



COMPARATIVE EVALUATION OF 4% ARTICAININE AND 2% LIDOCAINE (1:100,000 EPINEPHRINE) FOR INFERIOR ALVEOLAR NERVE BLOCK IN MANDIBULAR THIRD MOLAR SURGERY

Dr. Pallavi Rai¹, Prof. Dr. Hemant Mehra², Dr. Abhijeet Humne^{3*}, Prof. Dr. Hemant Gupta⁴

¹MDS, Oral and Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow, Uttar Pradesh, India

²MDS, Oral and Maxillofacial Surgery, Saraswati Dental College and Hospital, Lucknow, Uttar Pradesh, India

^{3*}MDS, Oral and Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow, Uttar Pradesh, India

⁴MDS, Oral and Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow, Uttar Pradesh, India

***Corresponding Author:** Dr. Abhijeet Humne

*MDS, Oral and Maxillofacial Surgery, Babu Banarasi Das College of Dental Sciences, Lucknow, Uttar Pradesh, India, Telephone: +91 8806577728, Email: humneabhijeet@gmail.com

ABSTRACT

Background of the study: This study compares the anesthetic efficacy of 4% Articaine versus 2% Lidocaine, both with epinephrine 1:100,000, administered via the inferior alveolar nerve block technique during the surgical extraction of bilateral impacted lower third molars.

Study design: A randomized double-blind clinical study was conducted on 40 patients that required bilateral surgical extraction of impacted lower third molars. Each patient was administered 4% articaine on one side and 2% lidocaine on other side with the same concentration of vasoconstrictor (epinephrine 1:100,000). The following study variables for each anesthetic solution were assessed: latency (time to onset), duration of anesthetic effect, the amount of anesthetic solution used, haemodynamic parameters.

Result: Statistically significant differences were seen in the onset and duration of anesthesia. Articaine demonstrated a faster onset and a significantly longer duration of action when compared with lidocaine. No significant difference were observed in both the anesthetic agent group in the context of other hemodynamic parameters (Blood pressure, oxygen saturation, respiratory rate,)

Conclusion: When comparing the latency and duration of the anesthetic action, 4% articaine performs better than 2% lidocaine clinically. Other hemodynamic characteristics, however, did not show any statistically significant variations.

Keywords: Efficacy, Articaine, Lidocaine, Impacted, Mandibular third molar, Randomized study

STATEMENT AND DECLARATIONS: We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for

authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We further confirm that any aspect of the work covered in this manuscript that has involved either experimental animals or human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

COMPETING INTERESTS: No Competing interests

INTRODUCTION

Local anesthesia refers to the reversible loss of sensation in a specific bodily location brought on by a decrease in nerve ending excitement or a process inhibition in peripheral nerve endings, without causing loss of consciousness.¹ Effective pain control is the cornerstone of dentistry, making local anesthetics an imperative part in routine practice.

Nils Lofgren initially synthesized and introduced lidocaine (chemically known as diethyl-2, 6-dimethylacetanilide) in 1943. It remains a frequently used local anesthetic due to its rapid onset, predictable anesthetic depths and a known safety profile. The approximate duration of lidocaine's anesthetic effect for a 2% solution with epinephrine as a vasoconstrictor is 60 to 90 minutes minutes at pulpal level and 180 minutes in soft tissue; with its onset varying from 2 to 3 min and a half-life of 1.6-hours. Lidocaine continues to be regarded as the gold standard anesthetic agent against which newer local anesthetics are compared.^{1 2}

Articaine hydrochloride, an amide type of local anesthetic, is characterized by a thiophene ring structure that augments its tissue penetration and lipid solubility. It has a molecular weight of 320.8 with the chemical name of 4-methyl-3-(propyl-amino) propionamido-2- thiophenecarboxylic acid, methyl ester. Articaine exhibits higher bone penetration when compared to other amide anesthetic drugs because of its superior bone diffusibility and favourable hemostatic properties. Due to the abovesaid advantages, articaine has gained significant popularity in the field of maxillofacial surgery, and is frequently proposed as the best alternative to lidocaine.

This study was designed to assess and compare the anesthetic effectiveness of 4% Articaine with 1:100,000 adrenaline and 2% Lignocaine with 1:80,000 adrenaline for the surgical extraction of impacted mandibular third molar using the traditional inferior alveolar nerve block technique in adult patients.

A randomized double blind study was conducted with the following objectives:

- to evaluate and compare the effectiveness of 4 % articaine and 2% lidocaine for the surgical removal of bilateral impacted third molar.
- to compare the duration of anesthesia following an injection of articaine and lidocaine,
- to observe the effects of both the agents on the cardiovascular parameters
- to record subjective and objective symptoms during the procedure.²

METHODOLOGY

A total of 40 patients requiring the surgical extraction of mandibular bilateral impacted teeth reporting to Dept. of Oral and Maxillofacial Surgery, Babu Banarasi Das Dental college, Lucknow were selected for our study (Fig.1.). Each patient required similar surgical procedures on both sides of the jaw, and these procedures were completed in two appointment scheduled one to two months apart.

In the first appointment the patients were randomly selected to receive either 2 % lidocaine or 4% Articaine both with 1:100,000 epinephrine, administered via the inferior alveolar nerve block technique. In the second appointment, alternate local anesthetic was administered in a crossed-over study design. Subjective symptoms was noted when the patient experienced numbness of the lip, while the objective symptoms was assessed by evaluating the soft tissue anesthesia using a blunt instrumentation at every 10 seconds interval.

Two groups, one for each of the local anesthetic agents employed in the study, were assigned to the

data collected during the investigation, Articaine comprised group A and Lidocaine comprised group B. (Fig. 2 and 3)

The data obtained in the study included were: Onset of anesthesia, Recorded from time of injection to the onset of anesthesia of the lipas subjective and The objective symptoms.² Duration of surgery was measured from time of placing the incision to the last suture placed. The duration of anesthesia was in turn recorded as the time from initial patient perception of the anesthetic effect to the moment in which the effect began to fade. Blood pressure, oxygen saturation and heart rate were recorded before the administration of local anesthetics and after 5, 15, 30 minute.(Fig. 2 & 3). Any indications of systemic toxicity were monitored, including increased heart rate, blood pressure, and respiration rate, talkativeness, slurred speech, anxiety, localized muscle twitching and tremor of the hand and feet, and nervousness.²

A Visual Analog Scale (0–10) was used to score intraoperative pain (e.g. none, minimal, mild, moderate, severe). The data obtained in the study: including Onset of anesthesia, duration of anesthesia, pain scores and hemodynamic changes were statistically analyzed using Wilcoxon Sign Rank test and Mann-Whitney U test.

AIMS AND OBJECTIVES

The study's goal is to evaluate the effectiveness of 4% articaine and 2% lidocaine during the surgical removal of an impacted mandibular third molar.

OBJECTIVES

The objectives of the study will be to evaluate

- 1. To evaluate the effectiveness of articaine and lidocaine for the surgical removal of an impacted third molar in the mandible.
- 2. To compare with lidocaine and analyze the length of time anesthesia lasts following an injection of articaine
- 3. To observe the effects of the combination of lidocaine 2% and articaine 4% on the cardiovascular system.³
- 4. To look for any clinical symptoms of systemic toxicity.

FIGURES



Fig 1: (A) Pre-op OPG; (B) Post- op OPG after extraction of 48 (C) Post-op OPG after extraction of both 38,48



Fig 2: Intra-operative Pictures with Lidocaine (tooth extracted 48)

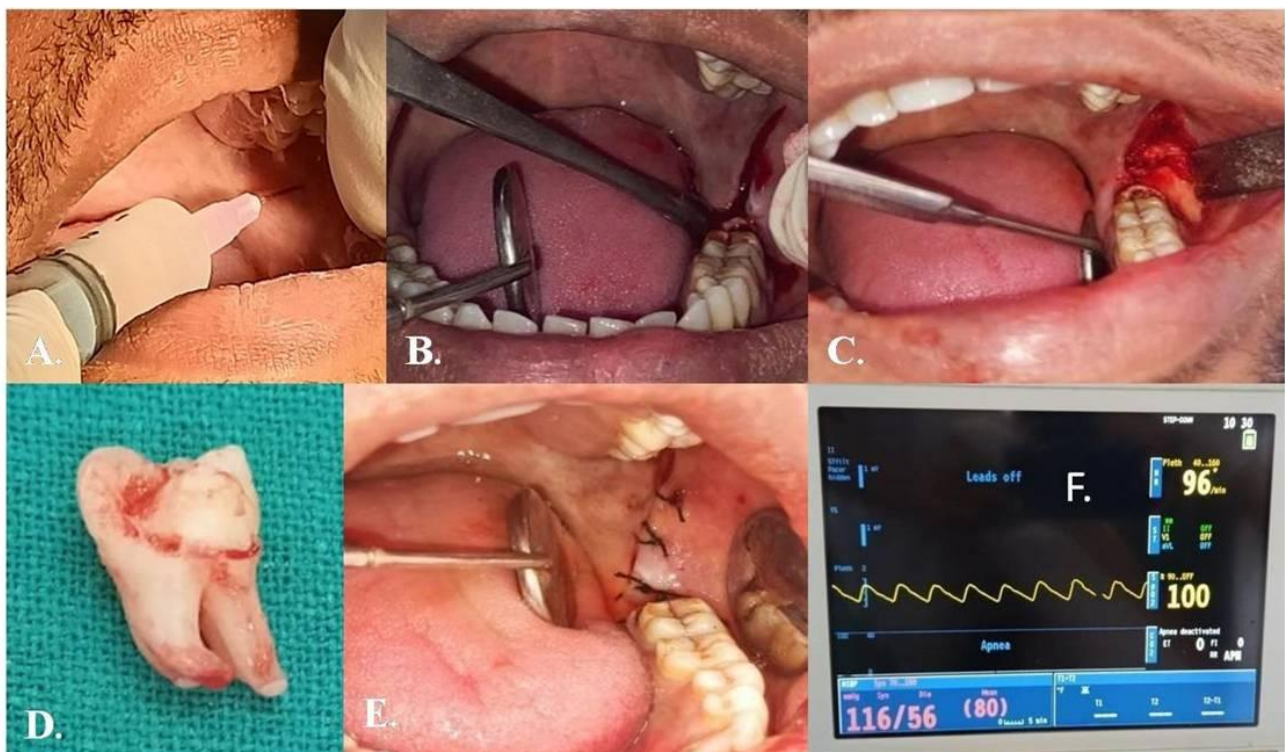


Fig 3: Intra-op Pictures with Articaine (tooth extracted 38)

TABLES:

Table I : Gender wise distribution of mean age

Mean Age (years)					
Gender	N	%	Mean	Std. Deviation	P value
Males	15	40%	27.0000	7.43864	0.980, NS
Females	25	60%	27.0667	5.93376	

Table II : Intergroup comparison of pain scores

Pain

Local anesthesia group	N	Minimum	Maximum	Mean	Std. Deviation	P value
4 % ARTICAINES WITH 1:100000 ADR	40	.00	2.00	.2400	.59722	0.107, NS
2 % LIDOCAINE WITH 1:100000 ADR	40	.00	5.00	.8000	1.47196	

Table III : Intergroup comparison of time of onset (in seconds)

Time of Onset (Seconds)					
	Mean	Std. Deviation	Std. Error Mean	p value	P value
Group I	122.29	19.411	3.962	0.001	Significant
Group II	176.85	21.389	4.194		

Table IV : Intergroup comparison of duration of anaesthesia (in seconds)

Duration of anaesthesia (seconds)				
	Mean	N	Std. Deviation	P value
4 % ARTICAINES WITH 1:100000 ADR	8692.93	40	930.36	0.001, S
2 % LIDOCAINE WITH 1:100000 ADR	7083.13	40	1128.81	

Table V : Intergroup comparison of pulse rate

Inter group comparison of mean pulse rate				
Group	Pre op	5 minutes	mean change	P value
Group 1	85.28±8.76	91.64±3.64	-6.36±9.03	0.031 (sig)
Group 2	79.08±9.34	90.88±8.20	-11.80±8.89	
	Pre op	15 minutes	mean change	
Group 1	85.28±8.76	87.16±8.19	-1.88±10.88	0.021 (sig)
Group 2	79.08±9.34	88.40±9.24	-9.32±12.72	
	Pre op	30 minutes	mean change	
Group 1	85.28±8.76	86.28±9.77	-1.00±11.90	0.679 (non-sig)
Group 2	79.08±9.34	81.48±8.48	-2.40±12.47	

RESULT:

The study population comprised of 40% males and 60% females. The comparison of mean age between males and females showed no statistically significant difference. (Table I)

The mean pain score in the Group I (Articaine) was 0.65 and in the Group II (Lidocaine) was 0.76. The intergroup comparison between the Group I and Group II was statistically non-significant, although Group I demonstrated a slightly lower pain score. (Table II) ⁶

The Intergroup comparison of time of onset (in seconds) was done by using Independent t test. The mean time of onset for 4% articaine was 122.29 which is significantly less when compared to 2 % lidocaine was 176.85.(Table III)

The mean duration of anaesthesia for 4% articaine was 8692.93 sec which is significantly more when compared to 2% lidocaine that was 7083.13, indicating a longer duration of anesthesia of articaine (Table IV).

Intergroup comparison of pulse rate was done using Mann Whitney U test. It was found that at 15 min, the mean pulse rate among Articaine group was significantly higher than that among Lidocaine group. At pre-op & 30 min, the mean pulse rate was also found to be slightly higher than that among Lidocaine group, however, these difference were not clinically significant overall. (Table V) ⁵

Discussion

In our study, 60% of the total patients were females whereas only 40% of the patients were males. We believe the higher female predilection could be due to the fact there is higher incidence of impacted third molar in female due to smaller jaw size as compared to males, pertaining to mendelian theory of impacted third molar. ¹⁷

In our study we measured pain on VAS scale, the maximum intra-operative VAS out of 1–10 for Articaine is 2 while for Lidocaine it is 5. Intergroup comparison of pain scores was done by using Mann Whitney U test that showed the mean pain score of 0.24 for articaine and 0.8 for lidocaine. The reduced pain experienced while depositing 4 % articaine is due to the thiophene group in the molecule, which enhances liposolubility, could be the reason for the drugs capacity to dissolve into tissues easily. Also the pH of lidocaine is 5-5.5 and of articaine is 4.4-5.2. Low pH of lidocaine produces more pain and burning sensation than articaine. However these results were statistically non-significant. ^{17 8 9 12}

In our study, the mean time of onset of articaine was 122.29 seconds which was significantly shorter than lidocaine that was 176.85 ^[3 4 5 6 7] The average time of onset for subjective symptoms for Articaine in our study was 2.05 minute min and for Lidocaine it was 2.96 min, this was however clinically nonsignificant. The greater time of onset of lidocaine is attributed to its higher latency that has a greater pKa value (7.9) as compared to articaine whose pKa value is found to be (7.8).

Following the administration of the local anesthetic, the oxygen saturation changes were measured and compared to the baseline value in both groups. The Spo2 value measured preoperatively for 4 % articaine and 2 % lidocaine was 99.12% and 98.6% respectively. Intra-operatively the values measured at 5 min ,15 min, and 30 min showed minimal fluctuations , and was statistically non-significant between both the groups. Although, at 15 mins, Spo2 was found to be slightly higher for articaine than lidocaine which was also clinically insignificant. ^[5 14 15 16]

The mean pulse rate before administering the local anesthetics was 85.28 for articaine and 79.08 for lidocaine. Intra-operatively the values measured at 5min,15 min, and 30 min showed a temporary increase in both the groups. It was noted that at 15 min, the mean pulse rate among Articaine group was significantly higher than that among Lignocaine group. However no significant difference was found in pulse rate for both the groups ^[4 8 10 14 16] .

The mean respiratory rate for articaine and lidocaine was 18.56±1.60 and 18.64±1.75 breaths/min respectively when evaluated preoperatively. Intra-operatively the values were measured at 5 min, 15 min , 30 minutes which remained comparable in both the groups at all time interval, with no significant statistical difference. We believe that the alteration of the respiratory rate could be due to stress and anxiety during extraction procedure.

In the similar way, the change in the systolic and diastolic blood pressure was measured and compared with the baseline value in both groups. It was found out that there was a slight elevation in the blood pressure which aligns with normal physiological response to the surgical simulation during pre-operative stage and at 5 min, 15 min and 30 minute. However, no statistical difference was found in blood pressure values for both articaine and lidocaine groups. ^[1 5 14 16]

The mean duration of anesthesia of Articaine was 2 hr 41 min and of lidocaine was 2 hr 5 min which showed that the duration of anaesthesia is significantly more in Articaine group. ^[4 5 6 7 8 9 10] This findings aligns with the fact that articaine has a better lipid solubility and a greater tissue perfusion.

Overall, our findings establishes that 4% articaine provides quicker onset, longer duration of anesthesia, and a reduced injection- associated discomfort when compared to 2% lidocaine, without any significant alteration in the vital parameters. These observations support the clinical preference

for articaine in procedures that requires rapid anesthesia with longer duration of action. However, further studies with larger sample sizes are recommended to validate these findings and to evaluate the long-term safety outcomes across diverse population groups.

Conclusion:

In our study, the results obtained suggest that Articaine is as potent as Lidocaine (Gold standard). Both the anesthetic agent showed comparable anesthetic property and a stable haemodynamic parameters. However, they both differ in onset of action and duration of anaesthesia. Articaine exhibits a shorter time of onset, longer duration of action and greater diffusion property due to greater liposolubility, makes it an ideal anaesthetic agent to be used in dentistry.^{13 15}

Although, there are few study reports showing increase incidence of paresthesia with 4 % articaine following inferior alveolar nerve block^{12 16}, no adverse effect during or after the procedure in our study. Based on the results obtained and clinical experience, we conclude that 4% articaine is a safe local anesthetic agent and performs better pharmacologically than 2% lidocaine, especially in terms of onset and duration of the anesthetic effect.^{11 14 19}

This study corroborates with the wider clinical application of articaine, while also highlighting the need of a larger sample, long-term studies, to evaluate its safety profile and efficiency in the diverse population group.

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