RESEARCH PAPER

Comparative Analysis of the Effectiveness of 0.75% Ropivacaine HCL and Normal Saline as Local Application for Post-operative Pain Control after Surgical Removal of Impacted Mandibular Third Molars

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ABSTRACT

Background: Pain involves a complex interaction of physiological and psychological processes in response to tissue injury or noxious stimuli. It is one of the most frequent postoperative complications observed after third molar extraction, often leading to notable discomfort, emotional distress, and temporary functional impairment. While non-steroidal anti-inflammatory drugs (NSAIDs) are commonly administered for pain relief, their use is sometimes limited by adverse effects, and to eliminate that, long-acting anaesthetic drugs can be used alternatively. Local drug delivery reduces systemic toxicity by sustained release of the drug to the target site.

Objective: To evaluate and compare the postoperative pain, patient's satisfaction towards postoperative pain control, postoperative supplemental analgesic rescue use (time) on using Normal Saline and Ropivacaine HCL soaked in Absorbable gelatin sponge when placed in the extraction socket after impacted mandibular third molar surgery.

Materials and Methods: A single-blinded, randomised controlled experiment was carried out on 26 individuals who underwent surgical extraction of the mandibular third molar. The patients were randomly divided into two groups. Patients in Group 1 (n=13) got an Absorbable gelatin sponge (AGS) soaked in 0.9% normal saline and put in the extraction socket. Group 2 (n=13) used 0.75% ordinary ropivacaine HCL to soak AGS in the extraction socket. Post-operative pain was measured using a visual analogue scale after 5 hours, 12 hours, 24 hours, 48 hours, 72 hours, and 96 hours after surgery on days 1, 2, 3, 4 and 7. Rescue analgesic medication were also evaluated.

Results: The study found a substantial ($p<0.05$) reduction in post-operative pain in the ropivacaine group compared to the control group at 5-hour, 12-hour, 24-hour, day 2, day 3, and day 4. In the ropivacaine group, analgesic medication intake was lower than in the other groups.

Conclusion: Placing 0.75% ropivacaine in an absorbable gelatin sponge in the extraction socket following impacted mandibular third molar surgery is an effective and safe way to alleviate postoperative pain. It has a good effect on the patient's pain control and reduces the need for analgesics.

Keywords: Impacted mandibular third molar, Ropivacaine, Normal saline, Absorbable Gelatin Sponge, Post-operative pain, Analgesic drugs

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INTRODUCTION

Third molar eruption typically occurs between 18 to 24 years of age, yet timing largely varies, making extraction one of the most common dental procedures [1]. About 90% of adults have mandibular third molars, and nearly one-third experience at least one impaction[2], often influenced by genetic and environmental factors [3]. Although routine, third-molar surgery involves incisions, bone removal, and nerve blocks, posing risks such as pain, swelling, alveolar osteitis, or nerve injury that reduce post-operative quality of life [4,5]. Complication rates (4.6–30.9%) depend on age, systemic health, impaction pattern, and surgical skill [5,6], hence, effective pain management is vital [7].

Conventional analgesics target inflammation or central pain pathways but cause systemic effects drowsiness, gastrointestinal distress, respiratory depression and risk of issues [8,9]. Local anaesthetic agents provide targeted relief by blocking nerve conduction. Lignocaine (HCl), a fast-acting amide, offers moderate duration, while Bupivacaine (HCl), more lipophilic, provides stronger and longer analgesia [10]. However, their effects often decline within eight hours as plasma levels peak within 30–45 minutes and decline by six hours [11]. Sustained delivery methods enhance duration and safety by limiting systemic absorption [12,13]. Intra-socket drug application enables localised and prolonged analgesia. Gelfoam, an absorbable gelatin sponge, functions as a biocompatible matrix prolonging anaesthetic retention [14].

The aim of this study is to evaluate and compare the efficacy of Normal Saline and 0.75% Ropivacaine HCL soaked in Absorbable gelatin sponge when placed in the extraction socket after impacted mandibular third molar surgery.

METHODOLOGY

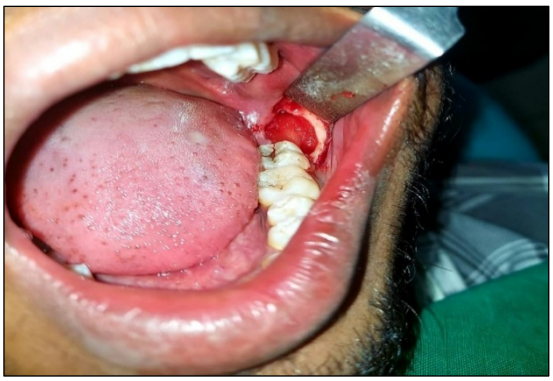
This single-blinded prospective randomised controlled trial was performed on patients reporting to KLE PRABHAKAR KORE Hospital, Belagavi, who are undergoing the surgical extraction of impacted mandibular third molar for the duration of 6 months, from February 2025 to August 2025

Participants aged 18 to 50 years presenting with impacted mandibular third molars were enrolled based on specific eligibility criteria. Only non-smoking patients with ASA I physical status, normal bleeding and clotting profiles, and no prior use of analgesics were included. All participants provided informed consent and had moderately impacted third molars (Pederson Index 3–5). Patients were excluded if they declined participation, had systemic illness or immunocompromised status, allergy to anaesthetic agents, had an active infection (e.g., pericoronitis), or had any concomitant pathology (e.g., tumour, cyst), or were pregnant or nursing female participants.

Patients diagnosed with mandibular impacted third molars based on established clinical and radiographic parameters and meeting the inclusion criteria were recruited for the study. Each participant underwent a thorough preoperative evaluation, including a detailed case history, vital sign assessment, and required haematological investigations. After explaining the surgical procedure and potential outcomes, informed written consent was obtained from all participants. The patients were then randomly assigned into two equal groups using computer-generated allocation: Group A (Control), which received 0.9% normal saline–soaked absorbable gelatin sponges used and Group B (Study), in which 0.75% Ropivacaine HCl–soaked absorbable gelatin sponges were used as shown in Figure 1.

All extractions were performed in the oral surgery unit by a single experienced surgeon under strict aseptic conditions to maintain procedural uniformity and minimise operator bias. Preoperatively, patients were instructed to rinse with an equal mixture of 0.2% chlorhexidine and normal saline, followed by skin disinfection using 5% povidone-iodine with sterile draping. Local anaesthesia was achieved through inferior alveolar, lingual, and long buccal nerve blocks using 2% lignocaine with adrenaline (1:80,000). A full-thickness Ward's incision was made to reflect a mucoperiosteal flap, and bone guttering with tooth sectioning, when necessary, was carried out under copious saline irrigation. After extraction, the socket was curetted to remove granulation tissue, trimmed for sharp bone edges, and irrigated thoroughly. The designated sponge was then placed in the socket according to group allocation, followed by flap repositioning and closure with 3-0 silk sutures. Standard postoperative instructions were given, and patients were prescribed a five-day antibiotic regimen (Amoxicillin 500 mg q8h for 5days), analgesics (Paracetamol 650 mg q8h for 3 days), anti-inflammatory (Chymoral Forte q8h for 3 days), and gastroprotective drugs (Pantoprazole 40 mg OD for 5 days), with Ibuprofen 400 mg as rescue medication. Patients were instructed to document the rescue medication they took. Follow-up was on postoperative days 2, 5 and 7th day for suture removal.

Figure 1: Placement of ropivacaine-soaked gelatin sponge in the third molar extraction socket



Statistical methods: Descriptive statistics were presented using mean and standard deviation for continuous variables, and frequency with percentage for categorical variables. Visual representation of data was done through bar charts and line charts where appropriate.

To assess differences between the two intervention groups, categorical variables were analyzed using the Chi-square test. For numerical variables, independent samples t-tests were used for normally distributed data, whereas non-parametric tests, such as the Mann–Whitney U test, were employed for

data not meeting normality assumptions. The choice of statistical test was based on the type and distribution of the variable under analysis. All statistical tests were two-tailed, and a p-value of less than 0.05 was considered indicative of statistical P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis [30].

Table 1: Distribution of Parameter in study groups (N=26)

Parameter	Study Group		P-value
	Control (n=13)	Ropivacaine (n=13)	
Age [Mean ± SD]	26.17 ± 5.39	27.83 ± 5.57	0.361*
Gender			
Female	5 (38.5%)	7 (53.8%)	0.431†
Male	8 (61.5%)	6 (46.2%)	
Tooth of Extraction			
Tooth in 3rd Quadrant (48)	8 (61.54%)	7 (53.85%)	0.691†
Tooth in 4th Quadrant (38)	5 (38.46%)	6 (46.15%)	
Pederson's Difficulty Index [Mean ± SD]	4.88 ± 0.69	5.31 ± 0.52	0.073*

**: Independent T- Test & †: Chi-Square test*

The mean age of participants was 26.17 ± 5.39 years in the Control group and 27.83 ± 5.57 years in the Ropivacaine group, with no statistically significant difference (p = 0.361). Gender distribution was comparable between groups, with 5 males(38.5%) and 8 females(61.5%) in the Control group, and 7 females(53.8%) and 6 males(46.2%) in the Ropivacaine group(p = 0.431). The side of extraction was also evenly distributed with 8 left-sided(61.5%) and 5 right-sided(38.5%) extractions in the Control group compared to 7 left(53.8%) and 6 right(46.2%) in the Ropivacaine group (p = 0.691). Pederson's difficulty was comparable between groups (4.88 ± 0.69 vs 5.31 ± 0.52, p = 0.073), indicating no baseline difference in surgical difficulty. Hence both groups were demographically and surgically comparable at baseline. (Table 1 and Graph 1 to Graph 4)

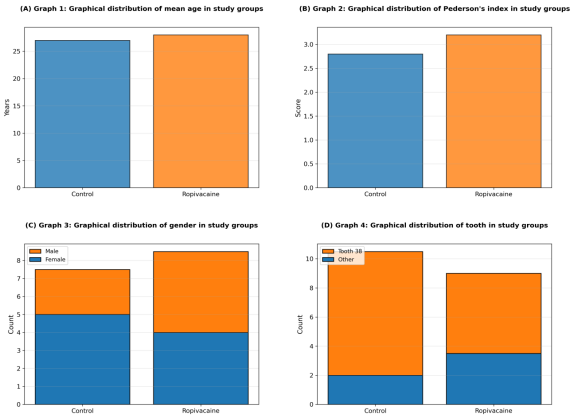


Table 2: Comparison of Mean VAS Scores at Different Time Points in study groups (N=26)

Time Point	Control (Mean ± SD)	Ropivacaine (Mean ± SD)	p-value
5th Hour	7.72 ± 0.71	5.52 ± 0.71	< 0.001*
12th Hour	7.77 ± 0.70	5.68 ± 0.61	< 0.001*
24th Hour	7.03 ± 0.88	5.27 ± 0.81	< 0.001*
48th Hour	5.40 ± 0.72	4.35 ± 0.77	0.001*
72nd Hour	4.68 ± 0.05	4.07 ± 0.05	< 0.001*
96th Hour	3.02 ± 0.80	2.27 ± 0.00	0.005*
7th Day	0.85 ± 0.64	0.60 ± 0.64	0.329*
Overall	5.21 ± 2.50	3.97 ± 1.85	< 0.001*

**: Independent T- test*

At all postoperative time points except Day 7, the Ropivacaine group demonstrated significantly lower pain levels compared to the Control group (all p < 0.001 except 7th day). For example, at the 5th hour, the mean pain score was 7.72 ± 0.71 in the Control group, versus 5.52 ± 0.71 in the Ropivacaine group (p < 0.001). By 48th hour, scores reduced to 5.40±0.72 vs 4.35±0.77 (p=0.001). On Day 7, pain was minimal in both groups (0.85±0.64 vs 0.60±0.64, p=0.329). The overall mean pain score was significantly lower in the Ropivacaine group (3.97 ± 1.85) compared with Control (5.21 ± 2.50, p < 0.001). Hence Ropivacaine provided superior and longer-lasting postoperative analgesia. (Table 2 and Graph 5)

Graph 5: Comparison of Mean VAS Scores at Different Time Points in study groups (N=26)

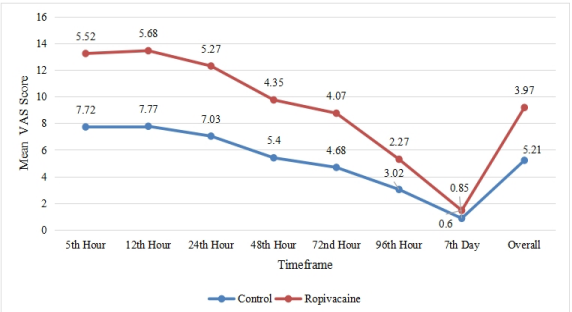


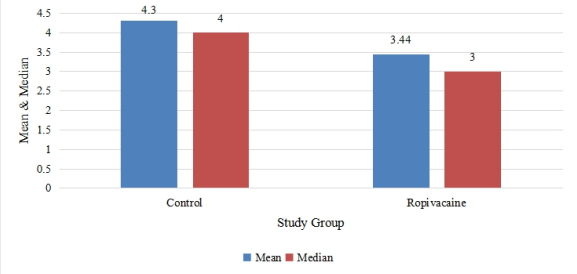
Table 3: Comparison of mean Total Analgesic Rescue Drug Intake in study groups (N=26)

Group	Mean ± SD	Median	p-value
Control	4.30 ± 2.74	4 (2.43–5.30)	0.344 £
Ropivacaine	3.44 ± 2.28	3 (1.92–4.09)	

£: Mann-Whitney U test

The mean number of rescue analgesic doses consumed was 4.30 ± 2.74 in the Control group and 3.44 ± 2.28 in the Ropivacaine group. The median intake (IQR) was 4 (2.43–5.30) for Control and 3 (1.92–4.09) for Ropivacaine. This difference was not statistically significant (p = 0.344, Mann-Whitney U test). Although analgesic intake was numerically lower in the Ropivacaine group, the reduction was not statistically significant. (Table 3 and Graph 6)

Graph 6: Comparison of mean Total Analgesic Rescue Drug Intake in study groups (N=26)



DISCUSSION

This single-blinded randomised controlled trial evaluated the efficacy of 0.75% Ropivacaine HCL soaked absorbable gelatin sponge (AGS) compared to normal saline in managing postoperative pain following impacted mandibular third molar surgery. Local anaesthetics like lignocaine, bupivacaine, and ropivacaine inhibit nerve conduction by blocking sodium channels, effectively reducing perioperative and postoperative pain[15]. Ropivacaine's pharmacological advantages include longer duration and lower systemic toxicity, making it a preferred agent in dental anesthesia[16,17]. Utilizing sustained-release systems such as AGS prolongs anaesthetic presence at the surgical site and reduces the need for systemic analgesics[18,15,19]. The Gelfoam® sponge is particularly valued for its biocompatibility, ease of use, and rapid absorption without causing tissue fibrosis[20].

In agreement with previous studies showing bupivacaine's effectiveness in different surgeries[21-27], our results demonstrated significant early postoperative pain reduction and improved patient satisfaction in the Ropivacaine group compared to saline controls. While differences in rescue analgesic use were not statistically significant, fewer patients required additional pain medication after Ropivacaine application. Additionally, no significant differences in postoperative edema or trismus were observed, confirming the procedure's safety.

Ropivacaine's prolonged action and vasoconstrictive properties likely contribute to sustained analgesia and enhanced recovery compared to saline-control conditions[28,29]. Gupta et al. (2020) compared the efficacy of lignocaine, bupivacaine, and ropivacaine in 250 patients undergoing posterior tooth extraction. The participants were divided into three groups receiving 2% lignocaine, 0.5% bupivacaine, and 0.75% ropivacaine, respectively. Intraoperative vital signs and postoperative pain were evaluated using the Visual Analogue Scale (VAS) and Verbal Rating Scale (VRS). The results demonstrated significant intergroup differences, with ropivacaine providing superior anesthetic depth and prolonged analgesia compared to lignocaine and bupivacaine. The authors concluded that ropivacaine offered the most effective postoperative pain control among the three agents, corroborating the present study's findings that its pharmacologic profile ensures extended analgesic duration without compromising hemodynamic stability[30]

LIMITATIONS

Study limitations including sample size and single-blind design underscore the need for larger, multi-centre trials to confirm these results and evaluate broader clinical outcomes.

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