

## CENTRAL NERVOUS SYSTEM

### STRUCTURAL CHANGES

**Volume & weight** ↓ 5% every decade

**Synapse** ↓ number & Δ morphology

**Cytoskeletal protein** Δ structure

**Vasculature** development of atherosclerosis & arteriolosclerosis

- Oxidative damage
- Impaired energy & metabolism
- Intra & extracellular protein aggregate accumulation

### FUNCTIONAL CHANGES

**Attention** ↓ due to difficulty in multitasking

**Executive function** No change

**Memory** ↑ difficulty learning new information

**Language** No change

**Visuospatial skills** worsen

**Psychomotor** slowing

### ↑ Risk for developing:

- Mild cognitive impairment
- Dementia
- Delirium



## CARDIOVASCULAR SYTEM

### STRUCTURAL CHANGES

**Arteries** ↑ Stiffness & tone

**Myocardial composition = LV**

↑ Stiffness

↓ Diastolic relaxation

↑ Mass by 10-15% per year after age 50

**Valve leaflets** Thicken & ↑ diameter

- Elastin fragmentation & collagen cross linkage → fibrosis & stiffness
- ↓ response to vasoactive substances

### FUNCTIONAL CHANGES

**HR & rhythm**

↓ Parasympathetic response

**Arteries**

↓ Compliance ↑ Impedance

**Myocardium = LV**

Diastolic dysfunction

**Valves**

↑ Regurgitation

### ↑ Risk for developing:

- Hypertension
- Atherosclerosis
- Valvular disease & heart failure

### ↓ Exercise capacity



## PULMONARY SYSTEM

### STRUCTURAL CHANGES

**Alveoli**

↓ Elastic recoil ↑ Size

**Chest wall**

↑ Stiffness

Δ Chest shape to "Barrelled shape"

**Muscles**

↓ Diaphragm & accessory muscles strength

- Elastin fragmentation & collagen cross linkage → fibrosis & stiffness
- Articular surface calcification
- Vertebral height loss

### FUNCTIONAL CHANGES

= **TLC** (Total lung capacity)

↑ **RV** (Resting volume)

5-10% per decade

↓ **VC** (Vital capacity)

↓ **FEV1** (Forced expiratory volume at 1 min) 23-32ml per year

↓ **FVC** (Forced Vital Capacity)

14-30ml per year

↓ **DLCO** (Diffuse Lung capacity for carbon monoxide)

### ↑ Risk for developing:

- COPD and/or Idiopathic Pulmonary Fibrosis (IPF)
- Respiratory infections



## RENAL SYSTEM

### STRUCTURAL CHANGES

- \*Renal mass** ↓ Cortex > Medula
- \*Glomeruli** ↓ Nephron #, focal sclerosis & thickening of glomerular basement membrane
- Tubules** Hypertrophy & ↓ Length
- Vasculature** Arterial-Venous shunt formation

### GLOMERULOSCLEROSIS

- Extracellular matrix proliferation & replacement
- Glomerular loss
- Nephron loss

### FUNCTIONAL CHANGES

- Renal reserve** ↓
- \*GFR (Glomerular filtration rate)** ↓ 10% per decade
- Tubules** ↓ Ability to concentrate & acidify the urine
- \*Blood flow** ↓ 10% per decade
- Vasculature** ↑ Resistance

### ↑ Risk for developing:

- Renal injury
- Medication & toxin side effects
- Difficulty managing volume & fluid challenges



\*Changes start after 4th decade of life

## GASTROINTESTINAL SYSTEM

### STRUCTURAL CHANGES

- Muscle** ↓ Function
- Myenteric neurons** ↓ Number
- Prostaglandin** ↓ Production
- Gastric mucosa gel layer** Thinning
- Immunity** Impaired
- Perfusion** ↓ Stomach & Liver

- Elastin fragmentation & collagen cross linkage → fibrosis & stiffness
- Impaired energy & metabolism
- Oxidative damage

### FUNCTIONAL CHANGES

- Food transit** Impaired in esophagus, stomach & colon
- Gastric cytoprotection** Impaired
- Micronutrient absorption** Impaired
- Liver** ↓ Medications & toxins clearance

### ↑ Risk for developing:

- Oropharyngeal & esophageal dysphagia
- Aspiration
- Constipation
- Gastric mucosa damage & ulcer formation
- Drug-drug interactions



## MUSCULOSKELETAL SYSTEM

### STRUCTURAL CHANGES

- MUSCLE**
- Mass volume ↓ by 1 - 2% per year
- Strength ↓ by 3 - 4% per year
- BONE**
- Density ↓ by 0.5% per year
- Structure ↑ Fragility

- Muscle cell death
- Muscle protein imbalance
- Impaired regeneration
- Impaired neuromuscular transmission

### FUNCTIONAL CHANGES

- MUSCLE**
- ↑ Sarcopenia = Atrophy
- ↑ Dynapenia = Weakness
- BONE**
- Alterations on architecture

### ↑ Risk for developing:

- Gait instability → Falls
- Osteoporosis → Fractures

