The effects of adding dexamethasone to epidural bupivacaine for lower limb orthopedic surgery

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Introduction
Dexamethasone when given epidurally with local anesthetics is known to reduce postoperative pain and postoperative analgesic consumption in several types of surgical procedures.

Objective
The objective of this study was to evaluate the effect of epidural dexamethasone on postoperative analgesia in patients who were undergoing lower limb orthopedic surgery.

Patients and methods
It is a prospective, randomized, double-blinded comparative study carried out in Assiut University Hospital, Egypt. It included 50 patients divided into two equal groups (25 in each), who underwent lower limb orthopedic surgery. The saline group: who received 15 ml epidural plain bupivacaine (0.5%)+2 ml normal saline (BS) and the dexamethasone group: who received 15 ml epidural plain bupivacaine (0.5%)+8 mg dexamethasone (2 ml) (BD). Postoperatively, when the pain score of at least 4, the rescue analgesia was given in the form of fentanyl and bupivacaine epidurally and paracetamol (perfalgan) 1 g was given routinely for all patients intravenous drip/8 h. Pain was evaluated by visual analog scale every 4 h in the postoperative 24 h. Time to first request for analgesia and total dose of rescue analgesia (epidural fentanyl/bupivacaine) in the first, 24 h postoperative was recorded.

Results
Dexamethasone significantly reduced the first, 24 h postoperative pain score (visual analog scale), and postoperative epidural fentanyl consumption (70.00 vs. 43.40 μg) in the first, 24 h postoperative. Dexamethasone also significantly prolonged the time to first request for analgesia (3.38 ± 0.072 vs. 15.24 ± 2.03 h).

Conclusion
Epidural dexamethasone with bupivacaine offers favorable effects on postoperative analgesia in lower limb orthopedic surgery.

Keywords:
bupivacaine, dexamethasone, postoperative pain

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Introduction

Inadequate postoperative pain relief can delay recovery, increase healthcare costs, and reduce patient satisfaction. Effective postoperative pain control is an essential component of the care of the surgical patient. Inadequate pain control, apart from being inhumane, may result in increased morbidity or mortality [1]. Evidence suggests that surgery suppresses the immune system and this suppression is proportionate to the invasiveness of the surgery; good analgesia can reduce this deleterious effect [2].

The advantages of effective postoperative pain management include patient comfort and therefore satisfaction, earlier mobilization, fewer pulmonary and cardiac complications, a reduced risk of deep vein thrombosis, faster recovery with less likelihood of the development of neuropathic pain, and reduced cost of care [3].

The pathophysiological mechanisms for epidural steroid effects may be related to the anti-inflammatory action, edema reduction, or shrinkage of connective tissue [4]. Local steroid application was found to suppress transmission in thin unmyelinated C-fibers, but not in myelinated A-β fibers [5]. It has also been suggested that steroids may bind directly to the intracellular glucocorticoid receptor, and their effects are predominantly mediated through altered protein synthesis through gene transcription [6]. Epidural dexamethasone may affect intraspinal prostaglandin formation. Acute noxious stimulation of peripheral tissues during surgical stimulation leads to activation of phospholipase A2 and upregulation of the expression of cyclooxygenase-2 in the spinal cord, leading to prostaglandin synthesis and a resultant

hyperalgesic state. Preoperative administration of steroids may reduce these responses, by virtue of their anti-inflammatory and immunosuppressive effects, by inhibiting both phospholipase A2 and cyclooxygenase-2 enzymes [7]. In addition to the analgesic effects of dexamethasone in different peripheral nerve blocks, there have also been reports on the use of dexamethasone during epidural blocks in adult patients [8]. Epidurally injected dexamethasone added to local anesthetics was found to prolong the duration of the epidural block and to have an opioid-sparing and antiemetic effect in the postoperative period [9]. The primary purpose of this study was estimation of postoperative 24 h opioid consumption and the secondary purpose was to evaluate the duration of postoperative analgesia.

Patients and methods

The study design and patients was a prospective, double-blinded and randomized clinical study, which was carried out in Assiut University Hospital between June 2016 and January 2017. After approval by the local ethics committee under IRB1710021, and registration in clinical trials under tNCT03231215, an informed written consent was obtained from every study participant.

Inclusion criteria

Patients over 18 years old, both male and female, American Society of Anesthesiologists I, II, and III were undergoing lower limb orthopedic surgery.

Exclusion criteria

Patients' refusal, any contraindication for epidural anesthesia, morbid obesity (BMI > 40), allergy to an amide local anesthetic, substance abuse disorder or chronic opioid use, and failed technique.

Study groups

Fifty patients were randomly allocated into two groups of equal size to receive either 15 ml epidural plain bupivacaine (0.5%)+2 ml normal saline group (BS), or 15 ml epidural plain bupivacaine (0.5%)+8 mg dexamethasone (2 ml) group (BD).

Epidural anesthesia

The standard monitors were attached to the patients (pulse oximetry, ECG, noninvasive blood pressure), and total volume of 500 ml normal saline solution was infused as a preload. The patients were put in the sitting position for epidural puncture. The patient's back was prepared with an antiseptic solution and was draped with a sterile towel. After infiltration with 2 ml lidocaine 1%, the epidural anesthesia was given in L3–L4 or L4–L5 inter-vertebral space using a midline approach with 18 G Touhy needle and loss of resistance technique for localization of epidural space and then the catheter was threaded through the needle; the needle was withdrawn over the catheter, then either of the drugs used (dexamethasone, saline) was injected according to randomization. All patients received oxygen by face mask.

Postoperative pain control

Pain was assessed every 4 h for the first 24 h. Significant pain was defined as one that has a score of 4 or above or the patient requested pain medication and rescue analgesic was given in the form of fentanyl 100 μg (2 ml)+bupivacaine 0.5% (5 ml)+13 ml normal saline solution in 20 ml syringe, so the fentanyl concentration will be 5 μg/ml and bupivacaine concentration will be 0.125. Then 7.0 ml solution was given epidurally when indicated and parcetamol (perfalgan) 1 g was given and intravenous drip/8 h to all patients routinely.

Data collection

Patient's characteristics and surgical data include: age, sex, weight, and height, type and duration of surgery. Postoperative pain evaluation during rest by visual analog scale between 0 and 10 (0 = no pain, 10 = most severe pain). The score was recorded every 4 h in the first 24 h postoperative. Time to first request for analgesia and total dose of rescue analgesia (epidural fentanyl/bupivacaine) in the first 24 h postoperative was recorded.

Sample size calculation

Sample size calculation was performed with online DSS RESEARCH (Decision Support Systems, LP/DSS Research. Washington, DC USA) calculators. To detect a reduction in postoperative opioid consumption by 20% we need to include 25 patients in each group, with x error 0.05; this will give an actual power of 80%.

Statistical analysis

The collected data were analyzed using the SPSS, version 20 statistical package (Armonk, NY: IBM Corp. USA). Data with a continuous variation were expressed as mean ± SD and compared using paired t-test, if normally distributed and compared by Mann–Whitney test if not normally distributed. Differences were considered statistically significant if P value less than 0.05 was obtained.

Results

Fifty patients were enrolled in the study, randomly allocated to two groups, control group (BS) and dexamethasone group (BD) as shown in consort flow diagram (Fig. 1).

Patient's characteristics and operative data

No significant differences had been observed between both groups ($P > 0.05$), as regards age, sex, weight, height, type of operation, and operative time; the results were similar among the two groups (Table 1).

Postoperative pain

The mean values of postoperative visual analog scale were significantly lower in the dexamethasone group than in the saline group ($P < 0.05$) in the time points evaluated in the first 24 h postoperatively, except immediately postoperative, where it was insignificant (0 time). The duration of postoperative analgesia was significantly longer in group BD (15.24 ± 2.03 h) than in group BS (3.38 ± 0.72 h) with P value less than 0.05. Consequently, the total postoperative epidural fentanyl consumption was significantly lower ($P < 0.05$) in group BD than in group BS as shown in Table 2 and Fig. 2.

Discussion

This study evaluated the effect of epidural dexamethasone with bupivacaine on the duration of postoperative analgesia and postoperative epidural opioid (fentanyl) consumption in patients undergoing lower limb orthopedic surgery. We found that epidural dexamethasone 8 mg plus 0.5% plain bupivacaine 15 ml prolonged the postoperative analgesia and reduce the 24 h epidural opioid (fentanyl) consumption.

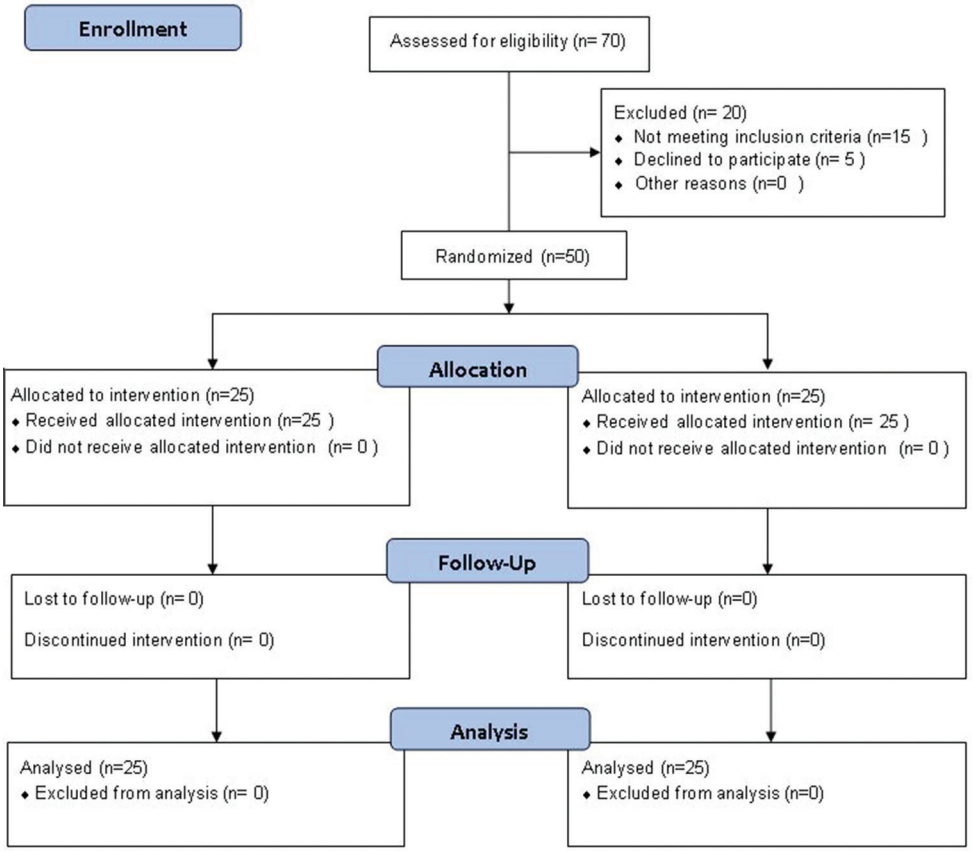
In a meta-analysis of 29 studies, Albrech *et al.* [10] found that perineural dexamethasone prolonged the

Table 1 Demographic and operative data

	Group I (BS)	Group II (BD)	*P*
Age (years)	42.60±12.87	40.92±14.50	0.34
Sex (male:female)	15:10	17:8	
Weight (kg)	71.44±7.65	74.32±7.81	0.20
Height (cm)	165.88±6.77	168.24±6.18	0.08
Type of surgery			
HTO	9	8	
Plating femur	10	9	
Ankle surgery	6	8	
Operative time (min)	95.60±23.01	91.80±24.90	0.23

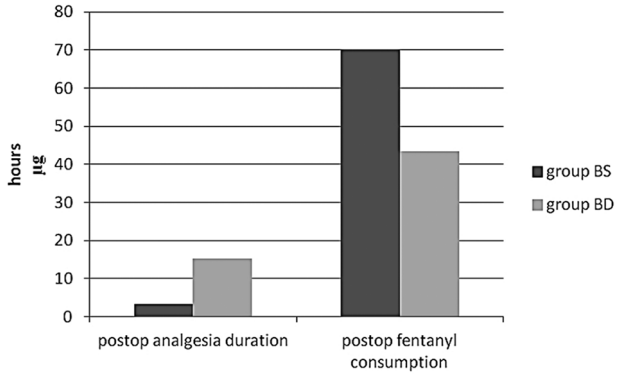
Values were expressed as mean±SD, ratio, and numbers. HTO, high tibial osteotomy. $P<0.05$ is considered statistically significant.

Figure 1



Consort flow diagram.

Figure 2



Postoperative analgesia duration (h), and postoperative 24 h epidural fentanyl consumption (µg).

Table 2 Postoperative visual analog scale, duration of analgesia, and fentanyl consumption

Postoperative	BS group (*n*=25)	BD group (*n*=25)	*P*
0 h	0.56±0.71	0.32±0.55	0.23
4 h	3.36±0.70	0.80±0.57	0.001*
8 h	3.36±0.63	1.24±0.83	0.001*
12 h	3.60±0.64	1.88±1.12	0.001*
16 h	3.96±0.84	2.84±0.89	0.001*
20 h	4.08±0.86	3.44±0.58	0.007*
24 h	4.16±0.74	3.72±0.61	0.024*
Duration of postoperative analgesia	3.38±0.72	15.24±2.03	0.001*
Postoperative fentanyl consumption	70.00±22.59	43.40±20.90	0.001*

Values were expressed as mean±SD. **P*>0.05, significant.

durations of analgesia and motor blockade from short-term, medium-term and long-term action local anesthetics. Similarly, dexamethasone was associated with a reduction in pain scores at rest during the intermediate (8–12 h) and late (24 h) postoperative periods and in movement at all times. At 24 postoperative hours, cumulative morphine consumption and the rate of nausea or vomiting were also reduced.

It has been noted that the analgesic time associated with the regional block was prolonged when dexamethasone was given via an intramuscular and intravenous route [11].

Postoperative prolongation of the duration of analgesia and reduction of opioid consumption have been confirmed when dexamethasone was added to epidural local anesthetics in many types of surgical procedures, like pediatric inguinal herniotomy [12], total abdominal hysterectomy [13], gastrectomy [14], and laparoscopic cholecystectomy [8].

Conclusion

Dexamethasone was found to be a good adjuvant for bupivacaine in epidural block. The present study showed that the addition of dexamethasone to epidural bupivacaine prolonged the duration of postoperative analgesia and decreased the consumption of postoperative opioids, delayed the time of first analgesic request and decreased the frequency of consumption of analgesics postoperatively in patients who were undergoing lower limb orthopedic surgeries.

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Conflicts of interest

There are no conflicts of interest.

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