The Impact of 4% Articaine on ECG: Insights from a Randomised Control Trial

Original Article

Dr. SAKTHI.S , Dr. DURAIRAJ.D , Dr. JAMES ANTONY , Dr. NATHIYA , Dr. Thennarasu.A.R

DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY ADHIPARASAKTHI DENTAL COLLEGE AND HOSPITAL MELMARUVATHUR, TAMIL NADU, INDIA

ABSTRACT

AND BACKGROUND OF THE STUDY

Articaine can be used as alternative drug of choice for lignocaine because it has rapid onset and longer duration of action so these qualities of articaine can be beneficial for patient travelling from long distance in which patient can be free from pain. The aim of this study is to Compare the efficacy and safety such
as blood pressure and pulse rate ,ECG of the both of 4% Articaine with 1:100,000 epinephrine and 2% Lignocaine with 1:100,000 epinephrine in patients operated for mandibular third molar impaction.

METHOD This is a randomized controlled clinical trial a total 30 subjects were participated in the study with age ranging from 2245- years and parameters such as Drug volume(ml) ,Duration of surgical procedure, Intra operative pain evaluation, Onset of anesthesia, Duration of anesthesia, Duration of postoperative analgesia, ECG,blood pressure,pulse,spo2,temperature were assessed .

Results: It was evident that 4% articaine has longer duration of action and great postoperative analgesia in terms of 2% lignocaine and there was no significant difference in ECG,blood pressure,pulse ,spo2,temperature

Conclusion It was established that 4% articaine is more effective than 2% lignocaine. Hence might be thought of as a lignocaine substitute in clinical settings.A local anaesthetic solution that is efficient enough to produce sufficient anaesthesia while causing minimal problems is essential for minor oral surgical procedures sufficient anaesthesia while causing minimal problems is essential for minor oral surgical proceduresKeywordsspo2, blood pressure, ecg, lignocaine, articaine

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Corresponding Author: Dr. SAKTHI.S , DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY ADHIPARASAKTHI DENTAL COLLEGE AND HOSPITAL MELMARUVATHUR, TAMIL NADU, INDIA , **Mobile:** XXXX, **E-mail:** sakthidentiste@gmail.com

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INTRODUCTION:

A surgeon should do a painless procedure inorder to gain confidence of the patient for that local anaesthesia is needed. Local anesthetics are chemicals that block nerve conduction in a specific, temporary, and completely reversible manner without affecting the consciousness of the patient [1]. The potency of lidocaine is presently regarded as the standard for comparison with other local anesthetics. Lidocaine is the most commonly used because of its well-known pharmacokinetic characteristics and low toxicity compared with other anesthetics [2] In other hand , articaine hydrochloride was discovered by Rusching et al. in 1929 which he named it as carticaine [3].

The biochemical composition of articaine is different from other amide anaesthetics. The lipophilic part of articaine is made up of a thiophene ring, whereas other amide anaesthetics contain a benzene ring [4].Malamed et al. reported articaine to be a safe local anesthetic after comparing the drug with 2% lidocaine and epinephrine 1:100,000 and can be used in both adults and children. Articaine is outstanding as the local anesthetic indicated for dental procedures and control of postoperative pain [5].

This study`s intension is to determine the cardiac safety and efficacy of articaine in patient undergoing surgical removal of mandibular third molar . Safety evaluations included vital signs and ECG monitoring before giving LA and immediately after completion of procedure . Physiological responses associated with local anesthetic solutions containing a vasoconstrictor have included changes in heart rate and blood and dysrhythmias , ischemic changes (ST segment and T wave) and the release of catecholamine's ,endocrine response to surgery and hypokalemia. These changes are regulated by the net balance between sympathetic and parasympathetic activity, and both stress and pain will further modify autonomic response [6,7,8,9,10].

These vasoconstrictor-induced physiological events when exceed the normal range, the risk of morbidity or even mortality increases. So,special attention must be given to cardiovascular patients. Hence articaine is assessed for its systemic side effects such as effect

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on cardiovascular system.According to literature the information available about the cardiovascular response to dental LA with articaine is limited to healthy patients

MATERIALS AND METHODS

This is a randomized controlled clinical trial done to Compare and Analyze efficacy and safety of 4% Articaine with 1:100,000 epinephrine and 2% Lignocaine with 1:100,000 epinephrine during surgical removal of mandibular third molar. Patients who required surgical removal of mandibular third molar were selected for the study. A total of 30 patients were selected and divided into two groups.The inclusion and exclusion criteria is mentioned in table 1.

TABLE 1: inclusion and exclusion criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
Age should be 22-45 years	Medical history suggestive of known or suspected allergies to amide, systemic disease, pregnancy/lactation, subjects who had analgesics 24 h prior.
Patients requiring surgical removal of impacted mandibular third molars.	Patient on anticoagulant and antiplatelet therapy
Infection such as pericoronitis and pericoronal abscess will be given Antibiotic coverage and then proceed with treatment atleast after 5 days	Patient undergoing hemodialysis or immunosuppressive therapy
	Patients not willing to give consent for the study

PARAMETERS EVALUATED:

PARAMETERS ASSESDED INTRA AND POST OPERATIVELY

Drug volume(ml) and any additional injections will be recorded.

Duration of surgical procedure(min) from time of incision to last suture placed.

Intra operative pain evaluation: on Heft-Parker Visual Analog Scale.

Onset of anesthesia: (min) will be calculated by recording the time of injection, the time when patient first reports numbness of the lower lip and tongue and objectively checked on the attached gingiva with sharp dental probe.

Duration of anesthesia: (min) will be determined subjectively, patients will be asked to record the time when anesthesia had worn off completely and data will be collected over phone call.

Duration of postoperative analgesia: (min) difference between the end of surgery and the ingestion of the first analgesic tablet for pain relief.

ECG,BLOOD PRESSURE,PULSE,SPO2,TEMPERATURE METHODOLOGY:-
The complete method consisting of,

Pre operative evaluation

Surgical technique

Post operative management

Follow up

PRE OPERATIVE EVALUATION:-

Pre operatively, patients should be assessed which comes under inclusion and exclusion criterias. • Medical assessment of patient and general surgical fitness.

Pre-operative IOPA or OPG should be taken to assess the difficulty index of the teeth
Difficulty index will be assessed(pederson difficulty index).

Heart rate ,Spo2,Pulse,Temperature ,Blood pressure,ECG
PARAMETERS ASSESDED POST OPERATIVELY
Drug volume(ml) and any additional injections will be recorded.

Duration of surgical procedure(min) from time of incision to last suture placed.

Intra operative pain evaluation on Heft-Parker Visual Analog Scale.

Onset of anesthesia: (min) will be calculated by recording the time of injection, the time when patient first reports numbness of the lower lip and tongue and objectively checked on the attached gingiva with sharp dental probe.

Duration of anesthesia: (min) will be determined subjectively, patients will be asked to record the time when anesthesia had worn off completely and data will be collected over phone call.

Duration of postoperative analgesia: (min) difference between the end of surgery and the ingestion of the first analgesic tablet for pain relief.

Heart rate ,Spo2,Pulse,Temperature ,Blood pressure,ECG

Results

TABLE 2: Comparison of onset, duration of anesthesia and duration of postoperative analgesia of articaine and lignocaine

	GROUPS	N	MEAN±SD	t VALUE	p VALUE
ONSET(mins)	LIGNOCAINE	15	3.20±0.74	1.357	0.186
	ARTICAINE	15	2.48±0.54		
Duration of anesthesia (mins)	LIGNOCAINE	15	194.33±16.78	12.665	<0.001**
	ARTICAINE	15	364.33±49.20		
Duration of postoperative analgesia (mins)	LIGNOCAINE	15	145.33±11.87	21.334	<0.001**
	ARTICAINE	15	293.33±24.10		

The difference between the onset of action of lignocaine and articaine group was not statistically significant. (p>0.05)

The difference between the duration of anesthesia of lignocaine and articaine was found to be statistically significant. (p<0.001)

The difference between the duration of postoperative analgesia of lignocaine and articaine group was observed to be statistically significant.(p<0.001)

This indicates that the groups differed significantly in terms of duration of anesthesia and post operative analgesia. Articaine group had higher value as compared to lignocaine group.

TABLE 3: Comparison of Mean values of systolic and diastolic blood pressures

S.NO	PARAMETER	LIGNOCAINE	ARTICAINE	t VALUE	p-VALUE
1.	SBP1	116±5.070	118±17.80	0.339	0.311
2.	DBP1	76±5.070	75.33±5.16	0.356	0.361
3.	SBP2	120±5.345	118±6.76	0.898	0.188
4.	DBP2	81.27±7.261	82.43±8.25	1.010	0.162

SBP1: systolic blood pressure before anesthetic injection; SBP2: systolic blood pressure after anesthetic injection; DBP1: diastolic blood pressure before anesthetic injection; DBP2: diastolic blood pressure after anesthetic injection.

Table 3 shows comparison of Systolic and diastolic blood pressure before and after anesthetic injection in both the groups. No statistically significant difference was observed between groups indicating that the groups did not differ significantly in terms of systolic as well as diastolic blood pressure both before and after injection.

S.NO	PARAMETER	LIGNOCAINE	ARTICAINE	t VALUE	p-VALUE
1.	Pulse pre-op	74.33±3.24	77.33±3.48	1.829	0.039*
2.	Pulse post-op	76±4.43	79.27±6.23	1.995	0.028*

The mean pre-operative pulse rate in Group A and Group B were 77.33±3.48 and 74.33±3.24.

The mean post-operative pulse rate in Group A and Group B were 79.27±6.23 and 76±4.43.
The difference between the pulse rate of lignocaine and articaine group both pre operative as well as post operative was statistically significant.(p<0.05). Post Operative pulse value was higher in articaine group as compared to lignocaine group.
The duration of surgical procedure was comparatively longer in lignocaine group than articaine group.

The difference between the duration of surgical procedure of lignocaine and articaine group was statistically significant.(p<0.05)[table 5].

TABLE 5: Comparison of mean values of duration of surgical procedure under lidocaine and articaine injection

PARAMETER	LIGNOCAINE (In minutes)	ARTICAINE (In minutes)	t VALUE	p-VALUE
Duration of surgical procedure	37.8±4.56	29.67±3.632	3.3558	0.001*

TABLE 6: Comparison of intra operative pain score between groups – Mann Whitney U test

S.NO	PARAMETER	LIGNOCAINE Median±IQR	ARTICAINE Median±IQR	Test statistic	P value
1.	Intra operative pain score	1±0	1±0	117.50	0.838

[Table 6] shows comparison of intraoperative pain score between groups using Mann whitney U test. Statistically significant difference was not observed between groups($p>0.05$). Both the groups had similar average pain scores at the end of the study.

TABLE 7: Comparison of drug volumes between groups – Independent samples t test

[Table 7]shows comparison of drug volume in ml between groups using independent samples t test. The result was found to be highly significant($p<0.001$). This indicates that there exists significant difference between the mean values of drug volume of groups at the end of the study

S.NO	PARAMETER	LIGNOCAINE Mean ± SD	ARTICAINE Mean ± SD	Test statistic	P value
1.	Drug volume in ml	3.32 ± 0.32	2.10 ± 0.45	8.595	<0.001**

TABLE 8: Comparison of SPO 2 between pre operative and post operative mean values in two groups- Paired samples t test

		Mean	Std. Deviation	Mean difference	P value
Lignocaine	Pre operative	98.333	1.589	-0.134	0.830
	Pre operative	98.467	1.457		
Articaine	Pre operative	98.867	1.589	-0.400	0.348
	Pre operative	99.267	1.457		

[Table 8]shows comparison of mean SpO2 levels Pre operative and post operative in each group of the study. In lignocaine group, the preoperative value was observed to be 98.333±1.589 while the post operative value was found to be 98.467 ± 1.457. There is no statistically significant difference between pre OP and post OP values in lignocaine group($p>0.05$). The preoperative value in articaine group was found to be 98.867±1.187 while the post operative value was observed to be 99.267±0.799. No statistically significant difference was observed between pre OP and post OP values in articaine group.

TABLE 9: Comparison of SPO2 values preop and post op in two study groups – Independent samples t test

	Groups	N	Mean	Std. Deviation	Mean difference	P value
Pre operative	Lignocaine	15	98.333	1.589	-0.53	0.307
	Articaine	15	98.867	1.187		
Post operative	Lignocaine	15	98.467	1.457	-0.80	0.073
	Articaine	15	99.267	0.799		

[Table 9]shows comparison of Sp O2 values between lignocaine and articaine groups at pre OP and post OP levels. The comparison was done using independent samples t test. The result obtained was not statistically significant($p>0.05$) indicating no difference between groups before as well as after treatment.

ECG:

ECG was assessed pre and post-operatively in two groups showed shows normal sinus rhythm without ST segment elevation,inverted T wave, No ischemic changes .

DISCUSSION

Management of pain in oral surgery is a step towards success for the surgical procedure as it brings fame to the doctor from patient's perspective, if this painless surgery with more efficient post-operative analgesia and ensured safety for the patient can be provided it will increase the quality of practice. Number of local anesthetics has been assessed for their efficacy and postoperative analgesia. Diversity of local anesthesia are available in the market, Articaine is a Gold standard local anaesthetic with comparable rapid onset of action and longer duration of action, better post-operative pain control which have been studied extensively and being compared with lignocaine.Regardless of use of any local anaesthetic solution there are certain factors to be taken into consideration which includes the speed of injection, volume of solution deposited, density of tissue, and patient psychology. When administering local anaesthetics, discomfort is frequently due to the anaesthetic solution`s acidic pH. Plain local anaesthetic solution has a pH of about 5.5, while vasoconstrictor-containing solutions have a pH of about 4.5. The administration of the drug should be more comfortable if alkalinizing agents like carbon dioxide or sodium bicarbonate are added to the anaesthesia. Additionally, anaesthetics also have a quick onset of action and strong efficacy at higher pH levels. [11, 12 ,13 ,14 ,15]

Articaine was assessed for any systematic changes brought about by the anesthetic agent pertaining to systolic, diastolic, Blood pressure, Pulse, ECG.The bulk of comparative research connected to anaesthesia and third molar surgery have shown that patients' age and gender did not differ significantly among groups with mean ages of 22 to 25 years in our study. Our study takes into account a number of important factors, including the necessity of re-anesthesia during surgery and the evaluation of anaesthetic efficacy using equal volumes rather than similar dosages due to the difficulties of executing an electric pulp stimulus test for the purpose of objectively determining anaesthetic efficacy. The average volume used in our study coincides with the study of Malamed et al. [5] Through the use of the VAS, the depth of intraoperative anaesthesia was assessed, although there was no statistically significant difference between the two groups' values. [16, 17, 18, 19, 20] In our study 4% articaine has rapid onset of action 2.48±0.54min as compared to lignocaine 3.20±0.74min, though the data are statistically insignificant. Our findings are consistent with the study of Moore et al. [13] The difference between the duration of postoperative analgesia of lignocaine and articaine group was observed to be statistically significant. ($p<0.001$). The result from our study can be compared with study conducted by colombini et al for articaine (198 + 28.86 min) although he compared it with mepivacaine [16] Many hemodynamic studies have been carried out with patients subjected to local anesthetic injection with a vasoconstrictor [21, 22, 23, 24, 25] In our study no hypertensive peak was observed in the measurement of systolic, diastolic, or mean blood pressure at any evaluation time. No statistically significant difference was observed between groups indicating that the groups did not differ significantly in terms of systolic as well as diastolic blood pressure both before and after injection. The difference between the pulse rate of lignocaine and articaine group both pre-operative as well as post-operative was statistically significant. ($p<0.05$).

Our study report can be compared with study done by Lasemi, Esshagh et al compare the effects of 4% articaine with 1:100,000 epinephrine and 4% articaine with 1:200,000 epinephrineconcluded that the evaluation of the parameters reveals no significant differences were observed. The changes in SBP, DBP, and pulse rate during and five minutes after the injection, as well as the onset and duration of anaesthesia, were the same in both groups. [19] The ECG which was taken before administration of local anaesthetic and immediately after completion of procedure on both groups. The ECG reveals there was normal sinus rhythm with no ST segment elevation, inverted T wave, ischemic changes. So, this indicates that 4% articaine with 1:100,000 adrenaline is a safe drug for heart which can be compared with control drug 2% lignocaine with 1:100,000. There is no evidence in literature regarding ECG changes in 4% articaine and 2% Lignocaine. Temperature of body were assessed to evaluate whether local anaesthetic solution may contribute to thermal changeIn our study no statistically significant difference was observed in both the groups ($p>0.05$). This indicates that the mean temperature values after treatment did not change significantly from their values before treatment in both the groups involved in the study. There was no significant change noted in the oxygen saturation from the base line values at different time intervals after administration of 4 % Articaine and 2 % Lidocaine ($p>0.05$) indicating no difference between groups before as well as after treatment. Several authors Colombini B, Santos CF, Martinez AA ,Elad S reported in sync with our findings [26,27,28,29,30]

CONCLUSIONS

In this study, it was established that 4% articaine is more effective than 2% lignocaine, has a longer duration of anaesthesia, and provides greater postoperative analgesia. Hence might be thought of as a lignocaine substitute in clinical settings. Due to each patient's individual pain threshold, it is challenging to standardize research based on these pain control factors. A local anaesthetic solution that is efficient enough to produce sufficient anaesthesia while causing minimal problems is essential for minor oral surgical procedures. Although articaine has been compared to lidocaine as the gold standard anaesthetic agent, articaine has better potency, a shorter half-life, less toxicity, a faster onset, and more protein binding. There is no life threatening ECG changes noted with 4% articaine so it is safe to use in daily routine minor oral surgical procedure

Additional Information
Disclosures
Human subjects: Consent was obtained or waived by all participants in this study. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

CONFLICT OF INTEREST

This clinical study was self-funded by the authors, with no conflict of interest.

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