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COMPARING EFFICACY OF ARTICAINE AND LIGNOCAINE IN MAXILLARY IRREVERSIBLE PULPITIS CASES IN TERMS OF PAIN MANAGEMENT

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ABSTRACT

Background: In the field of dentistry, effective pain management is critical, especially in cases of maxillary irreversible pulpitis. Articaine and lignocaine, both local anesthetics, are commonly used, but their comparative efficacy in managing pain during dental procedures remains an area of active research.

Objective: The objective of this study was to compare the intraoperative pain relief and overall efficacy of two analgesic drugs, A and B, in patients undergoing a medical procedure. The study aimed to assess which drug offers superior pain control and minimizes the need for supplemental injections.

Study Design: This was a randomized controlled trial.

Study Setting: The study was conducted at Outpatient Department of Operative Dentistry, Fatima Memorial Hospital, Lahore.

Methodology: This randomized controlled trial included 75 patients, aged 18-50 years, undergoing a specific medical procedure. The participants were divided into two groups: 40 received Drug A, and 35 received Drug B. Pain levels were recorded during the procedure, with categories including no pain, moderate pain (1-5), and unbearable pain (6-10). The need for supplemental analgesic injections was also documented.

Results: Drug A resulted in significantly higher reports of moderate (85%) and unbearable pain (10%) compared to Drug B, where 62.9% of patients reported no pain ($p < 0.001$). Drug B showed greater efficacy, with 62.9% of patients reporting effective pain relief, compared to only 5% in the Drug A group ($p = 0.001$). Additionally, supplemental injections were more frequently required in the Drug A group (62.5%) than in the Drug B group (28.6%).

Conclusion: Drug B demonstrated superior efficacy in managing intraoperative pain compared to Drug A, as evidenced by lower pain scores and a reduced need for supplemental analgesia. Drug B should be considered a more effective option for pain control during similar procedures.

Keywords: Intraoperative pain, analgesia, Drug A, Drug B, randomized controlled trial, pain management.

INTRODUCTION

Endodontics, the branch of dentistry that deals with the cause, diagnosis, prevention, and treatment of diseases of the dental pulp, usually involves the removal of pulp tissue from the pulp cavity and its replacement with suitable restorative material. This process is commonly known as pulp canal therapy or root canal therapy.[1] Local anesthetic agents are essential for successful endodontic procedures, and their pharmacologic properties play a special role in the treatment of painful, acutely or chronically inflamed, or necrotic teeth. The dosage of local anesthetic agents must be limited to prevent toxicity, which may be enhanced by the co-administration of sedative or narcotic drugs that affect hepatic drug metabolism.[2,3]

Endodontic patients can develop central and peripheral sensitization, making them particularly challenging for pain control. Morphogenetic changes resulting from neurogenic inflammation can render pain fibers more resistant to the action of local anesthetic agents.[4] The use of vasoconstrictors with conventional and supplemental injection techniques, such as intraosseous injections, is necessary to prolong the duration of local anesthetic action but can place patients with cardiovascular disease at some risk. Acknowledging all of these aspects of local anesthesia in endodontics will better prepare the operator for predictably safe and effective patient care.[5]

Although many endodontists focus on drugs for pain control, this is only one aspect of the clinician's armamentarium for managing endodontic pain. Several studies indicate that various clinical procedures provide substantial benefits in relieving odontogenic pain. Attributing success or failure to a particular treatment or procedure can be challenging. It is common for endodontists to review cases that seem similar in nature but respond differently to the same clinical approach. In contrast, similar cases may respond equally well to different treatments. A direct cause-and-effect clinical relationship may actually result from a variety of variables that were either not recognized or not fully appreciated.[6,7] The level of a patient's anxiety and preoperative pain has been shown to affect the levels of postoperative pain. Preoperative pain and anxiety are thus predictors of ineffective local anesthesia and postoperative pain.[8,9]

One such study found that 4% articaine was 1.59 to 3.76 times more likely to produce anesthetic success than 2% lidocaine, and 3.81 times more likely when given as an infiltration.[10] Similarly, a separate study found that 4% articaine with 1:100,000 epinephrine was superior to 2% lidocaine with 1:100,000 epinephrine in patients with irreversible pulpitis when given as a maxillary buccal infiltration. Other studies, however, have found no significant difference in the efficacy of 2% lidocaine (1:100,000) and 4% articaine (1:100,000) in achieving anesthesia of maxillary teeth with irreversible pulpitis.[11]

Thus far, research at the clinical, pharmacological, and molecular levels has been undertaken to estimate the benefits of articaine over traditional lignocaine. However, the efficacy of articaine in cases of irreversible pulpitis remains limited. Recognizing the importance of providing profound anesthesia for patients undergoing endodontic procedures, clinicians continually seek to identify a local anesthetic agent that provides the highest level of efficacy at an affordable cost. Given the limited studies comparing articaine and lignocaine with this pathology, I have been encouraged to undertake this comparison in a scientific manner and from a local perspective. The objective of the study was to compare efficacy of articaine and lignocaine in maxillary irreversible pulpitis cases in terms of pain management.

METHODS

The study was approved by the IRB (FMS-12-IRB-D-110) of the hospital. Informed written consent was obtained from all patients who were willing to participate. The study was designed as a triple-blind randomized controlled trial. It was conducted at the Outpatient Department of Operative Dentistry, Fatima Memorial Hospital, Lahore, Pakistan from 2017 to 2018. The sample size was calculated using WinPepi software, with a significance level of 5% and a power of 80%. Based on assumed proportions of 100% in Group A (articaine injection) and 80% in Group B (lidocaine injection), the required sample size was 70 patients, with 35 patients in each group. A non-probability consecutive sampling technique was employed. The inclusion criteria for the study were patients aged 25 to 45 years, both male and female, with maxillary first molar teeth diagnosed with symptomatic irreversible pulpitis. Patients were excluded if they had any contraindications to local anesthesia, such as a known allergy, or if they had a local acute infection, periapical abscess, or necrotic tooth, as diagnosed clinically and radiographically by an expert endodontist.

Socio-demographic data and symptoms were recorded, and subjects were examined for signs. Relevant investigations, including sensibility tests and radiographs, were performed. Patients were randomly divided into two groups, A and B, using a simple coin toss method. The study was triple-blinded by removing the drug labels from the cartridges and encoding one drug as A and the other as B. The patients, investigators, and statistical analysts were unaware of the type of anesthetic used during the procedure. Both solutions were encoded so that the investigator administering the anesthesia could not identify the anesthetic solution. For both groups, the drugs were delivered using a standard aspirating syringe with a sterile, single-use 27G 0.40 x 21mm disposable dental needle. The anesthetic was administered at the buccal vestibule adjacent to the tooth to be treated, at a rate of approximately 1ml/min. Five minutes after administration, an electric pulp test was performed using the SybronEndo Kerr Vitality Scanner 2006. The test was labeled positive if the patient showed visible signs of pain (e.g., blinking or changes in facial expression) and negative in the absence of such signs. If the test was positive, 0.2-0.4ml of the same anesthetic agent was injected intraligamentarily as a supplemental injection. After 2 minutes, the test was repeated, and this step was continued until a negative result was achieved. Pulpal anesthesia was considered successful if electric pulp tester readings were higher than 80 without eliciting pain.

During endodontic therapy, peri-operative pain was measured subjectively using the VAS on a 10 cm scale, with 1 cm intervals representing pain levels from "no pain" (on the right) to "worst pain" (on the left). Patients were asked to mark the number that best described the pain they experienced during the procedure. All data were recorded on a specially designed proforma. Patient comfort was adequately taken care of throughout the procedure, with a female dental surgery assistant present for young female patients.

Efficacy was labeled as the absence of pain after local anesthesia administration during pre-operative and peri-operative endodontic procedures. It was determined by the reduction in the patient’s pain in response to electric stimulation before treatment and during access cavity preparation and pulpectomy, with the Visual Analogue Scale (VAS) used to grade responses. Success was defined as no or mild discomfort during the procedure. Symptomatic Irreversible Pulpitis was labeled as a condition where the vital inflamed pulp was incapable of healing, requiring root canal treatment. Key characteristics included sharp pain upon thermal stimulus, lingering pain lasting 30 seconds or more, unprovoked pain, and referred pain, assessed through dental history and thermal testing.

Data were entered and analyzed using SPSS version 20. Descriptive analysis involved calculating the mean and standard deviation for age and individual pain scores. Standard deviations of VAS values were calculated for both drugs A and B. Efficacy and gender were presented as frequency and percentage. Efficacy in both groups was compared using the chi-square test. Data were stratified for age, gender, baseline pain score, and educational status, and post-stratification chi-square tests were applied, considering a p-value > 0.05 as significant.

RESULTS

The demographic characteristics of patients, as shown in Table 1, indicated that the age distribution was as follows: 14.67% were aged 18-25, 29.33% were aged 26-33, 38.67% were aged 34-42, and 17.33% were aged 43-50, with a mean age of 34.8 ± 8.01 years. In terms of gender, 44% were male and 56% were female. Regarding education levels, 58.67% had graduated, 20% had completed intermediate education, 10.67% had matriculated, 8% held a master's degree, and 1.33% were either under matriculated or illiterate.

Table: Demographic Characteristics of Patients

Variable	Categories	Frequency (%)
Age Range	18-25	11 (14.67)
	26-33	22 (29.33)
	34-42	29 (38.67)
	43-50	13 (17.33)
	Mean Age	34.8 ± 8.01
Gender	Male	44 (44)
	Female	56 (56)
Education Level	Graduation	35 (58.67)
	Intermediate	12 (20)
	Matric	8 (10.67)
	Masters	5 (8)
	Under Matric/Illiterate	1 (1.33)

In Table 2, the context of supplemental injections required during procedures revealed that 62.5% of patients receiving Drug A required supplements, compared to 28.6% of patients receiving Drug B. Overall, 56% of patients did not require supplements, while 44% did.

Table 2: Supplemental injection required during procedure

Drug	Supplement (Yes)	Supplement (No)
Drug A	25 (62.5%)	15 (37.5%)
Drug B	10 (28.6%)	25 (71.4%)

The distribution of patients by drug type and supplement use in Table 3 showed that 42.5% of patients using Drug A did not require supplements, whereas 71.4% of those using Drug B did not require supplements.

Table 3: Distribution of Patients by Drug Type and Supplement Use

Drug Type	No Supplement n (%)	Yes Supplement n (%)	Total n (%)
Drug A	17 (42.5%)	23 (57.5%)	40 (100%)
Drug B	25 (71.4%)	10 (28.6%)	35 (100%)
Total	42 (56%)	33 (44%)	75 (100%)

The gender-wise distribution of patients experiencing pain peri-operatively in Table 4 revealed that 30.3% of males experienced no pain, while 69.7% reported moderate pain. Among females, 33.3% reported no pain, 57.1% experienced moderate pain, and 9.5% reported unbearable pain. The overall pain distribution indicated that 32% of patients reported no pain, 62.7% reported moderate pain, and 5.3% reported unbearable pain.

Table 4: Gender-Wise Distribution of Patients Experiencing Pain Per Operatively

Gender	No Pain	Moderate Pain (1-5)	Unbearable Pain (6-10)	Total	P-value
Male	10 (30.3%)	23 (69.7%)	0 (0%)	33 (100%)	0.160
Female	14 (33.3%)	24 (57.1%)	4 (9.5%)	42 (100%)	
Total	24 (32.0%)	47 (62.7%)	4 (5.3%)	75 (100%)	

Regarding age categorization in Table 5, the youngest age group (18-25) experienced moderate pain (63.6%) more frequently than no pain (27.3%). The 26-33 age group had 40.9% reporting no pain and 59.1% reporting moderate pain. In the 34-42 group, 31.0% experienced no pain, while 62.1% reported moderate pain. The 43-50 age group showed 23.1% with no pain and 69.2% with moderate pain.

Table 5: Age Categorization of Patients Experiencing Pain Per Operatively

Age Group	No Pain	Moderate Pain (1-5)	Unbearable Pain (6-10)	Total	P-value
18-25	3 (27.3%)	7 (63.6%)	1 (9.1%)	11 (100%)	0.000
26-33	9 (40.9%)	13 (59.1%)	0 (0%)	22 (100%)	
34-42	9 (31.0%)	18 (62.1%)	2 (6.9%)	29 (100%)	
43-50	3 (23.1%)	9 (69.2%)	1 (7.7%)	13 (100%)	
Total	24 (32.0%)	47 (62.7%)	4 (5.3%)	75 (100%)	

Table 6 indicated that pain status during the procedure showed that 5.0% of patients receiving Drug A reported no pain, while a significant 85.0% experienced moderate pain. Conversely, 62.9% of patients receiving Drug B reported no pain, while only 37.1% experienced moderate pain.

Table 6: Pain Status During Procedure

Drug	No Pain	Moderate Pain (1-5)	Unbearable Pain (6-10)	Total	P-value
Drug A	2 (5.0%)	34 (85.0%)	4 (10.0%)	40 (100%)	0.000
Drug B	22 (62.9%)	13 (37.1%)	0 (0%)	35 (100%)	
Total	24 (32.0%)	47 (62.7%)	4 (5.3%)	75 (100%)	

Finally, the comparison of efficacy between Drug A and Drug B in Table 7 showed that 95.0% of patients receiving Drug A reported no efficacy, whereas 37.1% of those receiving Drug B did. Overall, 68.0% of patients reported no efficacy across both drug types.

Table 7: Comparing Efficacy of Drug A and B Per Operatively

Drug	Efficacy (No)	Efficacy (Yes)	Total	P-value
Drug A	38 (95.0%)	2 (5.0%)	40 (100%)	0.001
Drug B	13 (37.1%)	22 (62.9%)	35 (100%)	
Total	51 (68.0%)	24 (32.0%)	75 (100%)	

DISCUSSION

The results of the present study showed significant difference between 4% articaine and 2% lidocaine on anesthetic success following an infiltration injection for maxillary first molars with irreversible pulpitis (>0.05). The onset of anesthesia is an important issue for anesthesia success evaluation. The onset of anesthesia in inferior alveolar nerve block and infiltration injection are different and the letter technique provide quicker anesthesia. The onset of anesthesia in maxillary teeth is usually achieved within 5-7 min after administration of anesthesia. Therefore, in the present

study, an electric pulp test was performed 5 min after administration of anesthesia to initially test the effectiveness of the injection.[12]

In comparing our study with previous research, we observe both similarities and differences in the efficacy of articaine and lidocaine in pain management. In our study, Drug B (articaine) demonstrated superior analgesic efficacy over Drug A (lidocaine), with 62.9% of patients reporting no pain and significantly fewer requiring supplemental analgesia ($p < 0.001$). This outcome aligns with Tortamano et al. (2009), who found no statistically significant difference between lidocaine and articaine in pulpectomy success rates (56% and 58%, respectively), though our study reported a greater disparity between the two anesthetics.[13] Similarly, Krishna et al. (2023) found that articaine exhibited superior pain control with a VAS score of 1.07 compared to lidocaine's 1.53 during orthodontic extractions, which mirrors our findings where Drug B resulted in significantly lower pain scores ($p = 0.001$). The longer anesthetic duration for articaine reported by Krishna et al. (217 vs. 169 minutes for lidocaine) supports our observation that Drug B had a more sustained effect during the procedure.[14]

In contrast, Srinivasan et al. (2009) reported a higher success rate for pulpal anesthesia using articaine (100%) compared to lidocaine (80% in the premolar and 30% in molar teeth), demonstrating articaine's superior efficacy, which is consistent with our finding that Drug B provided better pain management. However, their success rate was notably higher than ours, likely due to differences in procedural contexts.[15] The meta-analysis by Miglani et al. (2021) further supports the enhanced efficacy of articaine, with a 1.37 times greater success rate for mandibular teeth compared to lidocaine. Though our study focused on different outcomes, this robust statistical evidence supports the general trend of articaine's superiority in dental procedures.[16] Additionally, Rogers et al. (2014) found that supplemental buccal infiltration (BI) with articaine was significantly more effective than lidocaine, aligning with our findings where fewer patients on Drug B required additional injections (28.6% vs. 62.5% for Drug A).[17] However, Syed et al. (2022) found no significant difference in the number of failed anesthesia cases between articaine and lidocaine, which contrasts with our results. Yet, the efficacy of articaine in their study was found to be better overall, consistent with our outcomes.[18] Similarly, Ahmed et al. (2014) reported no statistically significant difference in the anesthetic efficacy of the two agents in buccal infiltration, suggesting that the differences may be procedure-dependent.[19]

Finally, Chen et al. (2022) highlighted that while articaine may reduce pain scores more effectively than lidocaine in primary molar extractions, the difference may not be clinically significant, which contrasts with the clear efficacy observed in our study, though their focus was on a different procedural context. Our study, therefore, corroborates much of the existing evidence that articaine provides superior pain control compared to lidocaine in clinical settings, particularly in reducing pain scores and the need for supplemental analgesia.[20]

The strengths of our study include a robust sample size and a randomized controlled trial design, which enhances the reliability of the findings. The use of validated pain assessment tools, such as the VAS score, ensures objective measurement of patient outcomes. Additionally, the comparison between two commonly used anesthetics in dental procedures offers practical insights for clinical application. However, limitations include the single-center study setting, which may affect the generalizability of the results, and the short follow-up period, which limits the assessment of long-term efficacy and complications. Further multicenter trials are needed to validate our findings.

CONCLUSION

In conclusion, this study adds to the growing body of evidence supporting the use of articaine over lignocaine for pain management in dental procedures. Within the limitations of this study following conclusions can be made: 4% Articaine is more efficacious than 2% lignocaine in irreversible pulpitis cases

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