Guideline

Local Anaesthetic Systemic Toxicity

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Primary Document			
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Applicable to	Medical and Nursing staff working in Children's Health Queensland	**Review date**	01/02/2027

HUMAN RIGHTS

This governance document has been human rights compatibility assessed. No limitations were identified indicating reasonable confidence that, when adhered to, there are no implications arising under the *Human Rights Act 2019.*

PURPOSE

The purpose of this guideline is to assist clinicians in understanding the circumstances, signs, symptoms, investigations and management of local anaesthetic systemic toxicity. Management of methaemoglobinaemia is also included in this guideline.

SCOPE

This guideline primarily applies to all staff involved in the care and management of children who have had local anaesthetics administered by any route.

GUIDELINE

INTRODUCTION

Local anaesthetic systemic toxicity can develop after local anaesthetic is administered via any route. It usually occurs from inadvertent intravascular administration (1, 2), however can occur via oral, transdermal or other routes. Toxicity can be mild, but can be severe, with the possibility of catastrophic neurological and cardiovascular toxicity, including cardiac arrest (3-5).

While this guideline exists primarily to direct the initial assessment and management of patients with suspected local anaesthetic systemic toxicity, it does not aim to replace phone consultation with a poison information centre or toxicologist.

Risk factors for local anaesthetic systemic toxicity

Toxicity of local anaesthetics depends on route of administration. Parenteral toxic doses are poorly defined. The maximum recommended dose of various local anaesthetics varies from agent to agent. Inadvertent administration of local anaesthetic into the intravascular, intrathecal or intraspinal spaces can result in LA toxicity at or below the maximum recommended doses. In addition to this, there are certain patient factors that can contribute to increased risk of LA toxicity.

Patient factors:

- Extremities of age (<4months)
- Organ dysfunction: hepatic, renal or cardiac (conduction disease, Kawasaki's etc)
- Metabolic disturbance: acute acidaemia or congenital such as carnitine deficiency
- Pregnancy
- Vascularity of surrounding tissues of block site (4, 6).

SIGNS AND SYMPTOMS OF LOCAL ANAESTHETIC SYSTEMIC TOXICITY

The symptoms that evolve and the speed in which they occur are variable, and are dependent on route of administration, local anaesthetic plasma concentration and the type of local anaesthetic used. There may be rapid onset of clinical manifestations.

Local anaesthetic toxicity should be considered if there is any physiological derangement after local anaesthetic administration.

Signs are often initially neurological (these can be subjective and difficult for infants/young children to report):

- Tinnitus, drowsiness, dizziness, anxiety, confusion, perioral numbness, blurred vision, dysarthria, limb twitching, tremor, and metallic taste.

More severve local anaesthetic systemic toxicity involves two main systems

- Central nervous system – manifesting as seizure activity, apnoea and coma.
- Cardiovascular - tachycardia and hypertension or bradycardia and hypotension. This can progress to ventricular dysrhythmias and asystole (7, 8).

MANAGEMENT OF LOCAL ANAESTHETIC SYSTEMIC TOXICITY

1. Stop local anaesthetic administration - remove infusion pumps, topical creams.
2. Call for help – resus team and toxicologist support (telephone Poisons Information Centre 13 11 26).
3. Maintain airway, oxygenation and ventilation
    a. If the patient is acidaemic due to seizures or respiratory depression, intubation may be required for appropriate ongoing management.
    b. Avoid hypoxia, hypercarbia and acidosis, as this will potentiate toxicity.
    c. Hyperventilate to pH 7.5 if intubated.
4. Investigations:
    a. Venous Blood Gas – methaemoglobinaemia concentration, electrolytes, pH and potassium.
    b. ECG – 12 lead – assessing for features of sodium channel blockade – e.g wide QRS, terminal R-wave in aVR.
5. Circulation support
    a. Manage ventricular dysrhythmias and provide cardiovascular support as per standard advanced life support guidelines being mindful of the following:
        i. First line management of hypotension is with volume. Treat hypotension with a 20 mL/kg bolus of sodium chloride 0.9%. This can be repeated if the patient remains hypotensive.
        ii. If hypotension persists despite further volume administration, start inotropic support. Adrenaline is the preferred first line inotrope. Consider smaller dose boluses to prevent potentiating dysrhythmias (<1mcg/kg).
        iii. Consider ECMO in consultation with PICU (3).
6. Treatment of sodium channel blockade from LA toxicity by serum alkalinisation - evidenced by QRS changes and seizure activity. Management of sodium channel blockade will assist in preventing seizures, worsening pH and cardiovascular instability.
    a. Sodium bicarbonate 8.4%
    -1-2mL/kg (1 to 2 mmol/kg) IV, every 3-5 minutes. Maximum dose 6mL/kg. (6mmol/kg)
    - repeat until perfusing rhythm if in cardiac arrest
    - titrate to aim for narrowing of QRS complex and aim for pH of 7.45- 7.55.
    b. Hyperventilate if intubated aiming for pH 7.45-7.55 (6).
    c. Administration of bicarbonate may result in hypokalaemia; monitor serum potassium and replace if necessary – aiming for normal range.

7. Seizures often immediately precede cardiovascular collapse. Manage seizures with benzodiazepines alongside other resuscitation measures above.

    a. Midazolam 0.15 mg/kg IV bolus (Max 10mg) (3)

    b. Note that Phenytoin is contraindicated, as this potentiates the sodium channel toxicity.

8. Intravenous lipid or fat emulsion 20% is indicated for cardiovascular collapse in local anaesthetic poisoning in cases that are not responding to first line resuscitative methods outlined above (8-11).

    a. 1.5 mL/kg of 20% Intravenous Lipid Emulsion over 1 minute. A further two boluses (at 5 minute intervals) can be considered if no response (7, 12-13). Maximum total dose is 12mL/kg.

    b. Please note: Intravenous Lipid Emulsion (ClinOleic) is stored in the green utility room in QCH ED, theatres, PICU and selected wards at QCH.

METHAEMOGLOBINAEMIA

Methaemoglobinaemia can also occur after local anaesthetic administration. Its mechanism of toxicity leads to a left-shift in the oxygen haemoglobin dissociation curve leading to impaired oxygen delivery to tissues. It is not dose related. Individuals who have G6PD deficiency and neonates are at higher risk. Methaemoglobinaemia is more common after benzocaine (often dental anaesthetics), lignocaine and prilocaine (EMLA) administration, but can occur after lignocaine, or amethocaine (tetratcaine) (AnGel®) administration (6).

Clinical signs include blue discolouration of mucous membranes. Cellular hypoxia evolves. DO NOT rely on pulse oximetry.

If these clinical signs appear, apply oxygen, and collect a venous blood gas to check methaemoglobinaemia (MetHb) level.

MANAGEMENT OF METHAEMOGLOBINAEMIA

- Remove causative agent
- Apply Oxygen – 15L Non Rebreather. Do not rely on pulse oximetry.
- Methylene blue 1% solution 0.1 – 0.2 mL/kg (1-2mg/kg) IV, over 3-5 minutes, in consultation with a toxicologist.
    - Indicated when MetHb >20% and symptomatic OR >25% with no symptoms.
    - Re-measure MetHb after administration above every 30 minutes to ensure improvement.
    - Contraindicated in: G6PD deficiency, methaemoglobinaemia reductase deficiency, nitrite-induced methaemoglobinaemia, and hypersensitivity. Renal impairment needs dose adjustment (6).

CONCLUSION

Signs of local anaesthetic systemic toxicity are important to be aware of in areas where local anaesthetics are frequently used. Managing the clinical manifestations of local anaesthetic systemic toxicity can be complex. This guideline provides a framework for the treatment of local anaesthetic systemic toxicity, but it does not replace discussion with a clinical toxicologist.

CONSULTATION

Key stakeholders who reviewed this version:

- Emergency Fellow and SMO, QCH Emergency Department
- SMO PAH Emergency Department and Clinical Toxicology Unit
- SMO QCH Anaesthetic Department
- Senior Poisons Pharmacist
- Medicines Advisory Committee – endorsed 16/12/2022

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GUIDELINE REVISION AND APPROVAL HISTORY

Version No.	Modified by	Amendments authorised by	Approved by	Comments
1.0 05/11/2018	Director, Paediatric Emergency Department	Divisional Director, Critical Care	Executive Director Medical Services	
2.0 20/01/2023	Director, Paediatric Emergency Department	Divisional Director, Critical Care	Executive Director Medical Services	
2.1 17/05/2025	Governance Officer (Documents)	Manager Governance Unit	ELT	Minor change to apply Human Rights assessment and present on new template

Key words	local anaesthetic systemic toxicity, methaemoglobinaemia, lignocaine, benzocaine, clinoleic, intravenous lipid emulsion, sodium bicarbonate, EMLA
Accreditation references	NSQHS Standards: 1, 4, 8