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Original Research Article

Effect of Dexamethasone on Postoperative Analgesia When Added to Ropivacaine in "3-In-1" Femoral Nerve Block: A Randomized Control Trial

Dr. Snehil Gupta[1], Dr. U. D Sharma[2], Dr. Bhupendra Singh[3], Dr. Babita[4], Dr. Neelam Meena[5], Dr. Satveer Singh Gurjar[1]

[1]3rd Year Resident, [2]Senior Professor, [3]Assistant Professor, [5]Associate Professor,
Dept of Anaesthesiology, Dr. S. N Medical College, Jodhpur.
[4]Assistant Divisional Medical Officer, Divisional Railway Hospital Jodhpur.

Corresponding Author: Dr. Bhupendra Singh

ABSTRACT

Background: Shaft of femur fractures are commonly encountered in orthopaedic practice and "3-in-1"Femoral nerve block provide good postoperative analgesia. Adding dexamethasone as an adjuvant to local anaesthetics prolong the duration of analgesia.
Aim: To study the effect of dexamethasone with ropivacaine as postoperative analgesic using 3-in-1 femoral nerve block for fracture shaft femur surgery.
Materials & Methods: 80 patients were randomly allocated in two group R and group RD (each=40),received combined ultrasound-stimulation guided "3-in-1" Femoral nerve block using either 40 ml 0.5% Ropivacaine (group R) or 40 ml 0.5% Ropivacaine with 8 mg Dexamethasone (group RD) at the end of the surgery. Both the groups were assessed for duration of sensory block, motor block and analgesia, total opioid consumption and complications.
Results: Study revealed that the duration of motor block in group R was significantly less than group RD (397.5 ± 101.39 mins v/s 768 ± 229.86 mins). Also, Patients in Group R had earlier return of sensation than patients in Group RD. The mean time for duration of analgesia of group R is 527.32 ± 157.59 mins and group RD is 1159.5 ± 301.81 mins. Total opioid consumption showed significant difference between both the groups. (Group R 172.5±81.61 mg v/s group RD 57.5 ±63.59 mg of Tramadol: $p<0.001$).
Conclusion: Dexamethasone with 0.5% Ropivacaine in 3-in-1 femoral nerve block have significant prolongation of duration of postoperative analgesia with side-effects sparing profile, hence it is recommended in cases in which long duration of analgesia is required.

Keywords: "3-in-1" Femoral nerve block, Ropivacaine, Dexamethasone, fracture shaft of femur.

INTRODUCTION

Pain (WHO Definition): Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. [1]

Uncontrolled pain results in endocrine, metabolic and inflammatory responses which have adverse effects on various organ functions. [2] Fractures of shaft of femur are commonly encountered in orthopaedic practice. Postoperative pain relief can be achieved by a variety of techniques, such as IV patient-controlled analgesia (PCA), [3] epidural analgesia with narcotics and/or local anaesthetics, [4,5] and

lumbar plexus blockade. [6,7] It has been demonstrated that regional techniques provide better pain relief and allow more complete and faster postoperative rehabilitation than IV PCA with morphine. [8] However; it is associated with various side effects.

The "3-in-1" femoral nerve block through a single injection of a sufficient volume of local anaesthetic just below the inguinal ligament blocks the lumbar plexus. [9] This type of block is easy to perform and is commonly used for knee [7,10-14] and fractured femur shaft surgery. [15,16]

Local anaesthetic alone for peripheral nerve block provide good operative conditions but have shorter duration of postoperative analgesia. Increasing the volume (dose) of local anaesthetics may prolong the duration of analgesia [17] but may also increase the risk of systemic toxicity. [18] Addition of adjuvants to the local anaesthetic drug increases the potency, duration and quality of anaesthesia and postoperative analgesia in peripheral nerve block.

Steroids have powerful anti-inflammatory as well as analgesic property. The block prolonging effect may be due to its local action on nerve fibers and not a systemic one. Dexamethasone is a very potent and highly selective glucocorticoid. Various studies have been done using dexamethasone resulting in variable effects on onset but prolonged duration of analgesia. [20, 21-22] and motor block. [19, 20,21] Although femoral "3 in 1" nerve block found to provide good postoperative analgesia in fracture shaft femur, the results of studies investigating the efficacy of "3-in-1" nerve block are incomplete and inconclusive. [23,24]

MATERIALS AND METHODS

After institutional approval and informed consent, 80 patients of ASA grade I and II and age of 18-60 years were recruited. A randomized double blind study was conducted by dividing the patients into two groups:-

- GROUP R: Patient received Ropivacaine (0.5%) (38ml) + 2ml normal saline (total volume 40ml).
- GROUP RD: Patient received Ropivacaine (0.5%) (38ml) + 2 mg (8mg) Dexamethasone (total volume 40ml).

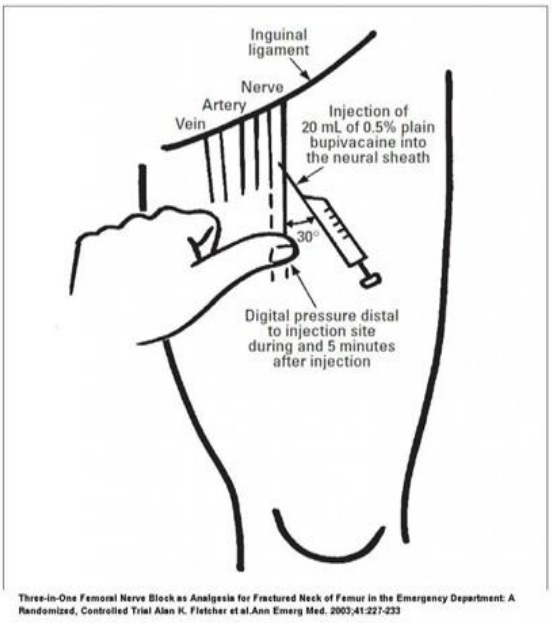
Patients were excluded if they were age <18 or >60 years, known hypersensitive to local anaesthetics, Opioid addicts, any systemic disease, diabetics, bleeding disorders, anatomical abnormality and any infection at the regional site, pregnant women, peripheral neuropathy or neurological deficits and Block failure cases.

During preoperative visits, patient's detailed history, general physical examination and systemic examination was carried out. On arriving in the operation room patients were premedicated with 0.03mg/kg inj. midazolam. Spinal anaesthesia was performed using 15 mg heavy 0.5% bupivacaine at L3-4 or L4-5 interspace with 25 gauge spinal needle (B.Braun; Melsungen, Germany).

After completion of the surgical procedure, patients underwent combined ultrasound (U/S) nerve stimulation guided single shot "3-in-1" FNB for postoperative analgesia. The skin was prepared with 10% iodine and with all sterile preparation done, and the U/S probe (M-turbo 11-mm broadband linear array, 6–14MHz; Sonosite, Bothell, Washington, USA) was sheathed. The U/S probe placed on the femoral crease and aimed posteriorly to identify the femoral artery and nerve. A 23-G, 50-mm-long needle (Locoplex-Vygon, Ecouen, France) connected to a nerve stimulator (Plexygon-Vygon, Ecouen, France) was inserted 1 cm lateral to the probe and advanced under ultrasonographic guidance by the in plane technique toward the femoral nerve. When the needle tip come close to the femoral nerve, the nerve stimulator was switched on and the needle adjusted to elicit quadriceps twitches with a current 0.4 mA. Drug dilutions with labelled syringes were prepared immediately before

the surgery by another anaesthetist who was not involved in observation and they were delivered in similar unidentifiable syringes. 40 mL of either 0.5% Ropivacaine with 8 mg of dexamethasone (Group R n = 40), or 40ml of 0.5% Ropivacaine with 2ml normal saline (Group RD n = 40) were injected with increments and gentle aspirations. After resolution of spinal anaesthesia (defined as a sensory level of less than L4), the adequacy of the femoral sensory nerve block was tested by the pinprick sensation test at the anterior aspect of the thigh and muscle strength according to ability to raise the leg. Insufficient analgesia to the pinpricks or no change in motor strength in the 30 min observation period will be accepted as failed block and excluded from further analysis.

Injection technique of 3-in-1 femoral nerve block.



Three-in-One Femoral Nerve Block as Analgesia for Fractured Neck of Femur in the Emergency Department: A Randomized, Controlled Trial Alan K. Fletcher et al.Ann Emerg Med. 2003;41:227-233

Figure No. 1

The duration of block and recovery of normal sensation in all the areas of nerve distribution was tested by pinprick test. The duration of motor block was tested by modified bromage scale. Pain was assessed with the standard visual analogue scale (VAS) (0 =no pain to 10 = worst imaginable pain) determined every hour after the surgery for first 6 hours then 2 hourly for next 6 hours and every 4 hours for last 12 hours. As rescue analgesia, Inj. Diclofenac 1mg/kg I.V. as infusion in 100 ml normal saline was given on VAS score >4 and then repeated 12 hrly, Inj. Tramadol 50 mg I.V as supplement analgesia whenever VAS score ≥ 4 persists for more than 30 min after inj. Diclofenac and incremental dose of 50 mg Tramadol repeated if pain persists after 5 min. Total opioid consumption and number of patients who received supplemental doses were also recorded. Side effects like nausea, vomiting, itching, urinary retention, sedation or dry mouth were observed for and Inj. ondansetron 0.1 mg/kg was standardized to be given for nausea and vomiting.

Statistical method: Descriptive data presented as mean ± SD. Continuous data analyzed by paired / unpaired 't' tests ,Fischer exact test and Chi-square test to assess the statistical difference between groups. Statistical analysis was performed with "Graph pad prism version 5.03". Arithemic mean median (range), standard deviation, standard error of mean.

RESULTS

Analysis of the patient's characteristics (age, sex, ratio, weight and ASA grade) demonstrated no significant difference between the two groups (p value was > 0.05).Patients in Group R had earlier return of sensation than patients in Group RD in areas supplied by all the three sensory nerves. It also showed that return of obturator nerve supply is relatively earlier than lateral cutaneous and femoral nerve in both the groups. Duration of motor block in group R was significantly less than group RD (397.5 ± 101.39 minutes v/s 768 ± 229.86 minutes). The mean time of the duration of analgesia time to rescue analgesia of group R is 527.32 ± 157.59 mins and of group RD is 1159.5 ± 301.81 mins. The analgesia lasted significantly longer in group RD as compared to group R ($p<0.0001$).

Total opioid consumption showed statistically significant difference between both the groups. (Group R 172.5±81.61 mg v/s group RD 57.5 ±63.59 mg of Tramadol:

p<0.001). VAS score were significantly higher in group R and was statistically significant from 4 hours to 12 hours. As VAS score reached 4, rescue analgesic dose was given. Hence, VAS scores became comparable at 16, 20 and 24 hrs between both the groups. Incidence of nausea and vomiting was more frequent in group R. Although not statistically significant but higher incidence of sedation was faced by patients of group R. All the side effects were related to opioid consumption.

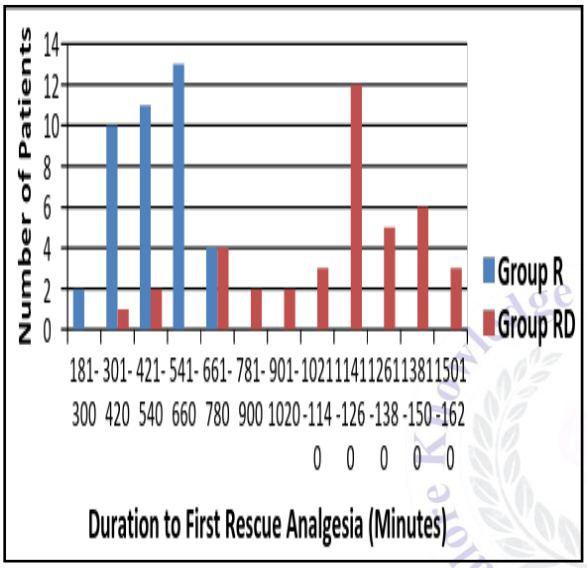


Figure No. 2: Distribution of Patients on Basis of Duration to First Rescue Analgesia Following Surgery

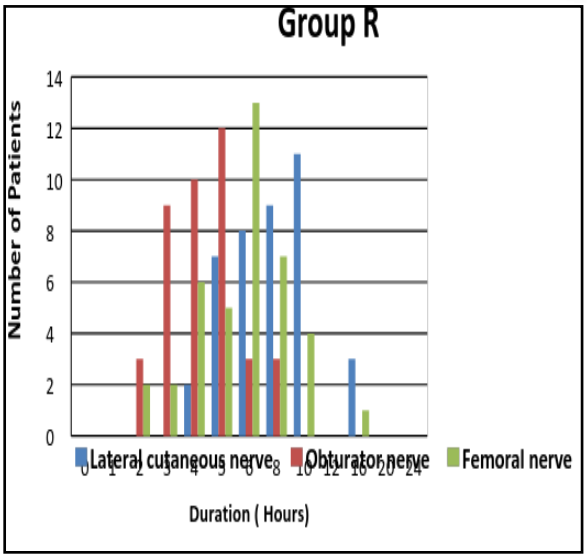


Figure No. 3: Comparison between the recoveries of sensory block in the areas supplied by three nerves in group R

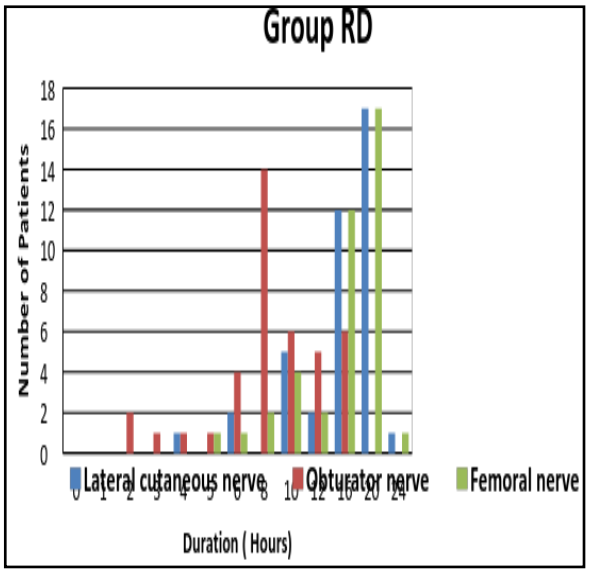


Figure No. 4: Comparison between the recovery of sensory block in the areas supplied by three nerves in group RD

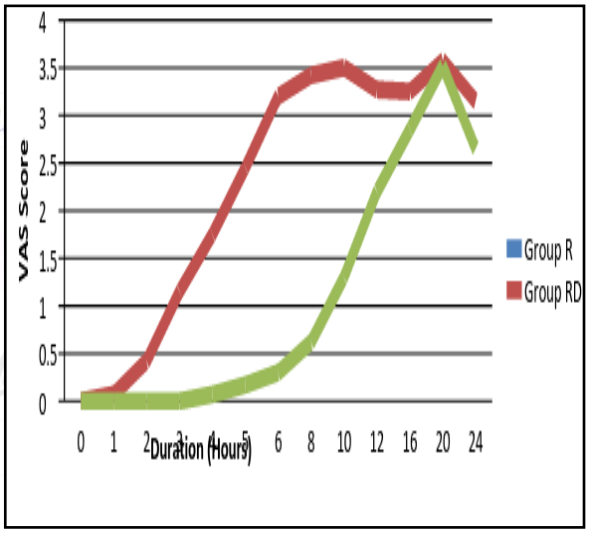


Figure No. 5: Visual Analogue Score

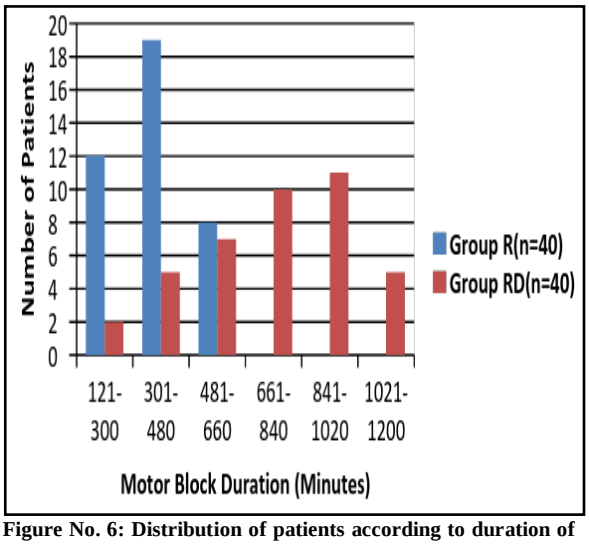


Figure No. 6: Distribution of patients according to duration of motor block

Table 1: Comparison of the both the study groups

Parameters	Group R (n=40)	Group RD (n=40)	P value
Mean Age (in Years)	41.2±14.41	34.77±15.63	0.597(NS)
Mean weight (in Kg)	61.82 ± 9.20	58.05 ± 8.27	0.0574
ASA Grade I Grade II	21 19	28 12	0.108
Duration of Surgery (in minutes)	78.25 ± 25.50	89.87 ± 23.68	0.079
Duration to first rescue analgesia (in minutes)	527.32 ± 157.59	1159.5 ± 301.81	<0.0001
Amount of supplement analgesia(mg)	172.5±81.61	57.5±63.59	-<0.0001
Duration of motor block (in hours)	397.5 ± 101.39	768 ± 229.86	<0.0001

DISCUSSION

Present study results demonstrate that the addition of dexamethasone to ropivacaine using single shot "3-in-1" Femoral nerve block significantly prolongs the analgesic effect of plain ropivacaine postoperatively. This led to reduced postoperative opioid consumption with fewer side effects.

These results are in keeping with the trend of previous studies using dexamethasone in femoral nerve block [25] and brachial plexus block [22,26-28] however, accurate comparisons are challenging because of the variety of local anaesthetic mixtures and adjuvants used, different studied, and different methods of evaluating block duration. The block prolongation we observed was approximately two fold with ropivacaine by adding dexamethasone.

Bridenbaugh has stated in a review of regional anaesthesia that "peripheral nerve block is the anaesthesia of choice for operations on the lower leg and foot." [29] Moore emphasized that "open operations on or above the knee cannot be carried out only under the combination of sciatic and femoral nerve blocks unless the lateral cutaneous and obturator nerves are also blocked." [30] He also concluded, the possibility of adverse side effects, in attempting to provide block anaesthesia of all four nerves using conventional techniques, there may be requirement of as many as 10 to 15 insertions of the needle and as much as 65 to 95 ml of local anaesthetic agent, [30] increasing the chance of complications.

Winnie et al, [31] who is one of the pioneers in "3-in-1" femoral nerve block, performed the block by eliciting paresthesia of femoral nerve. Studies in adults and children have shown that US-guided FNBs are easy to learn, provide faster and longer pain relief, technically superior, decrease the opioid requirement and volume of local anesthetic for pain management compared to Nerve stimulator guidance [32-36] and should be considered in all patients with femoral fractures. [32,33,35]

Roxane Fournier et al [37] (1997) studied the effectiveness of "3-in-1"FNB after prosthetic hip surgery and found that duration of analgesia was prolonged in study group (298±39 min v/s 61±44 min, $p<0.05$) as compared to sham block. Brian D. Sites et al [38] (2004) concluded that FNB provide superior side effect-sparing analgesia when compared with intrathecal morphine in patients undergoing TKR. Hence they proved the analgesic sparing efficacy of triple nerve block in femur, knee and hip surgeries.

The 3-in-1 femoral nerve block depends on the advancement of a high volume of local anesthetic to the proximal lumbar plexus within the nerve sheath and the simultaneous blockage of the obturator nerve and lateral cutaneous nerve together with the femoral nerve. Wang et al (2002) [39] have obtained a similarly effective postoperative analgesia with 40 ml of 0.25 % bupivacaine. The quality of the nerve block has been linked to the volume of the local anesthetic used in many articles. Higher volumes of local anesthetics may therefore lead to better obturator nerve blockade values. Lang and Yip (1993) [40] reported the rate of obturator nerve retention as 4 % whereas in Singelyn et al [41] (1996) studied this percentage as high as 40%-55%. Although bupivacaine was used in both studies, the quantity was 30 ml for

Lang and Yip's (1993) study and 40 ml for Singelyn et al' s study (1996).

We did not experience an unsuccessful block in the present study with 40 ml ropivacaine at a 0.5 % concentration. The high rate of block success was due to several reasons. First of all, the block was localized correctly by using an ultrasound guided peripheral nerve stimulator. Secondly, the volume and dose of the local anesthetic was relatively high and we applied pressure distal to the injection area. We thus ensured adequate proximal spread of the local anesthetic in the femoral sheath.

Glidasio S. DeOliveira et al [42] conducted a Meta analysis including nine randomized control trials with 760 subjects and concluded that perineural dexamethasone improves postoperative pain outcomes when given as an adjuvant to brachial plexes block with no reports of persistent nerve injury.

Our study reveals that mean time from the performance of the block to the complete recovery of the motor function up to "Modified Bromage scale 1" in group R is 397.5 ± 101.39 minutes and for group RD is 768 ± 229.86 minutes. It was observed that none of the patient was able to move hip joint up to 24 hours postoperatively even after complete motor recovery in other areas. This was probably due to psychological fear of patient after surgery. Hence we considered "Modified Bromage Scale 1" (i.e. Patient is unable to move hip but is able to move the knee and ankle joint) as complete motor recovery.

The analgesia lasted significantly longer(R is 527.32 ± 157.59 minutes and of group RD is 1159.5 ± 301.81 minutes) in group RD as compared to group R ($p<0.0001$) i.e. highly statistically significant. This is consistent with observation of Mohamed Sayed–Elahl [25] who noticed significant prolongation of analgesia and motor block (group RD 1782 ± 288 min v/s group R 1356 ± 222 min: $P<0.001$) when dexamethasone was added to a 20 ml of 0.05% Ropivacaine in single shot femoral nerve block for postoperative analgesia in ACL reconstruction surgery.

VAS score were significantly higher in group R at the end of all the hours.VAS score were statistically significant at 4, 5, 6,8,10 and 12 hrs between both the groups. As VAS score reached 4, analgesic dose was given. Hence, VAS scores became comparable at 16, 20 and 24 hrs between both the groups.

None of our study patient complained of neurotoxicity or any other complaints attributable to dexamethasone, reports of corticosteroid-mediated neurotoxicity seem to be related to the vehicle polyethylene glycol and the preservative benzyl alcohol in steroid preparations as well as the presence of insoluble steroid particulate matter in the injectate, [43,44] neither of which applies to the formulation of dexamethasone (dexamethasone sodium phosphate) we used. Although corticosteroids have been used successfully for postoperative pain relief in oral, general, and orthopaedic surgery, [45,46] other studies have not corroborated these reports. [46] Adding a steroid to local anesthetic solution may not be indicated for all patients. For example, diabetic patients may experience hyperglycemia and patients with a continuing infectious process may be detrimentally affected by the anti-inflammatory effects of steroids but concerns about steroid induced hyperglycemia have been borne out in high dose I.V. regimens. [47]

In the follow up satisfaction survey, 35 % of the patients of group R rated their experience as "unsatisfactory" as compared to only 10 % in group RD. All the patients who were unsatisfied had severe nausea or vomiting at least once. Percentage of outstanding report was almost 47.5% in group RD in comparison to none in group R. Hence, the finding was statistically significant.

CONCLUSION

Thus to conclude dexamethasone have been found to have favourable side-effects sparing profile on "3-in-1" femoral nerve block when added with 0.5% ropivacaine .Significant prolongation of duration of post operative analgesia is noted hence recommended in cases in which long duration of pain is expected.

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