

Acomparative Evaluation of Anaesthetic Effectiveness Of 4 % Articaine ,0.5 % Bupivacaine And 2 % Lignocaine in General Tooth Extraction

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ABSTRACT

Background

Nowadays safe and efficient pain control is essential for today's dental practice. That randomized controlled study was conducted to evaluate the effectiveness of

4 % articaine ,0.5 % bupivacaine and 2 % lidocaine for removal of tooth. The local anaesthetic solutions in tooth removal depends on the following points: latency, anaesthetic effectiveness and duration of anaesthetic effect.

Objectives

The objectives of an study are to evaluate the analysis of anesthetic solutions of 4% Articaine, 0.5 % Bupivacaine and 2%Lignocaine using the Visual analogue scale (VAS SCALE).

Study design:

This randomized control study was performed in the oral surgery department from 1/8/2024 to 1/11/2024

The study between 150 patients of both sexes who come to oral surgery department for removal of tooth in the age between 20-60 years.

Materials and methods

The study involved 150 patients of both sexes, aged 20-60 years, who visited the oral surgery department for tooth extraction. Participants were randomly assigned into three groups of 50 patients each. The anesthetic solutions used for the extraction were as follows:

Group A: 0.5% bupivacaine with 1:200,000 epinephrine Group B: 4% articaine with 1:100,000 epinephrine Group C: 2% lignocaine with 1:100,000 epinephrine

The comparative analysis was conducted to evaluate the onset of anesthesia, duration of pain relief, and overall effectiveness of the different anesthetics used during the extraction process .

Results

The results indicated that 4% articaine was superior to both bupivacaine and lignocaine in terms of efficacy for tooth extraction procedures. Articaine provided quicker onset and longer-lasting anesthesia, making it the preferred choice for routine extractions.

Keywords: Articaine, Bupivacaine, Lignocaine, Anesthesia, Tooth Extraction, Pain Management.

1. INTRODUCTION

Pain management in dentistry is a critical aspect of patient care. Since 1884, local anesthetics have been widely used in dentistry for pain control during various procedures. Over time, the development of different anesthetic agents has helped in providing more effective pain relief, improving patient comfort, and enabling the performance of complex oral surgeries. In this study, we explore the comparative efficacy of three different local anesthetics in tooth extraction

procedures. In dentistry, 2% lidocaine is

frequently used. However, lidocaine is short acting (vasodilator). To increase the depth and time of anesthesia, epinephrine was added to lignocaine. Nonetheless, epinephrine contains local anesthetic solution is contraindicated in hyperthyroidism and significant cardiovascular diseases.

Furthermore, adding vasoconstrictor reduces the pH of the solution (acidic), rendering the injections uncomfortable to the patients. Hence, search for a long-acting local anesthetic agent with inherent vasoconstrictive property still endures. Bupivacaine (chemical name: 1-butyl-2',6'-pipecoloxylidide) was first synthesized by B. Ekenstam in 1957 and introduced into clinical use in 1963. It is a long-acting amide-type local anesthetic that provides a longer duration of action compared to lignocaine, largely due to its higher lipid solubility and strong protein-binding properties. The onset of action can vary from 1 to 10 minutes, with an effect lasting anywhere from 2 to 9 hours. Its half-life is about 20 hours. Bupivacaine is approximately four times as potent as lignocaine when administered in equivalent doses. This long-lasting anesthetic effect provides better postoperative pain relief, unlike lignocaine, which often leads to severe pain once its anesthetic effects wear off.

Articaine is an amide-type local anesthetic, characterized by the presence of a benzene ring in its structure. Typically administered as a 4% solution with 1:100,000 epinephrine, it is known for its potent anesthetic effects. The inclusion of a thiophene ring in its molecular composition enhances its effectiveness compared to other local anesthetics. Due to its higher lipid solubility, articaine is well-tolerated by tissues, making it

a reliable choice for peripheral nerve blocks or local infiltration. Research suggests that articaine is fast-acting, safe, and particularly suitable for use in oral surgical procedures.

Objectives

The objectives of an study are to evaluate the comparative analysis of anesthetic solutions of 4% Articaine, 0.5% Bupivacaine and 2% Lignocaine using the Visual analogue scale (VASSCALE)

2. MATERIALS AND METHODS

Study design-

This randomized control study was performed in the oral and maxillofacial surgery department of School of Dental Sciences, KVV, Karad for the duration of 3 months i.e. from 1/8/2024 to 1/11/2024

The study between 150 patients of both sexes who come to oral and maxillofacial surgery department for removal of tooth in the age between of 20-60 years.

Sample size :

A -90% to 95%

B-80% to 85%

C -85% to 87%

The sample size was based on the rate of local anesthetic solutions ranges between 80 to 90%. Therefore supposing $p = 85$ as the frequency of achievement rate with a 10% margin of error, the formula used was $n = Z^2 \cdot p \cdot q / d^2$ where p is success rate, $q = 1 - p$, d is the margin of error, and Z is the critical value from the standard normal distribution corresponding to the desired level of significance. This method ensures an appropriate sample size to estimate the success rate with a specified degree accuracy.

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Criteria

Onset, time of anesthesia, pain during the procedure, pain during injection and pain after the procedure done. also evaluate the complications after giving the anesthesia. blood pressure (mmHg) and heart rate (per minute) were evaluated for all participants.

Inclusion criteria –

All healthy participants

Age range between 20 -60 years

All tooth that are indicated for removal

Exclusion criteria

Pregnant women

People with an allergy of local anesthetic solutions Medically compromised

Painful tooth

Uncooperative patients

Ethical approval for the study

The Institutional Ethics Committee has given permission to initiate the research (Protocol Number 050/2024- 2025) titled, "A COMPARATIVE, CLINICAL EVALUATION OF ANESTHETIC EFFECTIVENESS OF 4% ARTICHAINE.

0.5% BUPIVACAINE AND 2% LIGNOCAINE IN

GENERAL TOOTH EXTRACTION" by Krishna Vishwa Vidyapeeth ,Karad.

3. MATERIALS AND METHODS

Participants were randomly assigned to three groups using a lottery system, with double-blinding procedures in place. Group A received 0.5% bupivacaine with 1:200,000 epinephrine, Group B received 4% articaine with 1:100,000 epinephrine, and Group C received 2% lignocaine with 1:100,000 epinephrine. Each group consisted of 50 patients who met the inclusion criteria.

The allocation of participants to the respective groups (A, B, and C) was performed by the investigator, who assigned a unique identification number to each participant. Group A received the 0.5% bupivacaine with 1:200,000 epinephrine, Group B was administered 4% articaine with 1:100,000 epinephrine, and Group C received 2% lignocaine with 1:100,000 epinephrine.

All patients were prepared for general tooth extraction and were given 1.5 mL of the anesthetic solution to achieve a complete nerve block in all groups. The procedure followed standard aseptic surgical techniques for both the extractions and the anesthesia administration.

The anesthetic effects were evaluated by assessing the pain during injection, the onset and duration of anesthesia, and any pain experienced throughout the procedure. After the tooth extractions, patients were provided with a five-day course of analgesics and antibiotics for post-operative care.



Fig 1 : 2% Lignocaine bottle



Fig 2 : 4% articaine (cartridges)



Fig 3 : 0.5% bupivacaine bottle

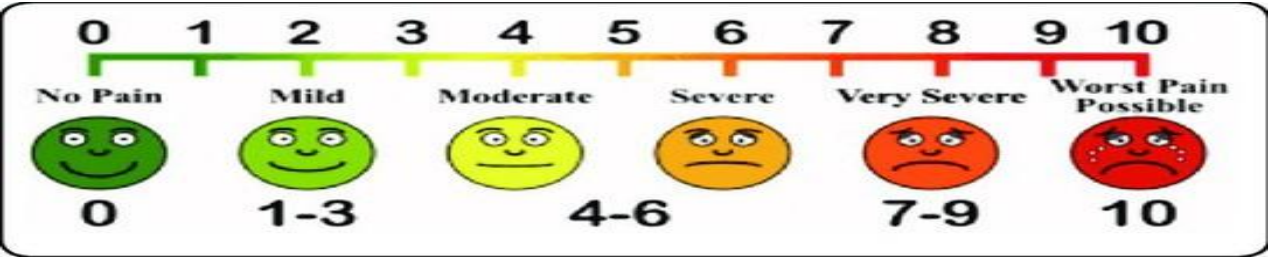
Mean, Mode, Medians of various quantitative variables were calculated to study the central tendency of the parameters, while standard deviations of the parameters were calculated for study .

4. RESULTS

Table no -1 Assessment for 4% Articaine ,0.5 % Bupivacaine and 2 % Lignocaine

Parameter	Group A	Group B	Group C	0.5% bupivacaine	4% articaine	2% lignocaine
SD						
Starting of action						
12.4						
(seconds)						
Time for soft tissue						
27.9						
anaesthesia (minutes)						
Duration of					5.8	
After						
analgesic effect						
(minutes)						

Table no -2 Assessment of pain points using VAS (Visual Analogue Scale) for 4% Articaine ,0.5 % Bupivacaine and 2 % Lignocaine



Method measurement of scale of used	number of patients		
	Group A 0.5% bupivacaine	Group B 4% articaine	Group C 2% lignocaine
No pain	11 patients	38 patients	12 patients
Mild Pain	26 patients	12 patients	23 patients
Moderate Pain	10 patients	-	11 patients
Severe Pain	3 patients	-	4 patients
Very Severe Pain	-	-	-
Worst Pain	-	-	-

Table no -2 Assessment of pain points using VAS (Visual Analogue Scale) for 4% Articaine ,0.5 % Bupivacaine and 2 % Lignocaine

5. DISCUSSION

The effectiveness of an anesthetic agent is typically assessed based on its ability to alleviate pain, the speed at which it takes effect, and the duration of its anesthetic action. Lignocaine, also known as lidocaine, is an amide- type local anesthetic commonly used for its relatively short duration of action. The World Health Organization (WHO) includes lignocaine on its essential drug list, and it works by blocking nerve impulse transmission.

Articaine, a similar anesthetic, exerts its effects by binding to voltage-gated sodium channels, preventing sodium ion influx, much like lignocaine.

Articaine has demonstrated superior anesthetic and analgesic properties compared to other local anesthetics, with a faster onset of action. This is consistent with our findings, which align with the conclusions of Badr and Aps, who noted that no single dental local anesthetic (lidocaine, 0.5% bupivacaine, or 4% articaine) provides complete anesthesia during tooth extraction. Additionally, studies evaluating the efficacy of articaine over

bupivacaine and lignocaine for dental procedures have shown that articaine provides longer-lasting soft tissue anesthesia and more effective postoperative pain management. Delusi et al. found that bupivacaine yielded higher patient satisfaction compared to lidocaine, while Pellicer-Chover et al. concluded that articaine outperformed both bupivacaine and lignocaine

in terms of clinical effectiveness, bleeding control, latency, and anesthesia duration.

Our study compared the effectiveness of 0.5% bupivacaine, 2% lignocaine, and 4% articaine in routine tooth extractions, evaluating factors such as pain during injection, onset and duration of anesthesia, procedural pain, and postoperative pain. We observed that articaine (group B) had a faster onset and a moderate duration of action compared to bupivacaine (group A) and lignocaine (group C). In contrast, bupivacaine provided the longest anesthetic duration. The rapid onset and moderate duration of action with articaine can be attributed to its increased ability to diffuse into nerve membranes, resulting from its higher concentration of free molecules in tissues. Furthermore, articaine's quick metabolism—via hydrolysis in plasma—leads to its faster elimination compared to bupivacaine and lignocaine, thus reducing the length of its postoperative analgesic effect.

Bupivacaine's prolonged anesthetic action is likely due to its lower epinephrine content (1:200,000) compared to the 1:100,000 epinephrine concentrations in articaine and lignocaine. Our study found comparable pain levels during the injection and after the procedure (measured via VAS) across all three anesthetics. However, more patients reported no postoperative pain following articaine administration than with bupivacaine or lignocaine. This supports the idea that 4% articaine is more effective than 0.5% bupivacaine and 2% lignocaine for general tooth extraction.

The study does have limitations, including a small sample size and a single-center design. Anesthetic efficacy was partly determined by patient-reported rescue analgesia use, which lacked objectivity. Additionally, randomization was done through a lottery system, and blinding was not optimal.

6. CONCLUSIONS

To assess the effectiveness of various anesthetic agents, this study found that lignocaine, bupivacaine, and articaine all provide reliable anesthesia. However, articaine stands out for its quicker onset of action, although its duration of effect is comparatively shorter. It also showed a tendency to require fewer instances of re-anesthesia, which was statistically insignificant but still notable when compared to both bupivacaine and lignocaine. Notably, the need for re-anesthesia was lower with articaine, making it particularly effective for procedures like tooth extraction. In conclusion, 4% articaine demonstrated superior anesthetic efficacy over 0.5% bupivacaine and 2% lignocaine in dental extractions.

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