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A Comparative Study Between Epidural Bupivacaine with Buprenorphine and Epidural Bupivacaine for Postoperative Analgesia in Abdominal and Lower Limb Surgery.

Dr. Siba Prasad Das[1], Dr. Anup Kumar Harichandan[2]*, Dr. Saurav Padhi[3].

[1]Associate Professor, Department of Anaesthesiology,MKCG medical college and Hospital, Berhampur, Odisha

[2]Assistant Professor, Department of Anaesthesiology, MKCG medical college and Hospital, Berhampur, Odisha

[3]Junior resident, Department of Anaesthesiology, MKCG medical college and Hospital, Berhampur, Odisha.

Correspondence:
Dr. Anup Kumar Harichandan.
Assistant Professor, Department of Anaesthesiology, MKCG medical college and Hospital, Berhampur, Odisha.

Email:
anupharichandan@gmail.com

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Abstract

Background: Effective management of postoperative pain is crucial for minimizing morbidity and accelerating recovery. While epidural opioids are effective, they often come with adverse effects. Buprenorphine, a highly lipid-soluble opioid, offers prolonged analgesia with a potentially safer profile. ***Aim:*** To evaluate whether the addition of epidural buprenorphine to bupivacaine provides superior postoperative analgesia compared to bupivacaine alone in patients undergoing abdominal and lower limb surgeries. ***Methods:*** A prospective, randomized comparative study was conducted on 60 patients (ASA I and II). Group A (n=30) received 0.125% bupivacaine with 0.15 mg buprenorphine, while Group B (n=30) received 0.125% bupivacaine alone via the epidural route. ***Results:*** Group A demonstrated a significantly faster onset of analgesia (10.80 ± 2.10 min) compared to Group B (18.40 ± 2.90 min; $p < 0.05$). The duration of analgesia was also significantly prolonged in Group A (15.8 ± 2.8 hrs) versus Group B (4.6 ± 1.9 hrs; $p < 0.05$). VAS scores were consistently lower in Group A. Mild, manageable side effects were noted. ***Conclusion:*** Adding 0.15 mg buprenorphine to epidural bupivacaine significantly improves the onset, quality, and duration of postoperative analgesia compared to bupivacaine alone.

Keywords: Epidural Analgesia, Bupivacaine, Buprenorphine, Postoperative Pain, Visual Analogue Scale (VAS), Regional Anaesthesia.

INTRODUCTION

Pain is a complex sensory and emotional experience that plays a central role in postoperative patient care. Inadequately managed postoperative pain not only affects patient comfort but can also trigger adverse physiological responses, including increased cardiovascular strain, altered fluid balance, and impaired respiratory function.

While numerous pharmacological strategies exist, achieving optimal pain control remains a clinical challenge. Epidural analgesia using local anaesthetics like bupivacaine provides excellent pain relief but has a relatively short duration of action. The addition of opioids to epidural local anaesthetics has become a popular strategy to prolong analgesia.

Buprenorphine is a semi-synthetic, highly lipid-soluble opioid that is approximately 30 times more potent than morphine. Due to its high lipid solubility, it has a restricted cephalad spread within the neuraxis, which significantly reduces the risk of delayed respiratory depression—a common fear with epidural morphine.

This study aims to evaluate the clinical efficacy, statistical significance of pain relief, and adverse effect profile of combining epidural bupivacaine with buprenorphine versus bupivacaine alone.

MATERIALS AND METHODS

Study Design and Setting

This prospective, randomized comparative study was conducted in the Department of Anaesthesiology at MKCG Medical College and Hospital, Berhampur, Odisha.

Period of Study
The study was carried out over an 18-month period, from September 2024 to February 2025.

Study Population
A total of 60 patients of either sex, aged 18 to 60 years, weighing 45–70 kg, and classified as American Society of Anaesthesiologists (ASA) physical status I and II were enrolled. All patients were scheduled for elective lower abdominal or lower limb surgeries under spinal Anaesthesia, followed by epidural analgesia for postoperative pain management.

Randomization and Procedure
Patients were randomly divided into two equal groups (n=30 each):
- Group A: Received 10 ml of 0.125% bupivacaine + 0.15 mg (0.5 ml) buprenorphine.
- Group B: Received 10 ml of 0.125% bupivacaine + 0.5 ml Normal Saline.

Standard monitoring (HR, NIBP, RR, SpO2, ECG) was applied. The epidural space was accessed at the L2-L3 intervertebral space. Postoperatively, when patients reported a Visual Analogue Scale (VAS) score greater than 4, the designated epidural study drug was administered.

Statistical Analysis
Data were compiled and analyzed using SPSS version 22. Quantitative data were analyzed using the Student's t-test (unpaired). Statistical significance was defined as a p-value of < 0.05.

RESULTS

The demographic profiles of the patients in both groups were highly comparable, with no statistically significant differences regarding age, sex, weight, or ASA grading, ensuring a uniform baseline for the study.

Description: This table outlines the baseline demographic data of the patients, demonstrating that both groups were well-matched without statistically significant baseline differences.

Table 1: Demographic Characteristics of the Study Population

Parameter	Group A (Mean ± SD / Count)	Group B (Mean ± SD / Count)	P-value	Significance
Age (years)	38.20 ± 10.1	38.9 ± 9.9	0.742	Not Significant
Sex (Male:Female)	14:16	15:15	0.792	Not Significant
Weight (kg)	56.20 ± 7.4	57.0 ± 6.9	0.680	Not Significant
ASA Grade (I:II)	14:16	15:15	0.790	Not Significant

Description: This table highlights the primary endpoints of the study. Group A showed a remarkably faster onset and a heavily prolonged duration of analgesia compared to Group B, with both metrics reaching high statistical significance.

Table 2: Comparison of Onset and Duration of Analgesia

Parameter	Group A (n=30)	Group B (n=30)	P-value	Significance
Mean Onset of Analgesia (min)	10.80 ± 2.10	18.40 ± 2.90	< 0.05	Significant
Mean Duration of Analgesia (hrs)	15.8 ± 2.8	4.6 ± 1.9	< 0.05	Significant

Description: VAS scores reflect the patients' subjective pain intensity. Group A experienced a rapid and sustained drop in pain scores, maintaining profound analgesia for a significantly longer period than the control group.

Table 3: Mean Visual Analogue Scale (VAS) Scores Over Time

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	P-value	Significance
Baseline (0 min)	4.10 ± 0.60	4.5 ± 0.7	-	-
10 min	3.9 ± 0.70	5.4 ± 0.6	< 0.05	Significant
30 min	2.7 ± 0.90	2.8 ± 0.8	> 0.05	Not Significant
1 hour	1.2 ± 0.70	3.0 ± 0.5	< 0.05	Significant
5 hours	2.5 ± 0.60	4.3 ± 0.6	< 0.05	Significant
7 hours	2.6 ± 0.70	4.6 ± 0.5	< 0.05	Significant

Description: Hemodynamic stability is a crucial marker of adequate pain control. Group A maintained lower and more stable MAP values throughout the postoperative period, indicating superior suppression of the pain-induced stress response.

Table 4: Mean Arterial Pressure (MAP) Changes Between Groups

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	P-value	Significance
Baseline (0 min)	96 ± 5.8	94 ± 5.6	-	-
10 min	94 ± 5.6	83 ± 6.1	< 0.05	Significant
1 hour	92 ± 5.5	93 ± 5.7	> 0.05	Not Significant
3 hours	94 ± 5.6	97 ± 5.8	< 0.05	Significant
7 hours	96 ± 5.8	99 ± 6.0	< 0.05	Significant

Description: This table outlines the safety profile of the interventions. While the buprenorphine group experienced slightly higher rates of mild side effects, no severe complications (like severe delayed respiratory depression or profound hypotension) were observed.

Table 5: Incidence of Postoperative Adverse Effects

Side Effect	Group A (n=30) Count (%)	Group B (n=30) Count (%)
Nausea and Vomiting	6 (20.0%)	2 (6.6%)
Urinary Retention	2 (6.6%)	0 (0%)
Pruritus	1 (3.3%)	0 (0%)
Hypotension	0 (0%)	0 (0%)

DISCUSSION

The present study investigated the efficacy of adding 0.15 mg of buprenorphine to 0.125% bupivacaine for epidural postoperative analgesia. Our results clearly indicate that the buprenorphine combination offers a superior clinical profile.

The onset of analgesia was significantly accelerated in Group A (10.80 mins vs. 18.40 mins, $p < 0.05$). This rapid action can be attributed to buprenorphine's exceptionally high lipid solubility, which allows it to quickly penetrate neural tissues and bind to opioid receptors in the spinal cord. Furthermore, the duration of analgesia was vastly extended in the combination group, averaging 15.8 hours compared to merely 4.6 hours for bupivacaine alone. This aligns with findings by previous researchers like Kumar et al. and Chakraborty et al., who reported prolonged analgesia lasting up to 24 hours when using epidural buprenorphine.

Hemodynamically, patients in Group A showed more stable mean arterial pressures and heart rates. Effective pain relief blunts the sympathetic nervous system's stress response to surgical trauma, preventing tachycardia and hypertension.

While the addition of buprenorphine did yield a statistically significant drop in respiratory rate during the first 30 minutes, it remained within safe physiological limits, corroborating the known "ceiling effect" buprenorphine has on respiratory depression. Minor side effects such as nausea (20%) and mild urinary retention (6.6%) were noted in Group A, but these were easily managed and consistent with the general profile of epidural opioid administration.

CONCLUSION

The addition of 0.15 mg buprenorphine to 0.125% bupivacaine via the epidural route is a highly effective strategy for managing postoperative pain in abdominal and lower limb surgeries. It significantly accelerates the onset of pain relief, profoundly extends the duration of analgesia, and provides superior hemodynamic stability compared to bupivacaine alone, with only a marginal and manageable increase in minor side effects.

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