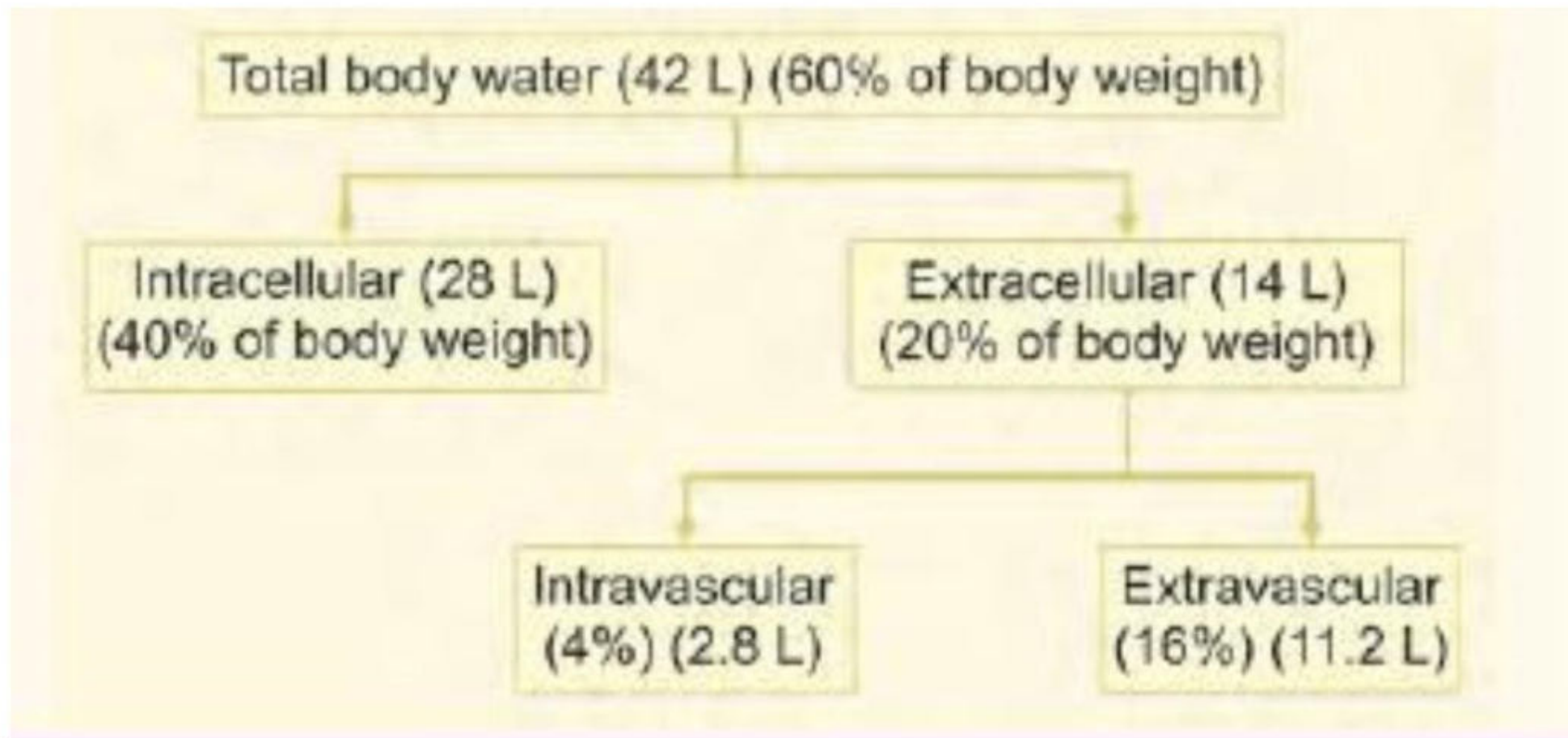


Electrolyte and Water Balance

Case Report

- A 55-year-old man was brought to the emergency with severe multiple injuries in a road traffic accident and crush injuries, fractures of the legs and scalp lacerations. He was conscious and breathing spontaneously. Pulse 130/min, BP 60/40 mm Hg, serum sodium 142 mmol/L, potassium 7.9 mmol/L, chloride 110 mmol/L, Blood urea 40 mg/dL, and serum creatinine 1.2 mg/dL.
- Interpret the laboratory data?
- What is the basis of the changes?

The body water compartments



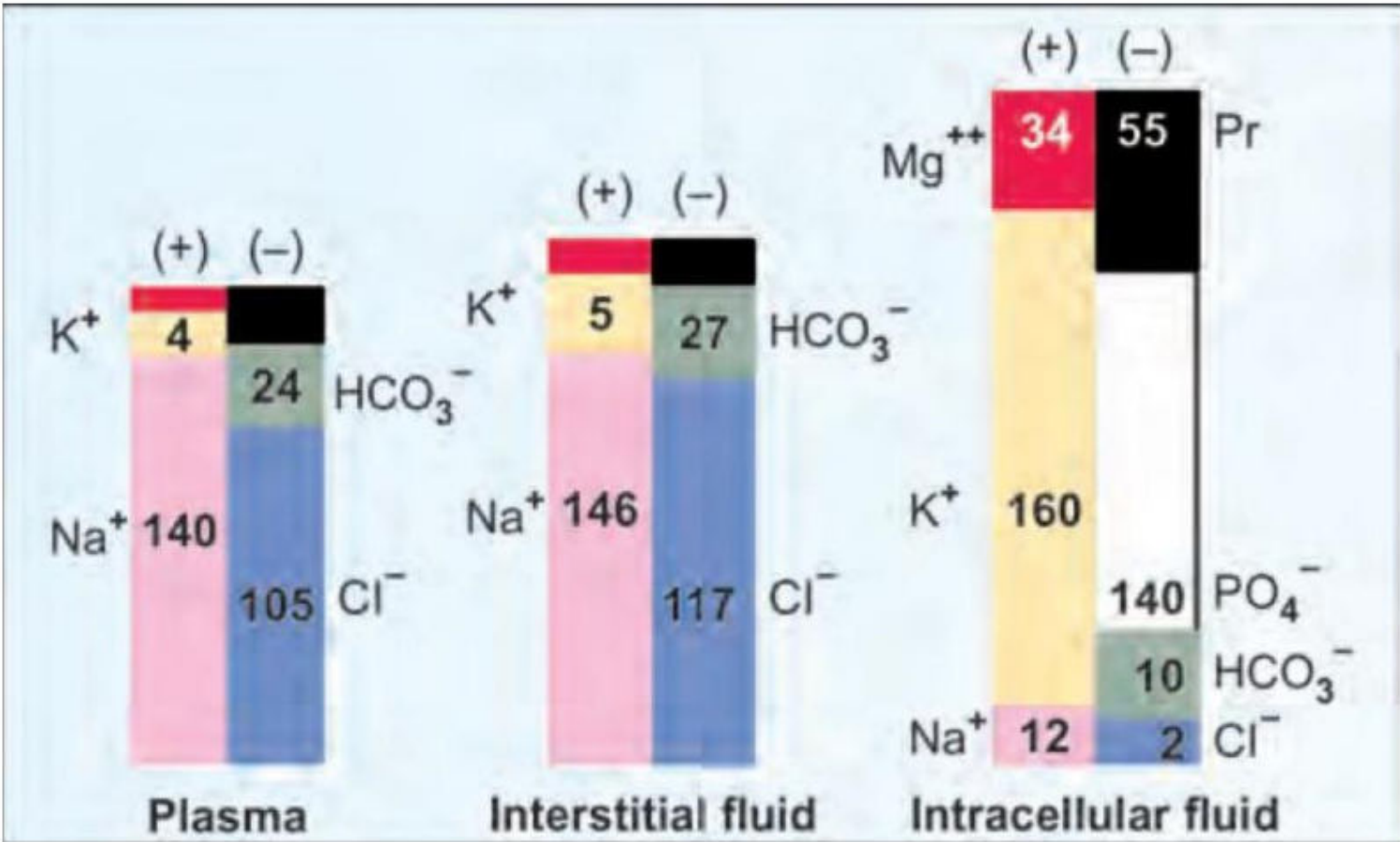
- During oxidation of foodstuffs,
 - 1 g carbohydrate produces
 - 0.6 mL of water,
 - 1 g protein releases
 - 0.4 mL water and
 - 1 g fat generates
 - 1.1 mL of water.
- major factors controlling the intake :
 - thirst and
 - the rate of metabolism.

Water balance in the body

<i>Intake per day</i>		<i>Output per day</i>	
Water in food	1250 mL	Urine	1500 mL
Oxidation of food	300 mL	Skin	500 mL
Drinking water	1200 mL	Lungs	700 mL
		Feces	50 mL
	2750 mL		2750 mL

- **Osmolarity means osmotic pressure exerted by the**
 - number of moles per liter of solution.
- **Osmolality is the osmotic pressure exerted by the**
 - number of moles per kg of solvent.
- osmotic balance is mainly maintained by
 - **Albumin**
- the major determinant factor of osmolality is
 - the **sodium**
- **The osmolality of plasma varies from**
 - **285 to 295 mosm/kg**

Gamblegrams showing composition of fluid compartments



Electrolyte and Water Composition of Body Fluid Compartments

Components	Plasma	Interstitial fluid	Intracellular fluid
Volume, H2O (TBW = 42 L)	3.5 L	10.5 L	28 L
Na+	142	145	12
K+	4	4	156
Ca+2	2.4	2-3	2.3
Mg2+	2	1-2	26
Trace elements	1	-	-
Total cations	155		
Cl-	103	114	4
HCO-	27	31	12
Protein-	16	-	55
Organic acids-	5		
HPO2 -	2		
SO2 -	1		
Total anions	154		

Formulas for Estimating Serum Osmolality and Effective Osmolality	
Osmolality	Effective Osmolality
$2 \times [\text{Na}^+ \text{ mEq/L}]$	$2 \times [\text{Na}^+ \text{ mEq/L}]$
$+ [\text{glucose mg/dL}] / 18$	$+ [\text{glucose mg/dL}] / 18$
$+ [\text{BUN mg/dL}] / 2.8$	
$= \text{Sosm (mosm/Kg H}_2\text{O)}$	$= \text{Sosm (mosm/Kg H}_2\text{O)}$

Regulation of Sodium and Water balance

- ADH
- Renin-Angiotensin system
- Autoregulation

Disturbances in Fluid and Electrolyte balance

- Isotonic contraction- Loss of fluid that is isotonic with plasma--Loss of GI fluid
- Hypotonic contraction—Predominant Na loss— Infusion of fluids with low sodium content like dextrose
- Hypertonic contraction ---Predominantly water depletion---Diarrhoea
- Isotonic expansion---Secondary to hypertension
- Hypotonic expansion---ADH excess
- Hypertonic expansion---Conns syndrome & Cushings syndrome_
Excess mineralocorticoid- sodium retention

Reference interval of Sodium:

136-145 mmol/L (Adult)

128-148 mmol/L (New born at 48 h)

Approx 127 mmol/L (From Umbilical cord)

Urinary sodium excretion = 120-240 mmol/day with large diurnal variation

At night = 20% of the peak

Hyponatremia typically manifests clinically as

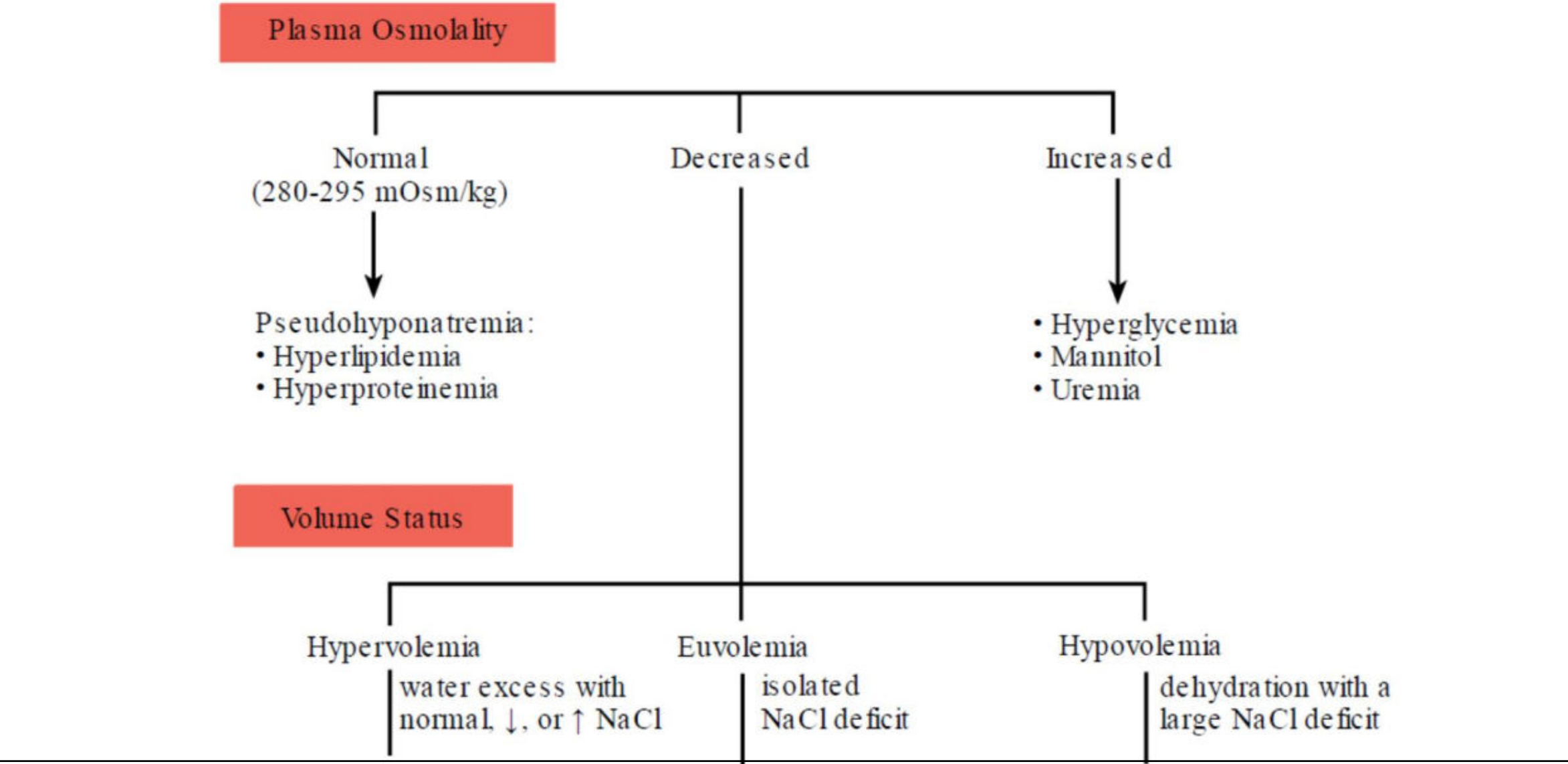
- (1) nausea,
- (2) generalize weakness, and
- (3) mental confusion.

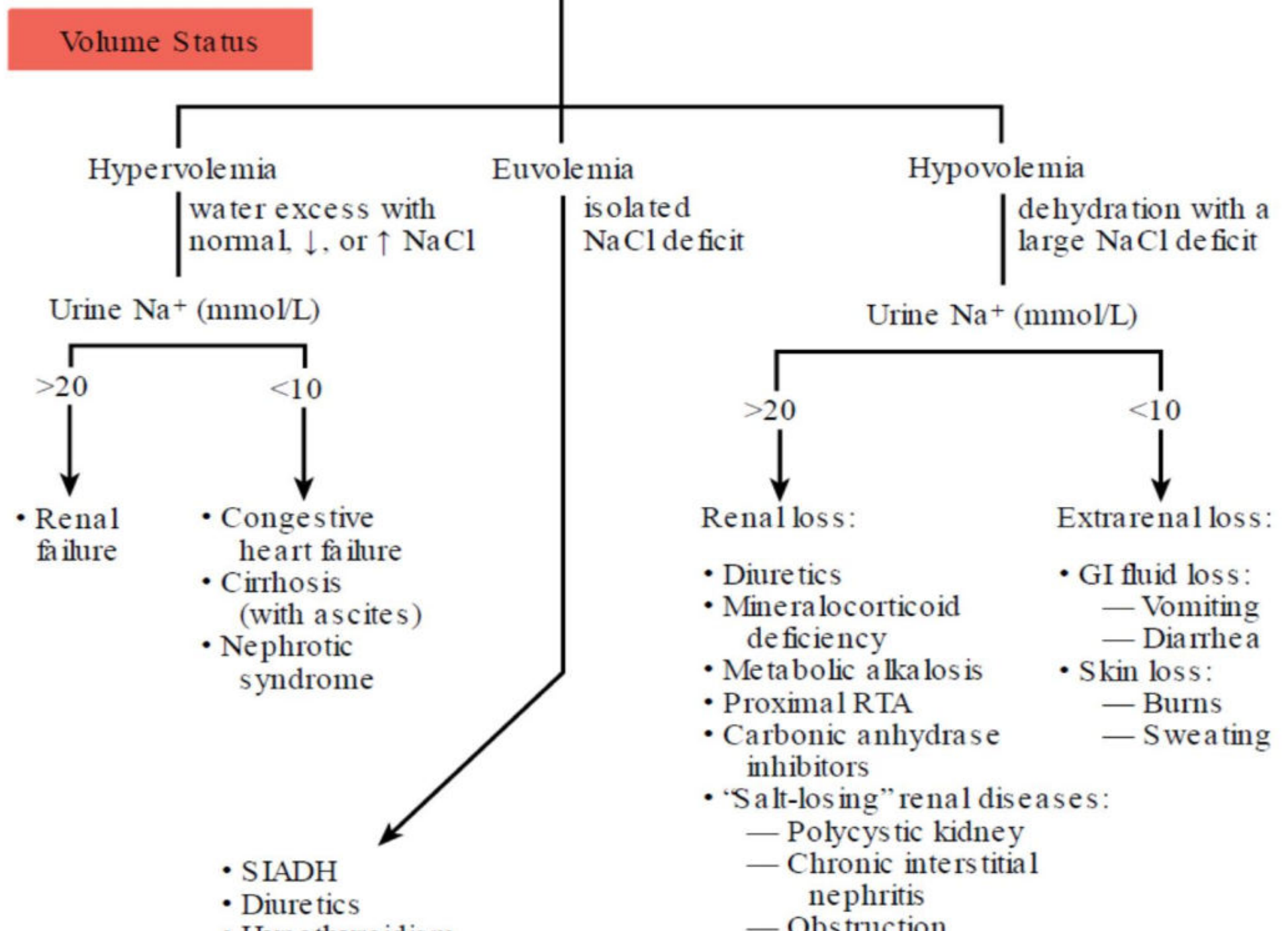
<120 mmol/L: mental confusion

<110 mmol/L : Ocular palsy

90-105 mmol/L: Severe mental impairment

Algorithm for the differential diagnosis of **hyponatremia**.

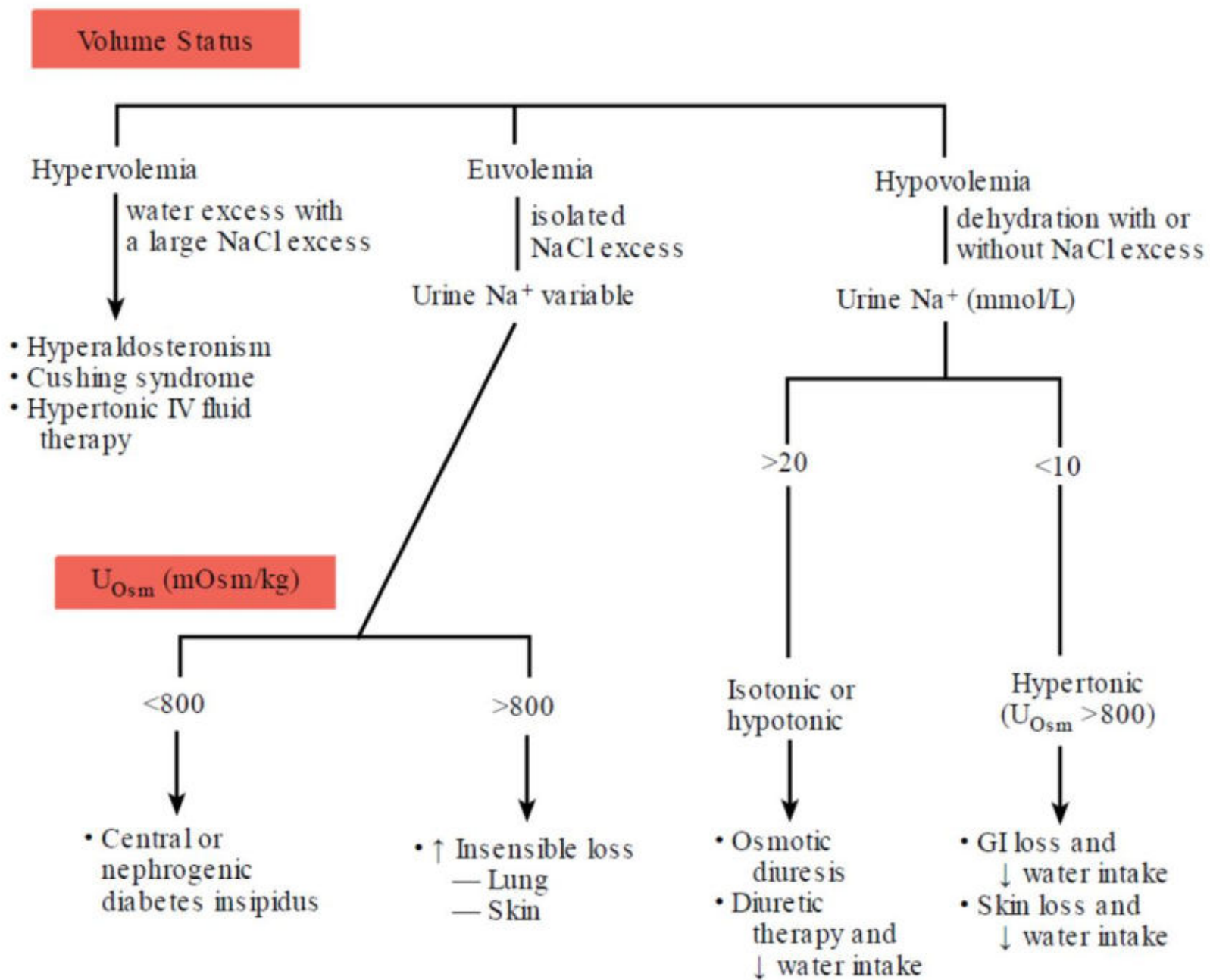




Hypernatremia Plasma sodium > 150 mmol/L

Symptoms are primarily neurologic
(because of neuronal cell loss of H₂O into the ECF)

1. Tremors
2. Irritability
3. Ataxia
4. Confusion
5. coma



Hypernatremia

HYPOKALEMIA

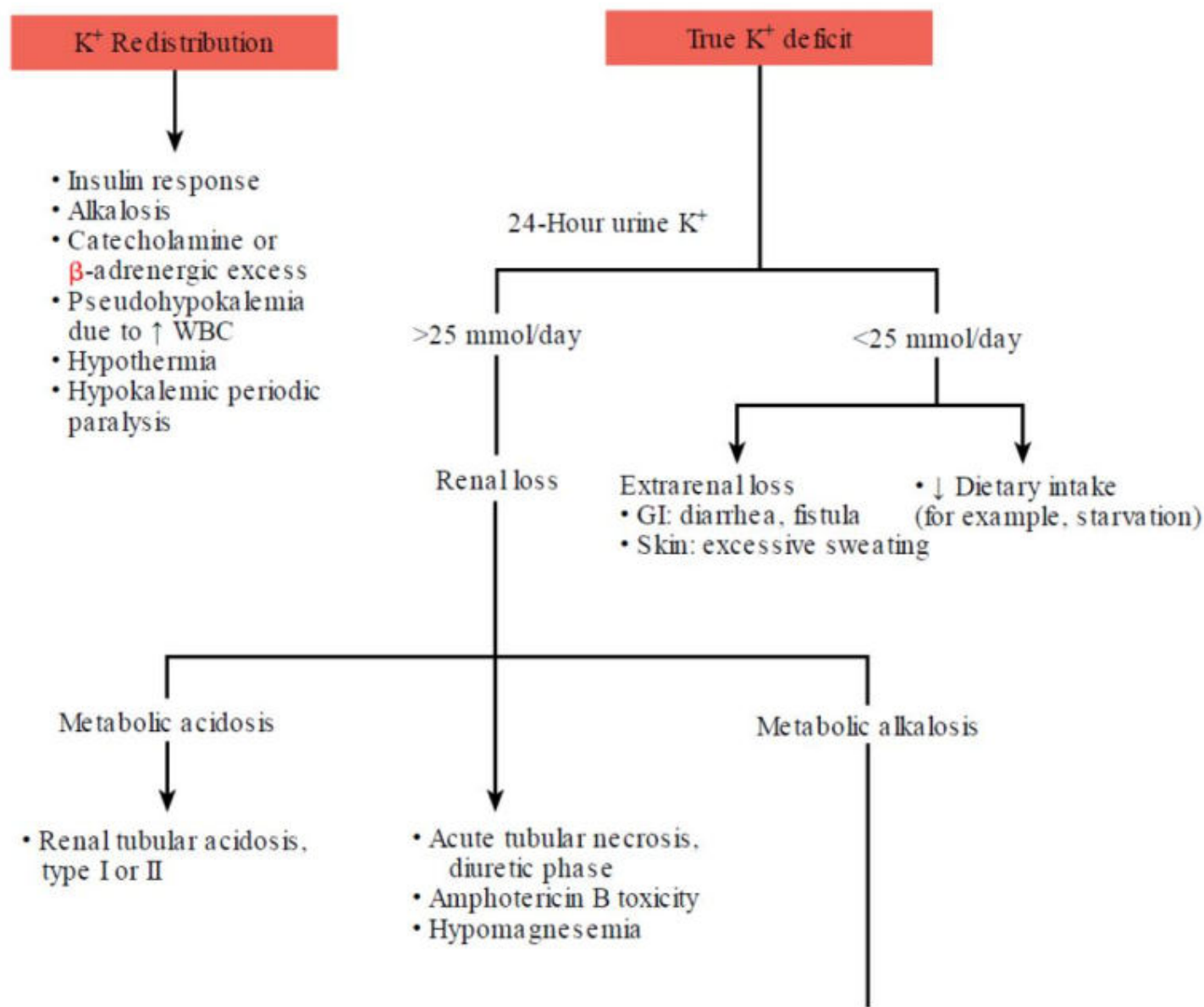
1. Muscle weakness
2. Irritability
3. Paralysis
4. Tachycardia
5. Cardiac conduction defect
6. Flattened T wave
7. Cardiac arrest

Reference interval of K⁺:
Serum=3.5-5.0 mmol/L (Adult)

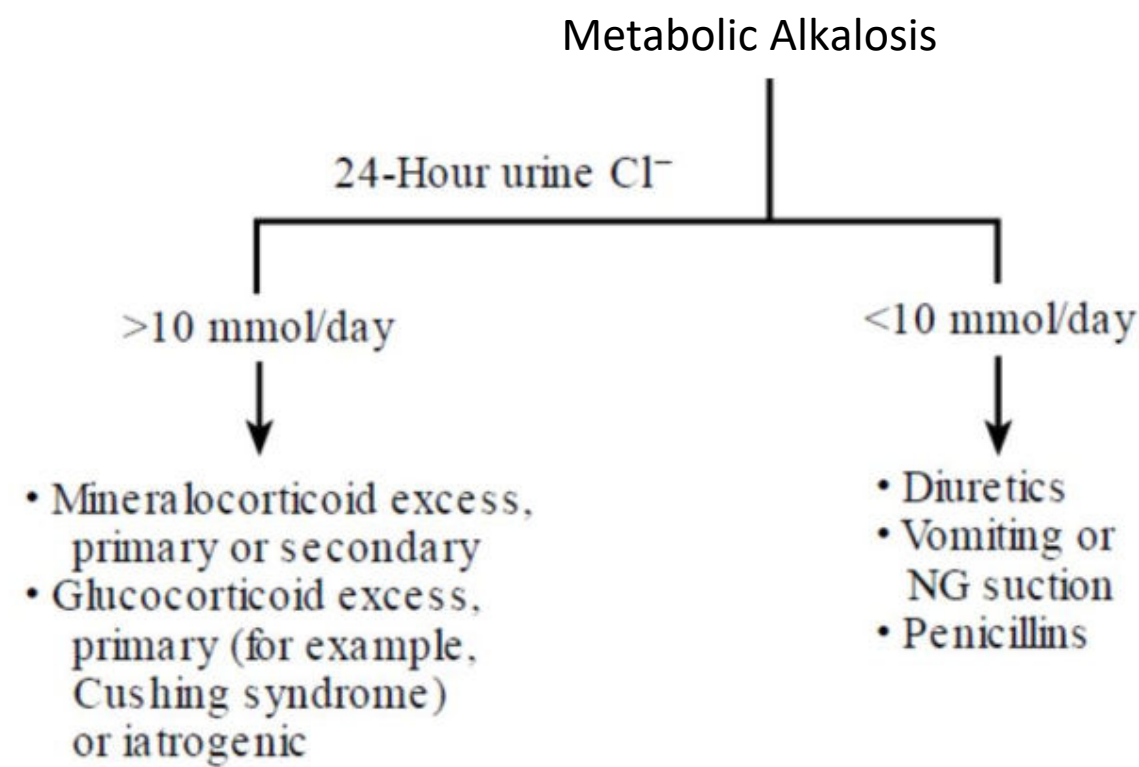
Plasma= 3.4-4.8 mmol/L (Adult)

3.7-5.9 mmol/L (Newborn)
CSF= 70% that of plasma

Hypokalemia

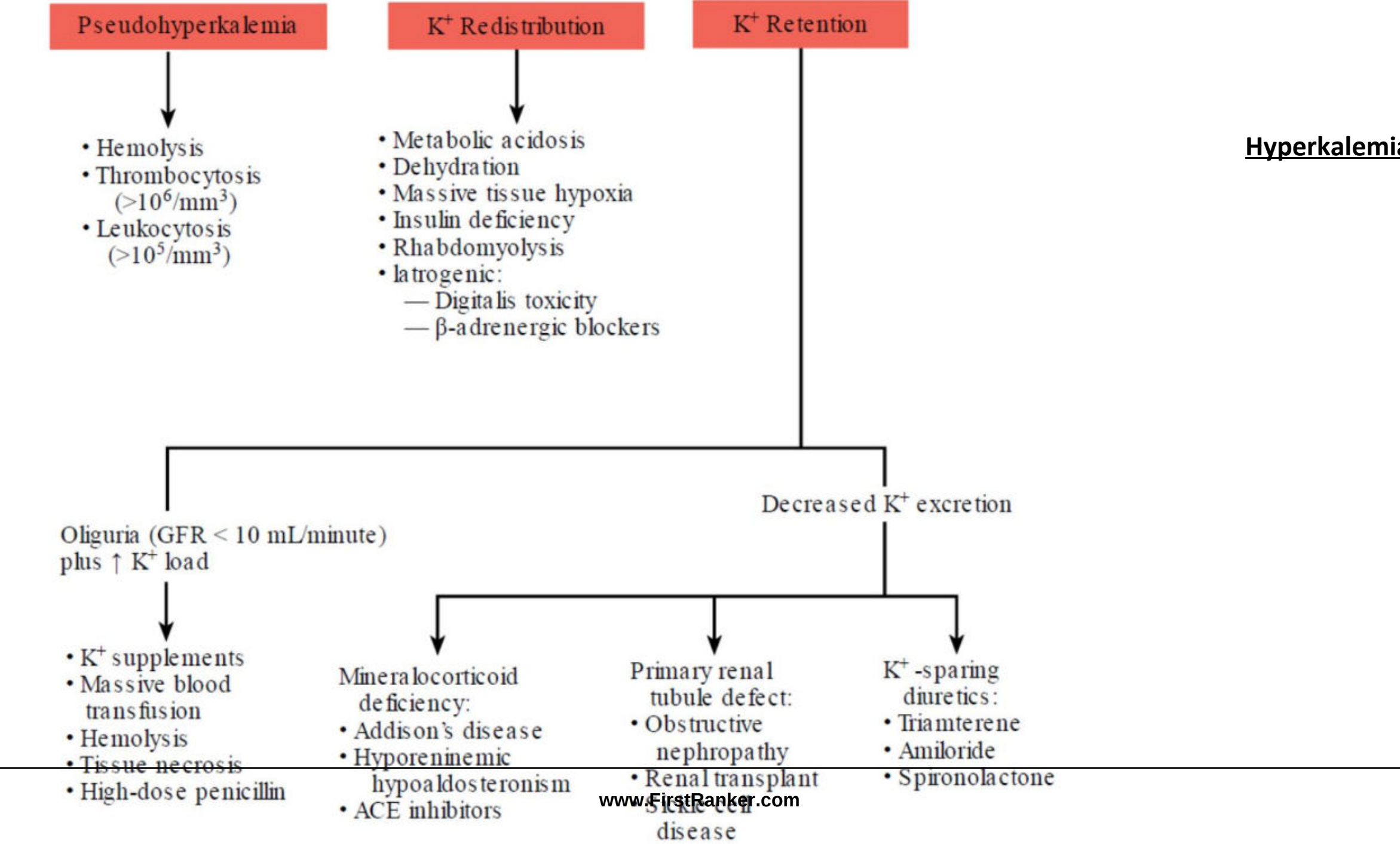


Hypokalemia (continued)



HYPERKALEMIA

- 1. Mental confusion
- 2. Weakness
- 3. Tingling
- 4. Flaccid paralysis of the extremities
- 5. Weakness of the respiratory muscles
- 6. Bradicardia
- 7. Conduction defects
- 8. Peripheral vascular collapse : Prolonged severe hyperkalemia >7 mmol/L
- 9. Cardiac arrest



MCQ 1

- A patient with diarrhoea may have all the following abnormalities except:
 - A. Metabolic acidosis
 - B. Hypertonic contraction of ECF
 - C. Urine with a high specific gravity
 - D. Isotonic contraction of ECF

MCQ 2

- Which of the following is the major intracellular cation?
 - A. Magnesium
 - B. Sodium
 - C. Calcium
 - D. Potassium

MCQ 3

- All 5the following hormones affect fluid and electrolyte balance except:
- A. Aldosterone
- B. ADH
- C. Cortisone
- D. Thyroxine

www.FirstRanker.com