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# Evaluation of Clinical Efficacy Of 4% Articaine with 1:100,000 Epinephrine for Surgical Removal of Impacted Maxillary Canine

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**ABSTRACT**

**Purpose:**The purpose of the study was to evaluate the anesthetic efficacy of 4% Articaine with 1:100,000 Epinephrine for surgical removal of impacted maxillary canine.

**Materials and method:**A prospective clinical trial was carried out involving 20 patients. The patients were allotted to either Group A or Group B. In Group A patients, 4% Articaine hydrochloride with 1:100,000 Adrenaline was administered and in Group B, 2% Lidocaine HCL with 1:80,000 Adrenaline was administered via buccal and palatal infiltrations. The impacted maxillary canine was removed by standard surgical procedure by a single operator. The time of onset of action, duration of anesthesia, efficacy of anesthesia, hemodynamic parameters and oxygen saturation were monitored during the procedure. Visual analog scale was used to assess pain during surgery.

**Results:** An onset period of 42 $\pm$ 7 seconds and 60 $\pm$ 4 seconds and duration of anesthesia of 120 $\pm$ 14 and 91 $\pm$ 10 min was found for Group A and Group B, respectively. Statistically significant differences were seen in the onset and duration of anesthesia between the groups. There were no statistically significant differences found between the groups in depth of anaesthesia, pain score and in hemodynamic parameters.

**Conclusion:**The4 % Articaine is equally effective in providing adequate depth of anaesthesia like that of 2% Lidocaine. 4% Articaine is better in terms of onset and duration of the anesthetic effect than 2% Lidocaine.

**KEY WORDS:** Articaine, Hemodynamics, Infiltration.

## I. INTRODUCTION

Local anesthesia forms the fortitude of pain control techniques in dentistry. They are chemicals that block the nerve conduction in a specific, temporary, and completely reversible manner without affecting the consciousness of the patient. Though cocaine has significant limitations as it has as a low therapeutic index, the risk of addiction and potentially lethal arrhythmias, it was the drug of choice for the control of surgical and dental pain until the beginning of the twentieth century. New amino amide local anesthetics were synthesized between 1891 and 1930, such as Tropicalize, Holocaine, Benzocaine, and Tetracaine. Besides, amino amide local anesthetics were prepared between 1898 and 1972, including Procaine, Chloropropane, Cinchocaine, Lidocaine, Mepivacaine, Prilocaine, Bupivacaine, Etidocaine, and Articaine.[59]In 1904, Alfred Einhorn synthesized Procaine that became the main local anesthetic in medicine and dentistry. Later in 1943, Nils Lofgren synthesized Lidocaine which was the first amide anesthetic prepared for local application. With the progressive introduction of Cocaine (1884), Procaine (1904), Lidocaine (1949), dentistry has been in the leading edge to provide patients with pain-free care.[42]

One of the most important prerequisites of dentistry is to achieve effective pain control during dental procedures. Lidocaine was marketed in 1948 and is presently the most commonly used local anesthetic in dentistry worldwide as it was more potent and less allergenic than Procaine. In the succeeding years, another amide local anesthetics (Prilocaine in 1953 by Lofgren and Tegner, Bupivacaine and Mepivacaine in 1957 by A.F Ekenstam, Etidocaine in 1971 by Takman) were introduced. Because of its high efficacy and safety, Lidocaine has become the gold standard drug among the newer local anesthetic agents. The local anesthetics used in dentistry are classified based on their chemical structure into amides and esters. Unlike ester agents' amides produce more rapid and reliable profound surgical anesthesia.Articaine hydrochloride was synthesized by Rusching et al. in 1969 under the name Carticaine and was first marketed in Germany (1976). Articaine differs from the previous amide local anesthetics in that it has a thiophene ring in its molecule instead of the usual aromatic ring which imparts Articaine more lipid solubility.[52]Articaine being a relatively new drug, which needs to be tested to be used as widely accepted anesthesia drug worldwide.

It should be aware that Articaine delivers nearly twice the concentration of active anesthetic to the patient; as compared to Lignocaine, thus one half of the amount should achieve similar anesthetic delivery. Due to a dense vascularization and innervation of the palatal mucosa, as well as, it's a strong attachment to bone, palatal local

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anesthesia injections are frequently associated with at least some level of discomfort. With increased diffusion, Articaine can produce profuse pulpal as well as palatal anesthesia after maxillary buccal infiltrations, thus enabling the clinicians to avoid painful palatal infiltration.

There are differences between the anterior and posterior regions of the maxilla in nerve innervation and bone quality. Different regions of the maxilla have different bone compositions. Age, gender, and race are factors that contribute to variation in the bone composition of the maxilla. The anterior region of the maxilla has denser bone than the posterior region, which can affect the diffusion and anesthetic ability of Articaine when used as a buccal infiltration.[3] Thus, the study aims to evaluate the anesthetic efficacy of the Articaine in the surgical removal of the impacted maxillary canine tooth.

**AIMS AND OBJECTIVES**

The purpose of the study was to evaluate the anesthetic efficacy of 4% Articaine with 1:100,000 epinephrine for surgical removal of impacted maxillary canine in terms of the following.

- Time of onset
- Pain
- Duration of anesthesia
- Hemodynamic changes after the administration of 4 % Articaine with 1:100,000 adrenaline.
- Signs of systemic toxicity.

## II. MATERIALS AND METHODS

This study was conducted in the Department of Oral and Maxillofacial Surgery, Ragas Dental College and Hospital, Chennai. All the patients scheduled for surgical removal of impacted maxillary canine were explained about the study and the patients willing to participate were included in the study. The patients were randomly allotted to either group A (Articaine) or group B (Lidocaine). In all the patients buccal and palatal infiltration was given to administer local anesthesia. Ethical clearance was obtained from the Institutional Review Board before commencing the study. Written informed consent was obtained from all the patients for both surgical procedures and radiological investigations before the procedure.Inclusion criteria includedtheabsence of systemic illness and no signs of inflammation or infection. Exclusion criteria includedknown or suspected allergies or sensitivities to amide-type local anesthetics or any ingredients in the anesthetic solution.Medical history of any systemic disease like- Hypertension, Diabetes, Thyroid disorders, Liver diseases, Renal diseases, bleeding & clotting disorders, etc.Pregnancy or lactation.Subjects who are under anti-depressants and sedatives.Subjects who had taken the analgesic medication 24 hours before administration of local anesthesia.Patients with any local pathological conditions that can influence the local anesthetic action like infection, bony exostosis, etc.

All patients were positioned at a semi-reclined position on the dental chair. Patients were prepared and draped. The surgical site was irrigated with saline and Hexedine mouthwash was given. 4% Articaine HCL with 1:100,000 Adrenaline (SEPTANEST; SEPTODONT Inc, FRANCE) was injected in the buccal and palatal mucosa (infiltration) over a period of 1 minute for Group A and 2% Lidocaine1:80,000 Adrenaline(LIGNOSPAN; SEPTODONT Inc, FRANCE) was injected in the buccal and palatal mucosa (infiltration) over a period of 1 minute for Group B.The patient was asked to inform when they feel the numbness and then the buccal and the palatal mucosa were examined using the pinprick test. The surgical access is achieved by either a buccal approach or a palatal approach or both depending on the type of impaction. A mucoperiosteal flap was elevated and bone guttering was carried out with 702 surgical bur with continuous irrigation with saline and the impacted canine tooth was exposed. Tooth sectioning was done when needed and the impacted canine tooth was extracted. Wound toileting was done and hemostasis achieved. The wound was closed with 3-0 silk and sutures were removed after a week. The patients were instructed to eat only soft food and abstain from forceful mouth washing for the first 24h. For postoperative pain control, all patients received Ketorolac Tromethamine 10mg which was administered twice daily, 500mg amoxicillin was prescribed every 8hourly (TID) for 5days to prevent infection. For plaque control, the patient used 0.12% chlorhexidine mouth rinse for one minute twice a day for two weeks postoperatively.Evaluation criteria for the data obtained in the study included**:** -

- Drug volume: - The amount of anesthetic used in each case and any additional injections required during the procedure were recorded.
- The onset of anesthesia: - Time of onset of anesthesia is calculated form the time elapsed from full needle withdrawal after injection until the patient first reports numbness and immediately checked for objective signs.

- Duration of surgical procedure: - From the time of incision placed to the last suture placed.
- Duration of anesthesia: - The duration of anesthesia is calculated by recording the time from the initial patient perception of the anesthetic effect to the moment in which the effect began to fade.
- Blood pressure, oxygen saturation and heart rate were recorded before the administration of local anesthesia and after 5,15,30,45 and 60 minutes.
- Signs of systemic toxicity: - Talkativeness, slurred speech, apprehension, localized muscle twitching, and postoperative complications like paresthesia and others were noted.
- Pain rating based on VAS score: - The VAS was taken by a different operator to avoid influencing the patient during scoring. Intraoperative pain was scored on a visual analog scale (0–10) at15minutes and 30 minutes.

## III. RESULTS

Data obtained was entered in an excel sheet and analyzed using SPSS v20. Significance was set at $p<0.005$. Since the data was found to follow a non-normal distribution, a non-parametric test (Mann Whitney u test) was used to test quantitative variables and the chi-square test was used to test qualitative variables. A total of twenty patients were included in the study, five male (50%) and five female (50%) patients with a mean age of 30.20 years (SD: 9.12) were allocated to Group A (Table.1). Four male (40%) and six female (60%) patients with a mean age of 29.30 years (SD: 8.42) were allocated to Group B (Table.2). Statistically, no significant difference was seen in mean age($p = 0.761$) & distribution of males and females ($p = 0.500$) between the two groups. The mean drug volume was 1.9ml (SD: 0.2) for Group A and 2.2 ml (SD: 0.5) for Group B (Table.3), there were no statistically significant differences between the two groups ($p > .50067$).The subjective intraoperative pain scoring by the patients showed no differences between the two anesthetic solutions, ($p > 0.639$ at 15minutes and $p > 0.135$ at 30 minutes interval) for Group A and Group B (Table.4, Table.5).The mean duration of the procedure was 39.00 min (SD: 5) for Group A and 42.00 min (SD: 4.5) for Group B (Table.3), there were no statistically significant differences between the two groups ($p = 0.202$).The mean onset of Anaesthesiawas 42 seconds (SD: 7) for Group A and 60 sec (SD: 4) for Group B (Table.3), there were statistically significant differences between the two groups ($p < 0.005 = 0.000$).The mean duration of Anaesthesia was 120.00 min (SD: 14) for Group A and 91.00 min (SD: 10) for Group B (Table.3), there were statistically significant differences between the two groups($p < 0.005 = 0.001$).Concerning the hemodynamics parameters, there was no statistically significant difference in blood pressure (Table.9) (Table.10) (Table.11), heart rate (Table.6), or oxygen saturation (Table.7) (Table.8) before and during the surgery ($p>0.05$).

## IV. DISCUSSION

Local anesthetics form the mainstay of pain control techniques in dentistry. The role of drugs used for local anesthesia is vital in the field of dentistry as they help the dentists in the successful completion of various dental procedures by ensuring less pain and discomfort for the patients. It can be said that local anesthesia forms the backbone of almost all dental procedures. Tooth extraction is one of the procedures that especially require a relatively pain-free arrangement. As effective as these drugs are, however, research has continued to seek safer and more effective local anesthetics. Articaine is emerging local anesthetic which due to its comparable safety and potency has been studied extensively and being compared with Lignocaine.

Local anesthetics provide adequate pain relief for the majority of dental procedures; however, failures do occur. These may be the result of anatomical, pharmacological, pharmaceutical, pathological, psychological or procedural factors (Byers et al. 1990, Wong & Jacobsen 1992, Quinn 1998, Hargreaves & Keiser 2002, Meechan 2005).[29] The local infiltration anesthesia (LIA) is significantly simpler compared to the nerve block techniques and less unpleasant for patients. However, it is not efficient if used for complicated exodontia like impacted tooth removal. Factors that affect both the depth and duration of a drug's anesthetic action include individual response to the drug, accuracy in the deposition of local anesthetic, the status of tissue at the site of drug deposition, anatomical variation and volume of anesthetic used. In this study, we used 4% Articaine with 1:100,000 epinephrine for the surgical removal of maxillary impacted canine due to its attributed effective pain control because of its better diffusion properties. Additionally, increased lipid solubility provides enhanced diffusion through hard and soft tissues. This feature enables the passage of the anesthetic even through thick cortical bone.

Robertson et al.[53] recorded successful analgesia with Articaine administered via local infiltration anesthesia for mandibular posterior teeth ranging from 75% to 92%, which was significantly higher when compared to Lidocaine. Even more, supplemental local infiltration with Articaine after IANB with Lidocaine provided better pulpal anesthesia of lower posterior teeth, enabling longer duration of anesthesia of the first molar and second premolar. Robertson concluded that both local buccal infiltration and Inferior alveolar nerve blockwith Articaine proved to be highly successful, in the region of the first molars and both premolars.However, they found buccal infiltration was not as effective in the mandibular second molar region. They attributed that the reasons being individual anatomical nature, such as the increased thickness of the buccal lamella in the region of the second molar, more lingual position of the mandibular canal, as well as the fact that the anesthetic was applied proximal to the mentioned tooth.Various authors have evaluated the success of mandibular first molar infiltrations using asymptomatic subjects, a cartridge of 4% Articaine with 1:100,000 epinephrine, and an electric pulp tester to evaluate pulpal anesthesia. Kanaa et al, Robertson et al, Jung et al, Corbett et al, Pabst et al, and McEntee et al used a similar methodology to the current study and showed 64%, 87%, 54%, 64% to 70%, 64% to 69%, and 67% success rates, respectively. The results of previous studies confirm that the buccal infiltration of a 1.8 ml Articaine would not provide predictable pulpal anesthesia of mandibular molars.[16,31,53]

Costa et al.[11] carried out a study to compare the onset and duration of pulpal anesthesia by maxillary infiltration using 2% Lidocaine with 1:100,000 epinephrine, 4% Articaine with 1:200,000 epinephrine, and reported that both solutions produced shorter onset and longer duration of pulpal anesthesia. Sierra - Rebolledo et al.[51] carried out a comparative study on the anesthetic efficacy of 4% Articaine versus 2% Lidocaine, both with epinephrine 1:100,000, in truncal block of the inferior alveolar nerve during the surgical extraction of impacted lower third molars and found out that 4% Articaine offers better clinical performance than 2% Lidocaine, particularly in terms of latency and duration of the anesthetic effect but statistically no significant differences in anesthetic efficacy were recorded between the two solutions. Kalia et al. did a study to compare the onset and duration of anaesthesia of 4% Articaine with epinephrine (1:100,000) versus 2% Lidocaine with epinephrine during exodontia and concluded that there were some significant differences between 4% Articaine and 2% Lidocaine in terms of subjective and objective symptoms and onset of pulpal anesthesia. The result showed that 4% Articaine had longer duration and onset of anesthesia as compared to 2% Lidocaine.

The choice of the anesthetic solution should be based on three main clinical considerations: anesthetic potency, latency (time to onset of anesthesia), and duration of the anesthetic effect. Other important considerations are the pharmacokinetics (absorption, distribution, metabolization, and excretion) and toxicity of the drug. The latency of Lidocaine varies from 2-3 minutes, with an approximate duration of anesthetic effect for 2% solutions with epinephrine 1:100,000 as vasoconstrictor of 85 minutes at pulp level, and 190 minutes in soft tissues.[52] Lidocaine is the local anesthetic most widely used for pain control since its pharmacokinetic characteristics and low toxicity compared with other ester-type anesthetics make it safe for use in dental practice. Its potency is presently regarded as the standard for comparison with other local anesthetics.

**Drug Volume**

Malamed reported that the mean volume of Articaine required to achieve anesthesia was 2.5 ±0.07 ml for simple procedures like single extractions (compared to 2.6ml ± 0.09 of Lidocaine) and 4.2ml ± 0.15 ml for complex procedures like multiple extractions, alveloectomies and other osseous procedures (compared to 4.5ml ± 0.21 of Lidocaine).[59]Sreekumar and Bhargava[8] conducted a study to compare the onset and duration of action of soft tissue and pulpal anesthesia with three different volumes 0.6 ml, 0.9 ml, and 1.2 ml of 4% Articaine with 1:100,000 epinephrine in maxillary anaesthesia and concluded that maxillary infiltration anesthesia with Articaine and epinephrine has a faster onset, a greater success rate, and a longer duration with volume of 1.2 ml.[55]In our study the mean drug volume was 1.9ml ± 0.2ml for Group A and 2.2 ml ± 0.5ml for Group B administered via buccal and palatal infiltrations, statistically no significant difference was present in the two groups.

**Onset of Action**

The onset of action depends on several factors, such as the intrinsic properties of the drug substance used, and the anesthetic technique employed. On the other hand, latency is directly

influenced by the corresponding pKa value—smaller pKa values being associated with shorter latency. Accordingly, 4% Articaine (pKa = 7.8) would at least, in theory, present a shorter latency than 2 % Lidocaine (pKa = 7.9). Dugal et al.[12] concluded the onset of action of Lidocaine was 1.15 min when injected for nerve blocks. Moore et al. reported that the onset of action was 3.0 ± 2.1min 4 % for Articaine HCl with 1:100,000 and 3.1 ± 2.3 min for 4 % Articaine HCl with 1:200,000 after maxillary infiltration of 1.0ml anesthetic solution.[45] Colombini et al. stated 149.50 ± 14.29 s for Articaine via IANB in lower third molar removal.[9] Rebolledo et al.[52] reported 53.03 s (0.93 min) for Articaine versus 75.04 sec (1.25 min) for Lidocaine in lower third molar removal. The mean onset of anesthesia was 42.2 seconds for Group A and60 seconds for Group B which was given as buccal and palatal infiltrations in our study, there were statistically significant differences between the two groups.

**Duration of Anaesthesia**

The duration of anesthesia is directly proportional to its degree of protein binding. However, the duration of the effect of the local anesthetic is also dependent on the injection site or concentration of vasoconstrictor present in the anesthetic solution being used. Articaine presents the greatest protein binding capacity of all the amide local anesthetics, comparable only to long-acting substances such as Bupivacaine, Ropivacaine, and Etidocaine. This, in turn, implies a longer duration of the anesthetic effect.[65] The duration of anesthesia required to complete the procedure will be a major consideration in the selection of a local anesthetic solution. Hass et al.[28] and Costa et al.[11] stated that 4% Articaine with 1:100,000 Epinephrine clinically presented the shortest onset and the longest duration periods and Articaine solutions produced both shortest onset and longer duration of pulpal anesthesia in maxillary infiltration than the Lidocaine solution but statistically did not conform better clinical results.

Moore et al. reported the mean duration of pulpal anesthesia with infiltration was (A100) 61.8 $\pm$ 59 minutes and (A200) 51.2 $\pm$ 55.9 minutes evaluated by electric pulp testing and there were statistically significant differences between the two groups.[45] In our study, the mean duration of Anaesthesia was 120.8 min for Group A and 91.8 min for Group B by maxillary infiltration and there were statistically significant differences between the two groups, the results of the present study are per the above-reported study. Colombini et al. concluded that the duration of anesthesia was 273.80 $\pm$ 15.94 minutes for Mepivacaine. Rebolledo et al.[50] reported 220.8 minutes for Articaine and while 168.2 minutes for Lidocaine Anaesthesia by inducing inferior alveolar nerve block anesthesia. The long period of analgesia for Articaine stated that the concentration of Articaine in the alveolus of tooth extraction is about 100 times higher than in systemic circulation. The saturable local Articaine mechanism has been considered as possibly contributing to the observed duration of the local anesthetic effect.

**Depth of Anaesthesia**

Depth of anesthesia was assessed using a visual analogue scale (VAS) and was taken by a different operator to avoid influencing the patient intraoperatively during the procedure for scoring the pain intensity. In our study intraoperative VAS of 1–10 for Group A and Group B the results are statistically not significant ($p > 0.639$ at 15minutes and $p > 0.135$ at 30 minutes interval) for Articaine and Lidocaine. According to Malamed et al, Rebolledo et al, Gregorio et al, reported the intraoperative analgesia evoked by Articaine may be explained by its ability to readily diffuse through tissues due to the presence of thiophene group in the molecule which increases liposolubility.[19,51]

**Efficacy of Articaine**

In our study, clinical evaluation of the efficacy of the two anesthetic solutions was made by comparing the need for re-anesthesia during surgery. In one intervention another dose of Articaine was administered and in three interventions another dose of Lidocaine was administered during the procedure. However, the mean drug volume used for re-anesthesia of the surgical area failed to reach statistical significance. Rebolledo et al,[51] Potonick et al.[49] reported that 2 % of Articaine more effectively depresses the compound action potential of theA-fibers in the isolated rat sural nerve than either 2 % or 4 % Lidocaine or 3 % Mepivacaine. Paessler et al.[23] concluded that the 4 % Articaine solution did not prove superior in the local anesthetic effect. Articaine 2 % with epinephrine 1:200,000, therefore,can be considered a suitable local anesthetic for tooth extractions. The most noticeable difference observed between the two injection solutions concerned the duration of anesthesia, which was significantly shortened under the low dose solution.

Santos et al.[54] reported that epinephrine concentration in 4 % Articaine solution doesnot influence the clinical efficacy of local anesthetic in terms of anesthetic properties (latency, postoperative analgesia, post-operative anesthesia and quality of anesthesia), intraoperative bleeding and hemodynamic parameters in patients undergoing lower third molar removal. Gregorio et al. stated that 4% Articaine provided a shorter time of onset, comparable homeostasis and post-operative pain control with a shorter duration of soft tissue anesthesia in lower third molar removal.

Uckan et al. and Lacet-Lima et al.[29] reported that Articaine demonstrated relatively good vestibule palatal diffusion with efficacy rates of anesthesia 98%. Retained maxillary third molar extractions could be performed with only buccal vestibule infiltrative terminal anesthesia in the majority of cases with no need for supplemental palatal anesthesia.

**Hemodynamics**

The major concern in dentistry is the perioperative hypertension crisis in hypertensive patients. As hypertension can bring about complications such as paralysis, heart and renal problems, and acute medical problems. Hypertensive patients constitute an important risk group in dental treatment. Although it is stated in the literature that local anesthetics with vasoconstrictors can be safely used during oral surgery in hypertensive patients, there are still some controversies about this subject. It has been reported that the use of anesthetic solutions without vasoconstrictors increases the risk of hypertensive crisis due to the potential pain caused by insufficient intraoperative anesthesia. Most clinicians prefer using local anesthetics without vasoconstrictors in hypertensive patients due to the negative effects of vasoconstrictors on the cardiovascular system. Therefore, hemodynamic aspects, like BP or heart rate (HR), in hypertensive patients come into prominence.[50]

In addition to HR and BP, myocardial ischemia is also important in hypertensive patients. Rate pressure product (RPP) and pressure rate quotient (PRQ) are described as the possible predictors of myocardial oxygen consumption and subsequent ischemia. RPP is defined as the product of systolic BP (SBP) and the HR, and PRQ is defined as the mean arterial pressure (MAP) divided by HR. Significant values suggested for RPP range from 12,000 to 20,000 to indicate ischemia and over 20,000 to indicate angina pectoris. It must be noted that 75% of all episodes of myocardial ischemia are silent and develops without anginal symptoms. For this reason, an RPP of 12,000 seems to provide a reasonable target value when monitoring ischemia. The target value for PRQ has been determined to be less than 1.08.[64]

In patients with cardiovascular disorders, Anaesthesia with its lower epinephrine content is usually preferred to avoid the systemic side effects of epinephrine. Epinephrine in anesthetic solutions causes local vasoconstriction and prolongs the duration of anesthesia. The systemic effects of epinephrine in local anesthetic agents have been discussed. Plasma epinephrine concentrations have been shown to increase more than 10-fold after administration of 3.6 mL of 2% Lidocaine with 1:80,000 epinephrine. Despite increases in serum catecholamine concentrations, the administration of local anesthetic agents appears to cause only minor hemodynamic changes. Twelve healthy patients can tolerate these abrupt increases in vasoconstrictor serum concentration, but patients with cardiovascular disease may not be able to; thus, less vasoconstrictor in the solution could be safer. However, it is generally agreed that epinephrine administration should be avoided when a patient's cardiovascular status is labile. Evaluation of blood pressure and heart rate is one of the most sensitive assays for the response to epinephrine levels. Our results show that both local anesthetic agents tested provide adequate anesthesia rapidly and sufficiently long for minor dental procedures without any significant hemodynamic changes. We have not included any medically compromised patients in our study.[23]

In our present study, the values of cardiovascular parameters showed that the pulse rate increased with the injection of 4 % Articaine and 2 % Lidocaine. The increase in pulse rate was maximum after 15 min of administration of Articaine and Lidocaine. The mean rise in the Articaine group was 4 beats/min and gradually decreased to the basal value after 30 min. The mean rise in Lidocaine group was 6 beats/min and gradually decreased to the basal value after 30 min and no statistically significant differences between the two groups. The change in the systolic and diastolic blood pressure was recorded after the administration of the local anesthetic agent and compared with the baseline value in both the groups. There was no significant change noted in the systolic or diastolic blood pressure from the baseline values at different time intervals after the administration of both the anesthetic solutions. Our results are comparable with that of Santos et al.[54] who reported that transient increase or decrease in

blood pressure and oxygen saturation were observed but they were neither clinically significant nor statistically significant. Local anesthesia with epinephrine may cause a slight increase in blood glucose concentration in type II controlled diabetic patients, which is not found to be clinically significant and therefore safe to use on diabetic patients. Hence, we have not evaluated the blood glucose level in our study.

**Oxygen Saturation**

The change in oxygen saturation was recorded after the administration of the local anesthetic agent and compared with the baseline value in both the groups. There was no significant change noted in the oxygen saturation from the baseline values at different time intervals after the administration of both the anesthetic solutions. Colombini et al, Santos et al, Martinez et al, Elad et al. reported in accordance with our result. Vasconcellos et al. suggested that all patients submitted to surgery for removal of third molars are at risk for hypoxia. Short episodes of hypoxia may have only minor consequences in healthy patients, but those in unhealthy may develop serious complications.[10,20,54,64.]

**Adverse Reactions**

According to literature, Articaine has the potential to cause methemoglobinemia, neuropathies, paraesthesia, hypersensitivity, allergy. Malamed et al. reported an overall incidence of adverse events in the combined studies was 22 % for Articaine and 20 % Lidocaine of which paraesthesia was 0.9 %, hypoesthesia 0.7 %, headache 0.55 %, infection 0.45 %, rash and pain 0.3 %. Methemoglobinemia has been shown to develop with some types of local anesthetics. Clinical tests of Articaine, Bupivacaine, and Etidocaine administered as central nerve block anesthetic for urological procedures(n = 103) indicated no elevation of methemoglobin with Articaine.[62]

Haas and Lennon[19]published a retrospective analysis of paresthesiaafter local anesthetic administration for nonsurgical dental procedures over 21 years. The analysis revealed a higher-than-expected frequency of paresthesia with Articaine, based on the number of cartridges used (2.27 per 1 million injections vs. an expected frequency of 1.20 per 1 million injections). Malamed et al also reported an increased incidence of nerve alterations, paresthesia's and hyperesthesia's, when administering 4% Articaine with epinephrine 1:100,000 versus 2% Lidocaine at the same vasoconstrictor concentration – suggesting a possible greater neurotoxic effect on the part of Articaine.[7] In this sense, Penarrocha et al[48] documented 14 cases of eye problems when using this anesthetic for infraorbital nerve block. Among the causes for these complications, the authors mentioned the possibility of increased diffusion of this anesthetic within the soft tissues and bone – thus facilitating Articaine penetration to the orbital cavity.

One of the most controversial aspects of Articaine administration is its potential to cause paresthesias after inferior alveolar nerve blockade,which leads some researchers to support the opinion that 4% Articaine should not be routinely used in this anesthetic application.Other authors attribute this adverse effect to the higher concentration of Articaine (4%) compared with other local anesthetics (e.g., 2% Lidocaine in association with epinephrine). Interestingly, Haas and Lennonalso observed the same side effect for Prilocaine, which is also available in the same concentration as Articaine. It may be possible to decrease the risk of paresthesias by using a lower concentration of Articaine to block the inferior alveolar nerve. However, in our study, we didn't encounter any kind of complications.[20]Articaine is contraindicated in patients allergic to amide- type anesthetics and patients allergic to metabisulfites (preservative present in the formula to extend the life of epinephrine). It is contraindicated in patients with hemoglobinopathies (sickle cell disease) and patients with idiopathic or congenital methemoglobinemia, but methemoglobinemia is not a concern in the dental practice due to the small volumes of Articaine used. In our study, we did not encounter any kind of adverse reaction.[52]

Articaine has few advantages over Lidocaine including being more potent due to its high lipid solubility, a long duration of action and having a higher rate of diffusion through both soft and hard tissue. Articaine causes a transient and completely reversible state of anesthesia (loss of sensation) during dental procedures. Articaine is used both for infiltration and block injections, and with the block technique, ityields the greatest duration of anesthesia. Also, in people with hypokalemia and sensory overstimulation, Lidocaine is not very effective, but Articaine works well.[52]Several studies have linked the use of Articaine to a lower level of pain in patients undergoing extractions.

## V. SUMMARY AND CONCLUSION

It can be concluded that the mean onset of

Anaesthesiafor articaine was 42 ± 7 seconds which was significantly less than that of Lidocaine59.5±4 seconds.The mean duration of Anaesthesiafor articaine was120 ± 14 minutes which was significantly higher than that of Lidocaine(91.8±10 min).The depth of anesthesia for surgical removal of canine tooth was adequate with Articaine and there was no significant difference when compared with Lidocaine($p > 0.639$ at 15minutes and $p > 0.135$ at 30 minutes interval for Articaine and Lidocaine).There was no significant difference between Articaine and Lidocaine in terms of pain score and hemodynamic changes.Articaine can be used as an alternative to lignocaine for maxillary canine impactions.

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**Table.1 AGE OF THE PARTICIPANTS**

| **AGE (Years)** | | |
|---|---|---|
| ARTICAINE (Group A) | Mean | 30.2000 |
| | Std. Deviation | 9.12627 |
| LIDOCAINE (Group B) | Mean | 29.3000 |
| | Std. Deviation | 8.42021 |

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**Table.2 GENDER OF THE PARTICIPANTS**

| GROUP | | Frequency | Percent |
|---|---|---|---|
| ARTICAINE (Group A) | MALE | 5 | 50.0 |
| | FEMALE | 5 | 50.0 |
| LIDOCAINE (Group B) | MALE | 4 | 40.0 |
| | FEMALE | 6 | 60.0 |

**Table.3 DRUG VOLUME, ONSET OF ANAESTHESIA, DURATION OF PROCEDURE & DURATION OF ANAESTHESIA**

| GROUP | DRUG VOLUME (ml) | ONSET OF ANAESTHESIA (Seconds) | DURATION OF PROCEDURE (Minutes) | DURATION OF ANAESTHESIA (Minutes) |
|---|---|---|---|---|
| ARTICAINE (Group A) | 1.8600 | 42.2000 | 39.5000 | 120.8000 |
| | 1.8000 | 41.0000 | 40.0000 | 125.0000 |
| | 1.80 | 36.00 | 40.00 | 100.00 |
| | .18974 | 7.33030 | 5.50252 | 14.58157 |
| LIDOCAINE (Group B) | 2.1800 | 60.0000 | 42.0000 | 91.8000 |

| | | | | |
|---|---|---|---|---|
| | 1.8000 | 59.5000 | 45.0000 | 91.0000 |
| | 1.80 | 54.00[a] | 45.00 | 90.00 |
| | .50067 | 4.08248 | 4.83046 | 10.72691 |
| | .091 | 0.000 | .202 | 0.001 |

**Table.4 PAIN SCORE AT 15 MINS**

**(Visual Analog Scale)**

| | | No Pain | Mild Pain | p- VALUE |
|---|---|---|---|---|
| GROUP | ARTICAINE (Group A) | 7 | 3 | |
| | LIDOCAINE (Group B) | 6 | 4 | .639 |

**Table.5 PAIN SCORE AT 30 MINS**

**(Visual Analog Scale)**

| | | No Pain | Mild Pain | P - Value |
|---|---|---|---|---|
| GROUP | ARTICAINE (Group A) | 4 | 6 | |
| | LIDOCAINE (Group B) | 4 | 6 | 0.135 |

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**Table.6 HEART RATE (HR)**

| GROUP | | HR BEFORE LA | HR AT 15 MIN | HR AT 30 MIN | HR AT 45 MIN | HR AT 60 MIN |
|---|---|---|---|---|---|---|
| ARTICAINE (Group A) | Mean | 76.0000 | 81.5000 | 74.8000 | 73.4000 | 74.4000 |
| | Median | 76.0000 | 80.0000 | 73.0000 | 70.0000 | 74.0000 |
| | Mode | 78.00 | 66.00 | 66.00 | 68.00 | 72.00 |
| | Std. Deviation | 8.90693 | 10.23339 | 8.59974 | 6.25744 | 8.31598 |
| LIDOCAINE (Group B) | Mean | 77.5000 | 83.3000 | 74.5000 | 75.0000 | 76.8000 |
| | Median | 78.0000 | 83.0000 | 74.0000 | 75.0000 | 78.0000 |
| | Mode | 78.00 | 84.00 | 78.00 | 70.00 | 80.00 |
| | Std. Deviation | 5.58271 | 6.63409 | 3.37474 | 5.43650 | 5.18116 |
| | p-VALUE | .648 | .543 | .647 | .396 | .491 |

**Table.7 OXYGEN SATURATION (OS)**

| GROUP | | OS BEFORE LA (%) | OS AT 15 MIN (%) | OS AT 30 MIN (%) | OS AT 45 MIN (%) | OS AT 60 MIN (%) |
|---|---|---|---|---|---|---|
| ARTICAINE (Group A) | Mean | 98.9000 | 96.7000 | 98.4000 | 98.5000 | 99.1000 |
| | Median | 99.0000 | 96.0000 | 98.5000 | 98.0000 | 99.0000 |
| | Mode | 99.00 | 96.00 | 99.00 | 98.00 | 100.00 |
| | Std. Deviation | .73786 | 1.25167 | .96609 | .70711 | .87560 |
| LIDOCAINE (Group B) | Mean | 98.8000 | 97.2000 | 98.7000 | 98.9000 | 99.3000 |
| | Median | 99.0000 | 97.5000 | 99.0000 | 99.0000 | 99.5000 |
| | Mode | 99.00 | 99.00 | 99.00 | 99.00 | 100.00 |
| | Std. Deviation | .91894 | 2.20101 | .82327 | .99443 | .82327 |
| | P - VALUE | .902 | .640 | .438 | .245 | .598 |

**Table.8 MEAN RANKS FOR HEART RATE & OXYGEN SATURATION**

| RANKS | | | | |
|---|---|---|---|---|
| | GROUP | N | Mean Rank | Sum of Ranks |
| HR BEFORE LA | ARTICAINE | 10 | 9.90 | 99.00 |
| | LIDOCAINE | 10 | 11.10 | 111.00 |
| | Total | 20 | | |
| HR AT 15 MIN | ARTICAINE | 10 | 9.70 | 97.00 |
| | LIDOCAINE | 10 | 11.30 | 113.00 |

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| | | | | |
|---|---|---|---|---|
| | Total | 20 | | |
| HR AT 30 MIN | ARTICAINE | 10 | 9.90 | 99.00 |
| | LIDOCAINE | 10 | 11.10 | 111.00 |
| | Total | 20 | | |
| HR AT 45 MIN | ARTICAINE | 10 | 9.40 | 94.00 |
| | LIDOCAINE | 10 | 11.60 | 116.00 |
| | Total | 20 | | |
| HR AT 60 MIN | ARTICAINE | 10 | 9.60 | 96.00 |
| | LIDOCAINE | 10 | 11.40 | 114.00 |
| | Total | 20 | | |
| OS BEFORE LA | ARTICAINE | 10 | 10.65 | 106.50 |
| | LIDOCAINE | 10 | 10.35 | 103.50 |
| | Total | 20 | | |
| OS AT 15 MIN | ARTICAINE | 10 | 9.90 | 99.00 |
| | LIDOCAINE | 10 | 11.10 | 111.00 |
| | Total | 20 | | |
| OS AT 30 MIN | ARTICAINE | 10 | 9.55 | 95.50 |
| | LIDOCAINE | 10 | 11.45 | 114.50 |
| | Total | 20 | | |
| OS AT 45 MIN | ARTICAINE | 10 | 9.05 | 90.50 |
| | LIDOCAINE | 10 | 11.95 | 119.50 |
| | Total | 20 | | |
| OS AT 60 MIN | ARTICAINE | 10 | 9.85 | 98.50 |
| | LIDOCAINE | 10 | 11.15 | 111.50 |
| | Total | 20 | | |

**Table.9 SYSTOLIC BLOOD PRESSURE (SYSTOLIC BP IN mmHg)**

| **GROUP** | | **SYSTOLIC BP BEFORE LA** | **SYSTOLIC BP AT 15 MIN** | **SYSTOLIC BP AT 30 MIN** | **SYSTOLIC BP AT 45 MIN** | **SYSTOLIC BP AT 60 MIN** |
|---|---|---|---|---|---|---|
| ARTICAINE (Group A) | Mean | 116.6000 | 130.4000 | 118.6000 | 115.6000 | 118.4000 |
| | Median | 115.0000 | 132.0000 | 119.0000 | 119.0000 | 120.0000 |
| | Mode | 110.00 | 128.00 | 110.00 | 100.00 | 120.00 |
| | Std. Deviation | 10.06865 | 13.29327 | 10.24370 | 10.27619 | 6.31049 |
| LIDOCAINE (Group B) | Mean | 121.0000 | 129.4000 | 117.8000 | 112.8000 | 117.8000 |
| | Median | 118.0000 | 124.0000 | 114.0000 | 110.0000 | 116.0000 |
| | Mode | 118.00 | 124.00 | 110.00 | 110.00 | 110.00 |
| | Std. Deviation | 10.50926 | 10.83410 | 9.68160 | 7.43565 | 8.66410 |
| | P - VALUE | .402 | .820 | .878 | .418 | .728 |

**Table.10 DIASTOLIC BLOOD PRESSURE (DIASTOLIC BP IN mmHg)**

| **GROUP** | | **DIASTOLIC BP BEFORE LA** | **DIASTOLIC BP AT 15 MIN** | **DIASTOLIC BP AT 30 MIN** | **DIASTOLIC BP AT 45 MIN** | **DIASTOLIC BP AT 60 MIN** |
|---|---|---|---|---|---|---|
| ARTICAINE (Group A) | Mean | 79.2000 | 86.6000 | 80.4000 | 77.8000 | 79.4000 |
| | Median | 81.0000 | 87.0000 | 80.0000 | 78.0000 | 81.0000 |
| | Mode | 70.00 | 80.00 | 80.00 | 78.00 | 82.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Std. Deviation | 7.25412 | 5.25357 | 3.62706 | 4.15799 | 6.04060 |
| LIDOCAINE (Group B) | Mean | 81.6000 | 81.0000 | 76.0000 | 75.6000 | 81.0000 |
| | Median | 80.0000 | 88.0000 | 79.0000 | 76.0000 | 79.0000 |
| | Mode | 80.00 | 88.00 | 80.00 | 76.00 | 78.00 |
| | Std. Deviation | 5.87272 | 10.03328 | 9.97775 | 4.08792 | 6.61648 |
| p-VALUE | | .673 | .398 | .333 | .200 | .704 |

**Table.11 MEAN RANKS FOR SYSTOLIC & DIASTOLIC BLOOD PRESSURE**

| | GROUP | N | MEAN RANK |
|---|---|---|---|
| SYSTOLIC BP BEFORE LA | ARTICAINE | 10 | 9.40 |
| | LIDOCAINE | 10 | 11.60 |
| DIASTOLIC BP BEFORE LA | ARTICAINE | 10 | 9.95 |
| | LIDOCAINE | 10 | 11.05 |
| SYSTOLIC BP AT 15 MIN | ARTICAINE | 10 | 10.80 |
| | LIDOCAINE | 10 | 10.20 |
| DIASTOLIC BP AT 15 MIN | ARTICAINE | 10 | 11.60 |
| | LIDOCAINE | 10 | 9.40 |
| SYSTOLIC BP AT 30 MIN | ARTICAINE | 10 | 10.70 |
| | LIDOCAINE | 10 | 10.30 |
| DIASTOLIC BP AT 30 MIN | ARTICAINE | 10 | 11.75 |
| | LIDOCAINE | 10 | 9.25 |
| SYSTOLIC BP AT 45 MIN | ARTICAINE | 10 | 11.55 |
| | LIDOCAINE | 10 | 9.45 |
| DIASTOLIC BP AT 45 MIN | ARTICAINE | 10 | 12.15 |
| | LIDOCAINE | 10 | 8.85 |
| SYSTOLIC BP AT 60 MIN | ARTICAINE | 10 | 10.95 |
| | LIDOCAINE | 10 | 10.05 |
| DIASTOLIC BP AT 60 MIN | ARTICAINE | 10 | 10.00 |
| | LIDOCAINE | 10 | 11.00 |

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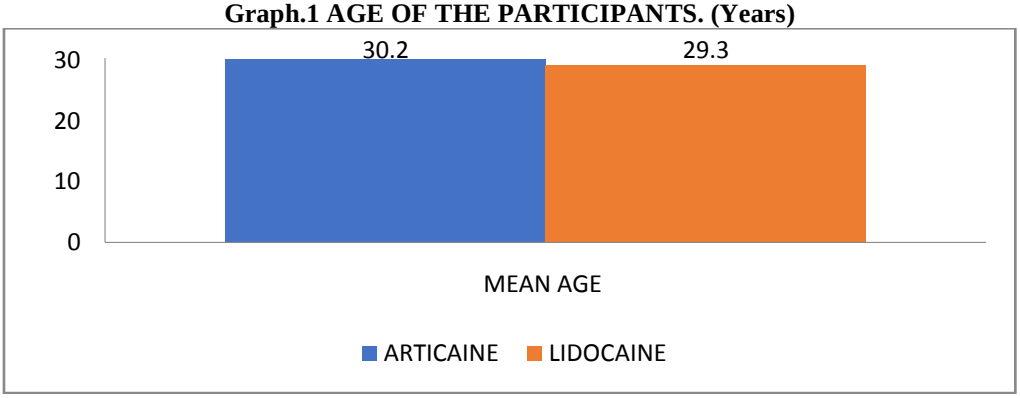
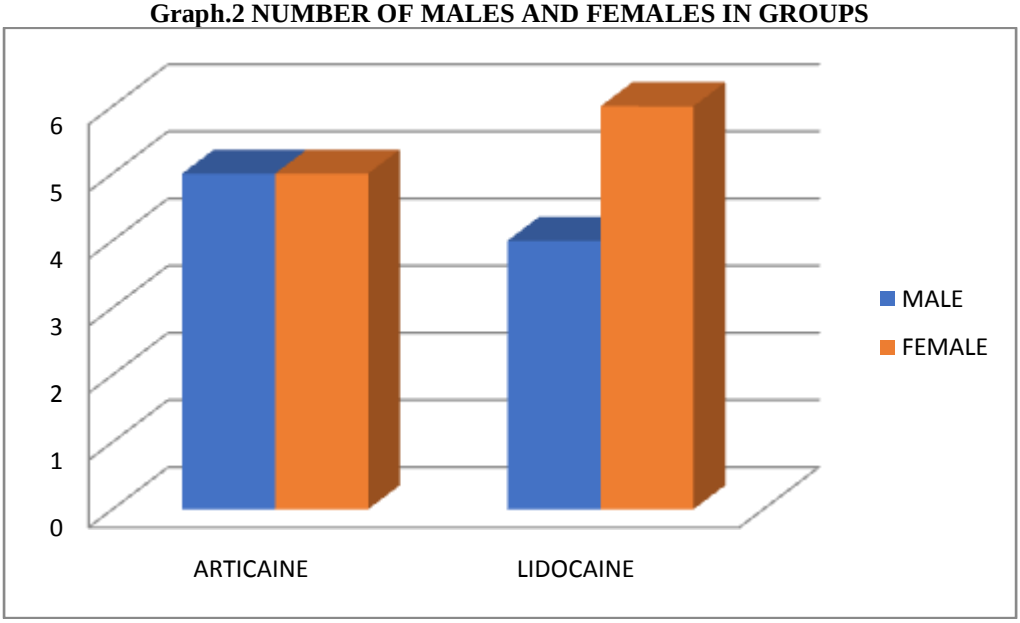
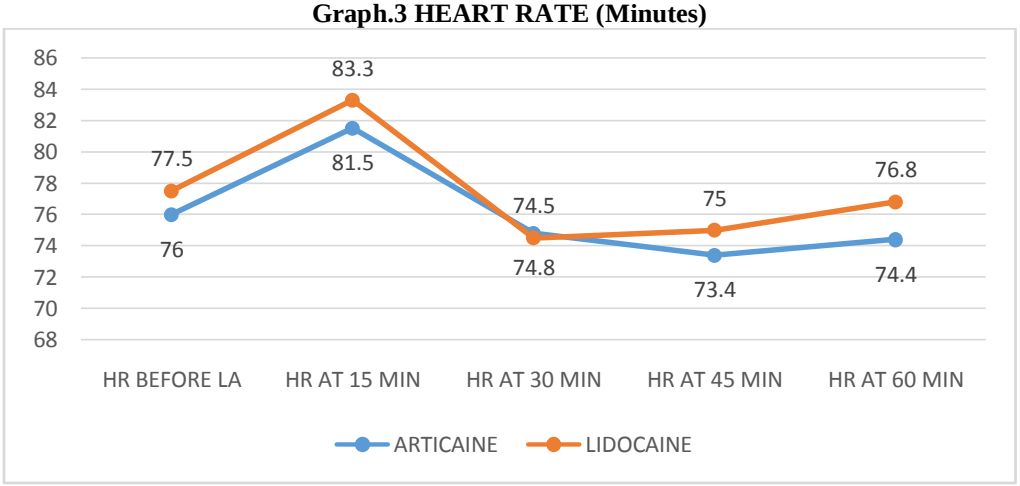
**Graph.1 AGE OF THE PARTICIPANTS. (Years)**




**Graph.2 NUMBER OF MALES AND FEMALES IN GROUPS**




**Graph.3 HEART RATE (Minutes)**



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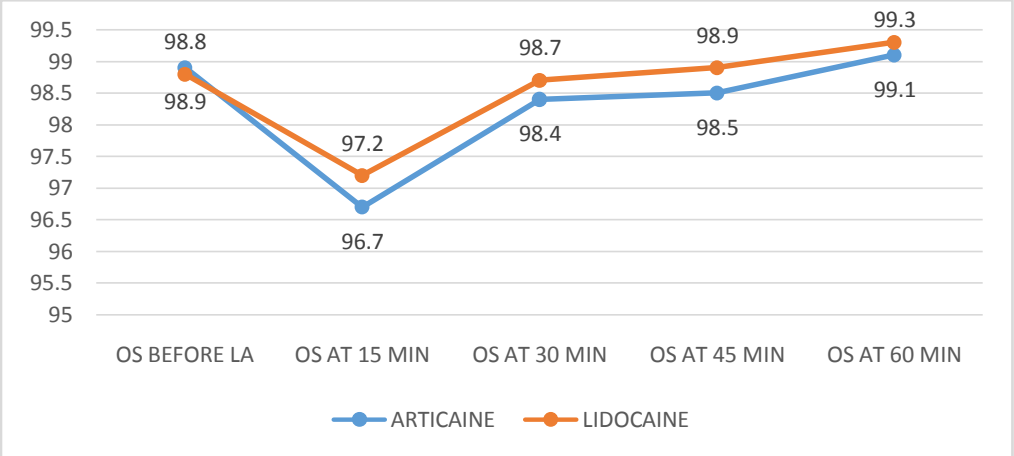
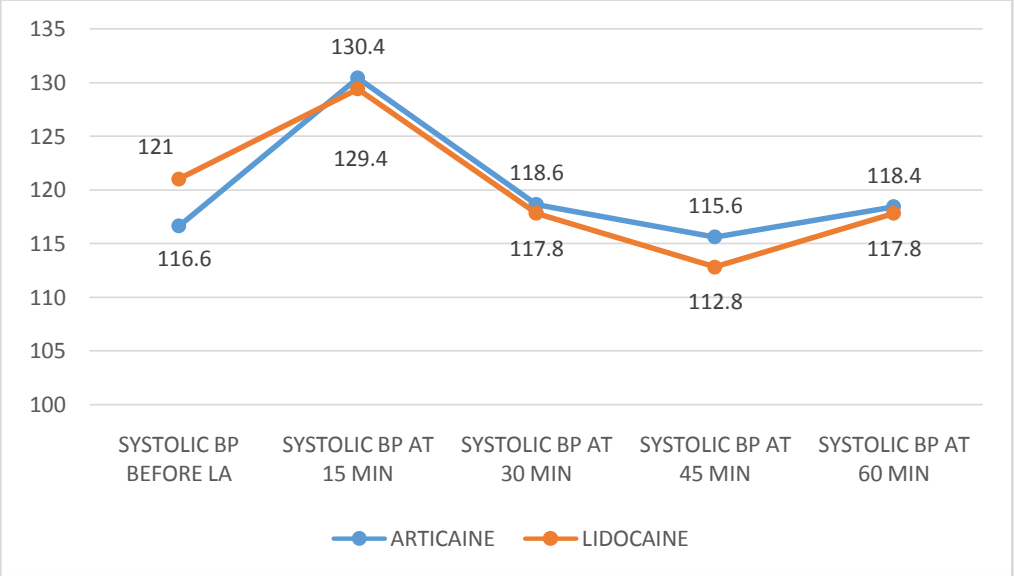
**Graph.4 OXYGEN SATURATION (%)**




**Graph.5 SYSTOLIC BLOOD PRESSURE (mmHg)**




**Graph.6 DIASTOLIC BLOOD PRESSURE (mmHg)**