KIDNEY HEALTH FOR ALL
PREPARING FOR THE UNEXPECTED,
SUPPORTING THE VULNERABLE!

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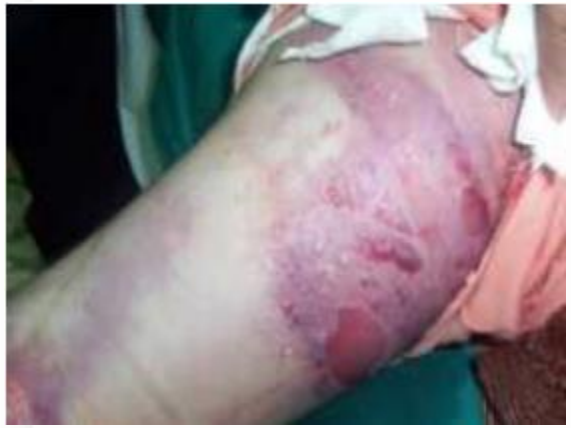

Rhabdomyolysis

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9 MARCH 2023

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Agenda

- Introduction: definition and epidemiology
- Causes of rhabdomyolysis
- Pathophysiology of the rhabdomyolysis
- Diagnosis of the rhabdonyolysis
- Rhabdomyolysis complications
- Management of the rhabdomyolysis
- Prevention of rhabdomyolysis

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INTRODUCTION

- Definition:
- A syndrome characterized by muscle necrosis and the release of intracellular muscle constituents into the circulation.

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INTRODUCTION

- 5-35% of patients with rhabdomyolysis develop ARF
  - Mortality is 3-50%

Epidemiology

The incidence of rhabdomyolysis varies with the underlying cause

Levels increase with disasters - eg, earthquakes & in war zones

Rhabdomyolysis account for ~7- 8% of all new cases of acute kidney injury

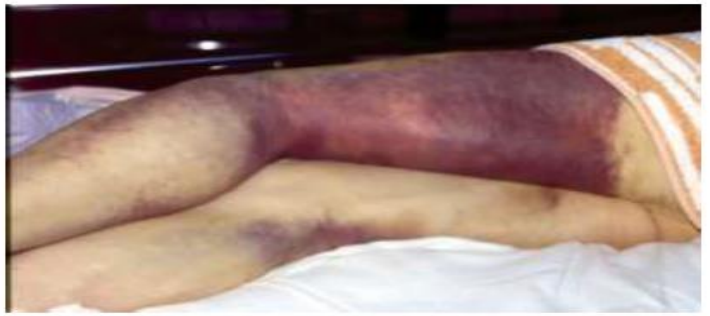
Definitions

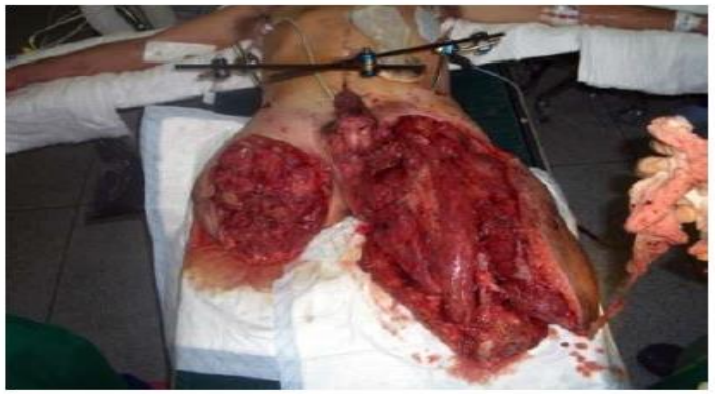
- **Rhabdomyolysis** - destruction of striated muscle (multiple causes)
- A crush *injury* is direct injury resulting from a crush
- A crush *syndrome* is the systemic manifestation of muscle cell damage

Resulting from 3 criteria

Crushing, Prolonged pressure, Devascularization

Also known as *Traumatic rhabdomyolysis*





Main causes of rhabdomyolysis

Strenous muscular activities
Extreme physical activity, Status epilepticus, Asmatic attack, Seizures

Crush
External weight, Prolonged Immobility, Bariatric surgery

Ischemia
Arterial occlusion, Compartmental syndrome, Sickle cell disease, Disseminated intravascular coagulation

Extremes of body temperature
Fever, Exertional heat stroke, Burns, Malignant hyperthermia, Hypotermia, Lightning

Drugs and toxins
Statins, Fibrates, Nicotinic acid, Anticholinergics, Antihistamines, Succinilcoline, Halothane, Corticosteroids, Cyclosporine, Phenothiazines, Protease inhibitors, Nefazodone, Itraconazole, Amfotericin B, Opium, Alcohol, Arsenic, Cocaine, Amphetamine

Metabolic Disorders
McArdle´s disease, Hypophosfatemia, Hypokalemia, Hyponatremia/Hypernatremia, Pancreatitis, Diabetic ketoacidosis, Renal tubular acidosis, Hyperthyroidism/Hypothyroidism, Nonketotic hyperosmolar states

Infections
Influenza A and B, Legionellae, Streptococcus, Staphylococcus, Salmonella, Francisella tularensis

Animal bites and toxicity
Honeybee, hornet and wasp stings, Snake bites, Fish poisoning, Fire ant bites

Causes of Rhabdomyolysis (Muscle Breakdown)

Traumatic

- Multiple Trauma
- Crush Injury
- Surgery
- Coma
- Immobilization

Nontraumatic

Exertional

- Exertion
- Heat illness
- Seizures
- Metabolic myopathies
- Malignant hyperthermia
- Neuroleptic Malignant Syndrome

Non exertional

- ETOH (ethyl alcohol Abuse)
- Drugs (statins, OTC, illicit)
- Infection
- Electrolytes

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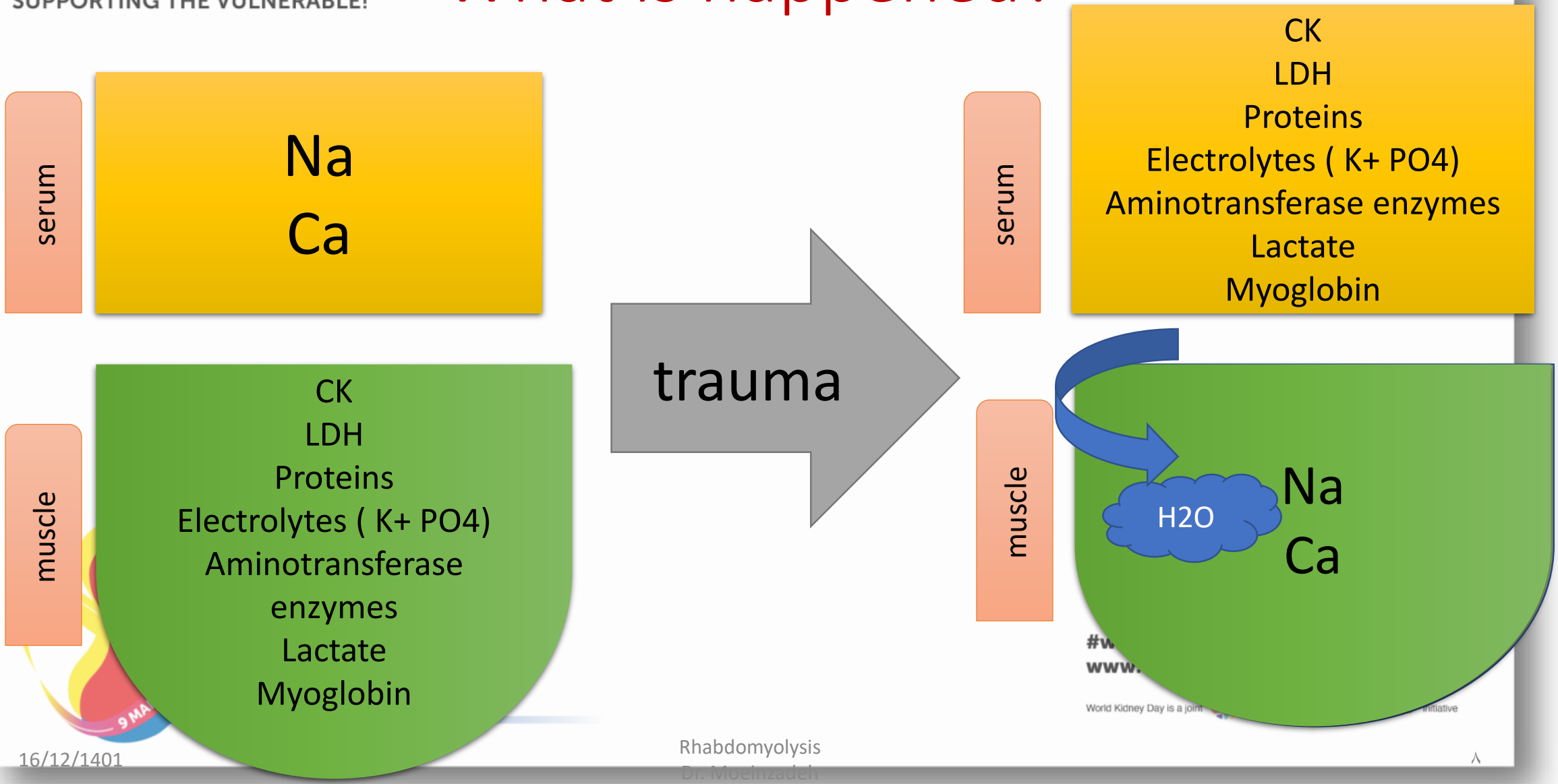
What is happened?



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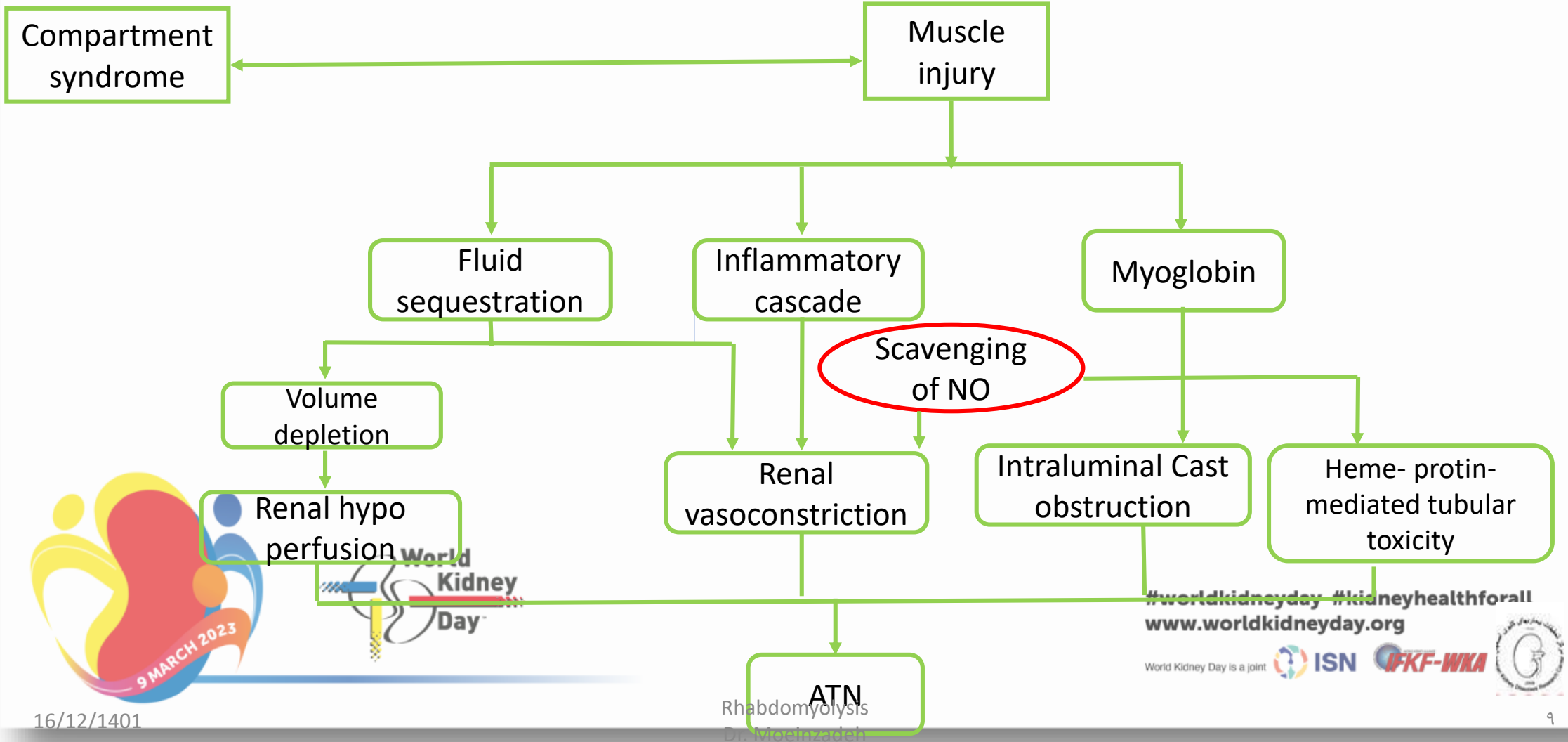

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CLINICAL MANIFESTATIONS AND DIAGNOSIS

- **When to suspect?**
- The classic presentation of rhabdomyolysis includes myalgias, red to brown urine due to myoglobinuria, and elevated serum muscle enzymes (including creatine kinase)

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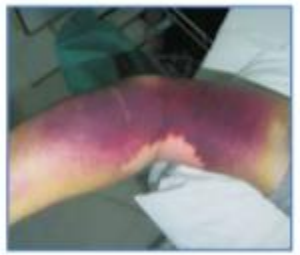
Clinical Manifestations of Rhabdomyolysis

- Range from asymptomatic to acute renal failure and DIC
  Triad : muscle pain , weakness , dark urine
- Local features:
  - Muscle pain, swelling, stiffness & tenderness
  - Bruising & compartment syndrome
  - Muscle & Limb weakness





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Clinical Manifestations of Rhabdomyolysis

- Systemic features:
  - Coca-cola coloured urine – Results from Myoglobinuria
  - General weakness
  - Confusion, unconsciousness
  - Fever, nausea/vomiting, Tachycardia
  - Less frequent urination
  - In severe cases: AKI (acute kidney injury)
  - Disseminated intravascular coagulation

Additional symptoms Overall Malaise - Fatigue - Joint pain – Seizures - Weight gain

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When to Suspect?

Clinical Presentation & Lab Ix

Myoglobin

Myoglobin excreted in urine

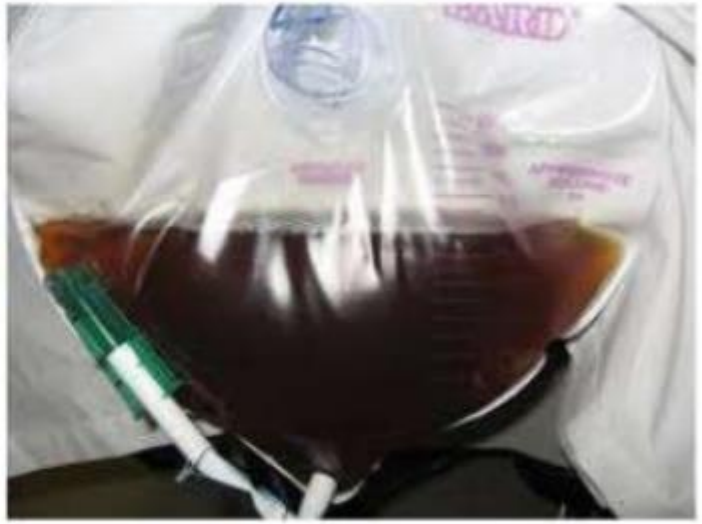
↓

Dark, reddish-brown urine (+ve dipstick)

↓

-ve microscopic evaluation of the urine for RBCs

(less than five per high-powered field)



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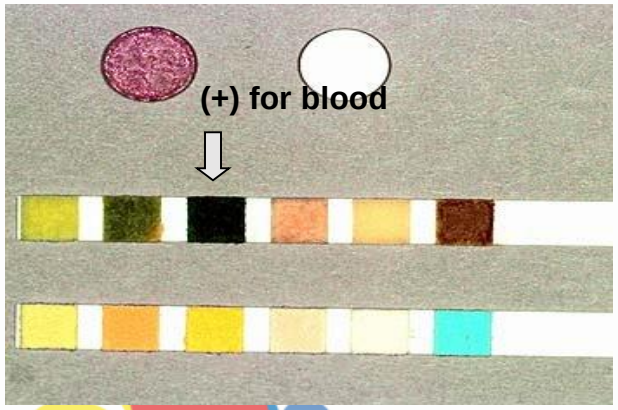
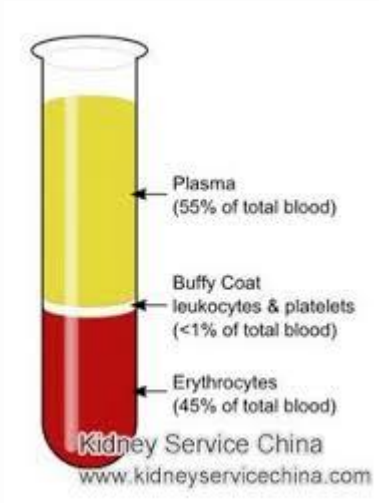
Urine analysis

- UA-myoglobinuria
  - **Dipstick will be (+) for hemoglobin, RBC's and myoglobin**
  - **Microscopy: <u>no RBC's</u>, brown casts, uric acid crystals**





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Muscle enzymes

- The hallmark of rhabdomyolysis is an elevation in serum muscle enzymes.
- Serum CK levels may be massively elevated to above 100,000 IU/L.
- Elevations in serum aminotransferases are common and can cause confusion if attributed to liver disease.

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When to Suspect?

Clinical Presentation & Lab Ix

Serum

CK, LDH

Purines → Uric Acid

Electrolytes (esp. K + and PO4)

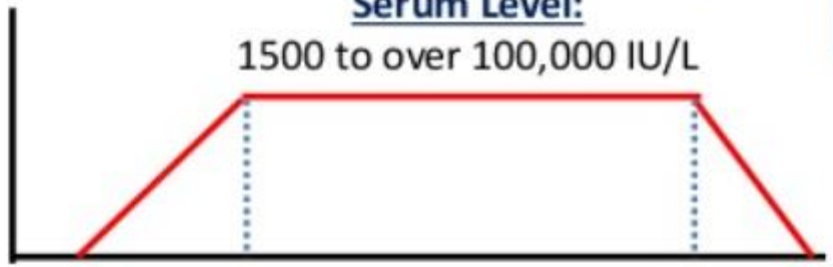
Aminotransferase enzymes

Lactate

Hypocalcemia, Hypovolemia

Type:
Mainly CK-MM, Small amount CK-MB

Serum Level:
1500 to over 100,000 IU/L



2 -12 hours after injury

24 -72 hours after injury

3-5 days after injury cessation

CK serum half-life = 1.5 days

declines 40 to 50 % of the previous day's value

If CK does not decline as expected

= continued muscle injury or the development of a compartment syndrome

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Exercise-induced rhabdomyolysis

- CPK rises after exercise are common and are asymptomatic in up to half of cases.
- A rise in CPK to >5000 U/L and/ or evidence of end-organ damage (eg, myoglobinuria or decline in renal/liver function) is sufficient for a diagnosis of exertional rhabdomyolysis.

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Electrolyte abnormalities

- Myoglobinuria
- Hyperkalemia
- Hyperphosphatemia
- Hypocalcemia
- Hyperuricemia

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Complications of Rhabdomyolysis

Early complications (< 12-72 hrs)

- Hypovolaemia
- Hyperkalaemia
- Hypocalcaemia
- Cardiac arrhythmias
- Cardiac arrest

Late complications (< 12-72 hrs)

- Kidney damage
- Acute tubular necrosis
- Acute renal failure 15%
- DIC
- ARDS
- sepsis

Early or late complications

Acute compartment syndrome

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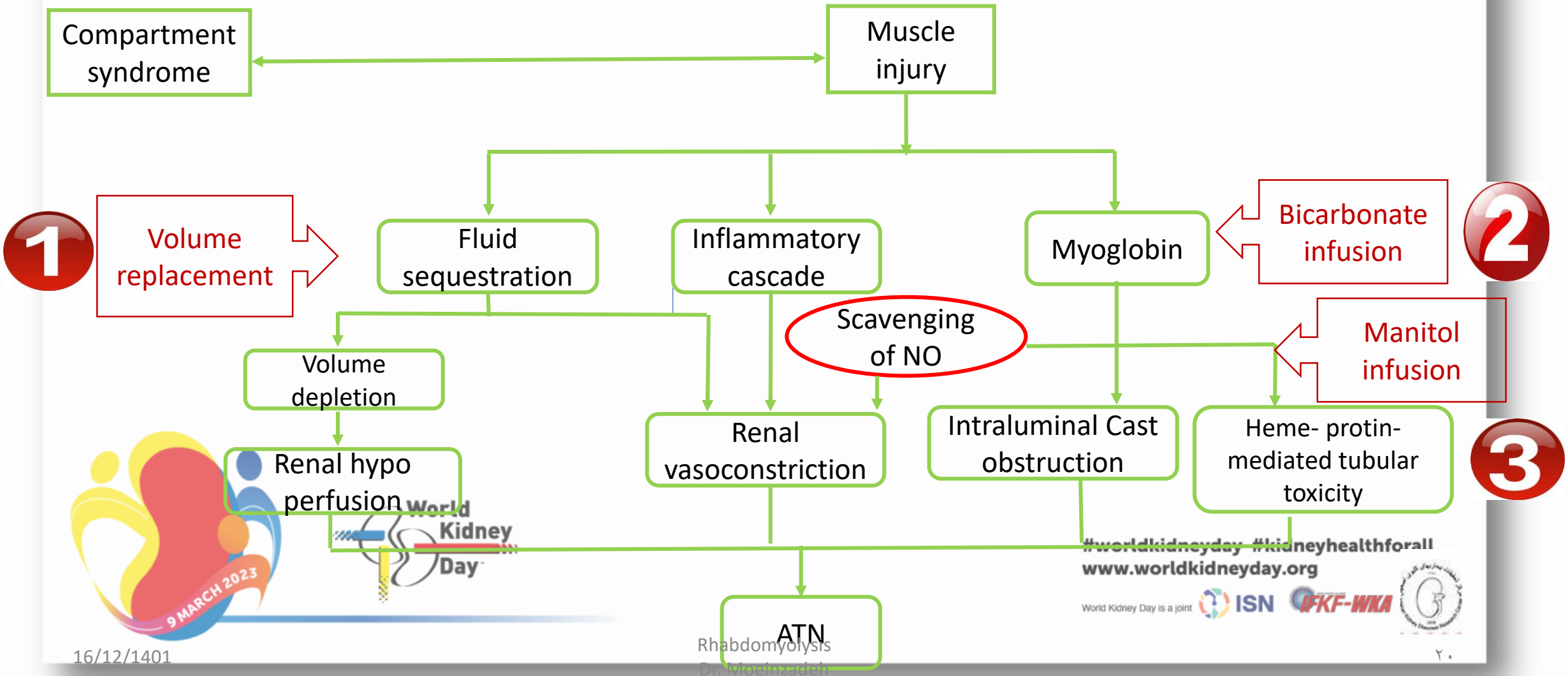
MANAGEMENT



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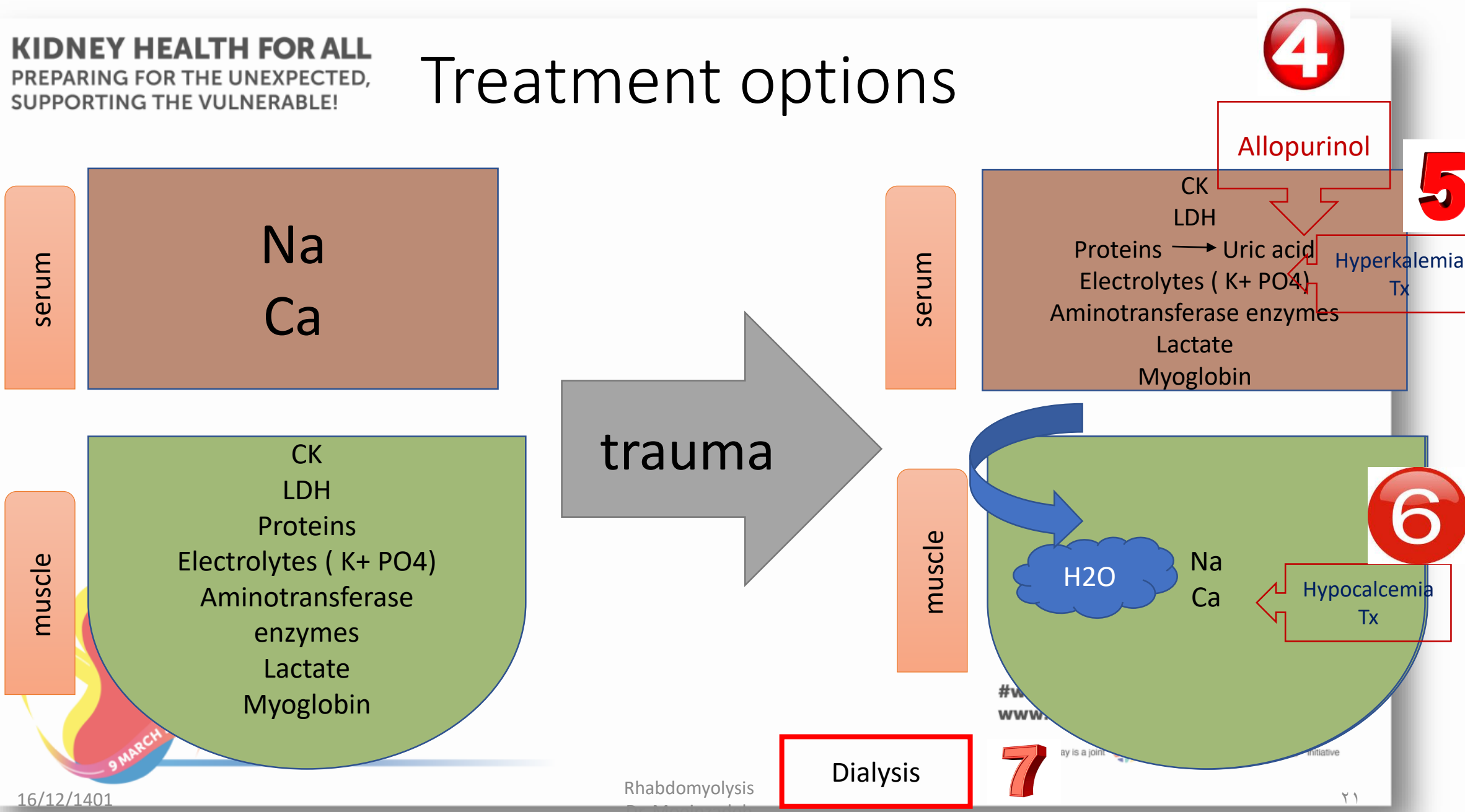
Treatment options



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MANAGEMENT

- Plasma volume expansion with intravenous isotonic saline should be given as soon as possible, even while trying to establish the cause of the rhabdomyolysis.
- Treatment of the underlying cause of the rhabdomyolysis.

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Volume repletion

- What? Isotonic Saline
- Target? Urine output: 200-300cc/h
- Until? CPK decrease to < 5000U/L
  Urine dipstick Negative for hematuria
- Caution: Hypervolemia
  Exaggerated compartment syndrome

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Bicarbonate infusion

- In CPK >5000: Severe injury. If : severe hypocalcemia is not present

PH< 7.5 HCO3 < 30mEq/L

Monitor PH/Ca q2h

When to stop?

1. Symptomatic hypocalcemia
2. PH > 7.5
3. HCO3 > 30 mEq/L
4. Urine PH doesn't rise above 6.5 after 3-4 h

HOW?

- 150 cc of 8/4% NaHCO3 + 1 lit DW5% (or Isotonic saline)
- Initial rate: 200cc/h
- Rate adjusted to achieve urine PH > 6.5

Evidence !!!

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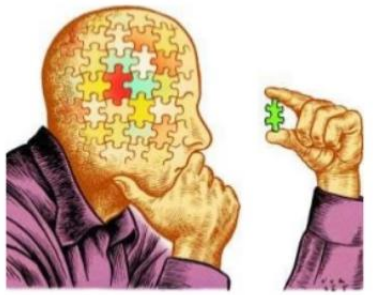
Manitol infusion



The evidence for the effectiveness of NaHCO3 infusion & Mannitol is very weak

- To whom? Urinary flow is adequate: >200cc/h
- Extremely CPK level: >30,000U/L

HOW?

- Rate: 5g/h added to each liter of infusion and not exceeding 1-2 g/Kg/day

When to stop?

1. Osmolar gap rises > 55mosmol/Kg
2. Diuresis: 200-300 cc/h cannot achieved

Increased risk of hyperosmolality, volume overload, Hyperkalemia

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Hypocalcemia

- Give Ca supplementation ONLY IF:
  - Symptomatic hypocalcemia
  - Management of hyperkalemia

WHY?

During the recovery phase:

<u>Release of calcium from injured muscle</u>:

Serum calcium levels return to normal and may rebound to significantly elevated level

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How can I prevent Rhabdomyolysis

- **Drink** plenty of fluids after strenuous exercise to dilute the urine and flush the myoglobin out of the kidney

- **Proper hydration** is also necessary after any condition or event that may involve damage to skeletal muscle

Urine Color Chart

1		
2		If your urine matches the colors 1, 2, or 3, you are properly hydrated.
3		Continue to consume fluids at the recommended amounts.
4		If your urine color is below the RED line, you are
5		DEHYDRATED and at risk for cramping and/or a heat illness!!
6		YOU NEED TO DRINK MORE WATER!
7		
8		

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Prognosis

- The overall prognosis for patients is favorable as most survivors recover sufficient kidney function to be dialysis independent, and many will recover to normal or near normal kidney function

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Features suggesting need for further investigation

R	Recurrent episodes of exertional rhabdomyolysis
H	Hyper CPK emia more than 8 weeks after event
A	Accustomed to exercise
B	Blood CPK concentration above × 50 upper limit of normal
D	Drug ingestion insufficient to explain exertional rhabdomyolysis
O	Other family members affected or Other exertional symptoms

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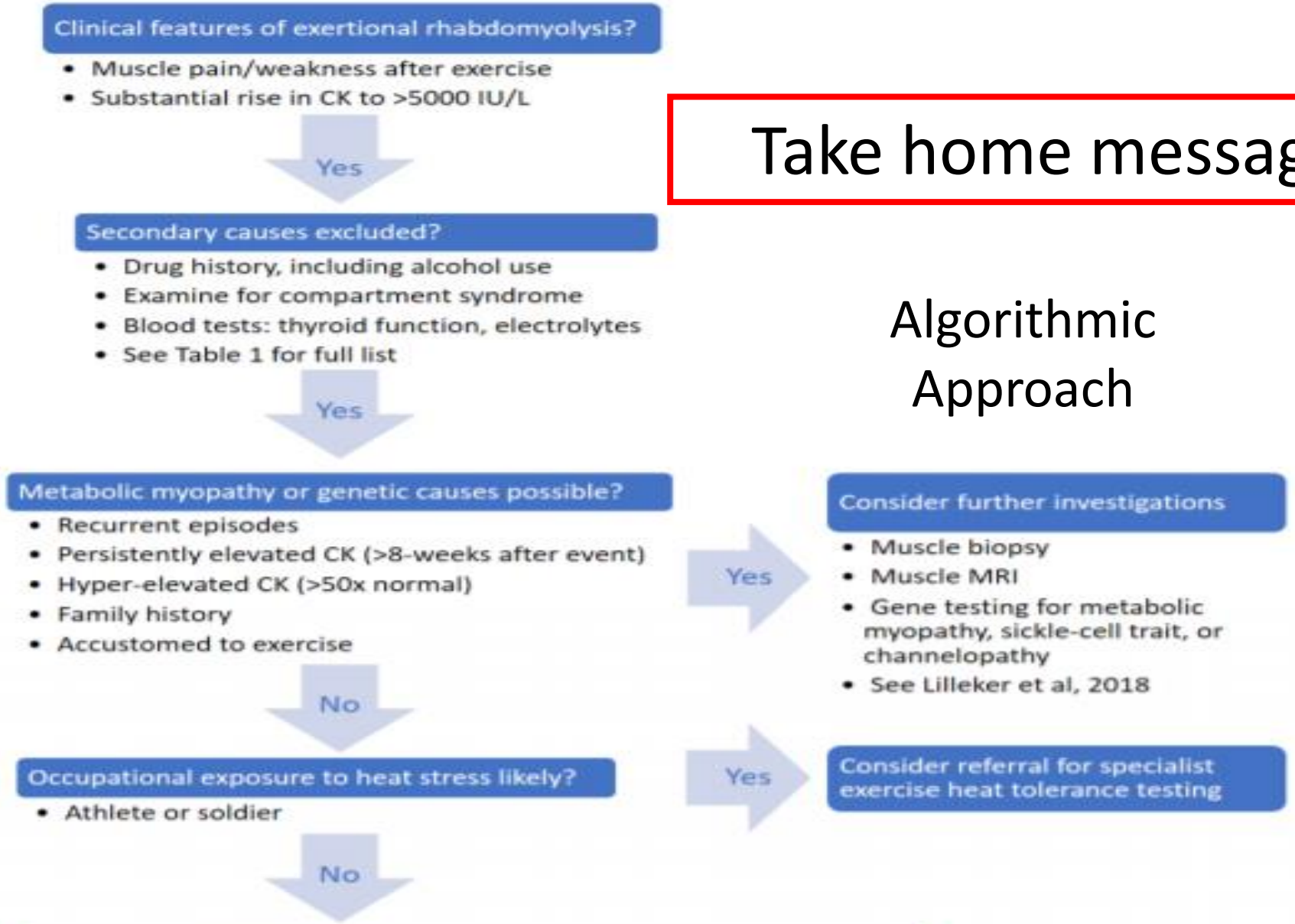
Take home message

Algorithmic Approach



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