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Efficacy of 7.5% Sodium Bicarbonate Buffered 2% Lidocaine with 1:80,000 Epinephrine in Exodontia

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Abstract **Original Research Article**

Objectives: The present study examined the efficacy and acceptability of buffered lidocaine (7.5% sodium bicarbonate and 2% lignocaine with 1:80,000 adrenaline) injection for pain management in dental extractions. ***Materials and Methods:*** A hundred patients aged between 20-60 years, according to the recommendations of the American Society of Anesthesiologists (ASA), who required teeth extraction either in maxillary or mandibular arch were considered. Routine exodontia was performed immediately after mixed sodium bicarbonate buffered lidocaine was administered. Simultaneously, the onset time of anesthesia was recorded using a stop clock, whereas pain perceived by the patient during injection and extraction was scored using a visual analog scale. The duration of anesthesia was assessed by the feeling of numbness and the first sign of pain. ***Results:*** One hundred patients were administered buffered lidocaine (pH 7.2). They had demonstrated a rapid onset (average of 41.20 sec) of anesthesia, a prolonged duration of anesthesia for soft tissues (average of 3.5 hrs), and low discomfort during injection (62%) and extraction (60%). ***Conclusion:*** Buffering lidocaine with sodium bicarbonate reduces the discomfort during the injection and hastens the onset of anesthesia for infiltrations and maxillary blocks when compared to mandibular block with an immersive action that prolongs the duration of soft tissue anesthesia up to 4-5 hrs. It is a simple, economical procedure that a dentist can efficiently perform before local anesthetic administration, making oral surgical operations more comfortable for patients.

Keywords: Buffered Lidocaine, Sodium Bicarbonate, Local anesthesia, Pain, Visual analog scale.

INTRODUCTION

A painless procedure and patient's comfort during oral surgical operations primarily rely on the competency of Local Anesthesia (LA) administered, making it facile for both the patient and surgeon. LA, most often the amide group member, lidocaine, forms a potent drug for pain control during such procedures **[1].** Lidocaine, as such, is an unstable, weak basic amide and therefore merchandised in an acidic preparation (pH 5.7-6.5) to augment its solubility and protract its shelf life. Adding a vasoconstrictor, epinephrine, to this commercially available lidocaine further lowers its pH (3.3- 5.5) to prolong the duration of its anesthetic action, decrease toxicity and achieve hemostasis **[2].** However, being the most widely used LA, pain and burning sensations have been reported on mucosal infiltration with epinephrine- containing lidocaine. It is due to the acidic pH of lidocaine with epinephrine that results in the slow onset of anesthesia and induces stinging pain or burning sensation by raising the hydrogen ions in the local tissue environment, causing discomfort for some patients during anesthetic administration **[2, 3].**

To address the above drawbacks, buffering or alkalinization of lidocaine with sodium bicarbonate (pH 7-8.5) is widely recommended just before its administration. The interaction of sodium bicarbonate with lidocaine hydrochloride acid will increase its pH and produce sodium chloride, water, and carbon dioxide (CO2). Sodium chloride released further dissociates to sodium and chlorine, which enter the circulation **[4].** *Catchlove et al.,* **[5]** stated that CO2 potentiates LA by direct depressant action on the axon, ion trapping of LA inside the nerve trunk, and converting them to active cations via altering nerve pH. In a systematic

review of 22 randomized clinical trials (RCTs) comprising humans, *Davies RJ et al.*, [**6]** found that buffering local anesthetics with sodium bicarbonate might minimize injection discomfort without reducing effectiveness.

In light of this history, the current study aimed to determine the efficacy of 7.5% sodium bicarbonate as an alkalinizing agent in 2% lidocaine with 1:80000 epinephrine and evaluate the timing of anesthesia onset, pain profiles following injection of LA, discomfort and duration of soft tissue anesthesia in minor surgical exodontia.

MATERIALS AND METHODS

A hundred patients reporting to the Department of Oral and Maxillofacial Surgery, Sibar Institute of Dental Sciences, Guntur seeking extraction of teeth in either maxillary or mandibular arch were selected, case history was documented with radiographic evaluation, and written informed consent was obtained from each patient as a customary study procedure. The protocol for the study was approved by the Institutional Ethics Committee (Ref no: Pr.01/IEC/SIBAR/2020) and study period was from January 2021 to December 2021. Patients aged between 20-60 yrs in ASA I and II categories who were not allergic to local anesthetic were included in this study. Patients who were not willing to participate, medically compromised, pregnant, with a history of allergic/hypersensitivity reaction, or under any medication that might clout the anesthetic assessment were excluded.

***Buffered LA preparation*:** Under sterile conditions, 1.8ml of 2% lidocaine with 1:80000 epinephrine (*Lignox®, Indoco remedies pvt ltd, India*) was loaded in a sterile disposable 2ml syringe. It was then diluted with 0.2ml of the 7.5% sodium bicarbonate solution (*Hindustan Medicines Pvt Ltd, India*) (Figure 1) in 9:1 dilution, and the syringe was inverted to mix the solution to attain complete buffering of the LA.

***Visual Analog Scale (VAS*):** This study employed a 10-cm linear VAS to gauge patients' reports of subjective pain. Antecedent to injection, patients were elucidated regarding VAS. The scores were recorded by making a handwritten mark on the VAS scale ranging from 0-10, representing a continuum from no pain to worst pain.

***Procedure*:**

Before tooth extraction, each patient received a freshly prepared buffered solution via a sterile 26-G disposable needle. Patients were instructed to ignore the pain of needle insertion and observe for any burning or stinging sensation during lidocaine administration. The pH value of 2% lidocaine with epinephrine was measured before and after buffering it with sodium bicarbonate in a digital pH meter and checked for its stability on litmus paper immediately at 10 min, 1 hr, and 24 hrs (Figure 2). A stop clock was used to record the time taken for the onset of the anesthetic effect immediately after the administration of LA. Patients were advised to use the VAS to score their discomfort or pain perceived following LA administration and extraction. The patients were then asked to wait until the soft tissue anesthetic had worn off, as the insensitivity of soft tissues under anesthesia was a visual indication regarding the duration of LA. All sensations in the soft tissues were time recorded at the instant they reverted to normal. Patients were reached by phone in certain cases, and the time was recorded.

The data related to pain during injection, onset, and efficacy of buffered anesthesia were recorded and analyzed using Descriptive statistical methods and tabulated in Microsoft excel. Mean value and standard deviation were computed for continuous variables.

RESULTS

This study included a hundred patients [40% males; 60% females] (Figure 3) aged between 20 to 60 years, with an average age of 46 years and no serious underlying comorbidities.

Patients who received injections of buffered sodium bicarbonate exhibited a quicker onset of anesthesia (41.20 seconds on average) and a longer duration of soft tissue anesthesia (3.25 hours on average) (Table 1).

Pain intensity after administration of buffered anesthesia was assessed and calculated based on VAS. The score ranged on a scale of 0-10, where patients with no pain scored 0; mild pain was categorized from scores 1-3, moderate pain from 4-6, severe pain from 7-8, and worst pain from 9-10.

62% of 100 patients experienced no discomfort during the injection, 31% experienced mild pain, 5% experienced moderate pain, and just 2% suffered severe pain (Table 2). Similarly, 60% of patients experienced no pain during extraction, 25% had mild pain, 11% had moderate pain, 2% had severe pain, and 2% experienced the worst pain (Figure 4).

Table 1: Mean statistics of age of patient, onset of action and duration of postoperative anaesthetic effect of lidocaine

	Minimum	Maximum	Mean	Std. Deviation
Age (in years)	16	75	46.87	13.47
Time of onset of anesthesia (in sec)	11.50	115.00	41.20	19.92
Duration of soft tissue anesthesia (in hours)	1.00	6.00	3.23	1.125

Table 2: No. of patients experienced pain during injection of buffered lidocaine

Pain during injection (visual analog scale)	Frequency	Percent
mild	31	31.0
moderate	5	5.0
no pain	62	62.0
severe	2	2.0

Figure 1: Sodium Bicarbonate 7.5% ampule is readily available and costs about Rs 20/ampule. No added preservative and therefore usually discarded at the end of the day

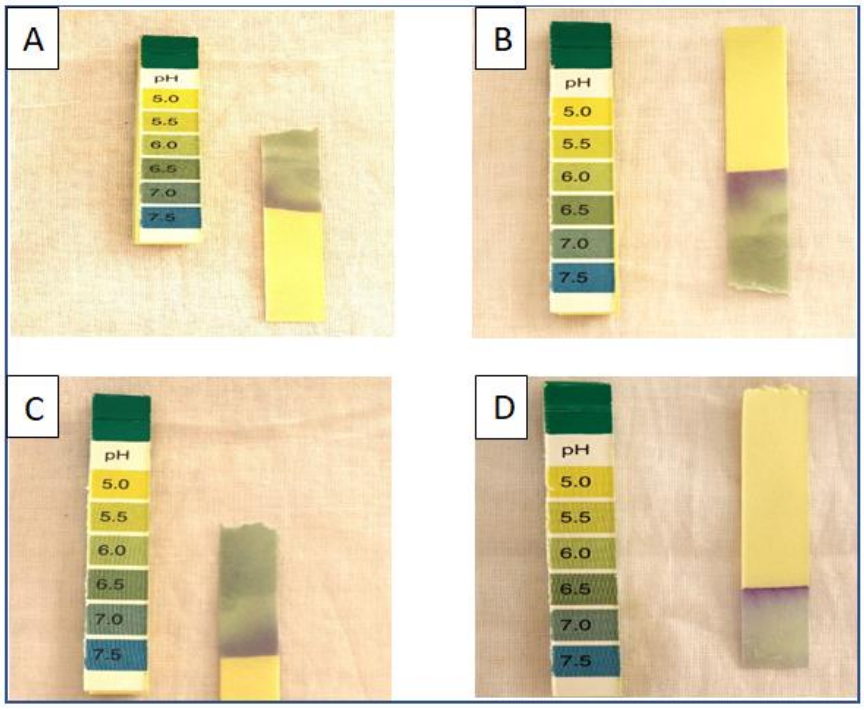

Figure 2: Photograph showing pH for mixture of 1.8 ml lidocaine with epinephrine and 0.2ml of 7.5% sodium bicarbonate on litmus paper at different time intervals. [A] pH observed immediately. [B] pH observed after 10 minutes. [C] pH observed after 1 hour. [D] pH observed after 24 hours

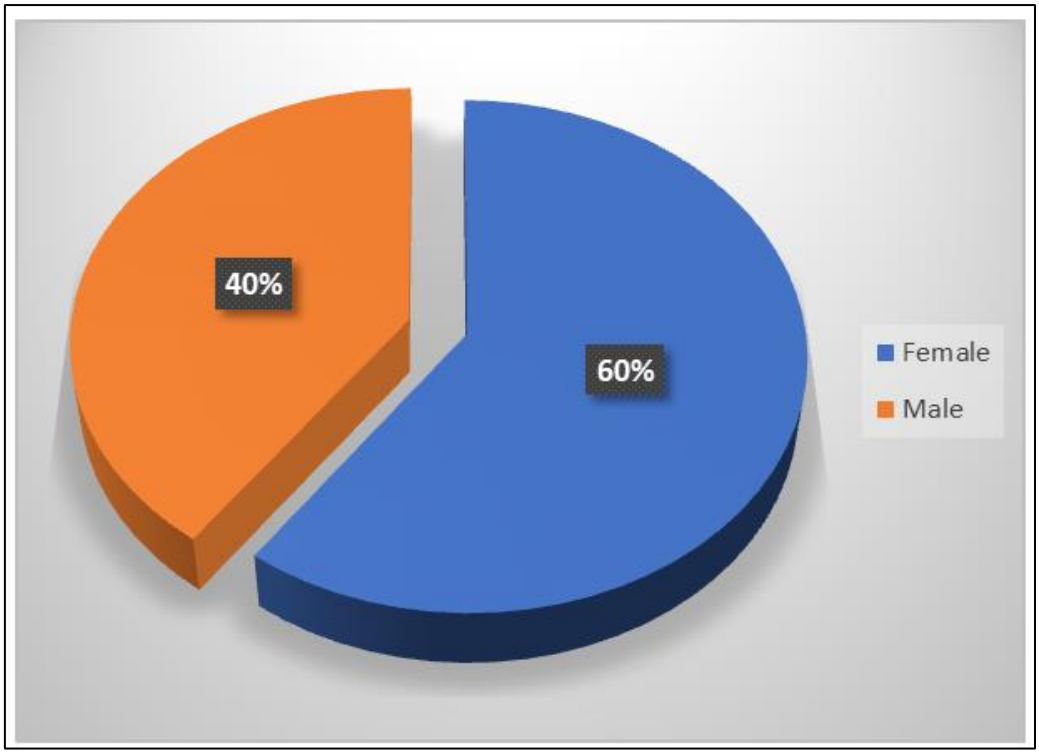

Figure 3: Gender distribution

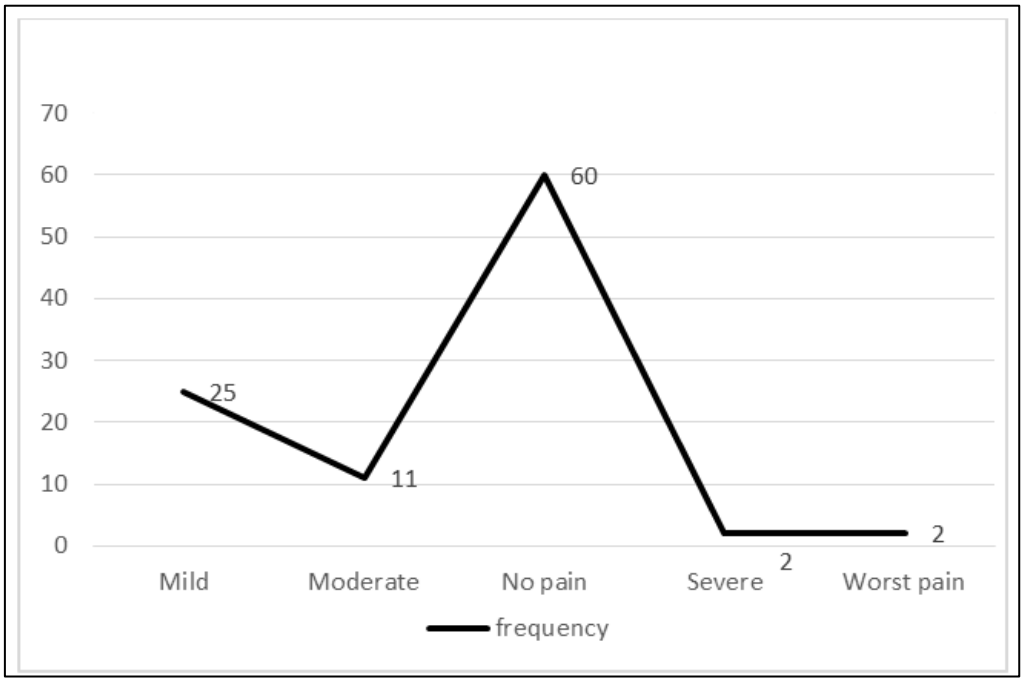

Figure 4: Line graph showing pain distribution during extraction as recorded by patient on VAS

DISCUSSION

The present study revealed that injection of buffered 2% lidocaine with 1:80000 epinephrine decreased the pain and discomfort during administration and extraction in most patients without the need for supplemental injections.

As a local anesthetic, lidocaine is most frequently used in oral surgery due to its rapid start and minimal adverse effects. Patients experiencing stinging sensation during lidocaine injection are mainly due to the rate of injection and acidity of the solution **[7].** The acidic pH of lidocaine with epinephrine decreases the availability of the deionized form of anesthetics and increases the tissue volume that causes pressure. Therefore, the Less the acidic nature, the more the deionized form, which increases the availability of the free base form, resulting in the desired anesthetic effect **[8].**

Galindo et al., **[9]** concluded that using pH-adjusted LA (basic solutions) was more beneficial when investigated during epidural analgesia, peripheral nerve blocks, and regional anesthesia.

Many mixtures of different concentrations of lidocaine and sodium bicarbonate have been advocated in the literature. The addition of 1 ml of 8.4%sodium bicarbonate to 10 ml of lidocaine with epinephrine is the most routine method to neutralize the acidic pH of lidocaine to a more physiological range. Due to the unavailability of 8.4% sodium bicarbonate, this study has opted for 7.5%, which was readily available that cost around 20 Rs per ampule. Under sterile conditions, 0.2ml of 7.5% sodium bicarbonate was blended with 1.8ml of 2% lidocaine with 1:80,000 epinephrine and was immediately injected.

Various studies have suggested the need for a proper volume ratio of sodium bicarbonate to neutralize the pH of lidocaine with epinephrine, as a higher volume ratio can lead to precipitation of solution due to excessive alkalinity and could result in tissue damage **[5, 10].** The recommended ratio of lidocaine with epinephrine and sodium bicarbonate was 9:1-10:1 to increase the onset of time, decrease the pain of injection and attain physiological pH **[7, 11].**

Momsen et al., **[12]** verified the proper ratio of 8.4% sodium bicarbonate required to neutralize pH to 7.4 for 1% lidocaine with 1:100,000 epinephrine was approximately 1 ml: 10 ml, with the stability of buffered solution for up to 24 hrs following preparation. In the present study, the pH of 2% lidocaine with 1:80,000 adrenaline was found to be 3.6 when measured using a pH meter, and for sodium bicarbonate buffered lidocaine, the pH recorded was 7.2, nearly equivalent to tissue pH (7.4), with the stability of buffered solution maintained up to 24 hrs. Therefore, there was no risk for precipitate formation observed with the concentration of sodium bicarbonate used for buffering in the current study.

The alkalinization of lidocaine with sodium bicarbonate increases the uncharged molecules availability of lidocaine, resulting in amplified diffusion through the neuronal membrane, and has an instant action on the binding of LA to sodium channels, thereby hastening the onset of anesthesia **[13].** We also observed a quicker onset of action after maxillary infiltration as compared to mandibular block with buffered lidocaine**.** The results were **as** per *Kanna et al*., **[14],** who reported onset of anesthesia was within 46.9 sec, and *Batista et al.*, **[15],** who reported the onset of anesthesia within 2 min but was in contrast to *Primosch et al*., **[16]** who reported no significant difference in pain and onset of anesthesia.

To the best of the author's knowledge, despite the assorted studies available on 8.4% sodium bicarbonate as an alkalinizing agent, the use of 7.5% sodium bicarbonate buffered lidocaine has previously been reported in hand surgery **[17]** but not used in oral surgery. The present study's data confirmed that buffering lidocaine with 7.5% sodium bicarbonate reduces pain and discomfort during the injection with faster and more immersive action and can be incorporated into routine clinical practice for extraction and other dental procedures requiring anesthesia. However, no control/comparative group was taken in the present study to validate the efficacy of buffered lidocaine, which served as a significant limitation. Moreover, the study was not standardized to a particular arch or injection technique which might lead to bias in the results achieved. Therefore, the clinical application of buffering lidocaine with 7.5% sodium bicarbonate for future research should be tailored accordingly to substantiate its efficacy in oral surgery.

CONCLUSION

The present study concludes that appending 7.5% sodium bicarbonate to 2% lidocaine with 1:80,000 adrenaline offsets the acidity of lidocaine, thereby waning both pain and burning sensations and easing the discomfort in most patients during injection of local anesthetics. In addition, this method also prolongs the duration of anesthesia with a shorter onset of action and prevents the need for supplemental local anesthetic injections.

REFERENCES

1. Guo, J., Yin, K., Roges, R., & Enciso, R. (2018). Efficacy of sodium bicarbonate buffered versus non-buffered lidocaine with epinephrine in inferior alveolar nerve block: A meta-analysis. *Journal of dental anesthesia and pain medicine*, 18(3), 129-42.
2. Malamed, S. F. (2014). Handbook of Local Anesthesia-E-Book 6th edition, Elsevier Health Sciences.
3. Christoph, R. A., Buchanan, L., & Begalla, S. S. (1998). Pain reduction in local anesthetic administration through pH buffering. *Ann Emerg Med*, 17, 117-120.
4. Primosch, R. E., & Robinson, I. (1996). Pain elicited during intraoral infiltration with buffered lidocaine. *Am J Dent*, 9(1), 5.
5. Catchlove, R. F. (1972). The influence of CO 2 and pH on local anesthetic action. *J Pharmacol Exp Ther*, 181, 298-309.
6. Davies, R. J. (2003). Buffering the pain of local anaesthetics: a systematic review. *Emerg Med*, 15, 81-8.
7. Frank, S. G., & Lalonde, D. H. (2012). How acidic is the lidocaine we are injecting, and how much bicarbonate should we add? *Can J Plast Surg*, 20(2), 71-73.
8. Hobeich, P., Simon, S., Schneiderman, E., & He, J. (2013). A prospective, randomized, double-blind comparison of the injection pain and anesthetic

onset of 2% lidocaine with 1:100,000 epinephrine buffered with 5% and 10% sodium bicarbonate in maxillary infiltrations. *J Endod*, 39(5), 597-9.
9. Galindo, A. (1983). pH-adjusted local anesthetics: Clinical experience. *Reg Anesth*, 8, 35-36.
10. Catchlove, R. (1973). The influence of CO2 and pH on local anestheticaction. *Survey of Anesthesiology*, 17, 184-185.
11. Best, C. A., Best, A. A., Best, T. J., & Hamilton, D. A. (2015). Buffered lidocaine and Bupivacaine Mixture – the Ideal Local Anesthetic Solution? *Plast Surg*, 23(2), 87-90.
12. Momsen, O. H., Roman, C. M., Mohammed, B. A., & Andersen, G. (2000). Neutralization of lidocaine-adrenaline. A simple method for less painful application of local anesthesia. *Ugeskr Laeger*, 162, 4391-4.
13. Gosteli, P., Gessel, E. V., & Gamulin, Z. (1995). Effects of pH adjustment and carbonation of lidocaine during epidural anesthesia for foot or ankle surgery. Anesth Analg, 81, 104-109.
14. Kanaa, M. D., Whitworth, J. M., Corbett, I. P., & Meechan, J. G. (2006). Articaine and lidocaine mandibular buccal infiltration anesthesia: a prospective randomized double-blind cross-over study. *J Endod*, 32, 296–298.
15. Da Batista Silva, C., Berto, L. A., Volpato, M. C., Ramacciato, J. C., Motta, R. H. L., Ranali, J., & Groppo, F. C. (2010). Anesthetic efficacy of articaine and lidocaine for incisive/mental nerve block. *J Endod*, 36, 438–441.
16. Primosch, R. E., & Robinson, I. (1996). Pain elicited during intraoral infiltration with buffered lidocaine. *Am J Dent*, 9(1), 5.
17. Raj, C. L., Nakarmi, K., Shrestha, S., & Rai, S. M. (2019). Buffered Versus Non Buffered Lignocaine with Adrenaline for Pain Control in Hand Surgery: A Comparative study. *Janaki Medical College Journal of Medical Sciences*, 7(2), 36-4.