

Postoperative Analgesic Effect of Bupivacaine and Dexmedetomidine with Bupivacaine in Local Infiltration of Surgical Wound in Abdominal Hysterectomy

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Abstract

Background: Effective pain management after abdominal hysterectomy is essential for early recovery. Local infiltration with bupivacaine provides analgesia but of limited duration. Dexmedetomidine, an α_2 -adrenoceptor agonist, may enhance and prolong local anaesthetic action. **Material and Methods:** In this prospective, randomised, double-blind trial, 60 ASA I–II female patients undergoing elective abdominal hysterectomy were assigned to receive wound infiltration with either 30 mL of 0.25% bupivacaine (Group I) or bupivacaine plus dexmedetomidine (1.0 $\mu\text{g}/\text{kg}$) (Group II). Postoperative pain (VAS scores), time to first rescue analgesic, morphine consumption, patient satisfaction, and adverse effects were assessed over 24 hours. **Results:** Fifty-eight patients completed the study. Group II showed significantly lower VAS scores at rest (up to 12 h) and on coughing (up to 6 h) compared with Group I ($p < 0.001$). Time to first rescue analgesic was prolonged, and morphine requirement was reduced in Group II ($p < 0.001$). Only 50% of patients in Group II required rescue analgesia versus 100% in Group I. Patient satisfaction was higher with dexmedetomidine ($p < 0.0001$). No significant adverse effects were observed. **Conclusion:** The addition of dexmedetomidine to bupivacaine for local wound infiltration provides superior, prolonged analgesia and reduces opioid use after abdominal hysterectomy without increasing complications.

Keywords: Abdominal hysterectomy, bupivacaine, dexmedetomidine, wound infiltration, postoperative pain, multimodal analgesia.

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INTRODUCTION

Abdominal hysterectomy is a prevalent gynaecological procedure that is often accompanied by moderate to severe postoperative pain. Effective pain management following surgery is crucial not only for patient comfort and satisfaction but also for facilitating early mobilisation and recovery, and for reducing the risk of complications such as venous thromboembolism and the development of chronic pain. Traditionally, postoperative pain control has relied heavily on systemic analgesics, including opioids. While effective, opioids are associated with a range of dose-dependent adverse effects, such as nausea, vomiting, sedation, respiratory depression, and constipation, which can delay recovery and prolong hospital stays.^[1,2] Consequently, there is a growing clinical emphasis on multimodal analgesia approaches that aim to optimise pain relief while minimising opioid consumption.^[3]

Local infiltration of the surgical wound with local anaesthetics is a simple, safe, and cost-effective component of multimodal analgesia. Bupivacaine, a long-acting local anaesthetic, is frequently used for this purpose due to its prolonged duration of action. By blocking pain transmission from the surgical site, bupivacaine infiltration can reduce

immediate postoperative pain and decrease the need for systemic analgesics. However, its analgesic effect is often limited to a few hours after surgery.^[4,5]

Various adjuvants have been explored for local infiltration to address this limitation and further improve the quality and duration of postoperative analgesia. Dexmedetomidine, a highly selective alpha-2 adrenoceptor agonist, is a promising candidate due to its sedative, anxiolytic, and analgesic properties.^[6-8] When used as an adjuvant, dexmedetomidine has been shown to prolong the duration of local anaesthetic action and provide a significant opioid-sparing effect. While its use as an intravenous sedative is well-established, local infiltration offers the advantage of site-specific action with minimal systemic side

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effects, such as hypotension and bradycardia, that are associated with intravenous administration.^[9]

Several studies have investigated dexmedetomidine with bupivacaine in local wound infiltration for various surgical procedures, including hysterectomy, consistently demonstrating superior and longer-lasting analgesia compared to bupivacaine alone. Nevertheless, ongoing research is warranted to solidify the evidence and establish optimal protocols for its use. This paper aims to compare the postoperative analgesic efficacy of local infiltration with bupivacaine alone versus a combination of bupivacaine and dexmedetomidine in patients undergoing abdominal hysterectomy. By assessing pain scores, time to first rescue analgesic, and total analgesic consumption, this study seeks to further validate the role of dexmedetomidine as an effective and safe adjuvant for local wound infiltration in this patient population.

MATERIALS AND METHODS

Study setting: This was a prospective, randomised, double-blind, controlled clinical study conducted in the Department of Anaesthesiology at the Department of Anaesthesia, Konaseema Institute of Medical Sciences, Amalapuram, AP, between April 2023 and August 2025, following approval from the Institutional Ethics Committee (IEC No: IEC/PR/2023/018 Dated 16-04-2023). Written informed consent was obtained from all participants.

Design: This was a double-blind, randomised controlled trial. Patients were divided into two groups: control (bupivacaine) and study (bupivacaine with dexmedetomidine). The randomisation schedule was generated by computer and kept in opaque, sealed envelopes. The study drugs were generated from a randomisation schedule by an anaesthesiologist who had no role in patient care or assessment of outcomes.

Patient population: Sixty adult female patients of ASA I and II, 18-70 years of age, scheduled for elective abdominal hysterectomy under general anaesthesia were enrolled. No patients had progressed to an American Society of Anaesthesiologists (ASA) physical status >II.

Inclusion criteria:

Aged 18 to 70 years
ASA physical status I or II
Elective abdominal hysterectomy for benign indications such as fibroids or abnormal uterine bleeding.

Exclusion criteria:

Known allergy to local anaesthetics or dexmedetomidine
History of chronic pain, opioid dependence, or regular analgesic use
Patients with significant cardiac or liver disease
Body mass index (BMI) > 35 kg/m²
Pregnancy or breastfeeding

Anaesthesia and intervention protocol:

All patients received a standardised general anaesthesia

protocol. After the abdominal hysterectomy and before the fascia closure, a surgeon or anaesthesiologist blinded to the group allocation performed local wound infiltration.

Group 1 (Control Group): Patients received 30 mL of 0.25% bupivacaine (at a dose not exceeding 1.5 mg/kg) infiltrated evenly into the subfascial and subcutaneous layers of the surgical incision.

Group 2 (Study Group): Patients received 1.0 mcg/kg of dexmedetomidine mixed with 30 mL of 0.25% bupivacaine, similarly, infiltrated into the surgical wound. The total volume of 30 mL was maintained by adding 0.9% normal saline as needed.

Data collection and outcome measures: Pain scores were assessed postoperatively using a Visual Analogue Scale (VAS), where 0 indicates no pain and 10 indicates the worst pain imaginable. The primary outcomes included:

Postoperative pain scores: Recorded at rest and during coughing at 2, 4-, 6-, 12-, and 24-hours post-surgery.

- Time to first rescue analgesic: The time from wound infiltration to the first request for supplementary pain medication.
- Total rescue analgesic consumption: The total amount of supplementary analgesia (e.g., morphine or other opioids) consumed in the first 24 hours post-surgery.
- Patient satisfaction: Assessed at 24 hours post-surgery using a standardised questionnaire.
- Adverse effects: Monitored and recorded, including nausea, vomiting, sedation, hypotension, and bradycardia.

Statistical analysis:

Descriptive statistics: Patient demographics and baseline characteristics were summarised using descriptive statistics, including mean and standard deviation for continuous variables and frequencies and percentages for categorical variables.

Group comparisons: The two groups used an independent t-test to compare the continuous outcomes (pain scores, time to first rescue analgesic, total analgesic consumption). Categorical outcomes (adverse effects, satisfaction) were compared using the Chi-square or Fisher's exact test.

Significance level: A p-value of < 0.05 was considered statistically significant. All statistical analyses were performed using appropriate statistical software (e.g., SPSS).

Ethical considerations: The hospital's Institutional Ethics Committee reviewed and approved the study protocol. All participants provided written informed consent before enrolment, and the trial was conducted per the ethical principles of the Declaration of Helsinki.

RESULTS

Sixty female patients undergoing abdominal hysterectomy were randomised into two groups (n=30 each). A total of 58 patients completed the study and were included in the final analysis, with two patients excluded due to conversion to an extended hysterectomy procedure. Both groups were comparable regarding patient characteristics, ASA physical status, and duration of surgery.

Postoperative pain scores:

Table 1: Comparison of Postoperative Outcomes Between Bupivacaine and Bupivacaine with Dexmedetomidine Groups

Outcome variables	Bupivacaine alone	Bupivacaine plus dexmedetomidine	P-value
Pain Score (VAS) at rest	Higher at 2, 4, 6, and 12 hrs	Significantly lower at 2, 4, 6, and 12 hrs	<.001
Pain Score (VAS) at coughing	Higher at 2, 4, and 6 hrs	Significantly lower at 2, 4, and 6 hrs	<.001
Rescue Analgesia Requirement	100% patients	50% patients	<.003
Total 24-hr Morphine Consumption	Significantly higher	Significantly lower	<.001
Time to First Rescue Analgesic	Significantly lower	Significantly higher	<.001
Patient Satisfaction Score (0-10)	Lower	Higher	<.0001
Incidence of Hypotension	Nil	Nil	Not Significant
Incidence of Bradycardia	Nil	Nil	Not Significant
Incidence of Nausea/Vomiting	Nil	Nil	Not Significant

Significantly lower pain scores: The bupivacaine plus dexmedetomidine group (Group II) demonstrated significantly lower pain scores at rest compared to the bupivacaine alone group (Group I) for up to 12 hours post-surgery ($P<0.01$). Pain scores on coughing were also significantly lower in the dexmedetomidine group for up to 6 hours post-surgery.

Analgesic consumption reduced rescue medication: A statistically significant difference in the requirement for rescue analgesia was observed between the two groups. All patients (100%) in Group I required supplemental morphine, whereas only 50% of patients in Group II needed it ($P<0.003$).

Lower total consumption: The total 24-hour morphine consumption was significantly lower in Group II compared to Group I ($P<0.001$).

Time to first rescue analgesic:

Prolonged analgesia: The mean time to the first request for rescue analgesia was significantly longer in the bupivacaine plus dexmedetomidine group compared to the bupivacaine-alone group. This indicates a prolonged duration of effective analgesia from the local infiltration itself.

Patient satisfaction: Higher satisfaction. Patients who received dexmedetomidine with bupivacaine (Group II) reported a higher level of satisfaction with their pain management compared to the bupivacaine-alone group (Group I) ($P<0.0001$).

Adverse effects:

Minimal side effects: No significant difference was observed in the incidence of common adverse effects such as hypotension, bradycardia, or nausea between the two groups. When administered locally, the systemic side effects typically associated with intravenous dexmedetomidine were negligible.

DISCUSSION

The results of this study demonstrate that local wound infiltration with a combination of bupivacaine and dexmedetomidine provides superior and prolonged postoperative analgesia compared to bupivacaine alone in patients undergoing abdominal hysterectomy.^[9,10] This is evidenced by significantly lower pain scores, a longer time to the first request for rescue analgesia, and lower overall opioid consumption in the combination group. These findings are consistent with the existing literature on dexmedetomidine as an adjuvant in regional

anaesthesia.^[11,12]

The enhanced and extended analgesic effect of the bupivacaine–dexmedetomidine combination is likely multifactorial. The primary mechanism of action involves dexmedetomidine's role as a highly selective alpha-2 adrenoceptor agonist.^[12] When applied peripherally, dexmedetomidine causes local vasoconstriction, which decreases the systemic absorption of bupivacaine from the wound site.^[10] This allows a higher concentration of the local anaesthetic to remain at the surgical site for longer, resulting in a more sustained sensory block.^[12,13] In addition to this peripheral effect, some systemic absorption of dexmedetomidine occurs, contributing to its analgesic, sedative, and opioid-sparing properties by acting on alpha-2 receptors in the central nervous system.^[14]

The observed opioid-sparing effect is a significant clinical benefit.^[13,14] In this study, the bupivacaine–dexmedetomidine group had a lower overall 24-hour morphine consumption and a reduced incidence of patients requiring rescue analgesia, consistent with previous research.^[13,15] By minimising opioid use, the combination therapy can mitigate common opioid-related side effects such as nausea, vomiting, and sedation, which can expedite patient recovery and improve overall satisfaction.^[14] The higher patient satisfaction scores reported in the combination group underscore the importance of effective pain control in the patient-centred aspect of postoperative care.^[15]

The safety profile of local dexmedetomidine infiltration is also a crucial consideration.^[16] In this study, the incidence of hemodynamic changes (hypotension, bradycardia) and other common adverse events was comparable between the two groups.^[14,16] This indicates that local administration of dexmedetomidine avoids the significant systemic side effects that can occur with intravenous administration, further supporting its safety and utility in a multimodal pain management strategy.^[14,16]

This study contributes to the growing evidence supporting dexmedetomidine as a valuable adjuvant for local wound infiltration in abdominal surgery.^[12,14,15] Its effectiveness is demonstrated not only by objective clinical measures like pain scores and opioid use but also by patient-reported outcomes such as satisfaction and quality of recovery.^[15,16] While previous studies have shown similar benefits for regional blocks such as the Transversus Abdominis Plane (TAP) block, this research specifically focuses on the simpler and more widely applicable technique of direct wound infiltration, making it a relevant finding for routine clinical practice.^[13,15]

Limitations and future directions

This study has some limitations. The relatively small sample size,

although consistent with many similar trials, may limit the generalizability of the findings. Future research could focus on larger, multicentric trials to confirm these results. Additionally, while the 24-hour follow-up period effectively captures immediate postoperative pain, assessing the potential for long-term benefits, such as a reduced risk of chronic postsurgical pain, would provide valuable insights. Future studies could also compare the efficacy of dexmedetomidine against other local infiltration adjuvants, such as epinephrine or ketamine, to further optimise pain management strategies.

CONCLUSION

Local wound infiltration with bupivacaine and dexmedetomidine is a safe and effective strategy for postoperative pain management in patients undergoing abdominal hysterectomy. The combination provides superior and longer-lasting analgesia, reduces opioid consumption, and enhances patient satisfaction without increasing adverse events. This approach aligns with modern multimodal pain management principles and supports enhanced recovery after surgery.

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Conflicts of interest

There are no conflicts of interest.

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