LAB MEDICINE EMERGENCIES

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Minivan Driver

no disclosures

CENSUS

Mr. Farmer

Ms. Colacey

Mr. Sweaty

Mrs. Sad

Mr. Etoh

Let's start rounding…

MR. FARMER

PMH/PSH

Never been to doctor.

SOCIAL HISTORY:

Married. Neversmoker. No ETOH.

MEDS:

None.

***Transferred from OSH for femur fracture after falling off tractor and being rolled over.

ADMIT LABS

Hemoglobin 11.7

WBC 11.8K

Platelets 198K

Creatinine 1.0

Glucose 146

Potassium 4.8

Sodium 138

***Fentanyl PCA, Western movie channel, and normal saline overnight, scheduled first case in morning.

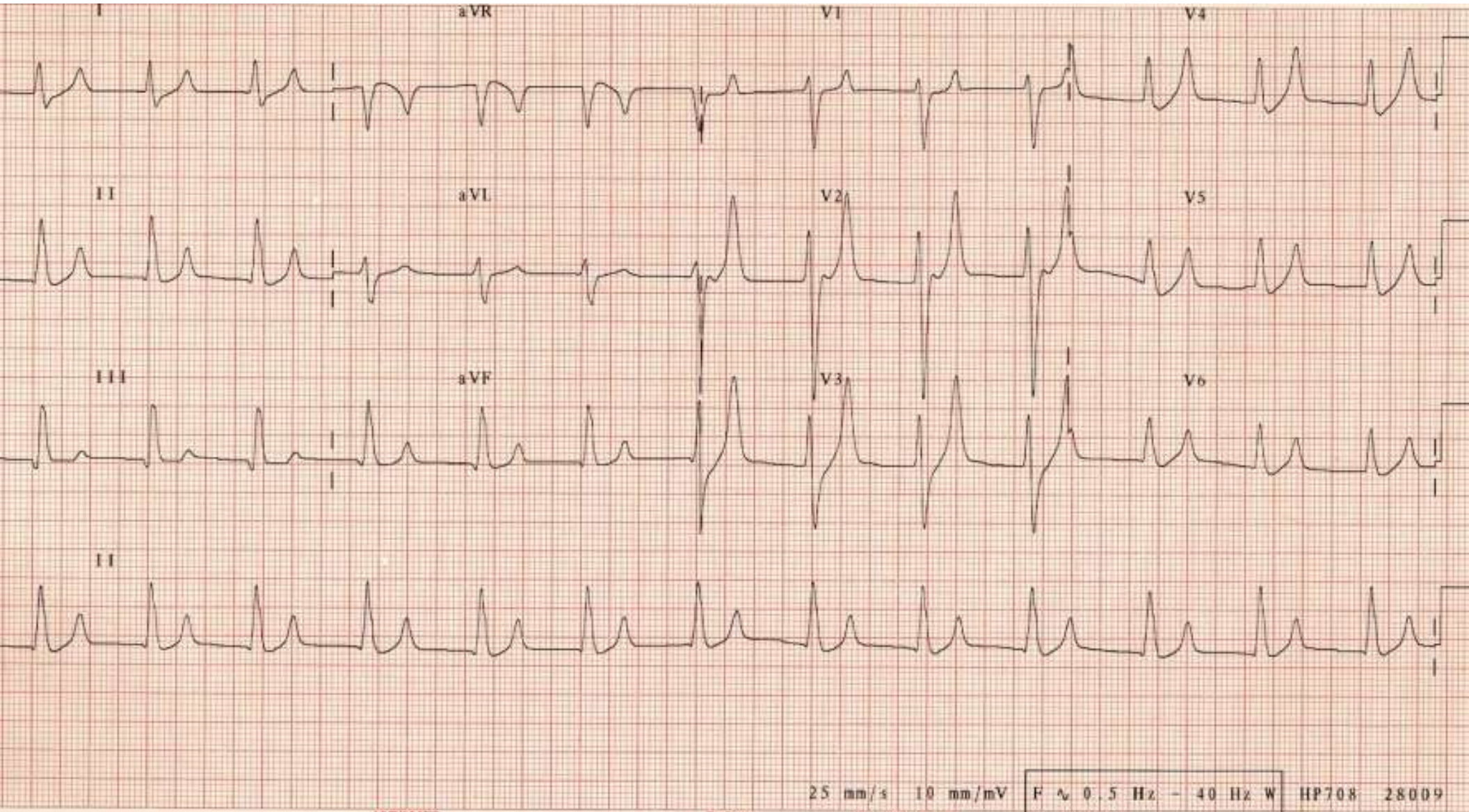
	ADMIT LABS	DAY 2
Hemoglobin	11.7	11.1
WBC	11.2	12.7
Platelets	199,000	159,000
Creatinine	1.0	2.7
Glucose	146	189
Potassium	4.8	**7.0**
Sodium	144	141

Potassium 7.0

Glucose	146	189
Potassium	4.8	**7.0**
Sodium	144	141

WHY EMERGENCY?

- **Cardiac Conduction abnormalities**
- **Paralysis**
- **Muscle Weakness**



RHABDOMYOLYSIS

Traumatic	Nontraumatic Exertional	Nontraumatic Nonexertional
Crush Syndrome Immobilization	Marked exertion Hyperthermia	Drugs Toxins Infections

What else causes high potassium????

HYPERKALEMIA

-Decreased excretion (renal dx)

-Tissue Catabolism (rhabdo, hemolysis, GI bleed)

-Cell shift (acidosis, lack of insulin)

-Excessive intake (IV, PO, KCl salt substitute)

-Blood transfusion

-Medications (ACE/ARB, K+ sparing, cyclosporine, NSAIDS)

-Pseudo (hemolysis, elevated WBC (> 50K) platelets (>1million))

-Heparin Induced Hypoaldosteronism (2-4d after admin)

And how can we fix it…

HYPERKALEMIA: TREATMENT

Intervention	Mechanism	Onset and Duration	Dose	Remember
Calcium Gluconate	Stabilize cardiac membrane.	Immediate Onset, transient	1000mg (10mL of 10% solution)	Can repeat X1 if EKG changes persist. Can exacerbate dig tox.
Albuterol	Shift potassium into cells	20-30 minutes, Transient	10-20mg in 4ml nebulized solution ever four hours.	Beta agonist
Insulin D50	Shift potassium into cells.	10-20minutes, transient	10units of regular insulin with D50	Monitor blood sugar closely.
Furosemide	Increases urinary potassium excretion	Onset: 5 - 30 mins Duration: 2 - 6 h	20 – 40 mg IV q12 – 24 h	Use only after hydration, Useful in volume overload, heart failure
Kayexalate	Increase potassium excretion.	1-2 hours	15-30grams orally	Do not give to post op or renal transplant pts
Dialysis	Potassium removal	Immediate	n/a	Marked tissue breakdown, ESRD on HD,
SZC/Patiromer	Cation exchange	1-4hours	10g TID x 48hrs or 8.4g daily.	?Restriction

STABILIZE

Intervention	Mechanism	Onset and Duration	Dose	Remember
Calcium Gluconate	Stabilize cardiac membrane.	Immediate Onset, transient	1000mg (10mL of 10% solution)	Can repeat X1 if EKG changes persist. Can exacerbate dig tox.

SHIFT

Intervention	Mechanism	Onset and Duration	Dose	Remember
Albuterol	Shift potassium into cells	20-30 minutes, Transient	10-20mg in 4ml nebulized solution ever four hours.	Beta agonist
Insulin D50	Shift potassium into cells.	10-20minutes, transient	10units of regular insulin with D50	Monitor blood sugar closely.

REMOVE

Intervention	Mechanism	Onset and Duration	Dose	Remember
Furosemide	Increases urinary potassium excretion	Onset: 5 - 30 mins Duration: 2 - 6 h	20 – 40 mg IV q12 – 24 h	Use only after hydration, Useful in volume overload, heart failure
SZC/Patiromer	Cation Exchange	1-4hours	10g TID x 48hrs	Restricted?
Dialysis	Potassium removal	Immediate	n/a	Marked tissue breakdown, ESRD on HD

Our next patient awaits…

MS. COLACEY

PMH/PSH

Obesity

PSH:

Right Total Knee

SOCIAL HISTORY:

Single. Wheelchair bound. Resides in SNF.

MEDS:

15 Lidoderm patches, Fentanyl patch. MiraLAX, Vitamin D, Tums

ROS:

“Confusion, back pain, Can’t poop!!!”

ADMIT LABS

Lab	Admission
Hemoglobin	10.2
MCV	86
Platelets	214,000
Sodium	133
Potassium	3.9
Bicarbonate	23
Creatinine	1.5
BUN	48
Alk Phos	586
ALT	38
Bilirubin	1.0
ABG	Normal
UA	Negative

ADMIT LABS

Lab	Admission
Hemoglobin	10.2
MCV	86
Platelets	214,000
Sodium	133
Potassium	4.8
Bicarbonate	23
Creatinine	1.5
BUN	48
Alk Phos	586
ALT	38
Bilirubin	1.0
ABG	Normal
UA	Negative
Calcium	14.6

ADMIT LABS

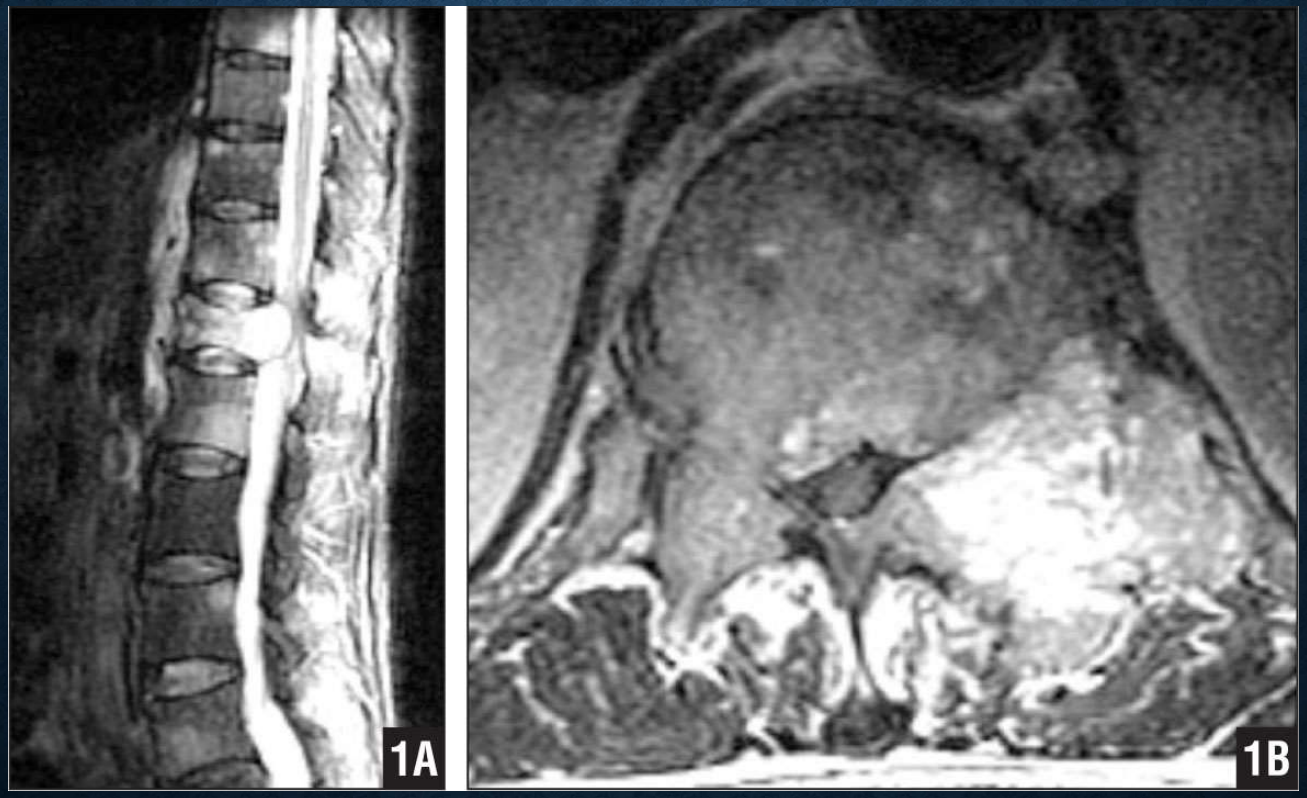
Lab	Admission
Hemoglobin	10.2
MCV	86
Platelets	214,000
Sodium	133
ALT	38
Bilirubin	1.0
ABG	Normal
UA	Negative
Calcium	14.6

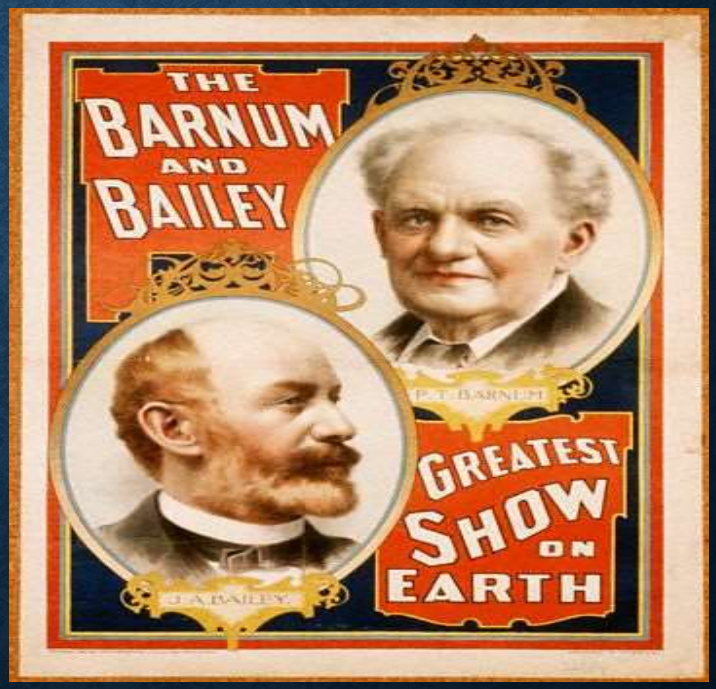
Calcium 14.6

WHY IS THIS AN EMERGENCY?

- Coma
- Cardiac Arrhythmia
- Renal failure
- Polyuria
- Polydipsia
- Dehydration
- Nausea
- Anorexia
- Muscle Weakness
- Constipation
- Nephrolithiasis

METASTATIC BREAST CANCER




THE
BARNUM
AND
BAILEY
GREATEST
SHOW
ON
EARTH

Prostate

Breast

Kidney

Thyroid

Lung

multiple myeloma

What else causes hypercalcemia?

HYPERCALCEMIA

-Primary Hyperparathyroidism

-Malignancy (PTH peptide, Bone Mets)

-Sarcoidosis

-Drugs (HCTZ, Lithium, Theophylline, Vitamin D)

-Vitamin D intoxification

-Hyperthyroidism

-Immobilization

HYPERCALCEMIA: TREATMENT

Intervention	Mechanism	Duration of action	Dose	Remember
Normal saline	Restores volume, promotes calcium excretion	Hours	200-300 ml/hr IV to maintain UOP 100-150 cc/hr	Caution in heart failure
Bisphosphonates	Block osteoclast mediated bone resorption	Onset: 1 – 3 d Duration: 2 - 4 wk.	Pamidronate IV 60-90mg (2 - 4 h) Zoledronic acid IV 4 - 8 mg (15 min)	Caution in renal failure Rare: Osteonecrosis of the jaw, esp. with repeated doses
Calcitonin	Increases calcium excretion Decreases Ca reabsorption	Onset: 1 – 4 h Duration: 6 – 12 h	4 - 8 IU/Kg q12h SQ/IV	Safe Tachyphylaxis limits use
Furosemide	Increases urinary Ca excretion	Onset: 5 - 30 mins Duration: 2 - 6 h	20 – 40 mg IV q12 – 24 h	No longer 1st line Rx, Use only after hydration, Useful in volume overload, heart failure
Corticosteroids	Inhibit cytokine mediated inflammation, vit D analog	Onset: 1-5 d Duration: 2-4 wks.	Prednisone 40-60 mg/d	Useful in lymphoma, granulomatous disease

HYDRATE!!!!

Intervention	Mechanism	Duration of action	Dose	Remember
Normal saline	Restores volume, promotes calcium excretion	Hours	200-300 ml/hr IV to maintain UOP 100-150 cc/hr	Caution in heart failure

MOVE CALCIUM

Intervention	Mechanism	Duration of action	Dose	Remember
Bisphosphonates	Block osteoclast mediated bone resorption	Onset: 1 – 3 d Duration: 2 - 4 wk.	Pamidronate IV 60-90mg (2 - 4 h) Zoledronic acid IV 4 - 8 mg (15 min)	Caution in renal failure Rare: Osteonecrosis of the jaw, esp. with repeated doses
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Furosemide	Increases urinary Ca excretion	Onset: 5 - 30 mins Duration: 2 - 6 h	20 – 40 mg IV q12 – 24 h	No longer 1st line Rx, Use only after hydration, Useful in volume overload, heart failure

TACHYPHYLAXIS:

Definition:

rapid development of tolerance or immunity to the effects of a drug

OTHER

Intervention	Mechanism	Duration of action	Dose	Remember
Corticosteroids	Inhibit cytokine mediated inflammation, vit D analog	Onset: 1-5 d Duration: 2-4 wks.	Prednisone 40-60 mg/d	Useful in lymphoma, granulomatous disease
Denosumab	Rank Ligand Inhibitor	Within 24hrs	60mg subcu may repeat x1	Not renally cleared.

WHAT ABOUT TOTAL VS IONIZED?

Corrected Calcium = Calcium + 0.8 (4.0-Albumin)

Calcium

Hyperalbuminemia

Hypoalbuminemia

Chronic Kidney Disease

Ionized

$$$$$$$$$$$$$$$$$$$$$$$$$$

Acid Base disorders

Hyperparathyroidism

Hyperphosphatemia

Time to move to our next patient…

MS. SAD

PMH

Diabetes

PSH:

4 Bunion Removals

SOCIAL HISTORY:

Widowed. Neversmoker. Recently placed in SNF by you.

MEDS:

Lisinopril 5mg daily, ASA 325mg daily, Zoloft 100mg daily (NEW)

******Vitals stable. Discharged three weeks ago, direct admit bounceback from SNF for confusion*******

LABS

Lab	Discharge	Admission
Hemoglobin	10.9	10.2
WBC	7000	8600
Platelets	186000	214,000
Sodium	136	**121**
Potassium	4.6	3.9
Glucose	133	146
Bicarbonate	19	23
Creatinine	0.9	1.1
BUN	19	16
AST	54	52
ALT	91	100
ABG	n/a	Normal
UA	n/a	Negative

LABS

Lab	Admission
Hemoglobin	10.2
WBC	8600
Glucose	146
Bicarbonate	23
Creatinine	1.1
BUN	28
AST	52
ALT	100
ABG	Normal
UA	Negative

Na 121

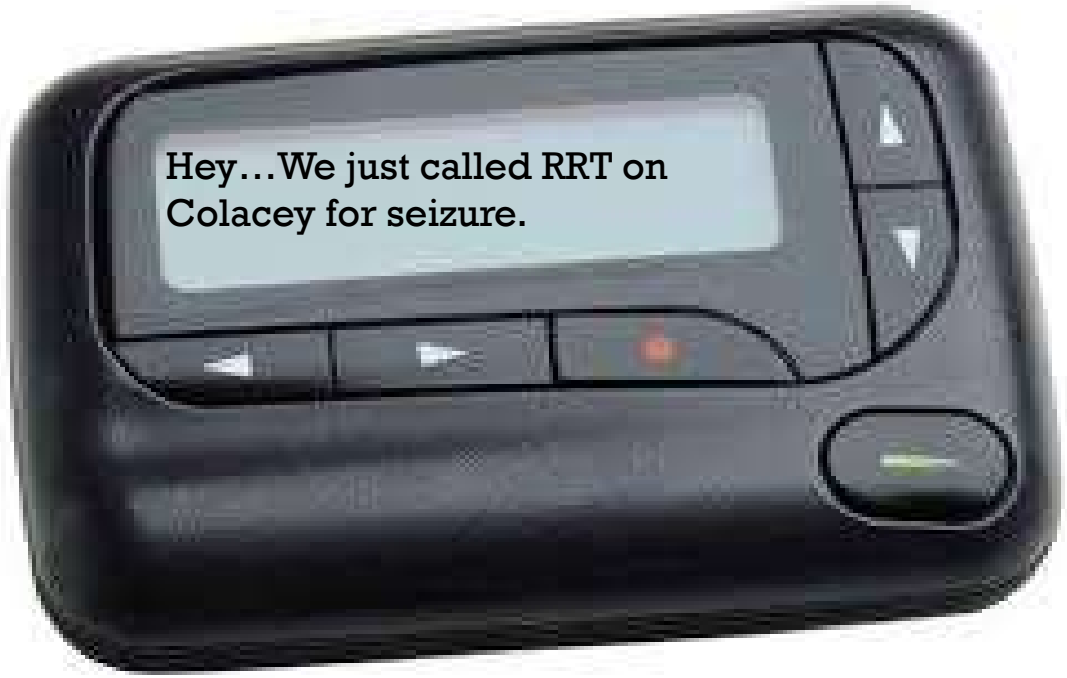
WHY IS THIS BAD?

- Cerebral Edema
- Seizures
- Coma
- Respiratory Arrest
- Malaise
- Nausea
- Headache
- Altered Mental Status

“Cute…but down here in the ER we wear vests and resuscitate with authority”

3L Saline→ Admit to Medicine

27 GRAMS OF SALT



Na+

118

Let's back up a bit…

What causes hyponatremia?

Hypovolemic

-Volume contraction

-Sweating, Diarrhea, or Vomiting

-Diuretics (Thiazides, Loop)

-Cerebral Salt Wasting

Euvolemic

-SIADH (Head trauma, Seizure, CNS disease, Neoplastic, Meds)

-Adrenal Failure

-Hypothyroidism

Hypervolemic

-Congestive Heart Failure

-Cirrhosis

-Polydipsia

-Nephrotic Syndrome

-Renal disease

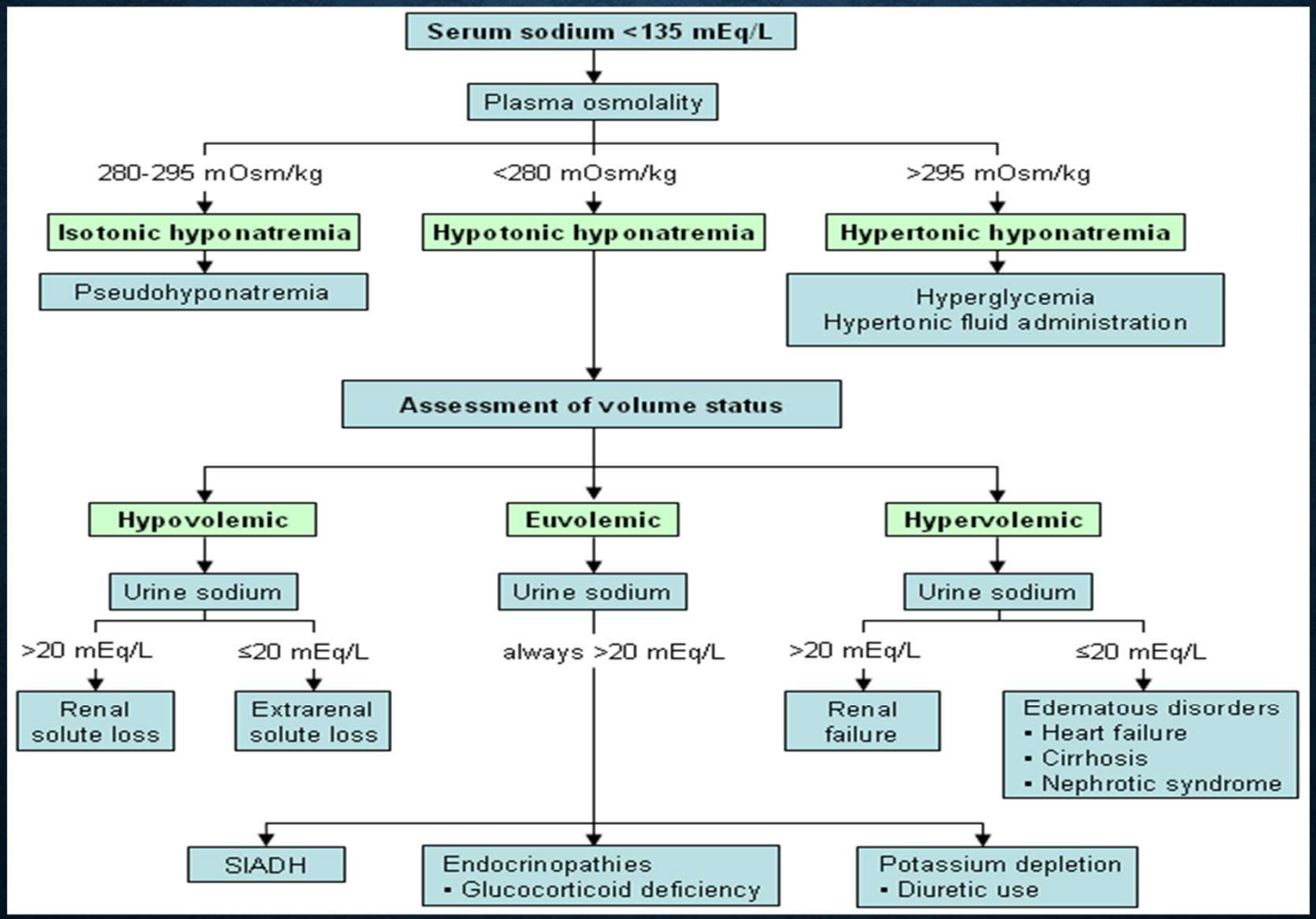
Pseudo

-Hyperglycemia *FOR EVERY 100 ABOVE 100 ADD 1.6*

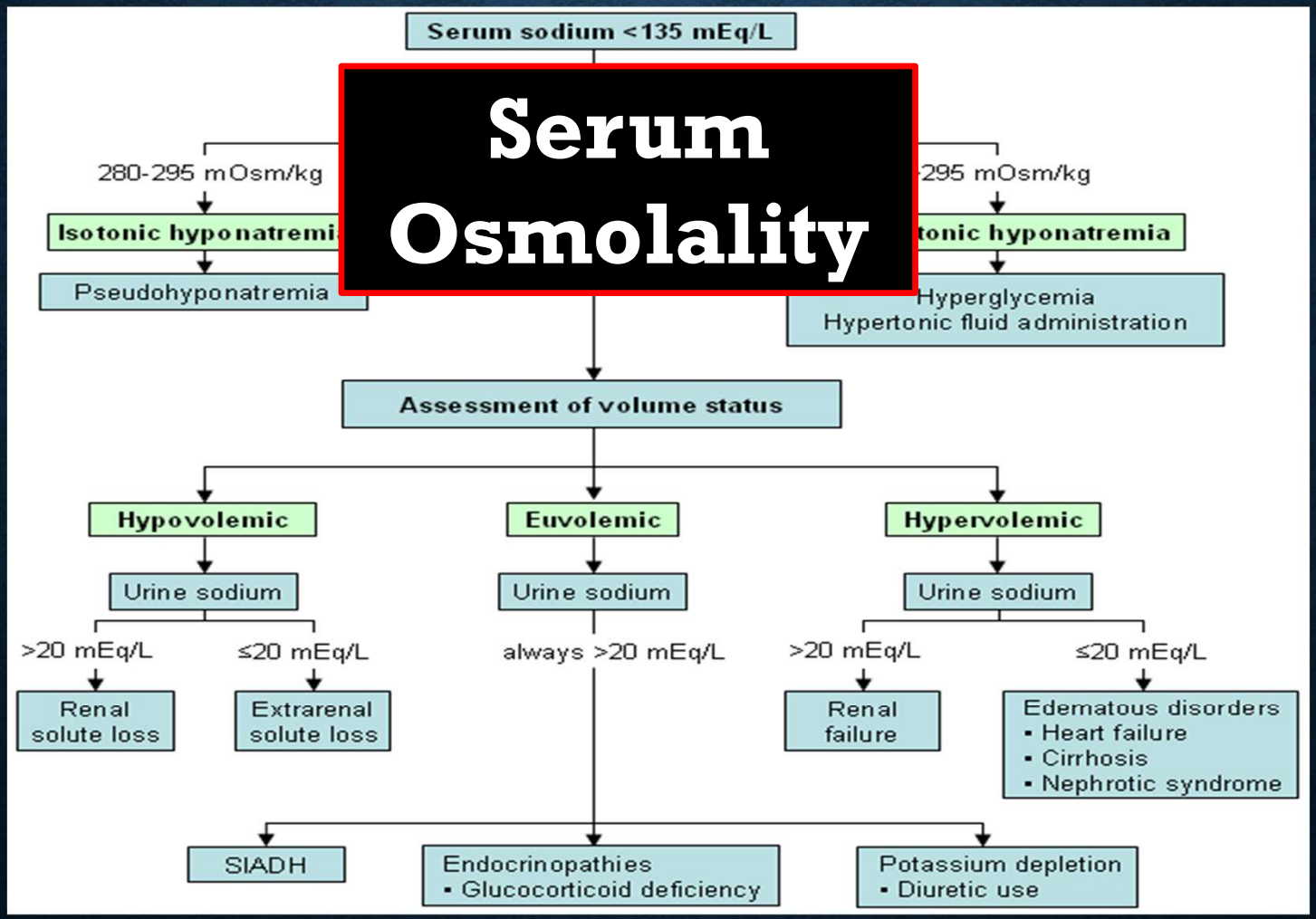
-Hypertriglyceridemia

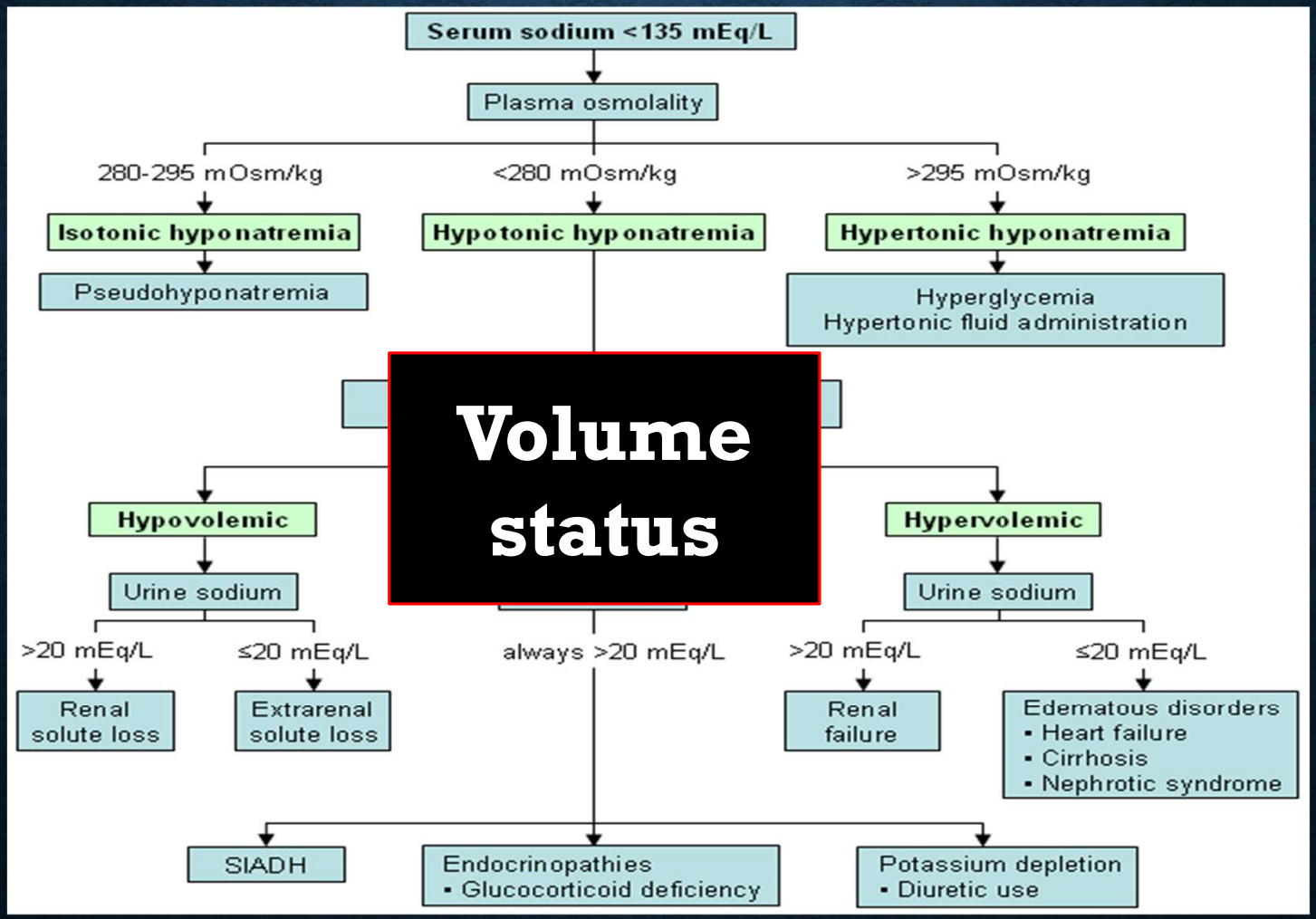
-Paraproteinemia

How do we figure it out?


Serum sodium <135 mEq/L
Plasma osmolality
280-295 mOsm/kg
<280 mOsm/kg
>295 mOsm/kg
Isotonic hyponatremia
Hypotonic hyponatremia
Hypertonic hyponatremia
Pseudohyponatremia
Hyperglycemia
Hypertonic fluid administration
Assessment of volume status
Hypovolemic
Euvolemic
Hypervolemic
Urine sodium
Urine sodium
Urine sodium
>20 mEq/L
≤20 mEq/L
always >20 mEq/L
>20 mEq/L
≤20 mEq/L
Renal solute loss
Extrarenal solute loss
Renal failure
Edematous disorders
▪ Heart failure
▪ Cirrhosis
▪ Nephrotic syndrome
SIADH
Endocrinopathies
▪ Glucocorticoid deficiency
Potassium depletion
▪ Diuretic use

Serum Osmolality

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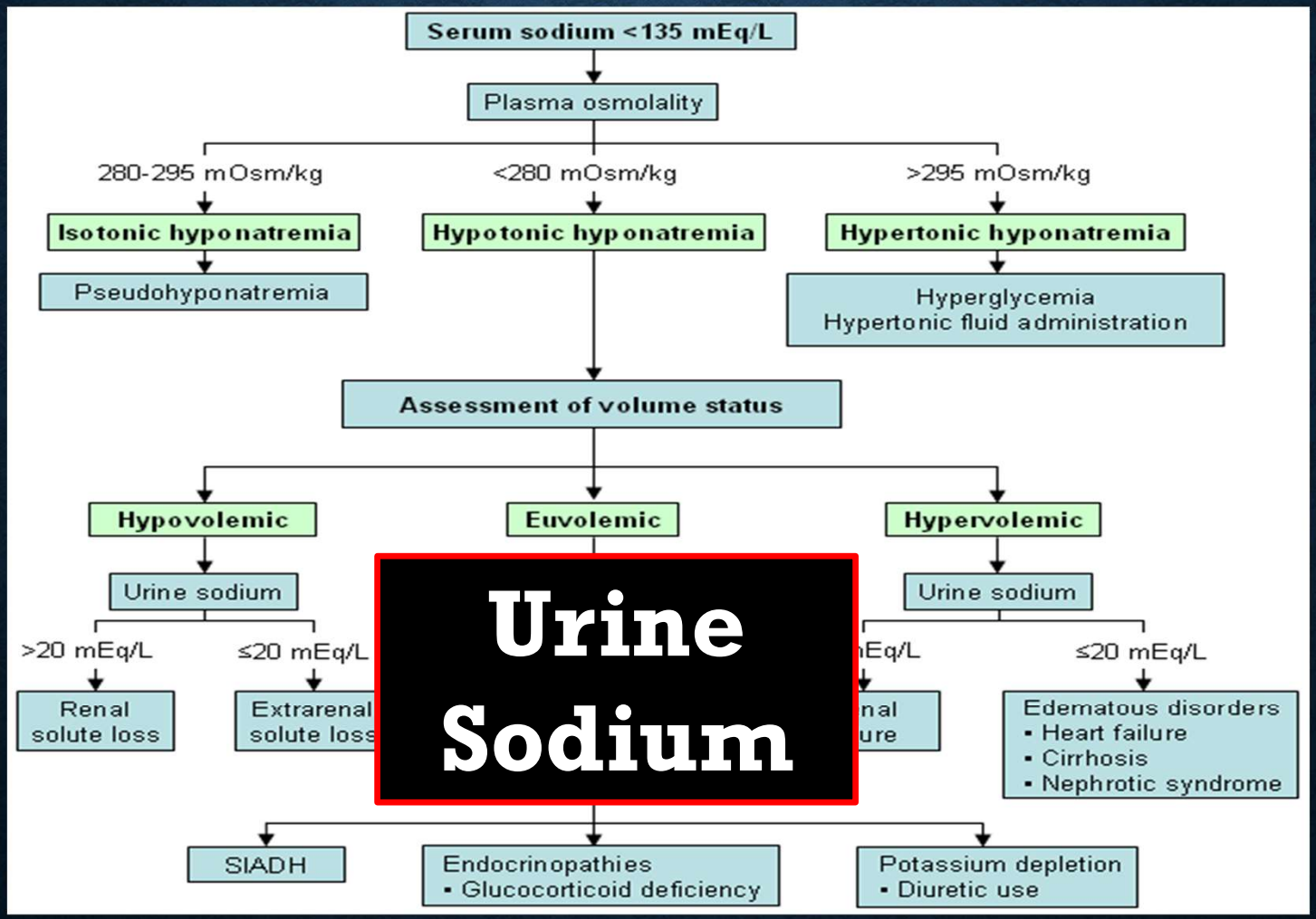
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Assessment of volume status
Hypovolemic
Euvolemic
Hypervolemic
Urine sodium
Urine sodium
>20 mEq/L
≤20 mEq/L
≤20 mEq/L
Renal solute loss
Extrarenal solute loss
Edematous disorders
▪ Heart failure
▪ Cirrhosis
▪ Nephrotic syndrome
Urine Sodium
SIADH
Endocrinopathies
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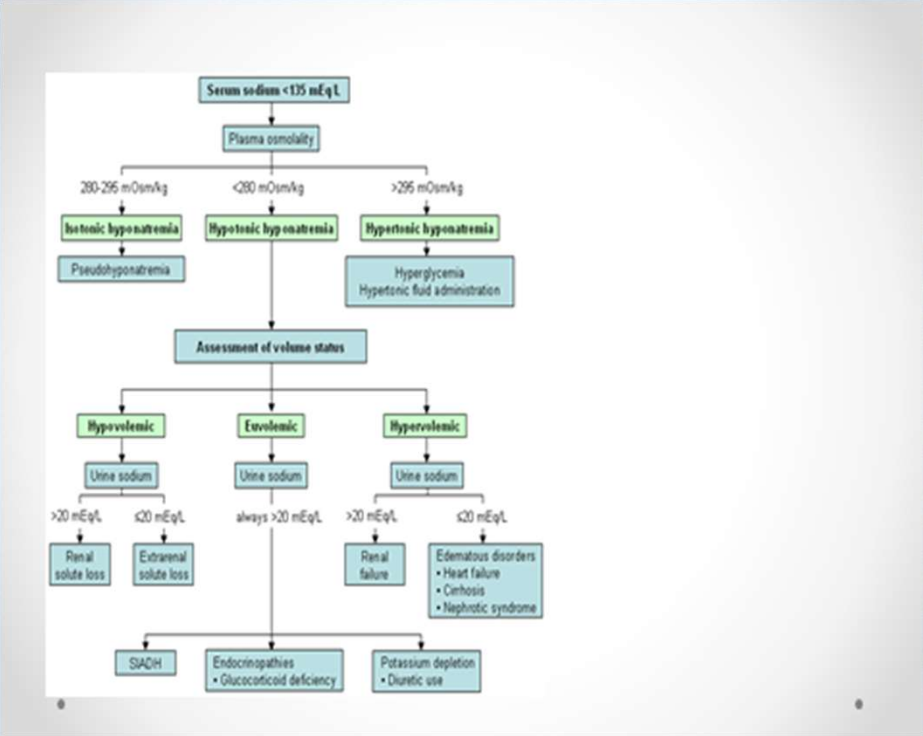
LABS



Lab	Admission
Sodium	121
Creatinine	1.1
BUN	18
Vitals	Normotensive
Edema	None
Serum Osmo	260
Orthostatics	Normal
Urine Sodium	58

SIADH

- Malignancy (Lung, Brain, GI, GU, lymphoma)
- Pulmonary (Pneumonia, asthma, COPD, Lung CA)
- Intracranial (Trauma, Stroke, Hemorrhage, Infection)
- Drugs (Antipsycotics, Antidepressants, Chemo, Ectasy)
- Misc (Pain, Nausea, Post Operative)

DIAGNOSING SIADH

Serum Osmo <275	**Normal Acid Base Status**
Euvolemic	**Normal Adrenal Function**
Urine Osmo >100 Osm/kg	**Normal renal function**
Urine Sodium > 40mEq/L	**Normal Thyroid**

How do we fix it?

TREATMENT PEARLS

Volume Contraction = Normal Saline

Fluid Overload = Diurese and Restrict

SIADH = Fluid Restrict (800mL per day)

3% Saline = 100mL bolus (2-3meq)

Goal <9meq in 24 hours

Osmotic Demyelination Syndrome (ODS)

MR. SWEATY

PMH

Diabetes

Chronic Kidney Disease

PSH:

Appendectomy

SOCIAL HISTORY:

Single. Significant alcohol and tobacco use.

MEDS:

NPH 15u BID, ASA 325mg Qday, Metoprolol 50mg BID, Norvasc 5mg BID

ROS:

Nausea, vomiting, weight loss. Night sweats.

ADMIT LABS

Lab	Admission
Hemoglobin	8.2
WBC	1,900
Platelets	54,000
Sodium	133
Potassium	6.3
Bicarbonate	23
Creatinine	1.5
LDH	645
Phosphorus	8.6
Calcium	6.8
Uric Acid	9.6

CAIRO-BISHOP CLASSIFICATION

LABORATORY TUMOR LYSIS SYNDROME
Uric acid ≥ 8mg/dL (≥ 476μmol/L) or 25% increase from baseline
Phosphorus ≥ 6.5mg/dL (≥ 2.1mmol/L) or 25% increase from baseline

CLINICAL TUMOR LYSIS SYNDROME
Creatinine > 1.5 times the upper limit of normal
Cardiac arrhythmia or sudden death
Seizure

WHY EMERGENCY?

Hyperuricemia

- Uric acid can crystallize in renal tubules and lead to acute renal failure

Hyperkalemia

- Life-threatening arrhythmias

Hyperphosphatemia

- Leads to hypocalcemia, tetany, seizures, arrhythmias

ADMIT LABS

Lab	Admission
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Creatinine	1.5
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Calcium	6.2
Uric Acid	9.6

Problem	Intervention	Dosage	Comments
Renal insufficiency	IV fluids	Normal saline, 3L/m2 daily	Caution if history of CHF
Hyperuricemia	Allopurinol (xanthine oxidase inhibitor) inhibits uric acid production Rasburicase (recombinant urate oxidase) Converts uric acid into water soluble allantoin	100 mg/m2 divided in 3 doses (every 8 hours) Commonly 600 mg initially followed by 300 mg/d (prophylaxis) IV 0.15-0.2 mg/kg/d (can be given up to 5 days)	Reduce dose in renal failure. Only effective in prophylaxis. Not recommended if uric acid level above 7.5 mg/dl For severe hyperuricemia. Contraindicated in pregnancy, G6PD deficiency Expensive
Hyperphosphatemia	Phosphate binders Dialysis	50-150 mg/kg daily	Low phosphorus diet Dialysis if refractory to therapy
Hyperkalemia	Insulin (Regular) Dextrose (50%) Calcium gluconate (10%) Kayexalate Sodium bicarbonate Albuterol Dialysis	10 units IV 5 ml Dextrose 50% IV push 1000 mg IV 20 mg nebulized	 If hyperkalemic ECG changes Dialysis if refractory to therapy
Hypocalcemia	Calcium gluconate (10%)	1000 mg IV (no faster than 200mg IV/minute)	Use only if symptomatic, Caution with severe hyperphosphatemia

Our last patient awaits…

MR. ETOH

PMH
None.

PSH:
None.

SOCIAL HISTORY:
Single. Significant for LOTS of alcohol and tobacco use.

MEDS:
None.

ROS:
Unknown.

LABS

Lab	Admission
Hemoglobin	10.2
MCV	101
Platelets	14,000
Sodium	128
Potassium	2.9
Bicarbonate	33
Creatinine	1.4
BUN	28
AST	252
ALT	112
Lactate	4.6
INR	4.1

MR. ETOH

Autopsy notes:

- Small Cell Lung Cancer
- Cirrhosis
- Subdural Bleed

LABS

Lab	Admission
Hemoglobin	10.2
MCV	101
Platelets	14,000
Sodium	128
Potassium	2.9
Bicarbonate	33
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AST	252
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ETOH

Decreases platelet aggregation 20 minutes after ingestion

Toxic to megakaryocytes

Causes liver disease and splenomegaly

Accelerates platelet apoptosis

Decreased TPO

Extra Credit:

MCV goes Up (Folate)

AST/ALT ratio 2:1 and typically less than 300

Magnesium down

DIC

Sepsis

Malignancy (leukemia, mucinous tumors (eg, pancreatic, gastric, ovarian), and brain tumors).

Trauma (central nervous system)

Infection (Bacterial, COVID)

Obstetrical complications

Intravascular hemolysis

WHAT IS THIS DIC YOU SPEAK OF?

Disseminated Intravascular Coagulation

Coagulation and Fibrinolysis at same time

Blood exposed to procoagulant (TF, LPS)

Acute vs Chronic

ISTH CRITERIA FOR DIC

FORMULA

Diagnostic criteria for overt DIC (patient has to have an underlying disorder known to be associated with overt DIC to use this algorithm):

Variable		Points
Platelet count, cells x 10^9/L	≥100	0
	50 to <100	1
	<50	2
Elevated levels of a fibrin-related marker* (e.g. D-dimer, fibrin degradation products)	No increase	0
	Moderate increase	2
	Severe increase	3
Prolonged PT, seconds	<3	0
	3 to <6	1
	≥6	2
Fibrinogen level, g/L	≥1	0
	<1	1

*Use lab-specific cutoff values.

*This scoring tool is only appropriate for use if there is presence of disease known to be associated with DIC.

Interpretation:

Score	Diagnosis
<5	Not suggestive of overt DIC, may be non-overt DIC; repeat within next 1-2 days and manage clinically as appropriate
≥5	Compatible with overt DIC; treat for DIC as appropriate and repeat scoring daily

https://www.mdcalc.com/calc/10203/isth-criteria-disseminated-intravascular-coagulation-dic

DIC MANAGEMENT

Treat underlying disorder!

Are they Clotting?

- Clinically overt Art/Ven TE or extensive deposition of fibrin (ischemia/skin infarcts)
- low dose heparin 500-1000u/hr (10u/kg/hr)
- Consider antithrombin replacement

Are they Bleeding?

- FFP replace clotting factors (16cc/kg)
- Cryoprecipitate for fibrinogen (>100)
- Platelets (keep >50K)

“LETS RUN THE LIST”

Mr. Farmer

Ms. Colacey

Mr. Sweaty

Mrs. Sad

Mr. Etoh

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UpToDate