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Comparison of conventional infrainguinal versus modified proximal suprainguinal approach of Fascia Iliaca Compartment Block for postoperative analgesia in Total Hip Arthroplasty. A prospective randomized study

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Abstract : Fascia Iliaca Compartment Block (FICB) has been widely used as a postoperative analgesic adjunct to opioids for total hip arthroplasty (THA), either by the conventional infrainguinal approach or the modified proximal suprainguinal approach irrespective of any specific advantage of one over the other.

This study was conducted to compare the analgesic efficacy of the two techniques of FICB for postoperative analgesia.

The 40 patients scheduled for THA were recruited for Intervention (s) and randomized to receive FICB either by suprainguinal approach (group S) or infrainguinal approach (group I) for postoperative analgesia with 40 ml of 0.2% bupivacaine, in addition to postoperative patient controlled analgesia (PCA) with morphine.

Visual analogue scale (VAS) and PCA morphine consumption was used to assess the postoperative pain at 3, 6, 12 and 24 hours. The primary outcome was cumulative PCA morphine consumption in 24 hours.

The pain intensity as measured by VAS scores showed significant reduction of intensity at 6 hours post block in group S as compared to group I (median [IQR] ; 2[0-3] ; 3[2.25-3] ; $p = 0.001$) but, there was no significant difference in VAS at 12 and 24 hours. Postoperatively, there was significant difference in time to first PCA morphine demand (356.28 ± 33.32 vs 291.48 ± 37.17, $p = < 0.001$, respectively) in-group S vs. group I. The postoperative morphine consumption was also significantly less in group S compared to group I at 6, 12 and 24 hours and the cumulative morphine consumption in 24 hours (6.95 ± 2.14 vs 10.50 ± 2.24, $p = < 0.001$ respectively) was also less.

In conclusion, in THA, suprainguinal approach of FICB has a superior postoperative analgesic efficacy compared to infrainguinal approach of FICB along with significantly less morphine consumption in first 24 hours.

Key words : Fascia iliaca block ; suprainguinal approach ; infrainguinal approach ; total hip arthroplasty ; analgesia ; morphine consumption.

Introduction

The Fascia Iliaca Compartment Block (FICB) has been used for perioperative analgesia in patients undergoing hip arthroplasty and femur fractures. The FICB has a higher rate of simultaneous block of the femoral and lateral femoral cutaneous nerve than perivascular femoral nerve block (1, 2). In the literature there are two techniques of Fascia Iliaca Compartment Block (FICB) administration has been described, a conventional infrainguinal approach by Dalens (1) and a modified suprainguinal approach by Stevens (3). The modified FICB advised by Stevens (3) has more proximal spread of local anesthetics, which is further confirmed in a cadaveric study (4). But, despite its higher spread, there has been no clinical randomized trial published in the literature, showing the superiority of modified suprainguinal approach of FICB over the infrainguinal for postoperative pain relief in total hip arthroplasty (THA). Thus, we hypothesized that modified suprainguinal approach of FICB provides better analgesia as compared to infrainguinal approach for pain relief in THA.

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We therefore undertook this prospective randomized trial to evaluate whether suprainguinal approach of FICB confers postoperative analgesic benefit over infrainguinal approach of FICB in patients undergoing total hip arthroplasty (THA).

Methods

Ethical approval of the study was taken up by the ethical committee of our institution and the trial was also registered at Clinical Trials Registry-India (CTRI) : vide reference no. CTRI/2014/02/004378 (CTRI Website URL – http://ctri.nic.in).

Forty patients of American Society of Anesthesiologists (ASA) physical status I and II aged 25 to 65 years, scheduled for THA from March 2012 to March 2013 at our tertiary healthcare center were recruited for the study. Exclusion criteria included patients on chronic analgesic therapy, allergy to local anesthetic, infection at the block site, neurological deficit in lower limbs, contraindication to subarachnoid block (SAB) and inability to comprehend visual analogue scale (VAS) score and patient controlled analgesia (PCA) device. All patients were explained about the study protocol and written informed consent was obtained from them. After a thorough pre-anesthetic checkup, all patients received oral premedication in the form of oral ranitidine (150 mg) and diazepam (10 mg) the night before and the morning of surgery.

All patients were randomized into *group S* (who received FICB by suprainguinal approach) or *group I* (who received FICB by infrainguinal approach) by a computer generated random number table method with randomized group sealed in an opaque envelope which were numbered and used sequentially.

In the operating room, standard monitoring including pulse oximeter (SpO_2), non-invasive blood pressure (NIBP), electrocardiogram (ECG) were attached and baseline haemodynamic values were noted. An intravenous access via a peripheral vein was secured. All patients in both groups received lumbar subarachnoid block with hyperbaric 0.5% bupivacaine (2.5 mL) in lateral position with surgical site being dependent. The adequacy of spinal block was checked by sensory and motor examination. Then the patients of both groups were placed in supine position and they received FICB administered by different approaches according to their allocated groups.

Group I patients received FICB by the conventional infrainguinal approach described originally by Dalens (1) "The classical landmark guided loss of resistance technique". According to this technique, the block needle was placed at a point 1 cm below the junction of middle and outer third of line joining the pubic tubercle and the anterior superior iliac spine (ASIS) and was advanced through the skin at right angle until first pop or loss of resistance was felt (while traversing fascia lata). The needle was then further advanced till second pop was felt (while traversing fascia iliaca). An assistant injected a 40 mL of solution containing 0.2% bupivacaine after a negative aspiration test while maintaining a firm compression immediately below the site of injection.

Group S patients received FICB by modified suprainguinal approach described by Stevens (3) which was also "landmark based loss of resistance technique". This technique was similar to the conventional technique described above except the point of placement of needle was 1 cm above the junction of middle and lateral third of line joining the pubic tubercle and the ASIS. Here also, the needle was advanced through the skin at right angles until first pop or loss of resistance was felt (while traversing the superficial fascia of abdominal wall). The needle was then further advanced until a second pop was felt (while traversing fascia transversalis). An assistant injected a 40 mL of solution containing 0.2% bupivacaine after a negative aspiration test

Intraoperative sedation was maintained with graded doses of Midazolam titrated to effect. Total intra operative blood loss was recorded and was replaced with adequate amount of balanced salt solutions. Any significant intra operative episode of hypotension (more than 20% of the base line) or bradycardia (less than 50 beats/minute) was recorded and treated with fluid bolus (250 ml of balanced salt solution) and injection atropine (0.3 to 0.6 mg) respectively. At the end of surgery all patients were shifted to the recovery room and standard monitoring like ECG, NIBP, SpO_2 were continued. All patients were provided with a patient controlled analgesia (PCA) morphine pump adjusted with morphine 1 mg bolus with a lock out time of 10 minutes. After 4 hours, the PCA device was readjusted for bolus and lockout interval depending on morphine consumption (4 hour limit dose of morphine was set as 12 mg and if despite of consumption of 12 mg morphine in 4 hours, if the VAS of patient would be > 3/10, it could be adjusted according to 4 hour limited dose of 20 mg Morphine by the Physician assessing post operative pain). PCA morphine consumption was assessed at 3, 6, 12 and 24 hours, where the time 0 was the start of

surgery. Postoperatively, pain scores (VAS score) at rest was assessed at 3, 6, 12 and 24 hours. All patients received routine care, including intravenous antibiotics and low molecular weight heparins as per our standard institute protocol.

The *primary outcome* of the study was 24-hour morphine consumption. *Secondary outcomes* were pain (VAS) scores and nausea or vomiting. The morphine consumption and VAS score was recorded by the nursing staff under supervision of a researcher who was unaware of the groups' allocation. The puncture site of the block was concealed using a sterile dressing in similar way in both groups. The data were recorded in a predesigned sheet for each patient attached with patient record file. However, the surgeon and the patient were unaware of the group to which patient was assigned.

Statistical analysis

Based on overall 24 hours morphine consumption in the study conducted by Stevens *et al*. (3) and assuming 20% reduction of morphine use to be of clinical significance, we required 18 patients in each group with $\alpha = 5\%$ and power of 80%. Statistical analysis was performed using STATA 12.0. The data is presented as mean (± SD) / median (inter quartile range) as appropriate. Baseline characteristics such as age, body weight, body mass index (BMI), sex distribution were compared using Chi-square test for categorical data and Student t-test for continuous variables. The intensity of pain assessed by VAS scores were compared by Mann-Whitney U test and the results are presented as median [Inter quartile range (IQR)]. Between the two groups, morphine consumption in the postoperative period was compared by t-test. The incidence of postoperative hypotension, bradycardia and opioid related other adverse effects such as urinary retention, postoperative nausea and vomiting, pruritus and respiratory depression were compared using chi square test. P value of < 0.05 was taken to be statistically significant for all data in this study.

Results

Out of 42 patients, 40 patients were enrolled for the study. Two patients did not meet the inclusion criteria. After recruitment, none of the patient was excluded and all 40 patients had completed the study and were included for study data analysis (Fig. 1). All patients had successful spinal block.

Table 1

Demographic Characteristics of Patients in Group S and Group I

Demographic variables	Group S (n = 20)	Group I (n = 20)
Age (years)	41.0 ± 15.4	45.3 ± 12.8
Weight (Kg)	59.0 ± 9.2	61.4 ± 7.8
BMI (kg/m^2)	23.3 ± 3.3	24.5 ± 3.3
Sex (male/female) (n)	14/6	11/9
Surgical time (min)	67.0 ± 9.2	73.5 ± 11.7

Data represented as mean ± SD, n : number of patients.

The patients of both the groups were comparable with regards to age, gender and body mass index (BMI) (Table 1).

Morphine consumption in postoperative period was significantly lower in-group S as compared to group I at time 6, 12 and 24 hours post block ($p < 0.05$) (Table 2). Also, cumulative 24 hour morphine consumption was significantly lower in group S as compared to group I ($p < 0.0001$) (Table 2). The first utilization of PCA morphine i.e. first analgesic demand was delayed in group S as compared to group I ($p < 0.0001$). The PCA demand frequency was significantly lower in patients of group S as compared to group I ($p < 0.05$) (Table 2). The pain intensity as measured by VAS scores showed significant reduction of intensity at 6 hours post block in group S as compared to group I ($p < 0.0001$) (Table 2). At other time intervals i.e. at 3, 12, and 24 hours, VAS scores were comparable in the two groups ($p > 0.05$) (Table 2).

Postoperative nausea and vomiting (PONV) was also significantly lower in-group S as compared to group I patients ($p < 0.05$) (Table 3). The intraoperative blood loss, fluid administration and haemodynamic parameters (heart rate and blood pressure) were comparable in the two groups ($p > 0.05$).

Discussion

We observed from our study that in THA modified suprainguinal FICB has significantly greater opioid sparing effect (i.e. requires less morphine consumption) as compared to the conventional infrainguinal FICB at 6, 12 and 24 hours for optimal analgesia in the postoperative period. The pain intensity as measured by VAS scores was significantly lower in suprainguinal FICB at 6 hours postoperatively as compared to infrainguinal FICB.

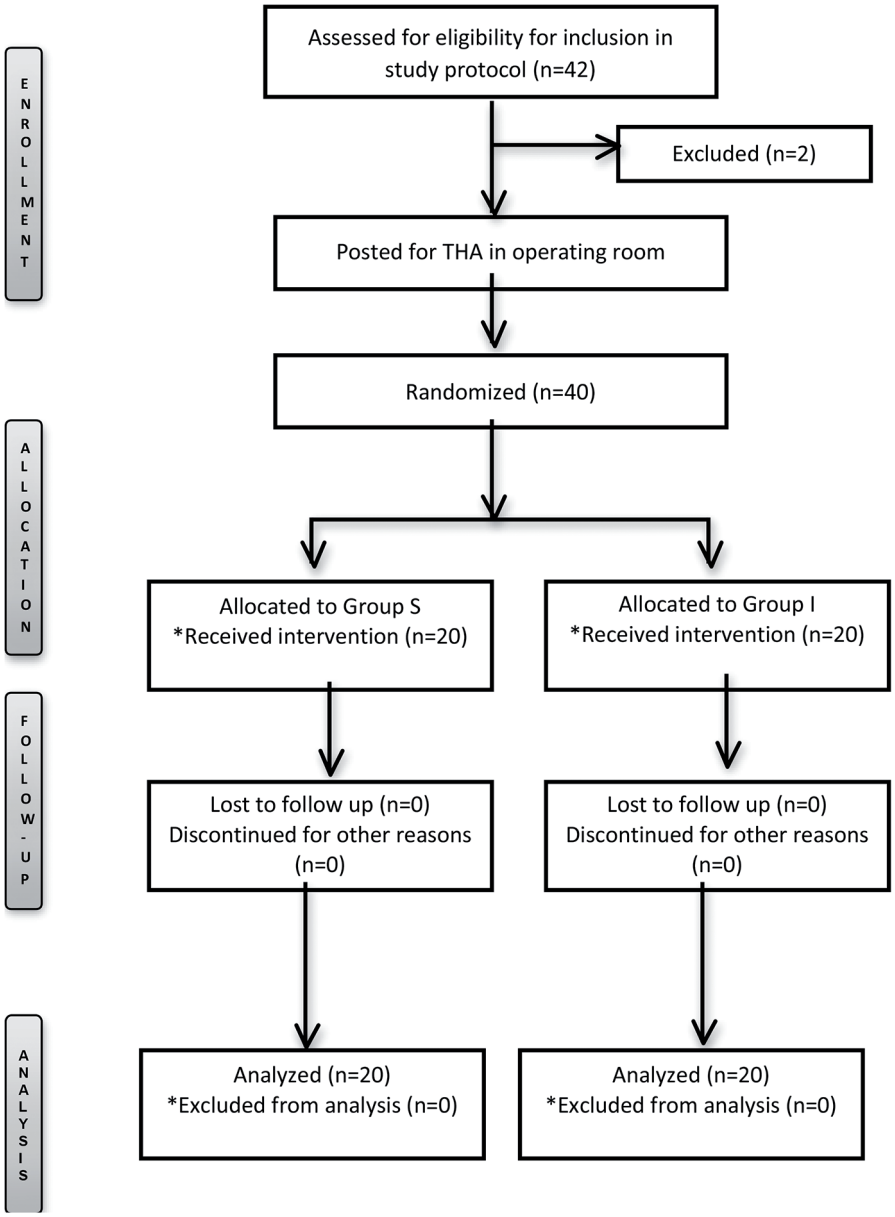

Fig. 1. — Study Protocol (Consort Flow Chart)

From our study we have also found that there is 34% more morphine sparing effect of modified FICB over conventional infrainguinal FICB. Therefore, this is in accordance with STEVENS (3) hypothesis that in suprainguinal FICB there is more cephalic spread of the local anesthetic agent and thus more effective blockage of lumbar plexus as compared to infrainguinal FICB. This spread aids in better analgesic effect of the block. The higher cephalad spread of local anesthetics by depositing the same volume above the inguinal ligament has also been substantiated by the cadaveric study by HEBBARD *et al.* (4).

Recently a study by SHARIAT *et al.* (6), concluded that FICB has no morphine sparing effect as compared to Sham block. This study seems in contrast with our study ; however on critical analyses of both studies, they happen to be complementing each other. SHARIAT *et al.* (6) performed the conventional infrainguinal FICB and ascertained the medial to lateral spread of local anesthetics instead of cephalad spread. In our study too, infrainguinal FICB has been significantly less effective than modified suprainguinal FICB. In our study, suprainguinal FICB has been shown to have 34% more morphine sparing effect than infrainguinal FICB, whilst the study

Table 2

Pain score and analgesic requirement in Group S and Group I in postoperative period

Parameters	Time (in hours)	Group S (n = 20)	Group I (n = 20)	P value
VAS score	3	0 (0-0)	0 (0-0)	1.00
	6	2 (0-3)	3 (2.25-3)	0.001
	12	2 (2-3)	2 (2-3)	0.571
	24	2 (2-2)	2 (1.25-3)	0.626
PCA demands	3	0 (0-0)	0 (0-0)	–
	6	2 (0-2)	3.5 (3-5)	< 0.0001
	12	5 (4-6)	5.5 (5-6)	0.005
	24	4 (2.25-5)	5.5 (4-6)	0.02
Morphine consumption	3	0	0	–
	6	0.95 ± 1.0	2.45 ± 1.0	< 0.0001
	12	3.10 ± 0.97	4.15 ± 0.93	0.001
	24	2.85 ± 1.18	3.90 ± 1.07	0.006
Total morphine consumption		6.95 ± 2.14	10.50 ± 2.24	< 0.0001

VAS, PCA demands represented as Median (IQR); Morphine consumption represented as mean ± SD ; n : number of patients.

by STEVENS *et al*. (3) showed suprainguinal FICB had 40% lower morphine consumption compared to sham block. Thus, the infrainguinal block has either no efficacy compared to sham block or has trivial clinical efficacy in THA.

There have been controversies about the efficacy of the conventional FICB in previous studies too. A study from Spanish literature found FICB to efficacious for up to 6 hours post block in THA but no difference in VAS scores, for the rest 24 hour period (7). Similarly, BIBOULET *et al*. (8) found femoral nerve block equivalent to placebo as opposed to psoas block in THA. They further hypothesized that the efficacy of psoas compartment block over femoral nerve block is due to higher approach to lumbar plexus. The same can be true in case of modified suprainguinal fascia iliaca compartment block in which the local anesthetics is deposited above the inguinal ligament leading to higher spread which was demonstrated by HEBBARD *et al*. (4) by injecting dye solutions in cadavers. In the contrary, MARHOFER *et al*. (8) investigated the spread of local anesthetics after a series of femoral nerve block using magnetic resonance imaging and found that there was no cephalad spread of local anesthetic which could have resulted in lumbar plexus block. The efficacy of conventional infrainguinal in THA is questionable as shown by the study by SHARIAT *et al*. (6). The bloch should be used only in knee surgeries due to absence of cephalad spread of local anesthetics.

In the present study, single shot FICB was preferred over continuous FICB due to ease of administration and simplicity and comparable opioid sparing analgesic effect of a single shot FICB. Moreover, continuous FICB causes prolonged postoperative motor block and require insertion of perineural catheters, which are expensive and require maintenance. Our study may be limited by the fact that the blocks were given by conventional landmark technique rather than ultrasound guided technique which has a better success rate. Also, the anesthesiologist performing the block couldn't be blinded. This flaw was overcome by blinding the person recording the VAS scores and employing objective means such as PCA morphine consumption to quantify postoperative pain. The other limitation is the variable effect of spinal anesthesia on postoperative analgesic requirement. For this reason the patients enrolled in this study were of similar demographic characteristics and a standard dose of 12.5 mg bupivacaine was used without any

Table 3

Incidence of adverse effects in Group S and Group I

Parameters	Group S (n = 20)	Group I (n = 20)	P value
Nausea	2 (10%)	11 (55%)	0.002
Vomiting	0 (0%)	4 (20%)	0.035
Urinary retention	6 (30%)	5 (25%)	0.723
Pruritus	0 (0%)	0 (0%)	–
Hypotension	1 (5%)	2 (10%)	0.548
Respiratory depression	0 (0%)	0 (0%)	–

Data represented n (%), n : number of patient.

adjuvants. The another limitation is that the study period is limited to 24 hours, as a single shot block was employed in the study. This was done because pain intensity is highest in the first 24 hours after surgery. Further studies with continuous blockade can help to ascertain the efficacy of these blocks for extended period in post arthroplasty.

We suggest that suprainguinal approach to fascia iliaca compartment block has a superior analgesic efficacy compared to infrainguinal fascia iliaca compartment block with significantly less morphine consumption in first 24 hours. However, further studies with more number of patients are needed to validate this point.

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