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Original Research Paper

Endodontics

COMPARISON OF ANAESTHETIC EFFICACY OF 0.75% ROPIVACAINE AND 2% LIDOCAINE FOR INFERIOR ALVEOLAR NERVE BLOCK IN IRREVERSIBLE PULPITIS – AN IN -VIVO STUDY

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ABSTRACT

Aim: To compare the anaesthetic efficacy of 0.75% Ropivacaine and 2% Lignocaine with 1:80,000 Epinephrine for Inferior Alveolar Nerve block injections in patients with irreversible pulpitis. **Methods:** A prospective, randomized, double-blind clinical trial was conducted on 90 adult patients with symptomatic irreversible pulpitis in mandibular posterior teeth. They were divided into two groups by randomized selection of the anaesthetic solution. Parameters evaluated were the onset of action, duration of anaesthesia and pain during endodontic treatment. **Statistical Analysis:** t-test and chi square test were used to compare the reading between two experimental groups and determine the success rate respectively. **Results:** Our study showed that duration of action of 0.75% ropivacaine was significantly longer than 2% lidocaine. Regarding the absence of pain during pulpectomy, ropivacaine had a higher success rate than lidocaine but the difference was not statistically significant. Lidocaine had somewhat faster onset of action but the results were comparable (P=0.05). **Conclusion:** Based on the findings of this study, we can conclude that 0.75% ropivacaine acts as effectively as 2% lignocaine with 1:80,000 adrenaline. It is a long acting local anaesthetic agent which can be used during endodontic treatment especially in case of irreversible pulpitis and also for longer postoperative pain management.

KEYWORDS : Ropivacaine, anaesthetic efficacy, irreversible pulpitis,

INTRODUCTION

Effective local anaesthesia forms the backbone of pain control techniques in dentistry. Achieving adequate anesthesia remains a challenge in conditions of irreversible pulpitis. The Inferior alveolar nerve block (IANB) does not always result in successful pulpal anesthesia.[1-3] It is, therefore, desirable to improve the success rates of the IANB injection in Endodontics. Ropivacaine Hydrochloride is a relatively new amide anaesthetic which was introduced for clinical use in 1996. It has some inherent favourable qualities such as low toxicity and relatively longer duration of action and its selectivity for nerve fibres responsible for pain transmission rather than motor function. It has so far been successfully used in gynaecology, surgery and obstetrics, but its use in dentistry is still limited.[4-6]

So, the present study was undertaken to contribute to a more profound knowledge about the use of Ropivacaine as a local anaesthetic agent for endodontic treatment.

MATERIAL AND METHOD

Study design: A double-blind randomized clinical trial comparing the anaesthetic efficacy of Ropivacaine (0.75%) and Lignocaine (2% with 1:80,000 adrenaline) [Fig 1] through the IANB in patients diagnosed with irreversible pulpitis in mandibular molars. The research protocol was approved by the Institutional ethics Board at K.D Dental College & Hospital, Mathura.

Data source: 90 adult patients aged between 18-50 years participated in this study. These patients had come to the Department of Conservative Dentistry & Endodontics, K.D. Dental College & Hospital with the chief complaint of moderate to severe spontaneous pain in a mandibular posterior tooth, exhibited a positive response to cold testing with Endo-Frost and were diagnosed with irreversible pulpitis. Exclusion criteria: Patients who took medication potentially interacting with any of the anaesthetics used, presence of systemic disorders, history of sensitivity to anaesthetic agents, pregnant and lactating women, missing healthy control tooth and inability to give informed consent.

A written informed consent was obtained from every patient.

Fig 1: (a) 0.75% Ropivacaine (b) 2% Lignocaine with 1:80,000 epinephrine (c) Encoded anaesthetic vials and paper slips

In order to achieve blinding, the dental assistant masked the two anaesthetic agents with code A and B [Fig 1]. The dental operator was unaware of the respective agent codes. For random selection of the anaesthetic agent, 90 paper slips were coded either A or B (45 for each). Each subject picked a slip randomly and was administered the agent corresponding to the code. The code (A or B) was recorded on the patient's evaluation sheet. The same operator administered all injections.

Before injection, baseline vitality of control tooth and test tooth was recorded using electric pulp testing (EPT). The standard IANB was administered using 1.5ml of anaesthetic solution and 0.5ml solution was used to anesthetize the lingual nerve.

The time of onset was recorded from the withdrawal of the needle after injection of local anaesthetic to subjective symptoms of lower lip and tongue numbness. Under rubber

dam isolation endodontic procedure was initiated.

Pain during the procedure was assessed using 170-mm Heft-Parker Visual Analogue Scale [HP-VAS] [Fig 2], where 0 describes no pain and 170 describes extreme/worst imaginable pain. Patient was instructed to place a vertical mark on the scale that best represents the intensity of pain. The anaesthetic injection was considered as successful if the patient reported no pain or weak/mild pain (HP- VAS score < 55mm) during endodontic treatment.

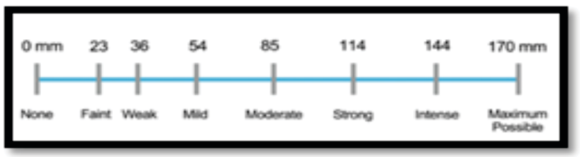


Fig 2: Heft-Parker visual analog scale (HP-VAS).

Duration of anaesthesia was measured from onset of anaesthesia to complete disappearance of numbness.

Statistical Analysis

The data were analysed using "SPSS 23" software and Microsoft Excel 2019. The comparison of onset, duration and HP-VAS scores between the two experimental groups (Ropivacaine "A" and Lidocaine "B") was done using t-test. Chi-square test was used to compare pain readings in both the groups and success rate of anaesthetic solutions was determined. For all the performed tests, the level for significance of differences was taken as $P \leq 0.05$.

RESULTS

In the present study, 90 patients were included, of which 43 were males and 47 were females.

The time of onset was longer for 0.75% ropivacaine (3.82 ± 0.75 mins) when compared to 2% lidocaine (3.53 ± 0.66) [Table 1]. Overall, the results were comparable (P=0.05) [Graph 1]

Table 1: Comparison of Onset of action, Duration of anesthesia and HP-VAS scores of both experimental groups.

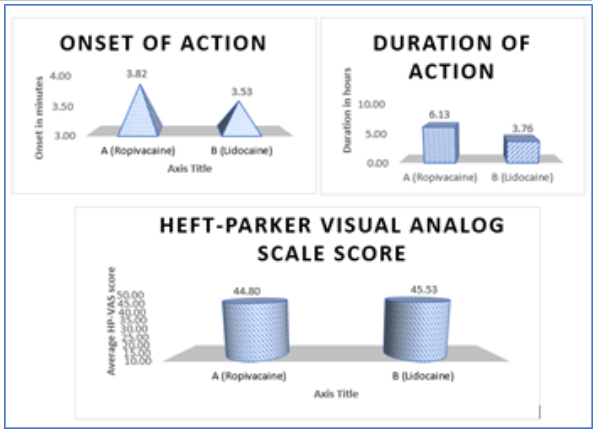
	A (Ropivacaine)				B (Lidocaine)				P
	Min	Max	Mean	SD	Min	Max	Mean	SD	Value
Onset of Action (minutes)	3	5	3.82	0.75	2	5	3.53	0.66	0.0553
Duration of Anaesthesia (hours)	5	7	6.13	0.81	3	5	3.76	0.71	0.0000
HP-VAS score	20	82	44.80	13.85	16	76	45.53	16.35	0.8189

Duration of action for 0.75% ropivacaine was 6.13 ± 0.81 hours, which was significantly longer than 2% lidocaine (3.76 ± 0.71 hours) [Table 1] [Graph 1]

All the patients in both the study groups reported subjective numbness of lip and tongue. 6 patients of the ropivacaine group (13%) and 9 patients of the lidocaine group (20%) reported pain during the endodontic treatment (HP-VAS score > 55mm). However, this difference was not statistically significant. (P=0.39) [Table 2] [Graph 1]

Table 2: Table depicting number of patients having no pain (HP-VAS score 0-53) or pain (HP-VAS score > 54) during the endodontic procedure.

HP-VAS score (in mm)	A (Ropivacaine)	B (Lidocaine)	P Value
0-53	39	36	0.3961
≥54	6	9	
Grand Total	45	45	



Graph 1: Bar graphs showing comparison of onset of action (in minutes), duration of action (in hours) and average HP-VAS scores (in mm) during the endodontic treatment in both experimental groups.

DISCUSSION

Local anaesthetic agents represent the primary means of pain control used by dentist. The high expectations and desires of patients from the dental treatment particularly the root canal treatment demand a pain-free endodontic procedure with a valuable comfort zone. Search for long-acting anaesthetic solutions for effective pain control during treatment of irreversible pulpitis still continues.[7]

Ropivacaine is a long acting regional anaesthetic agent that is structurally related to bupivacaine but with safer cardiovascular and central nervous system toxicity profile, longer duration of anaesthesia, selective action on the paintransmitting A, and C nerves and vasoconstriction properties.[8]

Mechanism of action: Ropivacaine causes reversible inhibition of sodium ion influx, and thereby blocks impulse conduction in nerve fibres. This action is potentiated by dose-dependent inhibition of potassium channels.[9] Ropivacaine is less lipophilic than bupivacaine and is less likely to penetrate large myelinated motor fibres; therefore, it has selective action on the pain transmitting A and C nerves rather than A fibres, which are involved in motor function.[8]

Compared to 0.5% Ropivacaine, the 0.75% solution provides clinically sufficient pulpal anesthesia.[10] Bhargav D et al. (2013)[11] compared 0.5% and 0.75% ropivacaine for inferior alveolar nerve block in lower third molar surgery, showed that 0.75% ropivacaine was more efficacious and desirable.

In this trial mandibular molars and premolars have been included to ward off the disparity in innervation. A report by Fowler et al. (2016)[12] investigated various volumes of Lignocaine in both premolars and molars with a diagnosis of irreversible pulpitis. They concluded that there exists no difference between the two groups of teeth.

Success of anesthesia

In previous studies, lip numbness has been used as an indicator of a clinically successful block, but it does not guarantee for successful pulpal anaesthesia.[13]

The Visual Analog Scale (VAS) is the most widely used tool for estimating both severities of pain and to judge the extent of pain relief.[4] The Heft-Parker visual analog scale (HP-VAS) is similar to the VAS, except that it is 170 mm in length and includes various descriptors which help interpret the data. [Fig 2]

In this study, the success rate of anaesthesia was defined as

the ability to penetrate into dentine, entering the pulp and instrumentation without pain (HP-VAS score of zero) or mild pain (HP-VAS rating ≤54 mm). The success rate of both the anaesthetic solutions was found to be comparable. The findings were similar to other studies by Bansal V et al. (2018)[14], Budharapu A et al. (2015)[15] reported in literature reporting equivalent efficacy of ropivacaine solution in terms of the profoundness of anaesthesia when compared with lignocaine ($p > 0.05$).

Onset and duration

Onset and duration of LA depends on pKa, lipid solubility, protein binding & vasoactivity. In the present study, the onset of 2% lidocaine came out to be faster as compared to 0.75% ropivacaine. This was in concurrence with Ernberg and Kopp. (2002)[10] and Oliveira et al. (2006)[16]. Although insignificant, this delay in onset of action may be attributed to the pKa value of ropivacaine (8.1) which is higher than lignocaine (7.9) & its intermediate lipid solubility.

The duration of anaesthesia for 0.75% ropivacaine (4 to 7 hours) came out to be significantly higher as compared to 2% lidocaine with 1:80,000 epinephrine (3 to 5 hours) which was advantageous for eliminating pain in immediate post-operative period. The longer duration of action of ropivacaine can be attributed to its greater protein binding capacity as compared to lidocaine.

Our study had some of its own limitations such as the pain perception for different patients is different as it is not a split mouth study which creates a bias in the study. And even though Visual analogue scale is widely used in pain assessment, it has a disadvantage that VAS scores are clearly and highly subjective.

CONCLUSION

Based on the findings of this study, we can conclude that 0.75% ropivacaine acts as effectively as 2% lignocaine with 1:80,000 epinephrine. However, in the future, triple-blinded trials with a larger sample size are recommended to make ropivacaine a popular anaesthetic agent for routine endodontic procedures.

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