UNIT I

Textbook of Medical Physiology, 11th Edition

Homeostasis II

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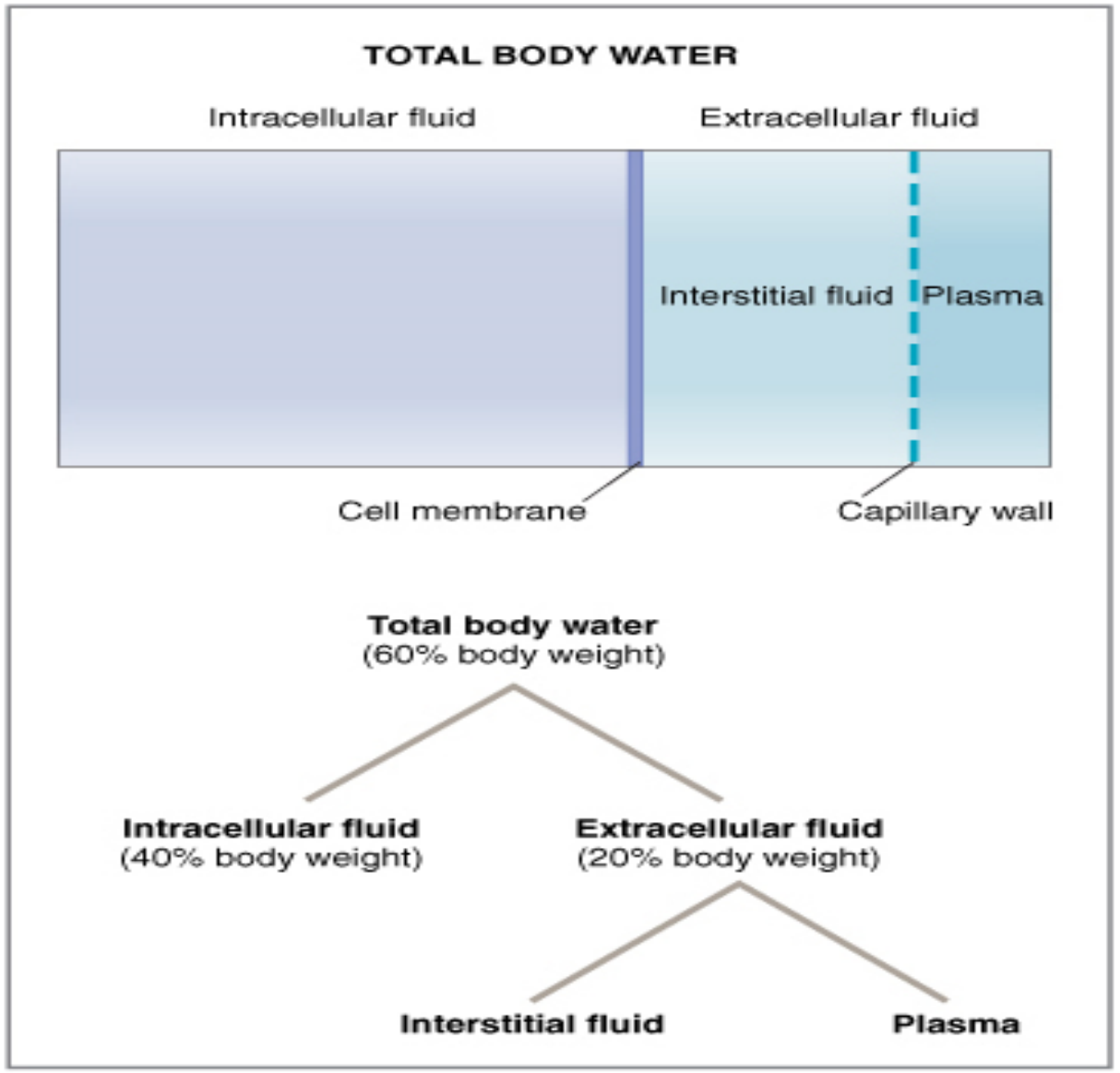
GUYTON & HALL

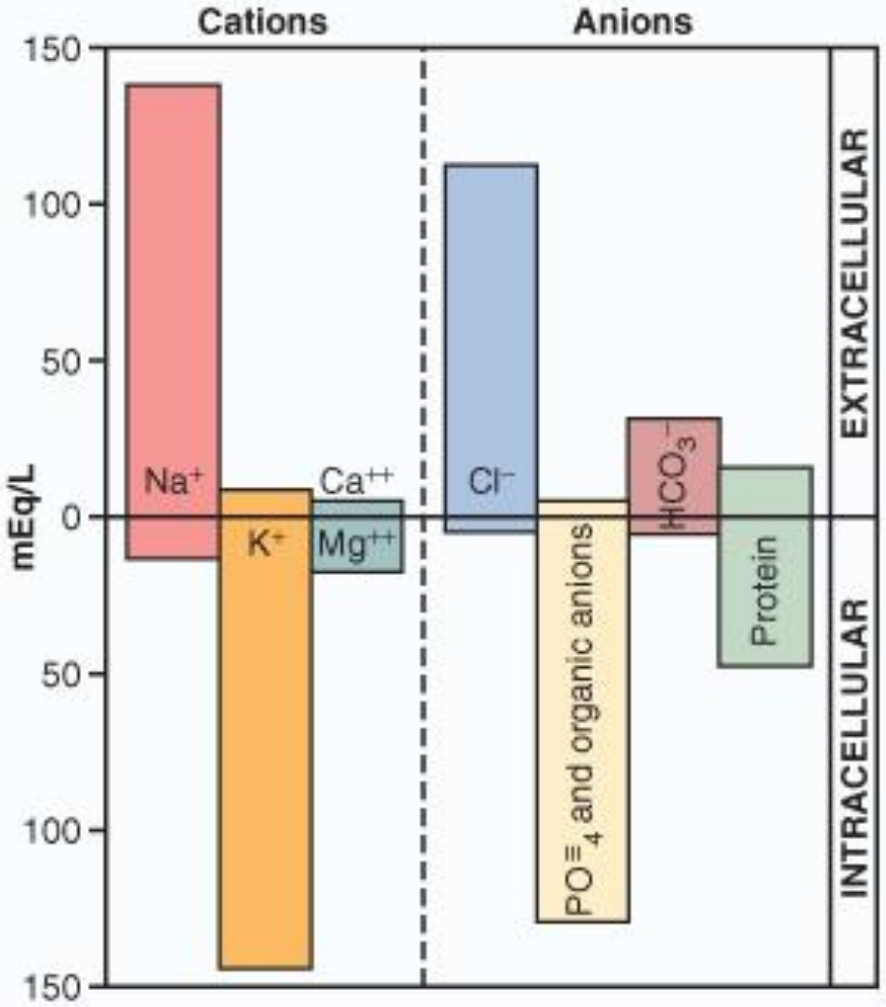
Changes in The Body Fluid Compartments (ECF & ICF) and Edema

Fluid Compartments



	Plasma (mOsm/L H_2O)	Interstitial (mOsm/L H_2O)	Intracellular (mOsm/L H_2O)
Na^+	142	139	14
K^+	4.2	4.0	140
Ca^{++}	1.3	1.2	0
Mg^{++}	0.8	0.7	20
Cl^-	108	108	4
HCO_3^-	24	28.3	10
$HPO_4^=$, $H_2PO_4^-$	2	2	11
$SO_4^=$	0.5	0.5	1
Phosphocreatine			45
Carnosine			14
Amino acids	2	2	8
Creatine	0.2	0.2	9
Lactate	1.2	1.2	1.5
Adenosine triphosphate			5
Hexose monophosphate			3.7
Glucose	5.6	5.6	
Protein	1.2	0.2	4
Urea	4	4	4
Others	4.8	3.9	10
Total mOsm/L	301.8	300.8	301.2
Corrected osmolar activity (mOsm/L)	282.0	281.0	281.0
Total osmotic pressure at 37 °C (mm Hg)	5443	5423	5423

Constituents of ECF and ICF



Volumes And Osmolarities of ECF and ICF in **Abnormal States**

- Some of the different factors that can cause extracellular and intracellular **volumes** to change:
  - ingestion of water
  - dehydration
  - intravenous infusion (IV)
  - abnormal sweating

Changes in Volume:

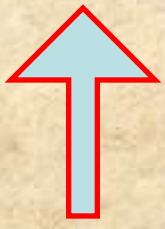
1. **Volume contraction**

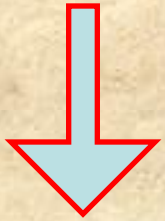
   A *decrease* in ECF volume

2. **Volume expansion**

   An *increase* in ECF volume

Changes in Osmolarity:

1.  **hypertonic (hyperosmotic)**

2.  **hypotonic (hyposmotic)**

Changes in volume & osmolarity

Volume contraction

removing

1- ***isotonic*** solution.

2- ***hypertonic*** solution.

3- ***hypotonic*** solution.

Volume expansion

Adding

1- ***isotonic*** solution.

2- ***hypertonic*** solution.

3- ***hypotonic*** solution.

Disturbance of body fluids

1- Identify any change occurring in the ECF

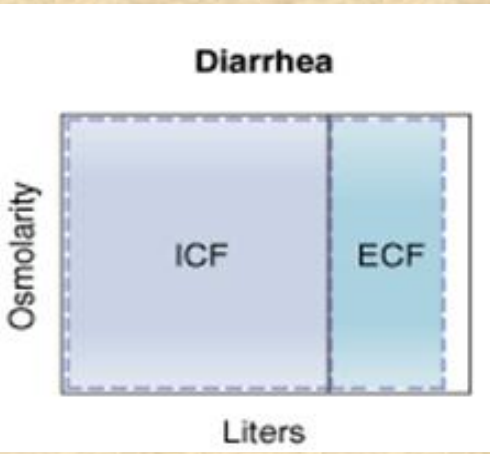
2- Decide whether that change will produce an increase, a decrease, or no change in ECF osmolarity

3- If there is a change in ECF osmolarity, determine whether water will shift into or out of the cells to reestablish equality between ECF osmolarity and ICF osmolarity

Volume Contraction (decrease in the ECF volume)

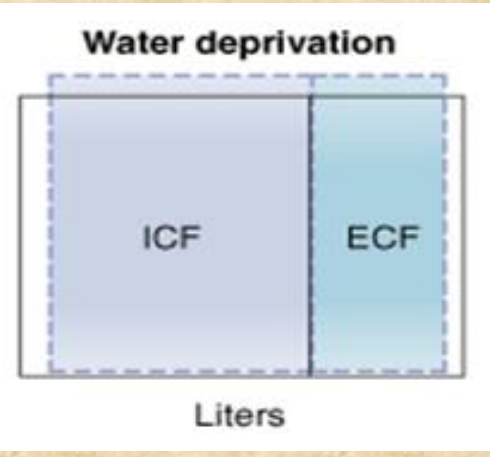
1. Isosmotic Volume Contraction "Diarrhea" :

- osmolarity of fluid lost ≈ osmolarity of ECF
- ↓ volume in ECF (loss of isosmotic fluid)
- ↓ arterial pressure

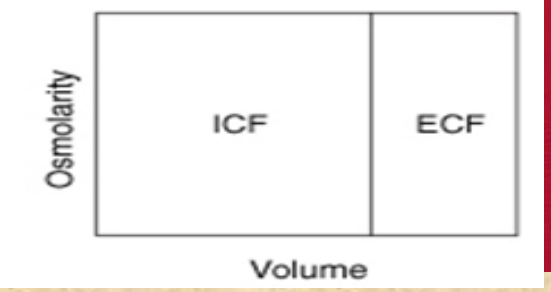


2. Hyperosmotic Volume Contraction e.g. "Water deprivation" :

- Water and NaCl
- Osmolarity and volume will change
- Hyposmotic fluid (small NaCl large water)
- ↑ Osmolarity in both ECF and ICF
- ↓Volume in both ECF and ICF

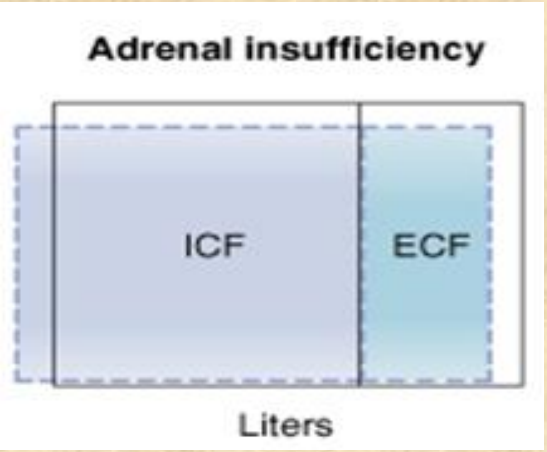


Volume Contraction (decrease in the ECF volume)

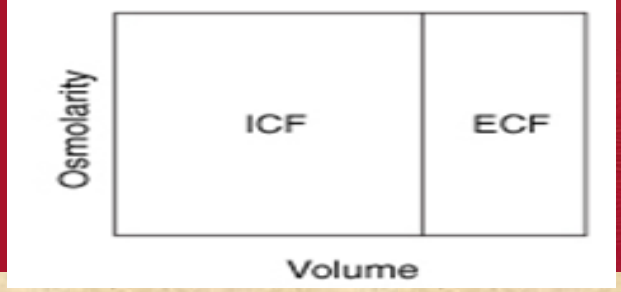


3. Hyposmotic Volume Contraction
"Adrenal insufficiency" :

- *Aldosterone* deficiency
- ↓ Na in the ECF
- ↓ osmolarity in both
- ↓ in ECF volume
- ↑ in ICF volume

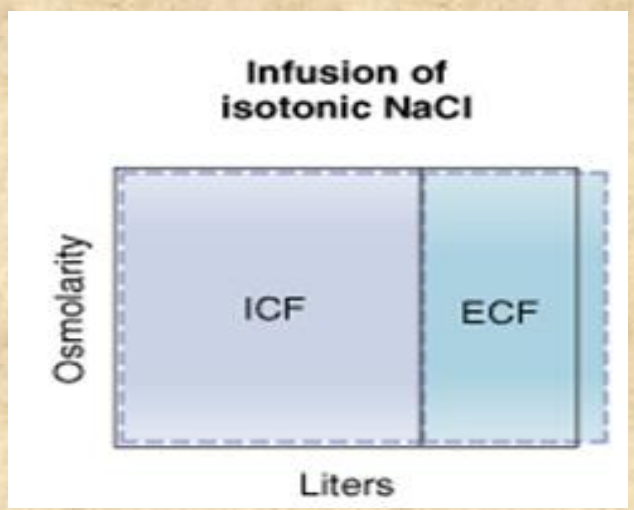


Volume Expansion (increase in the ECF volume)



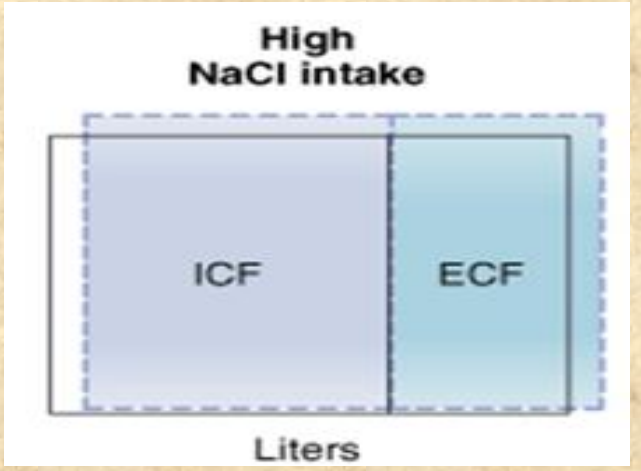
1. Isosmotic Volume Expansion
"Infusion of isotonic NaCl" :

- ↑ ECF volume
- No change in osmolarity

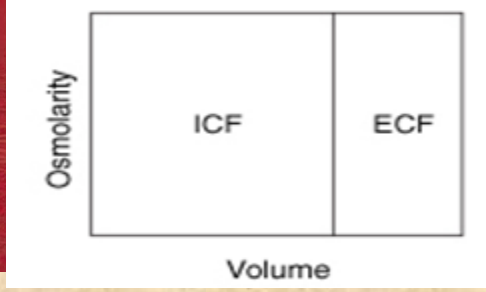


2. Hyperosmotic Volume Expansion
"High NaCl intake" :

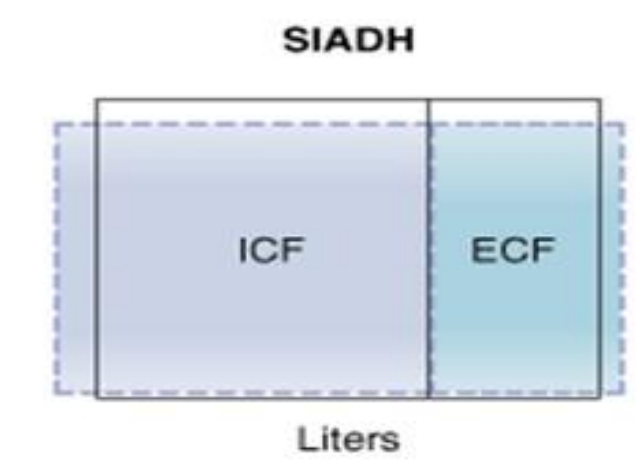
- ↑ eating salt,
- ↑ osmolarity in both.
- ↓ volume of ICF
- ↑ volume of ECF



Volume Expansion (increase in the ECF volume)



3. Hyposmotic Volume Expansion e.g. syndrome of inappropriate antidiurtic hormone (SIADH) :

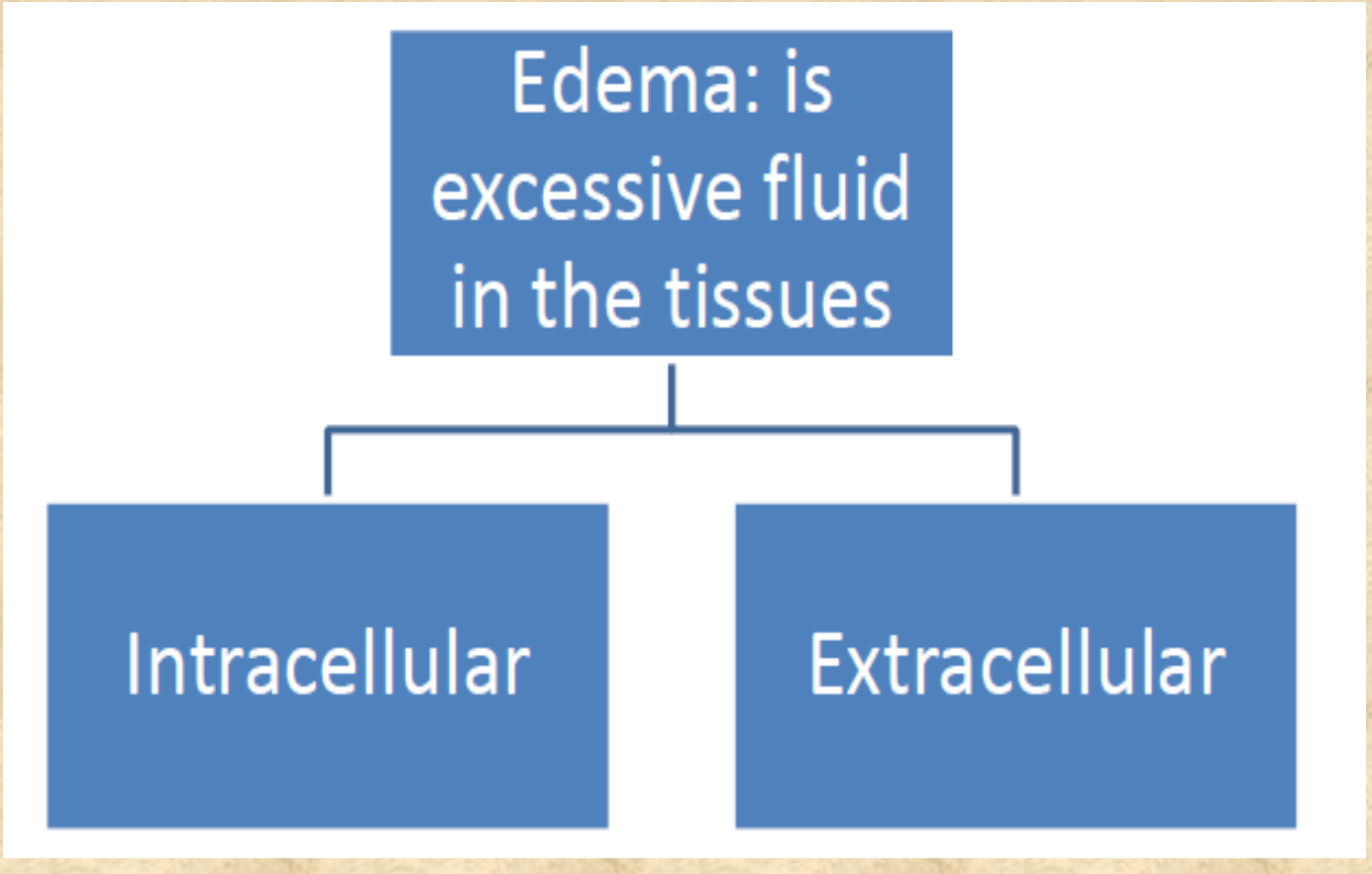


- High levels of antidiuretic hormone (ADH)

- ↑ volume

- ↓ osmolarity

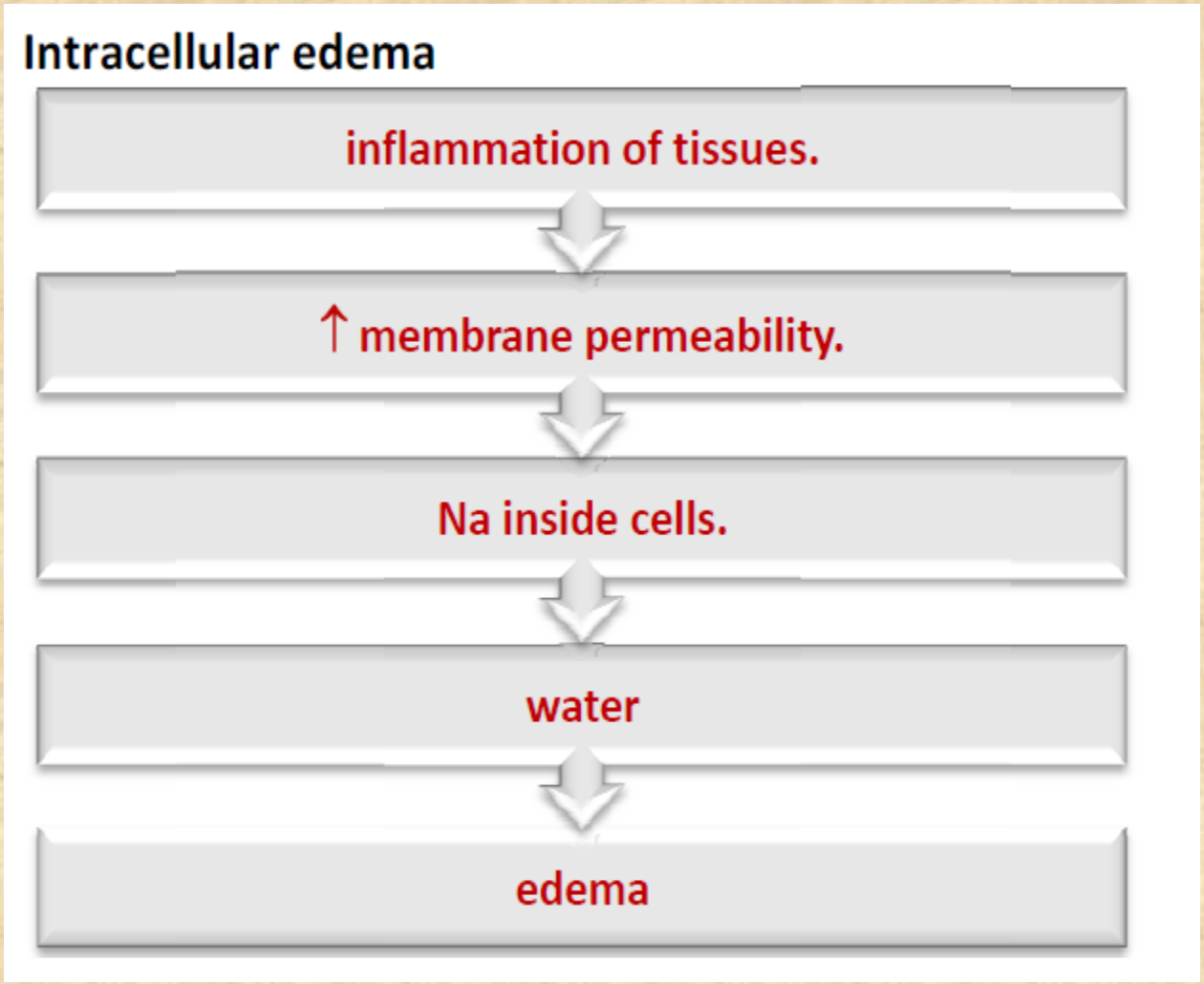
Edema



- *Edema occurs mainly in the **extracellular fluid compartment***

Edema

Edema



Edema

Extracellular edema: ***common clinical cause is excessive capillary fluid filtration.***

↑ Heart failure.

↓

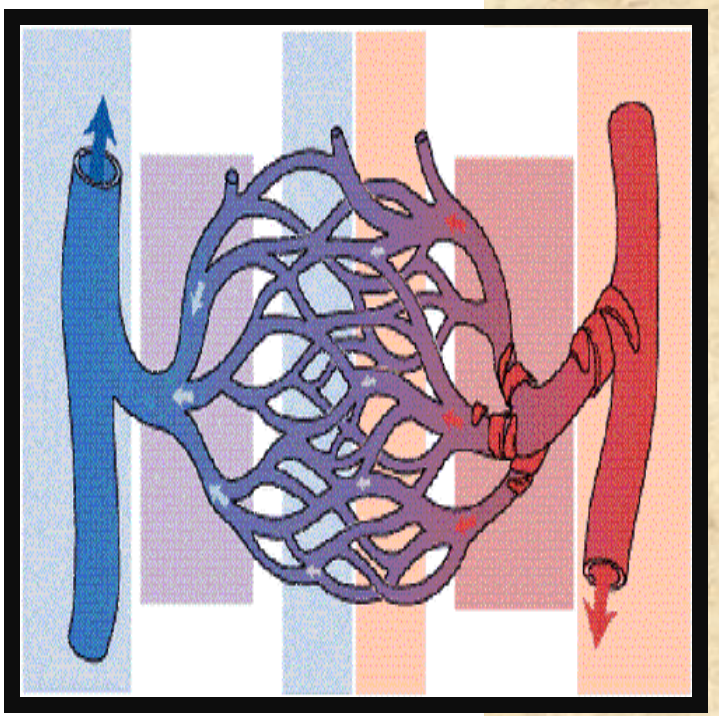
↑ capillary pressure

↓

filtration.

↓

edema



The End

Thank You