

An assessment of the awareness of local anesthetic systemic toxicity among multi-specialty postgraduate residents

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Abstract Local anesthetics (LAs) are extensively used in clinical practice by both anesthesiologists and non-anesthesiologists and are often associated with systemic toxicity. We hypothesize that this awareness is inadequate among medical specialists and entails a risk of misdiagnosis and underreporting of such events. We therefore conducted a cross-sectional questionnaire-based study to assess the level of understanding of LA use and effective management of systemic toxicity among 200 postgraduate residents of various specialties (with the exception of anesthesiology) in a tertiary care hospital in India from October to December 2013. Among those residents who had used LAs (193/200), 27 and 25 % of responders correctly identified the toxic doses of lidocaine and of lidocaine + adrenaline, respectively. Of the responders, 70 % always performed a negative aspiration of blood before injecting the drug, 27 % sometimes aspirated and the remaining 3 % never aspirated. The majority of the responders (93 %) were unaware of the toxic dose of bupivacaine. Only 70 % of responders believed that LAs could be toxic [95 % confidence interval (CI) 65.5–74.5 %], and 81 % of these correctly identified the signs and symptoms of cardiotoxicity. Only 2 % of responders knew that lipid emulsion is a part of its treatment (95 % CI 0.6–3.4 %). Based on these results, there is a definite need to increase the awareness of detection and

treatment of local anesthetic toxicity among all medical practitioners who regularly use LAs.

Keywords Local anesthetics · Awareness · Systemic toxicity · Lipid emulsion

Local anesthetics (LAs) are extensively used in clinical practice by both anesthesiologists and non-anesthesiologists. The side effects of LAs are most often minor or transient, but occasionally they may be life threatening and fatal, ranging from mild symptoms to major central nervous system (CNS) involvement and/or cardiac toxicity that can result in disability or death. Factors known to influence the likelihood and severity of local anesthetic systemic toxicity (LAST) include individual patient risk factors, concurrent medications, location and technique of block, specific LA compound, total LA dose, timing of detection and adequacy of treatment.

Published reports on LAST date back to the introduction of cocaine in 1884, bupivacaine and etidocaine in the 1970s and ropivacaine and levobupivacaine in the late 1980s [1, 2]. Ongoing research has thrown light on the pathophysiology of LAST, and new treatment modalities, such as lipid emulsion.¹ In 2007, the Association of Anaesthetists of Great Britain and Ireland (AAGBI) became the first medical society in the world to establish a guidance document on the use of lipid emulsion to treat LAST [3]. The American Society of Regional Anesthesia and Pain Medicine (ASRA) followed in 2010 with practice guidelines on the prevention and treatment of LAST [4]. Nevertheless, there appears to be a major unawareness among the medical fraternity in developing countries,

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¹ Lipid rescue™ Resuscitation. Available from www.lipidrescue.org; accessed 23 April 2014.

possibly accounting for the reported misdiagnosis and inadequate management and underreporting of such events which continue to this day.

The primary outcome of this study was to assess the level of awareness of LAST and the secondary outcome was to assess the understanding of LA use, toxic doses and the effective management of LAST among multi-speciality postgraduate residents.

A cross-sectional study was planned and a questionnaire was distributed among 200 residents of various postgraduate specialties (with the exception of anesthesiology) from October to December 2013 in a premier single-center postgraduate teaching hospital of India. Institutional Ethics Committee approval was obtained prior to the study; however, the requirement for written informed consent was waived off. A minimum sample size of 103 residents was deduced to attain a confidence level (CI) of 95 % with an error of margin of 5 %, assuming an expected awareness level of 80 %. Questions (as shown in Table 1) assessed the knowledge of the techniques used; maximum LA doses; signs, symptoms and treatment of LA toxicity; and awareness of lipid rescue. Data were analyzed using SPSS version 18.0 software (SPSS Inc., Chicago, IL) and expressed in numbers (percentages) with the confidence interval.

Among the 200 postgraduate residents who were interviewed, 100 residents were from clinical specialties, mainly General Surgery and Obstetrics/Gynecology (Table 2).

The majority of the residents used LA drugs (193/200, 96.5 %), and all of them had used lidocaine (193/193) while 24.9 % (48/193) had used bupivacaine. Most of them (135/193, 70 %) always performed a negative aspiration for blood before injecting LA, 27 % (52/193) sometimes aspirated and 3 % (6/193) never aspirated.

The most commonly used routes of injection were topical (108/200, 54 %) and subcutaneous (102/200, 51 %). Nearly half of the residents (90/200, 45 %), mainly from orthopedic and general surgical specialties, had given digital nerve blocks, with the most commonly injected sites being the upper and lower limbs (116/200, 58 %), followed by the face, trunk and scalp (76/200, 38 %).

Only 70 % of residents (140/200) thought that LA could be toxic (95 % CI 65.5–74.5 %) of whom, 27 % (38/140) and 25 % (35/140) correctly identified the toxic doses of plain lidocaine and lidocaine + adrenaline respectively. The majority of the residents (130/140, 93 %) were unaware of the toxic dose of bupivacaine.

Among the 140 residents who professed to be aware of LAST, 113 (81 %) and 71 (51 %) correctly identified the signs and symptoms of cardiotoxicity and neurotoxicity, respectively. Only 48 (34 %) of these could identify the signs and symptoms of both cardio- and neurotoxicity

caused by LAs. The most common cardiotoxicity signs identified by these residents were tachyarrhythmia, bradyarrhythmia, hypertension, hypotension, palpitation, syncope and cardiac arrest. In addition, 43 % of these 140 residents did not know how to treat LAST, with only 2 % (3/140) being aware of lipid emulsion (95 % CI 0.6–3.4 %); none of these latter three residents, however, knew the dose needed to treat LAST.

The technique of local anesthesia is widely used by practitioners, frequently in the absence of anesthesiologists. LAs are frequently overlooked and considered to be safe drugs. However, LAST can be refractory to standard resuscitation techniques and often has fatal consequences. Although research has broadened our knowledge on the pathophysiology, symptomatology, treatment and prevention of LAST, efforts towards improving patient safety continue to be futile due to an ignorance and lack of knowledge on the recent developments in this area. As hypothesized in our study, we have identified an obvious gap in the knowledge of signs and symptoms of LAST. Most of the residents surveyed were ignorant of the early neurotoxic symptoms, the treatment of which could avert a neuro- or cardiotoxicity event which would certainly develop in the absence of an intervention at the right time. In order to avoid an obvious bias, we excluded anesthesia residents as LAST forms part of the curriculum in anesthesiology. We found that 30 % of residents did not believe that LAs could be toxic, nor did they aspirate the patient before injecting the LA of choice. Aspiration prior to injecting LAs prevents accidental intravascular injection, especially when the nerves are enclosed in a neurovascular bundle, as is the case in intercostal nerve blocks, interscalene blocks, cervical plexus blocks and stellate ganglion blocks. Plasma concentrations of lidocaine of $>5 \mu\text{g/ml}$ are associated with symptoms of toxicity, while the therapeutic window is narrower for bupivacaine, which manifests toxicity symptoms at levels of $>1.5 \mu\text{g/ml}$ [5, 6]. The maximum safe doses of LAs depend upon the route of administration (subcutaneous), vascularity of the site (scalp, oral cavity, face) and protracted injection time (catheter) where the risk of toxicity is high even with the recommended doses. Vascularity of the injection site decreases in the order intercostal, caudal, epidural, brachial plexus, sciatic/femoral; hence, reduction in LA dose is vital to prevent LAST [7].

Among the 70 % of residents who knew that LA could be toxic, only 25 % knew the toxic dose of lidocaine. This lack of knowledge could lead to the irrational use of LA in terms of dosage, technique and improper monitoring, all of which could end in a patient with toxicity. ASRA established guidelines in 2010 which recommend the use of a 20 % intra-lipid emulsion as the specific antidote for the treatment of LAST; the lack of knowledge among doctors of this treatment is a great concern.

Table 1 Study questionnaire

QUESTIONS	ANSWERS
1. Have you used any local anesthetic?	Yes/No
2. If yes, which one?	Lidocaine/Bupivacaine
3. Have you used adrenaline with it?	Yes/No
4. Routes of administration?	Intradermal/lesional/subcutaneous/topical/nerve block
5. Site of injection?	Face/Oral cavity/Scalp/Trunk/Limbs/Perineum
6. % of drug/ volume you have used maximum?	-----
7. Do you aspirate before injecting?	Yes/ always/Sometimes/Never
8. Do you think that local anesthetics could be toxic?	Yes/No
9. If yes, what do you think is the maximum safe dose you could use?	Without adrenaline ----- With adrenaline -----
10. What symptoms/signs would you look for in a case of suspected LA toxicity?	
11. How would you treat local anesthetic toxicity?	Supportive/Specific therapy/Don't know
12. Have you heard of lipid rescue?	Yes/No
13. Which drug can you use as lipid rescue and what is the dose?	

Numerous case reports of LAST have been published, many of which were in the hands of non-anesthesiologists [8–12]. A survey in the UK among medical doctors revealed that 15 % of “non-anesthetic” doctors knew the recommended safe doses of plain lidocaine; for lidocaine + adrenaline and bupivacaine, 25 % and 14 %, respectively, were aware of the recommended safe doses [13]. Compared to our study, the survey also reports a higher level of awareness (7 %) among non-anesthesiologists of the role of intra-lipid for treating LAST. Although our study was conducted at a premier postgraduate teaching institution, the results may not be extrapolated to other institutions because of the differences in teaching curricula across the

world. Nonetheless, the desired level of awareness is lacking, and a deliberate effort must be made to improve this lack of knowledge. It should be noted that our assessment could be affected by the use of non-aspirating hypodermic syringes by dental surgeons with which negative aspiration for blood could not be checked before injection.

Early recognition and proper management of the toxicity symptoms could prevent adverse outcomes. As anesthesiologists, it is our responsibility to ensure patient safety in medical practice; hence, we must take serious steps towards educating our colleagues about LAST and its management. Based on our results, we recommend

Table 2 Postgraduate specialities and year of residency of medical residents sent a questionnaire ($n = 200$)

Speciality	Year			
	First	Second	Third	Total
Anatomy	5	3	4	12
Physiology	3	3	5	11
Biochemistry	4	5	3	12
Pathology	2	2	4	8
Microbiology	3	5	5	13
Pharmacology	4	3	5	12
Forensic medicine	5	3	1	9
Preventive social medicine	3	5	2	10
Radiology	3	2	3	8
Hospital administration	1	2	2	5
General medicine	4	4	4	12
General surgery	5	4	2	11
Obstetrics gynecology	4	4	4	12
Pediatrics	3	3	2	8
Orthopedics	3	2	4	9
Psychiatry	4	2	3	9
Ophthalmology	2	3	3	8
Ear nose throat	3	2	3	8
Dentistry	2	4	4	10
Neurosurgery	2	2	1	5
Cardiac surgery	2	1	1	4
Plastic surgery	1	1	2	4
Total	68	65	67	200

adequate training in the pathophysiology, symptomatology, prevention and treatment of LAST, and to include the latest guidelines on the use of lipid emulsion at both the undergraduate and postgraduate levels. The study reinforces a definite need to increase the awareness of detection and treatment of LAST among all doctors who routinely use it.

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Conflict of interest None.

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