The Egyptian Journal of Hospital Medicine (April 2022) Vol. 87, Page 2184-2189

Efficacy of Adding Dexamethasone to Levobupivacaine in Erector Spinae Block for Total Hip Arthroplasty

Tamer El-Metwally Farahat[a] , Nahla Salama EL-Bahnasawy[a] , Omnia Mahmoud Heikal[a*] and Hesham Abd El-Mohaimen[a]

[a]Anesthesia, ICU and Pain management Department, Faculty of medicine, Mansoura University, Mansourah, Egypt

***Corresponding author:** Omnia Mahmoud Heikal, ORCID no.:0000-0003-4327-6189,
Mobile: (+20)1276164958, E-mail: omniaheikal2009@gmail.com

ABSTRACT

Background: Dexamethasone, when supplemented to a nerve block, promotes its performance while diminishing opioid demands.

Objective: This study was designed to identify the analgesic efficacy of combining dexamethasone with levobupivacaine in the erector spinae block (ESB) for total hip arthroplasty (THA) utilizing ultrasound guidance.

Patients and Methods: 82 patients of both sexes, with ASA physical status I-II, aged from 40 to 70 years were scheduled for a unilateral ESB before general anaesthesia for total hip arthroplasty. They were randomly assigned to two equal groups (n=41each): Levo group: unilateral ESP block was done using 20 mL of 0.5% levobupivacaine only. Dexa group: unilateral ESP block using 19 mL 0.5% levobupivacaine and 1 ml dexamethasone. Preoperative pain was assessed by visual analogue scale (VAS) as well as particular hemodynamics preoperatively and at 0, 2, 4, 8, 12, 16 and 24 hours post-operatively. The total dose of pethidine (mg) given in the first 24-hour was recorded in both groups as the initial analgesic necessity. A list of postoperative complications was kept.

Result: Patients in dexa group demonstrated prolonged postoperative analgesia compared to those in levo group. In the first 24 hours, dexa group had a significantly lower postoperative VAS score, lower cumulative pethidine doses and longer duration until the first request for analgesia than levo group. The two groups had statistically negligible differences in hemodynamic alterations and the incidence of side effects.

Conclusions: Using dexamethasone as an adjuvant of ESB with Levobupivacaine, provided effective postoperative analgesia through reducing pain VAS score without any reported hemodynamics or postoperative complications.

Keywords: Dexamethasone, Levobupivacaine, Erector spinae block, total hip arthroplasty.

INTRODUCTION

The Erector Spinae Block (ESB) has been used to alleviate immediate postoperative pain after appointive ventral hernia repair via laparoscopic surgery, chest wall surgeries and weight-loss (bariatric) surgeries with employing ultrasound guidance. Ribs fracture, pain syndrome following thoracotomy, and persistent shoulder pain have all been alleviated with ESB [(1)]. It can be utilised to operate on the hip and proximal femur surgeries [(2)]. The erector spinae block (ESB) is a plane block in which a local anaesthetic is delivered superficial to one of the thoracic transverse processes meanwhile deep to the erector spinae muscles [(3)]. Because sending patients to a care facility with an implantable peripheral nerve catheters is often not practical, it is crucial to employ a single shot peripheral nerve block to extend the length and quality of analgesia [(4)].

When compared to bupivacaine, levobupivacaine showed a reduced risk of cardiovascular and CNS toxicity. In human volunteers, levobupivacaine exhibited a less negative inotropic impact and triggered less prolonging of the QTc interval than bupivacaine at intravenous dosages > 75 mg [(5, 6)].

Dexamethasone is thought to function by suppressing potassium channel-mediated discharge of C-fiber and diminishing the inflammatory responses. Human investigations revealed that not only the dexamethasone-treated group get a lengthy sensory but also a motor blockage than those in the control group [(7, 8, 9)]. Current study was designed to appraise the addition of dexamethasone to levobupivacaine as an adjuvant by ultrasound-guided ESP Block in patients having undergone total hip arthroplasty (THA) and its effect on the first analgesic request, total analgesic requirements, the perioperative hemodynamic changes, and any early complications.

PATIENTS AND METHOD:

This prospective, randomized-controlled study was conducted on 82 patients undergoing planned total hip arthroplasty (THA) in Mansoura University Hospitals between July 2019 and August 2020.

Exclusion criteria:

Reluctance to receive ESB, ASA III, or IV, blood diseases or bleeding disorders, bradycardias, heart blocks, pregnancy, local disease as inflammation or infections at the site of puncture, allergy to local anaesthetics or dexamethasone, central neuropathy, BMI > 35 kg/m^2, uncontrolled diabetes, significant cardiopulmonary disease, and mental illness.

The patients were divided randomly into two equal groups using a closed envelope model:

• Levo Group: 41 patients received unilateral ESP block on the operated side using 20 mL of the study solution of (0.5% levobupivacaine only), before induction of general anesthesia.

Received: 30/11/2021
Accepted: 29/01/2022

• Dexa Group: 41 patients received unilateral ESP block on the operated side using 20 mL of the study solution (19 mL of 0.5% levobupivacaine in addition to 1 mL or 4 mg dexamethasone), before induction of general anesthesia.

Patient preparation:

The day before surgery, all patients were interviewed. A history was taken, as well as a general and local assessment. All patients were asked to keep fasting for 6-8 hours before the scheduled procedure, and the routine investigations such as CBC, coagulation profile (PT and APTT), serum creatinine, liver function tests, and blood sugar were prescribed. Prior to surgery, all patients were instructed to use the Visual Analogue Pain Scale where 0 = no agony and 10 = maximum agony could be imagined to appraise the growing pain **[10].** In the operating room, vascular access was inserted then patients were put under sedation utilizing 0.015-0.02 mg/kg IV midazolam. Ringer acetate was infused for hydration and after application of a reaction/sensitivity test, a prophylactic antibiotic was administered. Standard heart rate (HR), three-lead ECG, non-invasive mean arterial blood pressure (MAP) as well as a pulse oximetry estimating the peripheral oxygen saturation readings (SPO2) were all used as part of routine monitoring.

Technique of the ultrasound guided ESB:

Equipment:

i. Sterile towels, gloves and gauze packs.
ii. Ultrasound machine (PHILIPS CLEAR VUE 350), with a low frequency (2-5 mhz) convex transducer covered by sterile sleeve and gel.
iii. Two 10 mL syringes filled with the study solution.
iv. A three mL syringe filled with 3 mL Lidocaine 2%
v. A 22-gauge spinal needle.

All procedures were carried out with the patient in a prone position. The low frequency convex transducer was covered with a sterile sleeve and sterile gel after the skin sterilization. The 4th lumbar vertebra has been identified. A low-frequency convex transducer was positioned 3 cm lateral to the L4 spinous process in a longitudinal parasagittal orientation. The erector spinae muscles were observed superficial to the L4 transverse process's tip. Subcutaneously, the patients' skin was numbed via 3 mL lidocaine 2%. An in-plane approach was used to introduce a 22-gauge spinal needle until it reached the transverse process. After negative aspiration, the study solution was delivered between the erector spinae muscles and the targeted transverse process in the interfacial plane. On the ultrasonographic imaging, the position of the needle tip was verified by observable fluid spread rising the erector spinae muscle off the bone silhouette of the transverse process **[11].** The timings of onset of both motor and sensory blocks, block durations, and analgesia duration were all recorded.

Anesthesia application:

Induction was accomplished by IV propofol (2-3 mg/kg), fentanyl IV (1 μ/kg) and atracurium besylate (0.5 mg/kg). To stabilize EtCO2 (30-35 mmHg), the patient was mechanically ventilated using such a volume control mode by TV (6-8 ml per kg), RR (12-18 breaths per min), and an I.E.ratio of 1:2. Anesthesia was maintained by a 1-2 percent isoflurane minimal alveolar concentration and a 60% air through O_2 mixture, along with periodic doses of atracurium (0.1 mg/kg). Another fentanyl dosage (25 microgram) was provided based on haemodynamics as if (blood pressure and heart rate were > 20% of the well-known baselines). The consumption of intra-operative fentanyl dosages was estimated. Foley's catheter was placed to keep track of the urine output. Intraoperative IV fluids were administered per body weight and considering the intraoperative loss. Monitoring and vital data recording were handled by another anesthesiologist who was blinded to the group assignment. All vital data, including HR and MAP, were recorded at the beginning of the operation (basal), after 15 minutes, 30 minutes, and then every 30 minutes until the surgery was completed. At the termination of surgery, the patients were meant to be extubated and taken off the ventilator if they met each single criterion of extubation, and neuromuscular reversal was obtained by combining neostigmine (0.05 mg/kg) with atropine (0.02 mg/kg). The time of surgery was recorded, which was the time starting from skin incision till the operation end. Time of anesthesia was recorded, which was the time from anesthesia induction till the patient extubation. On admission to the post-anesthesia care unit (PACU), a postoperative assessment is performed.

An observer blinded to the established study protocol recorded all vital data and hemodynamics (HR,MBP) at 0,2,4,8,12,16 and 24 hours post-operatively. In addition, time intervals and pain severity was also assessed and recorded using a 10-point VAS score. Paracetamol (1 g/8 hours) was administered to all of the patients. Pethidine (50 mg IM) was indicated for patients when they were in pain (visual analogue scale score $\geq$ 4). The time period for the initial analgesic necessity (duration of analgesia) was recorded. In both groups, the total dose of pethidine (mg) consumption in the first 24 hours postoperatively was recorded. Lower limb weakness, hematoma at the injection point, and hypotension were all noticed and documented. Also, opioid-related side effects such as nausea and/or vomiting, pruritus, and respiratory depression were recorded.

ETHICAL CONSIDERATIONS:

The study was approved by the Institutional Research Board (IRB) with a code number of MS/19.07.744, Faculty of Medicine, Mansoura University. An informed written consent was taken from every participant in the study. This work has been carried out in accordance with The Code of

Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

IBM's SPSS statistics (Statistical Package for the Social Sciences) for windows (version 25) was used for statistical analysis of the collected data. Normally distributed continuous variables were expressed as mean ± SD. Student t test was used for normally distributed continuous data respectively. Chi square test was used for categorical data using the crosstabs function. All tests were conducted with 95% confidence interval. P (Probability) value ≤ 0.05 was considered statistically significant.

RESULT

There were 82 patients in this study, ranging in age between 40 to 70 years old. According to adding an adjuvant, they were mainly categorized into two equal groups at random. In terms of demographic and preoperative data, there were no notable differences between the groups tested. Simultaneously, there have been no considerable differences in intraoperative variables, such as operation and anaesthesia durations, across the studied groups. **(Table1)**

Moreover, there was no statistical significant difference among the two groups in terms of intra-operative heart rate (HR) and mean arterial blood pressure (MAP) **(Table 2 and 3).**

Regarding the total postoperative analgesic requirement of pethidine (mg) in the first 24 hours, it was statistically significantly lower in dexa group when compared to levo group (69.76 ± 25.422 mg versus 96.67 ± 25.914 mg respectively) with P value < 0.001 **(table 5).** When compared to the levo group, the VAS score in the dexa group was lower at 6, 8, 12, 16, and 24 hours postoperatively **(Table 4**).

When comparing the exact part of time for the initial demand of analgesia in the dexa and levo groups, there was a statistically significantly delay in the group of dexa (13.07 ± 4.105 h. versus 6.79 ± 2.040 h. respectively) with P-value < 0.001**.** With a P-value < 0.001, there was a statistically significant decline at sum intraoperative fentanyl dosage in the dexa group compared to the levo group (19.76 ± 10.56 µg. versus 32.78 ± 21.16 µg.) respectively (**Table 5**).

There were no cases of postoperative nausea/vomiting, failing block, pleural injury, signs suggesting toxicity related to the local anaesthetics used, infection and or hematoma at the site of punctured skin in this current study.

Table (1): Patient's characteristics and surgery and anesthesia durations of the studied cases

	Levo group (n=41)	Dexa group (n=41)	P value
Age (years)	53.74 ± 5.27	51.60 ± 6.25	0.093
BMI (kg/m^2)	27.86 ± 2.56	28.24 ± 3.23	0.554
Gender •Male	24 (57.1%)	22 (52.4%)	0.661
•Female	18 (42.9%)	20 (47.6%)	
ASA •I	19 (45.2%)	18 (42.9%)	0.826
•II	23 (54.8%)	24 (57.1%)	
Duration of surgery (minutes)	141.67 ± 17.37	136.90 ± 20.77	0.258
Duration of anesthesia (minutes)	162.62 ± 19.88	158.33 ± 22.51	0.358

Data are expressed as mean ± SD or number (percentage) Levo, Levobupivacaine; Dexa, Dexamethasone; n, number; BMI, body mass index; ASA, American Society of Anesthesiologists.

Table (2): Basal and follow-up values of heart rate (beat/min) in the studied groups

Heartrate(bpm)	Levo group (n=41)	Dexa group (n=41)	P value
Basal	83.69±10.37	82.36±9.28	0.537
15 minutes	84.43±11.37	81.29±10.84	0.199
30 minutes	78.83±12.89	76.64±12.86	0.438
60 minutes	79.05±13.06	76.79±12.68	0.423
90 minutes	79.10±13.37	77.14±12.89	0.498
PACU	92.00±18.16	89.52±15.10	0.499
2 hours	72.81±17.79	70.26±16.17	0.494
4 hours	74.88±17.35	71.67±17.20	0.397
6 hours	77.17±19.12	73.36±16.80	0.335
8 hours	80.50±20.13	76.10±18.40	0.298
12 hours	84.26±21.62	77.93±18.98	0.158
16 hours	86.24±20.52	80.64±19.47	0.204
24 hours	88.62±21.30	82.48±21.03	0.187

Data are expressed as mean ± SD Bpm, beat per minute; Levo, Levobupivacaine; Dexa, Dexamethasone;

n, number; PACU, Post Anesthesia Care Unit.

Table (3): Basal and follow-up values of mean arterial pressure (mmHg) in the studied groups

MAP(mmHg)	Levo group (n=41)	Dexa group (n=41)	P value
Basal	90.33±5.75	90.88±5.39	0.654
15 minutes	88.95±8.64	91.02±7.34	0.240
30 minutes	86.33±12.43	87.64±9.98	0.596
60 minutes	85.81±13.00	87.86±9.78	0.417
90 minutes	85.76±12.85	87.60±10.15	0.470
PACU	88.40±13.40	90.29±10.38	0.474
2 hours	88.10±13.49	90.07±10.85	0.462
4 hours	88.12±13.44	89.74±10.81	0.545
6 hours	88.31±13.86	89.55±11.27	0.655
8hours	88.50±14.11	89.88±11.75	0.627
12 hours	88.26±14.29	90.40±11.45	0.451
16 hours	88.55±14.66	90.29±11.27	0.544
24 hours	88.88±14.51	90.05±11.51	0.684

Data are expressed as mean ± SD MAP, Mean Arterial Pressure; Levo, Levobupivacaine; Dexa, Dexamethasone; n, number; PACU, Post Anesthesia Care Unit.

Table (4): Basal and follow-up values of visual analogue scale score in the studied groups

VAS score	Levo group (n=41)	Dexa group (n=41)	P value
PACU	0.76±0.484	0.76±0.53	1
2 hours	1.10±0.692	0.90±0.61	0.187
4 hours	1.76±1.265	1.10±0.61	0.003
6 hours	2.74±1.211	1.31±0.74	<0.001
8 hours	3.07±1.156	2.00±0.93	<0.001
12 hours	3.21±1.025	2.38±0.98	<0.001
16 hours	4.93±1.421	3.79±1.20	<0.001
24 hours	4.43±1.500	3.50±1.27	0.003

Data are expressed as mean ± SD VAS, Visual Analogue Scale; Levo, Levobupivacaine; Dexa, Dexamethasone; n, number; PACU, Post Anesthesia Care Unit.

Table (5): First analgesic request (hours) and intra and postoperative opioids consumption (mg)

	Levo group	Dexa group (n=41)	P value
Intraoperative fentanyl (μg)	32.78±21.16	19.76±10.56	<0.001
First analgesic request (hours)	6.79±2.040	13.07±4.105	<0.001
Consumption of pethidine (mg)	96.67±25.914	69.76±25.422	<0.001

Data are expressed as mean ± SD

DISCUSSION

Erector spinae block (ESB) is a new regional anaesthetic treatment that can help with thoracic neuropathic pain and the immediate agonizing pain following surgeries performed at the chest or chest trauma [(12)].

Post-operative pain relief remains the cornerstone in the outcome of hip surgeries. It necessitates early establishment of physiotherapy that requires sensory than motor block, with the innovation of surgical and regional anaesthetic techniques but also advancement of pharmacologic therapy. Among the different anaesthetic methods, ESB is a promising sensory block at the level of hip innervations. ESB is a feasible peripheral nerve block for creating postoperative analgesia because it offers higher technical simplicity, reduce the likelihood of hypotension occurrence, and hematoma avoidance [(13)]. Because admitting the patients into a care facility or unit with indwelling peripheral nerve catheters is neither preferable nor feasible, strategies for the purpose of extending the analgesic impact of the one-shot nerve block postoperatively are still needed.

To the best of our knowledge, this current study is the first controlled trial comparing outcomes gained by using levobupivacaine–dexamethasone to levobupivacaine only for ESB in THA surgery. Various adjuncts to local anaesthetics have previously been shown to have advantages in clinical studies, but none

have been able to prolong effective blockade duration sufficiently [14, 15, 16, 17, 18, 19, 20].

We observed prolongation of postoperative analgesia when adding dexamethasone to levobupivacaine (13.07 hours) throughout contrasting to levobupivacaine only (6.79 hours). Dexamethasone, rather than clonidine, epinephrine, or midazolam, seem to be the most effective adjuvant for prolonging analgesia [21]. So, in the current trial, we employed it as an adjuvant to levobupivacaine. We relied on prior studies to determine the dose and volume utilized in this study, which revealed that the dose of levobupivacaine for peripheral nerve block was 2.5-150 mg with a concentration of 2.5-5 mg/ml [22]. In regards to the initial request for analgesia, **Fusco and colleagues** [23] utilised 20 mL of 0.5% levobupivacaine and 4 mg dexamethasone for bilateral ultrasonography ESB through laparoscopic abdominal surgery and found that adding dexamethasone delayed the first need for analgesia, but up to no postoperative opioid was necessary. Furthermore, **Singariya and colleagues**[24] proved, in a study of 90 patients who underwent unilateral umbilical hernia and got quadratus lumborum block using levobupivacaine with dexamethasone in one of two study groups. This combination resulted in lengthening of the time to first rescue analgesia, which copes with the result of our study. Regarding the reduction of the total postoperative opioids consumption in our study (69.76 mg compared to 96.67 mg pethidine in dexamethasone and control groups respectively), **Akkaya and his colleagues** [25] in a study of forty-two patients getting transverses abdominis plane (TAP) block after caesarean section, revealed that the overall expenditure of tramadol was vastly lesser in the dexamethasone group in comparable to the levobupivacaine group, which reinforces our findings in the current study. In contrast, **Chen and colleagues** [26] revealed in a meta-analysis that using dexamethasone as a local anaesthetic adjunct for transverses abdominis plane (TAP) block resulted in decreased postoperative opioid utilization. The current study found a vastly decline in VAS score at 6, 8, 12, 16, and 24 hours postoperatively in patients who received dexamethasone/levobupivacaine compared to patients who received levobupivacaine only, which appears to be consistent with the findings of **Zhang and colleagues** [27] who demonstrated that dexamethasone incorporated to local anaesthetics in TAP block actually reduce pain ratings at 4, 6, 12 hour post-operative period, which indeed led to prolongation of period till the first request of analgesia during the postoperative period, potentially reduce the total opioid consumption and also the incidence of nausea and or vomiting postoperatively. Furthermore, **Sharma and colleagues** [28] reported that VAS score was profoundly less in the dexamethasone and ropivacaine group when compared to the group of ropivacaine only from 4th to 12th hour of the post-operative period.

In our investigation, adding dexamethasone to levobupivacaine had no effect on hemodynamics (no significant changes among the analysed groups when compared baseline and follow-up heart rate and MAP), which is affirmed by the findings of **Elshaer and his colleagues** [29]. This might be related to the low systemically absorbed dosage of dexamethasone. Throughout this current study, participating patients reported no nausea/vomiting postoperatively, failing of the block technique, injured lung pleura, symptoms suggesting local anaesthetics toxicity, infection, and/or hematoma at the insertion point as a part of consequences related to the block technique. It is premised on the fact that the transverse process, where the block is injected, is not adjacent to any vulnerable anatomical structures [30]. We simultaneously performed the block using ultrasound guidance and appropriate volumes, concentrations, and doses of local anaesthetics. Our investigation found no evidence of opioid-related adverse effects, which might be due to the minimal dosages used in the postoperative phase. This coincides with **Ammar and Mahmoud's** study [31].

STUDY LIMITATIONS

The positive benefits of dexamethasone might be explained by its systemic absorption, which is a significant drawback in this study. We were unable to respond to this question due to a lack of perineural dexamethasone group.

CONCLUSION

In conclusion**,** using dexamethasone as an adjuvant to levobupivacaine in ESB in patients undergoing total hip arthroplasty allowed better effective postoperative analgesia through delaying the first analgesic request, lowering the total rescue analgesic consumption, and diminishing pain VAS score without any reported hemodynamic or postoperative complications.

Financial support and sponsorship: Nil.
Conflict of interest: Nil.

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