Original Article

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Anaesthesia Section

Effect of Preoperative Continuous Femoral Nerve Block in Ease of Administration of Spinal Anaesthesia for Fracture Neck of Femur Stabilisation: A Case-control Study

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ABSTRACT

Introduction: Subarachnoid block remains the anaesthesia modality of choice for surgical fixation of femur. Extreme fracture pain makes ideal positioning for spinal anaesthesia difficult. Preoperative continuous femoral block can provide analgesia for such patients.

Aim: To evaluate the effect of continuous femoral nerve block in ease of administration of spinal anaesthesia for fracture neck of femur stabilisation.

Materials and Methods: This was a prospective case-control study conducted at the Government Medical College, Kozhikode, Kerala, India, from September 2020 to September 2021. Total of 86 adult patients posted for fracture femur neck stabilisation were selected and divided into two groups- group 1 and group 2. Patients in group 1, were administered ultrasound guided continuous femoral nerve block with 0.2% ropivacaine (15 mL) followed by subarachnoid block and group 2 patients were administered subarachnoid block without prior femoral nerve block. Parameters observed included were Visual Analogue Score (VAS) score while positioning for spinal anaesthesia, ease of palpating interspinous space, time required to perform spinal anaesthesia, number of attempts required to achieve dural puncture, patient satisfaction score as well as haemodynamic and respiratory changes while positioning for subarachnoid block. Statistical analysis was done using IBM SPSS (Statistical Package for the Social Sciences) Statistics for Windows, version 20.0.

Results: Group 1 patients had significantly lower VAS scores while positioning for spinal anaesthesia (4.2±1.8 in group 1 as compared to 6.3±1.2 in group 2, p-value=0.001). There was a significant difference in the number of attempts required for dural puncture (1.3±0.4 in group 1 as compared to 1.8±0.6 in group 2, p-value=0.04) and total performance time for spinal anaesthesia (2.2±0.4 min in group 1 as compared to 3.3±0.9 minutes in group 2, p-value=0.02) between two groups. Patient satisfaction scores were significantly higher in group 1 compared to group 2 (9.3±0.6 in group 1 as compared to 6.5±0.5, p-value <0.001). Both groups were comparable in terms of ease of palpating inter spinous space, haemodynamic and respiratory changes during positioning for subarachnoid block.

Conclusion: Preoperative administration of continuous femoral nerve block provides better conditions for performing subarachnoid block in fracture neck of femur surgeries by reducing the pain while positioning.

Keywords: Fixation, Hip fracture, Local anaesthetics, Subarachnoid block

INTRODUCTION

Alleviation of pain has been the goal of healthcare providers from time immemorial. Most long bone fractures grade high in the pain intensity scale. Adequate analgesia is required to manage distress associated with hip fractures. Safe and effective management of fracture-related pain and anxiety will reduce patient's distress during initial evaluation and often aids in the definitive management of the fracture.

Surgical fixation is the gold standard for treatment of fracture neck of femur [1]. Regional anaesthesia is the technique of choice for surgical fixation of fracture femur [2]. Among various regional anaesthesia techniques, Subarachnoid Block (SAB) is the most commonly employed and preferred choice of anaesthesia [3].

Administration of spinal anaesthesia requires precise positioning and varying degrees of flexion of the spine so as to maximise the space for needle insertion between spinous processes [4]. Co-operation from the patient for positioning aids in administering spinal anaesthesia to a great extent. The levels of flexion of spine required is uncomfortable even for a normal patient with no bony pathology, making it a very difficult and painful experience for patients with fracture neck of femur. This will directly reflect on the ease of administration of SAB.

Various modalities like intravenous opioids, femoral nerve block, Fascia Iliaca Block (FIB) and Pericapsular Nerve Group Block (PENG) with different local anaesthetics have been advocated to reduce the pain preoperatively and improve the positioning of these patients [5-8]. Systemic analgesics, such as narcotics are commonly used but their side effects profile includes respiratory depression, cognitive impairment, vomiting, urinary retention and constipation [9]. The age group affected with femoral fractures are most commonly the elderly and opioids might not be the ideal analgesic in view of the side effects mentioned. Peripheral nerve blocks especially femoral nerve block is an attractive alternative [10].

Literature provides various studies on different methods that have been used to control the pain during patient positioning for spinal anaesthesia, but the results are inconsistent about the superiority of one over the other [5-8,10]. There are limited studies on the effect of continuous femoral nerve block in fracture femur patients in comparison to single injection techniques. Continuous femoral block has been found to be superior to single shot technique for total knee arthroplasties in a meta-analysis done by Li S et al., [11].

This study was conducted to evaluate the effect provided by continuous ultrasound guided femoral nerve block in the ease of administration of spinal anaesthesia, as well as the influence of continuous femoral nerve block on haemodynamic and respiratory changes while positioning for spinal anaesthesia in patients undergoing surgery for fracture femur. Parameters observed included Visual Analogue Score (VAS) score while positioning for

spinal anaesthesia, ease of palpating inter spinous space, time required to perform spinal anaesthesia, number of attempts required to achieve dural puncture, patient satisfaction score as well as blood pressure, heart rate and respiratory rate changes while positioning for subarachnoid block.

MATERIALS AND METHODS

This was a prospective case-control study conducted at the Government Medical College, Kozhikode, Kerala, India, from September 2020 to September 2021. Approval from Institutional Research and Ethics Committee (IREC) (GMCKKD/RP 2020/IEC/351 dated 24/01/2020) was obtained. Written informed consent was taken from all patients.

Sample size calculation: This was done using the formula

$$n=(Z\alpha+Z\beta)2 \times SD2 \times 2/d2$$

where Zα=1.96, Zβ=0.84, SD=Standard Deviation, d=effect size was 0.40 and sample size was calculated to be 43 in each group [12].

Inclusion criteria: Patients who belonged to American Society of Anaesthesiologist Physical Status (ASA PS) I, II and III were included in the study.

Exclusion criteria: Patients with history of coagulopathy, spinal deformities, spinal surgeries, neuropathic disorders, patients with psychological disorders or linguistic difficulties, known allergy to study drugs and infection at spinal site were excluded from the study.

Study Procedure

Total of 86 patients who underwent corrective surgery for fracture neck of femur were assigned to two groups depending on whether they received continuous femoral block prior to surgery or not.

Group 1 (Cases)- patients who received femoral nerve block prior to spinal anaesthesia and

Group 2 (Controls)- patients who received spinal anaesthesia without femoral nerve block.

Physical examination and laboratory evaluation was done preoperatively. On the day before surgery, procedure was explained to each patient. All patients were kept nil per oral overnight and premedicated with tablet alprazolam 0.5 mg, tablet ranitidine 150 mg and tablet metoclopramide 10 mg. They were advised fasting of eight hours for solids and two hours for clear liquids.

On the day of surgery, patients from both groups were secured with a peripheral IV access with 18 gauge cannula and received an infusion with ringer lactate at a rate of 15 mL/kg. Multipara monitor with electrocardiography, pulse rate, Oxygen saturation (SpO_2), respiratory rate and non invasive blood pressure measurement were recorded continuously. All patients were supplemented with oxygen (5 L/min) via face mask. Intravenous midazolam (0.01-0.05 mg/kg) and intravenous fentanyl (1 mcg/kg) were administered to patients of both group five minutes prior to positioning for spinal anaesthesia.

Group 1: All the patients were counselled and explained regarding femoral nerve block and spinal anaesthesia as well as the scoring of VAS i.e., which ranged from 0-10, where 0- no pain to 10-worst pain. Continuous femoral nerve block was inserted in the anaesthesia work room. After confirming the needle position, femoral nerve catheter (Contiplex, Braun) was inserted under ultrasound guidance (Mindray UMT200) after position being confirmed by hydro dissection. Fixing was done by subcutaneous tunnelling and skin suturing. A bolus dose of 0.2% ropivacaine 15 mL was injected through the catheter, 20 minutes prior to the planned procedure. An elastomeric infusion pump delivering 0.2% ropivacaine at a rate of 5 mL/hour was connected to the catheter, after which the patient was shifted to operation theatre. The patient was positioned for spinal anaesthesia in lateral position with fractured side down. Under sterile aseptic precautions and local anaesthesia, L3-L4 intervertebral space was palpated and subarachnoid block was administered using 25 gauge spinal needle with 0.5% bupivacaine (H). The dose of bupivacaine was decided by the anaesthesiologist performing the spinal anaesthesia, based on patient factors such as, age, weight and height. Patient was turned to supine position once spinal anaesthesia was administered. After confirming adequate anaesthesia, positioning for surgical procedure was done.

Group 2: All the patients were counselled and explained regarding the procedure of spinal anaesthesia as well as the scoring of VAS i.e., which ranged from 0-10, where 0-no pain to 10-worst pain. Spinal anaesthesia without prior femoral nerve block was administered to group 2 patients. Patient was positioned for spinal anaesthesia in lateral position with fractured side down. Under sterile aseptic precautions and local anaesthesia, L3-L4 intervertebral space palpated and subarachnoid block was administered using 25G spinal needle with 0.5% bupivacaine (H). The dose of bupivacaine was decided by the anaesthesiologist performing the spinal anaesthesia, based on patient factors such as, age, weight and height. Then the patient was turned to supine position. After confirming adequate anaesthesia, positioning for surgical procedure was done.

Parameters assessed:

- Pain experienced by the patients while positioning for spinal anaesthesia were assessed for both groups using the VAS.
- The ease of palpating interspinous space was assessed and graded on a scale of 1 to 5 by an anaesthesiologist who had an experience of atleast five years-

  1- easily palpable,

  2- palpable,

  3- difficult to palpate,

  4- very difficult to palpate,

  5- no space palpable,
- The total number of attempts required for achieving dural puncture and the total time required for administering spinal anaesthesia was documented by the investigator.
- Mean arterial pressure, respiratory rate and heart rate while positioning for spinal anaesthesia were also documented.
- Patient satisfaction scores were also asked for and documented (<5- very bad; 6-7- unsatisfactory; 8-10-good).

STATISTICAL ANALYSIS

Statistical analysis was done using IBM SPSS (Statistical Package for the Social Sciences) Statistics for Windows, version 20.0. Armonk, NY: IBM Corp. Continuous variables were summarised as mean±SD (Standard Deviation) or median with interquartile range based on normality. The percentage of individuals with a clinical outcome was summarised as frequency and proportions. The comparison of demographic parameters, clinical parameters at baseline was assessed using the Chi-square test or Fisher's exact test. A comparison of outcome parameters across both the groups at the endpoint was assessed using an unpaired t-test (for normally distributed continuous variables). A p-value of <0.05 was taken as statistically significant.

RESULTS

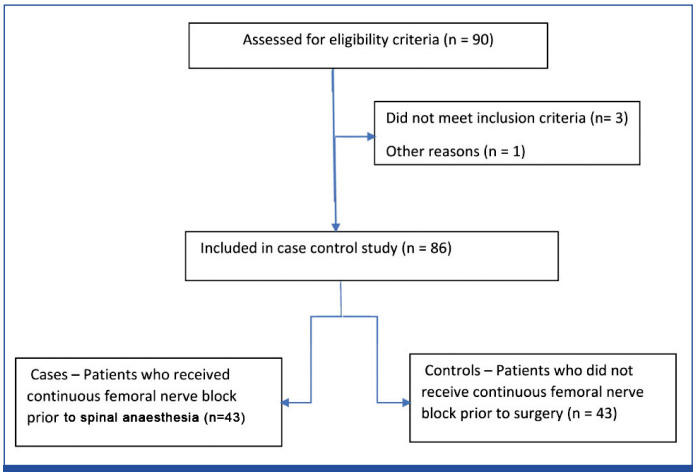
A total of 86 patients, 43 in each group, were included in the study [Table/Fig-1]. Patients in both groups were comparable with respect to demographic parameters [Table/Fig-2].

The VAS scores while positioning the patient for spinal anaesthesia were significantly less in group 1 as compared to group 2 (4.2±1.8 in group 1 as compared to 6.3±1.2 in group 2) [Table/Fig-3].

Ease of administration of spinal anaesthesia assessed by total time taken for spinal anaesthesia (2.2±0.4 min in group 1 as compared to 3.3±0.9 in group 2), number of attempts (1.3±0.4 in group 1 as compared to 1.8±0.6 in group 2) and patient satisfaction score

(9.3±0.6 in group 1 as compared to 6.5±0.5) were statistically significant between both groups with p-values of 0.02, 0.04 and 0.001 respectively [Table/Fig-3].

There was no statistical significance between the two groups with regard to ease of palpation of interspinous spaces (p-value=0.97) [Table/Fig-4].



[Table/Fig-1]: Flowchart depicting the case and control allocation.

Demographic features	Group 1	Group 2	p-value
Age (in years) (Mean±SD)	69.7±13.7	68.7±12.7	0.92
Weight (in Kg) (Mean±SD)	55.33±5.99	55.87±6.14	0.735
Genders (n, %)			
Male	16 (37.21)	20 (46.5)	0.38
Female	27 (62.7)	23 (53.5)	

[Table/Fig-2]: Demographic features.
p-value <0.05 considered as significant

Parameters	Group 1	Group 2	p-value (unpaired t test)
VAS score	4.2±0.8	6.3±1.2	0.001
Number of attempts	1.3±0.4	1.8±0.6	0.04
Total time taken (mins)	2.2±0.4	3.3±0.9	0.02
Patient satisfaction score	9.3±0.6	6.5±0.5	0.001

[Table/Fig-3]: Outcome parameters while performing spinal anaesthesia observed.
* Data expressed in mean±SD; p-value <0.05 considered as significant.

Ease of palpation	Total n (%)	Femoral nerve block with SA, n (%)	Spinal anaesthesia, n (%)	p-value
Easily palpable	6 (6.9)	3 (50.0)	3 (50.0)	0.97
Palpable	51 (59.3)	26 (50.9)	25 (49.1)	
Difficult to palpate	29 (33.7)	14 (48.2)	15 (51.8)	

[Table/Fig-4]: Distribution of ease of palpation of interspinous space among study groups.

The comparison of vital parameters (heart rate, mean arterial pressure, respiratory rate) measured while administering spinal anaesthesia between the 2 groups did not show any statistical significance (p-value >0.05) [Table/Fig-5].

Vital parameters	Group 1	Group 2	p-value
Heart rate while positioning	87.3±4.9	90.3±9.1	0.07
Mean arterial pressure while positioning	78.3±4.9	81.6±7.3	0.13
Respiratory rate while positioning	22.3±2.3	22.7±2.5	0.41

[Table/Fig-5]: Outcome parameters while performing spinal anaesthesia observed.
* Data expressed in mean±SD; p-value <0.05 considered as significant

DISCUSSION

Achieving optimal positioning for spinal anaesthesia in a patient with fracture femur is difficult due to the pain involved. Correct positioning during subarachnoid block is imperative from the perspective of surgeon, patient and anaesthesiologist alike [13,14]

This study evaluated the effects of continuous femoral nerve blockade in the ease of administration of spinal anaesthesia in fracture femur cases. Preoperative continuous femoral nerve block significantly improves the conditions for administration of spinal anaesthesia.

Femoral nerve block was selected in this study because of it's easily identifiable landmarks in ultrasound imaging. Ropivacaine was selected for this study in view of its inherent vasoconstrictive properties and lower toxic potential threshold in the cardiovascular and central nervous system. Also, ropivacaine is preferred more than bupivacaine for peripheral nerve blocks [15]. Li S et al., in a systematic review and meta-analysis of analgesic efficacy of continuous versus singe shot femoral nerve block after total knee arthroplasty concluded that continuous femoral block technique was more effective than single shot technique [11]. Continuous nerve block technique was adopted in this study because of limited number of studies in this regard and with a view of offering postoperative analgesia for the patient's thereby reducing the need of opioids.

Hsu YP et al., in their meta-analysis found that in 10 studies consisting of 584 participants showed that femoral nerve block was superior to in terms of analgesia obtained while positioning for spinal [10]. Present study also elicited similar results with the continuous femoral nerve block group having significantly less VAS scores. Guay J et al., in a meta-analysis spanning seven studies and 285 participants reported that peripheral nerve block administered single shot or continuous, resulted in less postoperative opioid requirement in comparison to no nerve block [6].

The time taken for administering spinal anaesthesia and the number of attempts was statistically significant between both groups (p-value <0.05). Similar to the present study Hsu YP et al., also found that femoral nerve block reduced the time for spinal anaesthesia in eight studies in their meta-analysis [10]. Shortening the time for spinal anaesthesia could be attributed to the relaxation of quadriceps muscle caused by the femoral nerve block [16]. However, ease of palpation of the spine, another parameter measured in assessing quality of spinal anaesthesia did not show any significant difference between both the groups. This could probably be due to presence of degenerative spine in the older age group which comprised about 80% of the participants of this study. Patient satisfaction scores were significantly better in the femoral nerve block group which could be a direct reflection of the analgesia provided as evidenced from the improved VAS scores. Hsu YP et al., in their meta-analysis observed that femoral block group had better patient acceptance [10]. Vital parameters while positioning for SAB were comparable between both groups.

Continuous femoral nerve block with ropivacaine 0.2% appears to aid in providing better conditions for subarachnoid block in fracture femur surgeries by virtue of reduced pain while positioning. It also elicited better patient satisfaction scores.

Limitation(s)

The economic output of using a nerve catheter along with an elastomeric pump was not explored in this study. A comparison between single shot versus continuous femoral block would have shed more light on the efficiency characterestics of each technique.

CONCLUSION(S)

Continuous femoral nerve block with 0.2% ropivacaine reduces pain while positioning for spinal anaesthesia in fracture femur surgery without any significant side effects as evidenced by lower VAS scores, lesser time and number of attempts of spinal anaesthesia and better patient satisfaction scores. Future prospects include evaluation of duration of spinal anaesthesia in combination with continuous femoral nerve block.

REFERENCES

[1] Lutnick E, Kang J, Freccero DM. Surgical treatment of femoral neck fractures: A brief review. Geriatrics. 2020;5(2):22. Doi: https://doi.org/10.3390/geriatrics5020022. PMID: 32244621.

[2] Ahn EJ, Kim HJ, Kim KW, Choi HR, Kang H, Bang SR. Comparison of general anaesthesia and regional anaesthesia in terms of mortality and complications in elderly patients with hip fracture: A nationwide population-based study. BMJ open. 2019;9(9):e029245. Doi: https://doi.org/10.1136/bmjopen-2019-029245. PMID: 31300593.

[3] Malhas L, Perlas A, Tierney S, Chan VW, Beattie S. The effect of anesthetic technique on mortality and major morbidity after hip fracture surgery: A retrospective, propensity-score matched-pairs cohort study. Regional Anesthesia & Pain Medicine. 2019;44(9):847-53.

[4] Rae JD, Fettes PD. Mechanisms and management of failed spinal anaesthesia. Hadzic's textbook of regional anaesthesia and acute pain management 2017. McGraw-Hill Education.

[5] Jain N, Mathur PR, Patodi V, Singh S. A comparative study of ultrasound-guided femoral nerve block versus fascia iliaca compartment block in patients with fracture femur for reducing pain associated with positioning for subarachnoid block. Indian Journal of Pain. 2018;32(3):150.

[6] Guay J, Parker MJ, Griffiths R, Kopp SL. Peripheral nerve blocks for hip fractures: A Cochrane review. Anesthesia & Analgesia. 2018;126(5):1695-704. Doi: https://doi.org/10.1213/ANE.0000000000002489. PMID: 28991122.

[7] Lee KH, Lee SJ, Park JH, Kim SH, Lee H, Oh DS, et al. Analgesia for spinal anesthesia positioning in elderly patients with proximal femoral fractures: Dexmedetomidine-ketamine versus dexmedetomidine-fentanyl. Medicine. 2020;99(20):e20001.

[8] Moussa ME, Awad HG, Hamid HS, Abdellatif AE, Sharaf AG. A comparative study between femoral nerve block and intravenous ketamine for pain management during positioning for spinal anesthesia in elderly patients with femur fracture. Anaesthesia, Pain & Intensive Care. 2022;26(3):297-303. Doi: https://doi.org/10.35975/apic.v26i3.1895.

[9] Jassal M, Egan G, Dahri K. Opioid prescribing in the elderly: A systematic review. J Pharm Technol. 2020;36(1):28-40. Doi: https://doi.org/10.1177/8755122519867975. PMID: 34752514.

[10] Hsu YP, Hsu CW, Chu KC, Huang WC, Bai CH, Huang CJ, et al. Efficacy and safety of femoral nerve block for the positioning of femur fracture patients before a spinal block–A systematic review and meta-analysis. PloS One. 2019;14(5):e0216337. Doi: https://doi.org/10.1371/journal.pone.0216337. PMID:31048897.

[11] Li S, Zhou J, Li X, Teng X, Li Y, Du C, et al. Analgesic impact of single-shot versus continuous femoral nerve block after total knee arthroplasty: A systematic review and meta-analysis. Advances in therapy. 2020;37(2):671-85. Doi: https://doi.org/10.1007/s12325-019-01194-z. PMID: 31925648.

[12] Bhosle P, Prakash A, Aphale S. Femoral Nerve Block for positioning during regional anaesthesia in patients with fracture femur: A randomized controlled study. J Med Dental Sci Res. 2015;2(11):04-06.

[13] Prakash S, Mullick P, Kumar SS, Diwan S, Singh R. Factors predicting difficult spinal block: A single centre study. J Anaesthesiol Clin Pharmacol. 2021;37(3):395. Doi: https://doi.org/10.4103/joacp.JOACP_196_19. PMID:34759550.

[14] Sprung J, Bourke DL, Grass J, Hammel J, Mascha E, Thomas P, et al. Predicting the difficult neuraxial block: A prospective study. Anesthesia & Analgesia. 1999;89(2):384-89. Doi: https://doi.org/10.1097/00000539-199908000-00025. PMID: 10439752.

[15] Hansen TG. Ropivacaine: A pharmacological review. Expert Review of Neurotherapeutics. 2014;4(5):781-91. Doi: https://doi.org/10.1586/14737175.4.5.781. PMID: 15853505.

[16] Edwards MD, Bethea JP, Hunnicutt JL, Slone HS, Woolf SK. Effect of adductor canal block versus femoral nerve block on quadriceps strength, function, and postoperative pain after anterior cruciate ligament reconstruction: A systematic review of level 1 studies. Am J Sports Med. 2020;48(9):2305-13. Doi: https://doi.org/10.1177/0363546519883589. PMID: 31800300.

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