

Fluid & electrolytes - II

22nd May 2011

Treatment of hyponatremia

- Treatment of underlying condition
- Water intoxication/ SIADH:
 - Fluid restriction: 1000ml/day
 - Diuretics
 - Hypertonic saline 3%, 5% NaCl
- Sodium supplement:
 - Na deficit = $0.6 \times \text{lean body weight} \times (130 - \text{serum sodium})$
 - (mmol) (Kg) (mmol/L)
- Na should be increased less than 12 mmol/L over 24 hour (< 0.5 mmol/L per hour)
- In acute hyponatremia (< 48 hours) rapid correction @ 1-2 mmol / hour can be done.
- Rapid correction: central pontine demyelination

Hypernatremia

- **Causes:**
 - Infusion of hypertonic solution eg saline, NaHCO₃,
 - DI
 - Chronic renal failure
 - Mineralocorticoid excess
- **CF:**
 - Lethargy, weakness, irritability, seizure, coma
- **T/t:**
 - correction of water deficit
 - Oral water
 - 5% dextrose, hypotonic saline 0.45%, 0.18% NaCl etc.

Potassium

- Major intracellular cation
- Serum level: 3.5 – 5 mmol/L
- Daily intake: 1mmol/Kg daily
- Excreted in urine.

Hypokalemia

- **Causes:**
 - GI losses: diarrhoea, vomiting, NG aspiration
 - Renal losses: diuretics, fluid mobilization
 - Cutaneous loss; burn
 - Insulin excess,
 - Aldosterone excess,
 - Villous adenoma of rectum
- **CF:**
 - Weakness
 - Cardiovascular: ECG changes---ectopy, T-wave depression, prominent U wave, arrhythmia

Hypokalemia...

Treatment:

- In mild case--- oral replacement
- Parenteral infusion: should not exceed 20mmol/hour

Hyperkalemia

Causes:

- Rhabdomyolysis
- Insulin deficiency
- Beta blocker
- Digitalis intoxication
- Reperfusion syndrome
- Renal failure

CF:

- ECG changes— tall tented T wave, reduced p wave, wide QRS complex,
- Cardiac asystole

Hyperkalemia...

Treatment:

- Mild hyperkalemia: decrease K intake, loop diuretics— frusemide
- Severe hyperkalemia:
 - NaHCO₃ 8.4% --- 1mmol/kg
 - Glucose with insulin: 0.5gm/kg body wt
 - Inhaled B-agonist: salbutamol, albuterol as nebuliser
 - Calcium gluconate 10%: 10ml over 10 min
 - Dialysis

Calcium

- Normal: 8.9 – 10.3 gm/dl
 - Ionized: --45%
 - Protein bound—40%
 - Complexed to other compounds—15%
- Ionized one is physiologically active
 - Daily intake: 500mg-1000mg
- Regulation:
 - PTH, vit D

Hypocalcemia

- Causes:
 - Ca sequestration: acute pancreatitis, rhabdomyolysis, massive blood transfusion
 - Vit D deficiency
 - Total thyroidectomy, hypoparathyroidism
 - Hypoalbuminemia: 1gm/dl decrease in albumin---- 0.8mg/dl decrease in serum Ca
 - Associated with Mg deficiency
- CF:
 - Perioral numbness & tingling
 - Tetany---- Chvostek's sign (facial muscle spasm on tapping over the branches of facial nerve
 - Trousseau's sign
 - Laryngeal spasm, seizure
 - ECG changes: ventricular arrhythmia, QT- interval prolongation

Hypocalcemia...

Treatment:

- Oral therapy: calcium salts---- Ca carbonate, Ca gluconate in chronic case, vitamin D also added
- Paarental therapy: calcium gluconate 10% 10 – 20ml over 10 minutes bolus then infusion @ 1-2 mg/kg elemental Ca per hour Calcium chloride

Hypercalcemia

- Causes:
 - Hyperthyroidism
 - Malignancy
 - Hyperthyroidism
 - Vitamin D intoxication
 - Long term bed ridden patients
 - Long term TPN
 - Thiazide diuretics
- CF:
 - Weakness, altered mental status, dehydration, nausea & vomiting, intestinal colicks, constipation, bone pain, renal stones

Hypercalcemia...

- **Treatment:**
 - Restriction of Ca intake
 - Treatment of underlying disorder
 - Correct dehydration
 - Severe cases: NaCl 0.9% & loop diuretics
 - Calcitonin
 - Pamidronate
 - Bisphosphonate
 - Plicamycin

Magnesium

Composition of crystalloid & colloid solutions (mM/L)

Solution	Na	K	Ca	Cl	Lactate	Colloid
Hartmann's	130	4	2.7	109	28	--
Normal saline (0.9% NaCl)	154	--	--	154	--	--
5%/10% Dextrose	--	--	--	--	--	--
Dextrose saline (4%D +0.18% NaCl)	30	--	--	30	--	--
Gelofusine	150	--	<1	150	--	Gelatine 4%
Haemacel	145	5.1	6.26	145	--	Polygelin 75g/L
Hetastarch	--	--	--	--	--	Hydroxyethyl starch 6%

Composition of GI secretions (mM/L)

Fluids	Volume ml/24 hr	Na	K	Cl	HCO ₃
Saliva	1500	10	25	10	30
Stomach	1500	50	15	110	--
Duodenum	1000	140	5	100	--
Ileum	3000	140	5	100	30
Colon	800	60	30	40	--
Pancreas	1000	140	5	75	115
Bile	800	140	5	100	35

Acid-base balance

- pH = 7.36 – 7.44
- Buffer system: HCO₃ buffer system
- HCO₃: H₂CO₃
 - CO₂ removal by lungs, acid & base (H & HCO₃) removal by kidney
 - Normal ratio 20:1
- PCO₂: 35-45 mmHg
- PO₂: 80-110 mmHg
- HCO₃: 22-25 mmol/L
- Anion gap: undetermined or unmeasured anions in blood.
 - 10-16 mmol/L
 - Anion gap = (Na + K) – (HCO₃+ Cl)
 - Increased in metabolic acidosis like ketoacidosis, lactic acidosis, salicylate poisoning.