ANESTHETIC EFFICIENCY AND SAFETY OF 4% ARTICAINE, 0.5% BUPIVACAINE WITH 2% LIGNOCAINE IN SURGICAL REMOVAL OF IMPACTED MANDIBULAR THIRD MOLARS - A COMPARATIVE PROSPECTIVE STUDY.

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ABSTRACT :

Introduction : Lignocaine is the most commonly used local anesthetic agent in oral and maxillo facial surgery especially in minor oral surgical procedures such as surgical removal of impacted mandibular third molars. Loss of anesthesia during extraction of mandibular 3rd molars has been reported even though right anesthesia technique and proper dose used. This was the back ground of this study.

Aim : Local anesthetics form the backbone of intra-operative and postoperative pain control. Conventional lignocaine has many disadvantages which have been compared with articaine and bupivacaine. Since there are few studies comparing articaine, bupivacaine with lignocaine, we have selected this study to evaluate the anesthetic efficacy and safety in surgical removal of impacted mandibular third molars.

Materials and Methods: **I**n this comparative prospective study, 90 patients of ASA physical status I and II belonging to age group of 18- 45 years undergoing surgical removal of impacted third molars allocated into 3 groups of 30 patients each, Group A (4% Articaine) and Group B (0.5 % Bupivacaine) and Group C (2% Lignocaine). Group A received 1.8 ml of 4% of Articaine (1: 100000) , Group B received 1.8ml of 0.5 % of Bupivacaine (1;100000), Group C received 1.8ml of 2% of Lignocaine (1: 100000) of inferior alveolar nerve blocks of local anesthesia. Parameters assessed were onset of action, intra operative bleeding, vital signs, quality and duration of postoperative analgesia and anesthesia.

Results: The results showed that time of onset of action was significantlyfaster in 4% articaine when compared to 2% lignocaine and 0.5% bupivacaine,whereas duration of post-operative anesthesia and analgesia was pointedly higherin bupivacaine followed by articaine and lignocaine in order.

Conclusion: Articaine was seems to be superior to bupivacaine in terms offaster onset of action, lesser bleeding, less significant duration of soft tissueanesthesia and better bone penetrating quality and less patient discomfort.

Key-words: Articaine, Bupivacaine, Lignocaine, Anesthesia, Analgesia.

INTRODUCTION

Anesthesia creates a painless state which facilitates surgery to be performed. For most dento-alveolar surgeries, local anesthetics are the backbone of intra-operative pain and immediate postoperative pain control. Clinically conventional lignocaine has disadvantages such as failure of anesthesia, severe pain during elevation of impacted mandibular third molars, some patients needs multiple injections for complete anesthesia for painless impacted tooth removal. There are relatively few studies conducted in India to prove local anesthetic efficacy and safety especially regarding the use of different local anesthetic agents in surgical removal of impacted mandibular third molars. This as a background, the present study was taken up to compare the anesthetic

efficacy of 4 % articaine (1 :100000), 0.5% bupivacaine (1 :100000) and with 2 % lignocaine (1 :100000) in surgical removal of impacted mandibular third molars to achieve the objective of complete pain control.

MATERIALS AND METHODS

This comparative prospective study was carried out after clearance from ethical committee on patients of department of oral and maxillofacial surgery at tamilnadu. Govt. Dental college and hospital, no: 1, Frazer bridge road, Chennai, tamilnadu, india from September 2017 to September 2018. A total of 90 adult subjects randomly selected from out patient department (both male and female), age group between 18-45 years included in this study.

Study Design: comparative prospective study.

Study location : **T**his was tertiary care teaching hospital based study done in department of oral and maxilla facial surgery, at Tamilnadu govt dental college and hospital, frazer bridge road, Chennai, Tamilnadu, India.

Study Duration : September 2017 to September 2018

Sample Size : 90 patients.

Subjects & selection method : The comparative prospective sturdy was drawn from ASA type I,II patients who presented to tamilnadu govt dental college and hospital with complained of painful impacted mandibular third molars between September 2017 to September 2018. Patient was divided into 3 groups (each group had 90 patients) .

Group A (N = 30 patients)

Group B (N = 30 patients)

Group C (N = 30 patients)

GROUP A - 1.8 ml of four % articaine hydrochloride (HCl) with one :1,00,000 adrenaline were administered.

GROUP B - 1.8 ml of 0.5% bupivacaine HCl with one :1,00,000 adrenaline were administered.

GROUP C - 1.8ml of two % lignocaine HCl with one :1,00,000 adrenaline were administered

INCLUSION CRITERIA

1. Age group between 18-45 years including male, female patients selected
2. Patients with impacted mandibular third molars only taken for study.
3. American Society of Anesthesiologists (ASA) Grade I,II patients were selected for the study.

EXCLUSION CRITERIA

1. Infected impacted mandibular third molars.
2. Patients allergic to amide and ester type of local anesthetics.

PARAMETERS

The local anesthetic agents used in this trial are evaluated for the following:

1. ON SET OF ANESTHESIA : LATENCY TIME (in seconds)- This willbecalculated from the time of needle withdrawal from the site of injection to loss of sensation of lower lip,tongue andmucosa.

   Subjective symptom: tingling or numbness of lower lip, tongue.

   Objective sign: dental explorer is applied on gingival tissues between lower premolars on the extraction side. (pinprick test).

2. QUALITY OF ANESTHESIA DURING THE SURGERY :

   This is based on pain rating using VISUAL ANALOG SCALE (VAS) – Patients were asked to rate the degree of pain during the procedure on this scale.

   Score zero = no discomfort reported by the patient during surgery (VAS zero)

   Score one = mild discomfort reported by the patient during surgery (VAS one - three)

   Score two = moderate discomfort reported by the patient during surgery (VAS four - six)

   Score three = severe discomfort reported by the patient during surgery (VAS seven - ten)

3. INTRA OPERATIVE BLEEDING:

Mild, moderate, severe. Assessed by visual estimation of number of swabs used, amount of fluid collected in the suction jar minus the estimated quantity of saline used for irrigation.

4. DURATION OF POST OPERATIVE ANALGESIA:

   Began with the end of surgery to beginning of post-operative pain.

5. DURATION OF POST OPERATIVE ANESTHESIA:

   Began with the end of surgery to beginning of soft tissue sensation returns to normal.

6. MONITORING VITAL SIGNS:

   Systolic blood pressure, Diastolic blood pressure, Pulse rate, Partial pressure of oxygen measured using pulse-oxymeter.

SURGICAL PROCEDURE

After written informed consent was obtained, a well –designed questionnaire was used to collect the data of the recruited patients retrospectively. Patients were evaluated as per the standard norms and enrolled according to the inclusion and exclusion criteria. 90 patients with 30 patients in each group were allocated for the study. GROUP A: 1.8 ml of four % articaine HCl with one :1,00,000 adrenaline- 30patients. [FIGURE 1] GROUP B: 1.8 ml of two % bupivacaine HCl with one :1,00,000 adrenaline- 30patients. [FIGURE 2] GROUP C: 1.8ml of 0.5% lignocaine HCl with one :1,00,000 adrenaline- 30patients. [FIGURE 3]. Under strict aseptic conditions, following the administration of local anesthetic solution suitable incision was given [FIGURE 4, 5], mucoperiosteal flap was gently reflected [FIGURE 6] and required amount of bone trimmed so as to disimpact the tooth from bony interference. Odontectomy was performed using 703 bur and tooth was dis-impacted out of the socket [FIGURE 7] .Sharp bony edges were trimmed and socket was thoroughly irrigated with saline and betadine. Primary closure was achieved following adequate hemostasis [FIGURE 8,9].

Fig [1] : 4% Articaine

Fig [2] : 0.5% Bupivacaine

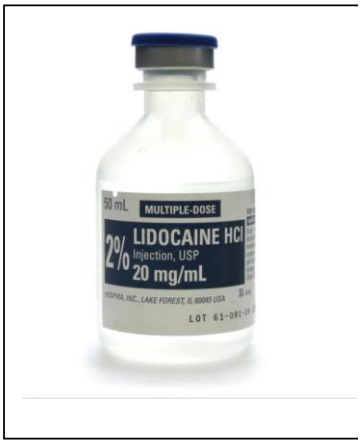

Fig [3] : 2% Lignocaine

Fig [4] : Inferior alveolar nerve block for mandibular third molar (48) surgical removal by a same operator.

Fig [5] : Ward's incision placed.

Fig [6] : Mucoperiosteal flap elevation around 48 for bone guttering .

Fig [7] : Bone guttering done around 48 with TC bur 703.

Fig [8] : Elevation of 48 with straight elevator.

Fig [9] : wound sutured.

Statistical analysis used:

Quantitative data was collected and assessed for normality using Statistical package for the social sciences (SPSS) version 16. Inter group comparison for categorical variables (qualitative variables) were carried out by using Pearson Chi-Square test. Inter group comparison for onset of pre-operative and post-operative anesthesia and analgesia were carried out by Analysis of Variance (ANOVA) followed by Tukey's post hoc test.

Results :

Our results coincides with this assumption, since the latency period was significantly shorter (Probability value (P)< 0.001) in group A patients, where average latency recorded was 150.77 ± 21.72 seconds as compared to group C and B where it was 175.50 ± 21.05, 314.73± 49.05 seconds respectively. [TABLE 1]

TABLE 1: DURATION OF PRE-OPERATIVE ANESTHESIA AND ANALGESIA (minutes)

S.NO	**PRE-OPERATIVE ANESTHESIA**			**PRE-OPERATIVE ANALGESIA**		
Groups	Group A	Group B	Group C	Group A	Group B	Group C
1.	225	429	200	139	314	135
2.	191	400	156	146	230	106
3.	166	374	165	137	224	125
4.	210	380	152	132	244	130
5.	181	227	175	168	187	142
6.	178	330	160	156	240	116
7.	197	338	152	179	232	123
8.	230	408	158	201	318	94

9.	170	347	139	147	197	146
10.	179	370	188	169	265	163
11.	157	312	175	107	222	141
12.	208	503	166	173	323	152
13.	183	529	157	168	484	129
14.	187	428	144	149	368	148
15.	186	399	153	148	324	139
16.	204	332	144	162	302	103
17.	196	499	133	178	439	123
18.	207	361	153	150	331	155
19.	178	485	168	145	395	160
20.	165	398	205	152	338	129
21.	191	423	151	179	393	151
22.	163	315	199	133	285	124
23.	183	404	154	168	374	133
24.	177	378	148	129	318	112
25.	156	373	142	136	283	153
26.	170	392	203	119	332	150
27.	159	423	155	166	398	142
28.	187	358	161	171	328	139
29.	164	437	136	185	362	147
30.	194	410	144	163	350	131

Despite the dissimilarity in physical properties, all the three anesthetics produce adequate depth of anesthesia on completion of removal of third molars. The extent of intra-operative bleeding was found to be mild in group A, C (90%), than group B (86.7%). More bleeding was observed with bupivacaine which could be interpreted due to the greater vasodilatory ability of bupivacaine. [TABLE 2] .

TABLE 2: INTRA-OPERATIVE BLEEDING

GROUPS		Intra-operative Bleeding		Total
		Mild	Moderate	
Articaine	Count	27	3	30
	% within Groups	90.0%	10.0%	100.0%
	%within Intraoperative Bleeding	33.8%	30.0%	33.3%
Bupivacaine	Count	26	4	30
	% within Groups	86.7%	13.3%	100.0%
	% within Intraoperative Bleeding	32.5%	40.0%	33.3%
Lignocaine	Count	27	3	30
	% within Groups	90.0%	10.0%	100.0%
	% within Intraoperative Bleeding	33.8%	30.0%	33.3%

The results were achieved using Tukey's post hoc test for multiple comparison and revealed that there was a significant difference in duration of onset of analgesia between group A and group B ($P < 0.001$) and between group B and group C ($P < 0.001$) how ever there was no

significant difference in duration of onset of anesthesia between group A and group C (P < 0.182). The duration of post-operative analgesia seems to be highest for Group B 313.33 ± 72.15 followed by group A 155.17 ± 21.01 and group C 134.70 ± 17.18. [TABLE 3] .

TABLE 3: DURATION OF ONSET OF ANESTHESIA, QUALITY OF ANESTHESIA AND INTRA OPERATIVE BLEEDING.

S.NO	**ONSET OF ANESTHESIA**			**QUALITYOF ANESTHESIA**			**INTRA OPERATIVE BLEEDING**		
Groups	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
1.	133	328	218	1	1	1	1	1	1
2.	216	288	146	1	2	1	1	2	1
3.	157	440	167	1	1	2	1	1	2
4.	139	285	157	2	1	1	1	1	1
5.	110	316	173	1	1	1	2	1	1
6.	142	290	182	1	1	1	1	1	1
7.	163	317	217	1	1	1	1	1	1
8.	165	292	188	1	1	1	1	1	1
9.	191	412	209	1	2	1	1	1	1
10.	152	294	169	1	1	1	1	1	1
11.	169	384	165	2	1	1	1	2	1
12.	172	289	149	1	1	1	2	1	1
13.	130	257	185	1	1	1	1	1	1
14.	137	379	183	1	1	1	1	1	1

15.	152	313	178	1	1	1	1	1	1
16.	174	252	193	1	1	2	1	1	2
17.	168	293	160	1	1	1	1	1	1
18.	149	244	177	1	1	1	1	1	1
19.	137	278	128	1	2	1	1	2	1
20.	148	273	169	1	1	1	1	1	1
21.	150	312	170	1	1	1	1	1	1
22.	118	306	159	1	1	1	2	1	1
23.	119	323	188	2	1	1	1	1	1
24.	156	296	209	1	1	2	1	1	2
25.	142	299	158	1	1	1	1	1	1
26.	161	312	186	1	2	1	1	1	1
27.	149	417	161	1	1	1	1	2	1
28.	133	286	178	1	1	1	1	1	1
29.	138	294	154	1	1	1	1	1	1
30.	153	373	189	1	1	1	1	1	1

Post-operative anesthesia is perceived to be highest for Group B 392.07 ± 62.76 followed by group A 184.73 ±19.21 and group C 161.20 ± 20.07. The level of significance is found to be $P < 0.001$. [TABLE 4] [TABLE 5] .

TABLE 4: MEAN AND STANDARD DEVIATION OF POST-OPERATIVE ANALGESIA

	GROUPS	**NUMBER (N)**	**MEAN**	**STANDARD (STD) DEVIATION**	**STD. ERROR MEAN**
POST OPERATIVE ANALGESIA	Group A	30	155.17	21.01	3.83
	Group B	30	313.33	72.15	13.17
	Group C	30	134.70	17.18	3.13

GROUP	**MEAN DIFFERENCE**	**STD.ERROR**	**SIGNIFICANCE**
GroupA Group B	-158.16	11.49	0.001
Group C	20.46	11.49	0.182
GroupB Group A	158.16	11.49	0.001
Group C	178.63	11.49	0.001
GroupC Group A	-20.46	11.49	0.182
Group B	-178.63	11.49	0.001

TABLE 5: DURATION OF POST-OPERATIVE ANESTHESIA (minutes)

	GROUPS	**N**	**MEAN**	**STD DEVIATION**	**STD. ERROR MEAN**
POST OPERATIVE ANESTHESIA	Group A	30	184.73	19.21	3.50
	Group B	30	392.07	62.76	11.45
	Group C	30	161.20	20.07	3.66

GROUP	**MEAN DIFFERENCE**	**STD.ERROR**	**SIGNIFICANCE**
GroupA Group B	-207.33	10.23	0.001
Group C	23.53	10.23	0.061
GroupB Group A	207.33	10.23	0.001
Group C	230.86	10.23	0.001
GroupC Group A	-23.53	10.23	0.061
Group B	-230.86	10.23	0.001

On individual comparison there was a significant difference in duration of onset of anesthesia between group A and group B($P < 0.001$) and between group B and group C ($P < 0.001$) how ever there was no significant difference in duration of onset of anesthesia between group A and group C ($P < 0.061$). [TABLE 6]

TABLE 6: MEAN AND STANDARD DEVIATION OF ONSET OF ANESTHESIA.

	GROUPS	N	MEAN	STD.DEVIATION	STD.ERROR MEAN
ONSET OF ANESTHESIA	Group A	30	150.77	21.72	3.96
	Group B	30	314.73	49.05	8.95
	Group C	30	175.50	21.05	3.84

GROUP	MEAN DIFFERENCE	STD. ERROR	SIGNIFICANCE
GroupA GroupB	-163.96	8.59	0.001
Group C	-24.73	8.59	0.014
GroupB Group A	163.96	8.59	0.001
Group C	139.23	8.59	0.001
GroupC Group A	24.73	8.59	0.014
Group B	-139.23	8.59	0.001

Vital signs such as blood pressure, oxygen saturation estimation was observed to be mild in 93.3% in group A, C and around 90% in group B whereas moderate in 6.7% noticed in group A,C and about 10% in group B. [TABLE 7] .

TABLE 7: VARIATION IN BLOOD PRESSURE

		Blood pressure		Total
		Mild	**Moderate**	
Articaine	Count	28	2	30
	% within Groups	93.3%	6.7%	100.0%
	% within diastolic pressure	33.7%	28.6%	33.3%
Bupivacaine	Count	27	3	30
	% within Groups	90.0%	10.0%	100.0%
	% within diastolic pressure	32.5%	42.9%	33.3%
Lignocaine	Count	28	2	30
	% within Groups	93.3%	6.7%	100.0%
	% within diastolic pressure	33.7%	28.6%	33.3%

TABLE 8: VARIATION IN OXYGEN SATURATION

		Oxygen saturation		Total
		Mild	**Moderate**	
Articaine	Count	28	2	30
	% within Groups	93.3%	6.7%	100.0%
	% within oxygen saturation	34.1%	25.0%	33.3%
Bupivacaine	Count	27	3	30
	% within Groups	90.0%	10.0%	100.0%
	% within oxygen saturation	32.9%	37.5%	33.3%
Lignocaine	Count	27	3	30
	% within Groups	90.0%	10.0%	100.0%
	% within oxygen saturation	32.9%	37.5%	33.3%

Pulse rate was found to be mild in 93.3% patients in group A and 90% in group B,C and moderate as 6.7% in group A, as ten % in group B, C. The P value was found to be insignificant. It was concluded that the anesthetic agent did not influence the vital signs during surgery. [TABLE 9] .

TABLE 9: VARIATION IN PULSE RATE

		Pulse rate		Total
		Mild	**Moderate**	
Groups	Articaine Count	28	2	30
	% withinGroups	93.3%	6.7%	100.0%
	% withinpulse rate	33.7%	28.6%	33.3%
	Bupivacaine Count	27	3	30
	% withinGroups	90.0%	10.0%	100.0%
	% withinpulse rate	32.5%	42.9%	33.3%
	Lignocaine Count	28	2	30
	% withinGroups	93.3%	6.7%	100.0%
	% withinpulse rate	33.7%	28.6%	33.3%

DISCUSSION

Onset of action of local anesthetic agents plays important role in preventing pre-operative pain especially acute pulpitis and acute pericoronitis of mandibular third molars. Nikil Kumar Jain , Reena Rachel Johnstated that " 4 % articaine had a significant faster onset of action and longer duration of action when compared to 2 % lignocaine" [1]. This was in contrast to our

study that we found no significance in deviation of onset of action between 4 % articaine and 0.5% bupivcaine, 2% lignocaine and 0.5% bupivacaine. Post operative analgesia is utmost important in order to prevent pain and discomfort once the oral surgeon surgically removes the deeply impacted mandibular third molars.Denis Brajković et al stated that "0.5% levobupivacaine is clinically effective for an inferior alveolar nerve block and postoperative pain control after third molar surgery" [2]. But conventional local anesthetic agent such as 2 % lignocaine had failed to give sufficient post operative analgesia in this study when we compared 4 % articaine and 0.5% bupivacaine groups. Post operative anesthesia and analgesia was highest in 0.5% bupivacaine followed by 4 % articaine, 2% lignocaine. Longer anesthesia and analgesia is useful when surgeon performs severe impaction of mandibular third molars which needs more intra operative time and bone removal to remove the impacted molars to reduce pain and discomfort to patient post operatively. K. Balakrishnan et al stated that "0.5% bupivacaine provides better and prolonged analgesia and anesthesia post operatively during surgical removal of impacted third molars" [3]. This statement was proved in our study that 0.5% bupivacaine has longest post operative anesthesia and analgesia compared with other groups. Intra operative bleeding during mandibular third molar surgery causes more frustration to surgeon and patient at chair side procedures. To control intra operative bleeding during third molar surgery is a real challenge to surgeon and it is also a relief from patient side. So, it is one of the prime factors for successful third molar surgery under local anesthesia. In our study intra operative bleeding was highest in 0.5% bupivacaine group followed by 4 % articaine, 2 % lignocaine groups because of the vasodilation property of 0.5% bupivacaine during impaction surgery. Monitoring vital signs during mandibular third molar impaction surgery is important for systemic evaluation of patient to avoid systemic complications. It was concluded that the anesthetic agents did not influence the vital signs during surgery. We had found in our study that 4 % articaine had the best intra operative bleeding control, less pain during mandibular third molar surgery, and adequate post operative pain control than 0.5% bupivacaine and the 2% lignocaine groups. Kiatanant Boonsirisethet al

stated that "The use of 4 % articaine for the inferior alveolar nerve block was clinically more effective in the onset of subjective and objective anesthesia, less intra operative pain as compared with the use of 2 % lidocaine" [4]. [5 6 7 8 9 10]

CONCLUSION

It was concluded that the anesthetic agent did not influence the vital signs during surgery. It can be specified that articaine can be used as a suitable alternative to lignocaine, especially when performing surgical procedures like removal of impacted mandibular third molars particularly required more bone removal, intra medullary bleeding during surgery, adequate post-op pain control. The use of articaine as an alternative to lignocaine is a viable option in terms of faster onset of action, longer postoperative anaesthesia and analgesia. Bupivacaine appears to be a valid substitute to articaine and lignocaine especially in anticipation of early post operative pain. Hence the selection of local anaesthetic agents for performing minor oral surgical procedure depends on the type of the surgical procedure, its duration, postoperative perception of pain by the individual. However as the sample size in the present study is small, larger and longitudinal studies are needed in this aspect to establish the results.

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Conflicts of interest :

There were no conflicts of interest.

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