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A Randomized Control Study to Compare the Efficacy of Carbonated Lignocaine with Lignocaine Hydrochloride in Mandibular Nerve Blocks: A Pilot Study

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Abstract:
Aim*: To compare the efficacy of carbonated lidocaine with lidocaine hydrochloride in relation to the pain, onset of anesthesia and duration in mandibular nerve blocks*
Materials and method*: Patients in the age group of 18-60 years were included in this study. They were randomly divided into two groups- a control group (receiving lignocaine hydrochloride with adrenaline) and a study group (receiving carbonated lignocaine with adrenaline). Following injection, pain at the site of injection, onset of action of the anesthetic and its duration were assessed.*
Results*: A total of 25 patients were done- 13-control group and 12-study group. There was found to be no significant difference in thepain, onset of action or duration of either of the two solutions. However, 7 of the 25 patients with a dentoalveolar abscesswere also included in the study. It was noted that in these patients, local anesthetic action of carbonated lignocaine was significantly more effective than that of the acidic lignocaine hydrochloride.*
Conclusion*: local anesthetics used routinely in dental clinics are ineffective at infection sites. However in this study we have found that alkalinized lignocaine has a good anesthetic action at infection sites, causing neutralization of the acidic environment and enhancing the nerve block.*
Key Words:*lignocaine hydrochloride, carbonated lignocaine, alkalinisation of local anesthetic solution*

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I. Introduction

Local anesthesia administration isaprerequisite for pain reduction while performing various restorative, endodontic, and minor surgical procedures. Ironically, administration of local anesthesia itself becomes a source of pain and anxiety for patients. Pain caused during local anesthesia administration has been attributed to many factors, including the speed of injection, technique and pH of the anesthetic solution.

Local anaesthetic solutions are in an aqueous form, and the pH of commercially available local anaesthetics is acidic. To increase their shelf life and stability, a vasoconstrictor, adrenaline is added [1.] Lignocaine hydrochloride with adrenaline has a variable onset of action, burning sensation during injection and a lingering pain due to damage of tissues for several days. At a low ph like 3.5-3.9, the number of lipophilic molecules will be around 1 in every 25,000 molecules. Effective pain blocking is thus delayed until the body can buffer the local anesthetic to physiologicph. This can take as long as 15 minutes. Occasionally, the patient may not have the capacity to convert enough local anesthetic for a profound anesthesia, resulting in failure.

Buffering removes these chemical and physiologic limitations. Once buffered the local anaesthetic contains a high level of dissolved carbon dioxide and about 6000 times more of the base form of anaesthetic. The dissolved carbon dioxide, during needle penetration, rapidly diffuses through the tissues and turns off the nociceptor responsible for initiating pain impulses. Thus making the entire injective process more comfortable for the patient. The science of buffering and the need for more rapid and predictable onset (as well as for more comfortable injections) in dentistry has led to the development of a technology for buffering lidocaine with epinephrine at chairside [3].

Sodium bicarbonate:

Sodium Bicarbonate Injection, is a sterile, nonpyrogenic solution of sodium bicarbonate (NaHCO3) in water for injection for administration by the intravenous route as an electrolyte replenisher and systemic alkalizer.Solutions are offered in concentrations of 7.5% and 8.4%.The solutions contain no bacteriostatic, antimicrobial agent or added buffer and are intended only for use as a single-dose injection. Sodium bicarbonate in water dissociates to provide sodium (Na^+) and bicarbonate ($HCO3^-$) ions

II. Materials and methods

Aim: To compare the efficacy of carbonated lidocaine with lidocaine hydrochloride in relation to the pain, onset of anesthesia and duration in mandibular nerve blocks.The study was done on patients between 18 - 60 years of age group reporting to the Department of Oral and Maxillofacial Surgery, KLE V.K. Institute of Dental Sciences, Belagavi, for extraction of mandibular teeth.

A total of 25 patients were included in this pilot study-
13-control group (receiving lignocaine hydrochloride with adrenaline) and
12-study group (receiving carbonated lignocaine with adrenaline).
Inclusion criteria for the study were:

- Patients who wish to undergo tooth extraction and who fall in the age group of 18-60 years.
- Patients with no contradictions to the drugs or anesthetic used in the surgical protocol.

Whereas, the exclusion criteria were as follows:

- Patients taking any medications that would alter pain perception
- Patients who are medically compromised or those with systemic illnesses
- Patient allergic to any medications.
- Pregnant women

III. Methodology

The detailed case history of all the patients were recorded. Subjects were then randomly divided into two groups-

- a control group (the ones receiving lignocaine hydrochloride with adrenaline) and
- a study group(the ones receiving carbonated lignocaine with adrenaline).

The solution of lidocaine hydrocarbonatewas freshly prepared mixing lignocaine hydrochloride with adrenaline and 7.5% sodium bicarbonate in the ratio of 10:0.5.The freshly prepared solution was then injected into the study group within 5 minutes of its preparation, while the control group received lidocaine hydrochloride with adrenaline.

Following injection, pain at the site of injection wasassessed. Patientwas asked to describe the pain on a numerical pain scale- a 10 point scale[0-no pain. 1-3-pain reported in response to questioning and without any behavioral signs. 4-6 moderate pain-pain reported spontaneously without questioning. 7-10 strong or unbearable pain-strong vocal response or response accompanied by withdrawal of arms or tears.]. Also, the time of onset of anesthesia was assessed by subjective and objective signs (A stop watch was used and time was recorded in minutes). Patient was asked to note down the time of first sensation of pain post extraction to assess the duration of anesthesia.

IV. Result

In the 25 patients included in the study, there was found to be no significant difference in the pain, onset of action or duration of either of the two solutions (table 1 & table 2). However, 7 of the 25 patients with a dentoalveolar abscess were also included in the study. In these patients surprisingly, the buffered local anesthetic was found to be very effective in producing an efficient local anesthesia at the site, thus making the procedure really comfortable and painless for the patients (table 3 & 4). Whereas the acidic lignocaine hydrochloride took a longer time to anesthetize the area in order to have a relatively painless surgical procedure. Even then, these patients did complain of minor discomfort during the procedure

V. Discussion

Catchlove demonstrated that free CO2 in lidocaine solution had an independent anesthetic effect, which was similar to the effect that lidocaine had on peripheral nerves. He suggested that where a solution contains both lidocaine and free CO2, it is the CO2 that may cause the more immediate form of analgesia, writing: "Since CO2 diffuses rapidly through the sheath and has an independent anesthetic effect, it probably reaches the axon before the local anesthetic, causing the earliest phase of the block." Their study showed a significantly more profound conduction block when free CO2 was present in lidocaine solution [8].

Alkalinisation has been part of the local anaesthetic literature for more than 100 years. The first clinical report of improved onset time by combining sodium bicarbonate solution with procaine with epinephrine was by Gros in 1910.[9]The first anaesthesia textbook reference to anaesthetic buffering (adding sodium bicarbonate to procaine with epinephrine) was made by Gwathmey and Baskerville in 1914.[10]

Although it is clear that there are significant benefits to buffering the lidocaine solutions that represent the gold standard in dental anaesthetics, the problem with adoption of this technique in dentistry (versus medical specialties such as emergency medicine where preinjectionanaesthetic buffering is common) has been that

dental anaesthetic cartridges are sealed containers that do not lend themselves to conveniently and precisely adding sodium bicarbonate solution prior to delivering the injection.[11]

Control group**: Table : 1**

Sr. no.	Age/sex	Pain scale	Onset of action (min)	Duration of anaesthesia (hours)
1.	36/f	3	5	2
2.	42/f	4	5.5	2
3.	55/m	3	5.5	2
4.	34/m	3	2.5	2.5
5.	25/m	5	3.5	2
6.	21/f	3	3	2.5
7.	48/f	6	3	2
8.	33/f	6	3.5	2
9.	47/m	4	3	2
10.	26/m	5	3	2.5
11.	36/m	6	4	2.5
12.	52/m	3	3	2
13.	28/m	4	4	2

Study group: Table : 2

Sr. no.	Age/sex	Pain scale	Onset of action (min)	Duration of anaesthesia (hours)
1.	58/m	3	2.5	2.5
2.	37/f	3	3	2
3.	22/m	4	3	2.5
4.	35/m	2	3.5	2.5
5.	30/f	2	3.5	3
6.	23/f	6	3	2
7.	28/f	2	3	2.5
8.	40/m	6	4	2
9.	47/f	5	3.5	2
10.	33/m	3	4	2
11.	28/f	3	3	2
12.	22/f	4	3	2.5

Control (patients with dentoalveolar abscess): Table 3

Sr. no.	Age/sex	Pain scale	Onset of action (min)	Duration of anaesthesia (hours)
1.	36/f	3	5	2
2.	42/f	4	5.5	2
3.	55/m	3	5.5	2

Study (patients with dentoalveolar abscess): Table 4

Sr. no.	Age/sex	Pain scale	Onset of action (min)	Duration of anaesthesia (hours)
1.	58/m	3	2.5	2.5
2.	37/f	3	3	2
3.	22/m	4	3	2.5
4.	35/m	2	3.5	2.5

VI. Conclusion

Local anesthetics used routinely in dental clinics are ineffective at infection sites. However in this study we have found that alkalinized lignocaine has a good anesthetic action at infection sites, causing neutralization of the acidic environment and enhancing the nerve block. Further study and analysis of the same shall be done to arrive to a firm conclusion for the same.

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