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Evaluation of the efficiency of Lidocaine 2% with Epinephrine 1:80000 buffered by sodium bicarbonates during regional anesthesia: A clinical study

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Abstract
Introduction: The local anesthetic used in dental anesthesia is considered a painful procedure to the majority of patients, it is known that the intra- oral injection is one of the most common reasons why patients escape treatment and that is due to the acidic nature of the anesthetic agent which in turn may delay the onset of anesthesia.
Materials & Methods: The local anesthetic used for dental anesthesia is one of the most common reasons patients avoid undergoing certain treatments. This may be attributed to the acidic, irritating nature of the anesthetic which in turn may lead to a delayed onset of anesthesia.
In this retrospective study, 2% lidocaine with 1:80000 epinephrine buffered with 8.4% sodium bicarbonate (1:10) was evaluated for its effects on the onset time as well as pain response and the duration of anesthesia. 15 patients were injected with the anterior infra-orbital injection and IANB injection with and without buffering with sodium bicarbonate.
Results: Anesthesia onset time in sodium carbonate buffered anterior infra-orbital injection was decreased by 0.07 minutes compared with the conventional injection, and that was not statistically significant. And in the buffered IANB injection the onset of anesthesia decreased 0.87 minutes compared with the conventional injection, and that was statistically significant difference (p=0.048).
Anesthesia duration was also decreased by 8 minutes in the buffered infra-orbital injection compared with the conventional injection, and this was statistically significant difference (p=0.21) and in the buffered IANB injection the duration was also decreased by 19.6 minutes, and that was statistically significant difference. (P = 0.010)
The pain induced by the buffered infra-orbital injection was decreased statistically significant by 2 degrees (P = 0.001), and was decreased in the buffered IANB injection by 1 degree (P = 0.007).
Conclusion: Buffering the anesthetic solution with sodium bicarbonate may induce lesser pain during injection and may decrease the onset time, but may negatively affect the anesthesia duration.

Keywords: Lidocaine 2%, sodium bicarbonates, anesthesia

Introduction
Local anesthetics can be defined as drugs that induce loss of sensations in a specific area of the body by inhibiting stimulation at the nerve ends [7].
Preferred properties of a local anesthetic include: non-irritating for tissues, short onset time for anesthesia, long working time allowing the medical or dental procedure to be completed [8].
Commercially available forms of local anesthetics with vasoconstrictors are often 1000 times as acidic as neutral physiological solutions [6]. Additionally, local anesthesia often causes pain and stress for most patients regardless of age, and is commonly the primary reason for delaying or avoiding treatment [1].
Most patients report a stinging or burning sensation during a local anesthetic injection, which is due to the increased availability of H+ ions that lead to increased acidity in the injection area, which in turn excites the pain receptors in that area [9].
Buffering a local anesthetic with sodium bicarbonate was studied in an attempt to address these problems [10].
The increased pH value increases the amount of local anesthetic in its base-free and non-charged form, which is the active part that leads to the clinically observed local anesthesia.

Highly fat-soluble forms of local anesthetics can penetrate the nervous membrane more easily, allowing easier access to the working site which translates into increased efficiency and longer working times [11, 7].

Materials & Methods

The sample included 15 patients who consented to undergo dental local anesthesia without a subsequent treatment. On each patient, the standard infraorbital injection was performed as well an infraorbital injection buffered with sodium bicarbonate. For all injections, the same side was used. The time between the two injections to compare was less than one week. At a later time, standard inferior alveolar block injection was performed as well as a buffered injection, with around one week between the two injections. The buffered lidocaine had 1:10 ratio as recommended by various previous studies [4, 5].

The type of injection was double-blinded, i.e. for both the patient and the dentist. This was achieved by hiding the label on each ampule using a fully opaque sticker which was removed after the procedure.

The sample was divided into 4 groups

1. Anterior infraorbital and conventional inferior alveolar block without buffering
2. Anterior infraorbital and conventional inferior alveolar block with buffering

Sodium bicarbonate was added following international recommendations. The ampule's content was moved to a sterile container and the required amount of sodium bicarbonate was added with a sterile disposable syringe such that the correct ratio (1:10) was reached. The buffered contents were put back into the ampule using a retractable syringe.

Opaque stickers were applied to all ampules to hide their composition.

Fig 1: Retractable syringe

Fig 2: 8.4% sodium bicarbonate

Analyzing results

Paired t-test was used to evaluate the impact of buffering with sodium bicarbonate on duration and onset time of anesthesia.

Wilcoxon signed-rank test was used to evaluate the impact of buffering with sodium bicarbonate on pain levels after each injection.

Measuring anesthesia onset time

The onset time was measured as the time starting from the moment the syringe was removed out of the patient's mouth to the moment where the anesthesia was confirmed to have taken effect using an electric pulp tester (Coxo C-Root IV), following manufacturer's instructions, on one of the teeth. The test was repeated every minute until the anesthesia was confirmed.

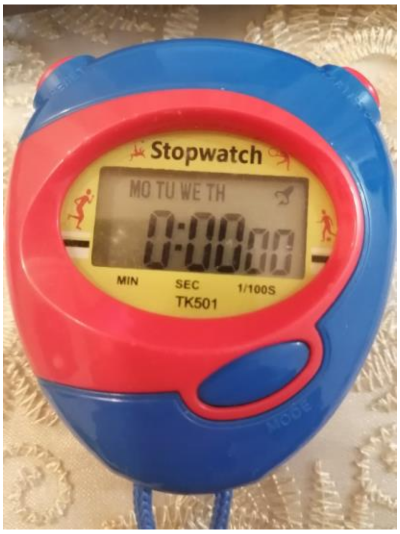

Fig 3: Stop watch used for pulp testing

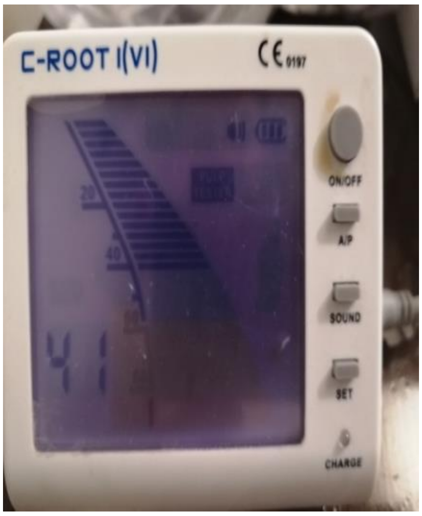

Fig 4: Electric pulp test (Coxo)

Measuring pain during injection

Visual pain scale was used to measure pain levels during the injection

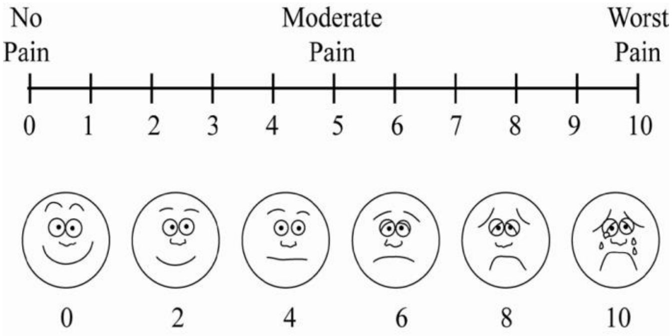

Fig 5: Visual pain scale

Measuring duration of anesthesia

Duration of anesthesia was measured in minutes from the time of anesthesia confirmed until the symptoms of anesthesia disappear.

Results and Discussion

Evaluating onset time and duration of anesthesia

The mean value for onset time for the infraorbital injection was reduced by 0.07 minutes with the sodium bicarbonate-buffered solution. This reduction was not statistically significant at p=0.582. For the mandibular alveolar nerve block, the mean value was reduced by 0.87 minutes which is statistically significant at p=0.048.

Looking at the mean values for the duration of anesthetic effect, the mean value for the infraorbital injection was reduced by 8 minutes when the solution was buffered, which is statistically significant at p=0.201. For the mandibular alveolar block injection, the value was reduced by 19.60, which is also statistically significant at p=0.010.

Injection	Parameter	T	p	Mean delta	Min	Max
Infraorbital	Onset time	0.564	0.582	0.07	0.46	-0.19
	Duration	2.600	0.021	8.00	11.92	1.40
Mandibular alveolar block	Onset time	2.162	0.048	0.87	1.55	0.01
	Duration	2.974	0.010	19.60	25.53	5.46

Figure 6 t-test

Evaluating pain response

For the infraorbital injections, 13 patients out of the 15 have experienced reduced pain with the buffered solution compared to the non-buffered one, with 2 other patients reporting similar levels of pain for both solutions. There is a statically significant difference between the pain levels associated with the two methods which evaluates to 2 pain levels (p = 0.001).

For the mandibular alveolar block injection, 9 patients reported reduced pain with the buffered solution, with 6 others reporting no reduction in pain compared to the non-buffered injection. There is a statically significant difference between the two solutions which evaluates to one pain level (p = 0.007).

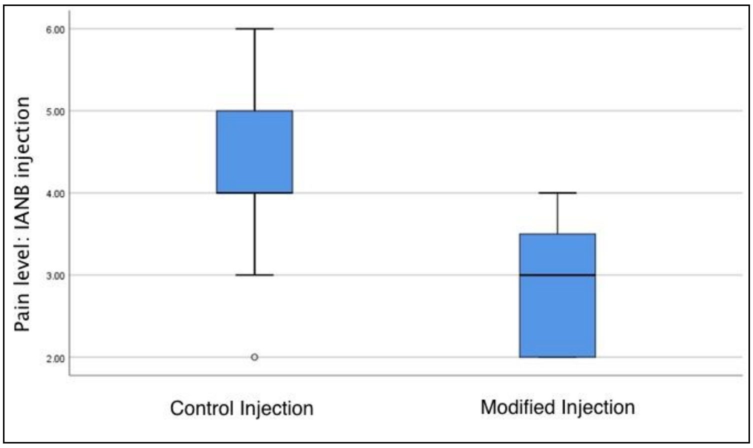

Fig 1: Pain levels after IANB injection

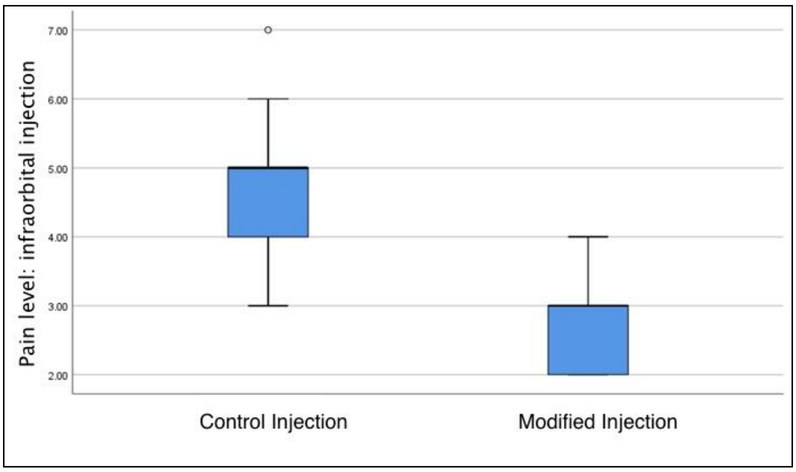

Fig 2: Pain levels after infraorbital injection

Discussion

Commercially available forms of local anesthetics with vasoconstrictors are often 1000 times as acidic as neutral physiological solutions [6] which often causes pain during the injection and delays onset time for anesthesia [12, 3].

The increased availability of H+ ions leads to increased acidity in the injection area, which in turn excites the pain receptors in that area [9]. the efficiency of duration the anesthetic drug is determined by the ability of its molecules to bind to proteins [7].

We found that buffering the anesthetic solution reduces pain during injection for both infraorbital and mandibular alveolar block injections, which corroborates the findings of Shyamala *et al*. 2016 [13]; Karkut, Reader, Drum, Nusstein & Beck, 2010 [14] as well Lee *et al*., 2013 [5] who used sodium bicarbonate solutions intradermally.

Our findings do not match those of Aulestia-Viera *et al*., 2018 [10] and Afolabi, Murphy, Chung, & Lalonde, 2013 [15] and who concluded that buffering does not reduce pain in maxillary local infiltration anesthesia. This might be due to the differences in the areas of injection, including tissue composition and thicknesses and different methods of assessing pain responses. Burns, Ferris, Feng, Cooper, & Brown, 2006 [16] found that buffered lidocaine (1% with epinephrine) causes less pain when injected cutaneously but the difference was not significant.

We have also found that the buffered solution caused a reduction in the onset time of anesthesia with the reduction being significant for the mandibular alveolar block injection, and insignificant for the infraorbital injection.

In a study by Shurtz *et al*., 2015 [17], it was found that the difference in onset times was not significant with the local infiltration method when using a buffered solution. Conversly, Aulestia-Viera *et al*., 2018 [10] found that for the mandibular alveolar block injection, the reduction was significant.

The increased pH value increases the amount of local anesthetic in its base-free and non-charged form, which is the active part that leads to the clinically observed local anesthesia.

Highly fat-soluble forms of local anesthetics can penetrate the nervous membrane more easily, allowing easier access to the working site which translates into increased efficiency and longer working times.

Looking at the duration of anesthesia, we have found that for the control group, the durations were longer than the buffered solution group for both the infraorbital and mandibular injections. However, the difference for infraorbital injection was not statically significant. No similar studies evaluated the duration of anesthesia for either injection; although Warren *et al*., 2017 [18] have suggested that the duration of anesthesia induced using non-buffered 2% lidocaine with epinephrine was similar to that of buffered lidocaine 1% with epinephrine. Our findings do not support the aforementioned study, neither do they support Afolabi *et al*., 2013 [15] who suggested that buffering with sodium bicarbonate lead to increased anesthesia durations when used for local upper lip anesthesia.

Sodium carbonate might block the binding of the protein compounds which comprise 10% of the nerve structure.

Conclusions

Pain associated with the infraorbital and mandibular alveolar block injections was reported as the lowest when the solution was buffered with sodium bicarbonate. The onset time for anesthesia was insignificantly less in the infraorbital injection when the solution was buffered. Conversely, for the mandibular alveolar block injection, the reduction in onset time was significant.

The duration of anesthesia was reduced with buffering. The reduction was insignificant for the infraorbital injection, and significant for the mandibular alveolar block injection.

References

1. Davoudi A. *et al.*, A brief review on the efficacy of different possible and nonpharmacological techniques in eliminating discomfort of local anesthesia injection during dental procedures, Anesth. essays Res. 2016; 10(1):13.
2. Malamed SF. Buffering local anesthetics in dentistry," Pulse. 2011; 44(6):pp.8-9.
3. Malamed SF, Falkel M. Advances in local anesthetics: pH buffering and dissolved CO2., Dent. Today. 2012; 31(5):88.
4. Vasan A, Baker JA, Shelby RA, Soo MSC. Impact of sodium bicarbonate-buffered lidocaine on patient pain during image-guided breast biopsy, J. Am. Coll. Radiol. 2017; 14(9):1194–1201.
5. Lee HJ, YJ. Cho HJ, Gong HS, Rhee SH, HS. Park SH. The effect of buffered lidocaine in local anesthesia: a prospective, randomized, double-blind study. J. Hand Surg. Am. 2013; 38(5):971–975.
6. Frank SG, Lalonde DH. How acidic is the lidocaine we are injecting, and how much bicarbonate should we add?, Can. J. Plast. Surg. 2012; 20(2):71-73.
7. Malamed SF. Handbook of Local Anesthesia, 2012; 6e.
8. Meechan JG, Robb ND, Seymour RA. Pain and anxiety control for the conscious dental patient. Oxford university press, 1998.
9. Cepeda MS, Africano JM, Polo R, Alcala R, Carr DB. What decline in pain intensity is meaningful to patients with acute pain?, Pain. 2003; (105)1–2:151–157.
10. Aulestia-Viera PV, Braga MM, Borsatti MA. The effect of adjusting the pH of local anaesthetics in dentistry: a systematic review and meta-analysis, Int. Endod. J. 2018; 51(8):862–876.
11. Chitre AP, Manual of Local Anaesthesia in Dentistry. JP Medical Ltd, 2016.
12. Hogan M-E, Perampaladas K, Machado M, Einarson TR, Taddio A. Systematic review and meta-analysis of the effect of warming local anesthetics on injection pain. Ann. Emerg. Med. 2011; 58(1):86–98.
13. Shyamala M. *et al.*, "A comparative study between bupivacaine with adrenaline and carbonated bupivacaine with adrenaline for surgical removal of impacted mandibular third molar. J. Maxillofac. Oral Surg., vol. 2016; (15)1:99–105.
14. Karkut B, Reader A, Drum M, Nusstein J, Beck M. A comparison of the local anesthetic efficacy of the extraoral versus the intraoral infraorbital nerve block. J. Am. Dent. Assoc. 2010; 141(2):185–192.
15. Afolabi O, Murphy A, Chung B, Lalonde DH. The effect of buffering on pain and duration of local anesthetic in the face: A double-blind, randomized controlled trial," Can. J. Plast. Surg. 2013; 21(4):209–212.
16. Burns CA, G. Ferris, C. Feng, J. Z. Cooper, and M. D. Brown, "Decreasing the pain of local anesthesia: a prospective, double-blind comparison of buffered, premixed 1% lidocaine with epinephrine versus 1% lidocaine freshly mixed with epinephrine. J. Am. Acad. Dermatol. 2006; (54)1:128–131.

17. Shurtz R, Nusstein J, Reader A, Drum M, Fowler S, Beck M. Buffered 4% articaine as a primary buccal infiltration of the mandibular first molar: A prospective, randomized, double-blind study, J. Endod. 2015; 41(9):1403-1407.
18. Warren VT. *et al.*, "Buffered 1% Lidocaine With Epinephrine Is as Effective as Non-Buffered 2% Lidocaine With Epinephrine for Mandibular Nerve Block. J. Oral Maxillofac. Surg. 2017; (75)7:1363–1366.