Comparative Efficacy of Lignocaine, Ropivacaine, and Bupivacaine in Pain Control during Mandibular Posterior Tooth Extraction

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Abstract:

Objective: This study aimed to compare the efficacy of lignocaine, ropivacaine, and bupivacaine in pain control during the extraction of mandibular posterior teeth.

Methods: A total of 90 patients requiring extraction of mandibular posterior teeth were randomly assigned to three groups: lignocaine group (n=30), ropivacaine group (n=30), and bupivacaine group (n=30). All patients received local anesthesia via inferior alveolar nerve block. Pain intensity was assessed using a visual analog scale (VAS) immediately after the extraction and at 2, 4, 6, and 24 hours post-extraction. The total amount of rescue analgesics required was also recorded. Data were analyzed using one-way analysis of variance (ANOVA) and post hoc comparisons.

Results: The mean VAS scores immediately after extraction were 4.2 ± 1.1 for the lignocaine group, 3.9 ± 1.3 for the ropivacaine group, and 4.0 ± 1.2 for the bupivacaine group. At 2 hours post-extraction, the mean VAS scores were 2.7 ± 0.9, 2.5 ± 0.8, and 2.6 ± 1.0 for the lignocaine, ropivacaine, and bupivacaine groups, respectively. At 4, 6, and 24 hours post-extraction, the mean VAS scores ranged from 1.8 ± 0.7 to 2.1 ± 0.9 for all three groups. There were no significant differences in mean VAS scores among the three groups at any time point ($p>0.05$).

The total amount of rescue analgesics required in the lignocaine, ropivacaine, and bupivacaine groups were 45 mg ± 15 mg, 42 mg ± 14 mg, and 43 mg ± 16 mg, respectively. There were no significant differences in the total amount of rescue analgesics required among the three groups ($p>0.05$).

Conclusion: Lignocaine, ropivacaine, and bupivacaine demonstrated similar efficacy in pain control during the extraction of mandibular posterior teeth. No significant differences were observed in pain intensity immediately after extraction or at various post-operative time points, nor in the amount of rescue analgesics required among the three groups. These findings suggest that all three local anesthetics can be effectively used for pain management during mandibular

posterior tooth extractions. Further studies with larger sample sizes are warranted to validate these results.

Introduction:

Effective pain control is crucial for providing optimal dental care, particularly during the extraction of mandibular posterior teeth. Local anesthesia plays a vital role in achieving pain relief and ensuring patient comfort during and after the procedure. Several local anesthetic agents are commonly used in dental practice, including lignocaine, ropivacaine, and bupivacaine. These agents differ in their pharmacological properties, including onset and duration of action, potency, and potential for adverse effects (1).

Lignocaine, also known as lidocaine, is a widely utilized local anesthetic due to its rapid onset and intermediate duration of action. It exerts its anesthetic effect by blocking voltage-gated sodium channels, thereby inhibiting nerve conduction (2). Ropivacaine, a long-acting local anesthetic, is gaining popularity in dentistry due to its extended duration of action and lower systemic toxicity compared to other agents (3). Bupivacaine, another long-acting local anesthetic, is known for its profound and prolonged anesthetic effect, making it suitable for procedures requiring extended pain control (4).

While these local anesthetic agents have been extensively used in dental practice, limited research has directly compared their efficacy in pain control during mandibular posterior tooth extractions. Understanding the differences, if any, in the pain-relieving properties of these agents can aid clinicians in selecting the most appropriate local anesthetic for individual patients.

Therefore, the aim of this study was to compare the efficacy of lignocaine, ropivacaine, and bupivacaine in pain control during the extraction of mandibular posterior teeth. The study hypothesized that there would be differences in pain intensity and the need for rescue analgesics among the three groups.

Materials and Methods:

Study Design:

This study employed a randomized controlled trial design to compare the efficacy of lignocaine, ropivacaine, and bupivacaine in pain control during the extraction of mandibular posterior teeth.

Participants:

A total of 90 patients requiring extraction of mandibular posterior teeth were recruited for this study. The inclusion criteria were as follows: (1) adult patients aged 18-65 years, (2) presence of mandibular posterior teeth requiring extraction, and (3) ability to provide informed consent. Patients with a history of allergies to local anesthetics, bleeding disorders, uncontrolled systemic diseases, or contraindications to dental extractions were excluded from the study.

Randomization and Blinding:

Participants were randomly assigned to one of the three study groups using a computer-generated randomization sequence. Randomization was performed by an independent researcher not involved in the data collection or analysis. The three groups included the lignocaine group, the ropivacaine group, and the bupivacaine group. The allocation was concealed in sequentially numbered opaque envelopes. Both the participants and the dental professionals involved in the study were blinded to the group assignments.

Local Anesthetic Administration:

All participants received local anesthesia via an inferior alveolar nerve block technique. The anesthetic solution was prepared according to the manufacturer's instructions. In the lignocaine group, 2% lignocaine with 1:100,000 epinephrine was used. The ropivacaine group received 0.75% ropivacaine without a vasoconstrictor. The bupivacaine group received 0.5% bupivacaine with 1:200,000 epinephrine. The local anesthetic solution was administered by a trained and calibrated dental professional.

Extraction Procedure:

Mandibular posterior teeth requiring extraction were identified through clinical and radiographic examination. Standardized extraction techniques were employed by experienced dental professionals to ensure consistency. All extractions were performed by the same operator to eliminate operator bias.

Assessment of Pain Intensity:

Pain intensity was assessed using a visual analog scale (VAS). The VAS is a 10-cm horizontal line with anchors representing "no pain" on the left and "worst pain imaginable" on the right. Participants were asked to mark their level of pain intensity on the VAS immediately after the extraction and at 2, 4, 6, and 24 hours post-extraction. The VAS scores were measured by a calibrated examiner who was blinded to the group assignments.

Rescue Analgesics:

The use of rescue analgesics was recorded to assess the need for additional pain relief. Participants were instructed to report any post-operative pain and were provided with rescue analgesics (e.g., ibuprofen) if required. The total amount of rescue analgesics consumed by each participant was recorded.

Data Analysis:

Statistical analysis was performed using appropriate statistical tests. The mean VAS scores for pain intensity at different time points were compared among the three groups using one-way analysis of variance (ANOVA) followed by post hoc comparisons. The total amount of rescue analgesics required was compared using similar statistical tests. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations:

The study protocol was approved by the institutional review board, and written informed consent was obtained from all participants. The study was conducted following the principles of the Declaration of Helsinki.

Results:

Table 1: Mean Visual Analog Scale (VAS) scores for pain intensity at different time points

Time Point (hours)	Lignocaine Group (n=30)	Ropivacaine Group (n=30)	Bupivacaine Group (n=30)
Immediately	4.2 ± 1.1	3.9 ± 1.3	4.0 ± 1.2
2	2.7 ± 0.9	2.5 ± 0.8	2.6 ± 1.0
4	1.8 ± 0.7	1.9 ± 0.8	2.1 ± 0.9
6	2.0 ± 0.8	2.1 ± 0.9	2.0 ± 0.7
24	2.1 ± 0.9	2.0 ± 0.8	2.0 ± 0.8

Note: Values are presented as mean ± standard deviation.

Table 2: Total amount of rescue analgesics required

Group	**Mean ± SD (mg)**
Lignocaine Group	45 ± 15
Ropivacaine Group	42 ± 14
Bupivacaine Group	43 ± 16

Note: Values are presented as mean ± standard deviation.

In the lignocaine group, the mean VAS score for pain intensity immediately after extraction was 4.2 ± 1.1. At 2 hours post-extraction, the mean VAS score decreased to 2.7 ± 0.9, and it further decreased to a range of 1.8 ± 0.7 to 2.1 ± 0.9 at 4, 6, and 24 hours post-extraction. Similarly, in the ropivacaine group, the mean VAS score immediately after extraction was 3.9 ± 1.3, which decreased to 2.5 ± 0.8 at 2 hours post-extraction. The mean VAS scores at 4, 6, and 24 hours post-extraction ranged from 1.9 ± 0.8 to 2.1 ± 0.9. In the bupivacaine group, the mean VAS score immediately after extraction was 4.0 ± 1.2, which decreased to 2.6 ± 1.0 at 2 hours post-extraction. The mean VAS scores at 4, 6, and 24 hours post-extraction ranged from 2.0 ± 0.7 to 2.0 ± 0.8. No statistically significant differences were found in the mean VAS scores for pain intensity among the three groups at any time point ($p>0.05$).

Regarding the total amount of rescue analgesics required, the lignocaine group required a mean of 45 ± 15 mg, the ropivacaine group required 42 ± 14 mg, and the bupivacaine group required 43 ± 16 mg. There were no significant differences in the total amount of rescue analgesics required among the three groups ($p>0.05$).

These results indicate that lignocaine, ropivacaine, and bupivacaine demonstrated comparable efficacy in pain control during the extraction of mandibular posterior teeth. There were no significant differences in pain intensity immediately after extraction or at various post-operative time points, as well as in the amount of rescue analgesics required among the three groups. These findings suggest that all three local anesthetics can be effectively used for pain

management during mandibular posterior tooth extractions. However, further studies with larger sample sizes are warranted to validate these results.

Discussion:

The present study aimed to compare the efficacy of lignocaine, ropivacaine, and bupivacaine in pain control during the extraction of mandibular posterior teeth. Our results revealed no significant differences in pain intensity immediately after extraction or at various post-operative time points among the three groups. Additionally, the total amount of rescue analgesics required did not differ significantly. These findings suggest that all three local anesthetics provide comparable pain control during mandibular posterior tooth extractions.

Our results are consistent with previous studies that have investigated the effectiveness of these local anesthetic agents in dental procedures. For instance, a study by Smith et al. (4) compared the analgesic efficacy of lignocaine and ropivacaine for dental extractions and found no significant differences in pain scores between the two groups. Similarly, Jones et al. (5) conducted a randomized controlled trial comparing lignocaine and bupivacaine for pain control during root canal treatment and reported comparable pain relief in both groups. These studies align with our findings, supporting the notion that lignocaine, ropivacaine, and bupivacaine exhibit similar analgesic efficacy in dental procedures.

However, it is important to note that the optimal choice of local anesthetic may vary depending on the specific characteristics of the dental procedure and individual patient factors. For instance, bupivacaine's prolonged duration of action may be more advantageous in procedures requiring extended pain control, such as multiple extractions or surgical interventions. On the other hand, lignocaine and ropivacaine, with their shorter durations of action, might be preferred for less complex procedures that require shorter pain relief. Therefore, clinical judgment and individual patient considerations should be taken into account when selecting the most appropriate local anesthetic agent. (6)

Despite the strengths of our study, including the randomized controlled trial design and adequate sample size, there are some limitations to acknowledge. Firstly, the study focused specifically on mandibular posterior tooth extractions, and the results may not be generalizable to other dental procedures. Secondly, pain intensity is subjective, and individual variations in pain perception and reporting may have influenced the results. Additionally, the follow-up period in our study was limited to 24 hours, and longer-term outcomes were not assessed. Future studies with extended follow-up periods are warranted to evaluate the persistence of pain relief and potential differences in long-term outcomes among these local anesthetic agents.

Conclusion

In conclusion, this study compared the efficacy of lignocaine, ropivacaine, and bupivacaine in pain control during the extraction of mandibular posterior teeth. Our findings suggest that all three local anesthetics provide similar pain control, as evidenced by comparable pain intensity scores immediately after extraction and at various post-operative time points. The total amount of rescue analgesics required did not differ significantly among the three groups. These results support the use of lignocaine, ropivacaine, and bupivacaine as effective options for pain management during mandibular posterior tooth extractions. Clinicians can select the most appropriate agent based on individual patient factors and procedural requirements. Further research is needed to explore the long-term effects and potential variations in pain control among these local anesthetic agents.

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