

## COMPARATIVE EVALUATION OF EFFICACY OF VARIOUS ADDITIVES (EPINEPHRINE, CLONIDINE, MANNITOL PLUS) ALONG WITH 2% LIGNOCAINE IN INFERIOR ALVEOLAR NERVE BLOCK FOR TEETH WITH IRREVERSIBLE PULPITIS: AN IN-VIVO STUDY

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### ABSTRACT:

Inferior Alveolar Nerve block (IAN) is the most frequently used mandibular injection technique for achieving local anesthesia in endodontics. Supplemental additives along with lignocaine 2% are essential to overcome failure of IAN block in patients with irreversible pulpitis. This study was done on 124 patients with the irreversible pulpitis in mandibular molar teeth and who fulfilled the inclusion criteria. Patients were divided into four groups each including thirty one subjects. Group 1 (control group) received plain 2% lignocaine. Group 2 received lignocaine 2% with epinephrine (1:1,00,000). Group 3 received 5ml lignocaine 2% with 0.5ml of epinephrine plus 0.5ml of mannitol plus. Group 4 received 2.ml of 2 % lignocaine with 12.5 mcg/ml of clonidine. Treatment was immediately stopped if pain occurred during the cavity preparation and discomfort was rated using visual analogue scale of 0–10. The results obtained were subjected to statistical analysis. In this study, adding 0.5 M mannitol plus to lidocaine with epinephrine formulation was significantly more effective in achieving a greater percentage of total pulpal anesthesia than lidocaine formulation without mannitol plus. Results of the study shows that the lignocaine plus epinephrine with mannitol plus shows promising results in achieving profound pulpal anaesthesia.

**Keywords:** Inferior alveolar nerve bloc; irreversible pulpitis; lignocaine; epinephrine; clonidine; mannitol plus.

### INTRODUCTION:

Stanley F. Malamed defined local anesthesia as the “loss of sensation in a circumscribed area of the body caused by the depression of excitation in nerve endings or an inhibition of the conduction process in peripheral nerves.”<sup>[1]</sup> Pain control in the early stages of endodontic treatment is an important aspect of a successful dental procedure.

Symptomatic Irreversible pulpitis is often characterized by spontaneous bouts of pain lasting for a few seconds up to several hours. Therefore, achievement of adequate pulpal anesthesia in the mandible has been challenging to the endodontist during the conventional Inferior alveolar nerve block (IANB) injection. The onset of pulpal anesthesia

usually occurs within 10-15 minutes. Teeth with irreversible pulpitis show eight fold higher rate of local anesthetic failure reportedly compared to control teeth with vital pulp.<sup>[2]</sup>

The inferior alveolar nerve (IAN) block is the technique of injection commonly used for local anesthesia in restorative and surgical procedures of the mandible. IAN block resulted in failure of pulpal anesthesia in most of the cases reported. Failure rates of 8 to 67% have been reported in experimental studies and clinical studies have found failure between 38 and 81% of the time.<sup>[3]</sup>

Walton and Abbott<sup>[4]</sup> found them the most difficult to anesthetize and were implicated in 47% of clinical situations. Malamed also reported through his study at the University of Southern California that the mandibular molars to be "the problem" in 91% of cases of inability to obtain adequate pulpal anesthesia.<sup>[4]</sup>

Accessory innervation, cross-innervation, and inaccuratelocation of injection have also been the possible factors for the failure of pulpal anesthesia. Perhaps, improper diffusion of the anesthetic agent into the nerve membrane could be the reason for failure. However, the most commonly cited factor in patients with pulpitis has been the activation of nociceptors by inflammation. Lidocaine is the most commonly used local anaesthetic agent in dentistry. And most commonly used vasoconstrictor is epinephrine.<sup>[1]</sup>

Vasoconstrictors are added to the local anaesthetic solution to increase the depth and duration of anaesthesia and to decrease systemic toxicity and also helps in haemostasis. The accurate dosage of vasoconstrictor in local anaesthetic solution to achieve sufficient pulpal anaesthesia however is not certain.<sup>[5]</sup> Various additives has been used to increase the efficacy of pulpal anaesthesia.. Hence this study was carried out to evaluate the efficacy of lidocaine with certain additives such as epinephrine, mannitol and clonidine in patient with symptomatic irreversible pulpitis

Mannitol is a 6-carbon sugar alcohol occurs naturally in fruits and vegetables and is an osmotic diuretic. It has been reported that a 0.5 mol/L solution of mannitol is proven to be effective in opening the perineural membrane which allows enhanced penetrability of local anaesthetic ions. However, the effects on neural conduction of a diluted mannitol/lidocaine formulation are yet to be proven.<sup>[6]</sup>

Clonidine is a selective alpha-2 adrenoceptor agonist with both central and peripheral actions, commonly used as a central antihypertensive agent. Clonidine enhances local anaesthesia via a variety of routes of administration such as epidural, brachial plexus anaesthesia, peripheral nerve block and dental anaesthesia. It has been reported that clonidine with lidocaine induced inhibition of C-fibre action potential. Clonidine directly inhibits pulpal neurons and C-fibres, partially A-

delta, and enhances the effect of anaesthesia when combined with local anaesthetics.<sup>[7]</sup>

Although, many studies have been carried out, to evaluate the success in local anaesthesia for irreversible pulpitis; using different local anaesthetic agents without any significant results. Hence, this study is carried out to evaluate the efficacy of lignocaine with various additives such as epinephrine, mannitol and clonidine in the inferior alveolar nerve blocks for symptomatic irreversible pulpitis.

## MATERIALS AND METHODS:

The prospective study was conducted on a total of 124 patients who reported to the out-patient department of Navodaya Dental College and Hospital with a complaint of pain in mandibular molar teeth. Patients aged 18 to 65 years with caries on mandibular molar teeth willing to participate in the study. Diabetic, hypertensive and hypotensive patients, history of allergy to the agents used in the study, hepatic disorders and renal disorders. Approval from Institutional Ethical Committee was obtained before the start of the study.

### Pre operative assessment

Clinical and Radiographic examination with Pulp vitality test carried out to confirm the diagnosis of symptomatic irreversible pulpitis. Preoperative pain score recorded on Visual Analog Scale (1-10).

### Reagents used:

1. Plain lignocaine (XYNOVA 2%)
2. Lignocaine with adrenaline 1: 1,00,000 (LOX 2%)
3. Epinephrine injection (VASOCON)
4. Clonidine injection (CLONEON)
5. Mannitol plus (Nirlife)

Patients were divided into four groups. And each group comprised of thirty one subjects.

**Group 1 (control group):** comprised of thirty one subjects. And each subject received local anesthesia with 2ml of 2% lignocaine. **Group 2** comprised of thirty one subjects and each subject received local anesthesia with 2ml of lignocaine 2% with epinephrine (1:1, 00,000). **Group 3** comprised of thirty one subjects and each subject received local anesthesia with 1ml lignocaine 2% combined with 0.5ml of Epinephrine plus 0.5ml of Mannitol plus. **Group 4:** comprised of thirty one subjects and each subject received local anesthesia with 2ml of 2 % lignocaine plus 12.5 mcg/ml of clonidine.

### PROCEDURE

Informed consent was taken before the procedure and Inferior alveolar block was given on the side to be operated using the agent assigned to the group to which patient belongs. After 15 minutes, lip numbness was checked to assess effect of anaesthesia. Access opening was done using Endo access and Endo Z burs. During the access opening if the patient complained of pain, procedure was

stopped and VAS score for pain was recorded. In case of successful anaesthesia, procedure was continued. The evaluation of success of local anaesthesia for inferior alveolar nerve block in the patients with irreversible pulpitis was done using visual analog scale (VAS) comparing the VAS in preoperative and intraoperative period.

## RESULTS:

Results obtained were tabulated in excel data sheet and subjected to statistical analysis. Statistical analysis was carried out using SPSS 20.0 software. Comparison between the two groups was done using student unpaired t test and comparison between all the groups was done using straight ANOVA test. P-value <0.005 was set as statistically significant and p-value <0.001 as highly significant. Table 1

## DISCUSSION:

Pain management is the most difficult aspect in the field of endodontics especially when an endodontist encounters a case of irreversible pulpitis. The mean+/-S.D values of VAS scores on comparison of pre-operative and intra-operative scores showed varying results with statistical significance in all groups. The mean values for lignocaine with epinephrine plus mannitol showed significantly good results when compared to other groups followed by group with lignocaine and clonidine.

This study results were according to the results shown by **Smith et al.**<sup>[8]</sup> who concluded that the local anaesthetic

effect was significant with lignocaine and mannitol when compared to lignocaine without mannitol. **Anand Kumar et al.**<sup>[9]</sup> documented the uses of mannitol in the medicine and made a review on the studies which used mannitol as an adjunct to local anaesthetic agents in the inferior alveolar nerve blocks. They concluded that combination of 0.5 M mannitol to 127.2 mg lidocaine with 50µg epinephrine has proven to be more effective in achieving pulpal anaesthesia than with that 127.2 mg lidocaine with 50 µg epinephrine combination without mannitol. **Wolf et al.**<sup>[10]</sup> in a prospective, randomized study showed that the efficacy of lidocaine with epinephrine plus 0.5 M mannitol in inferior alveolar nerve (IAN) blocks significantly improved effectiveness of total pulpal anesthesia compared with a lidocaine formulation without mannitol.

**Talati et al.**<sup>[11]</sup> conducted a comparative Study of Lidocaine and Lidocaine-Mannitol in anesthetizing human teeth with Inflamed Pulp showed that the addition of mannitol to the anesthetic solution may significantly increase the level of anesthesia in inflamed pulps. **Younkin et al.**<sup>[12]</sup> did a prospective study to assess the anesthetic efficacy of lidocaine with epinephrine compared to combination of lidocaine with epinephrine and 0.5 M mannitol in maxillary lateral incisor showed that combination of 0.5 M mannitol with lidocaine and epinephrine was significantly effective in success of total pulpal anesthesia, which correlates with the results of this present study.

**Thimmaiah PB et al.**<sup>[13]</sup> did a prospective, randomized, single blind study to determine the efficacy of combination of 2% lidocaine with 1:80000 epinephrine and 0.5mol/L Mannitol in inferior alveolar nerve block. They concluded that 2 % lidocaine with 1:80000 epinephrine and 0.5mol/L Mannitol gives significant results in pain improvement.

The most commonly used vasoconstrictor in dentistry is epinephrine.<sup>[1]</sup> Vasoconstrictors are added to the local anaesthetic solution to increase the depth and duration of anaesthesia. It is reported that adrenergic agonists (such as epinephrine) inhibit capsaicin-sensitive nociceptor terminals innervating dental pulp, decreasing iCGRP release.<sup>[5]</sup>

**Aggarwal et al.**<sup>[5]</sup> did a randomized controlled, double blind trial to evaluate and compare the efficacy of anaesthesia and pain during injection with 1.8 mL of 2% lidocaine with different concentrations of epinephrine 1: 80 000 and 1: 200 000 in patients with irreversible pulpitis. His study showed that 2% lidocaine solution used for IANB gives similar results as when used with 1:80,000 or 1:200 000 epinephrine concentrations for the pulpal anaesthesia.

In a comparative study by **Ridenour et al.**<sup>[3]</sup>, efficacy of a buffered lidocaine with epinephrine solution to a combination buffered lidocaine with epinephrine plus hyaluronidase solution in inferior alveolar nerve blocks showed that adding hyaluronidase did not contribute much for the success of

anaesthesia. In contrary to this, another similar study by **Satishet al**<sup>[14]</sup> which showed that Hyaluronidase increased the duration of the effects of lidocaine in inferior alveolar nerve blocks in patients with irreversible pulpitis.

In a prospective, randomized, single blind, crossover study by **Goodman et al.**<sup>[15]</sup> to compare the degree of pulpal anesthesia with 36 mg of lidocaine with 18 g epinephrine with that of a combination of 36 mg of lidocaine with 18g epinephrine and 36 mg meperidine with 18g epinephrine in IANB explained that the addition of meperidine to lidocaine solution does not increase the success rate of the inferior alveolar nerve block. **KP Shetty et al.**<sup>[16]</sup> conducted a prospective, randomized, double-blind, placebo-controlled study to compare the anaesthetic effect between lidocaine with and without magnesium sulphate for IANB in irreversible pulpitis says that magnesium sulphate addition lead to the success of IANB.

In another study by **Aggarwal et al.**<sup>[17]</sup> based on the hypothesis that, increasing the volume of anesthetic solution may improve the success rates of dental pulp anesthesia in patients with pulpal pain; concluded that increasing the volume of 2% lidocaine to 3.6 mL improved the success rate as compared with 1.8 mL; but did not give a clinical success rate of 100%. **Saatchi et al.**<sup>[18]</sup> conducted a prospective, randomized, double-blind study to compare the effect of buffered with non buffered 2% lidocaine with 1:80,000 epinephrine solution for inferior alveolar nerve (IAN) block. As per the

results, buffering the 2% lidocaine with 1:80,000 epinephrine with 8.4% sodium bicarbonate did not contribute to the improvement in the success of the IAN block in mandibular molars with symptomatic irreversible pulpitis. **Sampaio et al.** [19] in a study compared the effect of 0.5% bupivacaine with 1:200,000 epinephrine to that of 2% lidocaine with 1:100,000 epinephrine in the pulpectomy procedure. Patients who reported with no or mild pain implied the success rate of bupivacaine, which was 80% and lidocaine was 62.9%.

**Yadav S.** [20] made a systematic review of the studies to compare the rate of success of inferior alveolar nerve block (IANB) technique with that of combination of IANB and supplemental infiltration (SI) technique used for achieving pulpal anesthesia of mandibular teeth with irreversible pulpitis. Evidence gathered showed that the success was clinically significant with SI injection technique as compared to IANB injection technique, but was not statistically significant in the studies as no study is believed to have proven 100% success in any of the technique.

**Clonidine** is a selective alpha-2 adrenoceptor agonist with both central and peripheral actions used as a central antihypertensive agent in medicine. It enhances the local anaesthesia and analgesia in epidural, brachial plexus anaesthesia, peripheral nerve block and dental anaesthesia. It has been used as a vasoconstrictor alternative to epinephrine for different types of local anaesthesia to provide hemodynamic

stability due to its central hypotensive action. [7]

**Shadmehr et al.** [7] conducted a prospective, randomized, double-blind study aimed to compare the efficacy of lidocaine with epinephrine against lidocaine with clonidine for inferior alveolar nerve block (IANB) and hemodynamic stability in patients with irreversible pulpitis. They concluded that mandibular molars with irreversible pulpitis, addition of clonidine to lidocaine improved the success rate of IANB compared to a standard lidocaine/epinephrine solution.

In this study adding 0.5 M mannitol plus to lidocaine with epinephrine formulation was significantly more effective in achieving a greater percentage of total pulpal anesthesia (as defined in this study) than a lidocaine formulation without mannitol. Although the group with lignocaine in combination with clonidine showed significant results after the group of mannitol combination but, results obtained were in contrary to the other reports and were similar to that of obtained by **Shadmehret al.** [7]

## CONCLUSION:

The pulpal anaesthesia is the most difficult situation to deal with in cases of irreversible pulpitis. Many researchers have been striving to find the profound effect of local anaesthetic agents in varying amounts. Hence, an attempt was made to identify the effects of different agents in combination with lignocaine. The study presented here was aimed to

compre the efficacy of lignocaine in combination with epinephrine, clonidine and mannitol plus. Results of the study confirmed that the lignocaine plus epinephrine with mannitol plus show promising results in achieving profound

pulpal anaesthesia. Therefore, to evaluate the long-term efficacy of lignocaine with mannitol plus and epinephrine, varying amount and concentration of local anaesthetic agents should be done.

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**TABLES:**

**Table 1: Comparison of mean of preoperative and intraoperative VAS scores -**

		N	Mean	Standard. Deviation	t	df	p	Inference
Plain LA	Preop vas score	31	7.87	1.06	7.012	30	0.0001	Highly significant
	Intraop vas score	31	5.42	2.60			(<0.001)	
LA plus Epinephrine	Preop vas score	31	7.61	0.99	6.532	30	0.0001	Highly significant
	Intraop vas score	31	4.16	3.22			(<0.001)	
LA plus Epinephrine plus Mannitol	Preop vas score	31	7.26	1.32	16.315	30	0.0001	Highly significant
	Intraop vas score	31	.90	2.40			(<0.001)	
LA plus Clonidine	Preop vas score	31	7.39	.99	6.423	30	0.0001	Highly significant
	Intraop vas score	31	3.97	3.16			(<0.001)	