocol (2 h for clear liquid and 6 h for semisolid and solid) before surgery. The patients were pre-medicated with tablets alprazolam 0.5 mg and pantoprazole 40 mg previous night of surgery.

In the operation theatre, an intravenous (IV) cannula of 18 G was secured in non-dominant hand and ringer lactate at a rate of 10 ml/kg started. The standard ASA monitors in the form of electrocardiogram (ECG), pulse oximetry (SpO_2), non-invasive blood pressure (NIBP) were applied and baseline vital parameters were recorded. With all aseptic precautions, spinal anaesthesia was administered in sitting position at L3–4 or L4–5 interspace using 25 G Quincke tip spinal needle (B.Braun; Melsungen, Germany) using 3 ml of 0.5% heavy bupivacaine. Patients with partial or failed spinal were supplemented with general anaesthesia and excluded from the study. Heart rate (HR), peripheral oxygen saturation (SpO_2) and NIBP were recorded every 5 min during the intraoperative period.

After completion of the surgical procedure, US-guided QLB 1 or lateral QLB was performed in lateral position under all aseptic precautions using US machine (Sonosite turbo M, Bothell, Washington, USA) and linear US probe (6–13 MHz, 38 mm). The probe was placed in the mid-axillary line between the lower costal margin and the iliac crest in a transverse plane to view all abdominal layers. The probe was moved towards the posterior axillary line, to reach a point where all three abdominal muscles layers merge to form aponeurosis. The aponeurosis was then followed dorsally until the QL muscle was seen deep to transversalis fascia with its attachment to the transverse process of the L4 vertebral body [Figure 1]. A 22 G, 100 mm, blunt, insulated nerve block needle was inserted 1 cm medial to the probe and advanced using the in-plane technique with US real-time assessment. The injection site was the junction of transversalis fascia and the anterolateral border of QL muscle. The optimal point of injection was determined using hydrodissection with 2 ml of 0.9% normal saline (NS). After correct tip placement, the drug was injected in 5 ml increments with intermittent aspiration. During the injection, the distribution of LA was observed as a hypoechoic enlargement on ultrasonography. The group L patients received 20 ml of 0.25% inj. levobupivacaine + 1 ml NS and group D patients received 20 ml of 0.25% inj. levobupivacaine + 1 ml inj. dexamethasone (4 mg/ml), with a total volume of 21 ml in both groups. Study drug combinations were prepared by another anaesthesiologist, who was not part of the study. The person involved in the postoperative pain assessment and data collection was also blinded to the study groups. The HR, NIBP, SpO_2 and respiratory rate (RR) were recorded in the first 24 h. The primary objective of the study was to compare time to request for first rescue analgesia and secondary objectives were to calculate and compare total rescue analgesic doses and NRS. In the postoperative period, NRS was recorded at rest and on movement (knee flexion of operated side), (0 = no pain, 10 = intolerable pain) just after performing QLB and at an interval of 2 h up to 24 h in the postoperative period. Tramadol 2 mg/kg slow IV was given as rescue analgesic agent when NRS ≥4 at rest or on patient's demand, whichever occurred first. Despite tramadol injection, if NRS was ≥4, paracetamol 1 gm IV was given. NRS >4 after weaning off of spinal anaesthesia (The appearance of cold sensation with wet spirit cotton swab at T12 dermatome opposite to the surgical side) effect in the postoperative period was considered as failed QL block and such cases were excluded from the study. The patients were also observed for any possible adverse effects including nausea, vomiting, hypotension, bradycardia, arrhythmia, inadvertent femoral nerve block, LA toxicity and complication related to block till 24 h after surgery and managed as and when required. The patient satisfaction was graded as poor (1), fair (2), good (3), excellent (4).

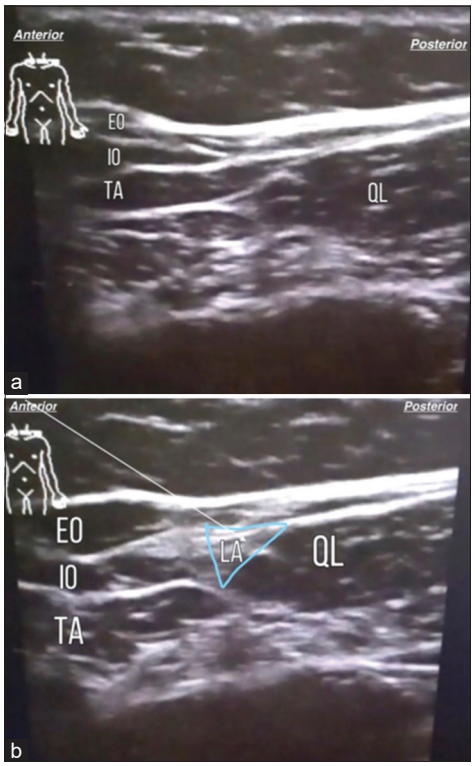

Figure 1: Ultrasound image of the anterior approach of quadratus lumborum block before injection (a) and after injection (b). EO = External olique muscle, IO = Internal olique muscle, TA = Transversus abdominus muscle, QL = Quadfratus lumborum muscle, LA = Local anaesthetic agent, Blue coloured area = Drug deposition site

The sample size calculation was based on the difference of mean duration of analgesia 4.95 h with a power of 80%, the significance level of 5% and confidence interval 95% (type 1 α error = 0.05 and β = 0.20).[14] The minimum sample size was calculated to be 39 patients in each group. Keeping a place for a 10% variation or the possibility of drop outs, we decided to include 45 patients in each group. Statistical analysis was performed using the Statistical Package for the Social Sciences (IBM SPSS version 20.0, Chicago, USA). Numerical data were analysed by using unpaired Student t-test and Mann–Whitney U test was used for comparing data with non-normal distribution. Categorical data were analysed by the Chi-Square test or Fisher's exact test as appropriate. Results were summarised as mean ± standard deviation (SD) or median with interquartile range (Q1-Q3) for continuous variables and as numbers or percentages

for categorical variables. For all statistical tests, a value of $P < 0.05$ was taken to be considered as significant.

RESULTS

A total of 98 patients were screened for eligibility in the study. Five patients did not meet the inclusion criteria and three patients refused to participate in the study. Ninety patients were randomised in two groups, with 45 in each [Figure 2]. The demographic data such as age, sex, height, weight and ASA were comparable in both groups [Table 1]. The haemodynamic and respiratory parameters were also comparable between the groups. The mean duration of surgery was comparable in both groups (40.71 ± 4.94 min in group L versus 41.8 ± 8.65 min in group D, $P = 0.465$). The mean time to request for first rescue analgesic agent was longer in group D compared to group L (1016.02 ± 205.97 min and 640 ± 132.96 min, $P < 0.0001$) [Table 2 and Figure 3]. The mean total rescue analgesic doses were lower in group D as compared to group L (233.55 ± 86.92 mg versus 328.22 ± 78.74 mg, $P < 0.0001$) [Table 2]. A total of 77.78% of patients in group L and 60% of patients in group D received two rescue analgesic dosages while 22.22% in group L and none in group D received three rescue analgesic dosages ($P < 0.0001$). None of the patients in both groups required tramadol in the first 6 hours while between 6 to 12 hours tramadol requirement was significantly higher in group L (84.44%) in comparison to group D (11.11%) ($P < 0.0001$). Eight (17.78%) patients in group L and two (4.44%) patients in group D received paracetamol as a rescue analgesic agent in the first 24 h ($P = 0.108$). Mean NRS scores at rest and movement were found to be lower in group D at all postoperative observations compared to group L ($P < 0.05$) [Figure 4]. The incidence of nausea, vomiting and hypotension was higher in group L compared to group D, but no statistical difference was observed in both the groups

Table 1: Demographic data between groups

Parameters	Group L	Group D	*P*
Age (years) (mean±SD)	37.73±13.55	39.88±13.76	0.45
Sex (male/female)	44/1	44/1	NA
Weight (kg)	74.8±9.00	74.68±8.86	0.95
Height (cm)	171.42±7.41	171.31±7.47	0.94
ASA-PS (I/II) (number of patients)	41/4	38/7	NA

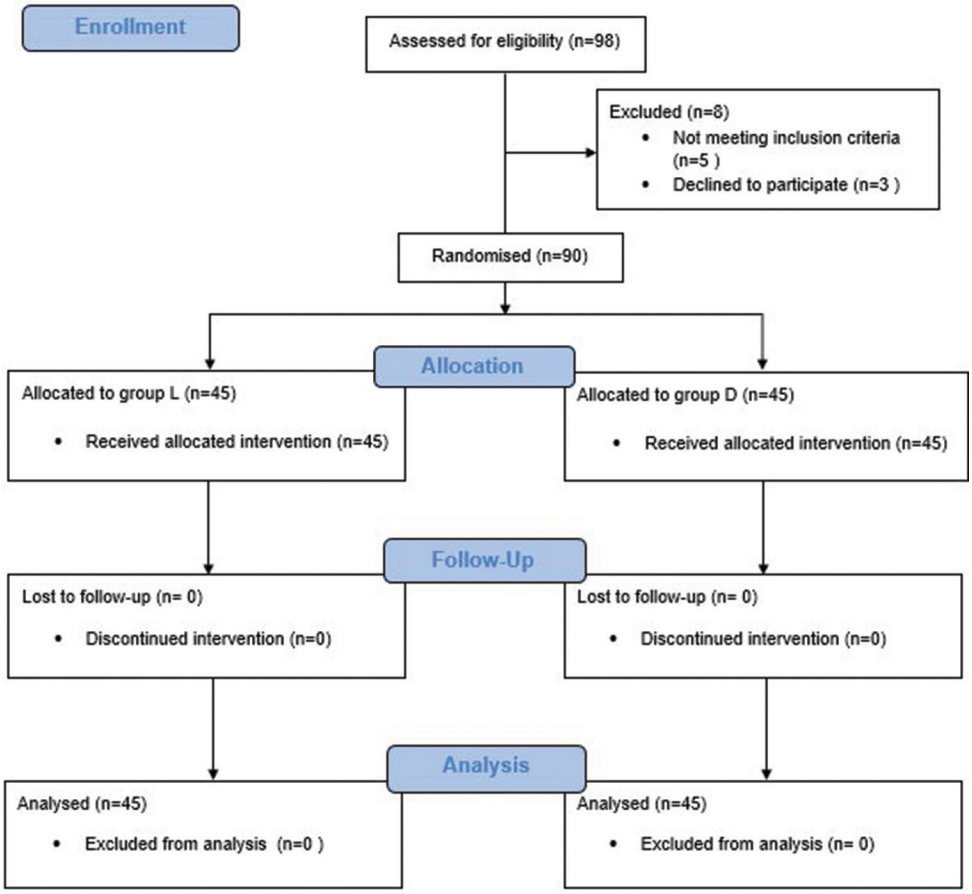

Figure 2: Consort flow diagram

Table 2: Comparison of duration of analgesia and total tramadol consumption

Parameters		Group L	Group D	*P*
Time to request for first rescue analgesic (min)	Mean±SD	640±132.96	1016.02±205.97	<0.0001
	Median Interquartile (Q1-Q3)	614 (590-720)	963 (847-1191)	
Total tramadol consumption in first 24 hours (mg)	Mean±SD	328.22±78.74	233.55±86.92	<0.0001
	Median Interquartile (Q1-Q3)	320 (280-360)	260 (160-300)	

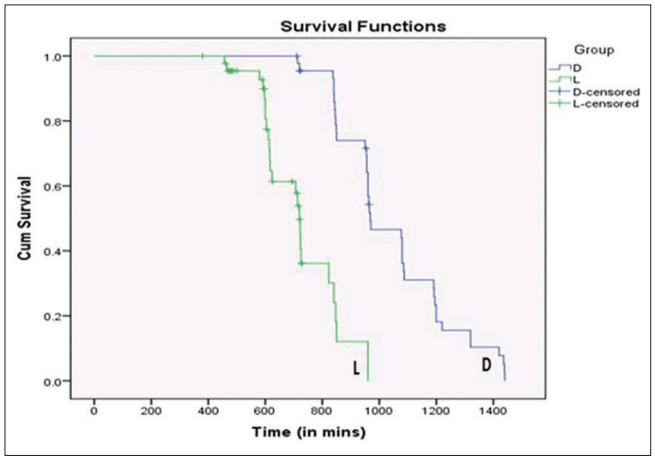

Figure 3: Consort diagram Kaplan-Meier curve for the duration of analgesia

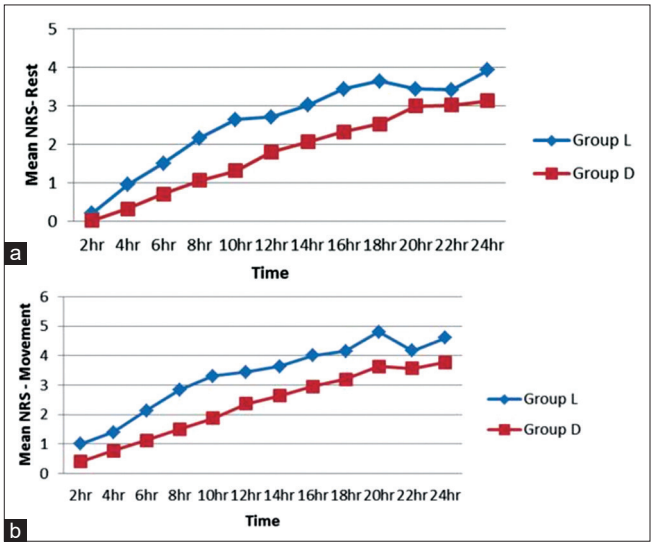

Figure 4: Comparison of NRS at rest (a) and on movement (b)

(P = 0.332, 0.293, 0.624 respectively). The patient satisfaction was excellent in 42.22% in group D while 8.89% in group L ($P < 0.0001$).

DISCUSSION

The main findings of our study were longer postoperative duration of analgesia and less postoperative opioid consumption in group D (0.25% levobupivacaine 20 ml, dexamethasone 4 mg) when compared to group L (0.25% levobupivacaine 20 ml, NS 1 ml) in patients undergoing unilateral inguinal hernia repair surgery.

The incorporation of US in regional anaesthesia in recent years resulted in significant improvement in the quality of nerve blocks, higher success rate with fewer complications and improved patient satisfaction. The newer regional anaesthetic techniques, long-acting LA and adjuvants are effective for the adequate management of acute pain.[2]

The QLB is an effective analgesic technique for various abdominal wall incisions. The QLB covers T7 to L2 dermatomes by the spread of LA drugs either into the paravertebral space or in the thoracolumbar plane, through iliohypogastric and ilioinguinal nerves, A and C fiber nociceptors, mechanoreceptors and high-density network of lumbar sympathetic fibers.[2,4] QLB has been earlier shown to prolong the duration of analgesia, reduced analgesic consumption and pain scores up to 48 h after caesarian section.[10-12] Recent studies suggest that QLB may be a good option for inguinal hernia repair surgeries in adults as well as paediatric patients.[6,7] Bilateral QLB has been shown to provide better perioperative analgesia and lesser opioid consumption compared with bilateral TAP block in patients undergoing lower abdominal surgeries.[18,19] QLB provides more extensive dermatomal blockade for a significantly longer duration of analgesia as compared to TAP blocks after laparoscopic ovarian surgery.[9] Unilateral transmuscular QLB (QLB-3) showed an effective postoperative analgesia method in children undergoing pyeloplasty and percutaneous nephrolithotomy (PNL) in adults.[5,8] QLB-3 reduces opioid consumption, speeds ambulation and allows the earlier discharge of the patients from the hospital in PNL surgeries.[8] The combination of lumbar erector spinae plane block (ESPB) and QLB was used for the anaesthesia management in high-risk patients undergoing hemiarthroplasty. The combination of the two blocks increased the effectiveness of one another and complemented the missing aspects.[20] The QLB provides somatic and visceral analgesia, hence, we studied the effect of dexamethasone with

levobupivacaine in QLB for patients undergoing open inguinal hernia repair surgery.

Levobupivacaine is a long-acting LA agent, commonly used for peripheral nerve block due to its better safety profile than that of bupivacaine. Despite long duration of action of levobupivacaine, it cannot provide analgesia for adequate period, hence there is need of adjuvants with LA in block or use of alternative analgesic administration for breakthrough surgical site pain, when effect of block wears off. Various adjuvants have been used and studied to improve the duration of LA action in different peripheral nerves and regional block techniques.[2] Dexamethasone as an adjuvant to LA has been shown to prolong the duration of pain-free period, less requirement for rescue opioids consumption, more patient satisfaction and lesser incidence of nausea and vomiting.[14-17] A similar finding was observed in our study.

The addition of dexamethasone 4 mg is equipotent to 8 mg dexamethasone in peripheral nerve block,[21] so this was the rationale behind the use of 4 mg dexamethasone in our study. Though dexamethasone is commonly administered as an anti-inflammatory and antiemetic agent, its mechanism as an adjuvant is not completely understood. The possible mechanism may be inhibition of phospholipase A2, potassium channel-mediated nociception transmission, local generation of inflammatory mediators and ectopic neuronal discharge.[22]

Less incidence of nausea and vomiting was found in group D, compared to group L, however, it was not statistically significant. This can be attributed to both lower consumption of tramadol and antiemetic role of dexamethasone. Possible mechanisms of action of the antiemetic action of dexamethasone as suggested by Chu CC *et al*. are its anti-inflammatory effect, direct central action at the solitary tract nucleus, interaction with the neurotransmitter serotonin, and receptor proteins tachykinin NK1 and NK2, alpha-adrenaline etc, maintenance of the normal physiological functions of organs and systems, regulation of the hypothalamic-pituitary-adrenal axis and by reducing pain and the concomitant use of opioids.[23] Our study did not have any complications associated with the use of dexamethasone with levobupivacaine in QLB. Type 1QLB failed to provide postoperative analgesia in surgeries involving dissection in the retroperitoneal area as there were high chances of damaging the thoracolumbar fascia.[24]

Possible limitations of this study were QLB was not used as a sole anaesthetic mode, the effect of the block was not assessed for bilateral or larger incisions and non-assessment of dermatomal level in the postoperative period.

CONCLUSIONS

The addition of dexamethasone to levobupivacaine in QLB in unilateral inguinal hernia repair surgery provides a prolonged duration of postoperative analgesia, with reduced analgesic requirements, a better quality of analgesia in terms of NRS and lesser incidence of side effects up to 24 h as compared to levobupivacaine alone group.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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