



## Body fluid compartments:

- ♣ Water constitute 50-70% of lean body weight.
- ♣ Total body water content is higher in men.
- ♣ Concentrated in skeletal muscles.
- ♣ Declines steadily with age.
- ♣ Intracellular fluids, 40% of body weight.
- ♣ Extracellular fluids, 20% of body weight :
  - ▶ Plasma or intravascular compartment 5%.
  - ▶ Interstitial compartment 15% .
- ♣  $Na^+$  is the principal extracellular cation .
- ♣  $Cl^-$  and  $HCO_3^-$  are the principal extracellular anions .
- ♣  $K^+$  and  $Mg^{+2}$  are the principal intracellular anions.
- ♣ Phosphates and negatively charged proteins are the principal intracellular anions .

## Fluid balance :

- ♣ Daily requirement.
- ♣ Replacement of ongoing loss.
- ♣ Correction of abnormalities.
- ♣ Basal Requirement :
  - ▶ 35cc / kg / day.
  - ▶ 100 cc / 50 cc / 20 cc
- ♣ Fluids turnover :
  - ▶ GI tract 6000-9000cc / day
  - ▶ Renal 1000-15000cc / day
  - ▶ Insensible loss 600-800cc / day.

## Volume disorders :

### ❖ Hypovolemia :

- ▶ Mild: 4% loss of TBW, 15% of blood .
- ▶ Moderate: 6% TBW, 15-30% of blood .
- ▶ Severe: 8% TBW, 30-40% of blood .
- ▶ Shock: > 8% TBW, >40% of blood .

### ❖ Hypervolemia :

- ▶ Parenteral overhydration .
- ▶ cardiac failure .
- ▶ renal failure .



## ❖ Hyponatremia :

### ♣ Hypotonic:

▶ Hypovolemic: Loss of isotonic fluids or replacement with inadequate volume of excessively hypotonic fluids.

▶ Hypervolemic: Fluid retaining .

▶ Isovolemic: SIADH .

♣ Isotonic: Pseudohyponatremia.

### ♣ Hypertonic:

▶ Non-sodium osmotic substances.

▶ 100 mg/dl glucose  $\text{Na}^+$  3 meq/l .

## λ Hyponatremia treatment :

♣ Underlying disorder .

♣ Water restriction .

♣ Loop diuretics .

♣ Rate of infusion .

## ❖ Hypernatremia :

♣ Water loss greater than salt loss .

♣ Hypovolemic: 3 meq rise in  $\text{Na}^+$  = 1 L loss of water .

♣ Isovolemic: Diabetes insipidus .

♣ Hypervolemic: iatrogenic, endocrine.

## λ Hypernatremia treatment :

♣ Underlying disorder.

♣ Water deficit =  $(0.6 \times \text{kg weight}) (\text{serum } \text{Na}^+ / 140 - 1)$ .

♣ Slow replacement.

## ❖ Hypokalemia :

♣ Redistributive losses from intracellular uptake of *potassium*

♣ Depletion: GI loss, renal loss.

♣ ECG changes, weakness, fatigue, ileus.

## λ Hypokalemia treatment :

♣ Adequate renal function .

♣ Enteral replacement .

♣ Parenteral replacement .

♣ Treat alkalosis.



## ❖ Hyperkalemia :

- ♣ Leukocytosis, hemolysis, thrombocytosis.
- ♣ Redistributonal: acidosis, tissue necrosis.
- ♣ Renal failure, excessive intake, *spironolactone*.
- ♣ Nausea, vomiting, diarrhea , colic.
- ♣ ECG changes .
- ♣ Cardiac arrest.

## λ Hyperkalemia treatment :

- ♣ Remove exogenous source.
- ♣ If  $> 7.5$  its an emergency:
  - ▶ *Calcium gluconate*
  - ▶ *Insulin and D50W*
  - ▶ *Kayexalate*.

## Acid-Base balance :

- ♣ Enzymatic balance.
- ♣ Three primary systems:
  - ▶ Buffer system: RBCs, proteins, *phosphate*.
  - ▶ Respiratory system .
  - ▶ Renal system .

## Metabolic acidosis :

- ♣ Overproduction or underexcretion of acid.
- ♣ *Anion gap* =  $\text{Na}^+ - (\text{Cl}^- + \text{HCO}_3^-)$ .
- ♣ Normal *anion gap* (RTA,diarrhea).
- ♣ Wide *anion gap* (DKA, RF,toxins ).