

OBSTETRIC EMERGENCIES SERIES

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May 2026



Anesthesia Complications

- L.A.S.T



L.A.S.T

Protein Binding

- LAs are largely bound to plasma and tissue proteins, but only **active in free, unbound state**.
- Major binding proteins: **albumin and alpha1-acid glycoprotein (AAG).**
- AAG binding characterized as high-affinity but low-capacity = LAs bind to AAG preferentially compared with albumin
  - ***basic, lipid-soluble drugs**
- Degree of protein binding is [ ] dependent and influenced by plasma pH.
  - The % of drug bound (inactive) ↓ as the pH ↑
  - The % of drug unbound (active) ↑ as the pH ↓

- With acidosis (eg: LA-induced seizures or cardiac arrest), the amount of free drug increases.
  - ➢ more pronounced with **bupi** than lido.
    - ➢ Ex: as the binding ↓ from 95% to 70% with acidosis, free bupivacaine ↑ from 5% to 30% (a factor of 6), although the total drug [ ] remains unchanged.
    - ➢ Because of this ↑ in free drug, acidosis renders **bupi markedly more toxic.**

Causes of Acidosis in Labor & Delivery:

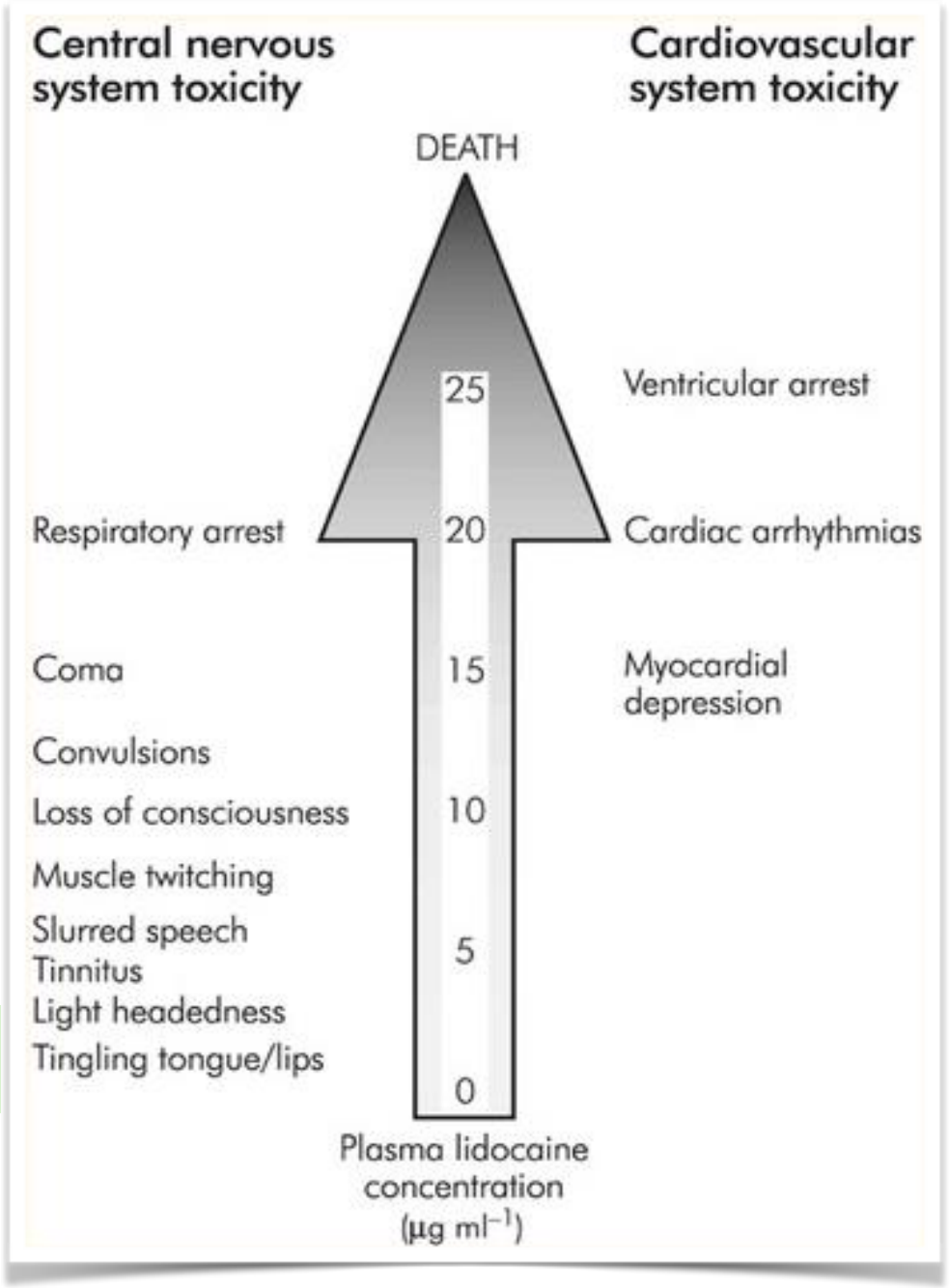
✓ Development of DKA or sepsis during labor
✓ Mag toxicity hypoventilation
✓ Hemorrhage

3. NYSORA. Local Anesthetics: Clinical Pharmacology and Rational Selection. 2015.

- LA causes CV collapse via cardiac myocyte Na^+ channel blockade
  - ➢ electrophysiological & contractile dysfunction

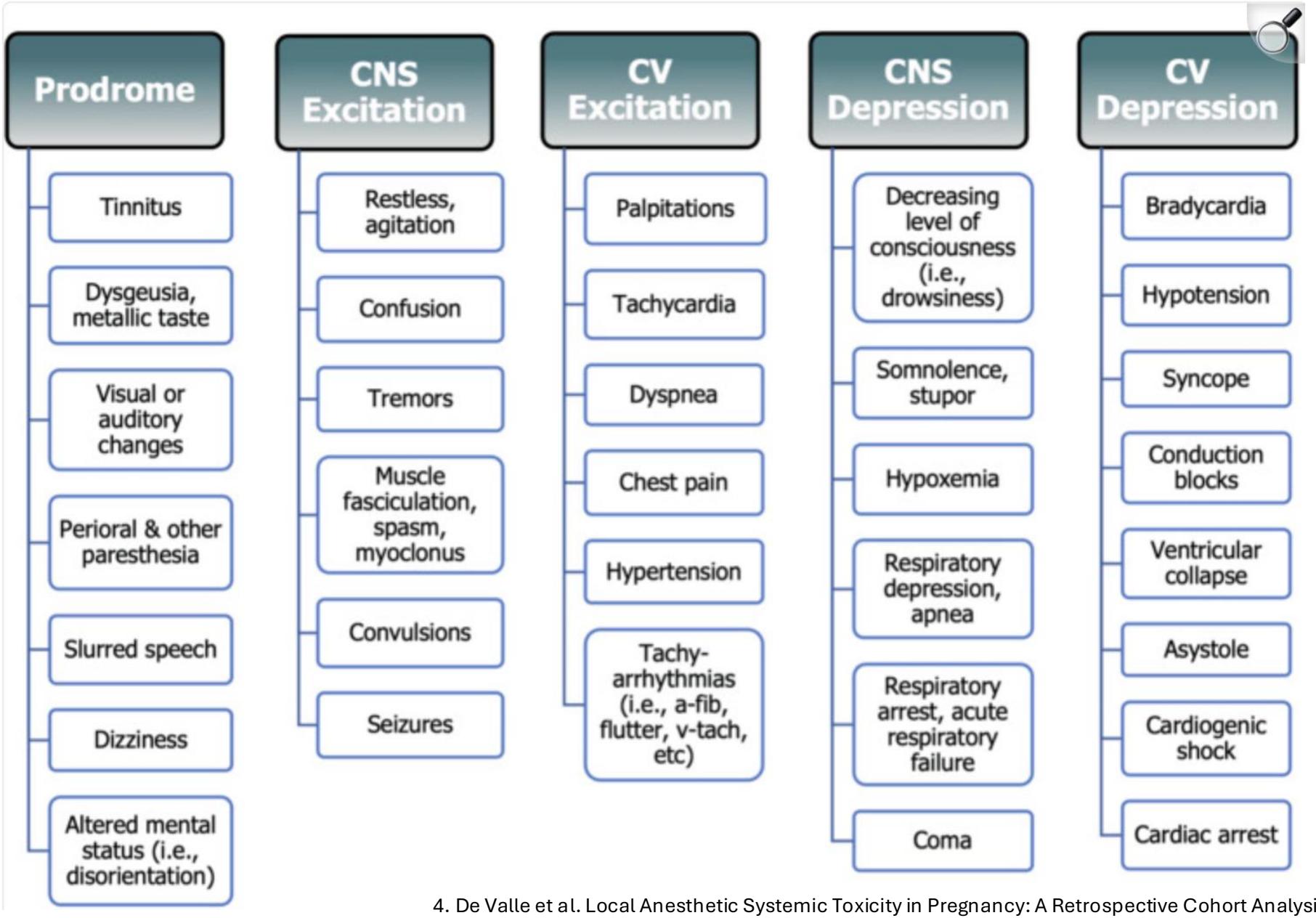
- Bupi/Marcaine most cardiotoxic.
  - Lipophilic profile ↑ toxicity
  - Higher affinity for cardiac Na^+ channels, binds longer
  - LIDO vs BUPI toxicity: lido has greater CNS symptoms while bupi has greater cardiac toxicity

The classic signs & symptoms we learn →



https://thejns.org/view/journals/j-neurosurg/132/3/article-p809.xml

Figure 1. Clinical presentation of local anesthetic systemic toxicity.



4. De Valle et al. Local Anesthetic Systemic Toxicity in Pregnancy: A Retrospective Cohort Analysis. *Cureus* 2024.

- No current monitoring method can prevent systemic toxicity.
- Cases of LAST have been reported despite:
  - ✓ Negative aspiration for blood
  - ✓ Use of recommended dosages
  - ✓ Observation of LA spread in a tissue plane and not IV
- Reminder that constant vigilance and preparation for treatment is essential during all regional procedures

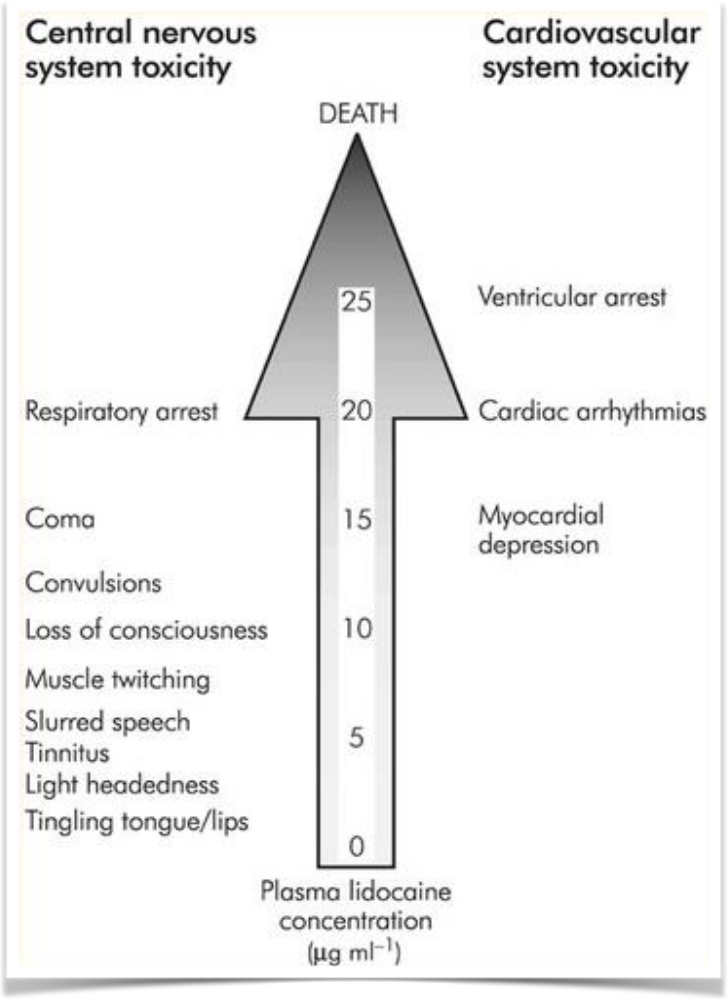
3. NYSORA. Local Anesthetics: Clinical Pharmacology and Rational Selection. 2015.

Cureus. 2024 Sep 11;16(9):e69215. doi: 10.7759/cureus.69215

Local Anesthetic Systemic Toxicity in Pregnancy: A Retrospective Cohort Analysis

Micah K De Valle [1,✉], Michael Adkison [1], Ruhi Maredia [1], Cooper Stevenson [1], Shobana Murugan [2]

- Matched cohorts : 276 pregnant vs 276 nonpregnant LAST pts 2013 -2023. (N=534)
- Cohorts matched on: age, race, obesity status, DM, metabolic disorders, LA type, and: cardiovascular, liver, kidney, & respiratory disease.
- Outcomes included prodromal symptoms of LAST & symptoms of CV and CNS excitation and depression.



https://thejns.org/view/journals/j-neurosurg/132/3/article-p809.xml

Results:

➢ LAST in pregnancy may display **more cardiac depression than nonpregnant cohorts**

Pregnant cohorts:

- Significantly **higher risk of cardiac depression** (RR=1.96 (95% CI: 1.44-2.66), p<0.01)
- Significantly **LOWER risk than non-pregnant cohort of:**
  - **Cardiac excitation** (RR=0.38 (95% CI: 0.22-0.63), p<0.01)
  - **Prodromal symptoms** (RR=0.17 (95% CI: 0.09-0.33), p<0.01)
  - **CNS excitation** (RR=0.44 (95% CI: 0.21-0.90), p=0.02)
  - **CNS depression** (RR=0.24 (95% CI: 0.13-0.48), p<0.01)
- Prodromal symptoms affected only ≤ 6.52% of OB pts, with **none experiencing tinnitus, taste disturbance, disorientation, restlessness or agitation, or tremors.**
  - **vs** 21% of nonpregnant pts found to have (+) prodromal symptoms

4. De Valle et al. Local Anesthetic Systemic Toxicity in Pregnancy: A Retrospective Cohort Analysis. *Cureus* 2024.

Cureus. 2024 Sep 11;16(9):e69215. doi: 10.7759/cureus.69215

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✓ Findings consistent with previous literature: only two reports detail a clear manifestation of prodromal symptoms in pregnant patients.

- Suggests detecting LAST in pregnancy may be less distinguishable, partly due to **absent or mildly presenting prodromes**
  - ➢ ~ 48.6% of pregnant cohort had **no identified symptoms** vs 21% of nonpregnant cohort.
    - Possible underreporting of symptoms or inability to distinguish LAST from physiologic/pathologic processes in pregnancy as well as complications of neuraxial anesthesia

- **34.1% of pregnant cohort experienced *CV depression***
- **Only ≤ 3.6%** exhibited *excitatory manifestations*:
  - HTN, palpitations, tachycardia, arrhythmias, seizures, or convulsions.
  - CV depression following LA admin may be sensitive marker of systemic toxicity in OB, helping clinicians differentiate anesthetic toxicity vs other OB conditions.

- ≤3.6% of the pregnant cohort exhibited evidence of severe LAST symptoms and clinical deterioration:
  syncope & collapse, cardiac arrest, respiratory arrest, acute respiratory failure, and somnolence, stupor, or coma.

  Existing data reports indicate that when severe manifestations of LAST occur in the general population, many patients initially experience CV depressive symptoms, such as bradycardia and hypotension, before progressing to cardiac arrest.

4. De Valle et al. Local Anesthetic Systemic Toxicity in Pregnancy: A Retrospective Cohort Analysis. *Cureus* 2024.

Cureus. 2024 Sep 11;16(9):e69215. doi: 10.7759/cureus.69215

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Table 3. Clinical outcomes post-match risk ratio analysis.

Clinical presentation	Pregnant (n=276)	Nonpregnant (n=276)	RR (95% CI)[a]	p-value[b]
Prodromal symptoms	≤10	58	0.17 (0.09-0.33)	<0.01
Cardiovascular excitation	18	48	0.38 (0.22-0.63)	<0.01
Cardiovascular depression	94	48	1.96 (1.44-2.66)	<0.01
Central nervous system excitation	≤10	23	0.44 (0.21-0.90)	0.02
Central nervous system depression	≤10	41	0.24 (0.13-0.48)	<0.01

4. De Valle et al. Local Anesthetic Systemic Toxicity in Pregnancy: A Retrospective Cohort Analysis. *Cureus* 2024.

Excitatory CNS stimulation phase may or not be present

- Apparent CNS stimulation and subsequent depression presumed 2/2 depression of neuronal activity.
  - Selective depression of inhibitory neurons is thought to account for the excitatory phase in vivo

- **However, rapid systemic admin of a LA may produce death *with no, or only transient, signs of CNS stimulation*.**
- Under these conditions, the **LA [] likely rises so rapidly that all neurons are depressed simultaneously**.

✓ Airway control and respiratory support constitute essential tx.

✓ Benzo is drug of choice for terminating convulsions.

- In non-pregnant pts, pre-med benzos often recommended to ↑ seizure threshold prior to regional)
  - caution as resp depression: sedation can → resp acidosis → higher plasma [] of free drug.

3. NYSORA. Local Anesthetics: Clinical Pharmacology and Rational Selection; 2015.

Intravenous lipid emulsion for local anaesthetic systemic toxicity in pregnant women: a scoping review

Research | Open access | Published: 14 February 2024
Volume 24, article number 138 (2024) Cite this article

- Identified 22 women who developed LAST during pregnancy and childbirth, all presented as case reports or series.
- Most frequent causes : **#1) drug overdose and #2) IV migration of the epidural catheter**
- Of the 15 women who received lipid emulsions, all survived, no lasting neuro or CV damage r/t LAST
- No adverse events or sfx following IV lipid emulsion reported in mothers or neonates.
- 5 out of 7 women who did *not* receive lipid emulsions survived, and the other two died.

- **Drug overdose most commonly occurring in TAP block associated with GA or spinal anesthesia for C/s.**
- The potential danger of TAP blocks in these situations has not previously been highlighted.
  - Large volume LA into a relatively vascular plane which may result in significant LA absorbtion.

10. Tsuji M, Nii M, Furuta M, et al. *BMC Pregnancy and Childbirth.* 2024

Intravenous lipid emulsion for local anaesthetic systemic toxicity in pregnant women: a scoping review

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Table 3 Characteristics of LAST

From: Intravenous lipid emulsion for local anaesthetic systemic toxicity in pregnant women: a scoping review

	Cases, N
Onset of LAST (*n* = 22)	
After birth	13
During labour or birth including CS	8
In pregnancy	1
Types of local anaesthesia (*n* = 19 excluding drug errors)	
TAP block after CS	11
Epidural CS (preceded by epidural for labour)	2
Epidural for labour	2
Spinal for CS	1
Combined spinal–epidural (CSE) for labor	1
Perineal nerve block	1
Infiltration anaesthesia for fetal thoracentesis	1

10. Tsuji M, Nii M, Furuta M, et al. *BMC Pregnancy and Childbirth*. 2024

Table 3 cont'd

Potential primary causes of LAST (*n* = 22)	
Overdose	4
Intravascular migration of an epidural catheter	3
Partial intramuscular injection	1
Wrong route drug error	3
NR or unclear	11
Clinical manifestations (*n* = 22)	
Central nervous system toxicity	
Early phase	9
Severe phase (seizure, loss of consciousness)	12
Unclear	1
Cardiovascular symptoms	
No	8
Early phase	5
Severe phase without cardiac arrest phase	3
Cardiac arrest	3
Unclear	3

10. Tsuji M, Nii M, Furuta M, et al. *BMC Pregnancy and Childbirth.* 2024

Types of anaesthetic(*n* = 19, numbers overlapping)	
Bupivacaine	18
Bupivacaine only	*(8)*
Bupivacaine + other	*(10)*
Ropivacaine	9
Ropivacaine only	*(2)*
Ropivacaine + other	*(7)*
Lidocaine	7
Lidocaine only	*(1)*
Lidocaine + other	*(6)*
Levobupivacaine	1
Levobupivacaine + other	*(1)*

Timing of lipid emulsion (*n* = 15)	
Early phase of LAST	5
Later/severe phase of LAST without cardiac arrest	9
Later/severe phase of LAST with cardiac arrest	1
Lipid dosage (*n* = 15)	
1 bolus only without any infusion	3
1 bolus and infusion[a]	9
2 boluses without any infusion	2
2 bolus and infusion	1

[a]This category includes Spence [37] who reported 100 ml of 20% intralipid, provided by two 50 ml boluses

EPI: The Real MVP



- Epi added to LAs to cause vasoconstriction and to serve as a marker for IV injection
- Epi and other α1-agonists ↑ LA duration largely by: **prolonging & increasing intraneural [] of LAs.**
- Blood flow ↓ *only briefly*, and **block will persist long after the α1 vasoconstrictive effect has dissipated.**[9]
- EPI as a vascular marker, or "tracer"
  - ~10–15 µg epi has reasonable (albeit imperfect) sensitivity and positive predictive value.
    - ↑ HR of 10+ bpm or ↑ SBP of 15+ mmHg suggests IV injection.
    - Incremental injection of LAs (3–5 mL) and frequent aspiration recommended and, **together with using test doses**, may have contributed to decrease in LAST seen with epidurals.[4]

Consider with:

✓ Epidural placement
✓ Top-offs – is she in pain bc catheter has migrated IV?
✓ Conversion for cesarean – large, toxic doses

2. Gitman et al. *NYSORA*. 2018.
6. Butterworth, J. *Clinical Pharmacology of Local Anesthetics*. 2018.

LAST in OB

- ✓ **In available case reports - usually an IV Epidural catheter converted for c/s with PLAIN lido (no epi)**
- ✓ A post c/s TAP block has also been reported to cause LAST. [8]

- ✓ **EVERY EPIDURAL DOSE can be a TEST DOSE**
  - ➢ For top-offs, *always consider she may be uncomfortable because catheter has migrated IV*, and is no longer supplying LA to epidural space.
    - ➢ Adding a few cc **lido w/epi** to every top off will automatically test dose the catheter to assess for IV migration.
  - ➢ Frequently aspirate between EVERY 3-5cc aliquot
    - ➢ **Lack of blood return does NOT exclude IV catheter.** (but absent s/s IV epi usually does – even if BB)
  - ➢ **NEGATIVE initial test dose for labor epidural placement *does not rule out IV catheter migration* by the time epidural conversion for c/s happens.**

- ✓ **EVERY BOLUS DOSE – ASSESS for s/s IV local anesthetic**
  - ➢ Can repeat test dose if pt is uncomfortable to r/o catheter migration.
    - ➢ 2% lido with 1:200,000 epi
    - ➢ Plain Lido – Add 0.1 cc (100mcg) epi from 1mg/cc epi vial.
      100mcg = 5mcg/cc in a 20cc lido syringe. (1:200,000)

5. J.D. Griffiths et al. *British Journal of Anaesthesia* 2025.

Case Report: **Untested** Epidural Catheter was IV

Apparent local anesthetic systemic toxicity following activation of an epidural catheter for cesarean delivery: diagnosis and management of an uncommon obstetric anesthesia complication

Youstina Soliman [a], Angelica A Hatfield [a], Russell K McAllister [a], Michael R Fettiplace [b], Michael P Hofkamp [a,✉]

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PMCID: PMC11332648 PMID: 39165828

Spoiler: Dingdongs DID NOT test the epidural catheter before dosing, and gave 15mL *plain* 2% lido (300 mg) without epi and had NO idea the epidural catheter was IV



- CSE placed. Spinal failed Alis test.
- Gave 300 mg lido via epidural catheter in three 5 mL doses over 8 min.
- T4 block, uneventful c/s delivery.

- ~ 30 minutes following the final 5 mL epidural lido, during fascial closing, pt s/s: AMS and progressive LOC with: dysconjugate gaze, decreased responsiveness, slurred speech and difficult to arouse.
- ECG displayed NSR without acute changes and there was no significant change in HR or BP.

- Presumptive dx of LAST: 60 mL of 20% intralipid. The pt's mental status improved to baseline within 5 min of lipid emulsion admin, complete recovery.

7. Soliman et al. *Baylor University Medical Center Proceedings*. 2024

Case Report: Epidural Catheter migrated IV despite (-) heme on aspiration.

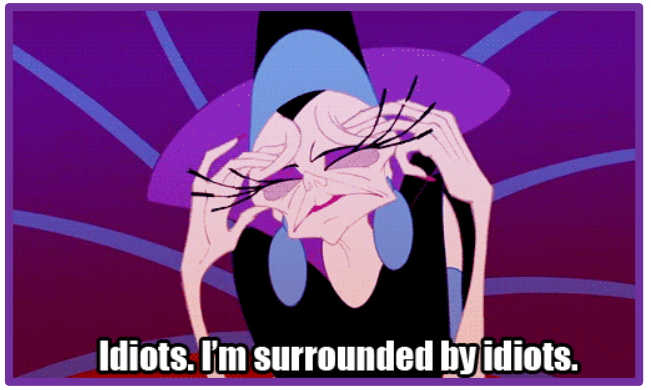
CASE REPORT

When Pain Relief Turns Perilous: Local Anesthetic Systemic Toxicity in Labor—A Case Report

Meenakshisundaram Mahalakshmi[1], Priya Vijayarajan[2]

Received on: 17 April 2025; *Accepted on*: 05 May 2025; *Published on*: 25 July 2025

Spoiler: Dingdongs AGAIN DID NOT test the epidural catheter before dosing. Then gave 10 mL of 0.75% ropi and 10 mL of 2% plain lido, with NO idea the epidural was IV.



- (-) 3 mL TD 2% lido w/ epi → 10 mL 0.2% ropi administered. Analgesia T10 level, infusion started at 8 mL/h.
- 3hrs later, fetal bradycardia w/ mec noted, prompting a STAT c/s.

- After confirming (-) aspiration, (**BUT NO TEST DOSE W/ EPI**) gave 10 mL 0.75% ropi + 10 mL 2% plain lido.
- Pt immediately developed facial twitching, abnormal limb movements, and seizure-like activity—suspected LAST
  - ✓ 100% O_2 + 4 mg IV midazolam. Emergency declared. Airway secured via RSI 100 mg prop & 100 mg sux
  - ✓ Baby delivered < 5 min
  - ✓ Post-delivery, pt developed bradycardia → PEA
  - ✓ Code blue → CPR, ACLS, + 100 mL of 20% intralipid (1.5 mL/kg) IV bolus, followed by a 250 mL infusion.
    - ✓ Rhythm check → pulseless VT → defibrillated (200 J) → ROSC achieved after 5 min CPR.
    - ✓ Remained HD stable and successfully extubated after 12 hrs
    - ✓ Postop recovery uneventful for both mother and baby.

In the discussion about prevention, authors suggested:

"Use epi for RaPiD AbSoRpTiOn pReVeNtiON: Add epi to reduce systemic absorption when injecting into highly vascular areas."



BRUH. WUT? *ANYTHING ELSE* MY DUDE? MAYBE USE EPI AS A TRACER FOR IV LA so you stop injecting?

Or just use chloroprocaine..

9. Mahalakshmi, M, Vijayarajan, P. *Journal of South Asian Federation of Obstetrics and Gynaecology*. 2025

Case Report: Epidural Catheter migration into vessel

Two for One: A Case Report of Intravenous Lipid Emulsion to Treat Local Anesthetic Systemic Toxicity in Term Pregnancy

Jonathan Dun-Chi Lin [*], Eellan Sivanesan [†], Terese T Horlocker [‡], Andres Missair [§]

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PMCID: PMC6484440 NIHMSID: NIHMS1023945 PMID: 28099175

- Normal CSE placement, **negative** test dose.
- Bupi 0.1% and fent 2.5 µg/mL PCEA started: basal 6 mL/h, bolus 6 mL, lockout 10 min, max bolus frequency 3/hr.
- A single 6-mL bolus from epidural pump
  - 50 min after admin of the first LA, Pt c/c tinnitus and metallic taste. ECG: narrow-complex sinus tach 130–140, normotensive
    - ✓ positioned LUD & supplemental O_2

➢ Palpitations, stating "something was off" and was "having an out-of-body experience."
➢ NO other meds given since starting epidural.
  - ✓ Presumptive dx LAST on basis of rapidly evolving symptoms.
  - ✓ PCEA stopped, and 1.5 mL/kg of 20% intralipid IV bolus, then infusion started at 0.25 mL/kg/min.

➢ Pt's symptoms resolved within 10 min of intralipid admin, and gtt was continued for an hour after symptom resolution.
➢ The pre-existing epidural catheter removed and tip was noted to be intact but blood-tinged
➢ Review of the epidural pump record revealed a total of **24 mL of bolus deliveries**. (+ basal rate = max 30mg total IV bupi)
  - ❖ So the epidural probably migrated right after the test dose and was IV the whole time.
  - ❖ 3 more pump boluses = she was uncomfortable = no LA in the epidural space – all IV.
  - ❖ If you're not getting significant relief by the next 15 minutes – CALL ANESTHESIA, don't just bolus yourself.

- 2hrs later, pt underwent an urgent pCS for arrest of active descent.
- Repeat CSE performed successfully at L3–L4 with 1.4mL of 0.75% bupi IT without complications. Epidural catheter never dosed.

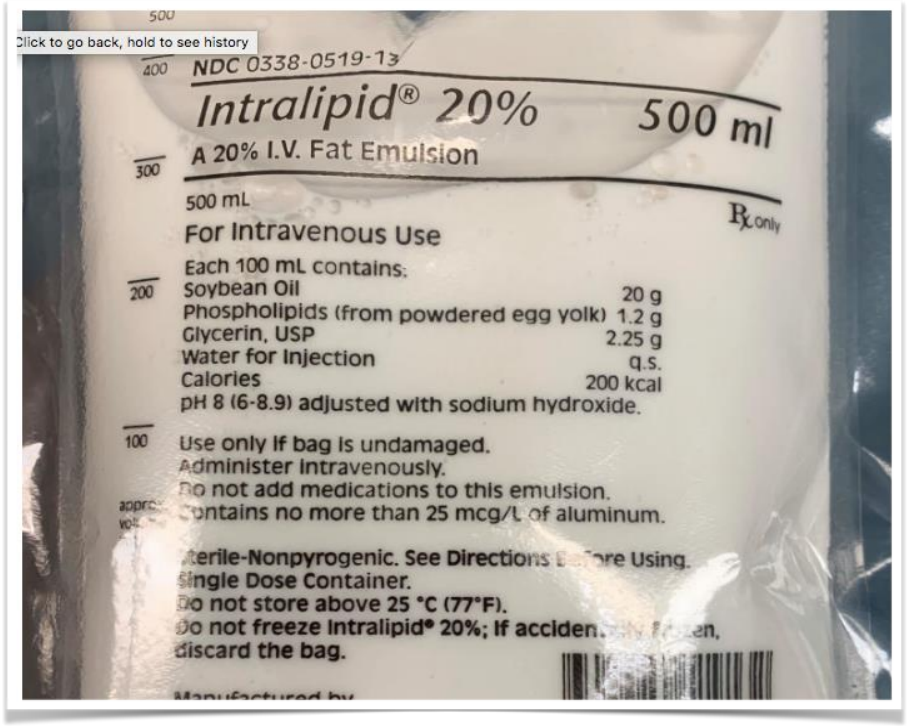
8. Dun-Chi Lin et al. Two for One. *A & A Case Reports* 2017

Initial Management of LAST

1. **Call for help**
2. **Establish ventilation with normocarbia**
3. **Circulatory support** (low-dose epi 50-100mcg)
   - ➢ Seizure control (use only **benzos***)
4. **Alert Cardiac Bypass Team**

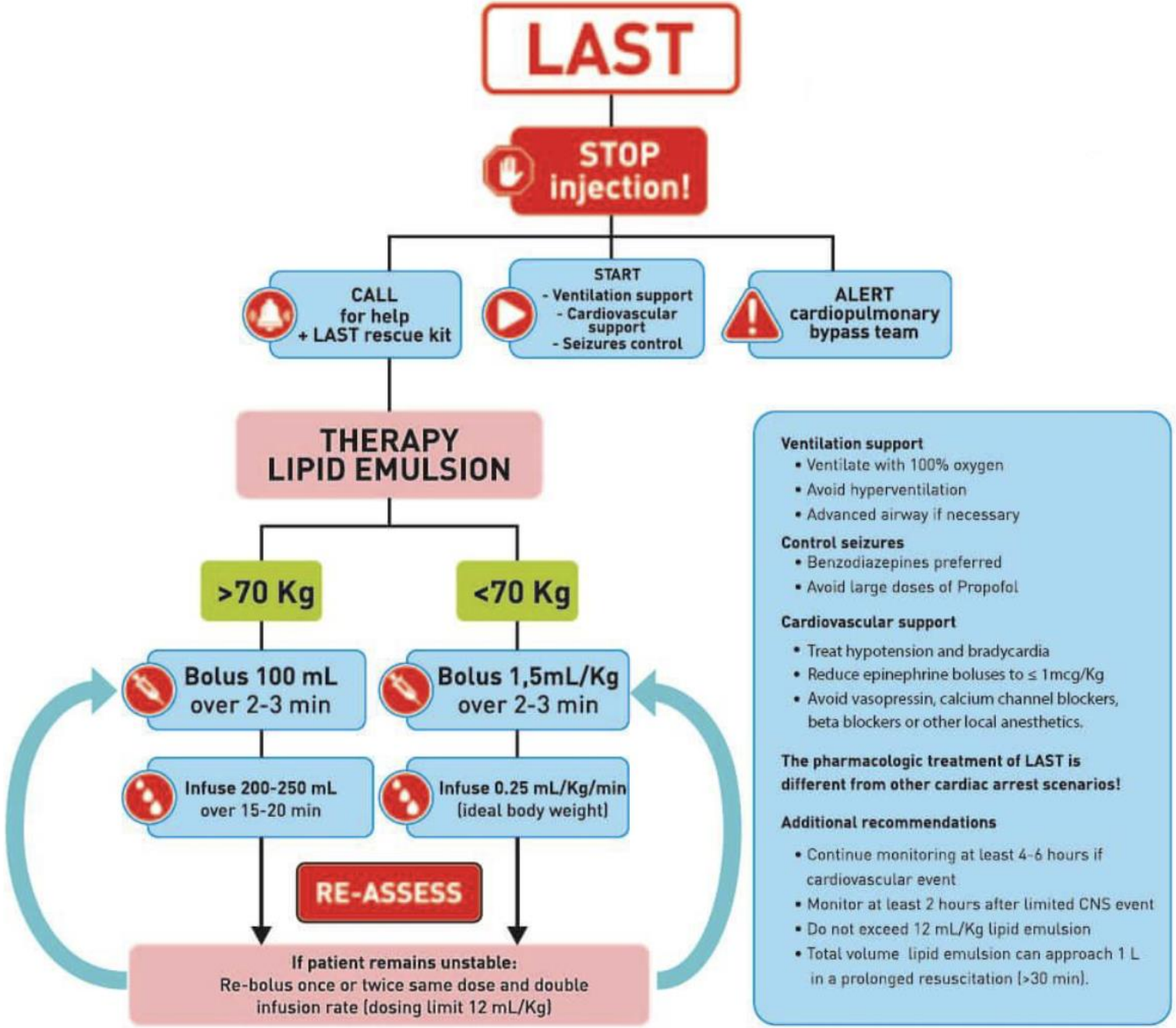
- ✓ *Immediate ventilation & oxygenation to prevent hypoxia & acidosis can reduce progression to seizures or cardiac arrest*
- ✓ *Avoid long-acting paralytics as they mask seizure activity. Reverse Roc if used.*

20% Fat Emulsion = INTRALIPID



- **SOYBEAN OIL: TRUE ANAPHYLACTIC SOY ALLERGY = CONTRAINDICATION**

- **Potential cross-sensitivity with severe PEANUT and EGG allergies**
  - **same as prop: egg lecithin from yolk – most egg allergies to egg white albumin protein**
- **Analphyaxis tx: Epi doses in LAST: Max 50-100mcg**



Ventilation support

- Ventilate with 100% oxygen
- Avoid hyperventilation
- Advanced airway if necessary

Control seizures

- Benzodiazepines preferred
- Avoid large doses of Propofol

Cardiovascular support

- Treat hypotension and bradycardia
- Reduce epinephrine boluses to ≤ 1mcg/Kg
- Avoid vasopressin, calcium channel blockers, beta blockers or other local anesthetics.

The pharmacologic treatment of LAST is different from other cardiac arrest scenarios!

Additional recommendations

- Continue monitoring at least 4-6 hours if cardiovascular event
- Monitor at least 2 hours after limited CNS event
- Do not exceed 12 mL/Kg lipid emulsion
- Total volume lipid emulsion can approach 1 L in a prolonged resuscitation (>30 min).

NYSORA®

INTRALIPID DOSE

- **Over 70 kg:**
  - **100 mL bolus over 2 - 3 min** + 250 mL infusion over 15 – 20 min
- Under 70 kg:
  - **1.5mL/kg BOLUS x 1 min +** 0.25 mL/kg/min infusion

If HOTN persists, **re-bolus** once or twice, and ***double the infusion rate***

- Max dose **< 12mL/kg**
- Total intralipid volume can approach **~ 1L** over ~ 30 min of CPR time

In Cardiac Arrest: STAT Resuscitative Cesarean Delivery < 5min

- INTUBATE & ***USE CPR TO CIRCULATE FAT EMULSION***
  - Manual LUD
  - Continue CPR/ACLS until intralipid effective → ROSC
    - Maintain LUD if uterus still palpable after fetal delivery
  - NO ROSC → CP Bypass until LA metabolized

ACLS FOR L.A.S.T

50-100mcg Epi code doses
0.5-1cc Bristajet per round





➢ SMALLER EPI ACLS DOSES of 0.8-1mcg/kg

- ~ 50-100 mcg for most pts
- Bristajet = 100mcg/cc
- 1mg/cc vial in 100cc NS = 10mcg/cc
- 1mg vial in 9cc NS = 100mcg/cc

➢ SEIZURE TX = BENZODIAZEPINE

- Midazolam, Lorazepam
- 🚫 ***Avoid Propofol**** - can worsen acidosis & cause cardiac depression/HOTN
  - use < 20mg increments if benzo unavailable.[3]

➢ VENTRICULAR ARRHYTHMIA TX = AMIODARONE

- Usual ACLS 300mg 1st dose, 150mg 2nd dose if needed
- Defibrillation can be used, often **ineffective** until LA cleared and Na+ channels regain function

➢ MAINTAIN NORMOCARBIA

- Hyper & hypocarbia worsen CNS toxicity, hypercarbia worsens cardiac toxicity.

➢ 🚫 AVOID VASOPRESSIN

- Assoc with poor outcomes: can cause pulmonary hemorrhage 2/2 high SVR impairing CO
- Can cause tetanic uterine contraction and further fetal distress

➢ 🚫 AVOID CCBs & BBs

- Worsens cardiac contractility and function.

NYSORA

Local Anesthetic Systemic Toxicity Checklist

ASRA

- Call for help
- Get LAST rescue kit
- Consider cardiopulmonary bypass team

+ Consider administering LIPID EMULSION early

LIPID EMULSION 20%
The order of administration (bolus or infusion) and method of infusion (manually, iv roller clamp, or pump) are not critical

over 70 kg

- Bolus ~100 mL over 2-3 min
- Infuse ~250 mL over 15-20 min

IF PATIENT REMAINS UNSTABLE:
- Repeat bolus
- Double infusion

under 70 kg

- Bolus ~1.5 mL/kg over 2-3 min
- Infuse ~0.25 mL/kg/min (consider using a pump if <40 kg)

IF PATIENT REMAINS UNSTABLE:
- Repeat bolus
- Double infusion

Seizure?

- Ensure adequate airway
- Benzodiazepine preferred
- If only propofol available, use low dose, e.g., 20 mg increments

Arrhythmia or Hypotension?

BEWARE
LAST Resuscitation is DIFFERENT from Standard ACLS

EPINEPHRINE
- Smaller than normal dose preferred
- Start with ≤1 mcg/kg

AVOID
- Local anesthetics
- Beta-blockers
- Calcium channel blockers
- Vasopressin

Stable?

- Continue lipid emulsion ≥15 min once hemodynamically stable
- Maximum lipid dose: 12 mL/kg

Once Stable, OBSERVE
- 2 hrs after seizure
- 4-6 hrs after cardiovascular instability
- As appropriate after cardiac arrest

ASRA PAIN MEDICINE EDUCATION RESEARCH

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Graphic: Erin Jane Neal

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