

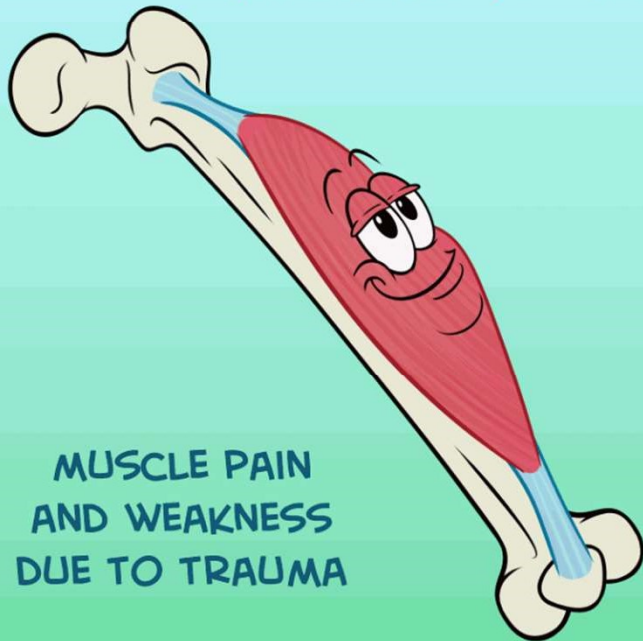


# RHABDOMYOLYSIS



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MUSCLE TISSUE BREAKDOWN WITH  
RELEASE OF INTRACELLULAR CONTENTS  
(MYOGLOBIN) INTO CIRCULATION



MUSCLE PAIN  
AND WEAKNESS  
DUE TO TRAUMA

ELEVATED CREATINE  
KINASE (CK) LEVELS



DARK, REDDISH  
BROWN URINE DUE  
TO MYOGLOBINURIA

MYOGLOBIN MAY OCCLUDE THE STRUCTURES OF THE KIDNEY  
AND BREAK DOWN INTO TOXIC COMPOUNDS LEADING TO  
ACUTE TUBULAR NECROSIS OR ACUTE RENAL FAILURE

TRAUMATIC	NON-TRAUMATIC	
Crush Injury	EXERTIONAL	NON-EXERTIONAL
Immobilization	Extreme exertion! (especially in untrained athletes)	Drugs and toxins
Multiple Trauma	Environmental heat	Alcoholism
Extensive third-degree burns	Malignant hypothermia	Infections (HIV, other viruses, bacteria)
	Seizures	Electrolyte abnormalities
	Neuroleptic malignant syndrome	Endocrinopathies, DKA
		Inflammatory myopathies
		Ischemic Limb Injury

TABLE 1

Medications and Toxic Substances That Increase the Risk of Rhabdomyolysis

Direct myotoxicity	Indirect muscle damage
HMG-CoA reductase inhibitors, especially in combination with fibrate-derived lipid-lowering agents such as niacin (nicotinic acid; Nicolar)	Alcohol
Cyclosporine (Sandimmune)	Central nervous system depressants
Itraconazole (Sporanox)	Cocaine
Erythromycin	Amphetamine
Colchicine	Ecstasy (MDMA)
Zidovudine (Retrovir)	LSD
Corticosteroids	Neuromuscular blocking agents

## LABS

↑ CK (>5x ULN)

Leukocytosis

Hyperkalemia, hyperphosphatemia, hypocalcemia

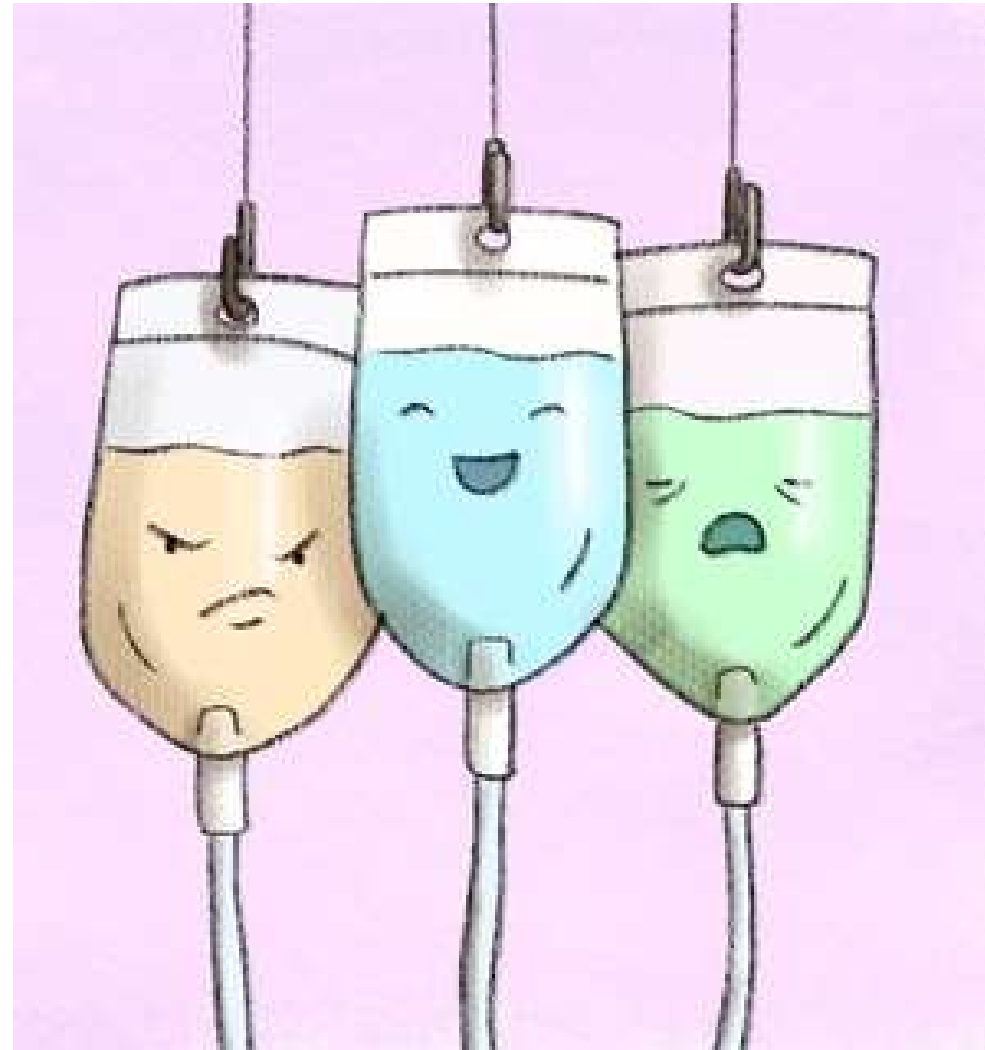
↑ Cr

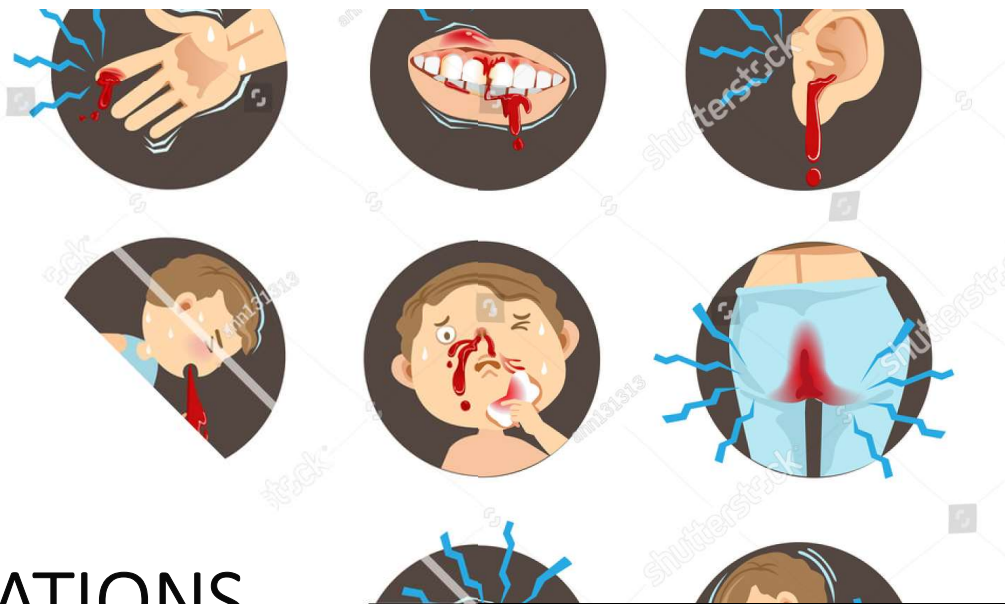
↑ AST and ALT

UA w/ positive Hgb but **NO** RBCs (myoglobinuria)

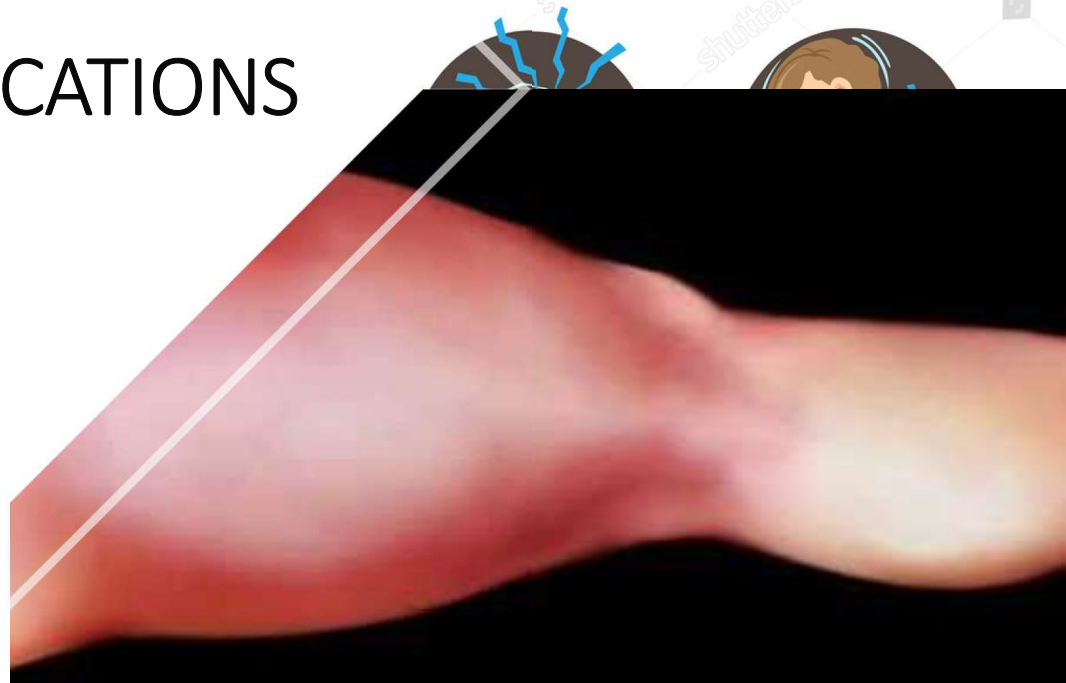
# TREATMENT

- **Treat underlying cause**
- Prevention of heme-associated AKI
  - **Aggressive fluid resuscitation** (1-2 L/hr)
  - At risk of AKI if CK > 5000
  - Watch out for volume overload (pulm congestion)
  - **Goals: CK < 5000 and/or UOP 200-300 cc/hr**
  - Consider loop diuretics if not meeting UOP goal
- Sodium Bicarbonate in severe rhabdomyolysis
  - Urine alkalinization
  - Meet ALL the following criteria
    - Hypocalcemia is **NOT** present
    - Arterial pH < 7.50
    - Serum bicarbonate < 30 mEq/L





## COMPLICATIONS





**CC:** AMS and diffuse muscle aches

**HPI:** 27 yr old man.

- Brought in by EMS. Was found riding his bicycle up and down the street for >14 hours. Non-linear thought process.

- Complained of diffuse muscle aches that started today

- Last smoked methamphetamines the day prior to admission

**PMH:** Methamphetamine use disorder

**SH:** Endorsed smoking meth daily. Denied ETOH or tobacco use.

**ALLERGIES:** NKDA

**MEDS:** none

**PHYSICAL EXAM:**

Tmax: **39.1C**, BP: 144/100, HR: **124**, RR: **22**, SpO2: 100% on RA

**General:** intoxicated young man. Lying flat in bed awake.

**HEENT:** PERRL, EOMI, dry mucus membranes

**CV:** tachycardic rate and regular rhythm, no M/R/G

**Pulm:** unlabored breathing on room air, CTAB

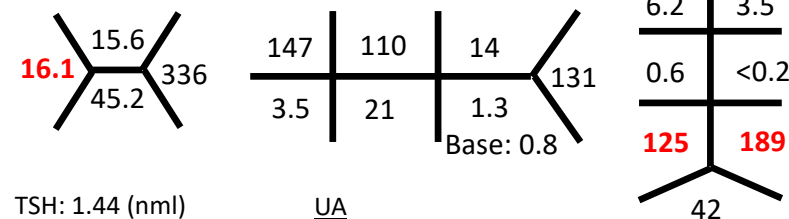
**GI:** nondistended, normal bowel sounds, soft, nontender, no hepatosplenomegaly

**MSK:** no edema, no cyanosis, mild tenderness in all extremities to palpation

**Skin:** No jaundice, diaphoretic

**Neuro:** intoxicated, not answering all questions appropriately, not following commands, moving extremities spontaneously

**LABS:**



TSH: 1.44 (nml)

Procal: 0.16 (ULN < 0.10)

Serum EtOH: <10

Utox:

**methamphetamine positive**

CK:

1347→1900→**11900**

UA

SG: 1.021

1+ protein

**2+ Hgb**

**RBC <1**

Nitrites: negative

LE: negative

Covid-19: negative

Blood cultures x2

No growth x5 days

**PROBLEM REPRESENTATION:**

Young man w/ hx methamphetamine use disorder, presenting w/ acute encephalopathy, found to have SIRS physiology, elevated CK, and myoglobinuria.

**DIAGNOSIS: Rhabdomyolysis**

**LEARNING POINTS:**

- Etiologies of rhabdomyolysis
  - Traumatic: Injury, immobilization, burns
  - Non-traumatic
    - Exertional: Extreme exercise, extreme heat, malignant hypothermia, seizures, NMS
    - Non-exertional: Drugs + toxins (statins, EtOH, meth), Infections, Electrolyte abnormalities, Endocrinopathies, Inflammatory myopathies
- Diagnosis
  - Elevated CK ( $\geq 5$ x upper limit normal)
  - Can have myalgias, red / brown urine, fever, leukocytosis, hyper-K, hyper-P, hypo-Ca,  $\uparrow$  Cr,  $\uparrow$  LFTs, UA w/ +Hgb but **NO** RBCs (myoglobinuria)
- Treatment
  - Treat underlying cause
  - Aggressive IV hydration (1-2 L/hr)
    - Watch out for fluid overload (pulm congestion)
    - Goals: CK < 5000 and/or UOP 200-300 cc/hr
    - Consider loop diuretics if not meeting UOP goal
  - Bicarbonate in severe rhabdomyolysis if ALL of the following are true:
    - No hypocalcemia (due to precipitate calcium carbonate, worsening hypocalcemia)
    - Arterial pH < 7.50
    - Serum bicarb < 30
- Complications
  - Cardiac arrhythmias/arrest, acute renal failure (CK > 16k), compartment syndrome, DIC