

The Knowledge of Dental Practitioners on Local Anesthetics and its Dosage

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Running title: Local anesthetics and its dosage

Abstract: Knowledge of pharmacology and toxicology of local anesthetics is important for their intelligent and judicious use. During their routine work most dentists often ignore important aspects of drug administration, notably the maximum dose and the dosage calculation. The total dose of local anesthetic must be determined for each patient based upon body weight. Hence the main aim of this study was to investigate awareness and knowledge of general dental practitioners regarding the maximum dose of the commonly used local anesthetics. The sample population of this study includes clinicians and postgraduate students. A generalized questionnaire based on hot pulp and its management was prepared and uploaded in an online platform, which was circulated among the sample population using various social media platforms. The total study population consisted of 136 dentists and post graduate students. Most of the participants had 1 - 3 years of experience with 83.09% of the total population. About 75.74% of the total population were aware of local anesthetic dosage calculation. The maximum dose of 2% lidocaine with vasoconstrictor that can be administered is 4.4 mg/kg. Only 41.18% of dental practitioners were aware of this. The maximum dose of Bupivacaine with vasoconstrictor that can be administered is 3 mg/kg. Within limits of the study, the knowledge of dental practitioners concerning local anesthetic dosage and its dose calculations appears inadequate. Lack of knowledge about the dose can lead to dose dependent life threatening conditions like Local Anesthetic Systemic Toxicity.

Keywords: Local anesthesia, dosage, dose calculations, lidocaine, bupivacaine, local anesthetic systemic toxicity

1. Introduction

In the last century, the world has witnessed many revolutions in medical care and treatments. One such revolution is the development of safe and effective local anesthetic agents which has proved to be the most important advancement in dental science to occur. Local anesthetics inhibit nerve conduction and are used in a variety of dental procedures to manage pain [1]. They are classified as amides or esters with short, intermediate or long action. In addition to the local anesthetic agent vasoconstrictors are also used in conjunction during the administration of the drug. [2].

Knowledge of pharmacology and toxicology of local anesthetics is important for their intelligent and judicious use. During their routine work most dentists often ignore important aspects of drug administration, notably the maximum dose and the dosage calculation [3]. The total dose of local anesthetic must be determined for each patient based upon body weight. Small children or frail individuals will require less than the average dosages. The use of vasoconstrictors such as Adrenaline may constitute the limiting factor to the amount of local anesthetic that can be administered safely over a given period of time. Certain medical problems, such as hyperthyroidism or cardiovascular system impairments may influence the choice of anesthetic and the amount of vasoconstrictor. Most dentists memorize the maximum number of local anesthetic cartridges that can be used [4]. Failure of anesthesia leads to

administration of more amounts of local anesthetic in order to achieve the required effect, and toxic reactions to local anesthetics can occur when the concentration in the blood stream becomes elevated over a short period of time. High concentrations of local anesthetic in the circulation may result from a rapid inadvertent injection directly into a blood vessel, or use of repeated injections [5].

Even though toxic reactions are more commonly encountered during the use of nerve block injections than infiltrations, some authors recommend performing two negative aspirations even when infiltration technique is used to administer. Dentists should be thoroughly aware of the dose required and the dosage calculations used for local anesthetics and should perform aspiration in all injections in order to avoid sudden intravascular injections which may lead to drug toxicity. 2% local anesthetic means 2 grams of the drug is dissolved in 100 ml of solution, that is, 20 mg per ml. Though these calculations are simple, many dentists are not confident in doing them [6]. Dentists are confused, when it comes to the maximum dose to be given, when changing concentrations. The use of local anesthetic cartridges has unfortunately spawned carelessness regarding the amount of anesthetic that can be administered to the patient, and such attitudes continue to prevail even in many respected and well established institutes. The presence of vasoconstrictors in the dental anesthetic cartridge makes it more important to know the calculations of the maximum dose for each drug.

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Local anesthetics are active pharmacological agents that can potentiate dose - related complications such as Local anesthetic systemic toxicity. With a rich case bank established over 3 decades we have been able to publish extensively in our domain [7–17]. Based on this inspiration we aim to investigate awareness and knowledge of general dental practitioners regarding the maximum dose of the commonly used local anesthetics. The study also determined the most commonly used local anesthetics by dental practitioners, the most frequent complications encountered during local anesthetic administration and whether or not aspiration is a common practice used by dental practitioners.

2. Materials and Methods

Study Setting:

The sample population of this study includes clinicians and postgraduate students. A generalized questionnaire based on local anesthetics and its dosage was prepared and uploaded in an online platform (survey planet) which was distributed among the sample population using various social media.

Sampling:

The total population of this study was 136 dental practitioners. In this research simple random sampling was done in order to minimise sampling bias. Internal validity was the pretested questionnaire. External validity was homogenisation and cross verification with existing studies.

Data Collection:

The questionnaire contained 12 questions. The participants were asked to answer all questions to access them. Independent variables such as demographic details were recorded. The Questionnaire investigated the clinician's awareness of the maximum dose of 2% lidocaine with adrenaline in terms of dose per kilogram and the maximum number of local anesthetic cartridges that can be administered to a healthy adult patient. The questionnaire asked whether the dentist performs aspiration in different injection techniques and also questioned the types of complications that the dentist had encountered during, or after the administration of local anesthesia. The collected data was tabulated in Microsoft Excel 2010.

Data Analytics:

The acquired data was subjected to statistical analysis. Microsoft Excel 2010 data spreadsheet was exposed to Statistical Package for Social Science (SPSS) for windows. Descriptive statistics was applied for the variables, chi - square tests were applied at a level of significance of 5% ($P < 0.05$).

3. Results and Discussion

The total study population consisted of 136 dentists and post graduate students. Most of the participants had 1 - 3 years of experience with 83.09% of the total population (Figure 1). About 75.74% of the total population were aware of local anesthetic dosage calculation (Figure 2). The maximum dose of 2% lidocaine with vasoconstrictor that can be administered is 4.4 mg/kg. Only 41.18% of dental practitioners were aware of this (Figure 3). The maximum dose of Bupivacaine with vasoconstrictor that can be

administered is 3 mg/kg. Only 33.09% of dental practitioners were aware of this (Figure 4). Only 16.18% of dental practitioners were aware of the total number of 2% lidocaine cartridges that can be administered (Figure 5). About 88.24% of dental practitioners use lidocaine in their practice (Figure 6). About 74.26% of respondents aspirate for all injections (Figure 7). Failure of anesthesia was the most common complication faced by dental practitioners with 24.26%, which was followed by hematoma (Figure 8). About 69.85% of the total population were aware of Local Anesthetic Systemic Toxicity (Figure 9).

Failure to appreciate the knowledge of the dosage of local anesthetics that can be safely administered to patients is a common problem faced by most dental practitioners. Considering that the local anesthetic is the most frequent drug that dentists administer to their patients on a routine basis, this lack of knowledge about the correct dose calculation is worrying. From the findings of this study it appears that administration of local anesthesia has become technical, rather than being a medical procedure. A questionnaire was developed in which most of the questions were designed as closed and pre - coded with all options already set, it was circulated among dental practitioners and postgraduate students. The total study population consisted of 136 dentists and post graduate students. Most of the participants had 1 - 3 years of clinical experience with 83.09% of the total population (Figure 1).

The maximum dose of 2% lidocaine with vasoconstrictor that can be administered is 4.4 mg/kg [18]. The maximum dose of Bupivacaine with vasoconstrictor that can be administered is 3 mg/kg [19]. Only 33.09% of dental practitioners were aware of this (Figure 4). Only 41.18% of dental practitioners were aware of this (Figure 3). These findings show that even though most dentists use local anesthetic routinely to perform various dental procedures, they don't give attention to the importance of the dosage used. A number of complications ranging from cardiovascular effects to vision loss can arise due to excessive administration of local anesthetics [20–23].

According to literature reports by Khalil, the maximum number of cartridges of 2% lidocaine with adrenaline that can be given to an adult healthy patient is 8 cartridges [18]. Only 16.18% of dental practitioners were aware of the total number of 2% lidocaine cartridges that can be administered (Figure 5). The remaining 84% of the study population were confused about the maximum number of cartridges that can be given. Such lack of knowledge may lead to complications when anesthetics are administered to medically compromised patients or children, since they require less doses of local anesthetics and vasoconstrictors than normal patients [24–26].

From this study, it was observed that 88.24% of dental practitioners use lidocaine in their practice (Figure 6). Lidocaine remains the most frequently used local anesthetic in most countries [4, 18]. Local anesthetic toxicity may arise due to inadvertent accidental intravascular injection of local anesthetics. Various literature authors recommend performing at least two negative aspirations before injecting local anesthetic solution [27, 28]. Findings in this study

reveals that about 74.26% of respondents aspirate for all injections (Figure 7).

Complications while administering local anesthetic is common due to careless drug delivery. Complications include both systemic and local effects [29]. It was observed that failure of anesthesia was the most common complication faced by dental practitioners with 24.26%, followed by hematoma with 21.32% (Figure 8). Local anesthetic systemic toxicity (LAST) is a life - threatening adverse event that occurs after excessive administration of local anesthetic drugs through a variety of routes [19]. It was observed from this study that about 69.85% of dental practitioners were aware of Local Anesthetic Systemic Toxicity (Figure 9).

4. Conclusion

Within limits of the study, the knowledge of dental practitioners concerning local anesthetic dosage and its dose calculations appears inadequate. Lack of knowledge about the dose can lead to dose dependent life threatening conditions like Local Anesthetic Systemic Toxicity. With recent advancements in dentistry, it is important that educational courses provide sufficient knowledge of local anesthetic dosage in order to update dental practitioners regarding the correct application of these critically important aspects in dentistry.

Acknowledgement

None

Conflict of Interest

The authors declare no conflict of interest.

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Figures

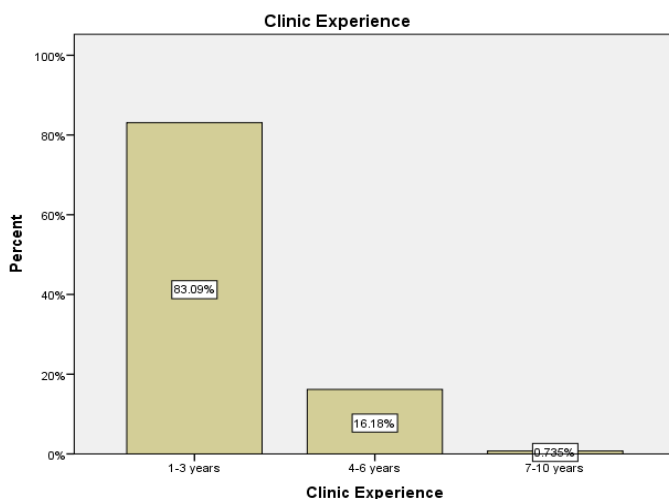


Figure 1: This bar graph depicts the percentage distribution of clinical experience of dental practitioners and postgraduate students who participated in this survey. X - axis denotes the years of experience and Y - axis represents the percentage distribution. Most of the participants had 1 - 3 years of experience with 83.09% of the total population.

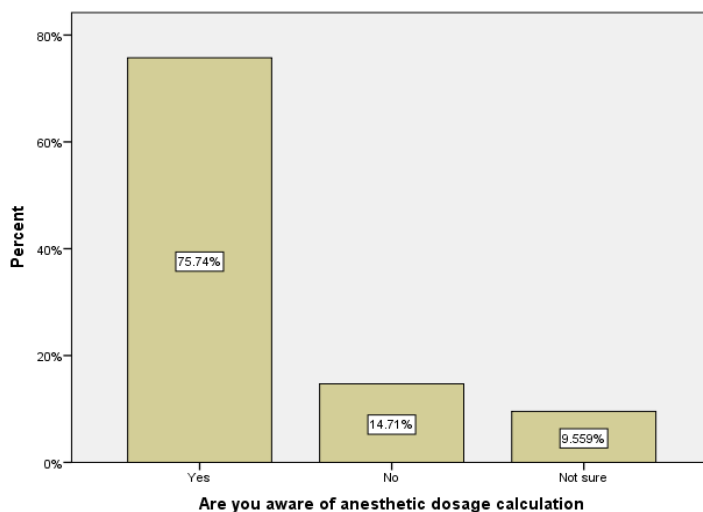


Figure 2: This bar graph depicts the awareness of dosage calculation of local anesthetic among dental practitioners and postgraduate students. X - axis denotes the response to question “Are you aware of local anesthetic dosage calculation?”, Y - axis represents the percentage distribution. About 75.74% of the total population were aware of local anesthetic dosage calculation.

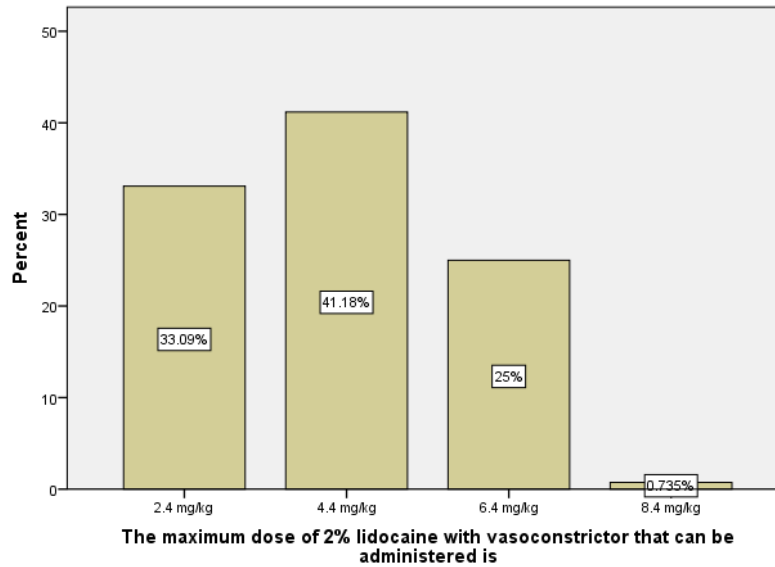


Figure 3: This bar graph depicts the awareness of maximum dosage of 2% lidocaine with adrenaline among dental practitioners and postgraduate students. X - axis denotes the response to question “The maximum dose of 2% lidocaine with vasoconstrictor that can be administered is”, Y - axis represents the percentage distribution. The maximum dose of 2% lidocaine with vasoconstrictor that can be administered is 4.4 mg/kg. Only 41.18% of dental practitioners were aware of this.

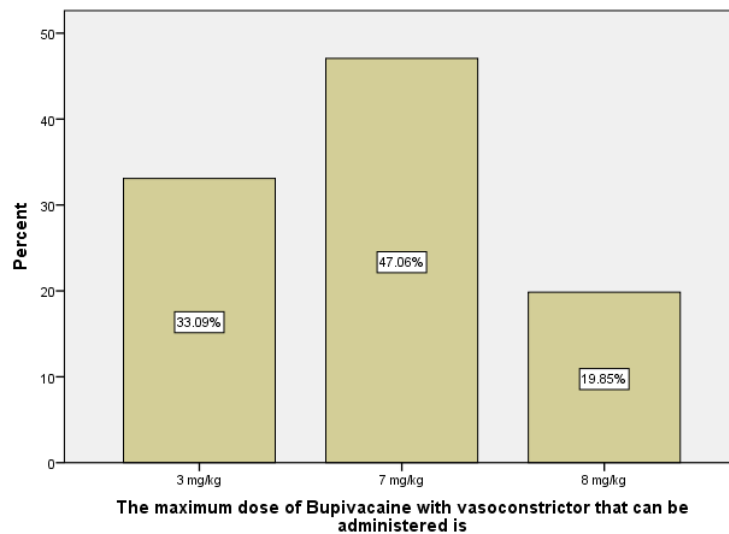


Figure 4: This bar graph depicts the awareness of dosage of local anesthetic among dental practitioners and postgraduate students. X - axis denotes the response to question “The maximum dose bupivacaine with vasoconstrictor that can be administered is”, Y - axis represents the percentage distribution. The maximum dose of Bupivacaine with vasoconstrictor that can be administered is 3 mg/kg. Only 33.09% of dental practitioners were aware of this.

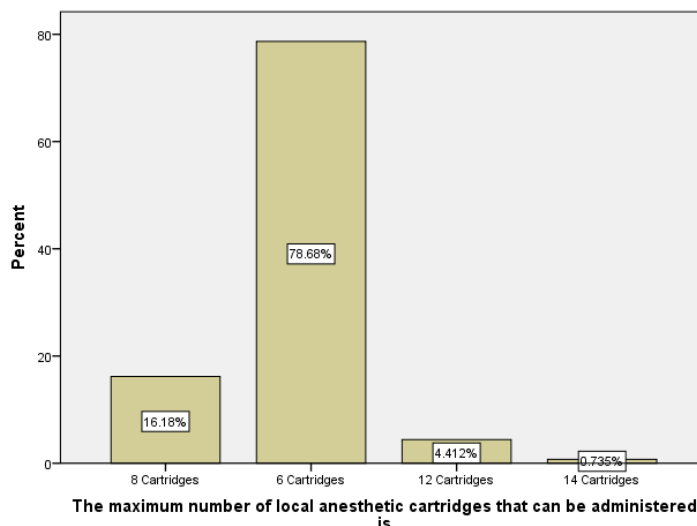


Figure 5: This bar graph depicts the awareness of the maximum number of 2% lidocaine with adrenaline cartridges that can be administered among dental practitioners and postgraduate students. X - axis denotes the response to question “the maximum number of 2% lidocaine with adrenaline cartridges that can be administered is”, Y - axis represents the percentage distribution. Only 16.18% of dental practitioners were aware of this.

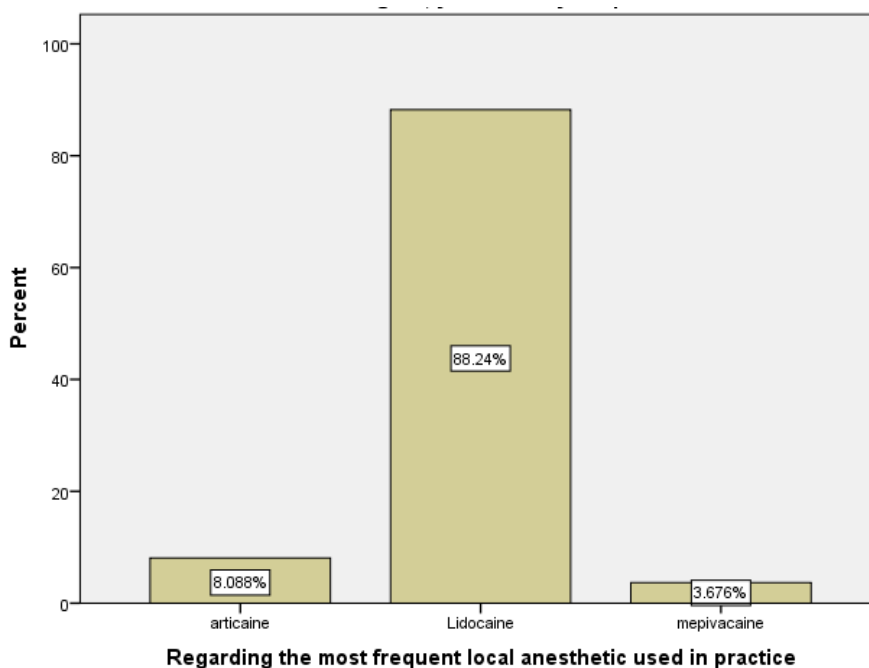


Figure 6: In this bar graph X - axis denotes the response to question regarding the most frequent local anesthetic used in their practice, Y - axis represents the percentage distribution. About 88.24% of dental practitioners use lidocaine in their practice.

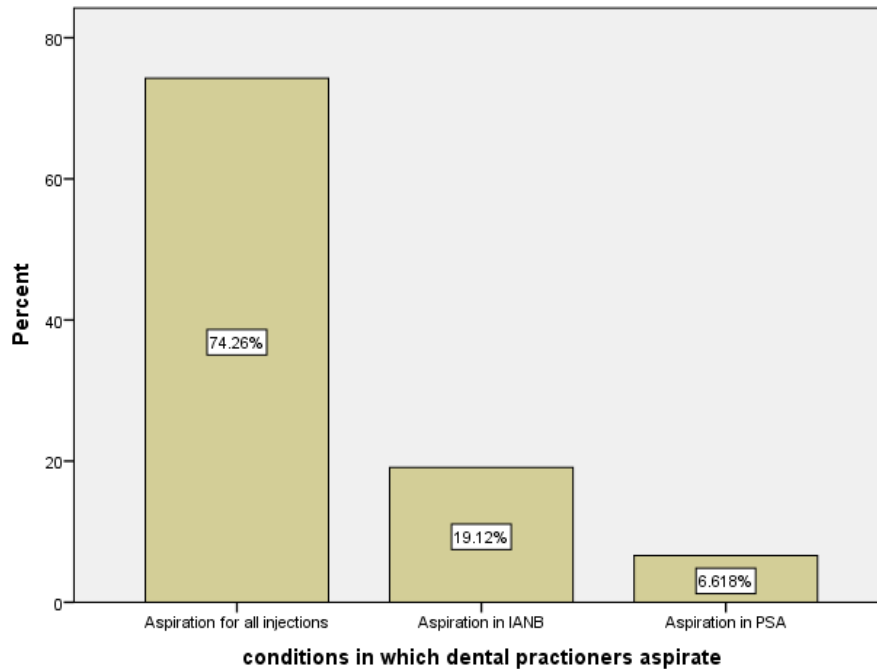


Figure 7: This bar graph represents the conditions in which dental practitioners and postgraduate students aspirate. X - axis denotes the response to questions regarding the conditions in which dental practitioners and postgraduate students aspirate, Y - axis represents the percentage distribution. About 74.26% of respondents aspirate for all injections.

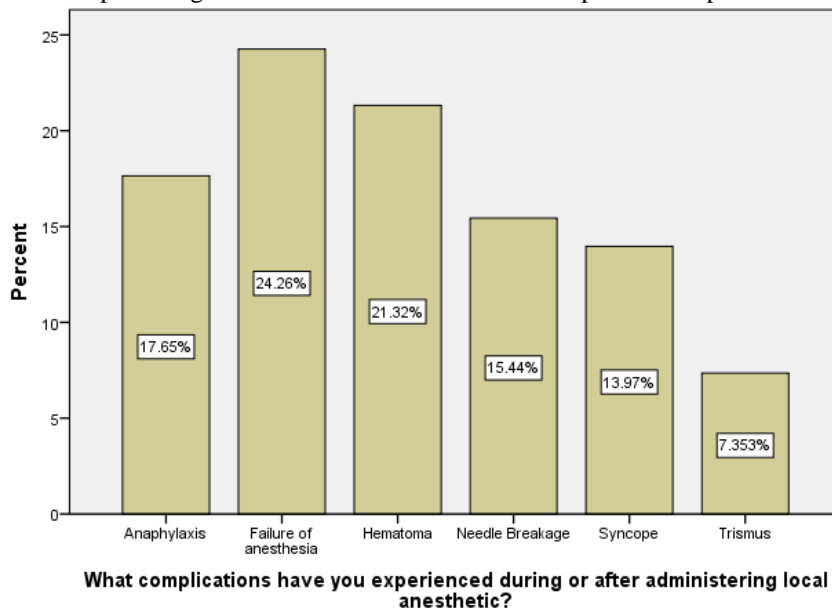
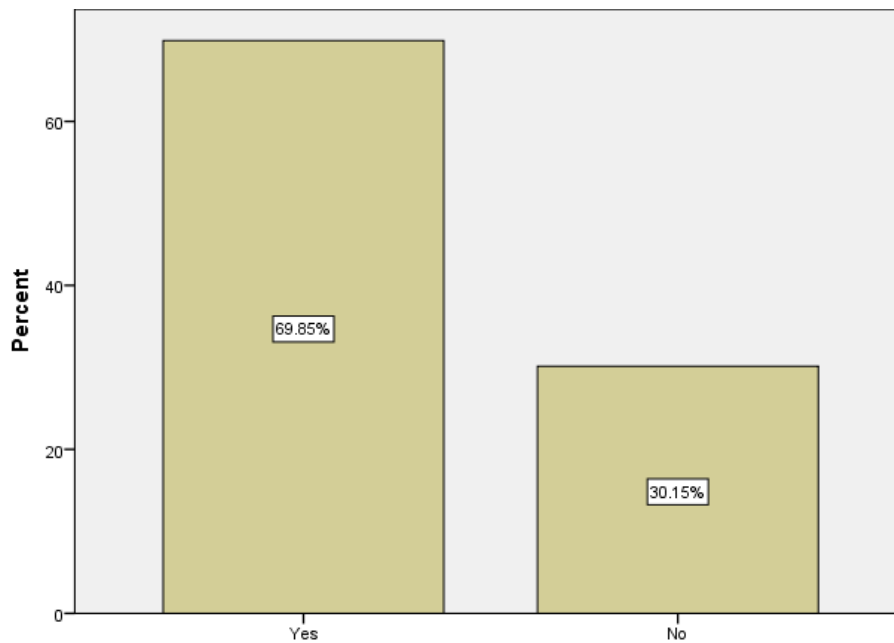


Figure 8: This bar graph depicts the complications encountered by dental practitioners and postgraduate students. X - axis denotes the response to question “What complications have you experienced during or after administering local anesthetic?”, Y - axis represents the percentage distribution. Failure of anesthesia was the most common complication faced by dental practitioners with 24.26%, which was followed by hematoma.



Are you aware of Local Anesthetic Systemic Toxicity?

Figure 9: This bar graph depicts the awareness of local anesthetic systemic toxicity (LAST) among dental practitioners and postgraduate students. X - axis denotes the response to question “Are you aware of Local Anesthetic Systemic Toxicity ?”, Y - axis represents the percentage distribution. About 69.85% of the total population were aware of Local Anesthetic Systemic Toxicity.