Comparative evaluation between fascia iliaca compartment block and intravenous fentanyl administration for painless positioning during spinal Anaesthesia in fracture femur surgeries: A randomized controlled study

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Abstract

Background: Pain poses a unique challenge to anaesthesiologist. Femur fracture is one such condition where patient experiences spikes of excruciating pain whenever patient is subjected to move or position for delivering central neuraxial anaesthesia which further increases stress response and results in poly-pharmacy to tackle its consequences. This study is designed to compare the efficacy of ultrasound guided Fascia Iliaca Compartment Block with bupivacaine over intravenous fentanyl for positioning during spinal anaesthesia in femur fracture cases.

Methodology: A single blinded, randomised study was carried out with 60 patients of ASA grade I and II aged between 18 to 70 years undergoing Femur fracture surgeries under spinal anaesthesia, patients are randomly allocated into two groups

Group FICB: will be given ultrasound guided Fascia Iliaca Compartment Block preoperatively with 30ml of 0.25% bupivacaine, the block will be done 15 minutes before the sub arachnoid block. Group FENT: will be administered intravenous fentanyl preoperatively according to their calculated body weight as 2mcg/kg body weight L.V.

Results: The VAS scores (P<0.0029), quality of patient positioning(P<0.0024), patient satisfaction(P<0.0284), Time to perform subarachnoid block (P<0.0001) heart rate (P<0.0022), Respiratory rate (P<0.0001) during positioning, Time for first rescue analgesic dose (P<0.0001) were comparatively better in the femoral nerve block group compared to intravenous fentanyl group and no statistically significant difference was observed in relation to mean arterial pressure, peripheral capillary oxygen saturation during positioning among both groups.

Conclusion: It is concluded that Fascia Iliaca Compartment Block is more efficacious than intravenous fentanyl for positioning during spinal anaesthesia in surgery for fracture femur cases.

Keywords: Fascia iliaca block, ultrasound guided fascia iliaca block, fentanyl, bupivacaine, perioperative analgesia

Introduction

Regional anaesthesia is the most widely used anaesthetic technique for orthopaedic procedures in lower limbs as it has many advantages over general anaesthesia, as it provides a good perioperative pain relief [3], reduces systemic analgesic requirements, decreases poly-pharmacy, avoids unnecessary airway manipulation, permits early ambulation and decreases chances of deep vein thrombosis [2].

Anaesthesia for femur surgeries is usually provided by subarachnoid block. Proper positioning during subarachnoid block is essential for a successful procedure. However, over riding of bone ends during movement worsens pain, delays positioning which in turn increases pain further [3]. Alleviating pain increases patient comfort and also provides better patient positioning for subarachnoid block [4]. Various drugs like Non-steroidal anti-inflammatory drugs, opioids, midazolam, ketamine, propofol have been in use to reduce the pain preoperatively and improve positioning in these patients. Among which Fentanyl a phenylpiperidine derivative synthetic opioid agonists chosen for study as it is 50-80 times more potent analgesic than morphine and has little hypnotic or sedative activity, has no
reported neural toxicity and has more rapid onset of action than other opioids, it induces a decrease in the MAC of co-administered volatile agents and increases the risk of non-depolarising Muscle relaxants, potential risk only being respiratory depression which will be monitored and counteracted as per requirement [3].

Nerve blocks have come up as an effective and a safe alternative to provide pain relief [6]. Ultrasound has provided anaesthesiologists, an effective tool for the identification and safe blockade of nerve fibres by precisely controlling the amount of drug to be delivered [7, 8, 9], hence ultrasound guided Fascia iliaca block is a promising technique for painless positioning of patient for central neuraxial blocks in fracture femur surgeries.

In this current study the field block is achieved with 30ml (within calculated toxicity dose as per patient) of 0.25% plain Bupivacaine a local anaesthetic, it has greater in-vivo relative potency, has higher protein binding capability thus increasing the duration of action. Potential risk for nerve blockades being the accidental administration of the local anaesthetic drug (Bupivacaine) into blood vessels or administering more than calculated toxic dosage, it results in seizures, cardiotoxicity causing cardiovascular collapse which can be prevented by careful administration of drug (within the toxic dosage) and by careful monitoring for toxicity signs like perioral-numbness, diaphoresis. Toxic affects if any are managed symptomatically and by lipid emulsion administration [8]. This study is designed to compare efficacy of Ultrasound guided Fascia Iliaca Block with bupivacaine over intravenous fentanyl for positioning during spinal anaesthesia in femur fracture cases.

Materials and Methods

Study Design: Prospective, Randomized, single-blind, Controlled study, with 60 patients divided into two groups

Group FICB: ultrasound guided Fascia Iliaca Compartment Block preoperatively with 30ml of 0.25% bupivacaine

Group FENT: Intravenous fentanyl preoperatively according to their calculated body weight as 2mcg/kg body weight I.V.

Inclusion Criteria
1. Patients belonging to ASA grade I and II.
2. Patients of either sex, between the age group 18 to 70 years.
3. Patients with fracture femur, posted for surgery under sub-arachnoid block.
4. Patients who give a valid informed consent.

Exclusion Criteria
1. Patients not satisfying inclusion criteria.
2. Patients belonging to ASA grade III or IV.
3. Patients with hemorrhagic diathesis, neurological disorders, psychiatric disorders.
4. Previous femoral bypass surgery.
5. Patients with allergy to local anaesthetics or opioids.
6. Patients with polytrauma, infection over the injection site.
7. Patients on previous opioid therapy.
8. Morbid obesity.
9. Patients who will be administered with supplementary epidural or general anaesthesia. (In patients with prolonged surgeries when conversion is required).
10. Patients with spinal deformities.
11. Patients who decline consent
12. Patients with language barrier.

Methodology

This study was conducted on sixty patients undergoing fracture femur surgeries at Konaseema Institute of medical sciences and research foundation between August 2019 to February 2020 Patients satisfying the inclusion criteria were selected, counselled about the risks and benefits involved in the study. After obtaining informed consent, patients who are willing to be included in the study were enrolled. They were preoperatively evaluated, clinically examined and assessed and were randomly allocated into two groups

Group FICB: Given ultrasound guided Fascia Iliaca Compartment Block preoperatively.

Group FENT: Administered intravenous Fentanyl preoperatively.

All patients were kept nil per oral for at least 6 hours before the procedure. Patients were shifted inside the operation theatre half an hour before the scheduled procedure. Baseline vitals such as pulse rate, non-invasive blood pressure, saturation in room air, respiratory rate, ECG pattern were recorded. Intravenous access was obtained with18G IV cannula and IV fluid was started. Oxygen was given via Hudson's mask at rate of 4 lit/min. Group FICB patients were placed in supine position. The local anaesthetic solution was prepared with 15 mL of 0.5% bupivacaine and 15ml of distilled water and hence 30ml of 0.25% bupivacaine. The Ultrasound Machine was powered on and the linear array probe was covered with sterile dressing after applying ultrasound gel. The probe was placed in horizontal direction over the anterior part of thigh just below the inguinal ligament. The ultrasound setting used to visualise was at a frequency of 10 MHz and a depth of 3-4cm. The gain and focus were adjusted according to the image scanned. Femoral artery was identified first. Then the iliacus muscle covered by fascia iliaca was identified lateral to the artery. An 18G needle was then inserted in plane to the ultrasound beam. The needle was advanced until the tip of the needle placed beneath the fascia iliaca (appreciating the give as the fascia is perforated) and after negative aspiration, the local anaesthetic was injected and its spread was visualized on the ultrasound screen. The fascia iliaca compartment block was done 15 minutes before the sub arachnoid block.

Group FENT patients were given dose of Inj. Fentanyl 2mcg/kg I.V as per their individual body weight. Hemodynamic variables heart rate, non-invasive blood pressure, saturation of oxygen, respiratory rate were recorded after the block/ iv fentanyl and at five minutes intervals till positioning.
The analgesia provided by either of the modes was assessed by using Visual analogue scale scores 15 minutes (i.e. during positioning) after the block/ I.V. Fentanyl.

**Visual Analogue Scale score**
Subarachnoid block was performed in the sitting posture under strict aseptic precautions in the L3-L4 space using 25G Quincke needle with 3ml of 0.5%Bupivacaine (hyperbaric, dextrose 80mg/ml) with or without adjuvant. The quality of patient positioning for administering spinal anaesthesia was recorded by another anaesthesiologist blinded to the mode of analgesia with scores of 0-3.0-Not satisfactory 1-satisfactory 2-good 3-optimal Time to perform spinal anaesthesia was recorded (time from beginning of positioning to end of spinal) Patient satisfaction was also recorded 1- satisfactory 2- not satisfactory Post-operative analgesia was standardized in all patients of both groups with Inj. Tramadol 50 mg I.V. 8th hourly; first dose was given when the patient complained pain. The collected data was recorded for statistical analysis.

**Results**
The results of 60 patients were as follows.

**Table 1: Vas During Positioning**

| VAS During Positioning - Groups | FICB Group | % | FENT Group | % |
|---------------------------------|------------|---|------------|---|
| VAS 0                           | 15         | 50.00 | 5 | 16.67 |
| VAS 2                           | 13         | 43.33 | 18 | 60.00 |
| VAS 4                           | 2          | 6.67 | 5 | 16.67 |
| VAS 6                           | 0          | 0.00 | 2 | 6.67 |
| Total                           | 30         | 100  | 30 | 100 |

p value 0.0029 as per unpaired t test, Significant

50% of patients in group FICB had VAS score of 0 when compared to 5% of patients in group FENT. This observation was statistically significant

**Table 2: Quality of Patient Positioning**

| QOP Positioning - Groups | FICB Group | % | FENT Group | % |
|--------------------------|------------|---|------------|---|
| QOPP 0                   | 0          | 0.00 | 2 | 6.67 |
| QOPP 1                   | 2          | 6.67 | 5 | 16.67 |
| QOPP 2                   | 13         | 43.33 | 18 | 60.00 |
| QOPP 3                   | 15         | 50.00 | 5 | 16.67 |
| Total                    | 30         | 100  | 30 | 100 |

p value 0.0024 as per unpaired t test, Significant

50% of pts feel optimal during positioning when compared to 16.67% in case of fentanyl group which was statistically significant.

**Table 3: Patient Satisfaction**

| Patient Satisfaction - Groups | FICB Group | % | FENT Group | % |
|------------------------------|------------|---|------------|---|
| Yes                          | 29         | 96.67 | 23 | 76.67 |
| No                           | 1          | 3.33 | 7 | 23.33 |
| Total                        | 30         | 100  | 30 | 100 |

P value Fishers Exact Test 0.0284 as per unpaired t test, Significant

Patient satisfaction is 96.67% for FICB group when compared to 76.67% for FENT group which was statistically significant

**Table 4: Time to Perform Sub Arachnoid Block**

| Time to Perform SAB - Groups | FICB Group | % | FENT Group | % |
|------------------------------|------------|---|------------|---|
| ≤ 5.00 mins                  | 17         | 56.67 | 3 | 10.00 |
| 5.01-6.00 mins               | 13         | 43.33 | 18 | 60.00 |
| 6.01-7.00 mins               | 0          | 0.00 | 8 | 26.67 |
| 7.01-8.00 mins               | 0          | 0.00 | 3 | 10.00 |
| Total                        | 30         | 100  | 30 | 100 |

p value 0.0001 as per unpaired t test, Significant

The mean time to perform subarachnoid block was significantly shorter in FICB group compared to FENT group by a mean difference of 58 seconds (16% shorter). which was significant statistically

**Table 5: Heart Rate**

| Heart Rate (beats per min) | Before Block | 5 mins | 10 mins | 15 mins (During Positioning) |
|---------------------------|--------------|--------|---------|------------------------------|
| FICB Group                | Mean         | SD     | Mean    | SD   |
|                           | 86.93        | 8.77   | 86.90   | 8.44 |
|                          | 85.63        | 82.37  | 97.63   | 7.13 |
| P value Unpaired t Test   | 0.4065       | 0.0027 | 0.0022  |

The mean heart rate was significantly lower in FENT group compared to FICB group by a mean difference of 6 bpm (6% lower), which is statistically significant

**Table 6: Mean Arterial Pressure**

| Mean Arterial Pressure (mm Hg) | Before Block | 5 mins | 10 mins | 15 mins (During Positioning) |
|-------------------------------|-------------|--------|---------|------------------------------|
| FICB Group                   | Mean         | SD     | Mean    | SD   |
|                              | 100.17      | 99.83  | 98.20   | 97.33 |
|                              | 100.80      | 99.20  | 98.17   | 97.13 |
| P value Unpaired t Test      | 0.3548      | 0.5262 | 0.5010  | 0.7649 |

P=0.7649 (P>0.05) as per unpaired t test
This implies there was no statistically significant difference in relation to mean arterial pressure between FICB group and FENT group

| Table 7: Peripheral Capillary Oxygen Saturation |
|------------------------------------------------|
| **Periperal Capillary Oxygen Saturation (%)** | **Before** | **5 mins** | **10 mins** | **15 mins** |
| **FICB** | Mean | 98.03 | 98.73 | 99.13 | 99.27 |
| Group | SD | 0.76 | 0.69 | 0.63 | 0.52 |
| **FENT** | Mean | 98.10 | 98.97 | 99.17 | 98.94 |
| Group | SD | 0.76 | 0.67 | 0.70 | 0.89 |
| P value Unpaired t Test | 0.7359 | 0.1892 | 0.8467 | 0.1118 |

This implies there was no statistically significant difference in relation to peripheral capillary oxygen saturation distribution between FICB group and FENT group

| Table 8: Respiratory Rate |
|---------------------------|
| **Respiratory Rate** (breaths per min) | **Before** | **5 mins** | **10 mins** | **15 mins** |
| **FICB** | Mean | 17.34 | 17.40 | 17.17 | 16.70 |
| Group | SD | 1.38 | 1.19 | 0.91 | 1.12 |
| **FENT** | Mean | 17.33 | 16.97 | 15.57 | 14.57 |
| Group | SD | 0.96 | 1.16 | 1.19 | 1.48 |
| P value Unpaired t Test | 0.8287 | 0.0873 | <0.0001 | <0.0001 |

The mean respiratory rate was significantly lower in FENT group compared to FICB group by a mean difference of 2 breaths per minute (11%) lower

| Table 9: First Rescue Analgesic Postoperative |
|---------------------------------------------|
| **First Rescue Analgesic Postoperative -Groups** | **FICB Group** | **%** | **FENT Group** | **%** |
| ≤ 3.0 hrs | 0 | 0.00 | 30 | 100.00 |
| 3.01-5.00 hrs | 3 | 1.00 | 0 | 0.00 |
| 5.01-7.00 hrs | 26 | 86.67 | 0 | 0.00 |
| 7.01-9.00 hrs | 1 | 3.33 | 0 | 0.00 |
| Total | 30 | 100 | 30 | 100 |

The mean time of first postoperative analgesic need was significantly delayed in FICB group compared to FENT group by a mean difference of 4 hours and 15 minutes (72% more delayed), which was statistically significant

**Discussion**

Spinal anaesthesia is the most commonly used anaesthetic technique of choice in orthopaedics for lower limb fractures. While regional anaesthesia has been shown to be more beneficial compared to general anaesthesia, patient positioning for neuraxial blockade may cause severe pain in patients with femur fractures. Various systemic analgesics are being used to provide pain relief during positioning in these patients. Among the systemic analgesics, opioids are widely used but they are known to be associated with side effects like cognitive impairment, vomiting, urinary retention, respiratory depression especially in the elderly. Nerve blocks like the 3 in 1 block, femoral nerve block, fascia iliaca compartment block have all come up as an alternative approach to provide pain relief and improve positioning in these patients. Also, since the injection is done away from the artery and nerve, there are minimal chances of neurovascular injury. It is the preferred technique of choice in orthopaedic surgery. The heart rate was significantly lower in FENT group at 10 and 15 minutes (P<0.05) while there was no significant difference in MAP and oxygen saturation between the two groups. The respiratory rate was significantly less in FENT group at 10 and 15 minutes (P<0.0001) though none of the patients had a respiratory rate of < 12/minute or a saturation of < 95%.

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FICB had the advantage of significant post op analgesia as the requirement of first rescue analgesic was after 5.90±0.80 hrs compared to 1.65±0.60 hrs in FENT group. (P<0.0001). There were no complications of block like infection, block failure, vascular puncture, nerve damage or systemic toxicity of bupivacaine.

In this study, Fascia Iliaca Compartment Block proved to be more advantageous than i.v. fentanyl to facilitate patient positioning in femur fractures. Fascia Iliaca Compartment Block could also be more useful in procedures like placing an epidural or in patients with spinal abnormalities where the patients may have to be in a sitting position for a longer time. Also, the placement of a catheter in the fascia iliaca compartment and inclusion of additives would further increase the duration of post op analgesia.

Conclusion
It is concluded that Fascia Iliaca Compartment Block is more efficacious than intravenous fentanyl for positioning during spinal anaesthesia in surgery for fracture femur. Fascia Iliaca Compartment Block provides superior analgesia, better quality of patient positioning, greater patient satisfaction thereby reducing the time taken to perform spinal anaesthesia in sitting position compared to i.v. fentanyl in fracture femur surgery.

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