



# Local Anesthetic Systemic Toxicity: A DNP Project

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## INTRODUCTION

- LAST = rare complication from inadvertent absorption of local anesthetics in the vasculature
- Incidence: ~2 per 1,000 nerve blocks.<sup>3</sup>
- Use of ultrasound and incremental dosing with frequent aspiration reduces incidence.<sup>1</sup>
- Use of a test dose that includes epinephrine can aid in early identification
- Signs & symptoms of LAST: circumoral numbness, tinnitus, confusion, dizziness, disorientation, and drowsiness → agitation, loss of consciousness, and seizures → cardiovascular collapse.<sup>1</sup>
- DNP Project Purpose: Create a quick reference guide (QRG) and assess CRNA perception of its adequacy which addresses a project site need

## Local Anesthetic Systemic Toxicity (LAST) Reference Tool

**Physiology of LAST**  
The mechanism of action for most local anesthetics is the blockade of the sodium ion channel on nerve axons, disrupting action potentials and blocking nerve signaling. In LAST, the plasma concentration of the local anesthetic increases and sodium channels in the brain and heart become blocked. Prolonged blockade of sodium channels in the heart and brain leads to inhibition of oxidative metabolism and inhibition of mitochondrial activity. This puts the heart and brain into an anoxic state. When in an anoxic state, the following signs and symptoms of LAST occur:

**How to Prevent LAST Occurrence**

- Understand High Risk Populations and Risk Factors
  - Extremes in age (very young & very old)
  - Low protein levels
  - Low muscle mass
  - Cardiac patients
  - Renal failure
- Understand the Drug Used
  - Type of LA (ester vs. amide)
  - Dose of LA
  - Volume of LA
- Utilization of ultrasound (reduces risk by 60-65%)
  - Increases accuracy, reduction in volume and dose of local anesthetic
- Knowledge of anatomy or site of injection
- Know maximum doses of local anesthetics (see chart)
- Incremental injection technique
- Test dose with epinephrine

**Signs and Symptoms**

- circumoral numbness
- tinnitus
- disorientation
- disorientation
- visual and auditory disturbances
- agitation
- seizures
- arrhythmias
- hypertension
- conduction disturbances
- cardiac arrest

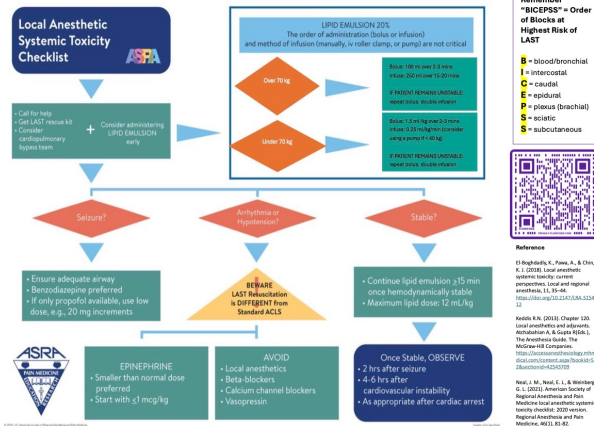
**Maximum Recommended Doses of Local Anesthetics**

Medication	Regular	with Epi
Lidocaine	3-4.5mg/kg	6-7mg/kg
Mepivacaine	4.5-5mg/kg	7mg/kg
Bupivacaine	2.5mg/kg	3mg/kg
Levobupivacaine	2mg/kg	2mg/kg
Ropivacaine	2.5mg/kg	3mg/kg
Chlorprocaine	10mg/kg	15mg/kg
Prilocaine	8mg/kg	10mg/kg
Prilocaine	5-6mg/kg	7.5-8mg/kg

**MOA of Lipid Emulsion Therapy**  
Lipid emulsion therapy has two functions: it's greatest MOA is from the function of a lipid emulsion – transporting the local anesthetic from an area of high-flow organs (heart and brain) to denervating organs (muscles, fat, liver). Additionally, lipid emulsion therapy has a **positive inotropic effect on the heart** (Di-Bugliardi et al., 2016).

**Remember "BICEPSS" = Order of Block at Highest Risk of LAST**

- B = blood/bronchial
- I = intracardial
- C = caudal
- E = epidural
- P = plexus (brachial)
- S = sciatic
- S = subcutaneous



## RESULTS

Figure 1

CRNAs support of implementing QRG at their facility (n=4)

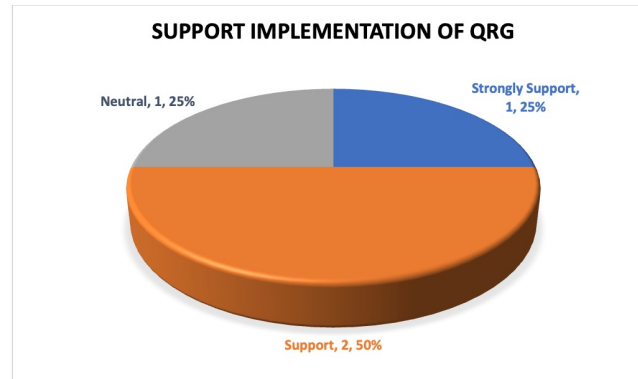
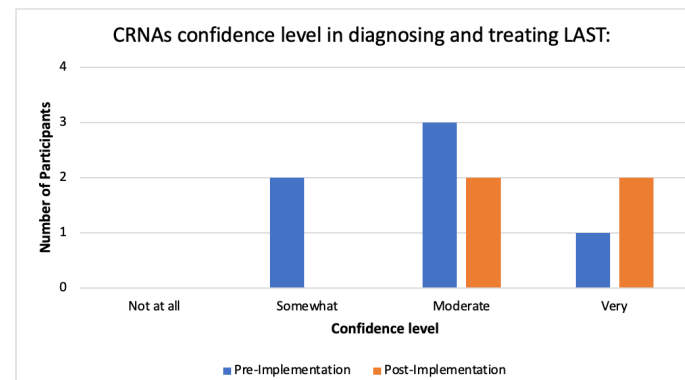


Figure 2

CRNA confidence level in diagnosing and treating LAST (pre-implementation n=6, post-implementation n=4)



## METHODS

- One Plan Do Study Act (PDSA) cycle<sup>2</sup>
- Literature search and synthesis performed
- Evidence-based practice QRG developed PowerPoint presentation with voiceover
- Two-week implementation phase
- Pre- and Post-implementation survey design with Qualtrics
- Data analyzed and visuals created with Excel

## DISCUSSION

- Pre-implementation survey participants = 6
- Post-implementation survey participants = 4
- Improved perception of LAST, its prevention, diagnosis and treatment
- Confidence level shifted
- Enhanced familiarity with drugs to avoid during LAST
- Furthered perception of mechanism of action of lipid emulsion therapy (LET)
- Despite a smaller sample size for post-implementation comparison, there is demonstrated support for QRG implementation

## CONCLUSIONS

- Overall:
  - Three of four recommend implementation of QRG
- Limitations:
  - most participants locums staff
  - small sample size
  - author physically present and one of the two project sites
  - short implementation time frame
- Future studies:
  - directly conversing and implementing with participants
  - increasing project implementation duration
  - larger sample size
- Sustainability:
  - QRG is an effective and inexpensive tool

## REFERENCES

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