

# Knowledge and safe use of local anesthetics by medical interns in Medellín, Colombia

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## Abstract

*Local anesthetics are used daily in diagnostic and therapeutic procedures; therefore, their unsafe use must be prevented through medical education to avoid adverse effects resulting from their application. **Objectives:** To describe the knowledge and practices related to the safe use of local anesthetics among final-year medical students in Medellín. **Materials and methods:** A descriptive, cross-sectional, observational study was conducted using non-probability sampling. Two hundred adult medical students in their final year of undergraduate studies enrolled at universities in Medellín were surveyed. Students who indicated they had not taken an anesthesiology course or who did not provide informed consent were excluded. Sociodemographic variables, variables related to the education received regarding the safe use of local anesthetics, and the frequency of applying preventive practices when administering them were evaluated. **Results:** 88% of respondents reported having received education related to the safe use of local anesthetics. Lidocaine was the most frequently used anesthetic among respondents (94.5%). A majority of students were unaware of the maximum safe dose of lidocaine. 51% of respondents almost never or never calculated the maximum safe dose before administering a local anesthetic, 45% almost never or never monitored vital signs, and 27% almost never or never administered the anesthetic in the presence of an instructor. 75% of respondents did not feel prepared to manage local anesthetic toxicity. **Conclusion:** The surveyed students perceived that they did not have optimal*

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*training in the safe use of local anesthetics and did not apply preventive strategies to reduce risks when administering these drugs.*

**Keywords:** *local anesthetics, use of Medications, knowledge, safety, medical students, primary prevention.*

### **Conocimiento y uso seguro de anestésicos locales por internos de medicina en Medellín, Colombia**

#### **Resumen**

*Los anestésicos locales son utilizados diariamente en procesos diagnósticos y terapéuticos, por lo que su uso inseguro debe prevenirse desde la educación médica, con el fin de evitar efectos adversos derivados de su aplicación. **Objetivos:** describir los conocimientos y prácticas relacionadas con el uso seguro de anestésicos locales que poseen los estudiantes de medicina de último año en Medellín. **Materiales y métodos:** estudio observacional, descriptivo y transversal en el que se aplicó un muestreo no probabilístico, encuestando a 200 estudiantes mayores de edad, que se encontraban en el último año del pregrado de medicina y que estuvieran matriculados en universidades de Medellín. Se excluyeron estudiantes que indicaron no haber cursado la asignatura de anestesiología y que no brindaron su consentimiento informado. Se evaluaron variables sociodemográficas, variables relacionadas con la educación recibida frente al uso seguro de anestésicos locales y la frecuencia de aplicación de prácticas preventivas al administrarlos. **Resultados:** el 88% de los encuestados aseguraron haber recibido educación relacionada con el uso seguro de anestésicos locales. La lidocaína fue el anestésico más utilizado por los encuestados, con un 94.5%. Predominaron los estudiantes que desconocían la dosis máxima segura de la lidocaína. El 51% de los encuestados casi nunca o nunca calculaban la dosis máxima segura antes de administrar un anestésico local; el 45% casi nunca o nunca realizaba monitorización de signos vitales y el 27% casi nunca o nunca realizaba la administración en compañía de un docente. El 75% de los encuestados no se sentían preparados para manejar una intoxicación por anestésicos locales. **Conclusión:** Los estudiantes encuestados percibían que no contaban con una formación óptima en el uso seguro de anestésicos locales y no aplicaban estrategias preventivas que disminuyeran los riesgos al administrar estos fármacos.*

**Palabras claves:** *anestésicos locales, utilización de medicamentos, conocimiento, seguridad, estudiantes de medicina, prevención primaria.*

### **Conhecimento e uso seguro de anestésicos locais por estagiários de medicina em Medellín, Colômbia**

#### **Resumo**

*Anestésicos locais são utilizados diariamente em procedimentos diagnósticos e terapêuticos; portanto, seu uso inseguro deve ser prevenido por meio da educação médica para evitar efeitos adversos decorrentes de sua aplicação. **Objetivos:** Descrever o*

*conhecimento e as práticas relacionadas ao uso seguro de anestésicos locais entre estudantes de medicina do último ano em Medellín. **Materiais e métodos:** Foi realizado um estudo observacional, transversal e descritivo, utilizando amostragem não probabilística. Duzentos estudantes de medicina adultos, cursando o último ano da graduação em universidades de Medellín, foram entrevistados. Foram excluídos os estudantes que indicaram não ter cursado anestesiologia ou que não forneceram o consentimento livre e esclarecido. Foram avaliadas variáveis sociodemográficas, variáveis relacionadas à educação recebida sobre o uso seguro de anestésicos locais e a frequência de aplicação de práticas preventivas na administração dos mesmos. **Resultados:** 88% dos participantes relataram ter recebido treinamento sobre o uso seguro de anestésicos locais. A lidocaína foi o anestésico mais frequentemente utilizado (94,5%). A maioria dos estudantes desconhecia a dose máxima segura de lidocaína. 51% dos participantes quase nunca ou nunca calcularam a dose máxima segura antes de administrar um anestésico local, 45% quase nunca ou nunca monitoraram os sinais vitais e 27% quase nunca ou nunca administraram o anestésico na presença de um instrutor. 75% dos participantes não se sentiram preparados para lidar com a toxicidade de anestésicos locais. **Conclusão:** Os estudantes entrevistados perceberam que não receberam treinamento adequado sobre o uso seguro de anestésicos locais e não aplicaram estratégias preventivas para reduzir os riscos ao administrar esses medicamentos.*

**Palavras-chave:** *anestésicos locais, uso de medicamentos, conhecimento, segurança, estudantes de medicina, prevenção primária*

## Introduction

Local anaesthetics are a pharmacological group that temporarily blocks nerve impulses by blocking voltage-dependent sodium channels. This effect on the cell membrane causes a loss of sensory, motor, and autonomic function. This is exploited daily in multiple diagnostic and therapeutic procedures. [1,2]

The continued use of these drugs means that healthcare professionals must have the necessary knowledge and practical skills to ensure patient safety when administering them, avoiding the effects of systemic intoxication. [3,4]

Although a high prevalence of local anaesthetic toxicity has not been reported, research indicates that for every 10,000 peripheral nerve blocks, there are approximately 7.5 to 20 episodes of local anaesthetic toxicity. Similarly, researchers have reported an approximate rate of four events per 10,000 epidural blocks. [1]

Among the main causes of local anaesthetic toxicity are intravenous administration, administration of doses above the safety range, increased absorption of the anaesthetic into the administered tissue, and accumulation of the metabolite. [1, 5]

The central nervous system and cardiovascular system will be the most affected after the onset of local anaesthetic intoxication, with mild symptoms occurring early on, known as premonitory symptoms, including dizziness, dysarthria, tinnitus, phosphenes, oral paraesthesia, metallic taste, disorientation, and drowsiness, to moderate and severe symptoms such as convulsions, apnoea, altered consciousness, respiratory depression, cardiac arrhythmias, hypotension, and death. [6, 7]

The World Health Organisation (WHO) defines health prevention as a set of “measures aimed not only at preventing the onset of disease, such as reducing risk factors, but also at

halting its progress and mitigating its consequences once it has taken hold". [8]

There are multiple preventive strategies that must be known and applied in order to ensure the safe use of a medicine, including knowledge of the maximum permitted dose for each pharmacological presentation, the application of the lowest effective dose, fractionated administration, aspiration of needles and catheters prior to administration, and continuous monitoring of vital signs [9].

Bearing in mind the importance of health-care professionals using local anaesthetics safely through knowledge and application of the aforementioned strategies, it is considered appropriate to evaluate the context in which this takes place among students, given that in a country such as Colombia, medical students will have the opportunity to participate actively in patient care, using this pharmacological group during their practical rotations.

Thus, the present study aims to describe the knowledge and practices related to the safe use of local anaesthetics among final-year medical students in Medellín.

## Materials and methods

A descriptive cross-sectional observational study was conducted from September 2022 to October 2023. A digital survey was administered to medical students who met the inclusion criteria, covering students of legal age who were in their final year of undergraduate medical training and studying at a university located in the city of Medellín, Colombia. Exclusion criteria included students who stated that they had not taken the anaesthesiology course and those who did not provide their informed consent.

Respondents were selected using non-probabilistic snowball sampling to subsequently assess sociodemographic characteristics, knowledge related to local anaesthetics, their safe administration, the application of preventive strategies against local anaesthetic intoxi-

cation, and their self-perception of their ability to manage local anaesthetic intoxication.

Among the sociodemographic variables of the respondents, the variable of gender (biological condition) was studied so that students could choose between male, female, and prefer not to say. Subsequently, to assess their age and the university to which they belonged, they were given the option to respond openly.

Student satisfaction with the education received during their training in the field of anaesthesiology was assessed, with a choice of yes or no options. Students were asked whether they had received education on the safe use of local anaesthetics, with a choice of yes or no answers.

Each student was asked whether they had ever administered local anaesthetics during their training, with a choice of yes or no answers. Students were then asked to indicate which local anaesthetic they had used most during their training, allowing them to give an open-ended response so that the data collected could subsequently be categorised.

Given the importance of knowing the maximum safe dose of a drug to prevent toxicity, students were asked to indicate the maximum dose of lidocaine with epinephrine and without epinephrine, with the option of a free response. The data collected was then categorised, with a low knowledge category assigned when less than 25% of respondents knew the answer, a low intermediate knowledge category for 26%-49%, a high intermediate category when 50-74% of the population knew the answer, and a high category if more than 75% of the population demonstrated knowledge.

Students were asked how often they applied preventive strategies in relation to local anaesthetic toxicity, giving them the options of always, most of the time, almost never, and never. Preventive strategies included methods such as calculating the maximum safe dose for each patient, monitoring vital signs before and during

drug administration, aspirating with the syringe prior to administration, and administering the anaesthetic under the supervision of a teacher.

The students' self-perception of their ability to manage local anaesthetic intoxication was assessed, giving them the option to choose between yes or no.

Finally, the information was analysed and processed using Epidat and Excel software. The variables were expressed in terms of measures of central tendency, absolute frequencies and relative frequencies.

## Results

When evaluating sociodemographic characteristics, it was found that 40.5% (n=81) of the population were men, 59% (n=118) were women, and 0.5% (n=1) preferred not to provide information about their biological condition. The average age of the population was 23.5 years.

During this research, a total of 200 medical students enrolled at five universities located in the city of Medellín were surveyed, including CES University 28.5% (n=57), Pontificia Bolivariana University 22% (n=44), Cooperativa de Colombia University 20% (n=40), the University of Antioquia 15% (n=30), and Remington University 14.5% (n=29).

72% of respondents reported feeling satisfied with the education they had received in the field of anaesthesiology during their training, while 28% of students reported feeling dissatisfied. 88% (n=176) of respondents reported having received training related to the safe use of local anaesthetics during their education.

One hundred per cent of students reported having administered local anaesthetics in a therapeutic or diagnostic setting during their training.

Students indicated that lidocaine was the anaesthetic they used most, with 94.5% (n=189), followed by 5% (n=10), who stated that the anaesthetic they used most was bupivacaine, and 0.5% (n=1), who reported that the anaesthetic they used most was midazolam, a drug that is not part of this pharmacological group. Subsequently, they were asked about their knowledge of the maximum dose that guarantees safe administration of lidocaine. (Table 1)

**Table 1. Knowledge of the maximum and safe dose of lidocaine**

Lidocaine without epinephrine		Lidocaine with epinephrine	
Dose mg/kg	%	Dose mg/kg	%
I don't remember.	52.5% (n=105)	I don't remember.	43.5% (n=87)
3 mg/kg	5% (n=10)	4 mg/kg	4% (n=8)
4 mg/kg	4.5% (n=9)	4.5 mg/kg	2.5% (n=5)
4.5 mg/kg	8% (n=16)	5 mg/kg	28% (n=56)
5 mg/kg	30% (n=60)	7 mg/kg	22% (n=44)

Thirty-eight per cent of respondents knew the maximum dose of lidocaine without epinephrine (4.5 mg/kg to 5 mg/kg), representing low intermediate knowledge, and 22% of respondents knew the maximum dose of lidocaine with epinephrine, which, when categorising the data, represented low knowledge.

The frequency with which respondents implemented strategies to prevent local anaesthetic toxicity during administration was studied, revealing that syringe aspiration prior to anaesthetic administration was the strategy most commonly used by students, while the least commonly used action was calculating the maximum dose indicated for each patient. (Table 2)

**Table 2. Application of preventive measures during the administration of local anaesthetics**

Preventive strategies	Never % = (n)	Almost never % = (n)	Most of the time % = (n)	Always % = (n)
Calculate the maximum safe dose for each patient.	9% (n=18)	42% (n=84)	32% (n=64)	17% (n=34)
Monitoring vital signs before and during the administration of local anaesthetics	8% (n=16)	37% (n=74)	24% (n=48)	31% (n=62)
Aspiration of the syringe prior to administration of the anaesthetic	0.5% (n=1)	4.5% (n=9)	9% (n=18)	86% (n=172)
Administer the anaesthetic in the presence of a teacher.	3.5% (n=7)	23.5% (n=47)	41% (n=82)	32% (n=64)

Finally, 75% of respondents considered that they were not prepared to manage local anaesthetic intoxication.

## Discussion

The participation of healthcare professionals in training, in diagnostic or therapeutic processes, allows medical students to strengthen their practical and theoretical knowledge, thus impacting the quality of the services they will provide in the future. However, it will be vitally important to ensure the optimal conditions required for trainees to benefit from training tools, without neglecting patient safety.

Studies [10-12] conducted in Latin America have highlighted the need to strengthen medical education focused on the use of local anaesthetics, based on the suboptimal level of knowledge reported among students.

Researchers in Peru assessed the level of knowledge of medical students regarding accidents and complications arising from local anaesthetics. The study reported that the respon-

dents' level of knowledge was average [10]. This need to reinforce education on local anaesthetics at the undergraduate level was also evident in the results of the present study, in which 12% of the students surveyed indicated that they had not received training related to the safe use of local anaesthetics during their training.

Knowledge of the maximum dose of a drug reduces the risks of its application. In the case of the maximum dose of lidocaine, the values vary in the literature, with a maximum dose of lidocaine without epinephrine of 4.5 mg/kg - 5 mg/kg and with epinephrine of up to 7 mg/kg being accepted as a general measure [6,12]. Thus, it was found that the students surveyed had low knowledge of the dosage of lidocaine with epinephrine and low-intermediate knowledge of the dosage of lidocaine without epinephrine when applying the categorisation in which knowledge in more than 75% of the population represented superior knowledge, 50%-74% high-intermediate, 26%-49% as low intermediate, and less than 25% as low.

In the city of Quito, Ecuador, the knowledge of local anaesthetics among anaesthesiologists was evaluated in comparison to anaesthesiology residents, concluding that "there is a deficit of knowledge in basic pharmacology regarding local anaesthetics". Meanwhile, in Arequipa, Peru, during a study in which dental students were surveyed, 89% of the students surveyed reported having a low level of knowledge regarding the dosage of local anaesthetics [13]. This is consistent with the results of the present study, in which the majority of students were unaware of the maximum dose of lidocaine.

In the present study, it was reported that 100% of the students surveyed had administered a local anaesthetic at some point during their training. In turn, it was identified that the anaesthetic most used by the students surveyed was lidocaine, with 94.5% (n=189), coinciding with data collected by Colombian authors who, during a systematic review evaluating the use of local anaesthetics in emergency services,

identified lidocaine as the most frequently administered local anaesthetic. [14]

In order to ensure the safe administration of local anaesthetics by students, it is vitally important that they are aware of and apply practices that reduce the potential risks associated with their use. Among the preventive strategies reported in the literature that seek to avoid local anaesthetic toxicity are syringe aspiration prior to local anaesthetic administration, close patient monitoring, appropriate selection of the drug to be administered, and accurate dosage calculation, among other practices [1,6,9]. When evaluating the frequency with which these practices were carried out among the respondents, it was found that they were not rigorously applied, increasing the risk in the care provided to their patients.

It is hoped that the results described above will have a positive impact on medical education, with the aim of strengthening the preparation of medical students in the safe administration of local anaesthetics. In turn, it is hoped that this will contribute to the field of medical research by providing useful information for future scientific studies.

## Conclusion

The students surveyed felt that they did not have adequate training in the safe use of local

anaesthetics and did not apply preventive strategies to reduce the risks when administering these drugs.

**Study limitations:** This research described medical students' knowledge and application of preventive practices based on their self-perception, so an objective measurement of this data was not achieved. Similarly, there is the limitation of having applied a non-probabilistic sampling, so it is not possible to make statistical inferences for population purposes.

**Ethical considerations:** In this research, respect for the dignity of the participants was ensured based on the principles established in Resolution 008430 of 1993, the Declaration of Helsinki, and Ezekiel Emanuel's ethical principles in human research.

**Conflicts of interest:** The authors declare that they had no conflicts of interest during this research.

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