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Lignocaine with adrenaline and carbonated Lignocaine with adrenaline for removal of mandibular molar teeth: A Comparative Study

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Abstract

Background: To compare efficacy between lignocaine with adrenaline and carbonated lignocaine with adrenaline on pain, onset of anesthesia, and duration of anesthesia for removal of mandibular molar teeth.

Study Design: All patients who underwent uncomplicated removal of mandibular molar teeth were included and a double blind randomized clinical study was conducted. 100 patients were included who had indications for removal of mandibular molar teeth and they were randomly allocated in two groups equally into Group A (non-carbonated lignocaine with adrenaline) and Group B (carbonated lignocaine with adrenaline). Pain during deposition of local anesthetic solution, the onset of anesthesia and duration of anesthesia were compared among the two groups.

Results: Pain was measured on a visual analogue scale (VAS). The mean VAS score was significantly low for carbonated lignocaine group ($p< 0.00001$). The mean time to onset of local anesthesia in Group B was 52.58 compared with 69.44 in Group A. The duration of action of local anesthesia in Group A and Group B had no significant difference and varied randomly.

Conclusion: It can be concluded that alkalized lignocaine with adrenaline has a faster onset of anesthesia and less pain during injection but duration of anesthesia had no difference.

Keywords: Local Anesthesia; alkalized lignocaine; exodontia

Introduction

The greatest apprehension for a patient during a dental visit is tooth extraction; to be precise the local anesthetic injection is what they dread of. It is often the only painful part of a dental procedure and requires a lot of technical maneuvers to make it as less painful as possible.[1] It has always been the main focus also for the dentist to make

the dental procedure as comfortable as possible which in turn is beneficial for the patient as well as the surgeon. Sometimes the experience of pain on injection is so bad that patients decline further interventions under local anesthesia.[1] The main cause of this pain is not only because of the needle penetration but also due to the tissue irritation that is caused by injecting the local anesthetic solution with adrenaline whose composition is adjusted to prolong its shelf life, thus making it more acidic.[2] Molecules in the cartridge mostly exist in water soluble form and are acidic.[20] Conversely, for the anesthetic to penetrate the nerve sheath, it must be in an unionized free base form; then the H^+ ion needs to dissociate from the ionized molecule. Since the physiological pH is about 7.4, an increase in H^+ in the tissues could cause pain by activating nociceptors such as the acid-sensing ion channels.[20]

To prevent this pain dentists have used various methods while depositing local anesthetic solution like topical anesthetics, slow infiltration, transcutaneous electrical nerve stimulation(TENS), computer-assisted local anesthesia (such as WAND) and vibration.[2] Another method of reducing the pain of injection is neutralizing the local anesthetic solution sodium bicarbonate. There is overwhelming evidence that buffered local anesthetics cause less pain on injection or no pain at all.[3] The reason behind this is buffering the solution increases the non-cationic form of the drug which increases the penetration of solution into the soft tissue nerve sheath thereby decreasing the pain during injection and produces rapid onset of action of local anesthetic solution.[4,5] Additionally the pKa value determines the potency of the drug so addition of an alkalizing agent into the local anesthetic solution produces a pH closer to the physiological pH.[4]

We have studied the effect of adding sodium bicarbonate to the local anesthetic solution on the pain of injection and also on the time for the onset of anesthesia and compared it with a control group where only local anesthetic with adrenaline was given.

Materials & Methods

A double blind randomized study was conducted in the department of oral and maxillofacial surgery to compare the efficacy between carbonated and non-carbonated lignocaine with adrenaline. After obtaining research and ethical committee approval, all patients who reported to the department for removal of the mandibular molar tooth were included in the study. Exclusion criteria included conditions like pregnancy, lactating females, history of local anesthetic allergy, medically compromised patients.

Subjects were randomly divided into two groups as Group A (control group) and Group B (study group) and 50 subjects were included in each group. A clinical comparative double-blind study was conducted in which the operator and the patient had no idea regarding which solution was deposited to whom. The control group was given lignocaine hydrochloride with 1:80000 adrenaline solution by injection and the study group was given the same solution but with sodium bicarbonate. For buffering the solution 3ml of 7.5% sodium bicarbonate was added to 30 ml of the above solution which yielded 1/10 dilution. If the time between injection and preparation of the solution was more than 5 minutes the solution was discarded.[6] The pH of lignocaine hydrochloride with 1:80000 adrenaline was 4-4.6 and that of the carbonated solution was 7.5-8.

The procedure was explained to the patient and informed consent was taken prior to starting the procedure. Local anesthetic allergic testing was carried out by depositing 0.2ml of a freshly prepared solution in the forearm intradermally using a 2ml disposable syringe. After administering the test dose, the patient was monitored for 30 minutes for signs and symptoms of an allergic reaction. All patients were given inferior alveolar, lingual and long

buccal nerve block using 2ml single-use syringes with of length 25mm with 24 gauge needle. Patients were kept under observation in the department for first post-operative hour and were discharged only if there were no complications.

Pain during injection was assessed using a four-point scale: 0= no pain, 1= mild pain (pain reported only on questioning), 2= moderate pain (pain reported spontaneously without questioning), 3= severe pain (strong vocal response and grimaces, withdrawal of arms, tears).[1]

The time of onset of anesthesia was noted from the first sensation of numbness or tingling in the anesthetized region. A straight probe was used to assess the onset by inserting it in the gingival sulcus of the teeth in the area of anesthesia. Duration of action of local anesthesia was calculated from the onset of anesthesia until the need for postoperative analgesia. This was noted by making hourly calls to the patient from the first postoperative hour to the requirement of analgesics.

Data from the VAS were analyzed using the Mann-Whitney U test and time of onset and duration of action of anesthesia were analyzed using Student's t-test. Probabilities of less than 0.001 were accepted as statistically significant.

Results

Among patients given lignocaine without sodium bicarbonate 36 patient's experienced severe pain, 12 patients had moderate pain and 2 patients experienced mild pain. On the contrary among all the patients who were given lignocaine with sodium bicarbonate only 2 of them experienced severe pain, 18 complained of moderate pain, 21 had mild pain and 9 patients had no pain at all (Figure 1). There was a significant difference statistically between the mean VAS score in Group A and Group B. The mean (SD) time (seconds) to the onset of anesthesia was 69.4 (11.5)

(9.7) (Figure 2). No statistical difference was found in this parameter and results varied randomly in both the groups.

Discussion

Pain is defined as an unpleasant emotional experience usually initiated by a noxious stimulus and transmitted over a specialized neural network to the central nervous system where it is interpreted as such.[7] Pain during injection is mainly due to the pH of local anesthesia (approx. 6.5) which is further lowered to the range of 3.3 by the addition of adrenaline and sodium bisulfite to the solution. The pain of injection can be reduced to an extent by injecting the solution slowly but altering the pH more towards the alkaline side reduces patient discomfort to a greater extent. There is a consensus that, for nerves with intact sheaths, local anesthetics are more potent in alkaline, than in neutral or acid, conditions.[8]

Sodium bicarbonate was used as an alkalizing agent in this study to increase the pH of the local anesthetic to a more physiological pH. It acts by increasing the plasma bicarbonate concentration, buffering excess hydrogen ions and raising the pH of blood, thus reversing clinical signs of acidosis.[9] Alkalizing the anesthetic solution makes the injection more comfortable, reduces onset time and increases its effectiveness as sodium bicarbonate increases the availability of uncharged lidocaine molecules (RN), also called the free base.[9] Additionally, sodium bicarbonate is also available in the tissues as bicarbonate ion, which alkalizes the extracellular pH. This increase in extracellular pH reduces the intracellular pH which also plays a part in increasing the effect of the local anesthetic block through protonation of intracellular free base local anesthetic ("ion trapping") and increasing the concentration gradient for the free base local anesthetic across the plasma membrane.[10]

Our results of VAS score for pain on injection were quite similar to studies done by Erramspouse,[11] Martin,[12] Davies[3] and Sarvela et al.[13] All of these studies reported that majority of the patients had no pain on injection when alkalized local anesthetic solution was used. The free base form of the local anesthetic solution is more lipids soluble, and so it diffuses faster into the nerve membrane. The cytoplasm was acidified by the membrane-permeating carbon dioxide leading to intracellular trapping of the cationic form of the local anesthetic agent.[14] Increasing the extracellular pH with constant extracellular concentration of local anesthetic solution results in a greater intracellular concentration of local anesthetic and more complete inhibition of sodium currents whether or not the intracellular carbon dioxide concentration or pH changes.[10] Sodium bicarbonate ions also non-specifically reduce the margin of safety for nerve conduction and may have a direct action on the binding of the local anesthetic to the sodium channel.[15] Gros[16] and Ritchie et al[17] concluded that the addition of sodium bicarbonate to solutions of lignocaine reduced the duration of onset of anesthesia. In our study, the duration of anesthesia varied between patients randomly. Even though the mean duration of action was slightly higher in carbonated lignocaine group but it was not statistically significant. Similar results were found by Sinnott et al[18] and Shyamala et al[6] where they stated that alkalizing lignocaine hastens the onset of action but does not change the duration of action.

Conclusion

The physiology, anatomy and the kinetics of the time course of local anesthetics suggest that the body's process of converting the cationic form of local anesthetic to active RN form are responsible for significant delay, uncertainty and inconsistency in anesthesia.[2] Taking a patient's physiology out of the latency equation by buffering the local anesthetic solution at chairside immediately prior to injection is an effective method to increase the efficacy of the anesthetic solution.[2] Bicarbonate buffering has been studied and written about for more than 50 years, and it is a process that has also been recently published Systemic Review by the Cochrane Collaboration[19], which concluded that sodium bicarbonate buffering of lidocaine is safe and effective for reducing injection pain.

We can conclude from this study that buffering a 2% lidocaine with 1:80000 adrenaline with sodium bicarbonate significantly decreases the pain on injection, provide faster onset when compared to non alkalized lignocaine solution.

References

1. Kashyap VM, Desai R, Reddy PB et al. Effect of Alkalinisation of lignocaine for intraoral nerve block on pain during injection, and speed of onset of anesthesia. Br J Oral Maxillofac Surg 2011; 49(8): 72-75
2. Agarwal A, Jithendra KD, Sinha A et al. To evaluate the anesthetic efficacy of sodium bicarbonate buffered 2% lidocaine with 1:100000 epinephrine in Inferior Alveolar Nerve Blocks: A prospective, randomized, double-blind study. Arch of Dent and Med Res 2015; 1(3): 17-23.
3. Davies RJ. Buffering the pain of local anaesthetics: a systematic review. Emerg Med 2003;15:81–89.
4. Gupta RP, Kapoor G (2006) Safety and efficacy of sodium bicarbonate versus hyaluronidase in peribulbar anaesthesia. MJAFI 62:116–118
5. Fulling PD, Peterfreund RA (2000) Alkalinisation and precipitation characteristics of 0.2 % ropivacaine. Reg Anesth Pain Med 25(5):518–521
6. Shyamala M, Ramesh C, Yuvraj V. A Comparitive Study between Bupivacaine with Adrenaline and

Carbonated Bupivacaine with Adrenaline for Surgical Removal of Impacted Mandibular Third Molar. J Maxillofac Oral Surg 2016; 15(1): 99-105

7. Bennett CR, editor. Monheim's local anesthesia and pain control in dental practise. 7th ed. St. Louis: CV Mosby; 1984
8. Bokesch PM, Raymond SA, Strichartz GR. Dependence of lidocaine potency on pH and pCO2. Anesth Analg 1987; 66:9–17.
9. Dollery C. Therapeutic drugs, vol. 2, 2nd ed. Edinburgh: Churchill Livingstone; 1999.
10. Arndt KA, Burton C, Noe JM. Minimizing the pain of local anesthesia. Plast Reconstr Surg 1983;72: 676–679.
11. Erramouspe J. Buffering local anaesthetic solutions with sodium bicarbonate: literature review and commentary. Hosp Pharm 1996;31:1275–1282
12. Martin AJ. pH-adjustment and discomfort caused by the intradermal injection of lignocaine. Anaesthesia 1990;45: 975–978 [Erratum: Anaesthesia 1991;46:242].
13. . Sarvela PJ, Paloheimo PJ, Nikki PH. Comparison of pH-adjusted bupivacaine 0.75% and a mixture of bupivacaine 0.75% and lidocaine 2%, both with hyaluronidase in day-case cataract surgery under regional anesthesia. Anesth Analg 1994;79: 35–39.
14. Masters JE. Randomized control trial of pH buffered lignocaine with adrenaline in outpatient operations. Br J Plast Surg 1998;51: 385–387.
15. Wong K, Strichartz GR, Raymond SA. On the mechanisms of potentiation of local anesthetics by bicarbonate buffer: drug structure-activity studies on isolated peripheral nerve. Anesth Analg 1993;76: 131–143.
16. Gros O. Uber die narkotica und Lokalanasthetica. Archiv fur experimentelle Pathologie und Pharmakologie 1910;63: 80–106.
17. Ritchie JM, Ritchie B, Greengard P. The effect of the nerve sheath on the action of local anesthetics. J Pharmacol Exp Ther 1965;150: 160–164.
18. Sinnott CJ, Garfield JM, Thalhammer JG, Strichartz GR. Addition of sodium bicarbonate to lidocaine decreases the duration of peripheral nerve block in the rat. Anesthesiology. 2000; 93(4): 1045-1052
19. Cepeda MS, Tzortzopoulou A, Thackrey M, et al. Adjusting the pH of lidocaine for reducing pain on injection. Cochrane Database Syst Rev 2010;CD: 65-81.
20. Aulestia-Viera PV, Braga MM, Borsatti MA. The effect of adjusting the pH of local anesthetics in dentistry: a systematic review and meta-analysis. Int Endod J 2018;51(8):862-876

Legend Figures

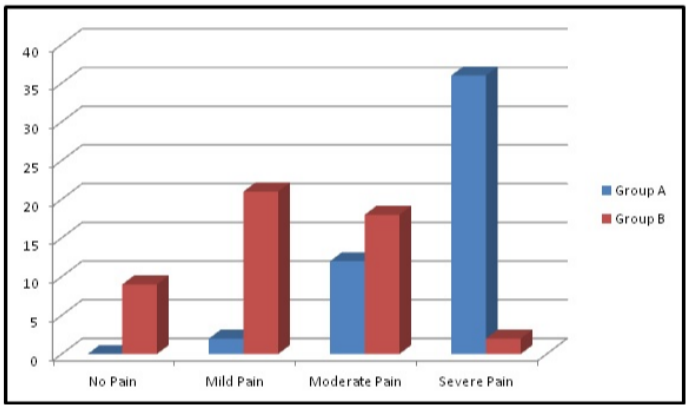

Figure1: VAS score comparison among patients of control and study group

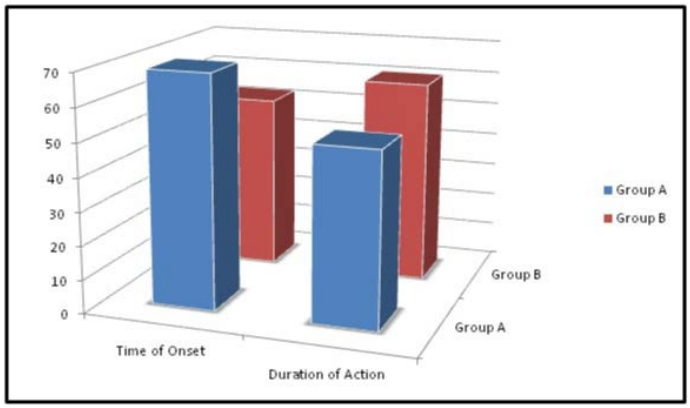

Figure 2: Mean comparison of time of onset of anesthesia and duration of anesthesia among control and study group