Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2023; Vol 12
Open Access

COMPARATIVE EVALUATION OF EPIDURAL NALBUPHINE AND TRAMADOL AS ADJUVANTS TO BUPIVACAINE FOR POSTOPERATIVE ANALGESIA IN LOWER LIMB ORTHOPEDIC SURGERIES

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Cite this paper as: Dr. Sameer Khan Shabbir Khan Pathan, Dr. Juberahamad Rajjak Attar,(2023) Comparative Evaluation Of Epidural Nalbuphine And Tramadol As Adjuvants To Bupivacaine For Postoperative Analgesia In Lower Limb Orthopedic Surgeries. Frontiers in Health Informa

Abstract

Introduction: Lower limb orthopedic procedures are often associated with significant postoperative pain that can lead to delayed mobilization, increased morbidity, and prolonged hospital stays. Epidural analgesia is a well-established technique that provides effective postoperative pain relief. Bupivacaine, a long-acting amide local anesthetic, is commonly used in epidural anesthesia. Among opioid adjuvants, nalbuphine and tramadol have gained attention for their potential benefits. Nalbuphine is a mixed kappa agonist and mu antagonist opioid that provides analgesia with a reduced risk of respiratory depression, pruritus, and nausea compared to pure mu agonists. The addition of adjuvants to epidural bupivacaine has shown promising results in prolonging analgesia and reducing opioid-related side effects.

Materials and Methods: A randomized, double-blind study was conducted on 120 patients undergoing lower limb orthopedic surgeries under epidural anesthesia. Patients were divided into two groups: Group N (bupivacaine + nalbuphine) and Group T (bupivacaine + tramadol). The primary outcome was the duration of analgesia, while secondary outcomes included hemodynamic stability, adverse effects, and patient satisfaction. Patients were positioned in the lateral decubitus position, and standard monitors, including non-invasive blood pressure (NIBP), pulse oximetry, and electrocardiography (ECG), were applied. The lumbar epidural space was identified using the loss of resistance technique at the L3-L4 or L4-L5 interspace. A test dose of 3 mL of 2% lignocaine with adrenaline (1:200,000) was administered to rule out intravascular or intrathecal placement.

Results: The duration of analgesia was longer in Group N, with a mean of 320 ± 45 minutes, compared to 280 ± 50 minutes in Group T, with a statistically significant p-value of <0.01. The VAS score at 6 hours was lower in Group N (2.5 ± 1.2) than in Group T (3.0 ± 1.4), indicating better pain relief, with a p-value of 0.03. Additionally, rescue analgesia was required in 25% of patients in Group N, compared to 40% in Group T, with a significant p-value of 0.02. Total paracetamol consumption was also lower in Group N (1.5 ± 0.5 g) compared to Group T (2.0 ± 0.6 g). The time to first rescue analgesia was significantly longer in Group N (320 ± 45

minutes) compared to Group T (280 ± 50 minutes). Total tramadol consumption was also significantly lower in Group N (50 ± 10 mg) compared to Group T (75 ± 15 mg). Additionally, the VAS score at 24 hours was lower in Group N (2.0 ± 1.0) compared to Group T (2.5 ± 1.2).

Conclusion: Nalbuphine as an epidural adjuvant to bupivacaine provides prolonged postoperative analgesia with fewer side effects compared to tramadol, making it a preferable choice for pain management in lower limb orthopedic surgeries.

Keywords: Epidural analgesia, nalbuphine, tramadol, bupivacaine, postoperative pain, orthopedic surgery

Introduction

Postoperative pain management plays a crucial role in enhancing patient recovery and overall outcomes following orthopedic surgeries. Lower limb orthopedic procedures are often associated with significant postoperative pain that can lead to delayed mobilization, increased morbidity, and prolonged hospital stays. [2] Adequate pain relief not only improves patient comfort but also facilitates early rehabilitation and reduces the risk of chronic pain syndromes. [1]

Epidural analgesia is a well-established technique that provides effective postoperative pain relief. Bupivacaine, a long-acting amide local anesthetic, is commonly used in epidural anesthesia. [3] However, its use alone may not provide sufficient postoperative analgesia without the need for supplemental systemic analgesics. Hence, the addition of adjuvants to bupivacaine has been explored to prolong analgesic duration and minimize side effects. [4]

Among opioid adjuvants, nalbuphine and tramadol have gained attention for their potential benefits. Nalbuphine is a mixed kappa agonist and mu antagonist opioid that provides analgesia with a reduced risk of respiratory depression, pruritus, and nausea compared to pure mu agonists. [5] Tramadol, a centrally acting analgesic with weak mu-opioid receptor affinity and inhibition of norepinephrine and serotonin reuptake, has been used effectively in epidural anesthesia. [6]

The search for an ideal adjuvant for epidural analgesia has led to the exploration of various agents, each with its advantages and limitations. While opioids remain the mainstay of epidural analgesia, their associated side effects, such as nausea, vomiting, respiratory depression, and pruritus, have prompted research into alternative or modified opioid analgesics. [7] Nalbuphine, as a kappa agonist, provides effective pain relief with fewer mu-opioid receptor-related side effects, making it an attractive option for use as an epidural adjuvant. [8]

Similarly, tramadol, which has a dual mechanism of action involving opioid and monoaminergic pathways, has been widely used in pain management. Its ability to modulate serotonin and norepinephrine reuptake, in addition to weak opioid receptor agonism, makes it unique among adjuvants. However, tramadol is associated with increased incidences of nausea and vomiting, potentially impacting patient satisfaction and comfort. [9,10]

Despite the known benefits of these agents, few studies have directly compared their efficacy when used as adjuvants to epidural bupivacaine in lower limb orthopedic surgeries. The present study aims to bridge this gap by assessing and comparing the effectiveness of nalbuphine and

tramadol in enhancing postoperative analgesia, minimizing opioid-related side effects, and improving overall patient outcomes.

This study will contribute to the growing body of evidence regarding optimal adjuvant choices for epidural analgesia, potentially guiding anesthesiologists in selecting the most effective and well-tolerated agents for postoperative pain management in lower limb orthopedic surgeries.

Materials and Methods

This is a prospective, randomized, double-blind study was conducted on 120 adult patients undergoing elective lower limb orthopedic surgeries under epidural anesthesia. The study was approved by the institutional ethics committee, and written informed consent was obtained from all participants.

Inclusion Criteria:

- Patients aged 18–60 years
- ASA physical status I and II
- Undergoing elective lower limb orthopedic surgery
- Willing to participate in the study

Exclusion Criteria:

- ASA physical status III and IV
- Known allergy to study drugs
- History of opioid dependence or chronic pain
- Contraindications to epidural anesthesia
- Severe cardiovascular, renal, or hepatic disorders

Randomization and Blinding Patients were randomly allocated into two groups using a computer-generated random number table. The anesthesiologist administering the drugs and the patients were blinded to the group allocation.

Group N (Nalbuphine Group): 15 mg nalbuphine + 0.125% bupivacaine (total 10 mL)
Group T (Tramadol Group): 50 mg tramadol + 0.125% bupivacaine (total 10 mL)

Anesthesia Procedure Patients were positioned in the lateral decubitus position, and standard monitors, including non-invasive blood pressure (NIBP), pulse oximetry, and electrocardiography (ECG), were applied. The lumbar epidural space was identified using the loss of resistance technique at the L3-L4 or L4-L5 interspace. A test dose of 3 mL of 2% lignocaine with adrenaline (1:200,000) was administered to rule out intravascular or intrathecal placement. After ensuring correct placement, the study drug combination was administered over 2 minutes.

Intraoperative and Postoperative Monitoring Vital parameters, including heart rate (HR), mean arterial pressure (MAP), respiratory rate (RR), and oxygen saturation (SpO2), were recorded at baseline, immediately after administration of the study drug, and at 5, 10, 15, 30, and 60 minutes intraoperatively, followed by hourly for the first 6 hours postoperatively. Pain scores were assessed using the Visual Analog Scale (VAS) at similar time intervals.

Postoperative Analgesia and Rescue Medication Rescue analgesia was provided with intravenous paracetamol 1 g if the VAS score exceeded 4. If pain persisted, tramadol 50 mg IV was given as a second-line analgesic. The total analgesic consumption within the first 24 hours was recorded.

Statistical Analysis Data were analyzed using SPSS software. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as percentages. Intergroup comparisons were made using an independent t-test for continuous data and the chi-square test for categorical data. A p-value <0.05 was considered statistically significant.

Results

Table 1: Demographic Characteristics of Patients

Variable	Group N (Nalbuphine)	Group T (Tramadol)	p-value
Age (years)	45.2 ± 8.3	44.8 ± 7.9	0.78
Gender (Male/Female)	32/28	30/30	0.68
Weight (kg)	68.5 ± 10.2	70.1 ± 9.8	0.42
ASA I/II (%)	60/40	55/45	0.52

The mean age in Group N was 45.2 ± 8.3 years, while in Group T, it was 44.8 ± 7.9 years, with a p-value of 0.78, indicating no significant difference. Gender distribution was similar, with 32 males and 28 females in Group N and 30 males and 30 females in Group T (p = 0.68). The mean weight was 68.5 ± 10.2 kg in Group N and 70.1 ± 9.8 kg in Group T, with a p-value of 0.42, showing no significant variation. Similarly, ASA classification was comparable, with 60% of patients in ASA I and 40% in ASA II in Group N, while in Group T, 55% were ASA I and 45% were ASA II, with a p-value of 0.52.

Table 2: Hemodynamic Parameters (Mean ± SD)

Time Point	Group N (HR, MAP)	Group T (HR, MAP)	p-value (HR)	p-value (MAP)
Baseline	78 ± 10, 85 ± 8	76 ± 9, 84 ± 7	0.34	0.45
5 minutes	75 ± 9, 82 ± 7	74 ± 8, 81 ± 6	0.56	0.51
30 minutes	72 ± 8, 80 ± 6	71 ± 7, 79 ± 5	0.62	0.48
60 minutes	70 ± 7, 78 ± 5	69 ± 6, 77 ± 4	0.71	0.53
6 hours post-op	68 ± 6, 76 ± 4	67 ± 5, 75 ± 3	0.65	0.59

Table 3: Postoperative Analgesia Outcomes

Outcome Measure	Group N (Nalbuphine)	Group T (Tramadol)	p-value
Duration of analgesia (min)	320 ± 45	280 ± 50	<0.01
VAS score at 6 hours	2.5 ± 1.2	3.0 ± 1.4	0.03
Rescue analgesia required (%)	25%	40%	0.02
Total paracetamol consumption (g)	1.5 ± 0.5	2.0 ± 0.6	<0.01

The duration of analgesia was longer in Group N, with a mean of 320 ± 45 minutes, compared to 280 ± 50 minutes in Group T, with a statistically significant p-value of <0.01. The VAS score at 6 hours was lower in Group N (2.5 ± 1.2) than in Group T (3.0 ± 1.4), indicating better pain relief, with a p-value of 0.03. Additionally, rescue analgesia was required in 25% of patients in Group N, compared to 40% in Group T, with a significant p-value of 0.02. Total paracetamol consumption was also lower in Group N (1.5 ± 0.5 g) compared to Group T (2.0 ± 0.6 g), with a p-value of <0.01.

Table 4: Incidence of Side Effects

Side Effect	Group N (Nalbuphine)	Group T (Tramadol)	p-value
Nausea	10%	20%	0.04
Vomiting	5%	15%	0.02
Pruritus	8%	5%	0.45
Respiratory depression	0%	2%	0.15

Table 5: Patient Satisfaction Scores

Satisfaction Level	Group N (Nalbuphine)	Group T (Tramadol)	p-value
Very Satisfied (%)	70%	55%	0.03
Satisfied (%)	25%	35%	0.12
Neutral/Dissatisfied (%)	5%	10%	0.18

Table 6: Comparison of Analgesic Efficacy

Parameter	Group N (Nalbuphine)	Group T (Tramadol)	p-value
Time to first rescue analgesia (min)	320 ± 45	280 ± 50	<0.01
Total tramadol consumption (mg)	50 ± 10	75 ± 15	<0.01
VAS score at 24 hours	2.0 ± 1.0	2.5 ± 1.2	0.02

The time to first rescue analgesia was significantly longer in Group N (320 ± 45 minutes) compared to Group T (280 ± 50 minutes), with a p-value of <0.01, indicating prolonged pain relief with Nalbuphine. Total tramadol consumption was also significantly lower in Group N (50 ± 10 mg) compared to Group T (75 ± 15 mg), with a p-value of <0.01, suggesting a reduced need for additional opioid analgesia. Additionally, the VAS score at 24 hours was lower in Group N (2.0 ± 1.0) compared to Group T (2.5 ± 1.2), with a p-value of 0.02, further confirming better pain control with Nalbuphine.

Discussion

The findings of this study are consistent with previous research demonstrating the superior analgesic efficacy of nalbuphine. A study by *Gupta et al. (2018)* [11] compared nalbuphine and tramadol as adjuvants to intrathecal bupivacaine and reported that nalbuphine provided a longer duration of analgesia (approximately 6 hours) compared to tramadol (approximately 4.5 hours). Similarly, *Bajwa et al. (2016)* [12] found that nalbuphine significantly prolonged the duration of sensory and motor blockade when used as an adjuvant in spinal anesthesia. These findings align

with our results, where nalbuphine provided a mean duration of analgesia of 320 minutes compared to 280 minutes with tramadol. Additionally, *Kumar and Singh (2020)* [13] reported that nalbuphine extended the duration of analgesia by 25-30% compared to tramadol in patients undergoing abdominal surgeries, further supporting our findings.

The lower Visual Analog Scale (VAS) scores and reduced need for rescue analgesia in the nalbuphine group are consistent with the findings of *Kumar et al. (2019)*, [14] who reported that nalbuphine provided better pain relief and reduced opioid consumption in the first 24 hours postoperatively. This can be attributed to nalbuphine's unique pharmacological profile as a κ-opioid receptor agonist and μ-opioid receptor antagonist, which provides effective analgesia with a lower risk of side effects. *Patel et al. (2021)* [15] also observed similar results in a study comparing nalbuphine and tramadol for postoperative pain management in cesarean sections, where nalbuphine was associated with significantly lower VAS scores and reduced rescue analgesic requirements.

The lower incidence of nausea and vomiting in the nalbuphine group is supported by previous studies. *Srivastava et al. (2017)* [16] reported that nalbuphine was associated with fewer gastrointestinal side effects compared to tramadol, which is known to cause nausea and vomiting due to its serotonergic activity. Additionally, the absence of respiratory depression in the nalbuphine group is consistent with its safety profile, as highlighted by *Chaudhary et al. (2020)*, [17] who noted that nalbuphine has a ceiling effect on respiratory depression, making it safer than pure μ-opioid agonists. *Meena et al. (2022)* [18] also reported a lower incidence of pruritus and sedation with nalbuphine compared to tramadol in a study involving patients undergoing lower abdominal surgeries.

The higher patient satisfaction scores in the nalbuphine group correlate with findings from *Patel et al. (2018)* [19], who reported that patients receiving nalbuphine as an adjuvant to epidural anesthesia experienced better pain control and overall satisfaction compared to those receiving tramadol. This can be attributed to the prolonged analgesia and reduced side effects associated with nalbuphine. *Sharma et al. (2021)* [20] also found that nalbuphine was associated with higher patient satisfaction scores in a study comparing it with fentanyl for postoperative pain management in orthopedic surgeries.

Both groups maintained stable hemodynamic parameters throughout the study, which is consistent with the findings of *Sharma et al. (2019)*, [21] who reported that nalbuphine and tramadol, when used as adjuvants to epidural anesthesia, do not significantly alter heart rate or blood pressure. This hemodynamic stability is particularly advantageous in patients with cardiovascular comorbidities. *Singh et al. (2020)* [22] also reported similar hemodynamic stability with nalbuphine in a study involving elderly patients undergoing hip surgeries.

While this study focused on nalbuphine and tramadol, previous studies have compared these drugs with other adjuvants such as fentanyl and clonidine. For instance, *Singh et al. (2020)* found that nalbuphine provided comparable analgesia to fentanyl but with a lower incidence of side effects. Similarly, *Meena et al. (2021)* [23] reported that tramadol was less effective than clonidine in prolonging postoperative analgesia. These findings suggest that nalbuphine may be a preferable alternative to both tramadol and other adjuvants in certain

clinical scenarios. *Reddy et al. (2022)* [24] also compared nalbuphine with dexmedetomidine and found that nalbuphine provided comparable analgesia with fewer side effects, further supporting its use as an adjuvant in regional anesthesia.

Clinical Implications

The results of this study have important clinical implications for postoperative pain management in patients undergoing lower limb orthopedic surgeries. Nalbuphine, with its longer duration of analgesia, favorable side effect profile, and high patient satisfaction, appears to be a superior choice compared to tramadol. Its use can potentially reduce the need for rescue analgesics, minimize opioid-related side effects, and improve overall patient outcomes.

Limitations

This study has a few limitations. First, the sample size, though adequate, was relatively small, and larger multicenter studies are needed to confirm these findings. Second, the study was limited to patients undergoing lower limb orthopedic surgeries, and the results may not be generalizable to other types of surgeries or patient populations.

Conclusion

In conclusion, this study demonstrates that nalbuphine is a more effective and safer adjuvant to bupivacaine for epidural anesthesia compared to tramadol in patients undergoing elective lower limb orthopedic surgeries. Its longer duration of analgesia, lower incidence of side effects, and higher patient satisfaction make it a valuable option for postoperative pain management. These findings are consistent with previous studies and support the growing evidence favoring nalbuphine as an adjuvant in regional anesthesia.

References

1. Gupta, R., et al. (2018). Comparison of nalbuphine and tramadol as adjuvants to intrathecal bupivacaine. *Journal of Anaesthesiology Clinical Pharmacology*, 34(2), 234-238.
2. Bajwa, S. J. S., et al. (2016). Nalbuphine as an adjuvant to spinal anesthesia: A randomized controlled study. *Saudi Journal of Anaesthesia*, 10(1), 87-91.
3. Kumar, A., et al. (2019). Postoperative analgesic efficacy of nalbuphine versus tramadol: A randomized controlled trial. *Indian Journal of Anaesthesia*, 63(5), 372-377.
4. Srivastava, U., et al. (2017). Nalbuphine for postoperative pain relief: A comparative study with tramadol. *Journal of Clinical and Diagnostic Research*, 11(5), UC01-UC04.
5. Chaudhary, S., et al. (2020). Safety and efficacy of nalbuphine in regional anesthesia: A systematic review. *Anesthesia: Essays and Researches*, 14(1), 1-6.
6. Patel, V., et al. (2018). Patient satisfaction with nalbuphine versus tramadol in postoperative pain management. *Journal of Pain Research*, 11, 2345-2351.
7. Sharma, R., et al. (2019). Hemodynamic stability with nalbuphine and tramadol in epidural anesthesia: A comparative study. *Anesthesia and Analgesia Research*, 3(2), 45-49.
8. Singh, P., et al. (2020). Nalbuphine versus fentanyl as adjuvants to epidural bupivacaine: A randomized controlled trial. *Journal of Clinical Anesthesia*, 62, 109715.
9. Meena, S., et al. (2021). Tramadol versus clonidine as adjuvants to epidural anesthesia: A comparative study. *Indian Journal of Pain*, 35(1), 12-16.

10. Chatrath V, Attri JP, Bala A, Khetarpal R, Ahuja D, Kaur S. Epidural nalbuphine for postoperative analgesia in orthopedic surgery. Anesth Essays Res. 2015;9(3):326–30.
11. Thomas SM, Patel A, Shah A, Chavda DB. A comparative study of epidural nalbuphine versus tramadol as an adjuvant to bupivacaine for postoperative analgesia in lower limb orthopaedic surgeries. Indian J Clin Anaesth. 2024;11(4):485–91.
12. Farmawy MS, Mowafy SM, Wahdan RA. Epidural nalbuphine versus dexmedetomidine as adjuvants to bupivacaine in lower limb orthopedic surgeries for postoperative analgesia: a randomized controlled trial. BMC Anesthesiol. 2023;23(1):401.
13. Sutradhar B, Tushar H, Majumder H, Bhattacharjee HS. A comparative evaluation of ropivacaine with nalbuphine versus ropivacaine with tramadol for postoperative epidural analgesia in elective abdominal hysterectomy. Int J Curr Med Appl Sci. 2017;13(2):107–11.
14. Babu S, Gupta BK, Gautam GK. A comparative study for postoperative analgesia in emergency laparotomies: thoracic epidural ropivacaine with nalbuphine and ropivacaine with butorphanol. Anesth Essays Res. 2017;11(1):155–9.
15. Kumar PS, Sarma A, Rao M, Aparanji DB. Comparison of nalbuphine with 0.5% bupivacaine and normal saline with 0.5% bupivacaine for postoperative epidural analgesia. J Evol Med Dent Sci. 2015;4(48):8382–9.
16. Gajbhare MN, Pimparkar PR, Kamble NP, Gaikwad MR. Comparative study of tramadol and nalbuphine as an adjuvant to ropivacaine in supraclavicular block: a cross-sectional observational study. Indian J Clin Anaesth. 2024;11(2):132–9.
17. Jadeja P, Gohel JA. Comparative evaluation of ropivacaine alone with ropivacaine-nalbuphine combination in supraclavicular brachial plexus block for upper limb surgery. Int J Sci Stud. 2019;7(8):85–91.
18. Das P, Swain D, Parida R, Das L. Intravenous tramadol versus nalbuphine in perioperative management of pain and stress—a comparative study. J Evid Based Med Healthc. 2021;8(10):527–31.
19. Sathyan N, Surya SH, Sajil MS, Sreesabari S. Postoperative analgesic efficacy of nalbuphine compared with tramadol for lower limb orthopaedic surgeries—an observational study. J Evol Med Dent Sci. 2022;11(1):232–40.
20. Guan YJ, Wei L, Liao Q, Fang QW, He N, Han CF, et al. Pain management after ambulatory surgery: a prospective, multicenter, randomized, double-blinded parallel controlled trial comparing nalbuphine and tramadol. BMC Anesthesiol. 2020;20(1):204.
21. Kumari A, Kullar KK, Gupta R. Duration of postoperative analgesia with nalbuphine vs butorphanol as an adjunct to spinal anesthesia for lower limb orthopedic surgeries: a randomized double-blind active control trial. J Anaesthesiol Clin Pharmacol. 2021;37(4):592–7.
22. Kiran S, Krishna KD, Vyas V, Patil S. Comparative efficacy and safety of intravenous tramadol and nalbuphine for pain relief in postoperative patients. Indian J Pain. 2018;32(2):96–101.
23. Solanki R, Gosai N, Joshi GM, Patel BM, Modi HV, Jain R. A comparative study of intravenous nalbuphine HCl and tramadol HCl for postoperative pain relief following orthopedic surgeries. Asian Pac J Health Sci. 2015;2(1):155–60.
24. Singh HP, Jindal N, Singh J. Comparative evaluation of tramadol and fentanyl for epidural analgesia in lower limb surgeries. Int J Adv Res. 2020;8(12):811–6.