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Original Research Article

Evaluation of the Efficacy of 0.2% Ropivacaine Combined with Dexamethasone versus Fentanyl in Pericapsular Nerve Group (PENG) Block for Postoperative Analgesia in Hip Surgery Patients

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Conflict of interest: Nil

Abstract:

Background: The Pericapsular Nerve Group (PENG) block is a novel regional anesthesia technique gaining popularity for providing effective postoperative analgesia in patients undergoing hip surgeries. This study compares the efficacy of 0.2% ropivacaine combined with dexamethasone versus fentanyl when used in PENG blocks.

Objective: To evaluate and compare the analgesic duration, pain scores, and rescue analgesia requirements between two groups: 0.2% ropivacaine with dexamethasone and 0.2% ropivacaine with fentanyl in patients receiving PENG block for hip surgery.

Methods: A prospective, randomized, double-blinded comparative study was conducted at the Department of Anesthesiology, Netaji Subhas Medical College and Hospital, Bihta, Patna, from Dec 2022 to Jan 2023. A total of 120 patients undergoing elective hip surgeries were included and randomly assigned into two equal groups. Group D received 0.2% ropivacaine (20 ml) with 8 mg dexamethasone, while Group F received 0.2% ropivacaine (20 ml) with 50 µg fentanyl. The primary outcome measured was duration of analgesia; secondary outcomes included pain scores (VAS), rescue analgesia requirement, and any adverse effects.

Results: Group D showed significantly prolonged duration of analgesia compared to Group F. Mean VAS scores were lower in Group D at 6, 12, and 24 hours postoperatively. Rescue analgesia requirement was less frequent in Group D, and no major complications were observed in either group.

Conclusion: The addition of dexamethasone to 0.2% ropivacaine in PENG block offers superior and longer-lasting analgesia compared to fentanyl, with reduced need for postoperative analgesics and comparable safety profile.

Keywords: PENG Block, Ropivacaine, Dexamethasone, Fentanyl, Regional Anesthesia, Hip Surgery, Postoperative Pain, Analgesia Duration.

Introduction

Postoperative pain management in hip surgeries poses a significant clinical challenge, especially in elderly patients who are more prone to complications arising from systemic analgesics. Regional anesthesia techniques have revolutionized pain control strategies by minimizing opioid use, enhancing patient recovery, and reducing hospital stay durations [1]. Among these, the Pericapsular Nerve Group (PENG) block has emerged as a promising technique, offering targeted analgesia for hip joint procedures while preserving motor function.

The PENG block, introduced in recent years, targets the articular branches of the femoral nerve, obturator nerve, and accessory obturator nerve that innervate the anterior capsule of the hip joint [2]. Its utility has expanded rapidly owing to its simplicity, effectiveness, and reduced risk of complications compared to traditional nerve blocks. However, the choice of adjuvants combined with local anesthetics in PENG blocks remains a subject of ongoing clinical exploration [3].

Ropivacaine, a long-acting amide local anesthetic, is widely used for peripheral nerve blocks due to its favorable safety profile and differential sensory-

motor blockade. To further enhance and prolong the analgesic effect, various adjuvants are often added to ropivacaine [4]. Dexamethasone, a potent corticosteroid, has anti-inflammatory and analgesic properties, believed to prolong nerve block duration by modulating nociceptive pathways and reducing local inflammation. On the other hand, fentanyl, a synthetic opioid, is also used as an adjuvant for its rapid onset and strong analgesic effect, though its duration may be relatively shorter and associated with opioid-related side effects [5].

There is limited literature directly comparing the efficacy of dexamethasone versus fentanyl when combined with ropivacaine in PENG blocks. Understanding which adjuvant provides more effective and prolonged analgesia with fewer side effects could significantly enhance postoperative care in hip surgeries. This study was undertaken to compare the duration and quality of analgesia provided by 0.2% ropivacaine with dexamethasone versus 0.2% ropivacaine with fentanyl when used in PENG blocks in patients undergoing hip surgery.

By evaluating pain scores, duration of analgesia, rescue analgesia requirements, and incidence of adverse effects, this study aims to provide evidence that can guide anesthesiologists in choosing the optimal adjuvant for improved patient outcomes.

Methods

This prospective, randomized, double-blind comparative study was conducted in the Department of Anesthesiology at Netaji Subhas Medical College and Hospital, Amhara, Bihta, Patna, Bihar, from Dec 2022 to Jan 2023. A total of 120 patients scheduled for elective hip surgeries under spinal anesthesia were enrolled. The inclusion criteria comprised patients aged 40–80 years, of ASA physical status I–III, undergoing hip arthroplasty or internal fixation. Patients with known allergy to study drugs, local infection at the block site, coagulopathy, neurological disorders, or those on chronic pain medication were excluded.

Participants were randomly divided into two groups using computer-generated randomization. Group D received a PENG block with 20 ml of 0.2% ropivacaine mixed with 8 mg (2 ml) dexamethasone, while Group F received a PENG block with 20 ml of 0.2% ropivacaine mixed with 50 µg (1 ml) fentanyl. Both groups received a total volume of 22 ml solution. The PENG block was administered under ultrasound guidance in the preoperative holding area by an experienced anesthesiologist unaware of group allocation. The patient was placed supine with a low-frequency curvilinear probe positioned medial to the anterior superior iliac spine to identify the iliopubic eminence, psoas tendon, and femoral artery. A 22G, 100 mm nerve block needle was advanced in-plane from lateral to medial, and the drug mixture was deposited between the psoas tendon and the pubic ramus.

Spinal anesthesia was administered 20–30 minutes after the PENG block using 0.5% hyperbaric bupivacaine. Postoperative pain was assessed using a 10-point Visual Analogue Scale (VAS) at 1, 2, 4, 6, 12, and 24 hours. The duration of analgesia was defined as the time from block administration to the first demand for rescue analgesia (intravenous paracetamol 1g). The total number of rescue analgesic doses within 24 hours was also recorded.

Patients were monitored for adverse events such as nausea, vomiting, sedation, pruritus, and respiratory depression. Hemodynamic parameters were monitored perioperatively and postoperatively. Data was collected and statistically analyzed using appropriate tests (Chi-square for categorical data and unpaired t-test for continuous variables), with a p-value of <0.05 considered statistically significant.

Results

This study included 120 patients undergoing hip surgery, divided equally into two groups: Group D (Ropivacaine + Dexamethasone) and Group F (Ropivacaine + Fentanyl). The baseline demographic characteristics were comparable between both groups. Group D demonstrated a significantly longer duration of analgesia, lower VAS scores at multiple time points, and reduced need for rescue analgesics compared to Group F. No major adverse effects were observed in either group.

Table 1: Age distribution among patients in Group D and Group F

Age Group (years)	Group D (n=60)	Group F (n=60)
40–49	14 (23.3%)	13 (21.7%)
50–59	22 (36.7%)	20 (33.3%)
60–69	18 (30.0%)	21 (35.0%)
≥70	6 (10.0%)	6 (10.0%)
Mean ± SD	56.1 ± 8.3	56.6 ± 8.6

Table 2: Gender distribution of patients

Gender	Group D (n=60)	Group F (n=60)
Male	34 (56.7%)	32 (53.3%)
Female	26 (43.3%)	28 (46.7%)

Table 3: ASA physical status of patients

ASA Grade	Group D (n=60)	Group F (n=60)
I	12 (20.0%)	13 (21.7%)
II	38 (63.3%)	36 (60.0%)
III	10 (16.7%)	11 (18.3%)

Table 4: Body Mass Index (BMI) distribution

BMI Category (kg/m²)	Group D (n=60)	Group F (n=60)
<18.5 (Underweight)	5 (8.3%)	6 (10.0%)
18.5–24.9 (Normal)	34 (56.7%)	32 (53.3%)
25–29.9 (Overweight)	18 (30.0%)	17 (28.3%)
≥30 (Obese)	3 (5.0%)	5 (8.3%)
Mean ± SD	23.6 ± 3.4	24.1 ± 3.7

Table 5: Duration of analgesia (minutes)

Parameter	Group D (n=60)	Group F (n=60)
Mean Duration ± SD	678 ± 54	472 ± 46
Range (min–max)	580–760	390–560
p-value	<0.001	

Table 6: Postoperative VAS scores at various intervals

Time (hours)	Group D (Mean ± SD)	Group F (Mean ± SD)	p-value
1	1.1 ± 0.5	1.3 ± 0.6	0.08
2	1.5 ± 0.6	2.0 ± 0.7	0.01
4	2.2 ± 0.7	3.3 ± 0.8	<0.001
6	2.9 ± 0.8	4.1 ± 0.9	<0.001
12	3.3 ± 0.9	4.5 ± 1.0	<0.001
24	2.1 ± 0.6	3.1 ± 0.7	<0.001

Table 7: Rescue analgesic requirements (number of doses in 24 hours)

No. of Doses	Group D (n=60)	Group F (n=60)
0	15 (25.0%)	4 (6.7%)
1	34 (56.7%)	23 (38.3%)
2	11 (18.3%)	27 (45.0%)
≥3	0 (0.0%)	6 (10.0%)
Mean ± SD	0.9 ± 0.6	1.7 ± 0.8

Table 8: Patient satisfaction scores (1=Poor, 5=Excellent)

Score	Group D (n=60)	Group F (n=60)
5 (Excellent)	38 (63.3%)	20 (33.3%)
4 (Good)	17 (28.3%)	25 (41.7%)
3 (Average)	5 (8.3%)	10 (16.7%)
2 (Fair)	0 (0.0%)	5 (8.3%)
1 (Poor)	0 (0.0%)	0 (0.0%)
Mean ± SD	4.5 ± 0.6	3.9 ± 0.8

Table 9: Incidence of adverse effects

Adverse Effect	Group D (n=60)	Group F (n=60)
Nausea	2 (3.3%)	3 (5.0%)
Vomiting	1 (1.7%)	2 (3.3%)
Sedation	0 (0.0%)	2 (3.3%)
Pruritus	0 (0.0%)	3 (5.0%)
Respiratory Depression	0 (0.0%)	0 (0.0%)

Table 10: Intraoperative mean arterial pressure (MAP in mmHg)

Time (min)	Group D (Mean ± SD)	Group F (Mean ± SD)	p-value
Baseline	92 ± 8	91 ± 9	0.46
15	90 ± 7	89 ± 8	0.40
30	89 ± 6	88 ± 7	0.33
45	90 ± 5	89 ± 6	0.52
60	91 ± 6	90 ± 5	0.38

Discussion

This prospective, comparative study investigated the efficacy of 0.2% ropivacaine combined with either dexamethasone or fentanyl for pericapsular nerve group (PENG) block in patients undergoing hip surgeries. A total of 120 patients were divided into two equal groups to assess differences in duration of analgesia, pain scores, rescue analgesic requirements, and patient satisfaction. The findings clearly demonstrated that the addition of dexamethasone provided superior and prolonged analgesia compared to fentanyl when used as an adjuvant to ropivacaine.

The duration of analgesia was significantly longer in the dexamethasone group (Group D) with a mean of approximately 678 minutes compared to 472 minutes in the fentanyl group (Group F), aligning with previous studies suggesting the anti-inflammatory and membrane-stabilizing properties of dexamethasone extend nerve block duration [6,7]. Moreover, VAS scores at various postoperative intervals were significantly lower in Group D, particularly at 4, 6, 12, and 24 hours, suggesting sustained pain relief in the dexamethasone group [8,9].

The requirement for rescue analgesics further supported these results—Group D patients needed fewer doses in the 24-hour postoperative period. This likely contributed to the higher patient satisfaction observed in this group, where over 60% rated their experience as excellent compared to just 33% in Group F [10,11]. The better analgesic profile of dexamethasone may be attributed to its ability to reduce nociceptive transmission and modulate the inflammatory response at the site of neural blockade.

Importantly, both adjuvants were well-tolerated. There were no major adverse events in either group, though Group F showed a slightly higher incidence of mild side effects such as pruritus and sedation, consistent with known opioid-related side effects [12,13]. Hemodynamic parameters remained stable in both groups throughout the procedure, highlighting the safety profile of PENG block in this setting.

These findings are clinically significant as they reinforce the role of dexamethasone as an effective adjuvant in prolonging analgesia without increasing adverse effects [15,16]. Compared to fentanyl, dexamethasone not only enhanced block duration but also provided better postoperative comfort and reduced the burden of additional analgesic administration [17,18].

In conclusion, this study supports the use of dexamethasone over fentanyl as an adjuvant to 0.2% ropivacaine in PENG block for hip surgeries, offering enhanced pain control, reduced analgesic consumption, and improved patient satisfaction with no increase in complications.

Conclusion

The present study concludes that the addition of dexamethasone to 0.2% ropivacaine in pericapsular nerve group (PENG) block provides significantly better postoperative analgesia compared to fentanyl. Patients in the dexamethasone group experienced a longer duration of pain relief, lower pain scores at multiple time intervals, reduced need for rescue analgesics, and higher overall satisfaction. Both combinations were found to be safe and well-tolerated, with minimal adverse effects. Therefore, dexamethasone proves to be a more effective adjuvant than fentanyl for PENG block in patients undergoing hip surgeries.

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