

A comparative Study on the Hemodynamic Effects of Local Anesthetics Articaine vs. Lidocaine in Healthy Patients

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Abstract

Objective: The purpose of the present investigation was to see the future prospects of a recently introduced anesthetic drug 4% Articaine with 1/100,000 epinephrine by comparing its effect on hemodynamic parameters as a local anesthetic for simple dental extractions with those of 2% Lidocaine with 1:100,000 epinephrine.

Materials and Methods: A randomized double-blinded clinical trial involving 32 healthy patients in two groups with a total of 64 patients was conducted. Only healthy patients were allowed to participate in this investigation. Patients in the first group were injected 4% Articaine with 1/100,000 epinephrine, whereas the patients in the second group were injected 2% Lidocaine with 1:100,000 epinephrine as a local anesthetic. The hemodynamic parameters including the diastolic blood pressure (DBP), systolic blood pressure (SBP), heart rate (HR) and oxygen saturation (SpO₂) were closely monitored at three different times i.e. prior to the injection of local anesthesia, 5 minutes after injecting local anesthesia and 5 minutes after finishing the procedure. A dose of 1.7 ml, 4% Articaine with 1/100,000 epinephrine was used with the first group, whereas a dose of 1.8 ml, 2% Lidocaine with 1:100,000 was used in case of the second group.

Results: In case of the first group injected with Articaine, the Mean Systolic Blood Pressure (SBP) was recorded as 121.97 ± 11.969 before injection, 119.44 ± 11.941 after injection and 122.59 ± 8.743 after extraction. Whereas SBP in case of Lidocaine was recorded as 122.16 ± 8.973 before injection, 126.12 ± 10.676 after injection and 125.78 ± 10.658 after extraction. Likewise, the Mean Diastolic Blood Pressure (DBP) for Articaine was 71.69 ± 9.816 before injection, 66.19 ± 7.925 after injection and 71.63 ± 8.867 after extraction vs 69.50 ± 10.100 before injection, 70.38 ± 10.400 after injection and 72.47 ± 9.517 after extraction for Lidocaine. The mean heart rate (HR) for Articaine was 76.97 ± 12.414 before injection, 78.19 ± 12.845 after injection and 74.72 ± 10.795 after extraction vs 82.28 ± 12.668 before injection, 86.97 ± 14.295 after injection and 82.13 ± 11.304 after extraction for Lidocaine. The mean oxygen saturation (SpO₂) for Articaine was 98.75 ± 1.295 before injection, 98.34 ± 1.842 after injection and 98.59 ± 1.266 after extraction vs 98.75 ± 1.778 before injection, 98.88 ± 1.996 after injection and 98.53 ± 2.185 after extraction for Lidocaine. A detailed statistical analyses did not indicate any significant difference between the two treatments for any of the hemodynamic parameters studied in the present investigations.

Conclusion: No significant differences in any of the hemodynamic parameters were observed at any stage of the investigations when the patients have injected with 4% Articaine with 1/100,000 epinephrine and 2% Lidocaine with 1:100,000 epinephrine. This proves that Articaine is a safe alternative to Lidocaine and can be used routinely in the dental setting.

Keywords: Lidocaine; Articaine; Oxygen Saturation (SpO₂); Systolic Blood Pressure; Diastolic Blood Pressure

Introduction

The role of drugs used for local anesthesia is vital in the field of dentistry as they help the dentists in the successful completion of various dental procedures by ensuring less pain and discomfort for the patients. It can be said that local anesthesia forms the backbone of almost all dental procedures. Tooth extraction is one of the procedures that especially require a relatively pain-free arrangement. The most common drug used for Anesthesia is Lidocaine. Historically, Lidocaine was made available in 1943. The dentists still consider it as the gold standard for local anesthesia in dentistry. Its popularity is mostly attributed to its low toxicity and safety [1]. Achieving proper anesthesia is not easy. Many patients find needle insertion painful, especially in the palatal region and with inferior alveolar nerve blocks. This has led to the development of newer local anesthetics such as Articaine. It was synthesized in 1969 by Rusching [2]. It has a few advantages over Lidocaine including being more potent due to its high lipid solubility, a long duration of action and having a higher rate of diffusion through both soft and hard tissue [3]. Due to these advantages, Articaine is currently gaining ground over Lidocaine as the most commonly used local anesthetic in Australia, the US, Canada and continental Europe [1,4]. Several studies have linked the use of Articaine to a lower level of pain in patients undergoing extractions [5]. The latest studies have also proved that a palatal injection is not always needed to achieve palatal anesthesia in patients who need extraction or flap surgery. This would decrease patient discomfort and eliminate the need for a second needle insertion [6]. Although a plenty of data is available that indicates the effect of Lidocaine on the hemodynamic parameters, such as Diastolic Blood Pressure (DBP), Systolic Blood Pressure (SBP), heart rate (HR) and oxygen saturation (SpO₂) are readily available, yet, a few studies have been conducted so far to determine the effects associated with the use of Articaine.

The present study was, therefore, undertaken 1) To compare the hemodynamic parameter changes associated with using Articaine with 1/100,000 epinephrine and 2% Lidocaine with 1:100,000 epinephrine for simple extraction 2) To explore the safety of Articaine to replace Lidocaine in the daily dental procedure.

Materials and Methods

This study was conducted in the Dental Hospital - King Saud University, Riyadh, Saudi Arabia. The approval for this study was accorded by the ethical committee formed under Institutional Review Board at King Khaled University Hospital. All patients referred for extraction to the maxillofacial clinic of the hospital were checked to satisfy the inclusion and exclusion criteria. The inclusion criteria included only healthy patients with simple extraction, whereas exclusion criteria included medically compromised patients, pregnant women, children and patients with difficult and surgical extraction. A prospective, randomized double-blind clinical trial was conducted. The sample size was determined using Minitab. At $\alpha=0.05$ with a standard deviation of 1 and power = 0.9. Accordingly, the sample size was set to be 64 with 32 in each group. The patients were selected according to the inclusion criteria. A total of 64 healthy patients ranging 18 to 60 years require only simple extraction were selected. The patients were contacted the day before the study and were informed not to take any drugs or medications or drink caffeinated drinks such as coffee and tea. Smokers were instructed not to smoke at the beginning of the day for their morning appointments and not to smoke for at least 2 hours prior to the afternoon appointments. All procedures were briefly explained to the patients who were clearly told that their participation in the present study was purely on a volunteer basis and they had a right to refuse to participate. Detailed medical and dental history was taken prior to the procedure from all volunteers who qualified for this study. Radiographic examination and other diagnostic tools were used when needed. Clinical examination was used to confirm cases that met the criteria for inclusion. Patients were asked to fill an anxiety survey and the Taylor anxiety scale was used to score them prior to starting the procedure. The hemodynamic parameters including the diastolic blood pressure (DBP), systolic blood pressure (SBP), heart rate (HR) and oxygen saturation (SpO₂) were closely monitored at three different times i.e. prior to the injection of local anesthesia, 5 minutes after injecting local anesthesia and 5 minutes after finishing the procedure. A dose of 1.7ml, 4% Articaine with 1/100,000 epinephrine was used with the first group, whereas a dose of 1.8 ml, 2% Lidocaine with 1:100,000 was used in case of the second group. Each extraction took between 7 - 10 minutes to complete. All carpules were stored in a well air-conditioned room in the oral and maxillofacial department at the Dental University Hospital at King Saud University. Mindray Datascope Accutorr V Vital Signs Monitor W/Masimo SPO₂

was used to monitor all readings. The first reading was taken prior to the first injection. Two readings were logged and their average was taken. The second two readings were logged 5 minutes after the first injection and their average was taken. The final two readings were logged 5 minutes after the procedure was finished and their average was taken. Neither the clinician nor the patients were aware of what kind of local anesthetic was being used during the procedure. All the carpules were marked and numbered from 1 to 64 and covered. A short needle with a 25 gauge was used for infiltration and a long needle with a 27 gauge was used for nerve blocks.

Statistical Analyses

The data collected were subjected to statistical analysis using SPSS software. Descriptive analysis, as well as crosstab analysis and Chi-square tests, were carried out 95% level of confidence. Shapiro-Wilk test was used for the normality of all variables. Normality was satisfied for all variables at all of the different reading intervals; before injecting, 5 minutes after the first injection, and 5 minutes after the procedures were done. The central limit theorem was used to assume all means satisfied normality since the sample size for each group was greater than 30. One way ANOVA repeated measurement was used to compare both Articaine and Lidocaine overall 3 intervals.

Results

The statistical analysis depicted that the average age of the participants was 31.6 ± 10.8 (Male 33.5 ± 13 , Female 30 ± 8.4). Whereas stress values were found to be normal except for one participant who had a score of 20 and was excluded from the results. The average value for stress in males was (4.9 ± 0.8) and for females (7.9 ± 0.9) . The t-Test revealed that the females showed a higher stress score compared to males with $P = (0.024)$. The stress value for both anesthetics did not show a significant difference. The stress value for Articaine was found to be (6.66 ± 0.962) and that in case of Lidocaine was (6.41 ± 0.88) and $P = (0.849)$ (Table 1). The SBP readings showed no significant difference between both anesthetics with Articaine having $P = (0.276)$ and Lidocaine $P = (0.281)$. Whereas DPB readings, however, showed a significant difference between the two treatments. In case of heart rate and Oxygen saturation (SpO_2), again no significant difference was found between the two treatments. The mean SBP for Articaine was 121.97 ± 11.969 before injection, 119.44 ± 11.941 after injection and 122.59 ± 8.743 after extraction vs 122.16 ± 8.973 before injection, 126.12 ± 10.676 after injection and 125.78 ± 10.658 after extraction for Lidocaine. The mean DBP for Articaine was 71.69 ± 9.816 before injection, 66.19 ± 7.925 after injection and 71.63 ± 8.867 after extraction vs 69.50 ± 10.100 before injection, 70.38 ± 10.400 after injection and 72.47 ± 9.517 after extraction for Lidocaine. The mean heart rate (HR) for Articaine was 76.97 ± 12.414 before injection, 78.19 ± 12.845 after injection and 74.72 ± 10.795 after extraction vs 82.28 ± 12.668 before injection, 86.97 ± 14.295 after injection and 82.13 ± 11.304 after extraction for Lidocaine with the difference being statistically insignificant. The mean oxygen saturation (SpO_2) for Articaine was 98.75 ± 1.295 before injection, 98.34 ± 1.842 after injection and 98.59 ± 1.266 after extraction vs 98.75 ± 1.778 before injection, 98.88 ± 1.996 after injection and 98.53 ± 2.185 after extraction for Lidocaine with the difference being statistically insignificant (Table 2).

Local Anesthetic		N	Mean	Std. Deviation	Std. Error Mean	
Age	Articaine	32	32.16	11.459	2.026	0.689
	Lidocaine	32	31.06	10.251	1.812	
Stress	Articaine	32	6.66	5.439	0.962	0.849
	Lidocaine	32	6.41	5.022	0.888	

Table 1

Local Anesthetic	N	Mean	Std. Deviation	Indp. T-test P-value	
SBP1	Articaine	32	121.97	11.969	.944
	Lidocaine	32	122.16	8.973	
DBP1	Articaine	32	71.69	9.816	.383
	Lidocaine	32	69.50	10.100	
SBP2	Articaine	32	119.44	11.941	.021
	Lidocaine	32	126.13	10.676	
DBP2	Articaine	32	66.19	7.925	.075
	Lidocaine	32	70.38	10.401	
SBP3	Articaine	32	122.59	8.743	.196
	Lidocaine	32	125.78	10.658	
DBP3	Articaine	32	71.63	8.867	.715
	Lidocaine	32	72.47	9.517	
HR1	Articaine	32	76.97	12.414	.095
	Lidocaine	32	82.28	12.668	
HR2	Articaine	32	78.19	12.845	.012
	Lidocaine	32	86.97	14.295	
HR3	Articaine	32	74.72	10.795	.009
	Lidocaine	32	82.13	11.304	
O1	Articaine	32	98.75	1.295	1.000
	Lidocaine	32	98.75	1.778	
O2	Articaine	32	98.34	1.842	.273
	Lidocaine	32	98.88	1.996	
O3	Articaine	32	98.59	1.266	.889
	Lidocaine	32	98.53	2.185	

Table 2

Discussion

The safe use of Lidocaine has been well demonstrated in many studies which do not show any adverse effect of the drug on the hemodynamics of patients [7,8]. That is why Lidocaine is widely used during dental procedures across the globe. On the other hand, Articaine's being a relatively new drug which needs to be tested to be used as widely accepted anesthesia drug worldwide, especially it has many advantages over Lidocaine such as better patient tolerance and less pain and discomfort which make it more favorable for use in the clinic. The use of a more potent anesthetic such as Articaine may waive the need for multiple injections and eliminate patient discomfort [9-14]. Lidocaine is still considered the gold standard of local anesthesia in the dental setting [13]. However, use of Articaine is progressively increasing around the world lately [15]. This may be due to the fact that Articaine's faster onset of action, lower peak plasma concentration, shorter elimination time and its minimal effects on the hemodynamic parameters was observed in a previous study by Bajwa and Jindal [16]. The two local anesthetics affected all hemodynamic parameters in a safe way. When compared to each other, there was no statistically significant difference. This is in line with what Sanatkar observed in his study [17]. One study observed that Articaine can be even considered safer than Lidocaine [18]. Both Articaine and Lidocaine's influence was within the safe limits. No abnormal or major unwanted changes were seen in the systolic, diastolic blood pressure, heart rate or oxygen saturation. These findings support the statement

that Articaine is a safe alternative to Lidocaine for use as a local anesthetic in the dental setting. It does not influence the hemodynamic parameters in an unwanted way and all readings were within the normal limits [19]. The changes seen in the hemodynamic readings were not statistically different when compared to the changes seen with Lidocaine.

Conclusion

No significant differences in any of the hemodynamic parameters were observed at any stage of the investigations when the patients were injected with 4% Articaine with 1/100,000 epinephrine and 2% Lidocaine with 1:100,000 epinephrine. This proves that Articaine is a safe alternative to Lidocaine and can be used routinely in the dental setting.

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Conflict of Interest

The authors declare that there is neither financial nor intellectual conflict of interest with any one.

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