



IJCRR

Section: Healthcare

ISI Impact Factor  
(2020-21): 1.899

IC Value (2020): 91.47

SJIF (2020) = 7.893



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# Comparative Evaluation of Haemodynamic Changes in Patients Undergoing Surgical Removal of Bilateral Impacted Lower Third Molars using 2% Lidocaine vs 4% Articaine with 1:100000 Epinephrine Concentration: A Double Blind Randomised Study

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## ABSTRACT

**Introduction:** Impacted mandibular third molars are one of the most common findings in the field of dentistry which requires surgical removal. Local Anaesthetics plays a major role to perform the procedure pain free although the anesthetics may exhibit some haemodynamic changes.

**Aim:** This study aimed to assess and compare the hemodynamic changes during the surgical removal of lower bilateral impacted third molars using local anaesthetic agents 2% Lidocaine or 4%Articaine both in conjunction with 1:100000 epinephrine concentration.

**Methodology:** Forty one patients with a mean age of 32.6 were enrolled to bilateral surgical removal of lower impacted third molars with an interval of three to four weeks between each surgery. Clinical parameters like Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Mean Arterial Pressure, Peripheral Saturation of Oxygen, Temperature and calculated parameters like Rate Pressure Product and Pressure Rate Quotient were assessed at three different time points: baselilne (Pre-operatively), Osteotomy/Odontosection/Luxation (Intra-operatively) and five minutes after completion of suture (Post-operatively).

**Result:** Forty one patients underwent thorough clinical examination, among which 33 patients fulfilled the criteria as they participated in both the surgical procedures. The present study found significant difference in the haemodynamic changes when comparing between the three time intervals in each group during the surgical procedure

**Conclusion:** No significant differences were found when comparing the hemodynamic behaviour between both the groups (2% lidocaine and 4% articaine) although significant differences were noted when comparing between the time points within each group.

**Key Words:** Lidocaine, Articaine, Epinephrine, Anaesthetic, Haemodynamic

## INTRODUCTION

The surgical removal of third molars is the most common and routine procedure in the field of Oral and Maxillofacial Surgery. Local anaesthetic plays a major role in limiting pain

and providing a pain free procedure. Most of the local anaesthetics are generally used in conjunction with a vasoconstrictor to delay the absorption of the local anaesthetic prolonging the duration of the anaesthetic and also to provide a

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ISSN: 2231-2196 (Print)

ISSN: 0975-5241 (Online)

Received: 24.04.2021

Revised: 02.07.2021

Accepted: 12.09.2021

Published: 16.01.2022

blood less field. In the literatures by Neves et al.<sup>1</sup>,2007 and Elad et al.<sup>2</sup>,2008 have confirmed the safety of using a local anaesthetic with a vasoconstrictor. Other few literatures by Vasconcellos et al.<sup>3</sup>,2008 and Sancho-Puchades et al.<sup>4</sup>,2012 have reported that patients who undergo surgical removal of third molars showed significant variations in blood pressure and heart rate.

Articaine is an amide local anaesthetic which contains a 'thiophene' ring instead of an aromatic ring thereby increasing liposolubility and potency.

The aim of the study is to assess and compare the haemodynamic effects on patients undergoing surgical removal of lower third molar using 2 % lidocaine hydrochloride with 1:100000 concentration of epinephrine and 4 % articaine hydrochloride with 1:100000 concentration of epinephrine.

## MATERIALS AND METHOD

**Study design:** This retrospective, randomised, controlled double-blinded split mouth study is approved by the Ethical Committee of the author's University. All of the participants enrolled in the study read and signed an informed consent confirming their acceptance to take part in the study. The study composed of two groups: Group A (procedure done under 2% Lidocaine with 1:100000 Epinephrine) and Group B (procedure done under 4% Articaine with 1:100000 Epinephrine)

**Sample Design** 41 healthy individuals aged between 18-40 years from September 2019 to March 2020 undergoing surgical removal of bilateral lower third molar impaction with a time interval of 3-4 weeks between the two surgical extractions were included in this study based on clinical examinations and radiographs. Impactions grading moderately difficult according to Pederson Scale was included in the study. The following exclusion criteria were applied: Patients with general health issues like hypertension, diabetes and cardiac disorders, patients with hypersensitivity to the drugs used in research, pregnant or lactating women, patients on blood thinners and mentally challenged patients.

**Blinding Details** Both surgeon and patient were blinded on what anaesthetic solution is been used. Blinding technique was done by covering the cartridge with two colored tapes to separate the two study groups. Only the assistant had access to the colour codes. On initial examination, the patient was directed to select from two sealed envelopes referring to the site of surgical removal (i.e. impacted 38 or impacted 48) along with the color coded cartridge containing the anaesthetic agent (i.e. either 2% Lidocaine or 4% Articaine) both of which used in conjunction with 1:100000 Epinephrine concentration. As soon as the assistant opened the envelope, the surgeon was informed about the site of surgery

and the colour coded anaesthetic cartridge was given. The second surgery was carried out on the contralateral side with the other type of anaesthetic agent after 3-4 weeks.

**Study Variables** Clinical parameters like Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Peripheral O<sub>2</sub> Saturation (SpO<sub>2</sub>) and Temperature (Temp.)(C) and calculated parameters as Mean Arterial Pressure (MAP), Rate Pressure Product (RPP) and Pressure Rate Quotient (PRQ) at three different time points during the surgical procedure:(1) Baseline at rest (Preoperative), (2) incision, flap elevation, osteotomy after administration of local anaesthetics (Intra operative) and (3) five minutes after completion of suture (Postoperative). All of the clinical parameters were recorded using a Multi - Para Monitor (Contec 12.1)

**Procedure** Patients who satisfied the criteria underwent detailed clinical examination. All the procedures were performed by the same operator. No premedication were prescribed to any of the participants. All the clinical parameters (HR, SBP, DBP, SpO<sub>2</sub> and Temp.) were assessed prior to the surgery (Preoperative). The patient was asked to do mouthwash with 2% Povidone-Iodine Germicide Gargle prior to the surgery. Inferior Alveolar Nerve Block (IANB) along with long buccal nerve block was administered using 2% Lidocaine with 1:100000 Epinephrine concentration (Henry Schein) 1.7mL cartridge or 4% Articaine with 1:100000 Epinephrine concentration (Septodont) with 1.7mL cartridge, using a volume of 3.4mL (2 cartridges). The method used was standard for all of the surgical procedures. Ward's/Modified ward's incision was placed and the mucoperiosteal flap elevated and reflected and osteotomy was done. The parameters were recorded once again (Intra operative). In few patients, odontosection had to be done and extracted. The tooth socket was cleaned by copious saline irrigation and curettage. The flap was sutured and approximated using 3-0 silk and haemostasis was achieved. After five minutes the clinical parameters were recorded again (Postoperative). After all surgical procedures, the patients received post-extraction instructions and were prescribed with the appropriate medications for the controlled of the post operative management.

**Statistical Analysis:** The data analysis was conducted using EPI INFO statistical software (version 7.2.2.6, CDC, Atlanta, Georgia US). Normality of the data was confirmed by Shapiro-Wilk test. Homogeneity of variances was assessed using levene's test. Descriptive statistics, Independent t-test and Paired t-test was used.

**Results:** Forty one patients underwent thorough clinical examination, but eight of them did not complete all stages as they did not undergo surgical removal of lower impacted third molar on the contralateral side. Therefore 33 patients (19 men and 14 women) with a mean age of 30.8 years and (SD = 12.52), participated in both the surgical procedures.

All the haemodynamic parameters were found to have no significant difference between the mean values for HR (Fig 1), SBP (Fig 2), DBP (Fig 3), MAP (Fig 4), SpO<sub>2</sub>(Fig 5), Temp, RPP (Fig 6) and PRQ when comparing the two anaesthetic groups (i.e 2% Lidocaine and 4% Articaine) both in conjunction with 1:100000 Epinephrine concentration at Preoperative, Intra operative and Postoperative time intervals.

The present study found significant difference in the haemodynamic changes when comparing between the three-time intervals in each group which can relate to patients anxiety and stress during the surgical procedure. HR and RPP showed significant difference in both the groups. In Lidocaine group (i.e. Group A) both HR (p=0.01) and RPP (p=0.006) showed significant increase from Preoperative to Intra-operative time interval. In Articaine group (i.e Group B) following significant differences were found: HR (p=0.017), SBP (p=0.00), DBP (p=0.016), MAP (p=0.00), SpO<sub>2</sub>(p=0.007), RPP (p=0.001) showed significant increase when comparing Preoperative and Intra-operative time intervals. (Table I)

## DISCUSSION

The present study confirms that no significant difference in the hemodynamic parameters between 2% Lidocaine and 4% Articaine both in conjunction with 1:100000 Epinephrine concentration. Even though there was no significant difference between the two groups, the present study assessed and found significant differences in three different time points throughout the surgical procedure. To eliminate any individual bias, split-mouth design was used and also to minimize any bias based on the volume of anaesthetic solution used, a cartridge each containing 1.7mL was used which doesn't correlate with earlier studies by Columbini et al.<sup>5</sup>,2006, Santos et al.<sup>6</sup>, 2007, Vasconcellos et al.<sup>3</sup>,2008 and de Morais et al.<sup>7</sup>,2012

A Multiparametric Vital Signs Monitor (Contec 12.1) was used to assess the haemodynamic parameters and made it possible to record the parameters during the surgical procedure so that a thorough assessment of the haemodynamic variation could be performed unlike earlier studies by Vasconcellos et al.<sup>3</sup>, 2008; Mestre Aspa et al.<sup>9</sup>, 2001; Sancho-Puchades et al.<sup>4</sup>, 2012; de Morais et al.<sup>7,8</sup>, 2012

A previous study by Stella et al.<sup>10</sup>, 2018 compared the same two local anaesthetic drugs as our study using a similar multi parametric monitor where the author assessed seven different time points throughout the procedure on 12 patients. The author reported that there was no variation in the haemodynamic status of the patients undergoing lower third molar extraction when comparing between 2% Lidocaine and 4% Articaine but the author reported significant differences when comparing the different time points during the procedure

within each group which correlates with our study. Our present study comprised of larger population comprising of 41 patients with three-time intervals, the results are almost similar and also similar to other previous literatures as well (Oretel et al.<sup>11</sup> 1999, Malamed et al.<sup>12</sup> 2001, Ogunlewe et al.<sup>13</sup> 2011, Silvestre et al.<sup>14</sup> 2011, de Morais et al.<sup>7,8</sup> 2012).

Malamed et al.<sup>12</sup> in 2001, studied the safety of an amide local anaesthetic agent (4% Articaine). The author compared with 2% Lidocaine (controlled group) to measure the post-procedural pain, headache, facial edema, infection, gingivitis and paresthesia on 1325 participants. The study included various dental procedures ranging from single extraction to multiple extractions but did not include surgical removal of impacted molars. Also the volume of local anaesthetic drug used varied according to the amount of anaesthesia needed for achieving pulpal and soft tissue anaesthesia which did not correlate to our study. Vital signs were recorded (Systolic Blood Pressure, Diastolic Blood Pressure, Heart Rate and Respiratory Rate) at one and five minutes post-administration of the drug and completion of the procedure. The author found no statistical difference between the two groups similar to our present study.

A Study by Ogunlewe et al.<sup>13</sup> in 2011, checked only 2% Lidocaine with and without vasoconstrictor on hypertensive patients. The study was conducted in 33 patients indicated for dental extraction and evaluated on Systolic Blood Pressure, Diastolic Blood Pressure and Heart Rate in both the groups. The study did not include any surgical removal of impacted molars to assess the hemodynamic changes in the two groups but results are similar to our present study with the group containing 2% Lidocaine with vasoconstrictor (epinephrine).

Silvestre et al.<sup>14</sup> in 2011 studied on 97 hypertensive patients having the maximum Systolic Blood Pressure of 139mmHg and Diastolic Blood Pressure of 84mmHg between two anaesthetic agents 4% Articaine with vasoconstrictor vs 3% Mepivacaine without vasoconstrictor. The hemodynamic parameters included in the study are Blood Pressure, Heart Rate and SpO<sub>2</sub> and checked at three time points on the participants who were undergoing single tooth extraction and extraction of erupted third molars. No Multi parameter monitor was used in the study which couldn't accomplish monitoring the hemodynamic changes during the procedure.

de Morais et al.<sup>7</sup> in 2012 did a similar split-mouth design study comparing the same two local anaesthetic agents on patients undergoing surgical removal of bilateral impaction of lower third molars. In this study the author included only those patients who had similar type of impaction, as in our present study impaction with moderate pederson score was included. The author excluded all surgical procedures exceeding more than 30 minutes and the procedure were done by different operator unlike our study where all procedures were done by a single operator. The hemodynamic changes

revealed significant differences in Pressure Rate Quotient (PRQ) between the two groups but showed the similar results when comparing the different time points in each group, whereas in the study conducted by the present author Pressure Rate Quotient (PRQ) was found to have no significant differences.

## CONCLUSION

The study was conducted to evaluate and compare the two local anaesthetic agents with similar concentration of epinephrine on patients while recording the clinical haemodynamic parameters. Either of the local anaesthetic did not show any major advantage over the other. 4 % Articaine with 1:100000 concentration of epinephrine provides similar quality of anaesthesia to 2 % Lidocaine with 1:100000 concentration of epinephrine. Hence use of both types of local anaesthetic can be considered for minor oral surgical procedures.

## ACKNOWLEDGEMENT

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors/ editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed

**Funding:** No funding was received

**Conflict of interests/ Competing interests:** The author declare that they have no conflict of interest

**Ethical Approval:** This study was approved by the research ethics committee of Dr. M.G.R. Educational and Research Institute (Ref: Dr.M.G.R/DU/TMDCH/EC/2020-21/334)

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**Table 1: Comparing the haemodynamic status between the three time intervals in each group. As shown in the Table below significance was noted in Pre-Op and Intra-Op intervals in both the groups.**

Lidocaine		N	Mean	Std. Deviation	p-value	Articaine		N	Mean	Std. Deviation	p-value
HR	Pre	37	85.59	14.891	.010*	HR	Pre	37	86.19	15.127	.017*
	Intra	37	92.16	18.025			Intra	37	92.35	18.252	
	Post	37	85.59	14.891			Post	37	86.19	15.127	
	Post	37	83.89	14.114			Post	37	86.73	13.209	
SBP	Pre	37	123.97	13.395	.078	SBP	Pre	37	123.62	11.706	.000*
	Intra	37	127.14	17.444			Intra	37	129.73	15.721	
	Post	37	123.97	13.395			Post	37	123.62	11.706	
	Post	37	120.43	18.280			Post	37	121.16	14.688	
DBP	Pre	37	78.86	9.352	.536	DBP	Pre	37	78.78	8.330	.016*
	Intra	37	79.78	11.294			Intra	37	80.92	9.636	
	Post	37	78.86	9.352			Post	37	78.78	8.330	
	Post	37	76.92	12.798			Post	37	77.38	10.634	
MAP	Pre	37	93.69	10.063	.197	MAP	Pre	37	93.3	8.311	.000*
	Intra	37	95.53	12.496			Intra	37	97.2	11.011	
	Post	37	93.69	10.063			Post	37	93.3	8.311	
	Post	37	91.56	14.141			Post	37	91.9	11.394	
O2 Saturation	Pre	37	97.84	1.191	.157	O2 Saturation	Pre	37	97.27	1.446	.007*
	Intra	37	98.24	1.038			Intra	37	97.97	1.142	
	Post	37	97.84	1.191			Post	37	97.27	1.446	
	Post	37	98.05	1.129			Post	37	97.97	1.166	
Temp	Pre	37	31.57	.7400	.766	Temp	Pre	37	31.46	.901	.302
	Intra	37	31.62	.9541			Intra	37	31.30	1.229	
	Post	37	31.57	.7400			Post	37	31.46	.901	
	Post	37	31.30	1.1229			Post	37	31.10	1.397	
RPP	Pre	37	10669.76	2333.538	.006*	RPP	Pre	37	10700.84	2447.231	.001*
	Intra	37	11759.92	3187.451			Intra	37	11989.57	3143.143	
	Post	37	10669.76	2333.538			Post	37	10700.84	2447.231	
	Post	37	10150.73	2611.128			Post	37	9992.54	3016.183	
PRQ	Pre	37	1.09	.247	.263	PRQ	Pre	37	1.12	.238	.382
	Intra	37	1.05	.253			Intra	37	1.09	.246	
	Post	37	1.09	.247			Post	37	1.12	.238	
	Post	37	1.05	.223			Post	37	1.08	.201	

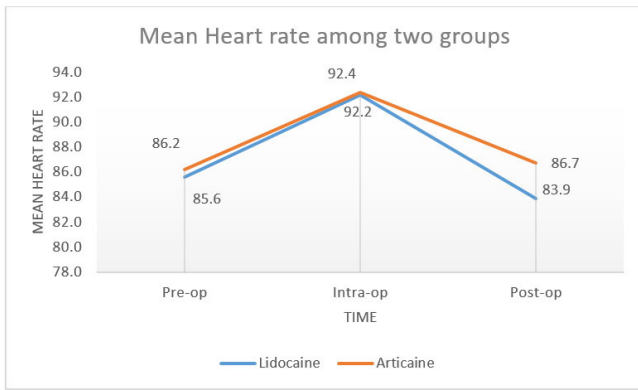


Figure 1: Mean heart rate among two groups.

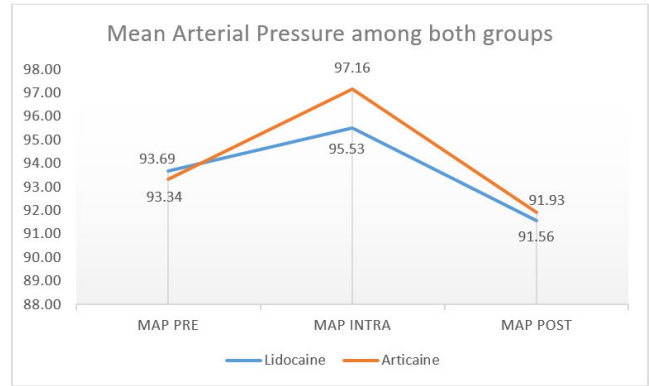


Figure 4: Mean Arterial Pressure among both groups.

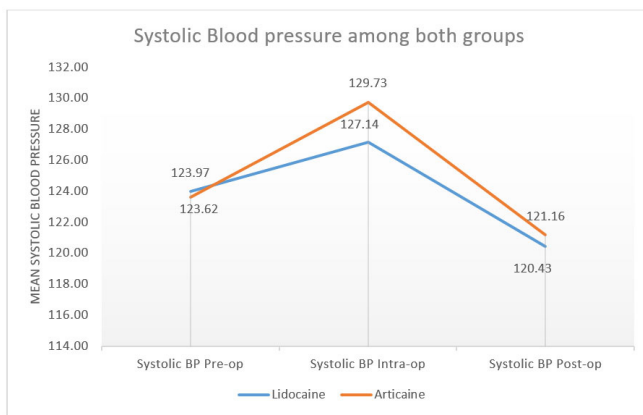


Figure 2: Mean Systolic Blood Pressure among two groups.

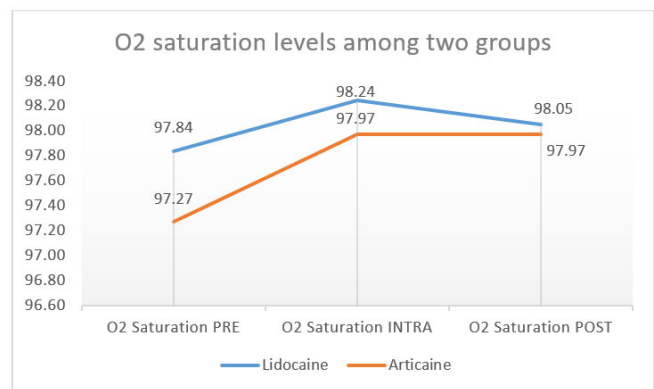


Figure 5: Mean oxygen saturation levels among both the groups.

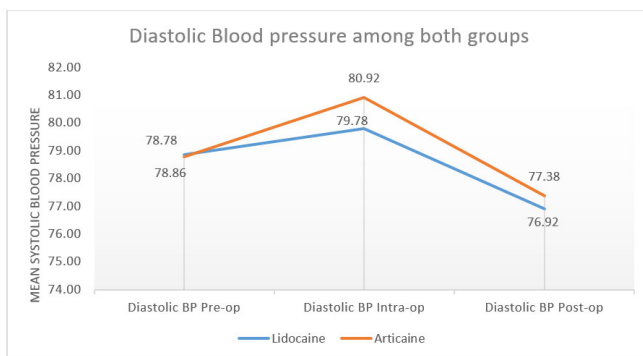


Figure 3: Mean Diastolic Blood Pressure among both groups

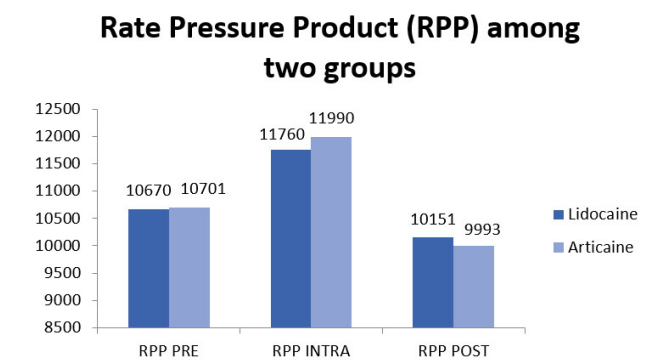


Figure 6: Mean rate pressure product among both the groups.