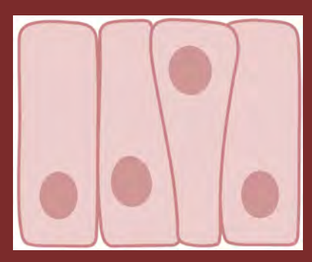
Cellular Adaptation

Atrophy Causes (4)

I. Disuse (eg: muscle)
II. Denervation (eg: no nerve input)
III. Loss of endocrine function (eg: menopause)
IV. Malnutrition + dec BF

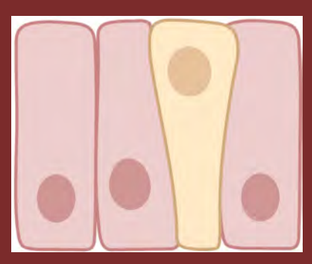
The "plasias"

Hyper - increase in cell number, typically normal
eg: mitosis

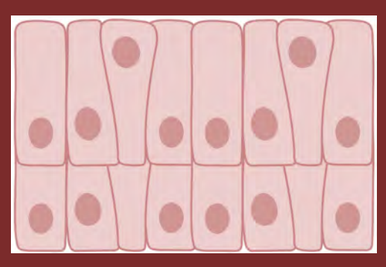


Meta - one cell type is replaced by another, not harmful, usually to substitute in another cell type that's more likely to survive, usually related to chronic irritation and inflam, reversible

eg: squamous epithelium replaces ciliated epithelium in the trachea of a smoker because one of squamous' function is to protect against abrasion whereas cilial function is to move mucus/pathogens/particles



Dys - crazy cell number inc., harmful, related to irritation and inflam, precursor to cancer, can be reversible if cause/stim is removed



eg: bronchopulmonary dysplasia - preterm babies who are ventilated and don't have enough surfactant typically develop BPD because of the damage to the lung tissue

Cell Injury

Ionizing Radiation

- frequencies above UV (x-ray, gamma, cosmic)
- creates **free radicals** (reactive substances with unpaired electrons = more reactive/unstable)
- eg: reactive oxygen species (ROS)
- **anti-oxidants** rid free radicals
- if more ROS than body can handle, damage occurs

Hypoxia/Ischemia

- reduced O2 to cells from:
  - inadequate O2 **in air**
  - respiratory disease
  - ischemia
- reduced ATP production b/c impaired mitochondria function
- inc lactic acid production due to low O2 for aerobic metabolism, inc pH
- reduced ATP for pumps (Na/K), influx Na and H2O, inc membrane permeability

Other Types

Non-iodizing radiation:
- frequencies below visible light (IR, microwaves)
- can result in burns

Ultraviolet:
- above visible, below x-rays
- inc risks of skin cancer

Physical: impact, temperature extremes, electricity

Chemical: drugs, minerals, metals (Pb, Hg), gases

Biologic: viruses, bacteria, prions, parasites

Nutritional: vitamin + mineral deficiencies/ toxicities

Apoptosis

- programmed cell death
- organized, controlled dismantaling of cell structures
- results in minimal surrouding subsequent damage

SIGNAL

enzymes degrade DNA+cytoplasmic proteins, **cell shrinks**

cell fragmentation begins, membrane "blebs", **plasma stays intact**

apoptotic bodies form from blebs, contain cell contents

phagocytosis of apoptotic cells and fragments occurs, no leakage = no inflammation

Necrosis

- accidental cell death
- not programmed, no signal, **pathologic**
- typical death pathway in ischemic, toxic, infectious and traumatic situations
- cell components fail/fall apart
- leakage = inflammation

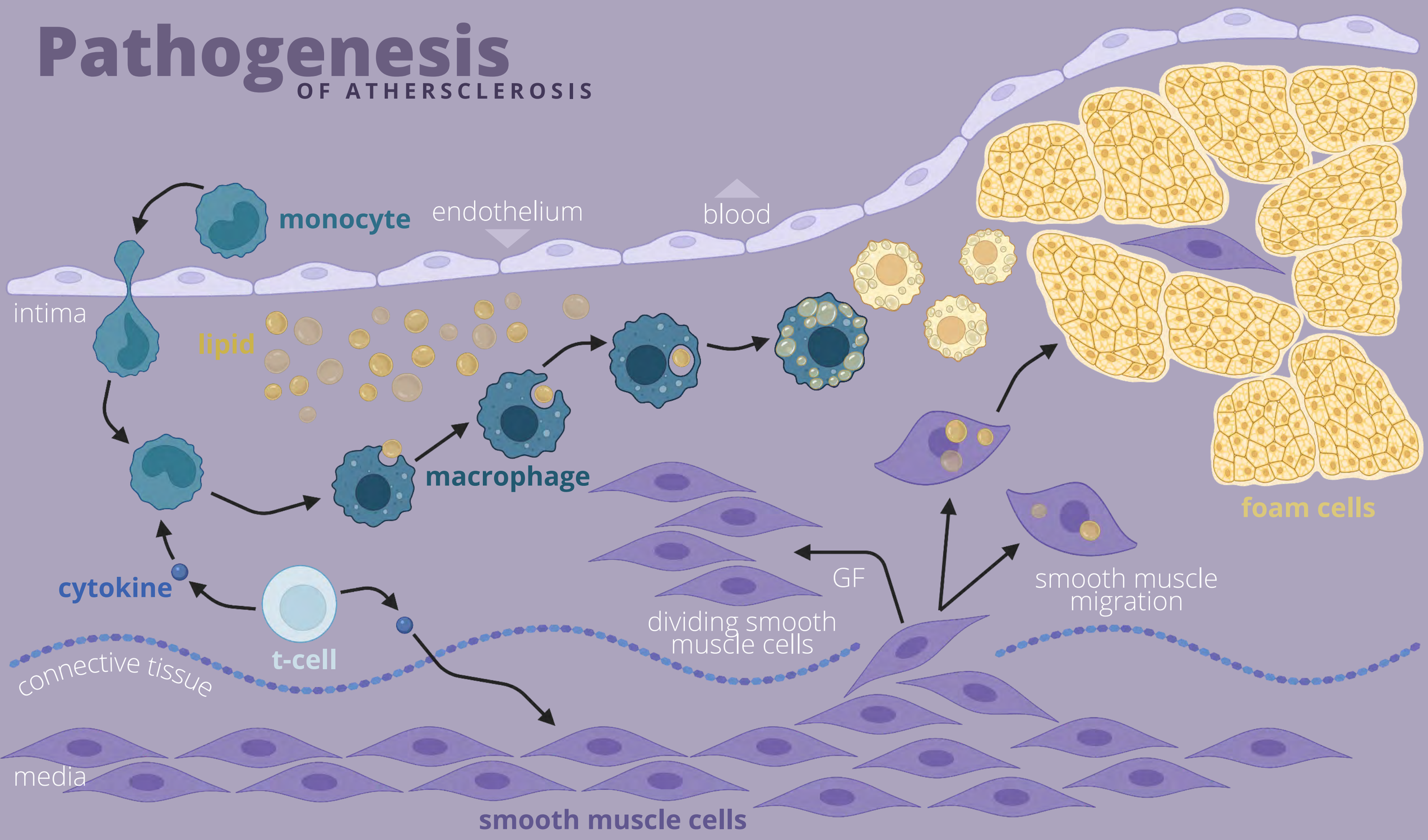
Reversible:
mitochondria and endoplasmic reticulum **swell**, membrane blebs

Irreversible:
plasma membrane, organelles and **nucleus breaks down**

contents leak out = **inflammation**

Cell Death

Pathogenesis
OF ATHERSCLEROSIS



INITIATED BY
chronic endothelial injury
hyperlipidemia, hypertension, smoking, viruses etc.

LEADS TO
state of inflammation
- interleukin-6 (IL-6) & tumor necrosis factor-α (TNF-α) induce C-reactive protein (CRP) synthesis in the liver
- CRP activates the complement system

INFLAMMATION MEANS
inc. endothelial permeability
- LDL droplets are able to leak through into the intima

FAT DROPLETS
aren't supposed to be there
- recognized as abnormal by macrophages
- macrophages phagocytose LDL

MACROPHAGES SEND
"need help" signal
- more macrophages are recruited via cytokines

NO OFF SWITCH SO
foam cells are created
- macrophages keep consuming LDL but can't break it down or exocytose
- lipid-filled macrophages turn into foam cells

INTRODUCING
the foam cell
- will continue to release inflammatory cytokines
- start to recruit more cells to the area (*eg: GF)*
- results in lots of imflammation in center of plaque

LONG TERM
imflammation
- can result in calcium deposits within plaque

JOINING ARE THE
smooth muscle cells
- attracted by the macrophage cytokines
- GF stimulates division leading to thickening of the intima
- muscle cells begin to take up LDL

CREATING THE
lipid core
- cytokines and GFs promote plaque formation
- lipid core accumulated under endothelium
- fibrous scar tissue forms walling off lipid core

STABLE PLAQUES
have **thick** fibrous caps, **partially** block vessels and therefore tend to **not form** clots

UNSTABLE PLAQUES
have **thin** fibrous caps, plaque can ulcerate (open) & rupture leading to **clot formation** and **complete** vessel blockage

CLINICAL MANIFESTATIONS
coronary arteries: chest pain/tightness **on exertion** *(angina)* due to dec. O2 to myocardium b/c of plaque

peripheral arteries: pain in legs *(leg claudication)* with exertion due to dec. O2 to musculature

Urinary Tract Infection (UTI)

ETIOLOGY
- bacteria (E. coli) from blood stream or ascending the urinary tract
  - hard to dislodge due to pili that attach onto uroepithelial lining
- 2nd most common bacterial infection
- females more likely than males
  - length of urethra is *longer in males* = higher chance it gets flushed out before reaching bladder

PATHOPHYSIOLOGY
- bacteria penetrates the protective mucin shield
- any obstructions prevent washout (so bacteria can continue to ascend)
- backwards flow (reflux) can push bacteria up tract
- catheters damage mucosal lining (protective barrier)

Lower UTI [urethra + bladder]
- aka cystitis
- suprapubic pain; dysuria = pain with urination
- **F**requency **U**rgency **N**octuria **D**ysuria

Upper UTI [kidney]
- more severe
- pain b/w rib and vertebrae
- associated with pyelonephritis
  - UTI where one or both kidneys are effected

DIAGNOSIS
- symptoms
- urinalysis (WBCs, blood, bacteria)
  - **turbid urine** = cloudy because contains things it shouldn't, incl. protein (due to inflam of tract)

TREATMENT
- based on type & contributing factors
- antibiotics
- only tx if symptomatic
  - exception = pregnancy

Glomerulonephritis

inflammation and proliferation of the glomerular capillary wall

ETIOLOGY
- autoimmunity
- ischemia
- drug toxicity
- idiopathic
- free radical damage
- vascular disorders
- bacterial infection

PATHOLOGY
- RBCs, proteins get into nephron = bad
  - then expelled through urine
    - leads to swelling and ++ BP

CLINICAL MANIFESTATIONS
- pain, edema, urine discolouration, hypertension
- hematuria (blood in urine)
- proteinuria (protein in urine)
- oliguria (reduced urine output)

PLASMA PROTEIN DEFICIT

- protein in plasma *normally* helps carry substances and **hold onto fluid**
- hold onto fluid via **oncotic pressure**
  - oncotic pressure: maintained by albumin, is the pressure that brings fluid back into capillaries
    - low oncotic pressure = fluid moves into interstitial space leading to swelling