Hyponatremia and Hypomagnesemia

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Hyponatremia

Salt and water imbalance

Management

Acute vs chronic

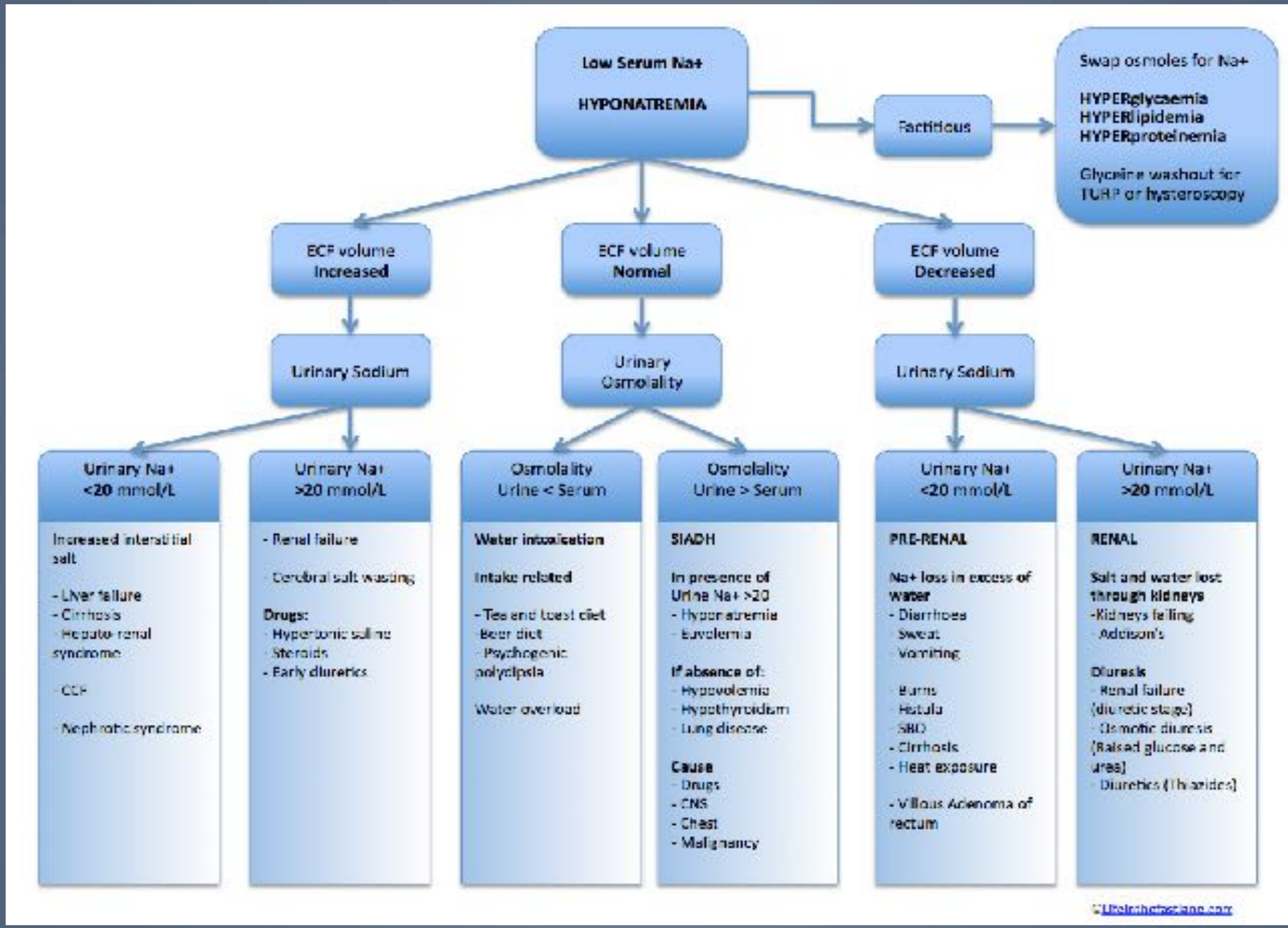
Approach

* How to make the correct diagnosis?

* How to treat safely?

Etiology

* Classification: volume status
* Classification: serum osmolality
* History and physical exam
* List of medications
* Serum: Bun, creat, lytes, glucose, osmolality
* Urinary: Na, osmolality


Low Serum Na+
HYPONATREMIA
Factitious
Swap osmoles for Na+
HYPERglycaemia
HYPERlipidemia
HYPERproteinemia
Glycine washout for TURP or hysteroscopy
ECF volume Increased
ECF volume Normal
ECF volume Decreased
Urinary Sodium
Urinary Osmolality
Urinary Sodium
Urinary Na+ <20 mmol/L
Increased interstitial salt
- Liver failure
- Cirrhosis
- Hepato-renal syndrome
- CCF
- Nephrotic syndrome
Urinary Na+ >20 mmol/L
- Renal failure
- Cerebral salt wasting
Drugs:
- Hypertonic saline
- Steroids
- Early diuretics
Osmolality Urine < Serum
Water intoxication
Intake related
- Tea and toast diet
- Beer diet
- Psychogenic polydipsia
Water overload
Osmolality Urine > Serum
SIADH
In presence of Urine Na+ >20
- Hyponatremia
- Euvolemia
If absence of:
- Hypovolemia
- Hypothyroidism
- Lung disease
Cause
- Drugs
- CNS
- Chest
- Malignancy
Urinary Na+ <20 mmol/L
PRE-RENAL
Na+ loss in excess of water
- Diarrhoea
- Sweat
- Vomiting
- Burns
- Fistula
- SBO
- Cirrhosis
- Heat exposure
- Villous Adenoma of rectum
Urinary Na+ >20 mmol/L
RENAL
Salt and water lost through kidneys
-Kidneys failing
- Addison's
Diuresis
- Renal failure (diuretic stage)
- Osmotic diuresis (Raised glucose and urea)
- Diuretics (Thiazides)

High ADH

* Hypovolemic hyponatremia
  * Extrarenal: Una <20 and Uosm >300
  * Renal: ex: diuretics Una>20
* Euvolemic hyponatremia
  * SIADH, Hypothyroidism, Adrenal insufficiency
  * Una > 20, Uosm >200
* Hypervolemic hyponatremia
  * CHF, Cirrhosis, Nephrotic syndrome
  * Una <20 and Uosm >300
* Careful when more then one etiology!! Misleading!

Not related to ADH

* CRF
* Primary Polydipsie (Una<20, Uosm 50-100)
* Beer Potomanie(low solute load-ROH)
* Tea and toast (low solute load)

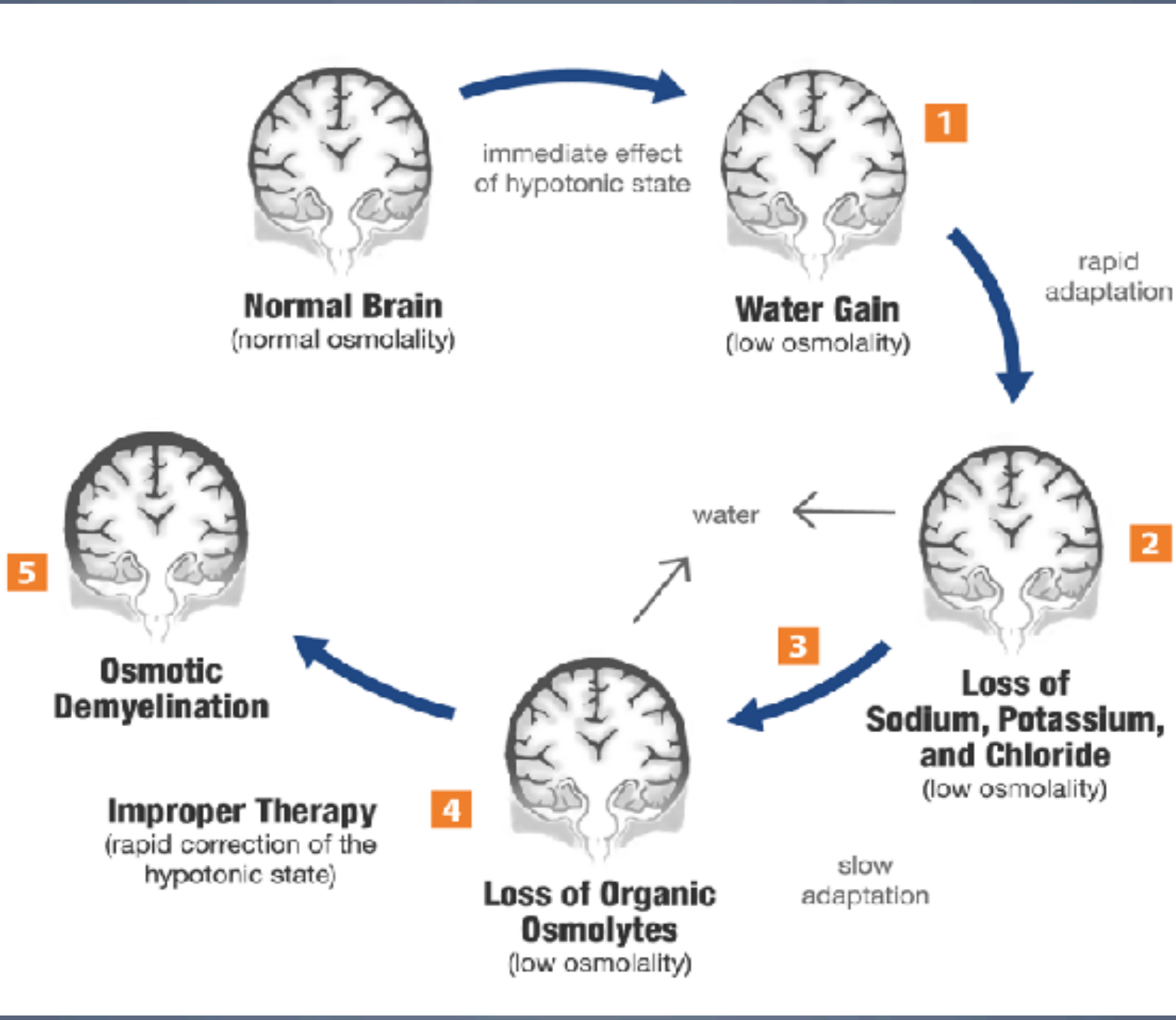
Acute vs chronic

- Acute HypoNa:
  - Cerebral edema
    - Nausea, malaise, headache, lethargy, seizures, coma
- Chronic HypoNa:
  - Impaired cognition
  - Attention deficit
  - Gait instability and falls in elderly
  - Osteoporosis

Acute Hyponatremia

Exercise induced, Post Op, Ectasy, Polydipsia

Symptomatic: 100 ml NaCl 3% in bolus infusions x 2-3 to increase Na 4-6 meq and resolve symptoms


Normal Brain
(normal osmolality)
immediate effect
of hypotonic state
1
Water Gain
(low osmolality)
rapid
adaptation
2
Loss of
Sodium, Potassium,
and Chloride
(low osmolality)
water
3
slow
adaptation
4
Loss of Organic
Osmolytes
(low osmolality)
Improper Therapy
(rapid correction of the
hypotonic state)
5
Osmotic
Demyelination

Treatment Chronic (>48hrs)

* Fear Osmotic Demyelination Syndrome(ODS)
  * Confusion, diorientation, coma and seizures
  * Behavioral changes
  * Dysarthria,Dysphagia
  * Paraparesis, quadrapareris
  * Locked in
* Prevention
  * Correction 8 meq/24 hrs and 18 meq/48 hrs
  * Risk greater if Na < 120
  * Follow Na q 2-4 hrs
  * D5% or Desmopressin if overcorrection

Prevention ODS and treatment

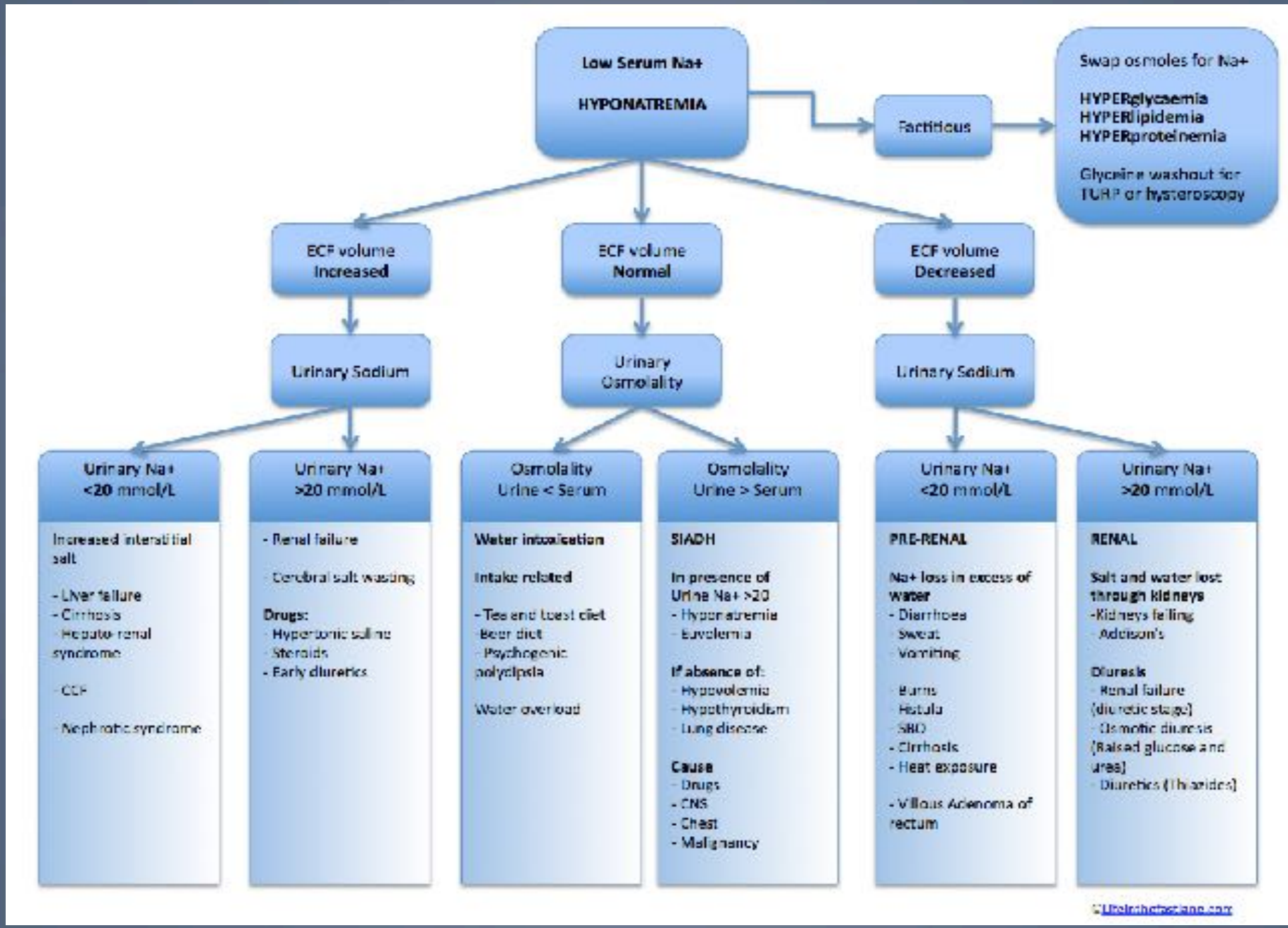
If overcorrection

* D5%(6ml/kg x 2 hrs)
* DDAVP 2microg iv or sc q 6hrs prn
* Aim for your 24 and 48 hrs goal(8 and 18 meq)
* High risk group aim 6 meq/24 hrs:
  * Alcoholism, liver disease, malnutrition, hypoK, Na <105

86 yo lady

* RA: Compression fracture of T6
* Symptoms of dizziness, nausea and disorientation
* Past history: HTN, DM 2, depression
* Medications: Hydrodiuril 25 mg qd(10 years)
  * Glyburide 5 mg bid(10 years)
  * Oxybutynin 4 mg/day (5 years)
  * Bethahistine 8 mg tid (1 week)
  * Domperidone 10 mg tid (1 week)
  * lorazepam 0.5 mg/day (10 years)
  * duloxetine 20 mg/day (2 weeks
* LABS: Na 116 meq/L (136-145)

* Visit to family physician 2 weeks ago:
  * Duloxetine prescribed for depression
* Visit to the clinic 1 week ago
  * Betahistine and motilium for nausea, vertigo
* Admited following a fall, complaining of nausea, disorientation
* Labs: Na 116 K 3.2 Bun 8 Creat 70 Osmolality 239
  * Urine Osm: 385 Una 32
* Dx?
* How to treat?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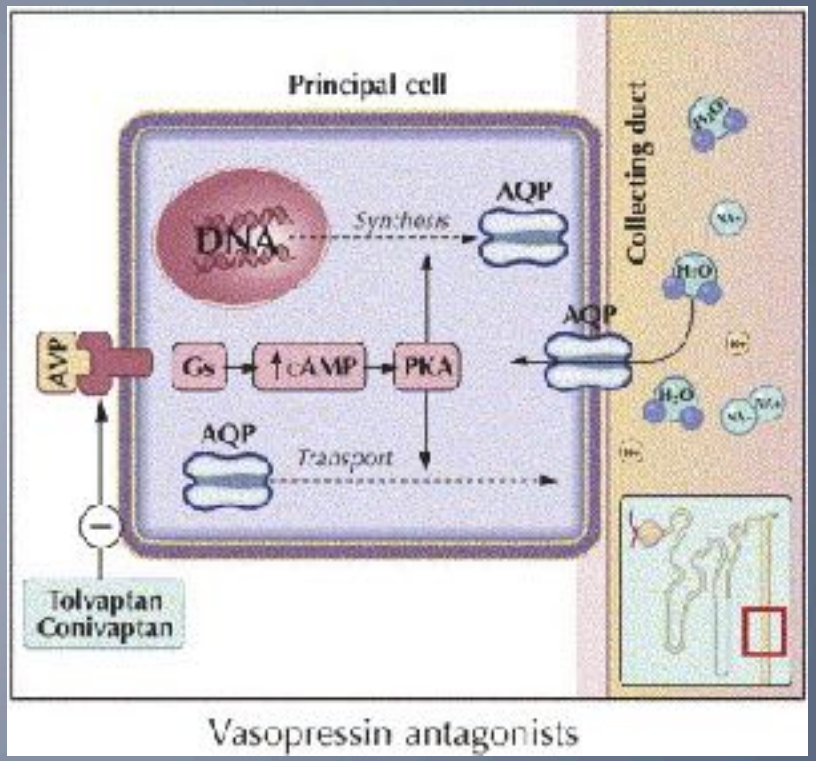
SIADH

* Stop HCTZ
* Fluid restriction 800 ml to 1000 ml
* NaCL in diet and NaCl tablets
* +- Loop Diuretics (Osm >500)
* NaCl 3% if **symptomatic**
* V2receptor antagonist: Tolvaptan
  * $$, rapid correction, no clear role

Tolvaptan(V2 receptor Antagonist

- CHF
- Cirrhosis
- SIADH
- ADPKD
- $$$
- Overly rapid correction!!
- Inadequate if neuro sx
- Do not use with NaCl 3%
- Monitoring of liver enzymes



Vasopressin antagonists

Hypomagnesemia

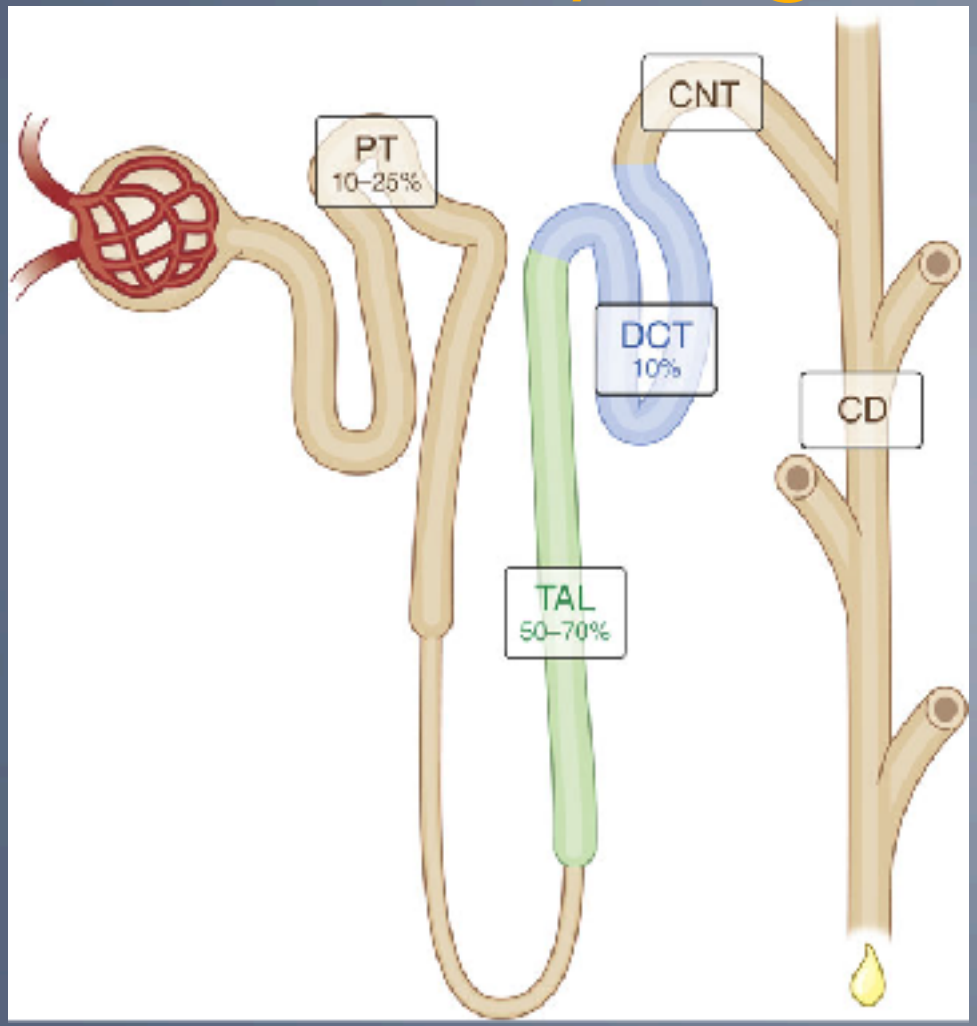
When to measure!?

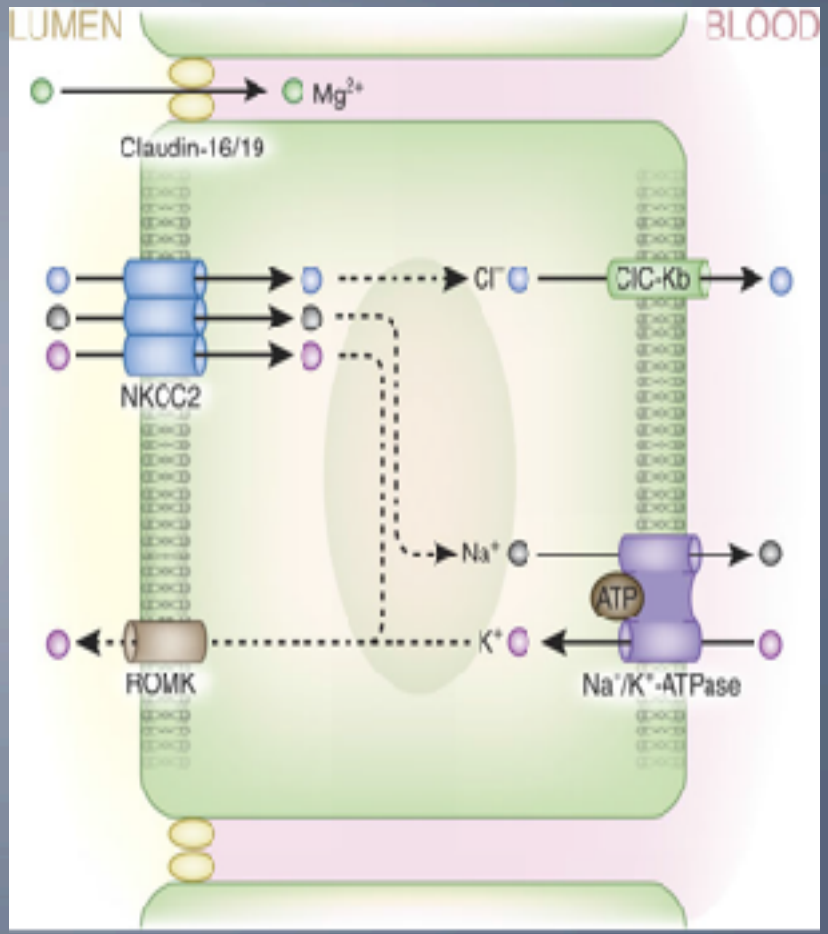
Importance of correction!?

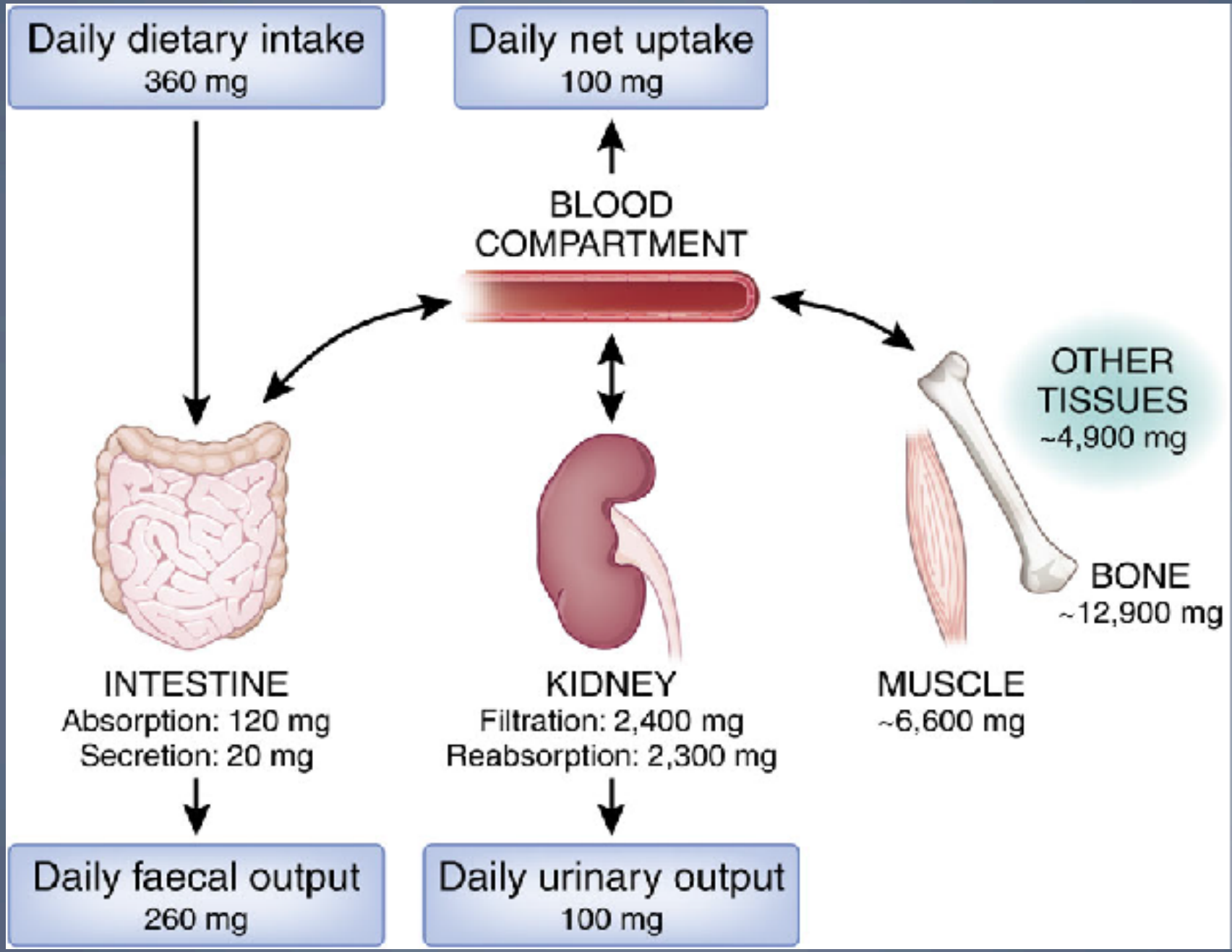
Hypomagnesemia

* What is the etiology ?
* What else should I look for?
* How can I prevent?
* How do I treat?

Kidney Mg Reabsorption






Daily dietary intake
360 mg
Daily net uptake
100 mg
BLOOD
COMPARTMENT
OTHER
TISSUES
~4,900 mg
BONE
~12,900 mg
INTESTINE
Absorption: 120 mg
Secretion: 20 mg
KIDNEY
Filtration: 2,400 mg
Reabsorption: 2,300 mg
MUSCLE
~6,600 mg
Daily faecal output
260 mg
Daily urinary output
100 mg

Physiology

* Mg balance related to Ca,K+
* Nature's physiologic CCB
* Cofactor for the intracellular Na-K pump

Etiology

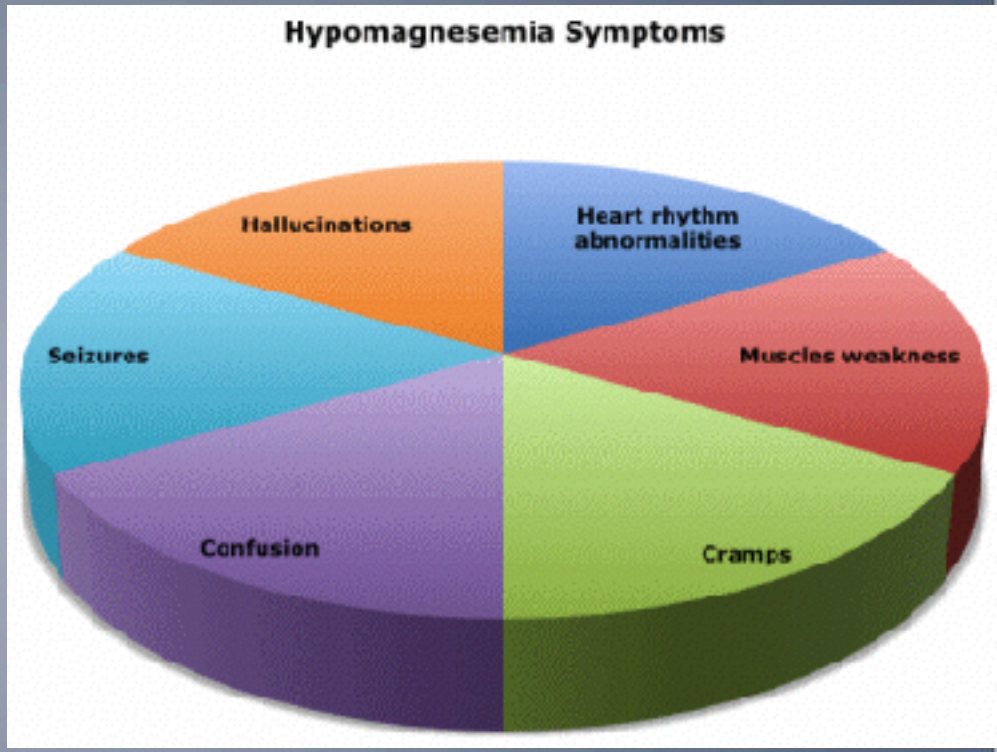
* Gastrointestinal
  * Diarrhea, malabsorption, steatorrhea, small bowel surgery
  * Acute pancreatitis
  * PPI
  * Genetic
* Poor intake
  * ROH (Thiamine increase Mg deficiency!)
  * Parenteral nutrition

Etiology

- Renal loss
  - Medications
    - Diuretics(loop,thiazide), Aminoglycoside, AmphoB, pentamidine, Calcineurin inh, Cisplatin, Chemotx-cetuximab…
  - Volume expansion
  - DM uncontrolled
  - ROH
  - HyperCa
  - Tubular dysfonction
    - Post ATN, Post obstruction, post tranplant
    - Bartter/Gitelman syndrome
    - Isolated hypoMg, Familial HypoMg, HyperCa

Signs and symptoms

* Asymptomatic
* Cognitive impairment
* Seizures-coma
* Muscular
* Cardiac:
  * arrythmia,
  * hypertension, IHD
* Insuline resistance



When to measure in asymptomatic patient

* DM
* PPI
* Chronic Diarrhea
* Diuretics, aminoglycoside, chemotx, calcineurin inhibitor
* Hypokalemia
* Hypo or hypercalcemia
* Malnourished
* ICU
* Acute MI

Evaluation

* FeMg = $\frac{\text{Umg x PCr}}{(0.7\text{x PMg}) \text{ x Ucr}}$ x 100%

  Above 2%: Mg renal loss

* Lytes, HCO3
* Ca,PO4,alb
* Bun, Creat
* Gluc

Treatment

* GI loss:
  * Treat the diarrhea
  * Consider stopping PPI
  * Supplements po or iv(symptoms, tolerance)
  * MgCl better tolerated and more effective
* Renal
  * Treat the cause if possible
  * Supplements: po or iv (symptoms, tolerance)
  * Consider amiloride

Treatment

* Severe symptoms: torsade de pointes
  * 1-2 g $MgSO_4$: 4-8 mmol in 15 min then infusion(4-8 g iv over 12-24 hrs)
* Severe neuromuscular symptoms: tetany
  * 1-2 g iv over 30-60 min then infusion
* Start po as soon as possible
* IV Mg inhibits reabsorption Mg in loop of Henley

Treatment

* Mg < 0.4 mmo/ll: give 4-8 g (16-32 mmol)
* Mg 0,4 – 0,6 mmol/L: 2-4 g (8-16 mmol)
* Mg 0,6-0,8 mmol/L: 1-2 g (4-8 mmol)

57 yo patient

* RC: Muscle spasm and weakness
* Past hx: DM 2, GERD, IHD, HTN, alcoholism
* Medications:
  * Metformin 1g bid
  * Gliclazide 80 mg bid
  * Pantoprazole 40 mg qd
  * Ramipril 10 mg qd
  * Bisoprolol 5 mg qd
  * Furosemide 20 mg qd
  * ASA 81 mg qd
* Labs: Mg 0,33 mmol/L (0,71-0,94)

57 yo

BP 190/100

K 3.4 mmol/L
Ca 1.97 mmol/L
Creatinine 80 mmol/L

FeMg 1%

HbA1c: 7,1%

HypoMg corrected after metformin stopped!

Conclusion

* Severe HypoNa can be fatal
* Chronic HypoNa as consequences
* Treat cautiously
* HypoMg is not always asymptomatic
* Look for HypoMg in patient at risk
* Correct if symptoms, below 0,6 mmol/L or if other risk factors of complications!

Thanks-Merci!