

Determination of Anesthetic Efficacy of Lidocaine Versus Bupivacaine in Single Visit Root Canal Treatment

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ABSTRACT

Objective: To compare the anesthetic efficacy of 2% Lidocaine with 1:80,000 epinephrine and 0.5% Bupivacaine with 1:200,000 epinephrine in one-visit root canal treatment in patients with symptomatic irreversible pulpitis.

Methods: A total of 60 patients presenting with symptomatic irreversible pulpitis with normal periapical tissues on periapical radiography of mandibular 1st and 2nd molars, reporting moderate to severe pain as assessed by visual analogue scale (VAS) for at least 24 hours were included in this study. All patients received local anesthesia via the inferior alveolar nerve block technique by the investigator. These patients were randomly allocated into two groups in which first group received 2% lidocaine with 1:80,000 epinephrine and the second group received 0.5% bupivacaine with 1:200,000 epinephrine. Patients were instructed to rate the intensity of pain during root canal treatment which was then noted on visual analogue scale (VAS).

Results: The average age of the patients was 34.15 ± 9.49 years, in which 32 (53.3%) were male and 28 (46.7%) were female. The anesthetic efficacy was significantly high in bupivacaine as compared to lidocaine local anesthesia group (76.7% versus 40%; $P=0.004$).

Conclusion: The administration of bupivacaine anesthetic agent for inferior alveolar nerve block (IANB) injections can be a better and appropriate pain management aid as compared to lidocaine during root canal treatment of patient with symptomatic irreversible pulpitis.

Keywords: Anesthetic efficacy, acute irreversible pulpitis, bupivacaine, local anesthetic agents, lidocaine, root canal treatment

HIGHLIGHTS

- Inferior alveolar nerve block injection with lidocaine is not always successful especially in cases with irreversibly inflamed pulp. In such cases, Bupivacaine can be a better and reliable option for local anesthesia as compare to lidocaine.
- Bupivacaine may help an endodontist and general dental practitioner in achieving a positive patient compliance and satisfaction in terms of pain free treatment.

INTRODUCTION

Local anesthetic agents represent the primary means of pain control used by dentist (1, 2). 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 (3, 4). The most widely used, popular and highly accepted injection technique for achieving a satisfying and profound local anesthesia for invasive and non-invasive mandibular end-

odontic procedure is the mandibular block of Inferior Alveolar Nerve (IANB) (5, 6). This technique has shown a valuable success rate in achieving pulpal anesthesia in mandibular posterior teeth for endodontic procedures (7).

Achieving a satisfactory and qualitative anesthesia with inferior alveolar nerve block (IANB) injections has now become one of the most imperative aspect of modern dentistry and a valuable tool during dental procedures (4, 8-10). However, there are numerous occasions, in which inadequate anesthesia was achieved following IANB, primarily in cases with symptomatic irreversibly inflamed pulp (11-13). The control of pain during and after root canal treatment in teeth with symptomatic irreversible pulpitis is an important demeanor of endodontic treatment (14).

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Many strategies have been described in order to provide a pain-free environment throughout and after the endodontic procedure, such as prescription of analgesics prior to the commencement of root canal treatment (15), occlusal relief (16) and lastly, the use of long-lasting local anesthetics (17).

In teeth with irreversible pulpitis, bupivacaine local anesthesia can be the foremost and first-line anesthetic agent of choice because it acts more efficiently on tetrodotoxin (TTX) resistance channels as compared to lidocaine (6, 18, 19). Two clinical studies have been established to compare the anesthetic efficacies between lidocaine and bupivacaine (4, 17). A randomized clinical-trial study has reported the anesthetic efficacy for bupivacaine to be 80% in a one-visit root canal treatment in teeth with irreversibly inflamed pulp whereas lidocaine showed an anesthetic efficacy of 62.9% (1). However, another research study has reported a slightly higher successful anesthetic efficacy for lidocaine 24.14% as compare to the bupivacaine group, 20% respectively (3). There is an evidence of less prevalence of pain during endodontic treatments, following the administration of bupivacaine local anesthesia for IANB as compared to lidocaine local anesthesia in population (20, 21). Recent epidemiological clinical studies have reported for post operative pain bupivacaine after 24 hours is 87.5% and lidocaine 50% respectively, thereby presenting lower pain scales for bupivacaine in single-visit root canal treatment procedures (14, 22).

The rationale for this research study was to determine anesthetic efficacy for inferior alveolar nerve block (IANB) anesthesia between bupivacaine and lidocaine local anesthesia in one-visit root canal treatment in patients with symptomatic irreversible pulpitis. Most of the previous studies have been done on western population but as such (1, 2), there is no local data available pertaining to this topic till date in Pakistan. This research study is the very first study to introduce a long-lasting anesthesia such as bupivacaine in Pakistan, in view of consideration that, endodontics performed with low or no pain improves patient comfort and patient-focused outcomes are important in the provision of care.

The results of this study would merely differ from western population in terms of socio-economic status, nutritional and dietary aspects, health awareness protocols and educational influences. The research data obtain from this study will surely create awareness among the endodontist and general dental practitioners (GDP) and can fulfill patient's expectations, demands; thereby performing an excellent and a qualitative successful dental treatment.

MATERIALS AND METHODS

A single-blinded randomized controlled trial was carried out after ethical review committee approval with a non-probability consecutive sampling technique from 11th February 2019 to 10th October 2019. A sample size of 60 patients was calculated by taking efficacy of bupivacaine that is 79.2% and lidocaine 20.8% (3), level of significance is 5%, power of study is 80% using Open Epi online sample calculator. Patients aged between 20 to 50 years presenting with symptomatic irreversible pulpitis with normal periapex of mandibular 1st and

2nd molar, reporting moderate to severe pain as assessed by visual analogue scale (VAS) for at least 24 hours were included. Patients with the presence of any uncontrolled systemic disease, lactating mothers, pregnancy or patients giving a history of taking analgesics 12 hours prior to the endodontic treatment were excluded.

Patients were randomly divided into two groups of 30 patients each by lottery method. A well explained written informed consent was taken prior to the commencement of procedure. All patients received local anesthesia through inferior alveolar nerve block technique by the investigator. The inferior alveolar nerve block (IANB) injection site was anesthetized topically with 20% Benzocaine, (Premier, Philadelphia, PA, USA) followed by an inferior alveolar nerve block injection with 27-G 0.41 mm×35 mm needle (Teruno Dental Needle; DFL Industria e Comercio Ltda, Rio De Janeiro, RJ, Brazil) fitted in aspirating syringe. In first group, 1.8 ml cartridge of 2% Lidocaine (Alphacaine 80;DFL,Rio de Janeiro, Brazil) with 1:80,000 epinephrine was given, while in the second group, 1.8 ml cartridge of 0.5% Bupivacaine (Vivacaine 0.5% HCl; Septodont, Ontario, Canada) with 1:200,000 epinephrine was given after obtaining negative aspiration. Patients were evaluated after 10 min for the presence of adequate anesthesia. If the reported inadequate anesthesia a second cartridge of 1.8ml bupivacaine or lidocaine was given according to their assigned group. However, if a attempt failed then the of pain was marked on visual analogue scale and supplemental pulpal anesthesia was given.

Once adequate anesthesia was achieved one-visit root canal treatment was performed under rubber dam isolation. Access opening was made with round bur and modified with endo-z bur (Dentsply, Maillifer, North America). Working length was established and copious amount of 3.5% sodium hypochlorite was used for canal irrigation throughout the procedure. Root canal preparation was done by Protaper rotary files (Dentsply, Maillifer, Switzerland) followed by obturation with protaper gutta percha point coated with AH plus sealer (Dentsply, Maillifer, USA). The size of protaper gutta percha point was determined by the size of last protaper finishing file used. The temporary restoration was placed using Cavit.

Visual analogue scale was explained to patient before treatment and asked to mark the intensity of pain on 10-centimeter line labeled with no pain (0) to worst pain (10) during root canal treatment. Absence of pain (0 on VAS) or presence of a mild pain (1-3 on VAS) was considered as success, whereas moderate (4-6 on VAS) and severe pain (>6 on VAS) during root canal treatment represented an unsuccessful anesthetic efficacy for the specific agent.

Statistical Analysis

The data were carefully collected and analyzed by SPSS version 25.0. The percentages and frequencies were calculated for qualitative variables like gender and anesthetic efficacy while Mean and Standards Deviation (15) were calculated for quantitative variables like age, duration of symptoms and Visual Analogue Scale score (VAS). The Chi-Square test was used to compare the anesthetic efficacy in both respective

groups. Stratification with respect to anesthetic efficacy and age was also done and a P value of <0.05 was considered as significant.

RESULTS

Gender distribution of 60 patients in both group showed 32 (53.3%) male and 28 (46.7%) female (Fig. 1). The age distribution of patients in both the lidocaine and bupivacaine

local anesthesia group is plotted in bar graph as shown in (Fig. 2). The average age of the patients seen in this study was 34.15 ± 9.49 years (95% CI: 31.70 to 36.60). The mean age of patients in lidocaine group was 33.80 and 34.50 in bupivacaine group. The mean duration of preoperative pain in lidocaine group was 19.83 and 19.97 in bupivacaine group as shown in (Table 1). The pre-treatment mean visual analogue scale (VAS) pain score was high in both groups but it was observed that during root canal treatment; the mean visual analogue scale (VAS) pain score was lowered in both groups. The 95% CI (Confidence Interval) also showed that mean pain score was significantly reduced in both anesthetic agents but particularly more reduction was reported in bupivacaine local anesthetic agent group. (Fig. 3) The comparison of anesthetic efficacy between lidocaine and bupivacaine during single-visit root canal treatment in patients with symptomatic irreversible pulpitis is shown in (Table 2.) In spite of the fact that maximum dose of 2 cartridges i.e 3.6 ml of local anesthesia were given to patients in both groups, it is observed that the anesthetic efficacy was significantly high in bupivacaine as compared to lidocaine local anesthesia group (76.7% vs. 40%; $p=0.004$). The stratification analysis was also performed with respect to age group and it was observed that a significant difference was observed with equal to and less than 35 years of age, showing a higher anesthetic

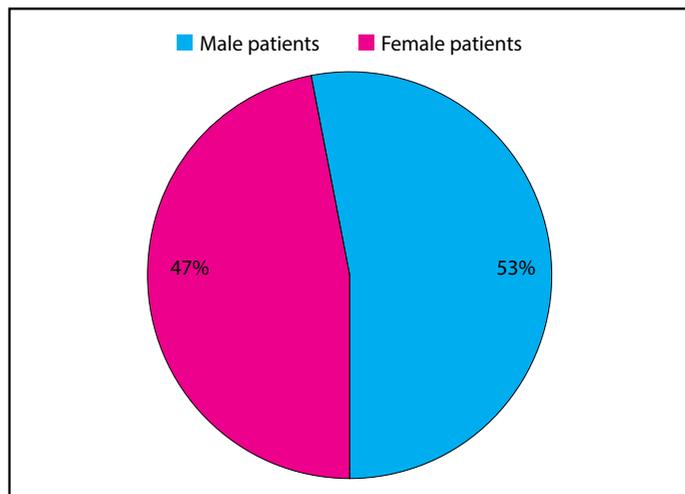


Figure 1. Gender distribution of patients

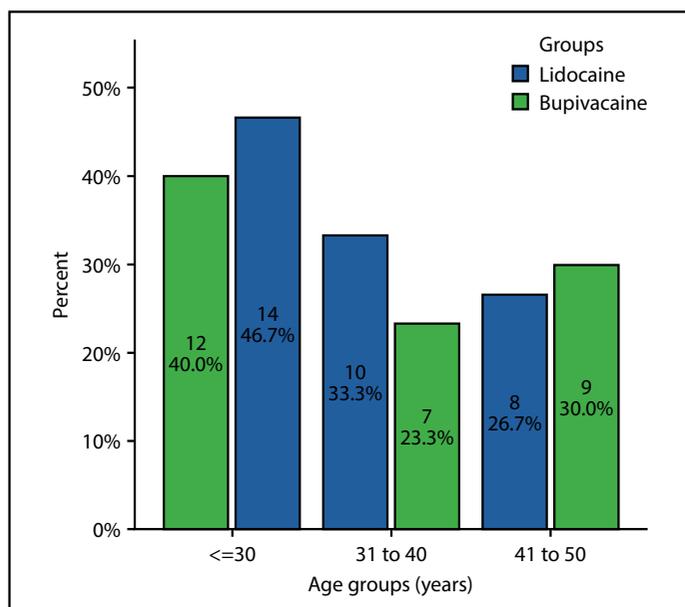


Figure 2. Comparison of anesthetic efficacy between bupivacaine and lidocaine in relation to age distribution of patients

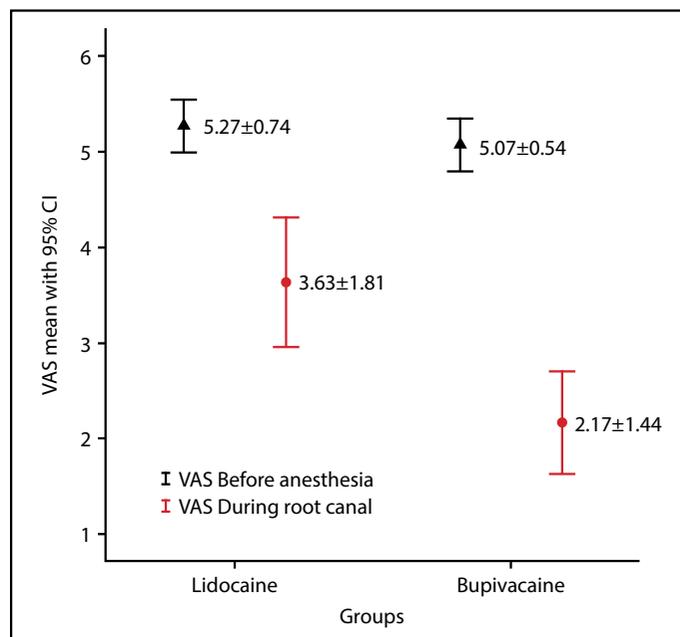


Figure 3. Mean and 95% Confidence Interval (CI) of the Visual Analogue Scale (VAS) with respect to Groups

TABLE 1. Descriptive statistics of mean age and duration of pre operative pain

Statistics	Age (Years)		Duration of pain pre-operatively (Hours)	
	Lidocaine group n=30	Bupivacaine group n=30	Lidocaine group n=30	Bupivacaine group n=30
Mean	33.80	34.50	19.83	19.97
Standard deviation	9.24	9.87	3.48	4.10
Minimum	20	20	10	10
Maximum	50	49	24	22

TABLE 2. Comparison of anesthetic efficacy between lidocaine and bupivacaine local anesthesia during single-visit root canal treatment in patients with symptomatic irreversible pulpitis

	Lidocaine n=30	Bupivacaine n=30	Total	P value
Yes	12 (40%)	23 (76.7%)	35	0.004
No	18 (60%)	7 (23.3%)	25	

Chi-Square: 11.31

TABLE 3. Comparison of anesthetic efficacy between lidocaine and bupivacaine local anesthesia during single-visit root canal treatment in patients with acute irreversible pulpitis for age ≤ 35 years

Anesthetic efficacy	Lidocaine n=19	Bupivacaine n=19	Total	P value
Yes	7 (36.8%)	17 (89.5%)	24	0.002
No	12 (63.2%)	2 (10.5%)	14	

Chi-Square: 11.31

TABLE 4. Comparison of anesthetic efficacy between lidocaine and bupivacaine local anesthesia during single-visit root canal treatment in patients with acute irreversible pulpitis for age > 35 years

Anesthetic efficacy	Lidocaine n=11	Bupivacaine n=11	Total	P value
Yes	5(45.5%)	6(54.5%)	11	0.67
No	6(54.5%)	5(45.5%)	11	

Chi-Square: 0.182

efficacy as shown in (Table 3) while other stratified group of age > 35 , showed a lower anesthetic efficacy as shown in (Table 4) respectively.

DISCUSSION

This study has compared the anesthetic efficacy between lidocaine and bupivacaine local anesthesia in patients presented with symptomatic irreversible pulpitis in which root canal treatment was performed in one visit. In current study there were 53.3% male and 46.7% female patients, showing a higher prevalence of male gender. This is supported by Osama et al. (23) who reported a higher incidence of male gender in his study group. Females had been reported to be more concerned about their breath and oral health; hence they appeared to be better motivated to demand for oral health care (8, 24). Furthermore, in the present study, pre-treatment mean visual analogue scale (VAS) pain score was high in both local anesthetic groups. However, it was observed that during root canal treatment mean visual analogue scale (VAS) pain score was low in both groups, but more reduction was observed in bupivacaine group. We also found that the anesthetic efficacy was significantly high in bupivacaine group as compared to lidocaine group. Recent systematic review and meta-analysis on efficacy of local anesthetic solutions on the success of inferior alveolar nerve block in patients with irreversible pulpitis also reported low efficacy of lidocaine as compared to bupivacaine and articaine (25, 26).

Neal et al. (27) found similar results to our study in which a significant decrease in pain scores were noticed when bupivacaine was compared to lidocaine, however, on subsequent days after the administration of lidocaine and bupivacaine; the pain scores were clearly comparable. Similarly, Rosenquist et al. (27) also found that pain scores were lower for a bupivacaine solution when compared to a lidocaine/diflunisal regimen at 2 and 3 hour postoperatively. In contrast to our results, Sampaio et al. (1) revealed that out of 70 patients only 15 patients (42.9%) in the lidocaine group and 7 patients (20%) in the bupivacaine group exhibited an adequate pulpal anesthesia. In addition to this Nusstein et al. (28) found a higher anesthetic success for the lidocaine solution which was similar for the first molar but higher for the premolar and lateral incisor. Danielsson et al. (28) found that the onset of pulpal anesthesia was slower with a solution of bupivacaine, when compared to a lidocaine solution, in maxillary infiltration anesthesia. Valpato et al. (20) reported bupivacaine reduces initial postoperative pain and the need for analgesics, however it does not completely eliminate pain or the need for any analgesic medications.

A relaxed and pain-free endodontic procedure is always the first-line of preference by the patients. An anesthetic agent such as bupivacaine may fulfill the following prerequisites of an endodontist as well as a General Dental Practitioner, thereby achieving a positive patient compliance and satisfaction. However, this study is limited by the fact there was an inadequate distribution of male and female patients and these patients were primarily selected by a non-probability convenience sampling technique. Moreover, no statistical significant difference was noticed in patients over 35 years of age therefore a study with larger sample size is warranted. It is highly recommended that such interventional research studies should be more often conducted with a much larger sample size along with the inclusion of other respective valuable variables in order to enhance the quality of respective research and achieve a higher positive accuracy of corresponding results in future.

CONCLUSION

The administration of bupivacaine anesthetic agent for inferior alveolar nerve block (IANB) injections can be a reliable and appropriate pain management aid as compared to lidocaine during root canal treatment of patient with symptomatic irreversible pulpitis.

Disclosures

Conflict of interest: Authors deny any conflict of interest.

Ethics Committee Approval: The study is approved by Ethics Committee of Altamash Institute of Dental Medicine (AIDM/EC/02/2019/04).

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