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RESEARCH ARTICLE

Awareness of Pulmonologists who Administer Local Anesthetics in Bronchoscopy Routine About Local Anesthetic Toxicity and Its Treatment: A Survey Study

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ABSTRACT

Objectives: The present study aims to evaluate the knowledge and awareness levels of pulmonologists regarding local anesthetic (LA) toxicity and the use of intravenous lipid therapy.

Methods: This study included research assistants, specialists, and faculty members working in the field of chest diseases in Türkiye, who agreed to participate. A survey consisting of 16 questions was prepared to assess physicians' knowledge regarding local anesthetic toxicity and the use of intravenous lipid therapy for its treatment. The survey was used to obtain participants' general knowledge of local anesthetic drugs, their toxicities, and general knowledge of toxicity treatment.

Results: A total of 109 physicians participated in this study. The highest participation was received from university hospitals (49.5%), and 47.7% of the participants had been working in this specialty for over 10 years. Lidocaine was the most commonly used agent (94.5%). Allergy (23.85%) and arrhythmia (21.1%) among the early signs of toxicity, and hepatotoxicity (34.86%) and cardiac arrest (33.94%) among the late signs, were frequently selected. While 21.1% of the physicians encountered toxicity, symptomatic treatment (54.13%) was the most frequently chosen method upon encountering toxicity. It was found that 57.8% of the physicians had not heard of lipid therapy for toxicity, and 6.4% used lipid therapy when encountering toxicity. Significant differences were found in the knowledge about treatment application among physicians by their roles in pulmonary clinics (p=0.00).

Conclusion: This study revealed a consistent lack of education and awareness among pulmonologists regarding local anesthetic toxicity and its treatment.

Keywords: Bronchoscopy, chest diseases, intravenous lipid therapy, local anesthetic systemic toxicity

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Introduction

Bronchoscopy is one of the procedures most frequently performed by pulmonologists. Diagnostic bronchoscopy plays an important role in assessing conditions such as pulmonary infections, malignancies, foreign body aspiration, and interstitial lung diseases.[1] On the other hand, therapeutic bronchoscopy is used for procedures such as relieving airway obstructions, removing foreign bodies, and controlling localized bleeding.[2] Bronchoscopy can be performed using either a flexible or rigid bronchoscope, and each method has its specific advantages and disadvantages. Flexible bronchoscopy is more commonly preferred due to its less invasive nature and the ability to perform it under sedation, whereas rigid bronchoscopy is typically conducted under general anesthesia and provides a larger working field.[3] These procedures are safely and effectively carried out under local anesthesia. However, a rare but serious complication that can occur during procedures involving local anesthetics is

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local anesthetic systemic toxicity (LAST). LAST manifests through neurological and cardiovascular symptoms, including seizures, arrhythmias, and cardiac arrest. Factors such as the type of local anesthetic, dosage, volume, method, and site of administration, and the patient's concomitant diseases play an important role in toxicity.[4] The incidence of LAST is low; even in extensive studies on ultrasound-guided nerve blocks, it has been observed in only 0.027% of the total procedures.[5] However, its impact can be severe, necessitating prompt diagnosis and intervention. The primary treatment for LAST includes oxygenation, ventilation, and advanced cardiovascular life support. Recent guidelines also emphasize the use of lipid emulsion therapy at the first sign of severe systemic toxicity, and this treatment has been demonstrated to be effective in reversing toxicity caused by local anesthetics.[6] Despite the existence of treatment protocols, there is a significant gap in knowledge and training among healthcare providers regarding the management of LAST. Many physicians lack adequate training in recognizing and managing LAST, and many are unaware of the specific guidelines for lipid emulsion therapy.[7] This gap can lead to suboptimal patient care outcomes, highlighting the need for enhanced educational programs and training initiatives to better equip physicians. Given the frequent use of procedures with local anesthetics in pulmonary clinics, this study aims to evaluate the knowledge and awareness of pulmonologists regarding local anesthesia toxicity and the use of intravenous lipid therapy.

Methods

Study Design

This study was conducted after obtaining approval from the local ethics committee (Session no: 2020/5, Decree no: 26). The present study included residents, specialists, and faculty physicians working in the pulmonology field in Türkiye who agreed to participate. A questionnaire consisting of 16 questions was prepared to assess physicians' knowledge about local anesthetic toxicity and the intravenous lipid therapy used in its treatment. The survey was completed in approximately 4–5 minutes. After obtaining verbal consent from the participants, the questionnaire was administered via face-to-face interviews, telephone, or email. The questions were sent to participants electronically through the link https://docs.google.com/forms/d/15qNcNEZ5TXneolj1TPm9k2h0LLi1-m9YVrxRjXMMRRo/edit. The questionnaire inquired about the participants' demographic characteristics, general knowledge about local anesthetic drugs and their toxicities, and general knowledge about toxicity treatment. The survey questions were prepared by making use of the studies carried out by Urfalıoğlu et al.[8] and Karasu et al.[9].

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) (IBM SPSS Statistics for iOS, Version 25, IBM Corporation, Armonk, NY) software was used in all statistical analyses. Percentage (%) and number (n) parameters were utilized for the statistical representation of categorical variables, whereas mean±standard deviation parameters were used for numerical variables. The significance level was set at $p<0.05$.

Results

The mean age of the participating physicians was found to be 37.62 (±9.49) years. Considering the institutional affiliation, 21.1% of the physicians were working in state hospitals, 21.1% in training and research hospitals, 8.3% in private hospitals, and 49.5% in university hospitals. Examining their positions, it was determined that 37.6% were resident physicians, 41.3% were specialist physicians, and 21.1% were faculty members. The distribution by the years of experience showed that 22% had 0–2 years, 19.2% had 2–5 years, 11.1% had 5–10 years, and 47.7% had more than 10 years of experience. Examining the frequency of performing bronchoscopy, it was found that 42.2% of the physicians performed it 0–5 times per month, 24.8% performed it 5–10 times per month, 24.8% performed it more than 10 times per month, and 8.2% never performed bronchoscopy. Nearly all the physicians (99.9%) used local anesthetics during bronchoscopy, while only 0.9% did not use them. Considering the methods of local anesthetic administration, the results showed that 11.9% of participants used a nebulizer and 88.1% used a spray. Regarding the type of local anesthetic used, 5.5% used benzocaine and 94.5% used lidocaine (Table 1).

The proportion of physicians who received training on the use of local anesthesia was 31.2%, that of those who could not recall their training status was 10.1%, and that of those who had not received any training was 58.7%. Additionally, only 8.3% used a test dose for local anesthesia, while 90.8% did not. The incidence of encountering local anesthetic systemic toxicity (LAST) was 21.1%, with 6.4% not encountering it, and 72.5% not recalling if they had encountered it (Table 2).

The early signs of local anesthetic toxicity reported included allergy (23.85%), arrhythmia (21.1%), hypotension (18.35%), anaphylaxis (16.51%), metallic taste (16.51%), tinnitus (11.93%), and other symptoms (7.34%). The late signs reported were hepatotoxicity (34.86%), cardiac arrest (33.94%), ischemia (30.28%), loss of consciousness (26.61%), infection (10.09%), and other symptoms (8.26%). For the treatment of toxicity, 54.13% of the physicians indicated symptomatic treatment, 22.94% indicated lipid emulsion therapy, 19.27% indicated antihistamine treatment, 17.43% indicated cardiopulmonary resuscitation, and 11.93% indicated the

Table 1. Demographic data of the survey participants and their responses regarding local anesthetic use

	n	%
Age (years)	37.62±9.491	
Place of employment		
State hospital	23	21.1
Education and Research Hospital	23	21.1
Private hospital	9	8.3
University hospital	54	49.5
Current position		
Physician assistant	41	37.6
Specialist doctor	45	41.3
Faculty member	23	21.1
Working time		
0-2 year	24	22
2-5 year	21	19.2
5-10 year	12	11.1
> 10 year	52	47.7
Frequency of performing bronchoscopy		
0-5 times per month	46	42.2
5-10 times per month	27	24.8
>10 times per month	27	24.8
None	9	8.2
Use of local anesthetic during bronchoscopy		
Yes	108	99.9
No	1	0.9
Local anesthetic route of administration in bronchoscopy		
Nebul	13	11.9
Spray	96	88.1
The most common type of local anesthetic you use in bronchoscopy		
Benzocaine	6	5.5
Lidocaine	103	94.5

use of methylene blue. Preventive measures against toxicity included monitoring (83%), using an appropriate dose (75%), intermittent administration (41%), test dose with adrenaline (13%), and aspiration (6%). Only 6.4% of the physicians knew how to administer and use lipid therapy, 12% had read scientific articles about lipid therapy in toxicity, 24.8% had heard about lipid therapy but could not recall the details, and 57.8% had never heard anything about the therapy. The proportion of physicians who encountered LAST and applied lipid therapy was 6.4%, whereas 12.8% used other treatments (Table 3). Significant differences were found in the knowledge of treatment applications among physicians based on their positions in pulmonary clinics; none of the resident physicians had read scientific articles about lipid therapy, whereas five specialist physicians and seven faculty members had read such articles (p=0.000) (Table 4).

Discussion

This study evaluated the knowledge of physicians working in the field of chest diseases in Türkiye regarding local anesthetic toxicity and intravenous lipid therapy. The vast majority of the participating physicians (99.9%) used local anesthetics during bronchoscopy. However, the study revealed a consistent lack of training and awareness regarding local anesthetic toxicity and its treatment. This finding is supported by the literature, as numerous studies have indicated that physicians do not have sufficient knowledge about LAST and that training in this area is inadequate.[10]

Almost all the physicians participating in this study reported using local anesthetics, typically in spray form (88.1%), during bronchoscopy procedures. The use of local anesthetics in bronchoscopy not only increases patient comfort but also suppresses undesirable reflexes such as coughing, thereby improving the success of the procedure.[11] Among the types of local anesthetics used, 94.5% of participants preferred lidocaine over benzocaine. According to the literature, the local anesthetics that can be used in bronchoscopy include lidocaine, benzocaine, tetracaine, and cocaine.[12] Lidocaine is considered the most commonly used, highly effective, and safe anesthetic during bronchoscopy.[11] Cocaine is preferred less due to its side effects and potential toxicity.[13] The use of benzocaine

Table 2. Participants' knowledge about local anesthetic applications

Questions	Answers	n	%
Have you received training on local anesthesia?	Yes	34	31.2
	I don't remember	11	10.1
	No	64	58.7
Do you use a test dose when administering local anesthesia?	Yes	9	8.3
	No	99	90.8
	Unanswered	1	0.9
Have you ever encountered local anesthetic toxicity?	Yes	23	21.1
	No	7	6.4
	I don't remember	79	72.5

Table 3. Participants' knowledge about local anesthetic toxicity

Questions	Answers	n	%
What are the early signs of local anesthetic toxicity?	Allergy	26	23.85
	Arrhythmia	23	21.10
	Hypotension	20	18.35
	Anaphylaxis	18	16.51
	Metallic taste on the tongue	18	16.51
	Tinnitus	13	11.93
	Other	8	7.34
What are the late manifestations of local anesthetic toxicity?	Hepatotoxicity	38	34.86
	Cardiac arrest	37	33.94
	Ischemia	33	30.28
	Loss of consciousness	29	26.61
	Infection	11	10.09
	Other	9	8.26
What is done in the treatment of toxicity?(More than one option can be selected)	Symptomatic treatment	59	54.13
	20% lipid solution	25	22.94
	Antihistamine treatment	21	19.27
	Cardiopulmonary resuscitation	19	17.43
	Methylene blue	13	11.93
What measures do you take to prevent toxicity? (You can select more than one option)	Monitoring	83	76.15
	Appropriate dosing	75	68.81
	Intermittent application	41	37.61
	Test dose with adrenaline	13	11.93
	Aspiration	6	5.5
What are your thoughts on the use of lipids in the treatment of toxicity?	I read a scientific article	12	11
	I heard about it but I don't remember the details	27	24.8
	Never heard of it	63	57.8
	I know its use and application	7	6.4
Have you used lipid therapy for toxicity?	I applied other treatment I encountered	14	12.8
	I have used lipid therapy	7	6.4
	I did not encounter toxicity	88	80.8

Table 4. Difference analysis of participants' knowledge about lipid therapy application

	Physician assistant (n=41)	Faculty member (n=23)	Specialist doctor (n=45)	Test value	p
I read scientific writing	0	7	5	x^2=30.066	0.000*
I heard about it but I don't remember the details	14	7	6		
Never heard of it	27	5	31		
I know its use and application	0	4	3		

Chi-square test; *: Statistically significance p<0.05.

as a local anesthetic can lead to methemoglobinemia, which reduces hemoglobin's oxygen-carrying capacity and can cause severe hypoxia.[14] A case study reported severe methemoglobinemia in a patient following the use of benzocaine, characterized by a drop in oxygen saturation to 85% and pronounced cyanosis during bronchoscopy.[15] The use of a test dose is important in local anesthetic administrations, particularly to reduce the risk of toxicity and to preemptively identify potential reactions to the drug. However, in this study, only 8.3% of the physicians used a test dose for local anesthesia during bronchoscopy. The administration of local anesthetics via intravascular

or intrathecal routes can lead to serious toxic reactions.[16] Additionally, high-dose injections over large areas can result in the systemic circulation of local anesthetics and subsequent toxicity.[17] Although there is no direct intravascular injection of local anesthetics during bronchoscopy, practitioners may not perceive the need for a test dose; however, caution regarding the dose applied in topical applications is essential due to the risk of Local Anesthetic Systemic Toxicity (LAST). The incidence of LAST among the survey participants was 21.1%, which is quite high when compared to the literature.

There are no definitive diagnostic criteria for local anesthetic toxicity. Knowledge of both early and late clinical symptoms is required to recognize it. Early symptoms include dizziness, confusion, tinnitus, perioral numbness, visual disturbances, allergy-anaphylaxis, seizures, tachycardia, hypotension, and arrhythmias. Late symptoms can involve hepatotoxicity, loss of consciousness, atrioventricular blocks, and progression to cardiac arrest.[18] LAST typically manifests rapidly with intravascular injection but can also present later due to absorption by the contacted tissues.[19] In procedures where local anesthetics are applied topically, such as bronchoscopy, close and monitored post-procedure follow-up of patients is very important for detecting late-onset toxicity symptoms. The symptoms mentioned above should be carefully monitored and promptly addressed.

The findings of this study are consistent with symptoms reported in the literature. Common early symptoms observed include allergies (23.85%), arrhythmias (21.1%), and hypotension (18.35%), whereas late symptoms include hepatotoxicity (34.86%), cardiac arrest (33.94%), and ischemia (30.28%). Measures such as dose control of local anesthetics, proper application techniques, and patient monitoring can help prevent toxicity.[20] Considering the precautions taken by participants to prevent toxicity, 83% reported using monitoring, 75% used the appropriate dose of local anesthetics, 41% employed intermittent application, 13% used adrenaline with a test dose, and 6% used aspiration. The high rate of monitoring (83%) facilitates early detection and prompt intervention of toxicity. Appropriate dosing and intermittent application reduce the risk of toxicity, while techniques such as adrenaline with a test dose and aspiration enhance procedural safety.

The treatment of LAST involves a series of steps that must be taken rapidly. First, the administration of the local anesthetic should be stopped immediately. Effective airway management should be employed to prevent hypoxia, hypercapnia, and acidosis, aiming to maintain normocapnia. Intravenous fluids and inotropic agents (adrenaline or noradrenaline) can be used for cardiovascular support. Lipid emulsion therapy is also very important; a 1.5 mL/kg bolus of 20% lipid emulsion is administered intravenously, followed by an infusion at a rate of 0.25 mL/kg/min. If hemodynamic stability is not achieved, a second bolus of 1.5 mL/kg can be given after 5 minutes, with the total dose not exceeding 12 mL/kg of ideal body weight. For seizure control, diazepam or midazolam is preferred, while small doses of propofol can be used cautiously. If there are signs of cardiac arrest or severe cardiovascular instability, CPR should be initiated following standard resuscitation guidelines. Throughout the treatment process, the patient's vital signs should be continuously monitored.[21]

Considering the LAST treatment methods, 54.13% of the participating physicians indicated symptomatic treatment, 22.94% indicated lipid solutions, 19.27% indicated antihistamine treatment, 17.43% indicated cardiopulmonary resuscitation, and 11.93% indicated the use of methylene blue. While symptomatic options come to the forefront in treatment, the selection rate (20%) of lipid solutions is low. The knowledge levels and treatment practices regarding lipid therapy among residents, specialists, and faculty physicians working in pulmonary clinics vary significantly. Furthermore, the proportion of physicians trained in local anesthesia is very low. The present study indicates that more effective training and guidelines need to be developed to minimize the differences in local anesthetic applications, thereby ensuring standardization in treatment processes.

Conclusion

The incidence of LAST with topical local anesthetics is very low, but it is still necessary to be careful even with such applications. The treatment of this condition, which can have serious complications, is also specific. The survey conducted revealed that most physicians in pulmonary clinics use local anesthetics during bronchoscopy, but there is a consistent lack of education and awareness regarding local anesthetic toxicity and its management. Enhancing education and awareness on this subject can improve patient safety and caregiving outcomes.

Disclosures

Ethics Committee Approval: The study was approved by The Kahramanmaras Sütçü İmam University Faculty of Medicine Clinical Research Ethics Committee (no: 26, date: 04/03/2020).

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