Title: *A call to all readers:* educating all surgeons on preventing and treatment of local anaesthetic systemic toxicity.

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The recent media report of a young patient who suffered cardiac arrest while undergoing surgery at the Cosmetic Institute, Sydney should remind all surgeons that local anaesthetic systemic toxicity (LAST) remains a potentially lethal iatrogenic problem.¹ LAST was first recognised soon after cocaine was introduced into clinical practice in the 1880's² and the problem persists despite 130 years' experience of local anaesthetic administration, advances in local anaesthetic pharmacology and a robust body of literature on LAST.³

All clinicians administering local anaesthetics should be aware of the risk factors for LAST, preventative strategies, presenting features and treatment. Local anaesthetic dosage and site of injection are independent risk factors for LAST^{4,5} and when local anaesthesia is the primary operative anaesthetic technique for surgeries such as bilateral breast augmentation or tumescent liposuction, or anaesthesia of the mucous membranes for endoscopic procedures, dangerously high blood levels of local anaesthetic may result. Standard practice of local anaesthetic administration includes selecting a total dose that is the least required to achieve the clinical objective, injecting in increments so that the entire dose isn't administered at once, aspirating frequently and use of adjuncts such as adrenaline to detect intravascular injection. These simple methods are credited with improving the safety of regional anaesthesia.⁶

LAST presents with variable symptoms, signs and timing.⁷ Classic features such as tinnitus, altered mental state, circumoral numbness and/or seizures followed by cardiac arrhythmias may not evolve according to textbook descriptions. Inter-patient variability, sedation or general anaesthesia all affect the clinical appearance of LAST.

Severe LAST depresses cardiac function and is worsened by hypoxia, coronary ischemia, acidosis, and hypotension leading to a potentially fatal vicious cycle: LAST reduces cardiac output resulting in tissue hypoxia which worsens LAST leading to clinical decline. Small patients are at increased risk of LAST and total anaesthetic doses should be reduced for them as well as those with co-morbidities, especially patients with pre-existing ischemic heart disease, cardiomyopathy, conduction defects or arrhythmias. Cardiac collapse in these patients may be ascribed mistakenly to their pre-existing co-morbidities, rather than local anaesthetic administration, leading to possibly deadly misdiagnosis.⁸

Many patients will not tolerate widespread local anaesthetic infiltration given for the purpose of surgical anaesthesia unless sedated. There is a fine line between conscious sedation and levels of sedation that compromise airway patency and ventilation – hypoventilation and attendant respiratory acidosis exacerbate LAST. In the abovementioned case at the Cosmetic Institute a high-risk scenario may have

evolved with hypoventilation, respiratory acidosis, hypoxia and a relatively low body weight patient all potentially contributing.

Airway maintenance, oxygenation and ventilation are essential to treatment of LAST.^{9,10} The importance of teamwork cannot be over emphasized and implementing crisis resource management and use of cognitive aids, including well-constructed protocols are critical. The American Society of Regional Anesthesia and Pain Medicine has published checklists for managing LAST (available for free at <https://www.asra.com/advisory-guidelines/article/3/checklist-for-treatment-of-local-anesthetic-systemic-toxicity>).¹¹ There is benefit in practicing the response to LAST by simulation.¹²

Lipid emulsion therapy (infusion of a 20% lipid emulsion, typically a total parenteral nutrition solution like Intralipid®) has been a major milestone in the management of LAST (and toxicity resulting from other lipid soluble drugs).¹³ If given early, lipid emulsion therapy may attenuate or prevent progression of LAST. Facilities where local anaesthetic is administered should have immediate access to lipid emulsion and protocols for its use in the management of LAST. A large initial bolus of lipid emulsion therapy, 1.5 mL/kg lean body mass of 20% lipid emulsion (100 mL for 70 kg patient) is used.

There is no firm scientific basis for establishing safe dosing limits for local anaesthetic, nevertheless, doses are adjusted according to patient age, co-

morbidities, physiological factors (pregnancy), weight and site of injection.¹⁴ It is the authors' experience that surgeons frequently ask the anaesthetist for dosing guidance. Perhaps the preoperative surgical time-out should include a dialogue that addresses this and relevant risk factors to be considered.

Learning to recognize and manage LAST will improve patient safety. Prevention is paramount and successful treatment of severe LAST may require advanced cardiac life support and lipid emulsion therapy. Local anaesthetics are administered by a wide range of healthcare providers in diverse practices¹⁵ and all practitioners who administer local anaesthetics need to know and consider the potential risks of LAST.

Disclosures: The authors are contributing to an American Society of Regional Anesthesia and Pain Medicine updated practice advisory on LAST. Dr. Weinberg maintains the educational site www.lipidrescue.org, holds a US patent related to lipid resuscitation and is co-founder of ResQ Pharma, Inc.

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