Edema

Excess fluid accumulation in the Extracellular/interstitial spaces

Pitting Edema

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

- **Localized**
- **Generalized**
  - Overfill
  - Underfill

Non-pitting Edema

<u>Lymphedema:</u>

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

Lymph node obstruction, alteration, or removal (tumors, mastectomies, surgeries, infections, congenital defects)

↓

Blocked lymphatic vessels

- Lymphatics are physically unable to drain fluid from the interstitum
- Lymphatics can't remove plasma proteins that leaked-out into ISF, so oncotic pressure of interstitium ↑

Buildup of fluid at site of tissues

<u>Myxedema:</u>

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)

2 basic pathophysiological mechanisms behind edema:

1. Fluid leakage out of capillaries into surrounding interstitium. *<u>(more common)</u>*
2. Failure of lymphatics to return fluid from interstitium back to blood. *<u>(rarer)</u>*

Edema: *Excess fluid accumulation in the Extracellular/interstitial spaces*

Pitting
Increased venous blood pressure

Localized
→Usually limited to lower extremities
→May be unilateral

Mass | **DVT** | **Central Venous stenosis**

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 <u>total</u> blood volume
(total body water)

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.

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

Lymphedema | Myxedema

Non-pitting

Edema: *Excess fluid accumulation in the Extracellular/interstitial spaces*

Pitting
Increased venous blood pressure

Localized

Generalized

Overfill
Kidneys pathologically retain NaCl and water → abnormally *high* EABV AND venous blood volume

Renal failure
(inability of nephrons to filter blood, thus inability to excrete NaCl + H2O)
→Acute renal failure
→Chronic renal failure
→Nephrotic syndrome in the setting of renal failure *(NaCl retention becomes primary cause of edema)*

Drugs
→NSAIDS
→Thiazolidinediones

Underfill
Pathologically *Low* EABV (low urine Na+, < 20), Kidneys adaptively retain NaCl and water

↑ blood vessel capacitance relative to blood volume
(due to pregnancy, liver disease, AV fistula, drugs)
↓
Less blood filling higher-capacitance vessels, ↓ EABV

Altered Starling Forces
(causing more fluid leakage into ISF)

↑ Capillary hydrostatic pressure
→Right Heart failure
→Constrictive pericarditis
→pericardial effusion

↑ Capillary Permeability
(usually in sick/ICU patients)
→Burns, alleries, 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)

Heart Failure
(Heart pumps less blood from veins into arteries)

Incr venous pressure
↓
Incr capillary hydrostatic pressure
↓
Incr bulk flow of fluid out of capillaries

Reduced arterial BP and EABV
↓
Activation of RAAS
↓
Kidneys retain more salt + water

Buildup of fluid in tissues all around the body (generalized effect, more in gravity-dependent regions)

Non-pitting

Lymphedema

Myxedema