Quick Review: Toxicity of Local Anesthetics

Local anesthesia is a reliable and traditional method for minor surgical procedures. The commonly used local anesthetic agents used include Lignocaine, Bupivacaine, Ropivacane, Mepivacaine and Prilocaine.

A number of local anesthetic techniques are employed which include infiltration, topical use, plexus blocks, field blocks, intravenous blocks and intrathecal or epidural use.

Addition of adrenaline (commonly 1:200,000 to 1: 125,000 concentration) to the local anesthetic solution hastens and prolongs the duration of action and permits higher dose of the drug to be used as it is more slowly absorbed into the circulation. However addition of adrenaline to local anesthetics also increases risk of cardiac arrythmias.

The side effects and toxicities of local anesthetics are divided in to:

- Local
- Primary side effects
- Systemic toxicity

The local adverse effects of anesthetic agents include neurovascular manifestations such as prolonged anesthesia and paresthesia, which may become irreversible. Local complications also include infection and haematoma

The common primary side effect is allergic reactions. Less than 1% of local anesthetic adverse reactions are due to allergic mechanisms. The ester-type local anesthetics such as Cocaine Procaine, Benzocaine and Tetracaine have higher risk of such reactions. Allergic reaction following local anesthetic administration may be caused by preservatives (methylparaben or related structures) included in the preparation. A prior history of allergic reactions to anesthetic drugs may be elicited and intradermal testing may be performed to prevent the allergic reactions.

The signs of allergic reactions include rash, urticaria, laryngeal edema, possible hypotension and bronchospasm.

Mild cutaneous reactions may be treated with Inj. Avil. and patients with more serious reactions with 0.3 cc of epinephrine sub-cutaneous (1:1000).

Systemic Toxicity is caused by excessively high plasma local anesthetic concentration. It may involve the central nervous system (CNS), the cardiovascular system, and the immune system. The effects on the immune system produce allergic reactions and may even change the hematologic milieu of the patient (methemoglobinemia). Cardiovascular effects are primarily those of direct myocardial depression and bradycardia, which may lead to cardiovascular collapse.

<u>Common causes of toxic plasma local anesthetic concentrations include:</u>

- Accidental direct intravascular injection during peripheral nerve block or epidural anesthesia.
- Excessive absorption from injection site (no intravascular injection).
- Initial dose of administered and vascularity of injection site.
- Whether or not epinephrine was used to provide local vasoconstriction
- Properties of the drug administered.

CNS Toxicity: The symptom development may be heralded by tongue and circumoral numbness. With local anesthetic entering the brain the initial symptoms are tinnitus, vertigo and restlessness. Subsequently slurred speech and skeletal muscle fasciculation may develop. Tonic-clonic seizures, generalized seizure with

alternating contractions and relaxations follow. These seizures may last for one -two minutes. This is accompanied by loss of consciousness. The CNS toxicity is dependent upon plasma drug, concentration of a drug, rate of injection, hyperkalemia.

The treatment of seizures includes:

- Assure adequate ventilation with oxygen. Add supplemental oxygen when local anesthetic toxicity first appears
- Intravenous midazolam (Versed) or diazepam (Valium) is used for Seizure suppression. Recent reports indicate that 1 mg/kg of intravenous propofol (Diprivan) and 2 mg/kg of intravenous thiopental (Pentothal) are successful in stopping anesthetic-induced seizures and muscle twitching.

Neurotoxicity may occur as a consequence of local anesthetic injection into subarachnoid or epidural spaces. The effects of neurotoxicity include, Groin numbness, long-lasting, isolated myotomal (muscle segment) weakness, Cauda equina syndrome.

Subarachnoid-space injections may produce transient radicular irritation.

Permanent neurological injury following regional anesthesia is rare and may manifest as moderate/severe lower back, buttocks, posterior thigh pain 24 hours following spinal anesthesia complete recovery

Hematological: Methemoglobinemia has been reported primarily with prilocaine toxicity; however, lidocaine and benzocaine also have been implicated. O-toluidine, the liver metabolite of prilocaine, is a potent oxidizer of hemoglobin to methemoglobin.

At low levels (1-3%), Methemoglobinemia can be asymptomatic, but at higher levels (10-40%) may be accompanied by cyanosis, cutaneous discoloration (gray), tachypnea, dyspnea, exercise intolerance, dizziness and syncope.

Methemoglobinemia should initially be treated symptomatically and then guided by blood levels of methemoglobin. Methylene blue and hyperbaric oxygen may be required in severe cases.