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Comparison of Pericapsular Nerve Group Block (PENG) Versus Fascia Iliaca Compartment Block (FICB) as Postoperative Pain Management in Hip Fracture Surgeries

Madatala Dakshinya Reddy[1], Sai Santhoshi Mounika P[1], Balli Sahithi[1], Mir Ahmeduddin Ali Khan[2]

[1]Post Graduate, Department of Anaesthesiology, Kamineni Academy of Medical Sciences and Research Centre, LB nagar, Hyderabad, Telangana, India.
[2]Associate Professor, Department of Anaesthesiology, Kamineni Academy of Medical Sciences and Research Centre, LB nagar, Hyderabad, Telangana, India.

Abstract

Background: Postoperative pain management promotes early ambulation and well-being, shortening hospital stays. PENG block is used to manage hip surgery patients' postoperative discomfort. This study compared PENG with FICB for post-op pain management. Total fentanyl consumption in 24 hrs, VAS pain score at 2,6,10,14,18,24 hrs postoperatively, Quadriceps femoris muscle strength at 2,6,10,14,18,24 hrs postoperatively.

Material and Methods:A randomized prospective comparative study was performed at Kamineni Academy of Medical Sciences and Research Centre Lb Nagar, Hyderabad, Telangana, India. in 40 patients aged >18 years and ASA 1& 2 groups, scheduled to undergo hip surgeries.patients were randomly allocated into two groups into P group who received PENG block and F group who received FICB. 30 ml of 0.25% Bupivacaine and 4 mg of Dexamethasone was given for both the groups in the nerve block. Outcomes measured were total fentanyl consumption in 24 hours , VAS score @ 2,6,10,14,18,24 hours postoperatively and quadriceps muscle muscle strength @2,6,10,14,18,24, hours postoperatively.

Results: There was significant difference in VAS scores and motor power which indicated the potency of sensory blockade and motor sparing seen with PENG block. Also, total fentanyl consumption in 24 hours was less in group P.**Conclusion:**Findings of this study suggest that PENG Block is superior postoperative analgesic modality to FICB in hip surgeries.

Keywords: Pericapsular Nerve Group Block (PENG), Fascia Iliaca Compartment Block (FICB), hip fracture surgery.

Corresponding Author: Dr. Dakshinya Reddy, Post Graduate, Department of Anaesthesiology, Kamineni Academy of Medical Sciences and Research Centre, LB nagar, Hyderabad, Telangana, India. Email: dakshinya.reddy115@gmail.com.

Introduction

The lower limb joins the pelvic girdle at the hip joint. This girdle is formed by the two hip bones which join anteriorly at the pubic symphysis and posteriorly with the sacrum at the sacroiliac joints.The nerves of the lower limb are derived from lumbar plexus of nerves (L1 – L4) within the posterior abdominal wall and sacral plexus of nerves (L4 – S4) in the posterior pelvic wall. The nerves of the lower limb are: femoral, obturator, sciatic, tibial, and common peroneal nerves

1. Femoral nerve: It is present on the front of the thigh and innervates the anterior thigh muscles.
2. Obturator nerve: It is present on the medial side of the thigh and innervates the adductors of the thigh.

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3. Sciatic nerve (largest and thickest nerve in the body): It is present in the gluteal region and the back of the thigh. It supplies muscles on the back of the thigh. In the lower part of the back of thigh, it divides into tibial and common peroneal nerves.
4. Tibial nerve: It is present on the back of the leg and supplies all the muscles on the back of the leg. At the ankle, behind medial malleolus, it divides into medial and lateral plantar nerves, which together supply all the muscles of the sole.
5. Common peroneal nerve: At the lateral side of the neck of fibula, it divides into the deep and superficial peroneal nerves. The deep peroneal nerve is present in the anterior compartment of the leg and supplies all the anterior leg

Conventionally Hip surgeries are done under sub arachnoid block, so postoperative pain management becomes challenging.Lumbar epidural,fascia iliaca compartment and femoral nerve blocks used in the past –were not sufficient to provide complete analgesia (as there was sparing of articular accessory nerves) and were also associated with lower extremity weakness.

Pericapsular nerve group block –is a novel regional anesthetic technique. With one injection, this technique blocks the nerves supplying anterior capsule of the hip –namely the obturator nerve, the accessory obturator nerve and the articular branches of the femoral nerve.

Material and Methods

After institutional ethical committee clearance and obtaining consent, 40 patients of age group 18 years and older, ASA I and II scheduled for hip fracture surgeries were selected,randomly allocated into 2 groups generated by computer generated random allocation at Kamineni Academy of Medical Sciences and Research Centre Lb Nagar, Hyderabad, Telangana, India.

Exclusion criteria

Patients with coagulopathy, infection at injection site, allergy to local anesthetics, severe cardiopulmonary disease, inability to comprehend visual analogue score (VAS)

Procedure

Patients after being shifted to OT, connecting to monitors, spinal anesthesia was performed in sitting position. Level of blockade assessed after 5 min. Once adequate level was achieved, surgery initiated. Intraoperatively patients hemodynamics were monitored. Intravenous fluids were administered according to patients requirement. After completion of surgery, anesthetist not involved in the study performed nerve blocks.

Pericapsular nerve group block: transducer placed over anterior inferior iliac spine moved inferiorly to visualise pubic ramus.

Femoral artery, ilio-pubic eminence were visualised. Using in-plane technique, needle ,30ml 0.25% bupivacaine +4mg dexamethasone deposited between psoas tendon and superior pubic ramus.

Fascia iliaca block:probe placed perpendicular to inguinal ligament.

Then moved laterally until sartorius was identified.Needle passed through fascia iliaca(a pop is felt)and 30ml 0.25% bupivacaine +4mg dexamethasone deposited just below fascia iliaca.

After performing the nerve block patients were shifted to the post anaesthesia care unit and monitored for 24 hours.

The following outcomes were measured:

1. Total fentanyl consumption in 24 hrs.
2. Visual analogue pain score at 2,6,10,14,18,24 hrs postoperatively.
3. Quadriceps femoris muscle strength at 2,6,10,14,18,24 hrs postoperatively.

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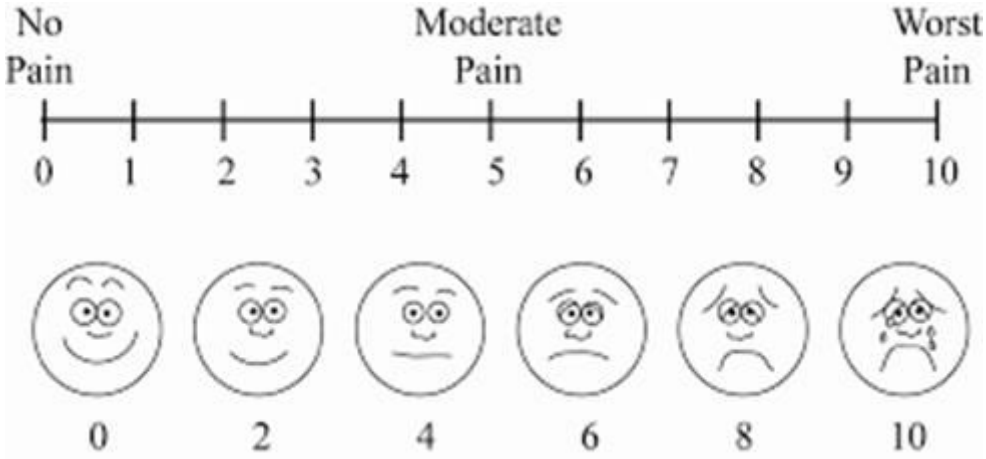
Visual analogue score and motor power were assessed as follows:



Grade	Muscle Power
0 - Zero	No muscle contraction is seen
1 - Trace	Flicker or Trace of contraction is seen
2 - Poor	Active movement only with gravity eliminated
3 - Fair	Active movement against gravity but not resistance
4 - Good	Active movement against gravity with some resistance
5 - Normal	Active movement against gravity with full resistance

Statistical analysis

Sample size for each group to achieve (alpha-0.05, power-80%), by calculating mean and standard deviation of primary outcome was 12.

Hence fixed sample size as 20.

Analysis done using statistical package of social sciences. Students t-test was applied for interpretation of results and $p<=0.05$ was considered statistically significant.

All the outcome measures were depicted as mean and standard deviation.

RESULTS

Table 1: Comparision of demographic data

Variables	**Group P (n=20)**	**Group F(n=20)**
Age	43.9 ± 8.5	49.6±6.8
Sex		
Male	14	12
Female	06	08
ASA		
I	07	09
II	13	11

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ASA = American Society of Anaesthesiologists

[Table 1] shows the demographic data of the study population which includes age, sex, ASA, type of surgery among two groups
In group P mean age of the study population was 43.9 ± 8.5 yrs while that in group F was 49.6±6.8 yrs.
In group P majority were males (14) followed by females (06). Similarly in group F majority were males (12) followed by 08 females.
In group P 7 patients belonged to ASA I group while 13 patients belonged to ASA II.

Table 2: Comparison of total fentanyl consumption in 24 hours between two groups

	Group Pmean±SD	Group Fmean±SD	P value
Total fentanyl consumption in 24 hours (in mcg)	200 ± 10	300 ± 20	< 0.0001

[Table 2] demonstrates the comparison of fentanyl consumption in 24 hours in two groups which was higher in group F (300 ± 20 mcg) than group P(200 ± 10mcg). the p value obtained was < 0.0001 which was statistically significant.

Table 3: Comparison of VAS scores between two groups.

VAS score	Group Pmean±SD	Group Fmean±SD	P value
2 HRS	0.6 ± 1.28	1.05 ± 1.35	0.286
6 HRS	1.85±0.98	1.90±1.15	0.883
10 HRS	1.92±0.80	3.0±1.10	0.001
14 HRS	1.60±0.75	2.1±0.67	0.032
18 HRS	1.3±0.76	2.0±0.68	0.003
24 HRS	1.4±0.57	2.1± 0.67	0.001

The above table demonstrates comparision of VAS scores @2,6,10,14,18,24 hours post operatively.
There was significant difference between two groups from 10th hour postoperatively showing lesser VAS scores in group P than group F.(P value < 0.05)

Table 4: Comparison of motor power between two groups

Motor Power	Group P mean±SD	Group F mean±SD	P Value
2 HRS	2.5±0.71	2.02±0.92	0.072
6 HRS	3.65±1.09	3.01±1.30	0.099
10 HRS	3.80±1.02	3.35±1.23	0.215
14 HRS	4.20±0.87	3.40±0.99	0.009
18 HRS	4.86±0.36	4.25±0.91	0.008
24 HRS	5.0±0.33	4.60±0.59	0.011

The above table demonstrates comparison of motor power grade @2,6,10,14,18,24 hours post operatively.
There was significant difference between two groups from 14th hour postoperatively showing better motor power in group P than group F(P value < 0.05).

DISCUSSION

Anterior capsule, which contains majority of the sensory innervation of the joint is the main source for postoperative pain. Anterior capsule is supplied by articular branches of femoral, obturator and accessory obturator nerves. Posterior capsule is supplied by nerve to quadratus femoris, small articular branches from sciatic nerve, superior gluteal nerves. The hip capsule

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is divided into 2 parts: anterior and posterior, with nociceptive fibers mostly present on the anterior part while the posterior part has mechanoreceptors.[1]

Short et al. performed an anatomical study and demonstrated that high articular branches of both the femoral and obturator nerves (and accessory obturator nerve) provide innervation to the anterior hip capsule since the anterior hip capsule receives the major sensory innervation.

The relationship of the articular branches from these three nerves to the inferomedial acetabulum and the space between the anterior inferior iliac spine and iliopubic eminence may indicate potential sites for regional analgesia.[2]

The inference is that the deposition of local anesthetics in the fascial plane between the psoas muscle and the upper pubic branch will contribute to anesthesia of articular branches of femoral, obturator nerves and accessory obturator nerves and, therefore, to analgesic coverage for hip surgery.

Therefore,Pericapsular nerve group block is more appropriate method of postoperative analgesia for hip surgeries. Wojciech Gola et al studied the Effectiveness of Fascia Iliaca Compartment Block after Elective Total Hip Replacement: A Prospective, Randomized, Controlled Study .The following parameters were recorded in the post-anesthesia care unit (PACU) and in the first 48 h: heart rate (HR/bpm); systolic Blood Pressure (SBP/mmHg); diastolic blood pressure (DBP/mmHg;); mean arterial pressure (MAP/mmHg) measured non-invasively at 4-h intervals; NRS pain severity at 4, 8, 12, 24, and 48 h both at rest and during rehabilitation; time to first analgesic intervention; oxycodone consumption within 48 h; and found that compared to intravenous multimodal analgesia, supra-inguinal fascia iliaca compartment block (S-FICB) is an effective form of analgesia for elective posterolateral total hip replacement.[3]

In a retrospective study that compared the analgesic effect of combining PENG block to infiltration of a local anesthetic after primary total Hip arthroplasty, the authors (Kiran Mysore MD et al.) identified 123 patients who met the inclusion criteria; 47 received and 76 did not receive PENG block. The result was that the PENG block was associated with a reduction in 24-hour hydromorphone consumption.

Following Girón et al.'s publication, which was the first author to discover this block, Ueshima and Otake documented their clinical experience using the PENG technique in four patients for the management of perioperative pain after reduction of hip dislocation and hip replacement; they concluded that in their successful experience, the PENG block technique could cover both the femoral and obturator nerves and could be used as a appropriate analgesic method for hip surgery.[4]

Our study demonstrated that fentanyl consumption in 24 hours was higher in group F (300 ± 20 mcg) than group P(200 ± 10mcg).

As high sensory articular branches of the femoral nerve which play a greater role in the innervation of the anterior hip capsule are blocked by pericapsular nerve group and not by fascia iliaca compartment block(FICB) ,the sensory blockade was more in PENG group with motor sparing effect as demonstrated by lesser VAS scores in group P than group F and better motor power in group P than group F.[5,6]

CONCLUSION

The findings of this study suggest that pericapsular nerve group block is a better analgesic modality than fascia iliaca compartment block in patients undergoing hip surgeries and also has motor sparing effect which promotes early ambulation and recovery.

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