Edema

*Excess fluid accumulation in the Extracellular/interstitial spaces*

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**Pitting Edema**

*Usually due to intravascular issues; lymphatics unblocked, so pressing on edema pushes fluid into lymph vessels; temporary lymphatic drainage causes pitting.*

- **Localized**
  - Overfill
  - Underfill

- **Generalized**

**Non-pitting Edema**

**Lymphedema:**

*Lymphatic drainage is blocked, so pressing on the edema doesn’t cause fluid there to be drained into lymph, so usually no pitting.*

- **Localized**
  - Underfill

- **Generalized**

**Myxedema:**

*Tissue is deposited under the skin; “edema” is not just fluid, so doesn’t leave pits*

- Grave’s disease
  - Infiltrative dermopathy
  - Edema (bilateral purple orange-peels on shins)

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2 basic pathophysiological mechanisms behind edema:

1. Fluid leakage out of capillaries into surrounding interstitium. (*more common*)
2. Failure of lymphatics to return fluid from interstitium back to blood. (*rarer*)
Edema: Excess fluid accumulation in the Extracellular/interstitial spaces

Pitting
Increased venous blood pressure

Localized
- Usually limited to lower extremities
- May be unilateral

Central Venous stenosis

DVT

Mass

Localized Blockage of veins draining a specific set of capillaries
- Backing up of blood ↑ capillary hydrostatic pressure
- Bulk flow of fluid out of capillaries into the local interstitium (localized edema)

Generalized

Overfill
- Kidneys pathologically retain NaCl + water
- High EABV (thus high urine Na+, > 40)
- High Venous blood volume

Underfill
- Pathologically Low EABV (low urine Na+, < 20)
- Kidneys adaptively retain NaCl + water
- High Venous blood volume

High total blood volume (total body water)

Non-pitting

Lymphedema

Myxedema

Abbreviations:
EABV = effective arterial blood volume
RAAS = renin-angiotensin-aldosterone system

Note:
- Arteries “autoregulate” the bloodflow into the capillaries with pre-capillary sphincters, keeping capillary hydrostatic pressures constant (arterial hypertension doesn’t cause edema).
- The venous system has no autoregulation, so high venous blood volume/pressure can back up into the capillaries and increase hydrostatic pressure, causing edema.
**Edema:** Excess fluid accumulation in the Extracellular/interstitial spaces

### Pitting
- Increased venous blood pressure

#### Localized
- **Overfill**
  - Kidneys pathologically retain NaCl and water \(\Rightarrow\) abnormally high EABV AND venous blood volume
  - Renal failure
    - (inability of nephrons to filter blood, thus inability to excrete \(\text{NaCl} + \text{H2O}\))
    - Acute renal failure
    - Chronic renal failure
  - Nephrotic syndrome in the setting of renal failure (NaCl retention becomes primary cause of edema)

### Generalized
- **Overfill**
  - Kidneys pathologically retain NaCl and water \(\Rightarrow\) abnormally high EABV AND venous blood volume

#### Drugs
- NSAIDS
- Thiazolidinediones

#### Underfill
- Pathologically Low EABV (low urine Na+, < 20), Kidneys adaptively retain NaCl and water
- **Altered Starling Forces** (causing more fluid leakage into ISF)
  - \(\uparrow\) Capillary hydrostatic pressure
    - Right Heart failure
    - Constrictive pericarditis
    - Pericardial effusion
    - Less blood filling higher-capacitance vessels, \(\downarrow\) EABV

#### ↑ Capillary permeability
- (usually in sick/ICU patients)
  - Burns, allergies, trauma, sepsis, ARDS
  - Idiopathic edema
  - Refeeding edema

#### ↓ Capillary oncotic pressure
- (low serum albumin)
  - ↓ plasma protein synthesis
    - (liver cirrhosis, malnutrition)
  - ↑ plasma protein loss (i.e. nephrotic syndromes)
  - Buildup of fluid in tissues all around the body (generalized effect, more in gravity-dependent regions)

### Non-pitting
- **Lymphedema**
- **Myxedema**

### *Heart Failure*
- (Heart pumps less blood from veins into arteries)
  - Reduced arterial BP and EABV
  - Activation of RAAS
  - Kidneys retain more salt + water
  - \(\downarrow\) capillary oncotic pressure
    - ↓ plasma protein synthesis
      - (liver cirrhosis, malnutrition)
    - ↑ plasma protein loss (i.e. nephrotic syndromes)
    - Buildup of fluid in tissues all around the body (generalized effect, more in gravity-dependent regions)
  - \(\uparrow\) Capillary hydrostatic pressure
    - Burns, allergies, trauma, sepsis, ARDS
    - Idiopathic edema
    - Refeeding edema
  - Incr capillary hydrostatic pressure
    - Incr bulk flow of fluid out of capillaries

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