



ORIGINAL ARTICLE

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Comparison of Post-Operative Analgesia between Peng Block Versus Fascia Iliaca Compartment Block using Bupivacaine with Magnesium Sulfate in Hip Surgeries: A Randomized Controlled Study in A Tertiary Care Hospital in Mandya

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ABSTRACT

Effective control of postoperative pain is a crucial component of perioperative care in orthopedic surgeries, especially hip procedures. Inadequately treated postoperative pain can result in delayed mobilization, prolonged hospital stay, and increased morbidity. Regional anesthesia techniques provide site-specific analgesia while minimizing systemic opioid requirements. The Pericapsular Nerve Group (PENG) block and Fascia Iliaca Compartment Block (FICB) are commonly used regional techniques for hip analgesia. This study compares their efficacy when combined with bupivacaine and magnesium sulfate. A randomized controlled study was conducted on 60 patients undergoing elective hip surgery. Patients were randomly allocated into two groups: Group P (n = 30) received ultrasound-guided PENG block with 25 ml of 0.25% bupivacaine and magnesium sulfate 750 mg. Group F (n = 30) received ultrasound-guided FICB with 25 ml of 0.25% bupivacaine and magnesium sulfate 750 mg. Duration of analgesia, VAS scores, motor power, rescue analgesic requirement, and adverse effects were assessed. The duration of analgesia was significantly longer in Group P compared to Group F (P < 0.001). VAS scores were significantly lower in the PENG group after 6 hours postoperatively. Group P required fewer rescue analgesics and demonstrated better preservation of quadriceps muscle strength. Minor adverse effects such as mild hypotension and dizziness were observed but were comparable between groups. PENG block with bupivacaine and magnesium sulfate provides superior postoperative analgesia, and reduced analgesic requirement compared to FICB in patients undergoing hip surgery. Use of MgSO₄ prolonged the analgesia by 30% approximately.

Keywords : PENG block, Fascia iliaca block, hip surgery, magnesium sulfate, ultrasound-guided nerve block

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INTRODUCTION

Hip surgeries are one of the common procedures of orthopedic department done in major OT. Usually, the hip surgeries are done under subarachnoid blocks so the postoperative pain management becomes challenging. Postoperative pain management and early recovery play an important role in the functional outcome following hip surgeries [1]. Lumbar epidurals, fascia iliaca compartment blocks (FICB), and femoral blocks have been used in the past to provide postoperative analgesia. Fascia iliaca plane is the compartment containing the Femoral nerve (FN) and the lateral femoral cutaneous nerve (LFCN) between the fascia iliaca and the underlying iliacus muscle. As a result, depositing a local anesthetic agent in this compartment will give anesthesia for hip, knee, and thigh with success rate of 67-90% [2].

To enhance the quality and duration of regional blocks, many adjuvants have been used in addition to local anesthetic drugs. Although these blocks were not sufficient to give complete analgesia, they were also associated with lower extremity weakness which can interfere with the early mobility of the patients [3]. Complete analgesia cannot be achieved by these techniques because of the sparing of articular accessory nerves supplying the hip capsule [4].

Short et al. documented that the anterior hip capsule is supplied by 3 main nerves Obturator nerve (ON), Accessory obturator nerve (AON) and Femoral nerve (FN). The high articular branches from FN and AON are consistently found between anterior inferior iliac spine (AIIS) and the iliopubic eminence (IPE), whereas the ON is found close to the inferomedial acetabulum. This anatomical knowledge has led to the origin of a new interfascial plane block known as pericapsular nerve group block (PENG).⁽⁵⁾ Hence, PENG block has been used as a good alternative for postoperative analgesia following hip fracture surgeries because it blocks ON, AON, FN and also accessory articular branches which innervates the anterior hip capsule.⁽⁵⁾ Evidence further supports the presence of N-methyl-D-aspartate (NMDA) receptors in skin and

muscles⁽⁶⁾ and this has led to the use of magnesium sulphate MgSO₄ (NMDA antagonist) as an adjunct to Local Anesthetics (LA) via different routes. So far, the role of MgSO₄ as an adjuvant to LA has been studied in neuraxial route, brachial plexus block and also via transverses abdominis block.⁽⁷⁾ But data establishing its role in PENG block and FICB with respect to its efficacy, dose required and duration of analgesia is limited. PENG block has been found to cover the articular accessory branches of hip, thereby providing complete analgesia. Hence, the aim of this study is to compare the efficacy of pericapsular nerve group block (PENG) block and fascia iliaca compartment blocks (FICB) as post-operative analgesia in hip fracture surgeries.

Aims and objectives

To compare the efficacy of post-operative analgesia of PENG block versus FICB block using Bupivacaine and MgSO₄ as adjuvant for patients undergoing hip surgeries.

MATERIAL AND METHODS

A randomized controlled study was carried out at a tertiary care hospital, following approval from the institutional ethics committee and enrolment with the Clinical Trial Registry of India (CTRI/2025/12/098689).

The inclusion criteria were:

- (1) Patients undergoing elective hip surgery at Mandya Institute of Medical Sciences, Mandya.
- (2) Patients of both sexes aged between 18 to 60 years.
- (3) Patients belonging to American Society of Anesthesiologists Physical Status grade 1 and grade 2.
- (4) Patients willing to give informed consent to participate in the study.

The study's exclusion criteria were:

- (1) Patients with cardio vascular or cerebro-vascular or peripheral vascular disease.
- (2) Patients with uncontrolled diabetes mellitus or bleeding disorders or local infection at needle insertion site.
- (3) ASA III and ASA IV.
- (4) Patients allergic to local anesthetic drugs.

Sample size is calculated by using formula, based on one of the previous studies (study by Senthil, et al).

$$N = [2(Z_{\alpha/2} + Z_{\beta})^2] \sigma^2 / d^2$$

Where $Z_{\alpha/2} = 1.96$ for 95% confidence interval

$Z_{\beta} = 0.84$ for 80% power σ = standard deviation = 0.73

d = mean difference between two groups = 0.6

$$\text{So, } n = 2(1.96 + 0.84)^2 (0.73)^2 / (0.6)^2$$

$n = 24$ approximately 30 in each group

A day prior to the surgery, all the patients underwent a preanesthetic evaluation enquiring into history of previous medical or surgical illness, drug allergies and clinical examination. Relevant investigations were advised during evaluation. After confirming adequate nil per oral, patients were shifted to the operation theatre. An informed consent was taken after explaining the procedure to the patient in the language best known to them. Patients who fulfilled our inclusion and exclusion criteria were included in the study and were randomized into two groups (group P and F) using simple randomization and closed envelope method according to the computer-generated table of random numbers. Patient, observer and statistician were blinded and anesthesiologist were given envelope, revealing which block to be given after the surgery.

On arrival to the operation theatre, basal parameters- Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP) and oxygen saturation (SpO₂) using standard monitoring equipment were recorded. Venous access was established using appropriate IV cannula and preloaded with intravenous fluids before being transferred to the operating theatre, where standard monitoring equipment were connected to assess baseline vital signs. All patients were given Subarachnoid block under strict aseptic precautions as the standard anesthetic technique in sitting position with legs kept parallel to each other. The interlaminar space at L3-L4 level was identified and using 25G Quincke spinal needle, lumbar puncture was performed. After confirmation of clear, free flowing cerebrospinal fluid, 0.5% hyperbaric bupivacaine 15mg was injected. The level of sensory blockade by pinprick method and motor blockade using Modified Bromage Scale was noted; block level was achieved up to T8 dermatomal level. During the procedure, the patient's vital signs, including heart rate, non-invasive blood pressure, ECG, and SpO₂, were continuously monitored. Following the regression of spinal anesthesia from T8 to T10 in the postoperative phase PENG (Group P) and FICB (Group F) were performed.

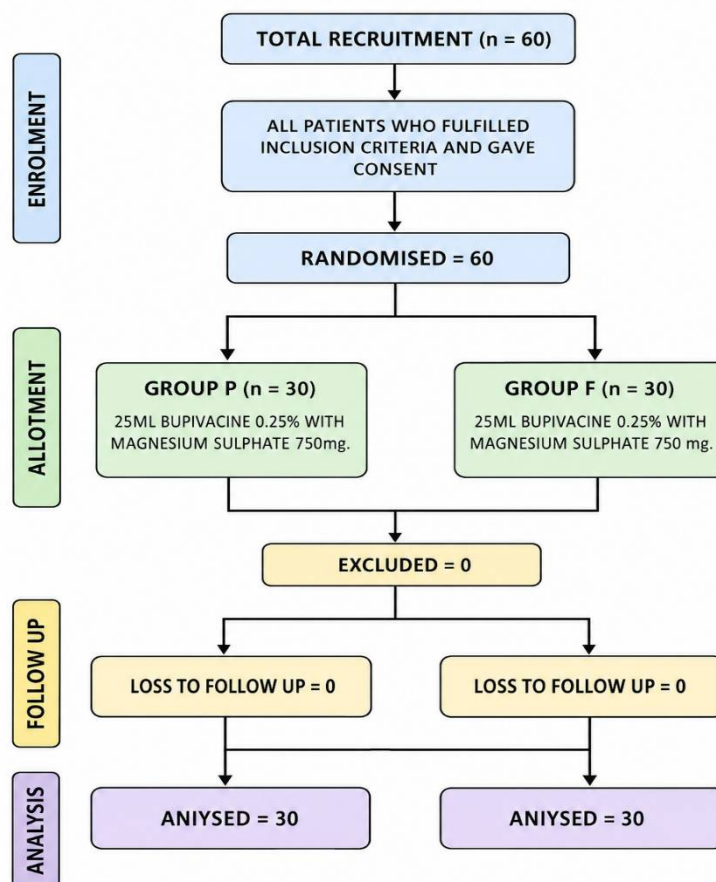
Group P patients receives PENG block under ultrasound guidance by an expert Anesthesiologist using curvilinear low-frequency ultrasound probe (2–5 MHz) (SonoSite™ M-Turbo, Bothell, WA, USA) initially placed in a transverse plane over the Anterior inferior iliac spine (AIIS) and then aligned with the pubic ramus by rotating the probe counter clockwise approximately 45 degrees to visualize the Iliopubic

Eminence (IPE), the iliopsoas muscle and tendon, the femoral artery, and pectineus muscle. A 23Gauge Quincke needle will be inserted in-plane and the needle tip is positioned in the musculofascial plane between the psoas tendon anteriorly and the pubic ramus posteriorly. 25 mL Inj. 0.25% bupivacaine with 1.5 ml Inj. MgSO₄ (750mg) will be injected in increments while observing for an adequate fluid spread in this plane.

Group F patients receive FICB block (Supra inguinal) under Ultrasound guidance using high-frequency linear transducer probe (6–13 MHz) (SonoSite™ M-Turbo, Bothell, WA, USA). Ultrasound probe will be used to identify the femoral artery at the level of the inguinal crease. Immediately lateral and deep to the femoral artery and vein the iliopsoas muscle is overlaid by a hyperechoic fascia iliaca. The femoral nerve will be seen lateral to the femoral artery wedged between the iliopsoas muscle and the fascia iliaca. Maneuvering the transducer laterally helps to visualize the sartorius muscle covered by its own fascia alongside the fascia iliaca. A line is drawn connecting the anterior superior iliac spine to the pubic tubercle, the needle tip is positioned at lateral third of the line under the fascia iliaca. 25 mL Inj. 0.25% bupivacaine with 1.5 ml Inj. MgSO₄ (750mg) will be injected until it spreads laterally toward the iliac spine and medially toward the femoral nerve.

At the end of the procedure, after giving the nerve block the patient is assessed for postoperative pain. All patients will be observed for vital parameters such as Heart rate (HR), Systolic blood pressure (SBP), Diastolic blood pressure (DBP), Mean arterial pressure (MAP), Peripheral oxygen saturation (SPO₂). VAS score for pain intensity, MRC scale for quadriceps muscle strength, Time of request for rescue analgesia (VAS ≥ 4) and perfusion index will also be recorded. Intravenous Inj. Paracetamol 1GM will be considered as rescue analgesic agent and repeated again if vas ≥ 4 . All patients will be monitored with above mentioned parameters at an interval of 2 minutes for first 10 minutes and every 5 minutes for first half an hour followed by every 4hrs up to 12hrs and then every 6hrs till 36hrs of postoperative duration.

Figure 1: CONSORT FLOW DIAGRAM



Statistical analysis

All data were entered in the Microsoft Excel sheet and analysed using the trial version of SPSS (Statistical Package for the Social Science) software. Continuous data were expressed as mean $\pm$ standard deviation, while categorical data were shown as absolute counts. To compare demographic information, analgesia

duration, heart rate (HR), and mean arterial pressure (MAP) between groups student t test was used and Shapiro-Wilk test for data distribution. For categorical data (gender and ASA) Fischer's test was used. Descriptive statistics utilized frequencies and proportions. A p-value of less than 0.05 was deemed statistically significant.

RESULTS

60 patients were studied in the two groups, 30 in each group. The demographic characters (age, gender) and ASA class were statistically similar in the two groups ($P > 0.05$)

TABLE 1: Comparative Demographic Data of Study Population

Parameter	Group		Std. Deviation
	Group P (n=30)	Group F (n=30)	
Age (in years)	56.23	57.3	2.43
Gender (Female/Male)	12/18	20/10	0.069
ASA I/II (n)	19/11	22/8	0.58

SD=Standard deviation n= number of patients p value <0.05 – significant

The age, gender and ASA distribution across the groups were not statistically significant.

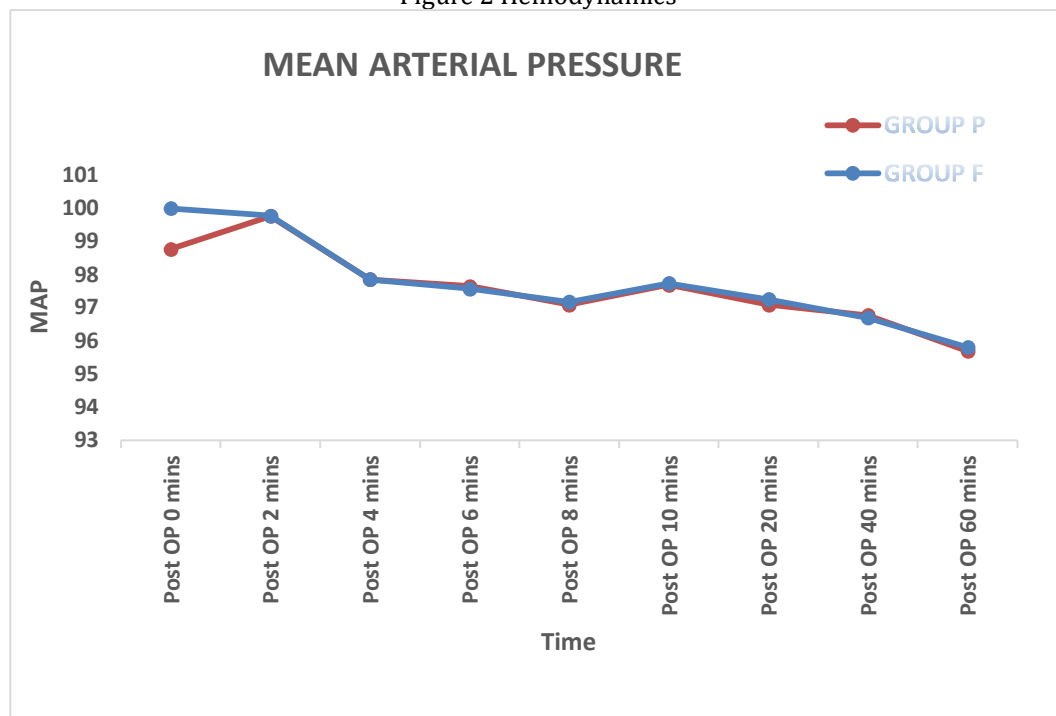
Table 2: Comparative Data on Outcomes of The Block

Parameter	Group		p value
	Group P (n=30)	Group F (n=30)	
Duration Of Analgesia in hours (SD)	18.2±3.2	13.6±2.9	<0.0001
Total Amount Of Rescue Analgesia Required (g)	0.7±0.3	2.3±0.4	<0.0001

SD=standard deviation n=number of patients p value <0.05 – significant, <0.0001 highly significant

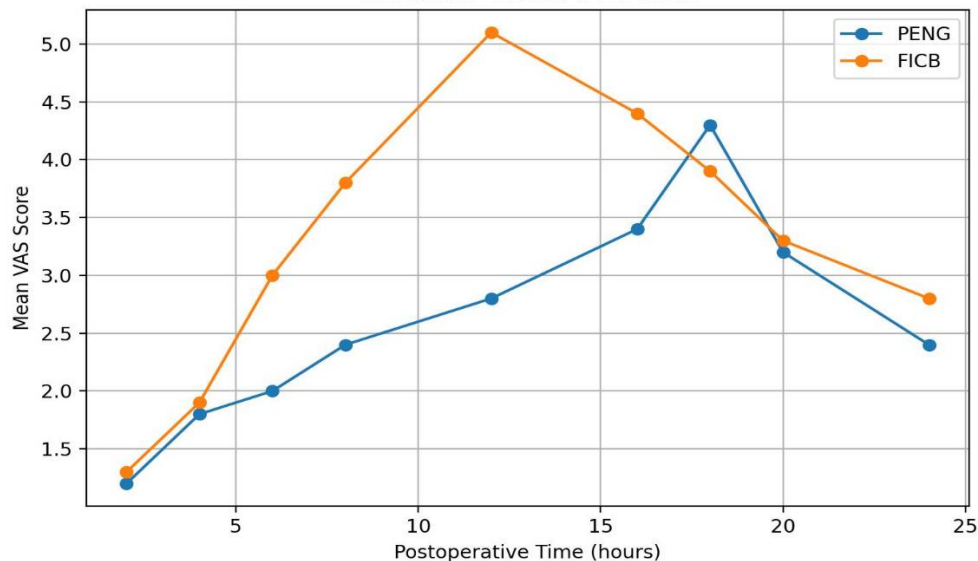
The duration of analgesia was significantly higher in Group P (18.20 ± 3.2) as compared to Group F (13.6 ± 2.9) ($P < 0.0001$). The total amount of rescue analgesia is the number of doses of Paracetamol (IV) 1 gram required to control the pain ,which was found to be greater in Group F than Group P ($P < 0.0001$).

Figure 2 Hemodynamics



The mean arterial pressure between the two groups were comparable in postoperative period.

Figure 3: Vas Trends
VAS Score Trends Over Time



At 2 hrs and 4 hrs, the difference in pain scores was not statistically significant ($P = 0.083$ and $P = 0.174$), suggesting similar early analgesic efficacy. However, at 6 hrs and beyond, PENG showed significantly lower VAS scores ($P < 0.05$), reflecting sustained pain relief due to denser block onset.

DISCUSSION

Hip fractures are the commonest reason for older people to require emergency surgery, and are the type of fracture most likely to require hospital admission, and account for more orthopedic trauma bed days than all other fractures combined [11]. Post operative pain management is a critical aspect of recovery, particularly for patients undergoing hip surgeries, where effective analgesia can significantly enhance patient outcomes. Peripheral nerve blocks seem to provide better effective analgesia than standard systemic analgesia in such patients [12]. Our research objective is to compare the efficacy and early mobilization in post-operative analgesia of PENG block versus FICB block under USG with 25 ml of 0.25% Bupivacaine with 750 mg MgSO₄ for patients undergoing hip surgeries.

Study tracks how well patients maintain while reporting less pain and improved muscle control plus faster recovery of mobility. Different studies had found the good efficacy results compared between PENG and FICB block in which PENG block improved the functional recovery stage [13].

To enhance the quality and duration of regional blocks, many adjuvants have been used in addition to local anesthetic drugs. Evidence further supports the presence of N methyl-D- aspartate (NMDA) receptors in skin and muscles and this has led to the use of magnesium sulphate MgSO₄ (NMDA antagonist) as an adjunct to Local Anesthesia (LA) via different routes. So far, the role of MgSO₄ as an adjuvant to LA has been studied in neuraxial route, brachial plexus block and also via transverses abdominis block [7].

The study by Natrajan et al. [8], have demonstrated that the PENG block provides superior postoperative analgesia with a lower Numeric Rating Scale (NRS) for pain. However, this study had a limited sample size, often involving fewer than 25 patients, which raises concerns about the generalizability of their findings. Due to the small sample sizes, the need for larger comparative studies has been emphasized to more accurately validate the efficacy of these techniques. In contrast, our study included a larger cohort, with more than 25 patients in each group, allowing for a more robust comparison. The results of our study showed significant improvement in postoperative pain relief in the PENG block group compared to the FICB group, further supporting its potential as a more effective analgesic approach.

For duration pf analgesia

Our study demonstrated that duration of analgesia in PENG group (18hrs) was significantly longer than that of FICB group (13hrs).

In contrast to our study, Shankar et al [14] observed that both PENG block group and FIB group had prolonged duration of analgesia 490 ± 40.8 minutes in PENG group and 470 ± 40.48 minutes in FICB group, But the difference was not significant. Raddaoui et al [8] observed that PENG block and FICB provided a similar duration (9.9 h in PENG block vs. 10.32 h in FICB). In Jadan et al [15], duration was not significantly

different between the FICB and PENG groups (the mean in FICB was 11.8 hours and 11.21 hours in PENG) ($P = 0.524$).

The difference between our study and others can be reasoned out by the volume of Bupivacaine and MgSO₄ has adjuvant used. The other factors that could have made a difference was the skill of operator and availability of high-quality ultrasound probe. Various studies have also mentioned about the learning curve for PENG block. As in our study, PENG block was performed by the senior anaesthesiologist well versed with PENG block, significant quality and duration of analgesia has been accounted for.

Our study noted that PENG group received lesser doses of rescue analgesia (inj. paracetamol 1gm iv) requirement in first 24 hrs than FICB group (inj paracetamol 2gm iv). Similar to our study, Pascarella et al [16], demonstrated that the PENG block reduced opioid consumption, during postoperative 48 h significantly. Reddy et al, study also demonstrated that fentanyl consumption in 24 hours was higher in group FICB group (300 ± 20 mcg) than group PENG (200 ± 10 mcg). Mosaffa et al [17] observed that the first time of the analgesic consumption after surgery was significantly longer in the PENG block compared with the FICB ($p = 0.007$) and the total dose of morphine consumption during 24 hours significantly reduced in the PENG block compared with the FICB group ($p = 0.008$).

Role of Magnesium Sulphate

Magnesium sulfate acts as an NMDA receptor antagonist and calcium channel blocker, reducing central sensitization and enhancing analgesic duration [7]. The higher dose used in this study (750 mg) may have contributed to prolonged analgesia without increasing adverse effects, though further studies are needed to establish the optimal dose and long-term safety.

LIMITATIONS

Small Sample Size: The study is based on only 60 patients at a single centre, which may limit the generalizability of the findings. Future studies with larger cohorts and pharmacokinetic correlation are needed to determine optimal dosing strategies and confirm the long-term safety of these drugs.

In the present study, the observation was only for the first 24 h postoperatively and not beyond. We did not document and compare the hemodynamics postoperatively.

Subjective Pain Assessment: The use of Visual Analog Scale (VAS) scores for pain assessment is subjective and may vary based on individual patient perceptions. This could affect the consistency of reported outcomes.

Patient Variability: Differences in patient demographics, comorbidities, or concurrent medications might confound results. These factors should ideally be controlled or stratified in future studies.

CONCLUSION

This study demonstrates that PENG block with bupivacaine and magnesium sulfate provides superior postoperative analgesia, reduces opioid requirements, and has a favorable safety profile compared to FICB in hip surgeries. These findings support the use of PENG block as a preferred regional analgesic technique for hip surgery. Use of MgSO₄ has increased the duration of analgesia by approximately 33-40%.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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