Dexmedetomidine As an Adjuvant to Bupivacaine in Ultrasound Fascia Iliaca Compartment Block in Proximal End Femur Surgeries

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ABSTRACT

Background: Fracture–neck femur is a common cause of hospital admission among the elderly population. Many patients admitted with fracture femur have long-standing cardiac, hepatic or renal problems. This makes a challenge to balance adequate analgesia with side effects of opioids. Fascia iliaca compartment block (FICB) is one of the peripheral nerve block techniques. It became widely used in providing postoperative analgesia for patient with fracture neck femur either in emergency department or in the operating room.

Objective: To evaluate the efficacy of addition of dexmedetomidine to bupivacaine on the duration and quality of postoperative analgesia in ultrasound guided fascia iliaca compartment block in proximal end femur surgeries.

Patients and methods: Sixty patients with American Society of Anesthesiologists (ASA) physical status I - II of both sexes aged from 20-60 years scheduled for proximal end femur surgeries. They were randomly assigned to one of two equal groups (n=30 each), using closed envelope technique: Bupivacaine group (B group), and Bupivacaine + dexmedetomidine (BD group). **Result:** Our study demonstrated prolongation of postoperative analgesia in bupivacaine-dexmedetomidine group (BD) compared to bupivacaine group (B). It showed statistically significant reduction in cumulative pethidine doses and prolongation in the time till first rescue analgesic is required in the BD group in comparison with the B group in the first 24 hours. Hemodynamic changes and incidence of side effects, were statistically insignificant among the two groups. **Conclusion:** Addition of dexmedetomidine, as an adjuvant to the local anesthetic bupivacaine, in ultrasound fascia iliaca compartment block provides prolongation of the duration of postoperative analgesia with less opioid consumption without remarkable side effects.

Keywords: Dexmedetomidine, Bupivacaine, Ultrasound-guided fascia iliaca, Proximal end femur surgeries.

INTRODUCTION

Lower extremities fractures are common injuries, which are associated with severe pain [(1)]. Positioning for neuraxial blocks is always a challenge, because even slight overriding of the fracture ends is intensely painful. Hence, prior to neuraxial blockade, analgesia is provided by conventional modes of pain relief like non-steroidal anti-inflammatory drugs (NSAIDs), opioids and also by peripheral nerve blocks such as, femoral nerve block, and fascia iliaca compartment block (FICB) [(2)].

Significant postoperative pain and other morbidities almost always complicate orthopedic surgeries. Despite the publication of multiple clinical practice guidelines for pain management throughout the last decade, effective analgesia remains a significant health care concern [(3)]. Regional anesthesia is now proved as the best modality used by the anesthesiologists to face postoperative pain. It improves surgical outcome, reduces blood loss and furthermore reduces the postoperative morbidity [(4)]. Regional nerve blocks have increased popularity in the last few years with acceptance from both the surgeon and patient [(5)].

(FICB) is an anterior approach to the lumbar plexus and was first described in 1989 and performed initially on children and later on adults. It was mainly used to provide analgesia following surgical procedures in the hip, femur and knee [(6)]. There is evidence that peripheral nerve blocks performed by ultrasound guidance are superior in terms of improved sensory and motor block, reduced need for analgesic supplements with fewer minor complications [(7)]. The use of ultrasound to perform the fascia iliaca block was found to be superior when compared with the traditional approach using, loss-of- resistance‟ to identify the correct plane, but still requires high volumes of local anesthetic [(8)].

Many additives to local anesthetics such as opioids, clonidine, neostigmine and tramadol have been used to increase the duration of the block, improve postoperative pain management and avoid the need for placing catheter for continuous local anesthetic drug infusion [(9)].

Dexmedetomidine is currently in focus for its sedative, anxiolytic and analgesic properties. Pre- and intra-operative intravenous dexmedetomidine administration has shown to prolong the duration of sensory block with local anesthetics during peripheral nerve blocks [(10)]. Many recent studies have suggested that the addition of dexmedetomidine as adjuvant to local anesthetics shortens the sensory and motor block onset time, prolongs both sensory and motor block duration [(11)]. It also significantly delays the first demand for analgesic supplementation, decreases 24 h analgesic consumption and is not associated with any major side-effect [(12)].

The aim of this study was to evaluate the

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efficacy of addition of dexmedetomidine to bupivacaine on the duration and quality of postoperative analgesia in ultrasound guided fascia iliaca compartment block in proximal end femur surgeries.

PATIENTS AND METHODS

This randomized controlled blind study was conducted at Mansoura Emergency Hospital between January, 2017 and August, 2019. Sixty patients scheduled for proximal end femur surgeries, of both sexes, aged between 20 to 60 years, with ASA physical status I-II, were Included in this study.

Ethical approval:

After approval of the Institutional Review Board (IRB) at Faculty of Medicine, Mansoura University under code number (MS/16.08.12), a written informed consent was obtained from every patient before allocated in this 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.

Exclusion Criteria: Exclusion criteria included Patient's refusal, ASA status III-IV, BMI > 35, Patients with multi-trauma or fractures, patients on chronic opioid use or addiction, contraindication to neuraxial anesthesia (e.g., coagulopathy, infection, etc.), infection at the site of block, previous femoral bypass surgery or inguinal hernia and history of allergy to local anesthetics or dexmedetomidine.

Randomization:

Patients were randomly allocated by closed envelope method according to medication given in FICB into 2 equal groups: (n=30 patients each)

Bupivacaine Group (Group B) (30 patients): 40 ml of 0.25% bupivacaine was used in ultrasound guided FICB.

Dexmedetomidine bupivacaine Group (Group BD) (30 patients): 40 ml of 0.25% Bupivacaine mixed with 0.5 mcg/kg dexmedetomidine was used in ultrasound guided FICB.

Blinding was achieved through the use of equal amounts of injectates used for each block in identical syringes prepared by a staff member who was not involved in the study. All blocks were performed by trained anesthetists who participated in the study.

Patient preparation:

All patients with planned proximal end femur surgeries were assessed preoperatively by detailed medical history taking, physical examination and basal laboratory investigations as complete blood count (CBC), coagulation profile, serum creatinine, liver function tests and blood sugar. Preoperatively patients were familiarized with the use of Visual Analogue scale (VAS) for pain assessment, where "0"no pain and "10" the most severe pain.

Intra-operative management:

In the operating theater, routine monitoring was applied including electrocardiography (ECG), noninvasive mean arterial pressure (MAP) and peripheral oxygen saturation (SPO_2). All patients were cannulated for fluid infusion and FICB was done half an hour before spinal anesthesia.

Technique of the ultrasound guided fascia iliaca compartment block:

This block was performed with the patient in the supine position and the bed flattened to maximize access to the inguinal area. We used **Korean Siemens ACUSON X300** ultrasound device in all patients. We started by sterilization of the area of block by antiseptic solution then injection of 1-2 ml of 1% lidocaine as a local anesthetic. For the approach below the inguinal ligament, we used a high frequency ultrasound probe (13-16 MHz) in a transverse direction below the inguinal ligament and identified the femoral artery pulsation and the iliacus muscle. Under complete aseptic technique, the needle (22-gauge spinal needle) was inserted in plane of the ultrasound beam, below the fascia iliaca and injection of local anesthetic (40 ml of the study solution) was done.

Assessment of FICB:

Femoral, obturator and lateral femoral cutaneous nerve dermatomes was assessed for sensory block with ice-cold test every 5 min for 30 min after the FICB at all patients. We assessed nerves that had been blocked at upper medial thigh for obturator nerve, anterior thigh for femoral nerve and lateral part of the thigh for lateral femoral cutaneous nerve**.**

Spinal anesthesia:

Under complete aseptic technique spinal anesthesia was performed in the sitting position at L3-4 intervertebral space. 15 mg hyperbaric bupivacaine 0.5% was injected in the subarachnoid space using a 25-gauge spinal needle.

Postoperative Assessment:

At the end of surgery, patients were transferred to the post anesthetic care unit (PACU). The VAS score was being assessed after surgery and whenever VAS ≥ 4, postoperative analgesia was provided with slow intravenous (IV) 25 mg pethidine as a single dose. During the following 4 hours after pethidine injection, if VAS still ≥ 4 slow IV 30 mg ketorolac was given.

Sensory and motor block of spinal anesthesia were evaluated in the non-traumatized limb in the PACU. The sensory block duration (the time from intrathecal injection till sensory recovery at the level of S1) was assessed by the return of the pin-prick sensation on lateral aspect of the foot. The duration of motor block (the time from of intrathecal injection to complete regression of motor block) was assessed by ability to lift the extended leg using Bromage scale.

Recorded Data:
VAS was recorded basally (before injection of FICB), 10 minutes after the injection, prior to spinal anesthesia, 30 min after the injection, 1hour, 2h, 3h, 4h, 6h, 8h, 12h, 18h, till 24 hours after the end of surgery. Hemodynamic data (Heart rate, mean arterial blood pressure (MAP)) were recorded at the same times of pain assessment. Level of spinal anesthesia, onset & duration of motor and sensory blocks, duration of surgery, time till the first rescue analgesic, total analgesic requirements in the first 24 hours after surgery, and any complication related to the drugs were recorded.

Sample size:

G power program (3.3.9.2) was used to calculate sample size. The time to the first request for analgesia used as the primary effect. One tailed t test for difference between two independent means was the computed statistical test. Effect size was chosen as 0.4, α error was 0.05 and a study power (1-ß error) of 0.9 was used. The resulted sample size was 30 patients for each group.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc., Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ^2) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD. Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value ≤ 0.05 was considered significant.

RESULTS

Patient's demographic data showed no statistically significant differences regarding age, sex and body mass index (BMI) among the two studied groups **(Table 1).**

The intraoperative HR and MBP showed statistically insignificant differences among the two studied groups **(Table 2 & 3).**

Motor and sensory block duration of spinal anesthesia was statistically insignificant among the two studied groups **(Table 4)**.

There was a statistically significant reduction of cumulative pethidine doses, while the time to the first request for analgesic in the BD group was longer in comparison with the B group in the first 24 hours (29 mg versus 62 mg respectively) **(Table 5)**.

Pain score at rest showed statistically significant decrease in the BD group at 8, 12 postoperative hours as compared to the B group **(Table 6)**.

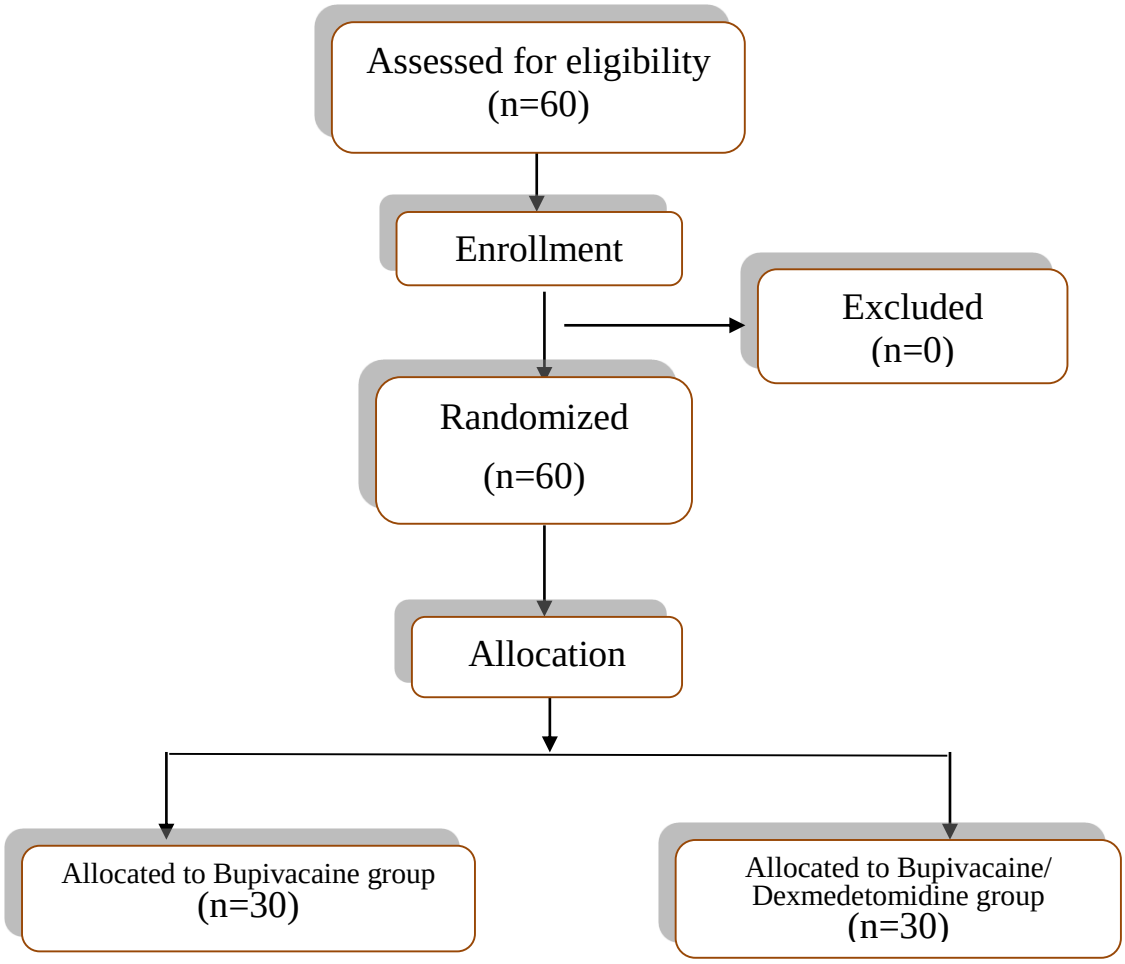

Figure (1): CONSORT flow diagram.

Table (1): Demographic data in the studied groups

Items	Group (B) (n=30)	Group (BD) (n=30)	P. value
Age (years)	54.10 ± 4.27	51.66 ± 7.40	0.268
Sex:			
-Male	17 (56.7%)	16 (53.3%)	0.795
-Female	13 (43.3%)	14 (46.7%)	
BMI (kg/m^2)	22.67 ± 3.1	23.65 ± 2.25	0.160
Type of surgery (DHS/Bipolar)	20/10	19/11	0.787
Duration of surgery (minutes)	115.9 ± 25.4	124.2 ± 34.5	0.294
ASA: I	10 (33.33%)	12 (40%)	0.256
II	20 (66.67%)	18 (60%)	

Data were expressed as Mean ± Standard deviation, except for Sex; expressed as Number ± Percentage
B: Bupivacaine, BD: bupivacaine & dexmedetomidine, n; number of cases BMI: Body mass index,
kg: kilogram, cm: centimeter, DHS: dynamic hip screw P-value is considered significant if calculated < 0.05

Table (2): Heart rate (beats /min) of the study in both groups. Data are in mean ± SD

Time	Group (B) (n=30)	Group (BD) (n=30)	P. value
Basal (before FICB)	106.7 ± 6.7	107.3 ± 8.3	0.742
After **10 min** from FICB	99.13 ± 5.2	100.23 ± 5.8	0.441
After **20 min** from FICB	95.3 ± 8.3	94.0 ± 9.0	0.560
After **30 min** from FICB	92.21 ± 3.3	91.06± 4.1	0.300
After **1h**. from FICB (30min. after spinal anesthesia)	71.09 ± 3.4	71.28 ± 3.5	0.827
After **2h**. from FICB	78.33 ± 10.9	78.86 ± 7.6	0.745
After **4h.** from FICB	79.3 ± 8.0	82.2 ± 7.4	0.147
After **6h.** from FICB	82.1 ± 7.5	81.4 ± 9.1	0.751
After **8h.** from FICB	81.89 ± 7.8	81.5 ± 8.6	0.856
After **12.** from FICB	82.3 ± 8.9	79.7 ± 9.6	0.281
After **18h.** from FICB	82.0 ± 9.0	80.1 ± 8.5	0.380
After **24h.** from FICB	82.2 ± 7.4	79.3 ± 8.0	0.147

*P-value <0.05: statistically significant.

Table (3): Mean arterial blood pressure (mmHg) values of the study in both groups (Data are in mean ± SD).

Time	Group (B) (n=30)	Group (BD) (n=30)	P. value
Basal (Before FICB)	92.62± 6.4	92.84 ± 6.8	0.895
After **10 min** from FICB	91.06± 4.1	92.21 ± 3.34	0.300
After **20 min** from FICB	89.29 ± 7.8	86.7 ± 9.0	0.241
After **30 min** from FICB	84.81 ± 5.2	83.62 ± 5.6	0.384
After **1h**. from FICB (30min. after spinal anesthesia)	64.53 ± 8.4	65.96 ± 6.5	0.468
After **2h.** from FICB	74.15 ± 8.3	73.70 ± 7.7	0.792
After **4h.** from FICB	87.83 ± 8.2	84.10 ± 6.5	0.245
After **6h.** from FICB	85.83 ± 8.8	84.53 ± 6.5	0.399
After **8h.** from FICB	84.13 ± 8.9	84.33 ± 6.8	0.289
After **12h.** from FICB	86.40 ± 8.8	84.27 ± 6.3	0.468
After **18h.** from FICB	86.40 ± 9.0	84.27 ± 6.5	0.354
After **24h.** from FICB	87.34 ± 7.8	85.18 ± 7.5	0.365

*P-value <0.05: statistically significant

Table (4): Motor and sensory block duration (hour) of spinal anesthesia

Items	Group (B) (n=30)	Group (BD) (n=30)	P. value
Duration of sensory block (hours)	3.3 ± 0.7	3.15 ± 0.81	**0.412**
Duration of motor block (hours)	2.41 ± 0.56	2.39 ± 0.61	**0.712**

Data expressed as Mean ± Standard deviation B: Bupivacaine, D: bupivacaine& dexmedetomidine, n: number, P-value is significant if calculated < 0.05 * & highly significant if calculated < 0.001 **

Table (5): The time to the first request for analgesia (hours), total pethidine (mg) requirement in the first 24 hours, and number of patients required additional analgesia (ketorolac 30 mg) in the studied groups

Items	Group (B) (n=30)	Group (BD) (n=30)	P. value
The time to the first request for analgesia (hours)	7.43 ± 2.12	15.2 ± 4.81*****	**< 0.001**
Pethidine (mg)	62 ±17.5	29 ± 11.5*****	**< 0.001**
Number of patients required (ketorolac 30 mg)	15 (50%)	6 (20%)*****	**0.014**

Data expressed as Mean ± Standard deviation, B: Bupivacaine, BD: bupivacaine & dexmedetomidine, µg: microgram, n: number, P-value is significant if calculated < 0.05 *

Table (6): Perioperative assessment of visual analogue scale (**VAS**) score (from 1-10) Data are in median (IQR)

Time	Group (B) (n=30)	Group (BD) (n=30)	P. value
Basal (Before FICB)	4 (4-5)	4 (4-5)	0.876
After **10 min** from FICB	4 (4-5)	4 (4-5)	0.876
After **20 min** from FICB	2 (2-3)	2 (2-3)	0.728
After **30 min** from FICB	2 (2-4)	2(2-3)	0.563
After **1h**. from FICB (30min. after spinal anesthesia)	1 (1-2)	1 (1-2)	0.563
After **2h**. from FICB	1 (1-2)	1 (1-2)	0.563
After **4h.** from FICB	2 (1-2)	1 (1-2)	0.100
After **6h.** from FICB	2 (1-3)	2 (1-2)	0.299
After **8h.** from FICB	4 (3-5)	2 (1-3) *****	**<0.001**
After**12h.** from FICB	4 (3-6)	3 (2-3) *****	**<0.001**
After**18h.** from FICB	4 (3-6)	4 (3-5)	0.518
After**24h.** from FICB	4 (3-5)	4 (3-5)	0.876

P-value is significant if calculated < 0.05 *

DISCUSSION

This randomized study was designed to evaluate the safety and efficacy of dexmedetomidine administered as an adjunct to the local anesthetic bupivacaine for postoperative analgesia in patients undergoing proximal end femur surgeries. The result of our study demonstrated prolongation of postoperative analgesia in bupivacaine-dexmedetomidine group (BD) in comparison with bupivacaine group (B). It showed statistically significant reduction in cumulative pethidine doses and prolongation of the time till first call for analgesia in the BD group in comparison with the B group in the first postoperative 24 hours. VAS score was statistically significant at 8, 12 postoperative hours in the BD group in comparison with the B group.

In regard to hemodynamic changes and incidence of side effects, differences were statistically insignificant among the two groups.

Many studies had confirmed that FICB has an analgesic effect after hip surgery, **Goitia-Arrola *et al.*** [13] found that fascia iliaca compartment block was effective in controlling initial postoperative pain in the first few hours after total hip surgery. Also **Krych *et al.*** [16] reported that FICB decreased opioid consumption, and provided a high quality of pain relief and patient satisfaction after hip surgery. On the other hand, **Shariat *et al.*** [14] reported no significant difference in postoperative pain score and 24 hours opioid consumption in 32 patients receiving FICB after total hip replacement. This may be due to low volume injected (30ml.). **Helayel *et al.*** [15] showed that the effective volumes of local anesthetics in the FICB capable of producing a block in 99% of cases were 37.3 mL for bupivacaine and 36.6 mL for ropivacaine.

Dexmedetomidine produces differential sensory – motor blockade (more sensory), which is unlikely to be achieved with dexamethasone [19] and often occur with liposomal bupivacaine [3]. **Abdallah *et al.*** [18] reported that dexmedetomidine has the advantage of prolongation of the duration of local anaesthetics**. Brummett *et al.*** [17] showed that dexmedetomidine prolonged the duration of sciatic nerve block after experimental and clinical studies.

As regards, the time till first rescue analgesia and total opioid consumption, **Hua *et al.*** [20] found that using dexmedetomidine combined with ropivacaine in FICB, provided prolongation of time till first rescue analgesia with less total opioid consumption and low level of VAS, which cope with our results. **Prabha *et al.*** [21] demonstrated that dexmedetomidine combined with ropivacaine prolongs the duration of postoperative analgesia in TAP block (with less postoperative visual analogue score) and reduces the postoperative analgesic requirements post hernia repair. **Parameswari and Udayakumar** [22] reported that TAP block after Caesarean section using dexmedetomidine as an adjuvant to bupivacaine, lead to prolongation of the time till first dose of rescue analgesia and reduction of the total dose of opioid requirement in the first 24-h. Dexmedetomidine at dose of 1 mcg/kg produces a high quality of peripheral nerve block with minimal side effects [23].

In the current study, we used dexmedetomidine in a dose of 0.5 mcg/ kg and didn't find statistical significance between the two groups as regards side effects of dexmedetomidine. Similar to our study, **Hua *et al.*** [20] found that FICB using dexmedetomidine with ropivacaine didn't affect the patient's cardiovascular indices. **Abdelaal *et al.*** [24] showed that addition of dexmedetomidine to levobupivacaine in TAP block improved analgesia in patients undergoing abdominoplasty with no remarkable side effects. In a meta-analysis, **El-Boghdadly *et al.*** [25] concluded that dexmedetomidine injection in supraclavicular brachial plexus block produces more prolongation in the duration of sensory and motor block, with prolonged postoperative analgesia. The benefits of dexmedetomidine outweighed the increased risk of transient bradycardia. **Patro *et al.*** [26] showed that addition of dexmedetomidine to intrathecal bupivacaine in infraumblical surgeries lead to longer duration of anaesthesia and analgesia with haemodynamic stability as compared to bupivacaine alone.

CONCLUSION

Addition of dexmedetomidine, as an adjuvant to the local anesthetic bupivacaine, in ultrasound fascia iliaca compartment block provides prolongation of the duration of postoperative analgesia with less opioid consumption without remarkable side effects.

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