Original research article

USG guided SIFIB to intravenous fentanyl in facilitating positioning of patients with acetabular fractures for neuraxial blocks: Total opioid consumption

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Abstract

The ultrasound-guided suprainguinal approach to FICB was first described by Hebbard *et al* in 2011. This method involved direct deposition of local anesthetic in the iliac fossa above the inguinal ligament by advancing the needle cranially beneath the fascia iliaca, starting from below the inguinal ligament until the needle tip passes superior to the inguinal ligament. A total of 30 patients were assessed for eligibility during the study period, out of which 20 patients were recruited. They were randomized to either receive suprainguinal fascia iliaca block (group B) or fentanyl (group F), with each group having 10 patients. The median opioid consumption in Group F was 70(57.5-85). Opioid was used in Group B as rescue analgesia in a single patient (median consumption 0(0)). Group F had higher median opioid consumption (+70.0) in comparison to Group B (SIFIB), and the difference was statistically significant (Mann-Whitney U=0.0, df=18, $p<0.05$).

Keywords: USG Guided SIFIB, Neuraxial Blocks, Total Opioid Consumption

Introduction

The acetabulum is a part of the ball and socket hip joint. An acetabular fracture is a break in the socket portion of the hip joint. These hip socket fractures are not common and occur much less frequently than fractures of the upper femur or femoral head (hip fractures). While the incidence of acetabular fractures in India is yet to be established, countries like the United Kingdom and France report an annual incidence of 3 per 1,00,000 and 4.95 per 1,00,000 respectively[1,2]. Fractures of the acetabulum usually occur following high impact trauma like motor vehicle accidents or fall from heights[3], wherein the head of the femur is driven into the pelvis. With the increasing incidence of road traffic accidents in India, these fractures are on the rise. These fractures are associated with significant tissue injury and are quite painful. Pain control in the perioperative period allows for rapid healing, early rehabilitation, and suppression of stress responses following injury.

The ultrasound-guided suprainguinal approach to FICB was first described by Hebbard *et al* in 2011. This method involved direct deposition of local anesthetic in the iliac fossa above the inguinal ligament by advancing the needle cranially beneath the fascia iliaca, starting from below the inguinal ligament until the needle tip passes superior to the inguinal ligament. It is thought that as a result of the more cranial deposition, there will be better spread under the fascia iliaca towards the medial side where the obturator nerve is located. It also ensures a more reliable LFCN block as this nerve tends to leave the fascia iliaca plane below the inguinal ligament. Vermeylen *et al* later demonstrated that using a volume of 40 ml local anesthetic there was complete sensory block of the lateral, medial and anterior aspect of the thigh in up to 80% of patients with the suprainguinal FICB as compared to only 30% in the conventional infrainguinal method[4].

Suprainguinal FICB has since then proven to be an excellent analgesic technique for hip surgeries. A randomized controlled trial by Desmet *et al* using suprainguinal FICB with 40 ml 0.5% ropivacaine in patients undergoing hip arthroplasty showed that morphine consumption in the first 24 hours

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postoperatively was significantly lower in the block group as compared to the control group which received no block. They also measured serum ropivacaine levels and found that not patient had levels above the therapeutic range[5]. The suprainguinal FICB has also shown to be superior to the infrainguinal approach for postoperative analgesia in total hip arthroplasties; A study by Kumar *et al* concluded that patients who received suprainguinal block had lower VAS score at 6 hours postoperatively, more time to first demand bolus from PCA pump and lower overall total morphine consumption. Encouragingly, a study by Bravo *et al* has shown the suprainguinal FICB is as effective as a lumbar plexus block for total hip arthroplasties. They found that there were no intergroup differences in terms of pain scores, time to first demand bolus or total morphine consumption. In addition, patients who received suprainguinal FICB had longer duration of block and had decreased time to readiness for hospital discharge and reduced duration of hospital stay[6].Thus, the suprainguinal fascia iliaca block is a safe, easy and effective regional anesthetic technique for hip and lower limb surgeries.

Methodology

Study Design

Randomized Controlled Pilot Study

Sample size

A sample size of 20 was taken, taking into consideration the low incidence of acetabular fractures and that it was a pilot study.

Inclusion criteria

1. Patientsabovetheageof18,postedforelectivesurgicalrepairofthe following acetabular fractures:
   a. Anterior column fractures
   b. Anterior column - posterior hemi-transverse fractures
   c. Associated both column fractures

2. Above patients undergoing surgery by following approaches of acetabular fracture repair:
   a. Iliofemoral approach
   b. Ilioinguinal approach
   c. Stoppas approach

Exclusion Criteria

1. Patient refusal
2. Anycontraindicationtoneuraxialblocklikecoagulopathy,localinfection, increase ICP etc.
3. Known allergy to local anaesthetic drugs.
4. Peripheral neuropathy
5. Hemodynamically unstable polytrauma patients.
6. Patients who were ASA 4 and above.

Assignment of intervention

Thepatientswereassignedtothetwogroupsusingcomputergenerated randomization.

Blinding

The study was single blinded. The anesthetist performing neuraxial block was blinded to obtain unbiased quality of positioning score

ANESTHETIC TECHNIQUE

Preoperative

Patients posted for acetabular fracture surgery by anterior approaches in supine or lateral position were recruited one day before the day of surgery. Only patients in whom neuraxial technique was feasible were included. A thorough pre anaesthetic check-up was done. The patients were explained about the study and informed written consent was obtained. They were given standard pre-operative nil per orally

instructions and any routine medications were continued or discontinued as required. The anesthetic technique including the block procedure and neuraxial technique was explained. VAS scores for pain and Comfort VAS scores were also explained. Patients were randomized using computer generated random numbers to either receive ultrasound guided Suprainguinal Fascia Iliaca block (group B) or intravenous fentanyl (group F) to facilitate positioning for neuraxial block.

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Intraoperative

Patients were shifted to the preoperative area or Operation theatre at least 45 minutes before surgery. Standard monitoring (Pulse oximeter, Non-invasive blood pressure, ECG) was initiated after entering the operation theatre. IV access was established. Antibiotic prophylaxis was given to all patients.

SITTING ANGLE (SA):

The angle made by the patient's spine with the operating table was taken as the SA. Patient lying supine indicates SA of 0°, and a patient who sits upright will have a SA of 90°. Patients were instructed to sit as much as possible. At the best position achieved by the patient, the sitting angle (SA) was measured objectively using a goniometer.

GROUP B (Receiving ultrasound guided Suprainguinal Fascia Iliaca Block [SIFIB] to facilitate positioning):

Prior to any intervention, baseline VAS score was obtained in supine position. Patient was then asked to attempt to sit as much and as briefly as possible with help. VAS score in sitting position was obtained and degree of sitting achieved [sitting angle (SA)] was measured using a goniometer.

BLOCK TECHNIQUE:

The block was performed in supine position with the hips extended. After cleaning and draping the inguinal region, the anterior superior iliac spine was palpated. A high frequency linear ultrasound transducer was used after a sterile cover was applied to it. The probe was placed over the anterior superior iliac spine, and orientated longitudinally with the marker pointing towards the midpoint of the line joining the xiphoid process and the umbilicus. The thick hyperechoic white line of the ilium and the more superficial, dark hypoechoiciliacus muscle with the fascia iliaca covering its surface was identified. The probe was then moved infero-medially, along the line of the inguinal ligament, until a bow tie or hour glass pattern formed by three muscles were seen- the Sartorius laterally, the internal oblique medially and the iliacus posteriorly. An 8cm block needle was then introduced through the skin, parallel to the probe, in-plane (with respect to the ultrasound beam), approximately 2 cm inferior to the inguinal ligament, and then advanced through the fascia iliaca at the level of the inguinal ligament. A 'pop' was felt when the needle passed through the fascia iliaca and into the iliacus muscle. The needle was then withdrawn to the fascia and the position confirmed by injection of 1 ml of local anaesthetic, which when correctly placed, formed a lens deep to the fascia, separating the abdominal muscles anteriorly and the iliacus posteriorly. The needle was then advanced into the lens and further local anaesthetic is injected.

Through this process of hydro-dissection the needle was passed superiorly, deep to the fascia iliaca and into the iliac fossa, moving only into the space created by the distending fluid. The fluid must spread freely across the surface of the muscle, separated from the deep circumflex iliac artery by the fascia iliaca. At the end-point, the local anaesthetic passes freely superiorly, over the iliacus muscle and into the iliac fossa. A total of 30 ml of 0.25% ropivacaine was injected slowly. Imaging during the entire injection was done to confirm that the local anaesthetic was not being injected intravascularly.

A waiting period of 30 minutes was given for the block to come to effect. Once the effect was established, VAS score was obtained in supine position. Following this patient was asked to sit for neuraxial block. The best sitting angle achieved and the VAS score was again measured. After successful positioning an anesthetist blinded to the mode of analgesia given to the patient performed the neuraxial block, which was a combined spinal and epidural using a needle through needle technique. The anesthetist was asked to provide a subjective quality of patient position score, which depended on the sitting angle achieved, the ability to remain sitting with minimal movement, help from OT staff required to remain sitting, all of which would in turn depend on the analgesia received.

The quality of positioning was measured as follows:

0 - not satisfactory

1 - satisfactory

2 - good

3 – optimal

In case of failure to achieve adequate positioning due to pain or VAS score > 5, intravenous fentanyl 0.5ug/kg up to a maximum of 2ug/kg was given as rescue analgesia. When rescue analgesia failed, patient was be taken up for surgery under general anesthesia or neuraxial under lateral position was attempted.

GROUP F (Receiving intravenous fentanyl to facilitate positioning):

Baseline VAS in supine and sitting position was measured. Patient was then asked to attempt to sit as

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much as possible with support. VAS score and sitting angle in this position was measured. Following this intravenous fentanyl 1ug/kg was given. Five minutes after injection, VAS score was measured in supine position. Patient was then asked to sit for neuraxial block when VAS score ≤5 and sitting angle and VAS score was again measured. In case VAS scores where > 5 or there was failure to achieve
adequate positioning due to pain, additional boluses of intravenous fentanyl 0.5ug/kg up to a maximum of 2ug/kg was given as rescue analgesia. Following successful positioning, an anesthetist blinded to the mode of analgesia given to the patient performed neuraxial block (combined spinal and epidural) and provided a subjective quality of patient position score as mentioned above. In case rescue analgesia failed, patient was positioned lateral for neuraxial block or taken up for surgery under general anesthesia.
The choice and dose of local anesthetic administered for spinal and epidural anesthesia was the decision of the anesthetist in the operation theatre. Hemodynamic variables including heart rate, non-invasive blood pressure, and pulse oximetry were measured throughout the procedure.

Postoperative

All patients were transferred to the post anesthesia care unit, where standard monitoring was applied. Patient comfort VAS scores were obtained and total perioperative opioid consumption was measured. Any complications associated with either intervention was noted.
Patients were shifted to the ward after the PACU discharge criteria were met. Postoperative analgesia was provided either by epidural morphine 30-50ug/kg twice daily or low dose local anesthetic epidural infusion with fentanyl.

Results
A total of 30 patients were assessed for eligibility during the study period, out of which 20 patients were recruited. They were randomized to either receive suprainguinal fascia iliaca block (group B) or fentanyl (group F), with each group having 10 patients. The demographic variables- age, sex and weightwere comparable in both the groups. All patients in both groups were male. There was no significant difference in the ASA physical status of patients in both the groups.

Table 1: Demographic data of study population

Demographic profile	Group F (N=10)	Group B (N=10)	p-value
1.Age (years)^	35.7±10.7	42.5±11.1	0.18*
2.Gender(Male/Female)	10/0	10/0	1.00#
3.Weight (kg)^	60.2±7.3	65.6±10.7	0.20*
4.ASA (I/II)	(7/3)	(9/1)	0.26#

^ corresponding values in mean ± standard deviation
*Two sample t test with equal variances, #Fisher exact test

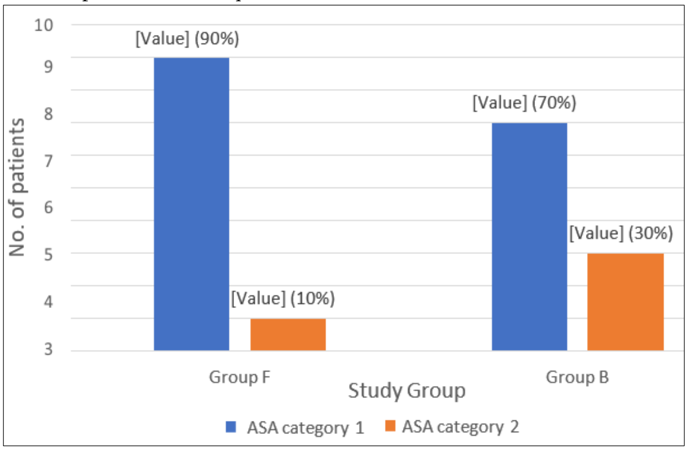

Fig1: Distribution of Patients According to ASA Category

Hemodynamic variables, i.e., Heart rate, systolic blood pressures and diastolic blood pressures were measured before and after intervention. There was no significant difference in these variables between the groups.

Table 2: Hemodynamic parameters of patients before and after intervention

Hemodynamic variables		Group F (n=10)	Group B (n=10)	p- value
Heart rate (beats per minute)	Baseline	82.4±17.0	89.6±13.0	0.30

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	After intervention	89.8±15.9	90.5±8.8	0.90
SBP (mmHg)	Baseline	131.6±7.8	131.4±12.1	0.96
	After intervention	134.1±9.0	134.4±10.7	0.92
DBP (mmHg)	Baseline	81.1±8.3	82.7±7.0	0.65
	After intervention	83±9.7	82.6±8.5	0.92

*Two sample t test with equal variances
SBP- systolic blood pressure, DBP- diastolic blood pressure

The median opioid consumption in Group F was 70(57.5-85). Opioid was used in Group B as rescue analgesia in a single patient (median consumption 0(0)). Group F had higher median opioid consumption (+70.0) in comparison to Group B (SIFIB), and the difference was statistically significant (Mann-Whitney U=0.0, df=18, $p<0.05$).
Only one patient required rescue analgesia in group B as compared to 4 patients in group F. However, there was no statistically significant association between groups of study participants and rescue bolus given ($p>0.05$).

Table 3: Fentanyl rescue bolus requirement in the study groups

		No. of Rescue boluses			p value
		0	1	2	
Group B	n	9	1	0	0.373
	% within group	90	10	0	
Group F	n	6	2	2	
	% within group	60	20	20	

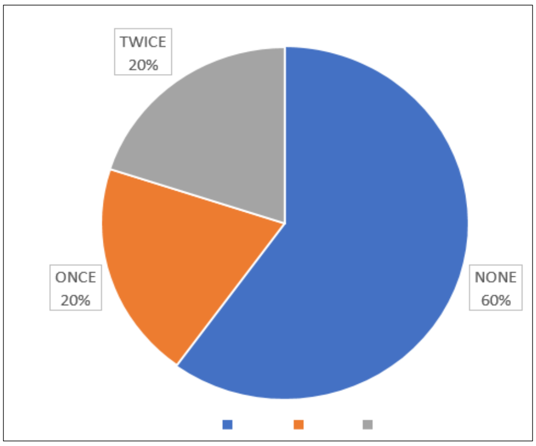

Fig2: Requirement of Rescue Analgesia in Group F

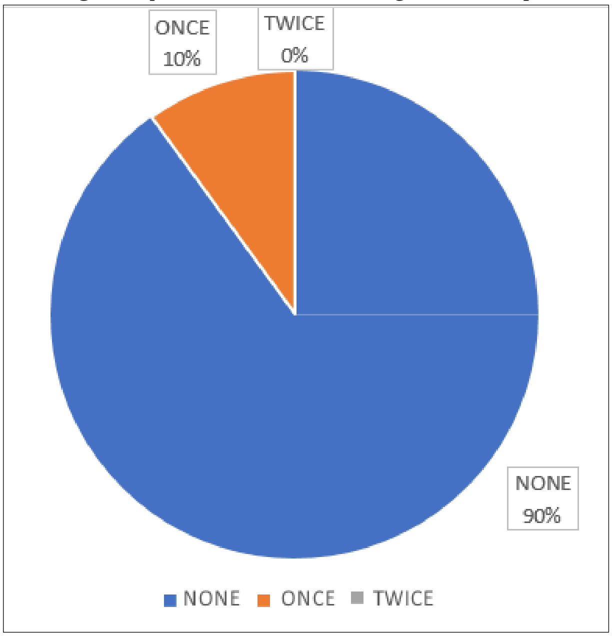

Fig3: Requirement of Rescue Analgesia In Group B

Discussion

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The intraoperative opioid consumption was also significantly lesser in group B with themedianconsumptionbeing0ascomparedtogroupFwithamedian consumption of 70(57.5-85) ug. This was expected as only one patient in group B received intraoperative opioid as a rescue bolus of fentanyl for positioning, as compared to group F in which all patients received at least 1ug/kg of fentanyl in addition to rescue boluses. In the study by Diakomi*et al*, an intravenous PCA morphine pump was used for postoperative analgesia. They reported that 94.7% of patients in fentanyl group received morphine during the first postoperative day compared with 42.9% patients (p< 0.001). Also, the time to first PCA demand bolus was also significantly lower in the fentanyl group as compared to the block group[7]. In most of these studies comparing analgesic modalities to facilitate positioning, surgery was carried out under spinal anesthesia. However, in our study, considering the length of the surgery and requirement of postoperative analgesia, the neuraxial blockade of choice was a combined spinal and epidural technique. In all patients, the epidural was activated intraoperatively to provide surgical anesthesia and a low dose epidural local anesthetic infusion was continued postoperatively. As a result, the last intraoperative epidural top up would confound the initial postoperative analgesic requirement and hence we did not assess the time to first postoperative analgesic requirement. A patient controlled epidural analgesia may have been a better postoperative choice in these patients. No complications related to block or intravenous opioids were detected in our study. Opioid related hypoventilation and desaturation was reported by Yun *et al* in their study[8]. This may be because their study group consisted largely of elderly population with femur fractures, whereas most of our study population were younger (35-45 years). Considering the volumes of local anesthetic given in the block and epidurally, there is a risk of local anesthetic systemic toxicity, however we did not encounter any in our study. We did not measure serum local anesthetic levels, however the local anesthetic dose was always calculated to ensure that safe limits were not crossed[9].

To the best of our knowledge, this is the first study assessing and comparing the use of different analgesic modalities for positioning of patients with acetabular fractures for neuraxial anesthesia. Studies by Rajashree*et al* and Diakomi*et al* have proven the efficacy of single shot FICB in providing postoperative analgesia[7,10]. This analgesic effect maybe prolongedby placing a catheter. However, being a compartment block, large volumes of local anesthetic would be needed, and when given as infusion has the risk of developing LAST.

Conclusion

The median opioid consumption in Group F was 70(57.5-85). Opioid was used in Group B as rescue analgesia in a single patient (median consumption 0(0)). Group F had higher median opioid consumption (+70.0) in comparison to Group B (SIFIB), and the difference was statistically significant.

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