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Local Anesthesia Toxicity
Nicole McCleery, RN, BSN, CCRN

Introduction
- Local anesthetic (LA) provides a way to relieve temporary pain in a small part of the body and has been used for over 100 years (Fencl, 2015).
- LA prevents the passage of surgical stimuli into the central nervous system (CNS) making a surgical procedure less painful for the patient (Noble, 2015).
- Anesthesia by anesthetist does not guarantee that the patient will not feel pain during surgery, but it can significantly reduce pain (Fencl, 2015).

Signs and symptoms
- Signs and symptoms of LA toxicity may be divided into three stages (Noble, 2015).
- Stage 1: Initial Focus
  - Agitation
  - Tachycardia
- Stage 2: Initial Focus
  - Cardiac arrhythmia
  - Myocyte instability
- Stage 3: Cardiac Arrhythmia
- Stage 4: Cardiac Arrhythmia
  - Bradycardia
  - Hypertension

Pathophysiology
- The classic description is prophylactic “high” affects on the CNS when going from CNS excitation to decreased CNS depression (Fencl, 2015).
- Systemic toxicity from local anesthetic (LA) occurs due to accidental intravascular injection, absorption from the tissues or repeated doses without balanced elimination (Neal et al., 2012).
- LA toxicity can be prevented by following correct guidelines and proper LA administration protocols (Neal et al., 2012).
- The pathophysiology of LAs are thought to be an extension of their action (Neal et al., 2012).
- Blocking cardiac voltage-gated sodium channels, prevents myocyte depolarization, resulting in potassium channel repolarization via potassium channels (Neal et al., 2012).
- The increase in sarcolemmal calcium which is voltage-dependent calcium channels can limit the increase of calcium available for contraction (Neal et al., 2012).
- Myocyte ATP is reduced which limits energy available for contraction, actin-myosin cycle and ion channel activation is osmotic (Ciechanowicz, 2015).
- LA rapidly cross cell membranes and toxicity can occur in many sites including intestines and mucous membrane.
- In the brain, LA affects inhibitory and excitatory pathways.
- In the heart, LAs can cause the rapid rate of sodium and calcium channels resulting in dysrhythmias and cardiac instability (Christie, Picard, Weinberg, 2015).
- LA can disrupt the normal action potential leading to reduced sodium and potassium concentrations and increased dysrhythmias (Christie, Picard, Weinberg, 2015).
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Nursing Implication
- A checklist was developed by the American Society of Regional Anesthesia and Pain Medicine (ASRA) (Fencl, 2015).
- Step 1: Initial Focus
  - Airway management: ventilate with 100% oxygen
  - Management of hemodynamics: preferred, IV access
- Step 2: Initial Focus
  - FAAP: Propofol in patients with cardiovascular instability
- Step 3: Cardiac Arrhythmia
  - Initiate ACLS if needed
  - Avoid vasoconstrictors, calcium channel blockers, beta blockers, or LA
- Step 4: Cardiac Arrhythmia
  - Reduce epinephrine doses to < 1 mcg/kg

Conclusion
- When the effectiveness of the checklist was researched by Neal et al. (2012), results showed the checklist was successful and efficient in managing LAs.
- Prevention measures (in a checklist form) have been put in place to help reduce the risk of LA toxicity (Noble, 2014).
- The early signs are caused by a change in oxygen transport (Neal et al., 2012).
- By educating all staff, effective management of this emerging situation will help influence the positive outcomes achieved.

References

Table 1. Checklist created by ASRA. Image provided by Neal, Mulroy & Weinberg, 2012.

Table 2. Image retrieved from http://www.nysora.com/regional-anesthetics/foundations-of-c%28-local-anesthesia.html

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References Cont.