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Case Study

- 40 year old male
- CC: altered mental status
- HPI: Found down by roommates for an unknown period of time. They were unable to arouse him and called 911. Per EMS, the patient was pale and diaphoretic with shallow respirations. Syringes filled with brown liquid were found beside the patient. Prior to arrival, patient received Narcan and oxygen via NRB.

Vitals: BP 88/60, HR 120, RR 30, SpO2 85% on 15 L, T 39.2C, bG 160

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Initial Actions and Assessment

- ABCDE
- Physical exam:
 - General appearance: Toxic, disoriented
 - HEENT: Dry mucous membranes
 - CVS: tachycardic, thready pulses
 - Lungs: crackles bilaterally
 - Abdomen: Soft, flat
 - Skin: Diaphoretic, warm, track marks on the hands, arms, feet
 - Neurological: Moving all 4 extremities, unable to follow commands
- RSI, IV Fluids, IV antibiotics

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Orders?

- 12-lead ECG
- CBC, CMP, Mg, Phos, Lactate, CRP, Procalcitonin, PT/INR, Troponin, CK
- Blood cultures
- Ethanol, acetaminophen, salicylates
- ABG
- CXR
- CT head
- UA, Urine cultures, UDS

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Results

CBC with Differential

05/13 2112

- WBC **28.01** ▲
- RBC 5.89
- Hgb 18.0
- Hct **55.2** ▲
- MCV 93.7
- MCH 30.6
- MCHC 32.6
- Platelet 151
- RDW 14.9
- MPV 9.2
- Neutro Abs **24.93** ▲
- Band Absolut... 0.84
- Lymph Abs 1.68
- Mono Abs 0.56
- Neutro **89.0** ▲
- Bands 3.0
- Lymph **6.0** ▼
- Monos 2.0
- NRBC 0
- RBC Morphol... Normal

Comprehensive Metabolic Panel

05/13 2112

- Sodium Lvl 138
- Potassium Lvl **6.3** ▲
- Chloride 106
- CO2 **14** ▼
- Calcium Serum **8.2** ▼
- Albumin Lvl 4.4
- Total Protein **9.3** ▲
- Glucose Lvl **158** ▲
- BUN **32** ▲
- Creatinine **4.2** ▲
- Bun:Creat Ra... 8
- Bilirubin Total 0.7
- Alk Phos 122
- AST **1,583** ▲
- Globulin (Calc) **4.9** ▲
- Osmolality (C... 286
- A/G Ratio **0.9** ▼
- AGAP **18** ▲
- ALT **310** ▲

Profile Critical Care Arterial

05/14 0400

- pH Art **7.26** ▼
- pCO2 Art **33.8** ▼
- pO2 Art 82.4
- PTO2 Art 40
- Allen Test Artline
- HCO3 Art **14.5** ▼
- Base Art **-11.5** ▼
- Hct (Calc) Art 50
- Hgb Art 16.3
- O2Hb Art **92.5** ▼
- COHb Art 1
- MetHgb Art 0.7
- O2 Saturation... 94
- pO2A-a (Calc) **158** ▲
- CTO2 Art (Calc) 21.2
- P50 (Calc) Art **32.7** ▲
- PF Ratio (Calc) **206** ▼
- Na Art 135
- K Art **7.6** ▲
- iCa Art **0.83** ▼
- Cl Art 109

High Sensitive Troponin I

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- High Sensitiv... **196.5** ▲

CRP Non-Cardiac

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- CRP Non Car... **3.41** ▲

Procalcitonin Plasma

05/13 2227

- Procalciton **11.52** ▲

- Anion Gap Art 11.2
- Lactic Acid Art... **6.8** ▲
- Respiratory R... 32
- Mechanical V... Yes
- Vt (Tidal Volu...)
- PEEP
- Set Rate
- Creatinine Art... **4.20** ▲
- BG GFR Afr A... 19
- BG GFR Non-... 15

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Urine



<https://wikem.org/wiki/Rhabdomyolysis>

Urinalysis Complete with Reflex to C&S (CCMS)

05/14 0318

- Color UA **Red** !
- Appearance UA **Turbid** !
- Specific Grav... 1.040
- pH UA 5.0
- Protein UA **100** !
- Glucose Qual... **100** !
- Ketones UA **Negative**
- Bilirubin UA **Small** !
- Occult Blood... **Moderate** !
- Urobilinogen... Normal
- Nitrite UA **Positive** !
- Leukocyte Es... **Moderate** !
- Red Blood C... **759** ▲
- White Blood... 1
- Epithelial Cell... 2
- Bacteria UA **None seen**
- Amorphous S... **Present** !
- UA Total Casts **2** ▲
- Status: Specimen Rec...

Urine Drug Screen 8 Medical

05/13 2156

- U Amphetami... **Positive** !
- U Barbiturate... **Negative**
- U Benzodiaz... **Negative**
- U Cannabis Scr **Positive** !
- U Cocaine Scr **Positive** !
- U Methadone... **Negative**
- U Opiates Scr **Negative**
- U Phencyclidi... **Negative**

Creatine Kinase Total

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- Total CK **>14,000** ▲

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Case Summary

- Acute hypoxic respiratory failure
- Opioid overdose
- Stimulant overdose
- Lactic acidosis
- Acute renal failure
- Hyperkalemia
- **Non-traumatic rhabdomyolysis**

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Rhabdomyolysis

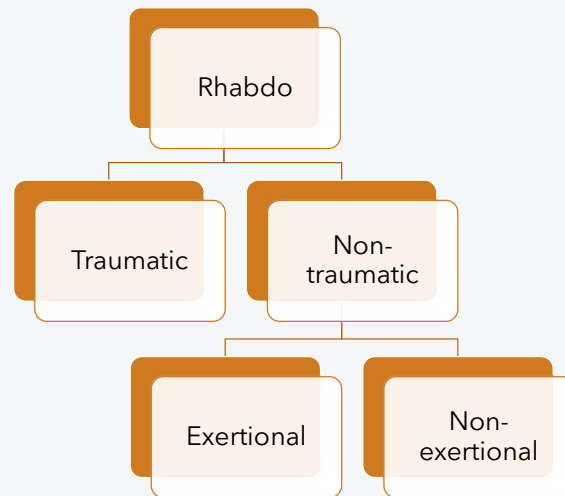
"Dissolution of skeletal muscle"



Vanholder R, Sever MS, Erek E, Lamiere N. Rhabdomyolysis. JASN. 2000;11(8):1553-1561.

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Causes of Rhabdo



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Non-exertional causes of Rhabdo

Muscle Hypoxia

Extreme temperature

Infectious

Drugs / Toxins

Electrolytes

Endocrine (thyroid)

Myopathies

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Clinical Features

- "Classic triad"
 - Myalgia (23%)
 - Muscle weakness (12%)
 - Tea-coloured urine
- Non-specific Sx
 - Fever, malaise, n/v
- Exam
 - Muscle tenderness and swelling
 - +/- motor or sensory deficits



Photo courtesy of James Heilman, MD. <https://commons.wikimedia.org/wiki/File:RhabdoUrine.JPG>

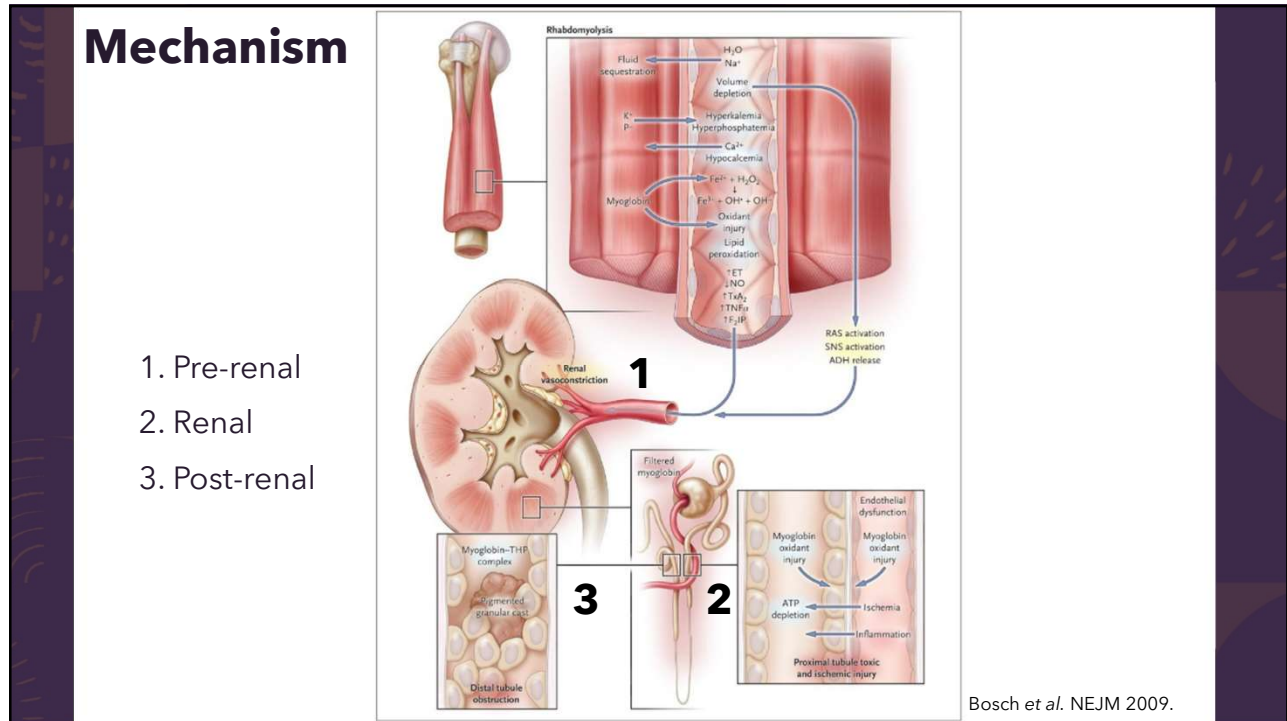
Stahl K, Rastelli E, Schoser B. A systematic review on the definition of rhabdomyolysis. J Neurol. 2020 Apr;267(4):877-882.

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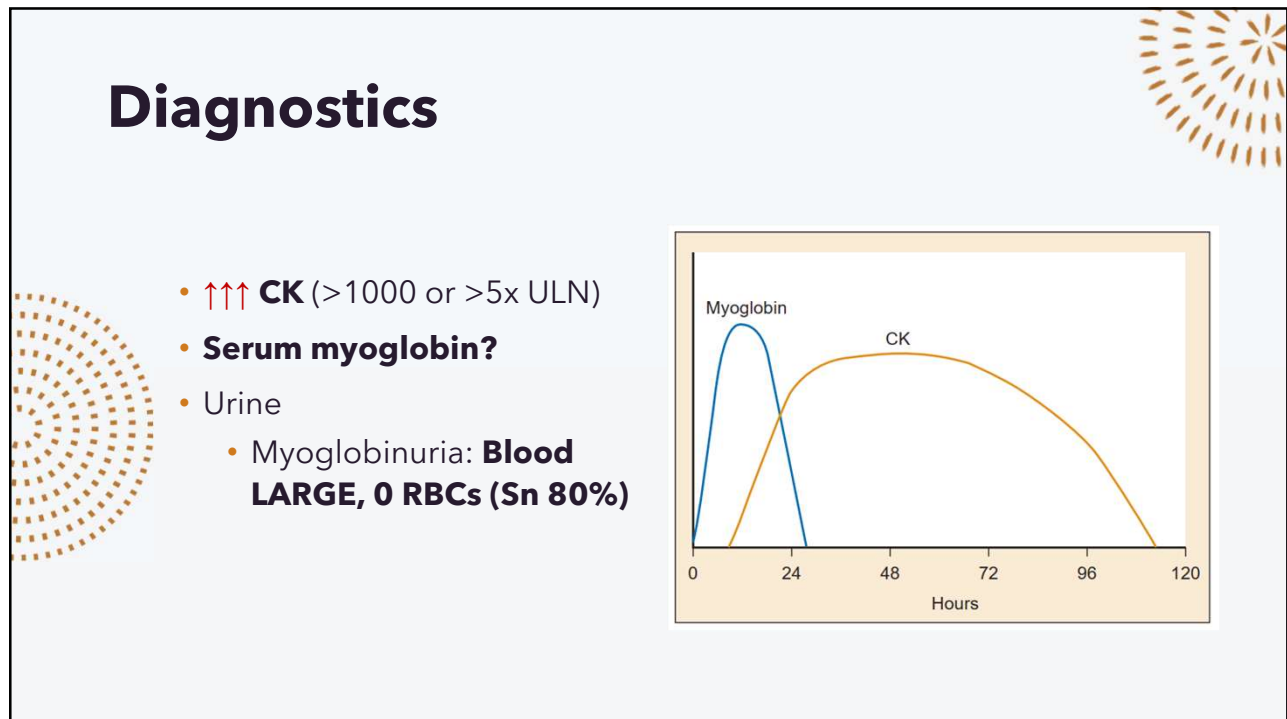
Complications

- Hypovolemia
- Compartment syndrome
- Cardiac arrhythmia
- DIC
- **Acute kidney injury (AKI)** with myoglobinuria

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Other investigations

- CMP
 - ↑ Cr, ↓ BUN:Cr
 - ↑ AST
- Electrolytes
 - ↑ K, ↑ Phos, ↑ uric acid
 - ↓ Ca
- ECG

Comprehensive Metabolic Panel	
05/13 2112	
Sodium Lvl	138
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Total Protein	9.3 ▲
Glucose Lvl	158 ▲
BUN	32 ▲
Creatinine	4.2 ▲
Bun:Creat Ra...	8
Bilirubin Total	0.7
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Prognosis - the McMahon Score

MD+
CALC

McMahon Score for Rhabdomyolysis

Predicts mortality or acute kidney injury (AKI) in rhabdomyolysis patients.

INSTRUCTIONS
Use in patients >10 years old with rhabdomyolysis (CPK >5,000 U/L within 72 hours of admission). Do not use in patients with pre-existing end-stage renal disease or with elevated CPK due to MI.

When to Use ▼ Pearls/Pitfalls ▼ Why Use ▼

McMahon score of ≥ 6 is 86% sensitive for identifying patients requiring RRT.

- Age
- Female sex
- Initial creatinine
- Initial calcium <7.5 mg/dL (1.88 mM)
- Initial phosphate
- Initial bicarbonate <19 mM
- Initial CK >40,000 U/L
- Rhabdomyolysis NOT caused by seizure, syncope, exercise, statins, or myositis

McMahon G, Zeng X, Waikur S. A risk prediction score for kidney failure or mortality in rhabdomyolysis. JAMA Int Med. 2013; 173(19):1821-8.

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Management

- Treat underlying pathology
- Treat electrolyte abnormalities (K)
- **IV fluids**
 - If hypovolemic ... Resuscitate
 - If euvolemic ... Titrate to UO 250-300 mL/hr
 - If hypervolemic ... **HOLD fluids**
- +/- RRT



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Other therapies

- Bicarbonate?
 - No overall mortality benefit
 - Sensible in non-anion gap or uremic metabolic acidosis
- Mannitol?
- Loop diuretics?



Isotonic bicarbonate is generally prepared by combining a liter of D5W with three 50-mEq ampules of sodium bicarbonate. This creates a roughly isotonic solution (~150 mEq/L).

https://emcrit.org/ibcc/fluid/#hypertonic_&_isotonic_bicarbonate

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Disposition

- **Admission**
 - Uncertain etiology
 - Renal injury
 - Electrolyte abnormality
 - Previous episodes
- **Discharge?**

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Summary

- ✓ Multifactorial disease
- ✓ CK for diagnosis
- ✓ McMahan score for prognosis
- ✓ Fluids if appropriate
- ! MYTH-BUSTED: Bicarbonate
- ! MYTH-BUSTED: Mannitol, Loop diuretics

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Thank you!
Any questions?

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