EXTRACORPOREAL NEPHROLOGY GROUP [ECNG]

RHABDOMYOLYSIS

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TERMINOLOGY

Myopathy	General term referring to any disease of muscles Can be acquired or inherited and can occur at birth or later in life
Myalgia	Muscle ache or weakness without creatine kinase elevation
Myositis	Muscle symptoms with creatine kinase elevation
Rhabdomyolysis	Muscle symptoms with marked creatine kinase elevation, typically substantially >11 times the upper limit of normal, a creatinine elevation consistent with pigment nephropathy, and usually with brown urine with myoglobinuria

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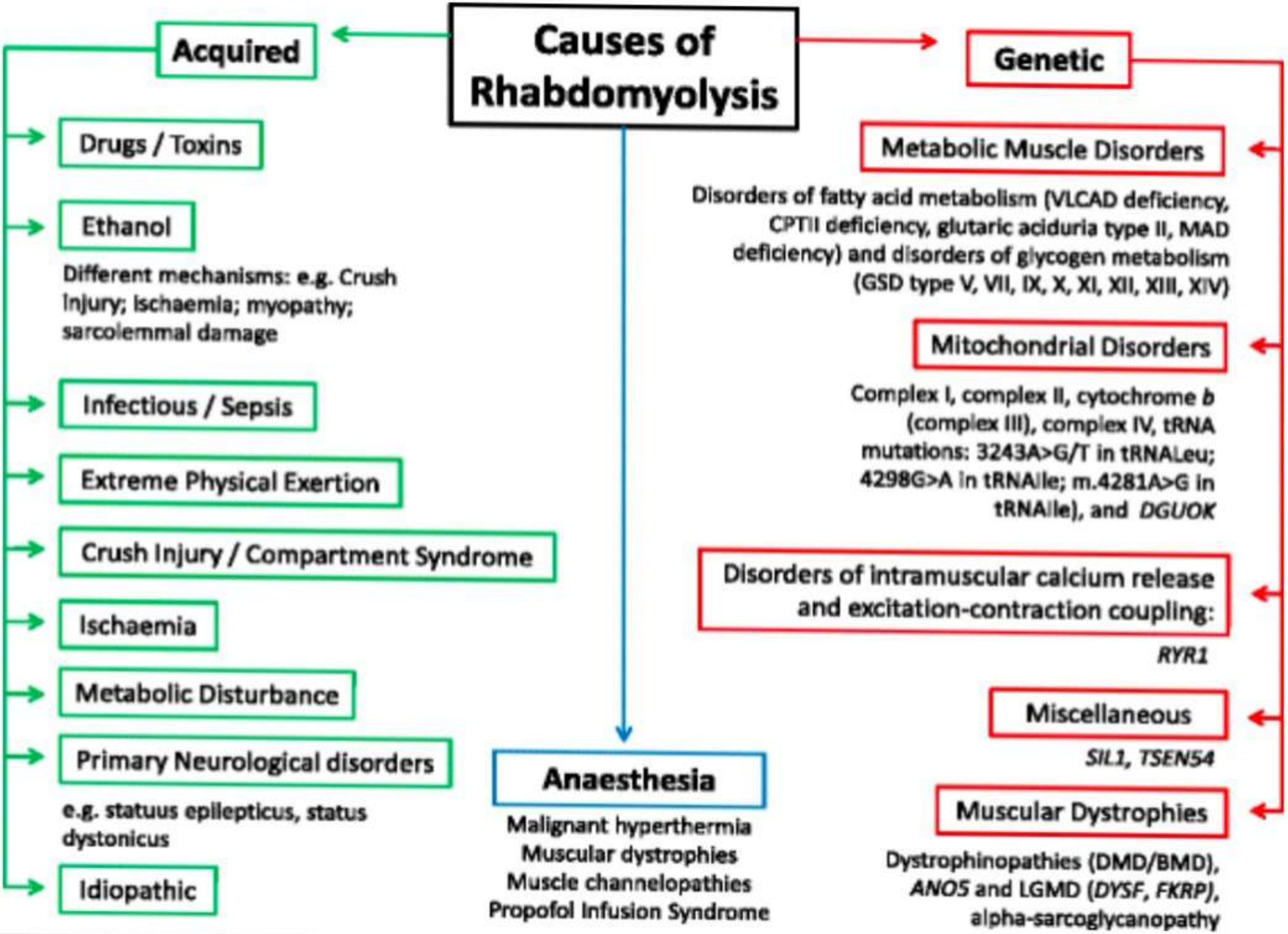
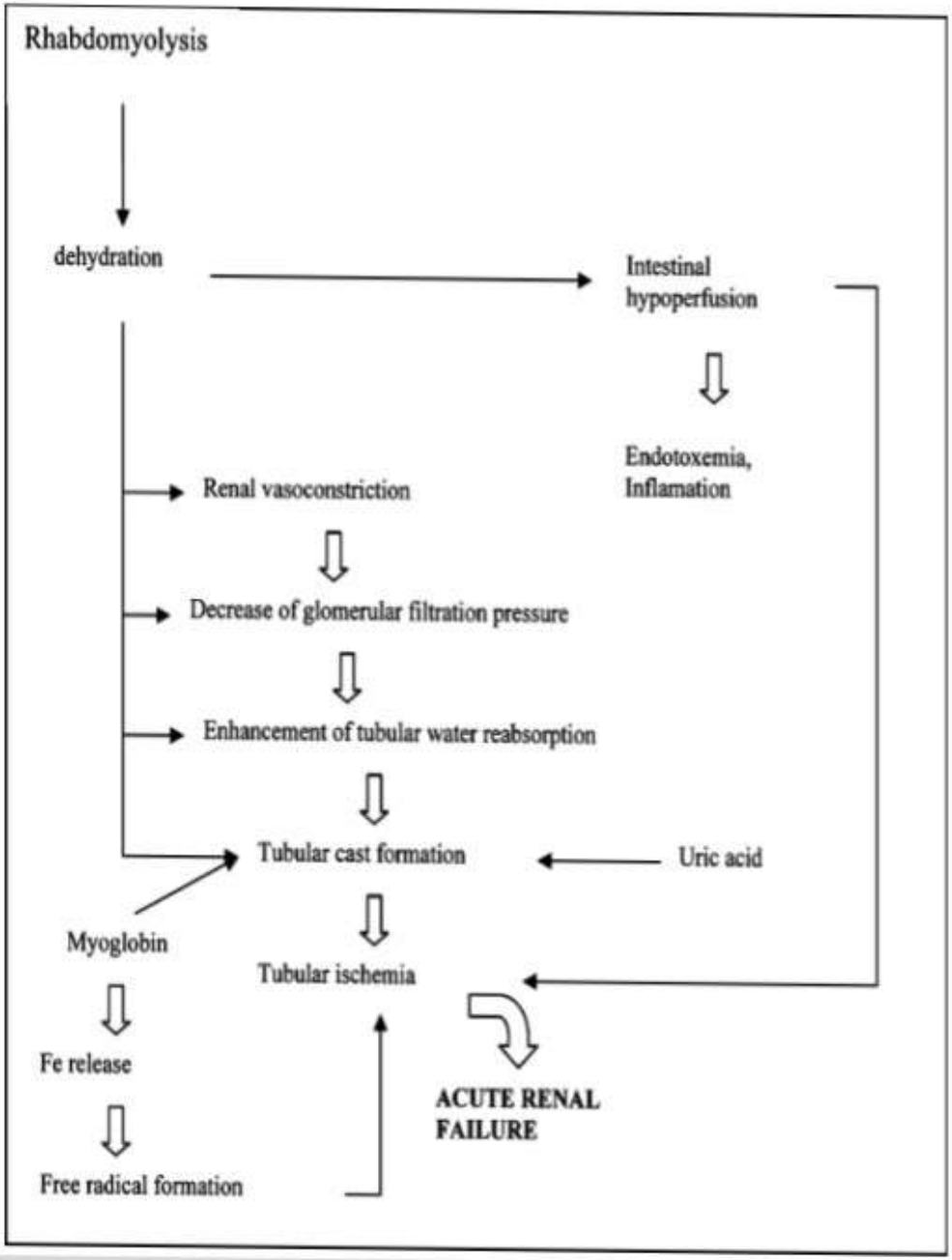
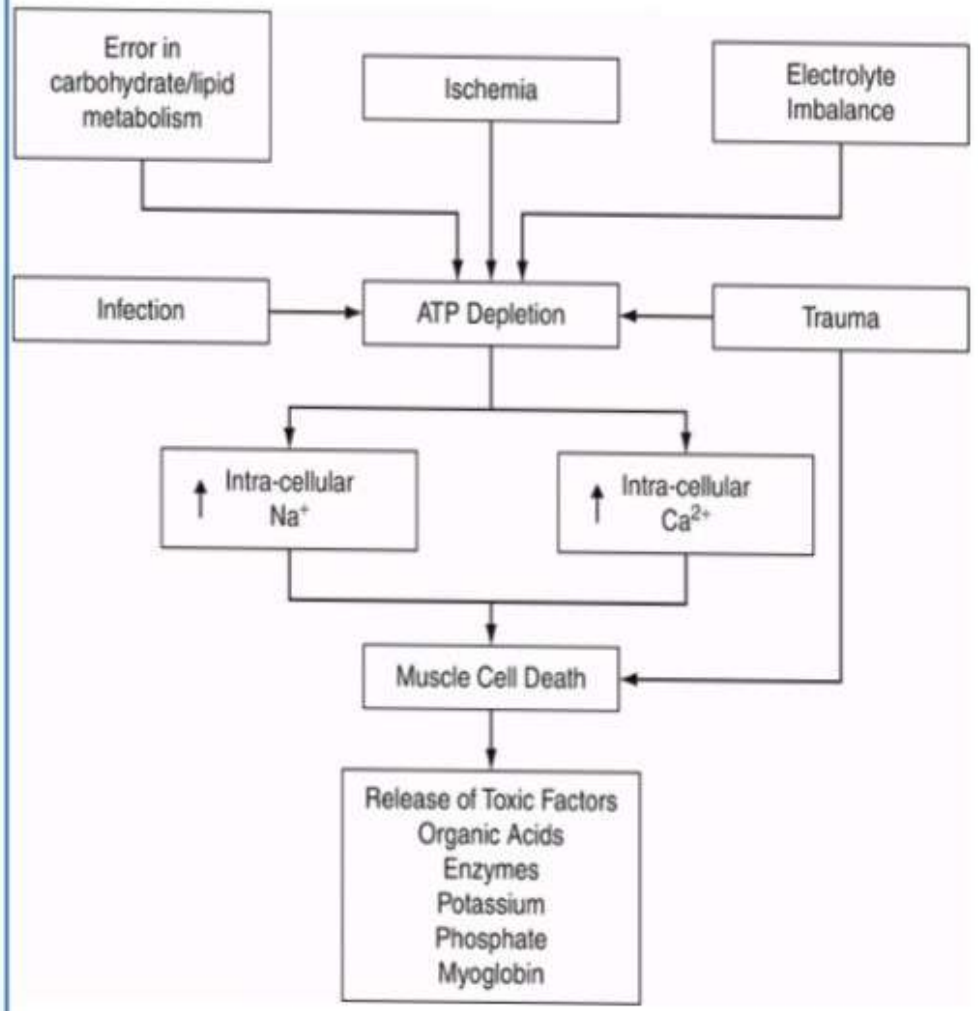
DRUGS - RHABDOMYOLYSIS

Statins	Other Antilipid Agents	Psychiatric Agents	Abused Substances	Antihistamines	Other
Lovastatin	Ezetimibe	Amitriptyline	Alcohol	Diphenhydramine	Amphotericin B
Pravastatin	Bezafibrate	Amoxapine	Cocaine	Doxylamine	Arsenic
Simvastatin	Clozafibrate	Doxepin	Heroin/Opiates		Azathioprine
Fluvastatin	Ciprofibrate	Fluoxetine	Amphetamines		Carbon monoxide
Atorvastatin	Clofibrate	Fluphenazine	Methamphetamines		Halothane
Rosuvastatin	Gemfibrozil	Haloperidol	Lysergic acid diethylamide		Naltrexone
		Lithium	Phencyclidine		Quinidine
		Protriptyline			Penicillamine
		Perphenazine			Pentamidine
		Promethazine			Propofol
		Chlorpromazine			Salicylates
		Trifluoperazine			Succinylcholine
		Venlafaxine			Theophylline
		Benzodiazepines			Terbutaline
		Barbiturates			Thiazides
					Vasopressin

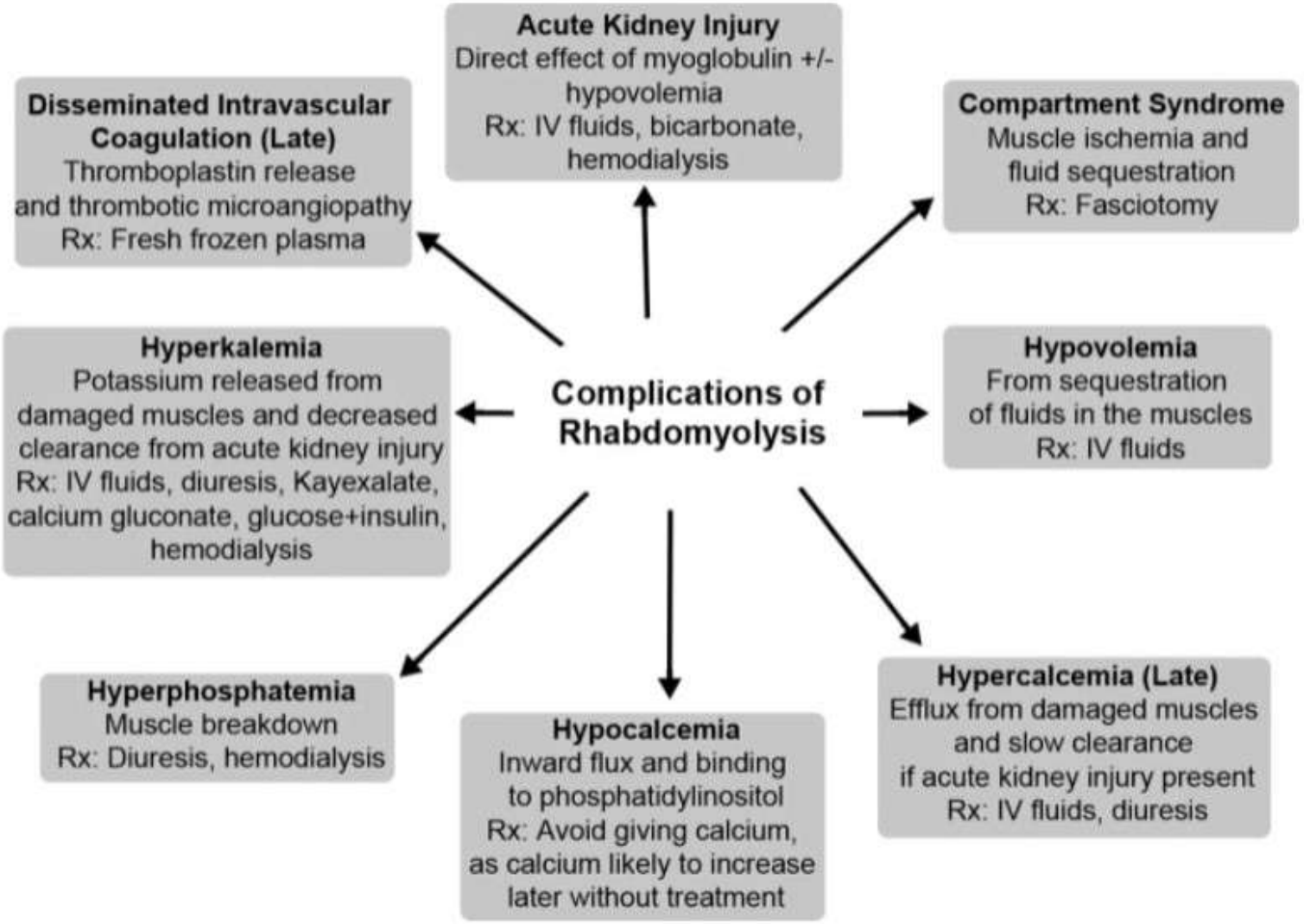

Causes of Rhabdomyolysis
Acquired
Drugs / Toxins
Ethanol
Different mechanisms: e.g. Crush Injury; Ischaemia; myopathy; sarcolemmal damage
Infectious / Sepsis
Extreme Physical Exertion
Crush Injury / Compartment Syndrome
Ischaemia
Metabolic Disturbance
Primary Neurological disorders
e.g. statuus epilepticus, status dystonicus
Idiopathic
Anaesthesia
Malignant hyperthermia
Muscular dystrophies
Muscle channelopathies
Propofol Infusion Syndrome
Genetic
Metabolic Muscle Disorders
Disorders of fatty acid metabolism (VLCAD deficiency, CPTII deficiency, glutaric aciduria type II, MAD deficiency) and disorders of glycogen metabolism (GSD type V, VII, IX, X, XI, XII, XIII, XIV)
Mitochondrial Disorders
Complex I, complex II, cytochrome b (complex III), complex IV, tRNA mutations: 3243A>G/T in tRNALeu; 4298G>A in tRNAIle; m.4281A>G in tRNAIle), and DGUOK
Disorders of intramuscular calcium release and excitation-contraction coupling:
RYR1
Miscellaneous
SIL1, TSEN54
Muscular Dystrophies
Dystrophinopathies (DMD/BMD), ANO5 and LGMD (DYSF, FKRP), alpha-sarcoglycanopathy

PATHOPHYSIOLOGY

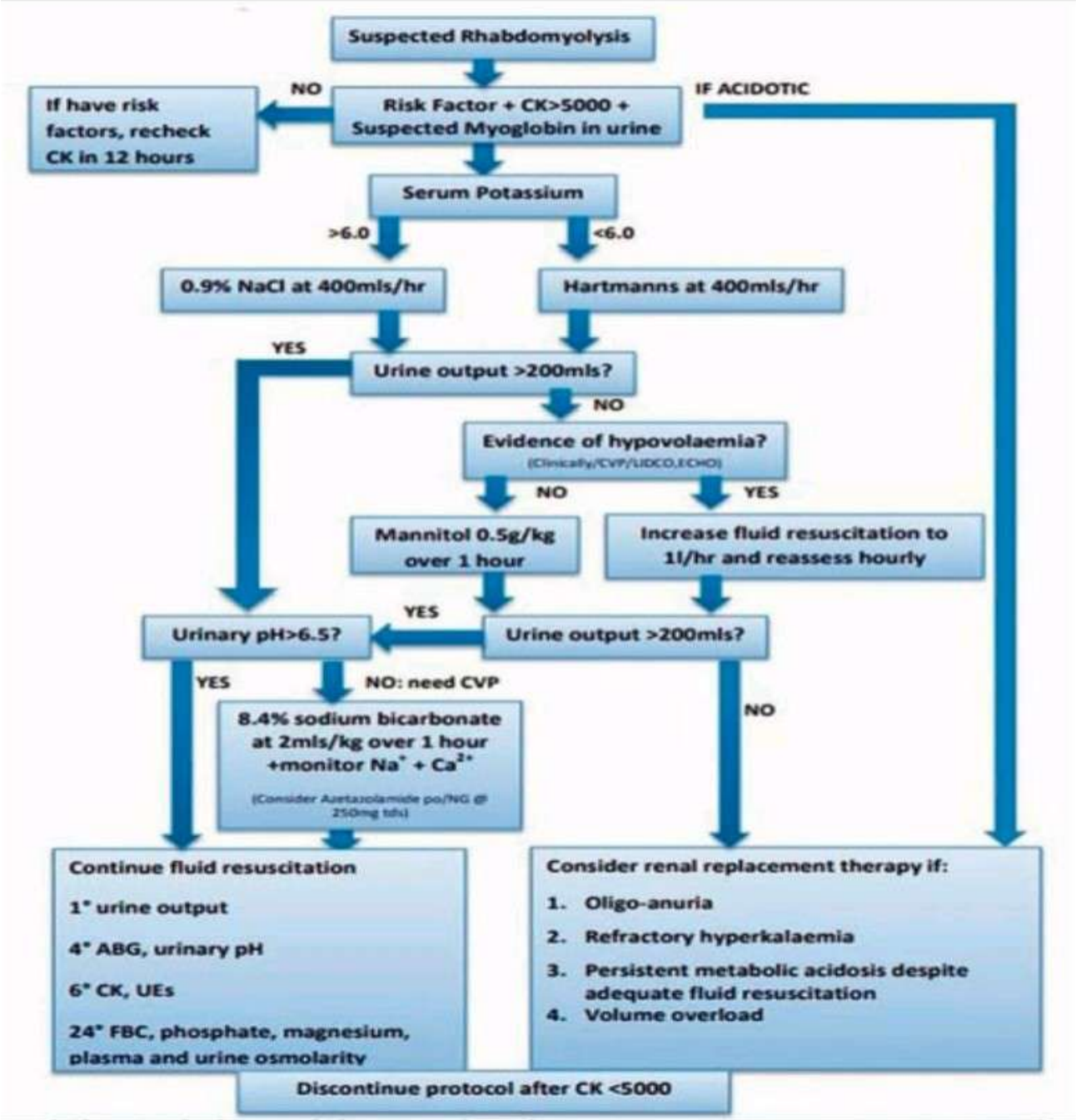




COMPLICATIONS



MANAGEMENT


Suspected Rhabdomyolysis
NO
If have risk factors, recheck CK in 12 hours
Risk Factor + CK>5000 + Suspected Myoglobin in urine
IF ACIDOTIC
Serum Potassium
>6.0
<6.0
0.9% NaCl at 400mls/hr
Hartmanns at 400mls/hr
YES
Urine output >200mls?
NO
Evidence of hypovolaemia?
(Clinically/CVP/LIDCO,ECHO)
NO
YES
Mannitol 0.5g/kg over 1 hour
Increase fluid resuscitation to 1l/hr and reassess hourly
YES
Urinary pH>6.5?
Urine output >200mls?
YES
NO: need CVP
NO
8.4% sodium bicarbonate at 2mls/kg over 1 hour +monitor Na+ + Ca2+
(Consider Acetazolamide po/NG @ 250mg tds)
Continue fluid resuscitation
1° urine output
4° ABG, urinary pH
6° CK, UEs
24° FBC, phosphate, magnesium, plasma and urine osmolarity
Consider renal replacement therapy if:
1. Oligo-anuria
2. Refractory hyperkalaemia
3. Persistent metabolic acidosis despite adequate fluid resuscitation
4. Volume overload
Discontinue protocol after CK <5000

TREATMENT

- **1.Fluid Resuscitation** (give IV fluids: either isotonic saline or RL) and
- Monitor I&O's). A good starting point is 400ml/hr.
- **2.Electrolyte Management**: Check K,
- Ca, Phos. Also regularly check ECG.
- **3.Alkalinize urine** .
- **4.Treat pain** with non-nephrotoxic agents. Discontinue all nephrotoxic or myotoxic medications.
- **5.Consider complications** such as compartment syndrome.
- If **McMohan Score** is high, but CK is low, this does NOT rule out Rhabdomyolysis. This may be a sign of an early disease course.
- If Mcmohan score <3, CK<5,000, no AKI, no electrolyte derangement with a normal EKG, and a cause has been identified and stopped, the patient is likely safe for discharge.

Table 11–2. McMahon risk prediction score.

Variable	Score
Age	
>50 to ≤70 years	1.5
>70 to ≤80 years	2.5
≥80 years	3.0
Female sex	1
Initial creatinine	
1.4–2.2 mg/dL	1.5
>2.2 mg/dL	3.0
Initial calcium <7.5 mg/dL	2.0
Initial CK >40,000 U/L	2.0
Initial phosphate	
4–5.4 mg/dL	1.5
>5.4 mg/dL	2.0
Underlying cause other than seizures, syncope, exercise, statins, or myositis	3.0
Initial serum bicarbonate <19 mEq/L	2.0

A SCORE MORE THAN 6 INCREASES RISK OF AKI.

RISK INCREASES BY 59 % IF SCORE MORE THAN 10.