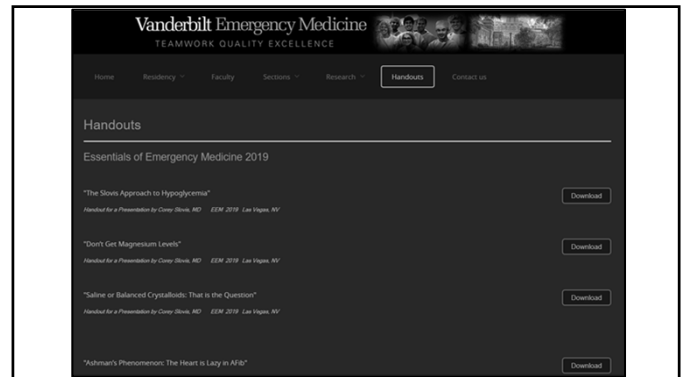


EMS World 2019 Hyperkalemia and Other Electrolyte Emergencies

Corey M. Slovis, M.D.
Vanderbilt University Medical Center
Metro Nashville Fire Department
Nashville International Airport
Nashville, TN



Mastering Emergency Medicine

- Secure the ABC's
- Consider or give NGT
- Five Causes
 - Five Steps
 - Five Reasons for almost everything

SECURE THE ABC'S

Hyperkalemia is the
Most Dangerous Acute
Electrolyte Emergency

HyperK = ECG

ECG Changes	Serum Level
-------------	-------------

Tall Peaked T	5.5 -6.5
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Loss of P Wave	6.5 - 7.5
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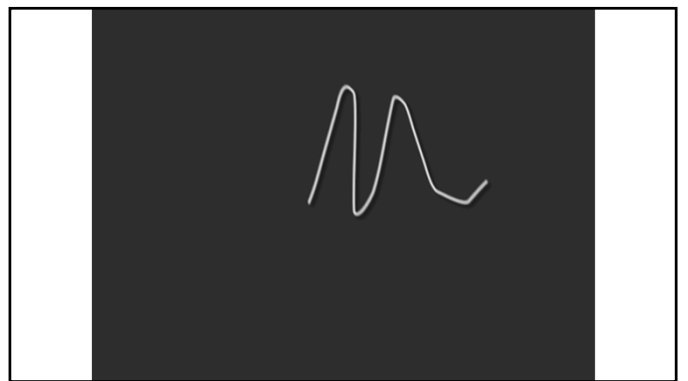
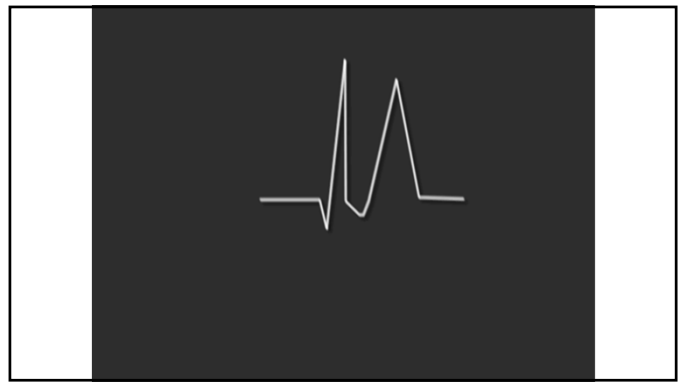
Widened QRS	usually > 8
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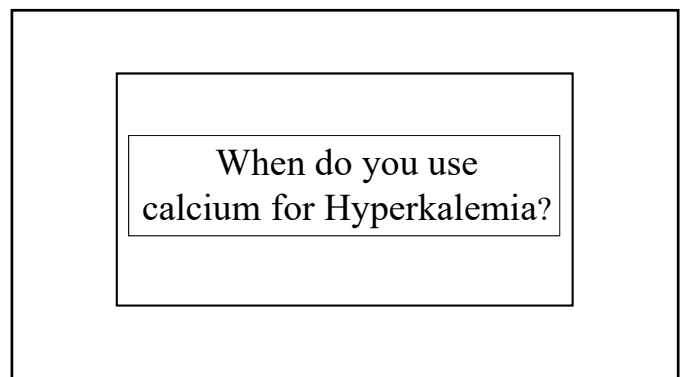
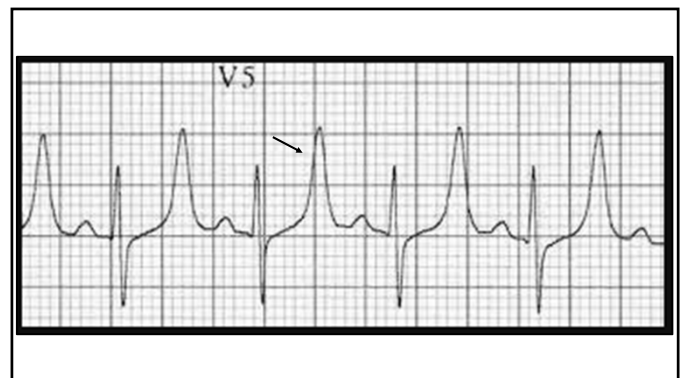
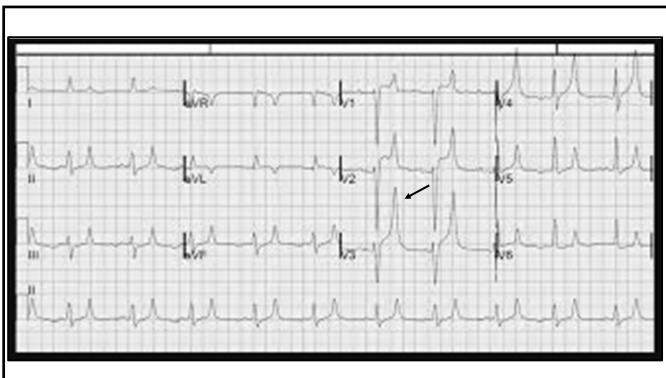
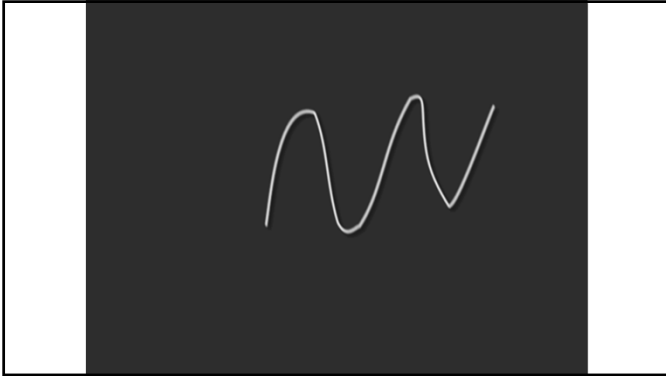
What are the 5 ECG Changes Seen in Hyperkalemia

- Tall Peaked T-Waves
- Prolonged P-R Interval
- Loss of P Wave
- Widening of QRS
- Sine Wave

I know its not really true, but I think of T waves as being made out of potassium







When do you use
calcium for Hyperkalemia?

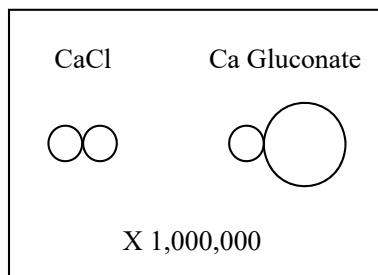
Calcium = Emergency = Wide QRS

- Calcium Tricks Cells
- Calcium Does NOT Affect Levels

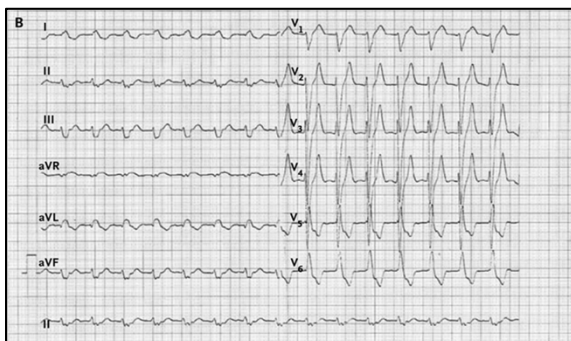
Calcium in Hyperkalemia

- Tricks Cell
- Recreates Electrical Gradient
- Temporary, lasts only 5-20 minutes
- Dose is 5-20 cc CaCl IV
- Potentially Dangerous

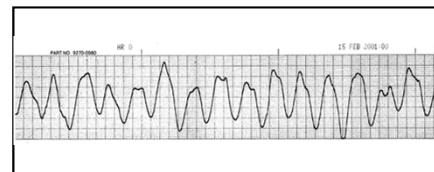
Be sure before using!



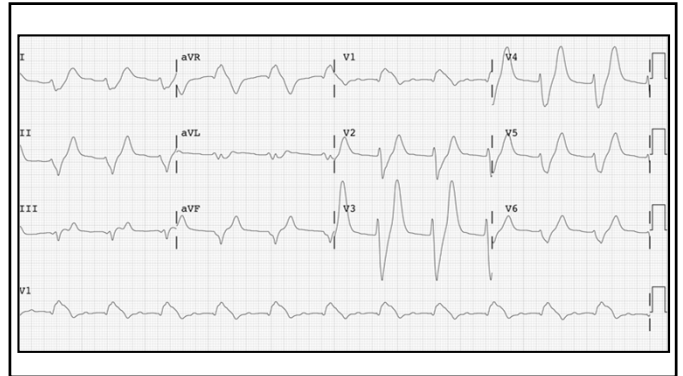
NEJM 2012;366:1824



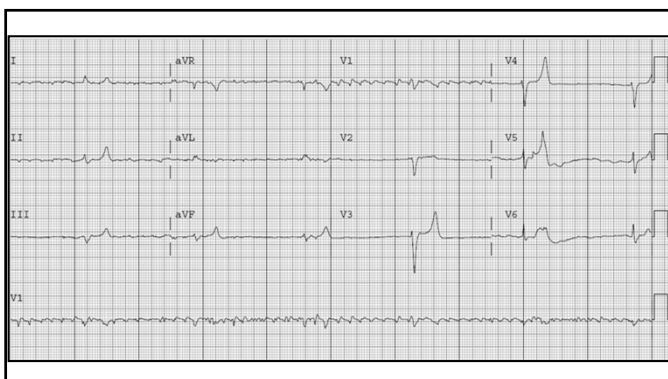
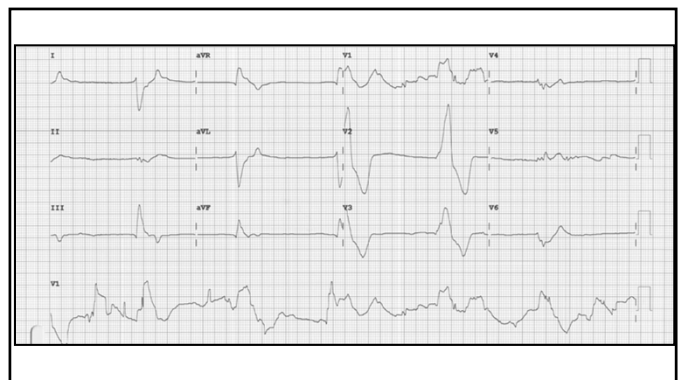
NEJM 2012;366:1824



Only give calcium if . . .
there is a wide QRS



~~Only give calcium if . . .
there is a wide QRS~~



~~Only give calcium if . . .
there is a wide QRS~~

Hyperkalemia Indications for CaCl

- Wide QRS
- Sine Wave
- Bradycardia and/or Heart Block

ECG Predictors of Adverse Events

West J Emerg Med 2017;18:963-71

- QRS prolongation most common predictor
 - Seen in 79% of pts with adverse events
 - Average QRS 152 msec
- Bradycardia second most common predictor
 - Seen in 60% of pts with adverse event
- 86% of patients had > 1 ECG abnormality

No patient with only peaked Ts or prolonged P-R duration had an adverse event

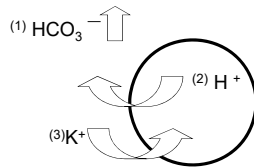
West J Emerg Med 2017;18:963-71

Don't Give Calcium
for Big T waves



Bicarbonate in Hyperkalemia

Bicarbonate For Hyperkalemia



- (1) As HCO_3^- is added to serum
 (2) H^+ from cell will move extracellularly to buffer alkali load
 (3) K^+ will move intracellularly to maintain the cell's electroneutrality.

Bicarbonate is Great in Hyperkalemia

but only if:

The Patient is Acidotic

Consider in patients who have hyperkalemic ECG changes after speaking with medical control especially if known to be acidotic and/or with Kussmaul respirations

Steps in Treating Hyperkalemia

- Reverse electrical effects
- Drive potassium into the cells
- Remove potassium from the body

STEP 1: Treating Hyperkalemia

Reversing Electrical Effect

Calcium Chloride

- 10 cc of 10% CaCl
- No more than 20 ccs

STEP 2: Treating Hyperkalemia

Removing K from the Body

Glucose and Insulin

- 2 amps of $\text{D}_{50}\%$
- 10 units regular insulin

Beta Agonist Mask

Bicarbonate if acidotic

- 1 – 2 amps of NaHCO_3

Consider Saline Bolus

- 200 cc NSS

Continuous albuterol or duonebs
are excellent quick ways to
drive K into the cell

STEP 3: Treating Hyperkalemia

Removing K from the Body

Forced Diuresis

- 250 - 500cc/hr NaCl
- Supplemented with Lasix

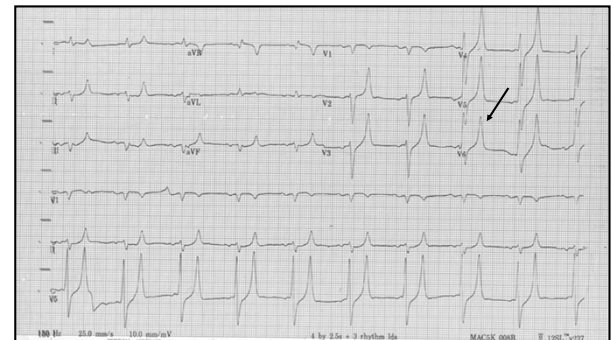
Ion Exchange Resin

- 30 - 60G Kayexalate

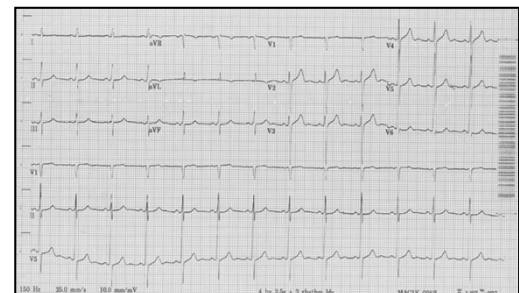
Dialysis

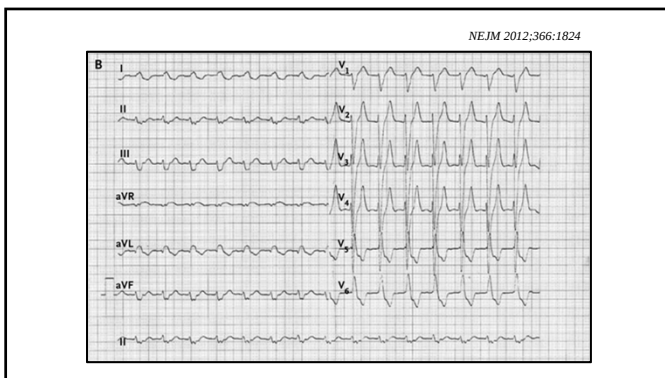
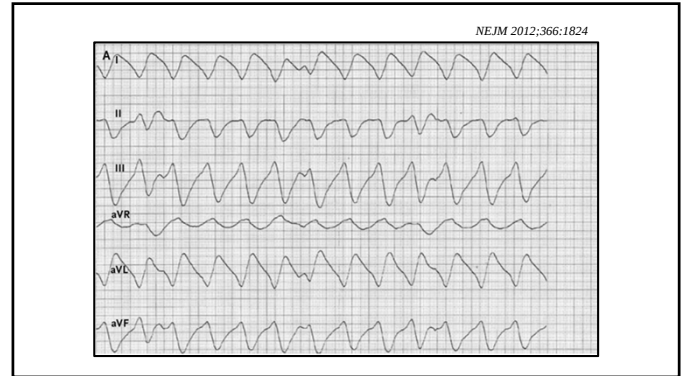
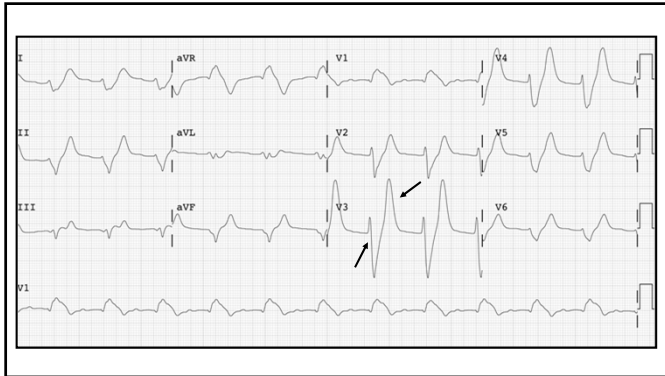
- Hemodialysis &/or Peritoneal

Hyperkalemic ECGs



Same patient post therapy





Hyperkalemia Treatments 5 Key Concepts

Calcium	Wide QRS
Bicarb	Acidosis
Glu/Insulin	Hypoglycemia
Beta Agonists	Benign and Easy
Volume	Selected Cases

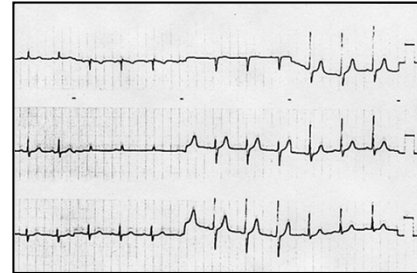
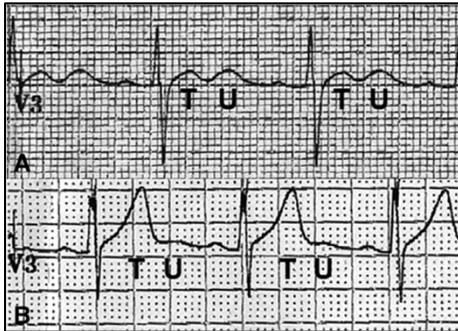
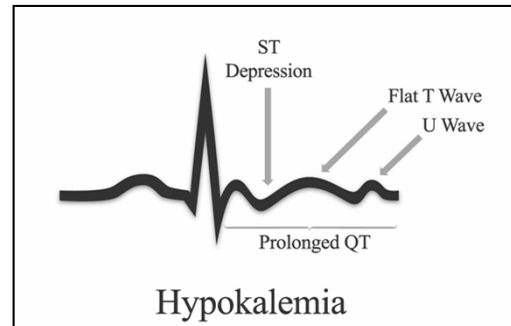
Hypokalemia

Hypokalemia - 5 Most Common Causes

- Decreased Intake
 - Chronic ETOH or Malnutrition
- Increased losses
 - Urine
 - Non K, Non Mag Sparing Diuretics
 - S/P Vomiting
 - GI
 - Chronic Diarrhea or Laxative Abuse
- Intracellular Shift
 - Hyperventilation or Metabolic Alkalosis

5 ECG Changes Hypokalemia

- Loss of T Wave
- U Waves
- Prolonged Q-T
- Torsades, VT, VF
- Diffuse, Nonspecific ST and T Wave Changes



The Ability of Physicians to Predict Electrolyte Deficiency From the ECG

The ECG is considered to be a fairly accurate reflection of a patient's electrolyte status. Two full-time academic emergency physicians, each board certified in two specialties, interpreted the ECGs of 97 consecutive alcoholic patients presenting to the emergency department. Serum potassium, calcium, and magnesium values were obtained on all patients within one hour of ECG performance. The physicians attempted to predict abnormalities of serum electrolytes from the ECG tracing alone when blinded to all laboratory values, the clinical situation, and each other's readings. The combined results of both readers yielded a sensitivity of .74 and a specificity of only .29. The positive predictive value of the ECG in predicting electrolyte deficiency was .41 and the negative predictive value was .63. Electrolyte disturbances cannot be accurately predicted from an ECG even in high-risk patients. Serum electrolyte determinations remain the most effective method of assessing for these deficiencies. (Pharm ED, Slovis BS, Slovis CM. The ability of physicians to predict electrolyte deficiency from the ECG. *Ann Emerg Med* May 1990;19:580-583.)

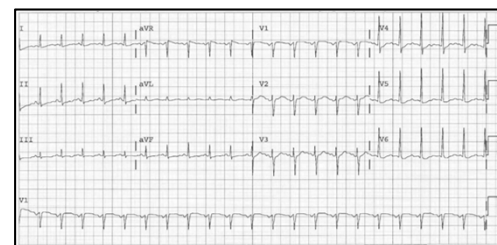
Kath D Whinn, MD
Barry S Slovis, MD, MEd
Craig M Slovis, MD, FACEP
Rochester, New York

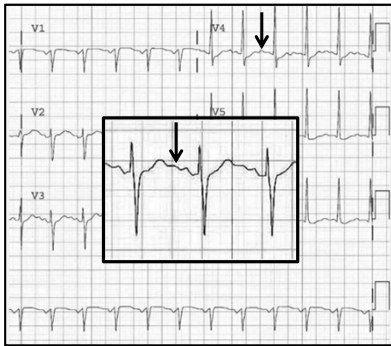
From the Department of Medicine and
Division of Emergency Medicine, Grady
Memorial Hospital and Emory University
School of Medicine, Atlanta, Georgia

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Address for reprints: Kath D Whinn, MD,
University of Rochester Medical Center,
Strong Memorial Hospital, 601 Unimont

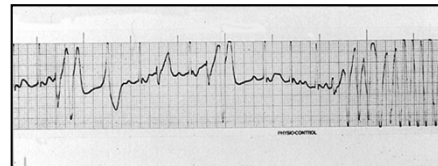
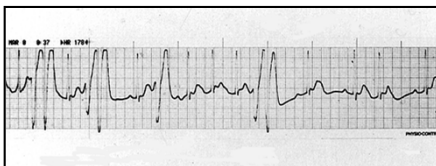
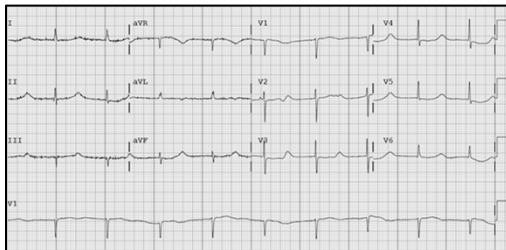
Annals of EM 1990

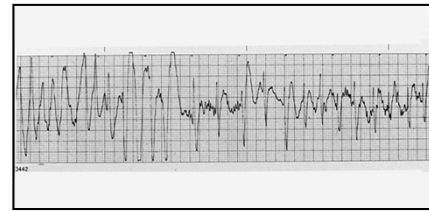
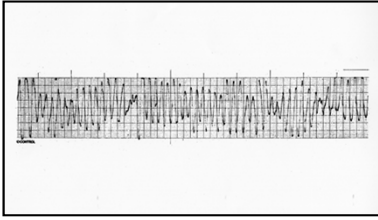




When is Hypokalemia
an Emergency?

QT = 500 mSec



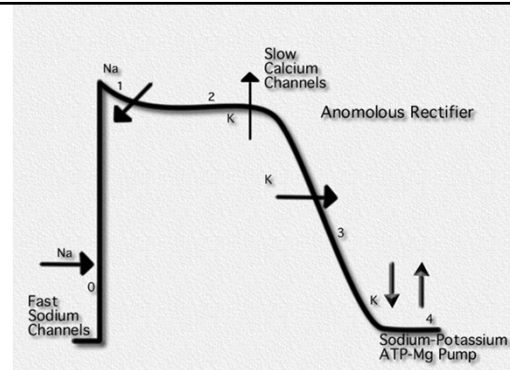


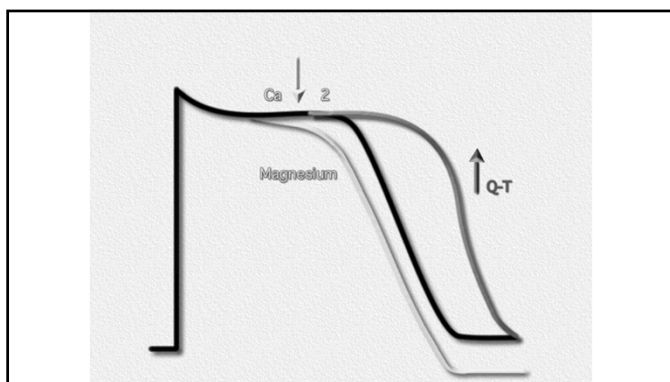
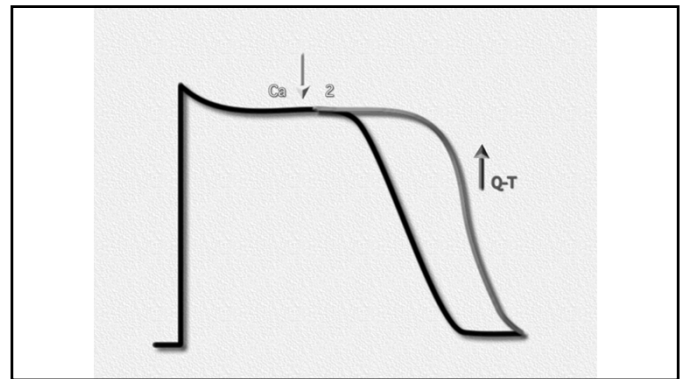
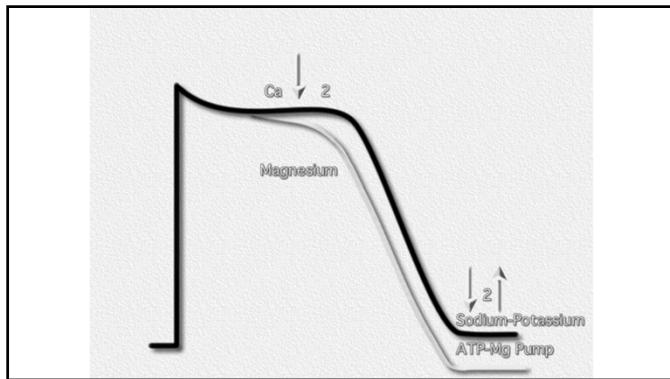
Treating Torsades

- Shock if pulseless
- 2 Grams Magnesium IV push

Hypokalemia
Beware Prolonged Q-T

Magnesium





What dosing of Magnesium makes you an expert?

Dose of Magnesium

- Loading Dose
 - 1-2 Grams over 0-60 minutes
... except eclampsia
- Maintenance Dose
 - 0.5 Gram per hour

Load with 1 – 2 grams
over 0 – 60 minutes

How quickly can you
safely raise
someone's serum
sodium?

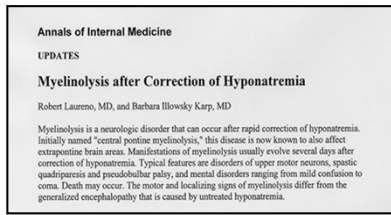
When do you use Hypertonic
Saline for Hyponatremia?

Correct Patients
At a Rate of
0.5 meq/hr or less

Never Change
Serum Na Level
by More Than
10-12 meq/day

Except acute hyponatremia
in runners or athletes who
were previously normal

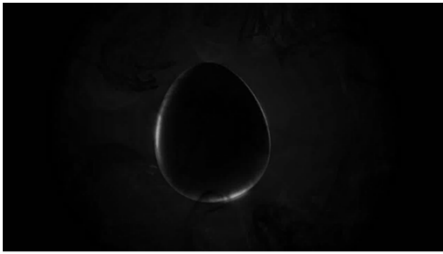
Why not raise patient's serum
sodium faster?



Ann Intern Med. 1997

Central Pontine Myelinolysis (CPM)

- Demyelinating disease of pons and CNS
- Flaccid paralysis, dysarthria, hypotension
- Alcoholics, malnourished, severely ill
- Caused by too rapid correction
- May be seen 1 to 2 days after correction



AMS

Status Seizure

- Vital Signs
- Toxic–Metabolic
- Structural
- Infectious
- Psychiatric

- Vital Signs
- Toxic–Metabolic
- Structural
- Infectious
- Epilepsy

Hypertonic Saline

- Indications Seizures
Coma
Focal Findings
- In order to use, Serum Sodium is usually 100 meq – 110 meq
- What concentration? 3 %

Give seizing
HypoNatremic patients
3% Hypertonic Saline

Hypernatremia

Hypernatremia = Dehydration



J Emerg Med 2013;

- 19 yo, no PMH, with AMS
- Drank 32 oz of soy sauce
- Equates to 10+ tablespoons of salt
- Serum sodium 177 mg/L
- pH 7.14, comatose, seizures
- > 10 tablespoons of NaCl

Treatment + Survival

- 6L D₅W over 30 minutes
- 5.2L D₅W over next 24 hours
- 9 day post admission WNL
- MRI WNL, no CPM
- Rapid rise = Rapid fall

Summary

Number One Cause of HyperK=

NOT

HyperK = ECG

Only give calcium if . . .
there is a wide QRS

~~Only give calcium if . . .
there is a wide QRS~~

How effective is bicarbonate
in Hyperkalemia?

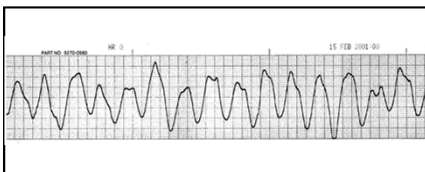
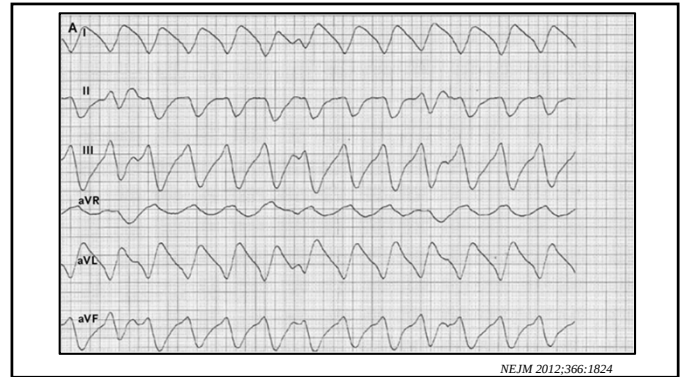
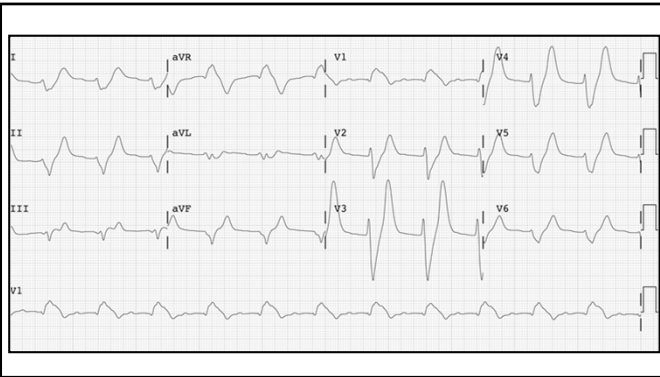
Bicarb only if . . . Acidotic

HypoK = HypoMag

Only give Hypertonic Saline if:
Sodium below 120 and:

- Seizures
- Coma or AMS
- Focal Findings

VanderbiltEM.com



SECURE THE ABC'S

