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TIME-BASED VISUAL ANALOG SCALE (VAS) ASSESSMENT IN POSTOPERATIVE EPIDURAL ANALGESIA: A COMPARATIVE STUDY OF ROPIVACAINE-FENTANYL VS BUPIVACAINE-FENTANYL

Anaesthesiology

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ABSTRACT

Background: Effective postoperative pain control improves patient satisfaction, functional recovery, and reduces complications. Epidural analgesia using ropivacaine or bupivacaine combined with fentanyl is commonly employed after infraumbilical surgeries. However, comparative data on their time-based pain relief patterns using VAS scoring are limited. **Methods:** A total of 120 patients undergoing infraumbilical surgery under combined spinal-epidural anaesthesia were involved in this prospective, randomized, double-blind trial. Group A received 0.1% ropivacaine with 2 mcg/ml fentanyl, and Group B received 0.1% bupivacaine with 2 mcg/ml fentanyl. VAS scores were recorded at 15-, 30-, 45-, 60-, 90-, 120-, 150- and 180-minutes post-epidural top-up. Rescue analgesia was given when VAS ≥ 3. Mean VAS scores and duration of analgesia were compared. **Results:** Group A showed slightly lower mean VAS scores over time, especially beyond the first hour, though differences were not statistically significant at most time points. The duration of analgesia (time until VAS ≥ 3) was longer in Group A (mean 152 ± 18 min) compared to Group B (mean 140 ± 22 min), p = 0.046. Fewer patients in Group A required rescue analgesia within the first 3 hours. **Conclusion:** Epidural ropivacaine-fentanyl offers comparable onset but longer-lasting analgesia than bupivacaine-fentanyl postoperatively. This supports the use of ropivacaine in cases where prolonged single-shot epidural relief is desired.

KEYWORDS

Epidural analgesia, post-operative pain, VAS, Ropivacaine, Bupivacaine

INTRODUCTION

Effective postoperative pain management is a cornerstone of enhanced surgical recovery. Inadequate control of pain can result in delayed mobilization, impaired respiratory function, increased stress response, and prolonged hospitalization. Among the various techniques available, epidural analgesia remains a preferred choice for infraumbilical surgeries due to its superior segmental control, reduced opioid consumption, and capacity to attenuate postoperative stress responses. [1,2]

The Visual Analog Scale (VAS) is one of the most widely used tools to measure pain intensity. Time-based VAS assessments enable clinicians to evaluate the efficacy and duration of postoperative analgesia in a quantifiable and standardized manner. Despite the extensive use of VAS in clinical trials, comparative evaluations of temporal pain trends between different local anaesthetic agents in epidural analgesia remain limited.

Bupivacaine has long been considered the gold standard for epidural anaesthesia due to its potent sensory and motor block properties. However, it carries a greater risk of cardiotoxicity and motor blockade, particularly with cumulative dosing or inadvertent intravascular injection [3,4]. Ropivacaine, a newer S-enantiomer of bupivacaine, offers a similar sensory block profile with reduced motor blockade and a lower propensity for systemic toxicity, making it increasingly popular for regional anaesthesia. [5,6]

When combined with fentanyl, both agents provide synergistic analgesia by acting at different levels of the pain pathway—ropivacaine via sodium channel blockade and fentanyl via μ-opioid receptor agonism. However, their temporal analgesic profiles, particularly in terms of onset, duration, and time-wise changes in VAS scores, have not been thoroughly compared in a single-dose postoperative epidural setting.

This study was undertaken to compare the time-based VAS scores and duration of postoperative epidural analgesia following administration of 0.1% ropivacaine with fentanyl versus 0.1% bupivacaine with fentanyl in patients undergoing infraumbilical surgeries. By evaluating pain at regular intervals up to 180 minutes, the study aims to identify which combination offers more sustained relief and reduces the need for early rescue analgesia.

MATERIALS AND METHODS

Study Design And Setting-

This was a randomized, double-blind, prospective, parallel-group study undertaken in the Department of Anaesthesiology at the Hind Institute of Medical Sciences, Mau, Ataria, Sitapur, Uttar Pradesh, India, over 18 months (January 2021 to July 2022). Approval was obtained from the Institutional Human Ethics Committee (Approval No. IHCE-HIMSA/MD/MS(20)/RD-14/01-21), and informed consent was obtained from all participants.

Study Population-

A total of 120 adult patients (aged 18–60 years), with American Society of Anaesthesiologists (ASA) physical status I or II, scheduled for elective infraumbilical surgeries under combined spinal-epidural anaesthesia (CSEA), were included.

Inclusion Criteria-

- Age 18–60 years
- ASA physical status I or II
- Elective infraumbilical surgery (e.g., inguinal hernia, lower limb orthopaedics)
- Informed written consent

Exclusion Criteria-

- Allergy to study drugs
- Coagulopathy or infection at the injection site
- Pre-existing neurological or psychiatric disorders
- Pregnancy or lactation
- ASA physical status ≥ III
- BMI > 35 kg/m²
- Failed catheter placement or conversion to general anaesthesia

Randomization And Blinding-

A computer-generated sequence was used to randomly assign patients into:

- **Group A:** 20 ml of 0.1% ropivacaine + fentanyl (2 mcg/ml)
- **Group B:** 20 ml of 0.1% bupivacaine + fentanyl (2 mcg/ml)

Blinding was maintained by having drug preparations performed by an independent anaesthesiologist. Both the patient and observer recording pain scores were blinded to group allocation.

Anaesthetic Technique-

All patients received CSEA at the L2–L3 or L3–L4 interspace. A test dose of 3 ml 2% lignocaine with adrenaline was used to rule out intrathecal or intravascular catheter placement. Spinal anaesthesia was administered separately with 3.5 ml of 0.5% hyperbaric bupivacaine.

Postoperatively, once spinal effects began wearing off and VAS ≥ 3, a single epidural top-up was given using the group-specific study drug.

Pain Assessment And Outcome Measures-

The Visual Analog Scale (VAS), which ranges from 0 (no pain) to 10 (worst pain imaginable), was used to measure pain. Time-based VAS scores were recorded at:

- 15-, 30-, 45-, 60-, 90-, 120-, 150-, and 180-minutes post-epidural injection.

The onset of analgesia was defined as the time taken for VAS to drop below 2.

The duration of analgesia was defined as the time from drug administration to when VAS again rose to ≥ 3 or when the patient requested rescue analgesia.

Rescue Analgesia-

If VAS ≥ 3, diclofenac sodium 75 mg intramuscular was administered as rescue analgesia, and the time was documented.

During the pre-operative phase, the patient was informed about the visual analogue scale (VAS) and post-operative analgesic techniques.

No pain I I I I I I I I I I Max. pain
1 2 3 4 5 6 7 8 9 10

Patients were instructed to mark on the line that represents the intensity of their discomfort on a 10-cm marked scale as shown above. Then the distance between the mark and no discomfort were measured. Pain was further graded as:

0- (VAS 0) Patient is comfortable
1- (VAS 1-3) Mild pain
2- (VAS 4-6) Moderate pain
3- (VAS 7-10) Severe pain

Statistical Analysis-

Data were analysed using IBM SPSS Statistics Version 20.0. Continuous variables (VAS scores, time to rescue) were presented as mean ± standard deviation and compared using the unpaired t-test. VAS changes over time were analysed using Repeated Measures ANOVA. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 120 patients were included in the final analysis, with 60 patients in each group (Group A: Ropivacaine-Fentanyl; Group B: Bupivacaine-Fentanyl). Both groups were comparable in terms of demographic variables such as age, weight, height, and ASA physical status (p > 0.05).

VAS Score Trends

The Visual Analog Scale (VAS) was used to measure postoperative pain at regular intervals for 180 minutes following a single epidural top-up. The mean VAS scores at each time point are presented in Table 1.

Table 1: Comparison of Mean VAS Scores Over Time

Time (min)	Group A VAS	Group B VAS
15	2.8	2.9
30	2.4	2.5
45	1.9	2.2
60	1.6	1.9
90	2.0	2.4
120	2.3	2.9
150	2.8	3.3
180	3.2	3.8

Group A consistently demonstrated lower mean VAS scores compared to Group B at most time intervals. This difference was especially apparent beyond the 60-minute mark.

However, using Repeated Measures ANOVA, the overall difference in VAS scores between the two groups over time was not statistically significant (p = 0.084).

At specific time points (150 and 180 minutes), Group B approached or crossed the VAS ≥ 3 threshold, indicating declining analgesic effect.

Figure 1 illustrates the VAS score trends over time. Group A maintained more stable analgesia, whereas Group B showed a progressive rise in VAS scores post 90 minutes.

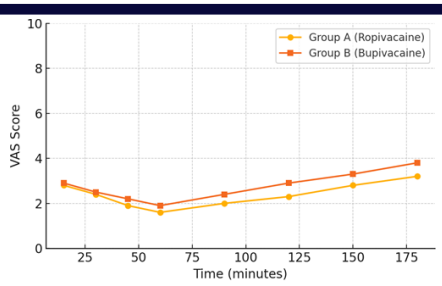

Figure 1: Time-based comparison of mean VAS scores between Group A (Ropivacaine) and Group B (Bupivacaine).

Duration Of Analgesia And Rescue Requirement

The mean duration of effective analgesia—defined as the time from drug administration to VAS ≥ 3—was 152 ± 18 minutes in Group A and 140 ± 22 minutes in Group B. The difference was statistically significant (p = 0.046) as calculated using the unpaired t-test.

Additionally, fewer patients in Group A required rescue analgesia within the 3-hour observation period. This suggests that ropivacaine-fentanyl provides more prolonged and consistent pain control than bupivacaine-fentanyl in the immediate postoperative setting.

DISCUSSION

Effective postoperative pain management remains a critical component of enhanced recovery after surgery (ERAS) protocols. This study compared the time-wise pain relief pattern, as measured by the Visual Analog Scale (VAS), following a single epidural dose of ropivacaine-fentanyl versus bupivacaine-fentanyl in patients undergoing infraumbilical surgeries.

Our findings demonstrated that while both groups achieved satisfactory pain relief in the early postoperative period, Group A (ropivacaine) maintained lower VAS scores beyond 60 minutes, with a statistically significant longer duration of analgesia (152 ± 18 min vs. 140 ± 22 min, p = 0.046). Although the overall difference in VAS scores across time points did not reach statistical significance by Repeated Measures ANOVA (p = 0.084), the trend toward sustained analgesia in the ropivacaine group was clinically relevant.

These results are consistent with the pharmacological profile of ropivacaine, which is known for providing prolonged sensory block with minimal motor involvement and reduced cardiotoxicity. Several previous studies support our findings. For example, Bhasin S et al. reported longer analgesia and fewer top-ups with ropivacaine-fentanyl than bupivacaine-fentanyl in lower abdominal surgeries. [9] Similarly, Kulkarni K demonstrated better hemodynamic and sensory block maintenance in ropivacaine users during labour analgesia, reinforcing the drug's favourable clinical profile. [10]

In contrast, bupivacaine, though historically considered the standard for epidural anaesthesia, is associated with greater motor block and shorter duration of sensory analgesia when used at lower concentrations. The progressive rise in VAS scores seen in our bupivacaine group beyond 120 minutes reflects this limitation. Furthermore, the greater number of patients in Group B requiring rescue analgesia within 3 hours underscores the shorter effective duration of action.

It is also noteworthy that ropivacaine's lower lipophilicity compared to bupivacaine may contribute to its slower systemic absorption and prolonged local effect. When combined with fentanyl, the synergy enhances analgesic efficacy without compromising safety—a benefit especially important in ambulatory and day-care surgeries.

Clinical Implications

From a practical standpoint, the results support the use of ropivacaine-fentanyl for single-dose epidural top-up in postoperative pain control where longer analgesia is desired without repeated dosing. The longer time to rescue analgesia and better pain profile beyond 2 hours favour its utility in procedures with anticipated moderate to severe early postoperative pain.

Limitations

This Study Had Some Limitations:

- The observation period was limited to 3 hours; longer follow-up could provide more insight into delayed rescue patterns.
- Patient satisfaction scores and motor block assessments were not included, which could have added value.
- Only ASA I–II patients were studied; results may not be generalizable to higher-risk populations or elderly cohorts.

CONCLUSION

This prospective, randomized, double-blind study evaluated the temporal pain relief pattern using the Visual Analog Scale (VAS) following a single epidural dose of 0.1% ropivacaine with fentanyl versus 0.1% bupivacaine with fentanyl in patients undergoing infraumbilical surgeries.

While both groups achieved effective analgesia, ropivacaine-fentanyl provided a significantly longer duration of pain relief, with a delayed requirement for rescue analgesia compared to bupivacaine-fentanyl. Although overall VAS score trends were not statistically different, Group A demonstrated more sustained analgesia beyond the 2-hour mark, reinforcing its clinical advantage.

Given its favourable safety profile, reduced motor blockade, and prolonged analgesic effect, ropivacaine-fentanyl may be considered a superior choice for postoperative epidural analgesia in infraumbilical surgeries—especially in contexts where extended single-dose pain control is preferred.

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