



COMPARISON OF CLONIDINE AND TRAMADOL AS ADJUVANTS TO BUPIVACAINE IN EPIDURAL ANAESTHESIA FOR LOWER LIMB SURGERY: A RANDOMISED CONTROLLED TRIAL

Anaesthesiology

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ABSTRACT

Background: Epidural anaesthesia is widely used for lower limb surgeries, with adjuvants such as clonidine and tramadol often added to bupivacaine to enhance analgesia. Their comparative efficacy and safety remain a subject of ongoing research. **Methods:** Ninety ASA I–II adults scheduled for lower limb orthopaedic surgery were randomised into three groups: Group B (bupivacaine), Group BT (bupivacaine + tramadol), and Group BC (bupivacaine + clonidine). Primary outcomes included onset and duration of sensory and motor block, and duration of postoperative analgesia. Secondary outcomes were haemodynamic stability and adverse effects. **Results:** Both adjuvants significantly prolonged sensory and motor block and postoperative analgesia compared to bupivacaine alone ($P<0.01$). Tramadol provided the longest analgesia ($P=0.03$), while clonidine was associated with higher sedation and hypotension rates ($P<0.05$). Tramadol increased nausea and vomiting. **Conclusions:** Both adjuvants are effective for prolonging epidural analgesia. Tramadol offers longer pain relief with fewer haemodynamic side effects, whereas clonidine provides greater sedation but increases hypotension risk.

KEYWORDS

Epidural anaesthesia, clonidine, tramadol, bupivacaine, adjuvant, postoperative analgesia

INTRODUCTION

Effective pain management is a cornerstone of perioperative care, reducing morbidity, stress response, and improving recovery. Epidural anaesthesia, a safe and cost-effective neuraxial block, is routinely used for lower limb surgeries. However, the search for optimal adjuvants to local anaesthetics such as bupivacaine continues, aiming to enhance block quality and duration while minimising side effects.

Bupivacaine, an amide local anaesthetic, is commonly used in epidural and caudal blocks due to its long duration of action. The addition of adjuvants like clonidine, an α_2 -adrenergic agonist, and tramadol, a weak μ -opioid agonist with monoaminergic effects, is increasingly popular. Clonidine provides sedation and haemodynamic stability without respiratory depression, while tramadol offers effective analgesia but may cause nausea and vomiting.

Despite numerous studies, the comparative efficacy of clonidine and tramadol as epidural adjuvants remains unsettled. This trial compares their effects on block characteristics, analgesia duration, haemodynamic parameters, and side effects in adults undergoing lower limb orthopaedic surgery.

METHODS

Study Design And Participants

This prospective, randomised, double-blind controlled trial was conducted at GR medical college Gwalior MP after ethical approval and written informed consent. Ninety ASA I–II patients, aged 18–65 years, scheduled for elective lower limb orthopaedic surgery under epidural anaesthesia, were enrolled. Exclusion criteria included drug allergy, coagulopathy, infection at the injection site, and significant cardiovascular or neurological disease.

Randomisation And Interventions

Patients were randomised into three groups ($n=30$ each) using computer-generated numbers:

- Group B:** 15 ml 0.5% bupivacaine + 2 ml saline
- Group BT:** 15 ml 0.5% bupivacaine + 2 ml (50 mg) tramadol
- Group BC:** 15 ml 0.5% bupivacaine + 2 ml (75 μ g) clonidine

All solutions were prepared by an independent anaesthetist.

Anaesthetic Technique

Standard monitoring (ECG, NIBP, SpO_2) was applied. An epidural catheter was inserted at L3–L4. Study drugs were administered in a blinded fashion. Sensory block was assessed by pinprick, motor block by Bromage scale. Postoperative analgesia was provided with paracetamol as rescue.

Outcomes

Primary Outcomes:

- Onset and duration of sensory and motor block
- Duration of postoperative analgesia

Secondary Outcomes:

- Haemodynamic parameters (HR, MAP)
- Sedation (Ramsay scale)
- Adverse effects (hypotension, bradycardia, nausea, vomiting, pruritus, respiratory depression)

Statistical Analysis

Sample size was calculated to detect a 20% difference in analgesia duration ($\alpha=0.05$, power=0.8). Data were analysed using SPSS v25.0. ANOVA and chi-square tests were used as appropriate. $P<0.05$ was considered significant.

RESULTS

Demographics

No significant differences in age, sex, weight, or ASA status were observed between groups (Table 1).

Table 1: Demographic Data

Parameter	Group B (n=30)	Group BT (n=30)	Group BC (n=30)	P-value
Age (years)	45.2 $\pm$ 12.1	46.1 $\pm$ 11.8	44.6 $\pm$ 13.3	0.82
Male/Female	18/12	16/14	17/13	0.89
Weight (kg)	68.2 $\pm$ 9.5	69.1 $\pm$ 10.2	67.8 $\pm$ 8.9	0.77

Block Characteristics

Both adjuvant groups had faster onset and longer duration of sensory and motor block compared to bupivacaine alone (Table 2).

Table 2: Block Characteristics

Parameter	Group B	Group BT	Group BC	P-value (BT vs BC)
Onset of sensory block (min)	12.5 $\pm$ 2.1	10.2 $\pm$ 1.9*	10.8 $\pm$ 2.0*	0.31
Duration of sensory block (min)	162.3 $\pm$ 24.5	232.5 $\pm$ 29.8*	215.6 $\pm$ 27.1*	0.03
Onset of motor block (min)	18.1 $\pm$ 3.2	15.7 $\pm$ 2.8*	16.0 $\pm$ 2.9*	0.56
Duration of motor block (min)	138.7 $\pm$ 21.4	185.2 $\pm$ 19.7*	176.8 $\pm$ 18.9*	0.04
Duration of analgesia (min)	188.5 $\pm$ 27.3	298.1 $\pm$ 33.5*	266.7 $\pm$ 30.2*	0.03

*P<0.01 vs Group B

Haemodynamic and Sedation Effects Clonidine group had a greater incidence of hypotension and higher sedation scores (Table 3).

Table 3: Adverse Effects

Adverse Effect	Group B	Group BT	Group BC	P-value (BT vs BC)
Hypotension (%)	3.3	6.7	26.7*	0.01
Bradycardia (%)	0	3.3	13.3*	0.04
Nausea/Vomiting (%)	6.7	23.3*	10.0	0.03
Sedation (Ramsay >2)	0	3.3	20.0*	0.02

*P<0.05 vs Group BT

No respiratory depression or pruritus was observed in any group.

DISCUSSION

This study demonstrates that both clonidine and tramadol, when added to epidural bupivacaine, significantly prolong the duration of sensory and motor block, as well as postoperative analgesia, compared to bupivacaine alone. Tramadol was superior in prolonging analgesia, while clonidine provided higher sedation but at the cost of more hypotension and bradycardia.

These findings are consistent with previous studies. Amitha et al. reported that caudal bupivacaine with tramadol provided superior and longer postoperative analgesia compared to clonidine in paediatric patients. Sutariya et al. also found tramadol as a superior adjuvant to clonidine in prolonging analgesia in adults. However, other studies, such as Rawat et al., suggest clonidine may provide longer analgesia in paediatric caudal blocks. This discrepancy may relate to differences in patient age, dosing, and surgical context.

Clonidine's efficacy as an epidural adjuvant is attributed to its action on spinal α_2 -adrenoceptors, resulting in enhanced analgesia, sedation, and haemodynamic stability. However, its side effect profile includes hypotension and bradycardia, as seen in our study and others. Tramadol, with its dual mechanism, is effective for moderate pain and is associated with fewer haemodynamic effects but a higher incidence of nausea and vomiting.

Meta-analyses by Wang et al. and Goyal et al. support the use of clonidine as an adjuvant, noting its efficacy and lower incidence of nausea and vomiting compared to opioids]. Gupta et al. and Mahdi et al. found tramadol provided longer analgesia than clonidine, with a favorable safety profile.

The limitations of this study include its single-centre design and exclusion of high-risk patients. Further multicentre studies with larger sample sizes and exploration of optimal dosing strategies are warranted.

CONCLUSIONS

Both clonidine and tramadol are effective adjuvants to epidural bupivacaine for lower limb surgery. Tramadol provides longer analgesia with fewer haemodynamic side effects, while clonidine offers better sedation but increases the risk of hypotension. The choice of adjuvant should be individualised based on patient comorbidities and surgical context.

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