A 32-year-old woman is brought to the emergency department by her boyfriend after she was found unresponsive and lying on the ground. She was last seen more than 24 hours ago. History is significant for substance use disorder. She has no other medical problems and takes no prescription drugs.

On physical examination, the patient is intubated and on mechanical ventilation. She is minimally responsive. Blood pressure is 120/75 mm Hg, and pulse rate is 110/min. The remainder of the vital signs and the cardiac, pulmonary, and abdominal examinations are unremarkable. The neurologic examination is nonfocal. Urine output has been <20 mL/h for the past 2 hours.

- **Which of the following if the most appropriate treatment?**
  a) Hemodialysis
  b) IV 0.9% saline
  c) IV 5% dextrose
  d) IV calcium gluconate infusion
  e) IV isotonic sodium bicarbonate in 5% dextrose

Laboratory studies:	
Calcium	6.9 mg/dL (1.7 mmol/L) ↓
Creatine kinase	40,000 U/L
Creatinine	2.8 mg/dL (247.5 µmol/L)
Electrolytes:	
Sodium	150 mEq/L (150 mmol/L)
Potassium	5.5 mEq/L (5.5 mmol/L)
Chloride	110 mEq/L (110 mmol/L)
Bicarbonate	16 mEq/L (16 mmol/L)
Phosphorus	5.9 mg/dL (1.9 mmol/L) ↑
Fractional excretion of sodium	<1%
Urine myoglobin	300 mg/mL
Urinalysis	Reddish brown urine; pH 5.2; 4+ blood; 2+ protein; granular casts
Toxicology screen	Positive for cocaine and opiates

A 32-year-old woman is brought to the emergency department by her boyfriend after she was found unresponsive and lying on the ground. She was last seen more than 24 hours ago. History is significant for substance use disorder. She has no other medical problems and takes no prescription drugs.

On physical examination, the patient is intubated and on mechanical ventilation. She is minimally responsive. Blood pressure is 120/75 mm Hg, and pulse rate is 110/min. The remainder of the vital signs and the cardiac, pulmonary, and abdominal examinations are unremarkable. The neurologic examination is nonfocal. Urine output has been <20 mL/h for the past 2 hours.

- **Which of the following if the most appropriate treatment?**
  - a) Hemodialysis
  - **b) IV 0.9% saline**
  - c) IV 5% dextrose
  - d) IV calcium gluconate infusion
  - e) IV isotonic sodium bicarbonate in 5% dextrose

Laboratory studies:	
Calcium	6.9 mg/dL (1.7 mmol/L)
Creatine kinase	40,000 U/L
Creatinine	2.8 mg/dL (247.5 µmol/L)
Electrolytes:	
Sodium	150 mEq/L (150 mmol/L)
Potassium	5.5 mEq/L (5.5 mmol/L)
Chloride	110 mEq/L (110 mmol/L)
Bicarbonate	16 mEq/L (16 mmol/L)
Phosphorus	5.9 mg/dL (1.9 mmol/L)
Fractional excretion of sodium	<1%
Urine myoglobin	300 mg/mL
Urinalysis	Reddish brown urine; pH 5.2; 4+ blood; 2+ protein; granular casts
Toxicology screen	Positive for cocaine and opiates

CC: agitation and weakness

HPI: 64 yr old woman.
- 3 months of agitation, confusion, and weakness
- Symptoms are getting worse, especially in the last 3 days
- Asking repeatedly for water, going to the bathroom many times a day and night, "wobbly on feet"

- No recent trauma or falls

- No other notable ROS

PMH: T2DM, hypothyroidism, bipolar disorder (remission)

SurgHx: Unilateral nephrectomy (possibly due to kidney mass?)

SH: Denied ETOH, tobacco, or drug use.
- Lives with son

ALLERGIES: NKDA

MEDS:
- Amitriptyline (TCA)
- Atorvastatin
- ASA
- Dulaglutide (GLP-1 agonist)
- Insulin
- Levothyroxine
- Lithium

PHYSICAL EXAM:

Tmax: 36.7C, **BP:** 112/66, **HR:** 72, **RR:** 17, **SpO2:** 98% on RA

General: Intermittent **agitation** / distress and then dozes off

HEENT: PERRLA, nonicteric sclera, dry MM, supple neck

CV: RRR, no M/R/G

Pulm: unlabored breathing on room air, CTAB

GI: obese, nondistended, nml bowel sounds, soft, nontender, no HSM

MSK: no edema, pulses 2+, warm extremities, no rigidity

Skin: No rashes, no lesions

Neuro: intermittently dozes off, A&O x1 (name), **diffuse tremors / myoclonic jerks**, moving all extremities spontaneously

LABS:

14	13	297
	42	

132	103	28	137
4.1	18	**1.8**	Base: 1.2

7.3	4.2
0.6	0.2
27	26
55	

EKG: NSR, QTC 453

Lithium: 2.2 (↑)
Utox: negative

Lactate: 2.2

TSH: 3.61 (nml)
FT4: 1.0 (nml)

<u>UA</u>
SG: 1.016
1+ protein
Nitrites: negative
2+ LE
50 WBC / HPF
Many bacteria

Urine Na: 39
Urine Cr: 219

Covid-19: negative

<u>Blood cultures x2</u>
No growth

<u>Urine cultures</u>
≥100,000 E. faecium

CTH: negative
CXR: negative

PROBLEM REPRESENTATION:

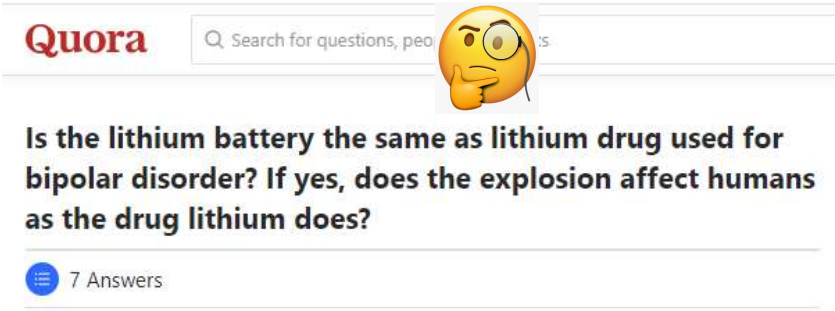
Elderly woman w/ hx unilateral nephrectomy, bipolar d/o on Lithium, hypothyroidism, presenting with chronic progressive encephalopathy, polydipsia, polyuria, ataxia, and tremors, found to have…

LITHIUM TOXICITY

LITHIUM

- Narrow therapeutic window

- Rapid GI absorption
- Excreted almost entirely by the **KIDNEYS**
  - Minor declines in renal function → toxicity



TRIGGERS OF TOXICITY

- Dehydration (vomiting, diarrhea, anorexia, warm climates)
- Anything that causes renal injury
  - Medication induced (ACEi or NSAIDs)
  - Old age (age-related renal decline)

MANIFESTATIONS

ACUTE

- GI
  - Nausea, vomiting, diarrhea
- Cardiac
  - Prolonged QTC & rarely bradycardia
  - Typically **NOT** associated w/ ↑ cardiac enzymes or LV dysfunction
- Neuro
  - Sluggishness, confusion, agitation, ataxia, NM excitability (tremors)
  - Seizures, nonconvulsive status epilepticus

CHRONIC

- Neuro
  - **SILENT** (Syndrome of Irreversible Li Effectuated Neurotoxicity)
- Renal
  - Nephrogenic DI

LABS

- Li levels: Trend q2-q4 hrs. Initial level **may NOT be peak**!
- Utox, Tylenol, Salicylate levels: common coingestion
- EKG: Check for prolonged QTC
- High TSH, low T3 & T4
- Calcium
- Beta-hCG: Teratogenic
- R/o etiologies of AKI
- R/o etiologies of AMS (MIST)

TREATMENT

- Evaluate ABCs
- STOP offending agent
- Call Poison Control 800-411-8080
- IVFs
- **GI decontamination**
- Dialysis

ACTIVATED CHARCOAL IS NOT EFFECTIVE FOR LITHIUM

POISON CONTROL

Useful Extensions and Phone Numbers

5-xxxx = 885- 3-xxxx = 793-

Units	Numbers + Fax
2A CCU	55335, Fax 55275
2A ICU	35656, Fax
2A MICU	55252, Fax 55343
2C SURG	56617, Fax 54027
2K SICU	55305, Fax 55313
2K TICU	53200, Fax 53221
3A ARU	55647, Fax 55634
3A RRU	52229, Fax 31823
3E SURG	52190, Fax 52052
3K MICC	56616, Fax 56638
3M L&D	56400, Fax 56454
3M NICU	56428, Fax 56440
4A ARU	52180, Fax 52175
4E MED	52208, Fax 31824
4K SURG	55660, Fax 55699
4K BURN	56666, Fax 56675
5A PCU	56640, Fax 56662
5M PEDS	55255, Fax 55259
5M PICU	55260, Fax 55263
6A Med	54090, Fax 54288
EPS	56100, Fax 56117
Pharmacy	
Main Hospital	52360
Main IV Room	52375, 52360 *1,1

Miscellaneous	
Admitting/Bed Control	56600, 56660
Cardiac Cath Lab	54350, Fax 35820
Central Supply	56790
Chaplain	56996, 56994
Chaplain Catholic	56997
Coroner	31900
ECHO	56092
EEG Outpatient	55590
EKG Department	54370
Employee Health	32658
Gateway (Sub Abuse)	800-488-9919
Human Resources	55450
Infection Control	55760
Information Systems	55300
Medical Records	55130
Mental Health	800-704-0900
Pager Office	57321
Poison Control	800-411-8080
Public Health	792-5050
PURC	54495
Resource Nurse	p275-3392
Renal Dialysis Inpt	55732
Renal Dialysis Outpt	55730
Respiratory Therapist	52080

DISPO

- Observe and provide supportive therapy
- Generally ok to discharge when Li < 1.5

CC: agitation and weakness

HPI: 64 yr old woman.
- 3 months of agitation, confusion, and weakness
- Symptoms are getting worse, especially in the last 3 days
- Asking repeatedly for water, going to the bathroom many times a day and night, "wobbly on feet"

- No recent trauma or falls

- No other notable ROS

PMH: T2DM, hypothyroidism, bipolar disorder (remission)

SurgHx: Unilateral nephrectomy (possibly due to kidney mass?)

SH: Denied ETOH, tobacco, or drug use.
- Lives with son

ALLERGIES: NKDA

MEDS:
- Amitriptyline (TCA)
- Atorvastatin
- ASA
- Dulaglutide (GLP-1 agonist)
- Insulin
- Levothyroxine
- Lithium

PHYSICAL EXAM:

Tmax: 36.7C, **BP:** 112/66, **HR:** 72, **RR:** 17, **SpO2:** 98% on RA

General: Intermittent **agitation** / distress and then dozes off

HEENT: PERRLA, nonicteric sclera, dry MM, supple neck

CV: RRR, no M/R/G

Pulm: unlabored breathing on room air, CTAB

GI: obese, nondistended, nml bowel sounds, soft, nontender, no HSM

MSK: no edema, pulses 2+, warm extremities, no rigidity

Skin: No rashes, no lesions

Neuro: intermittently dozes off, A&O x1 (name), **diffuse tremors / myoclonic jerks**, moving all extremities spontaneously

LABS:

14	13	297
	42	

132	103	28	137
4.1	18	**1.8**	Base: 1.2

7.3	4.2
0.6	0.2
27	26
55	

EKG: NSR, QTC 453

Lithium: 2.2 (↑)
Utox: negative

Lactate: 2.2

TSH: 3.61 (nml)
FT4: 1.0 (nml)

UA
SG: 1.016
1+ protein
Nitrites: negative
2+ LE
50 WBC / HPF
Many bacteria

Urine Na: 39
Urine Cr: 219

Covid-19: negative

Blood cultures x2
No growth

Urine cultures
≥100,000 E. faecium

CTH: negative
CXR: negative

PROBLEM REPRESENTATION:

Elderly woman w/ hx unilateral nephrectomy, bipolar d/o on Lithium, hypothyroidism, presenting with chronic progressive encephalopathy, polydipsia, polyuria, ataxia, and tremors, found to have…

DIAGNOSIS: LITHIUM TOXICITY

LEARNING POINTS:

- Li is almost entirely excreted by the **kidneys**, so even minor declines in function can trigger toxicity.
- Manifestations / Complications
  - Nausea, vomiting, diarrhea
  - Encephalopathy, agitation, ataxia, NM excitability, seizures, non-convulsive status
  - Syndrome of Irreversible Li Effectuated Neurotoxicity (SILENT)
  - Nephrogenic DI
- Check Li levels frequently because they **may NOT have peaked yet**!
- Treatment
  - Stop offending agent
  - Monitor ABCs
  - IVFs
  - GI decontamination (activated charcoal is NOT effective)
  - Dialysis
- Poison Control: 800-411-8080