

Age-related Changes



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Objectives of the lecture

At the end of this lecture the student will be able to:

Define the vitality with aging .

Distinguish between the age-related physiological changes and pathological changes of body systems.

Determine Age-related Changes in Musculoskeletal Cardiovascular, skin , and respiratory system .

ASPECTS OF AGING

- Two aspects of aging

Increase in vitality- birth to 30 years old (growth)

Decrease in vitality - 30 to death.(decline)

What is Vitality

- The ability to respond to stress, the amount of reserve capacity
- The greater number of functioning cells per organ the greater the ability to respond to stress
- Maximum vitality is 100%.
- Loss of vitality is 0.8% to 1% per year after age 30



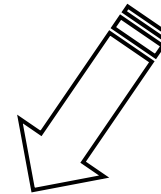
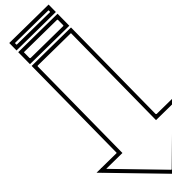
You

stress



Physiologic Reserve

Compensatory Mechanisms



You, Compensated



Frail Elderly



Limited

Blunted

Physiologic Reserve

Compensatory Mechanisms

"Tapped Out"



Clinically Decompensated

Age Related Changes

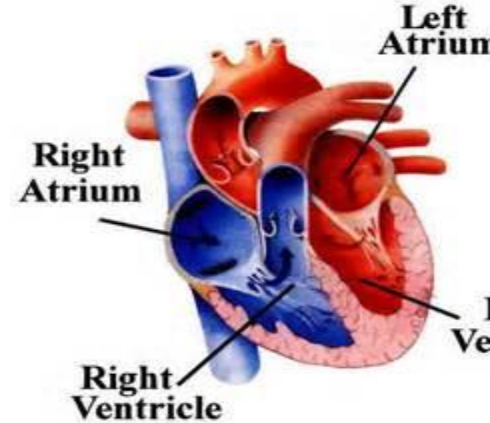
Changes that are part of **the normal** aging process (successful aging - good genes and lifestyle) and experienced by everyone

Age Associated Diseases (pathological changes)

Changes caused by interaction of **negative** genes and **a poor** lifestyle leading **to diseases** that reduce independence resulting in possible **dependent care**

Cardiovascular Changes Related to Aging

- Deposits of the "aging pigment," lipofuscin, accumulate.
- The valves of the heart thicken and become stiffer.
- The number of pacemaker cells decrease and fatty & fibrous tissues increase about the SA node. These changes may result in a slightly slower heart rate. And increase the risk of atrial fibrillation
- A slight increase in the size of the heart, especially the left ventricle, is common. The heart wall thickens & Some myocytes are replaced by fibrous tissue.
- The enlarged left ventricular wall has a decreased ability to expand during diastole Results in reduced and delayed filling



Cardiovascular Changes Related to Aging

- The left ventricle contracts less and ejects less blood.
- There is an increase in left atrium size, secondary to the decline in left ventricle compliance.
- This increases the work load on the atria
-

Cont.

- Under normal circumstances, the heart continues to adequately supply all parts of the body. However, an aging heart may be slightly less able to tolerate increased workloads.
- Examples of stressors include: illness, infections, emotional stress, injuries, and extreme physical exertion.

Changes in the Vessels

- **Arteries**

- thickening , stiffening & decrease in elasticity

results in:

- Increased peripheral resistance
- Increased arterial pressure

- **Veins**

- The ability of the vessel to contract is decreased.
- Dilation and tortuosity of veins may results in decreased venous return.

- Little research has been done on the aging veins

Heart Rate

- Resting heart rate (HR) does not change very much with age.
- The maximum exercise heart rate decreases with age.
- 200 beats/min at age 20
- 150 beats/min at age 70
- to calculate estimated maximum exercise heart rate:

Max HR= $220 - \text{age}(\text{years})$

The reason:

- 1- **Alteration in SA node activity**
- 2- **Reduce beta-adrenergic sensitivity**

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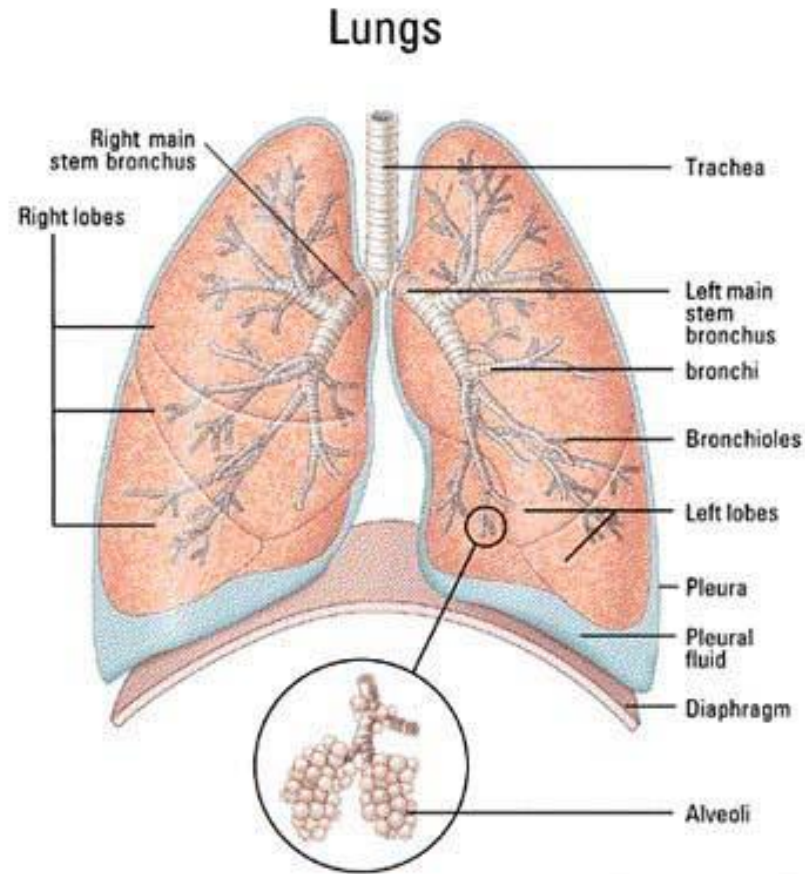
Stroke volume & COP

- **stroke volume (SV)** is the volume of blood pumped from one ventricle (usually left ventricle) of the heart with each beat.
- Stroke volume is changed little by aging; at rest in healthy individuals, there may even be a slight increase.
- Cardiac output at rest is unaffected by age. Maximum cardiac output and aerobic capacity are reduced with age. Due to decline in max HR and left ventricular ejection
- Max Cardiac Output = Stroke Volume X max HR
(ml/min) (ml/cycles) (cycles/min)

Blood Pressure

- Systolic BP tends to increase with age throughout life
 - 5-8 mm Hg per decade after 40-50 years of age
 - an index of arterial stiffness
- Diastolic BP tends to increase until the age of 60, then it stabilizes or **slowly declines**
- Increases in BP with age is a result of changes in total peripheral resistance and aortic compliance.
- **Baroreceptors** (stabilize BP during movement/activity) become less sensitive with aging. This may contribute to the relatively common finding of orthostatic hypotension.

Age-related Changes In The Lung



Age-related Changes in The Lung

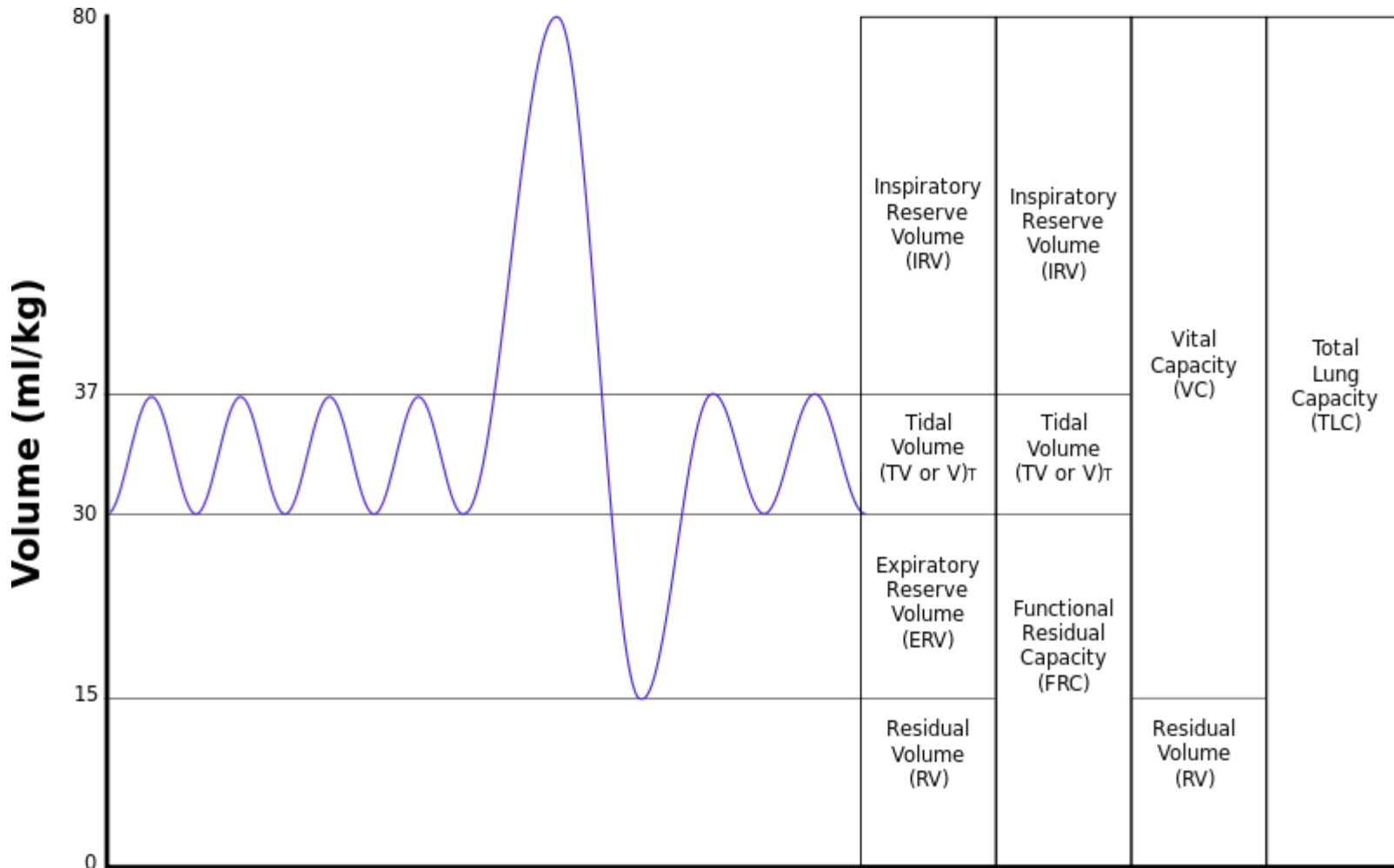
- ✓ The number of cilia & their level of activity is reduced.
- ✓ Decreased number of nerve endings in larynx.
- ✓ The cough reflex is blunted thus decreasing the effectiveness of cough.

Age-related Changes in The Lung

- ✓ The number of **FUNCTIONAL alveoli decreases** as the alveolar walls become thin, the alveoli enlarge, and are less elastic.
- ✓ ↓ elasticity of the lungs. The loss of elasticity accounts for "**senile hyperinflation**."
- ✓ ↓ The respiratory muscles strength & endurance.
- ✓ There is increased rigidity of chest wall (ie, decreased compliance).
- ✓ Osteoporosis of the vertebrae and ribs with a marked kyphoscoliosis..

Age-related Changes in The Lung

- Since , Static & dynamic measures of lung function generally deteriorates with age for example:
 - The FEV_1 drops
 - IRV decreased
 - VC is diminished by about 20%
 - RV increases by about 50%
 - Sao₂ decline.



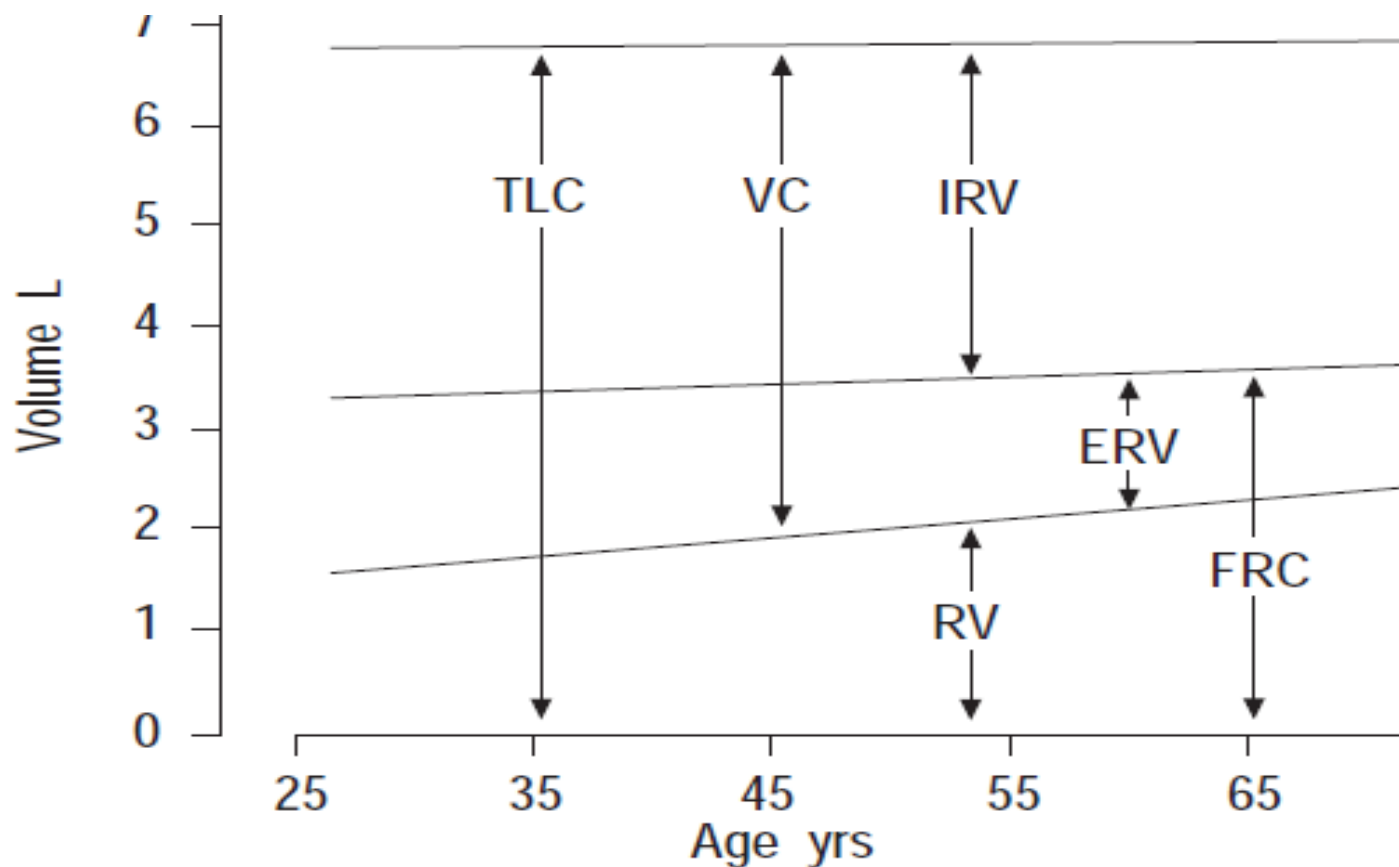


Fig. 1. – Evolution of lung volumes with ageing. TLC: total lung capacity; VC: vital capacity; IRV: inspiratory reserve volume; ERV: expiratory reserve volume; FRC: functional residual capacity; RV: residual volume. (Adapted from CRAPO *et al.*, 1982 [6].)

Age-related Changes in The Lung

- Combine less functional alveoli with slightly thickened capillaries → decreased surface area available for O₂-CO₂ exchange → lower O₂ to supply vital organs. Which results in :

A- Less oxygen in the system cuts down the amount of work that can be done.

B- Loss of efficiency in breathing especially during ex.

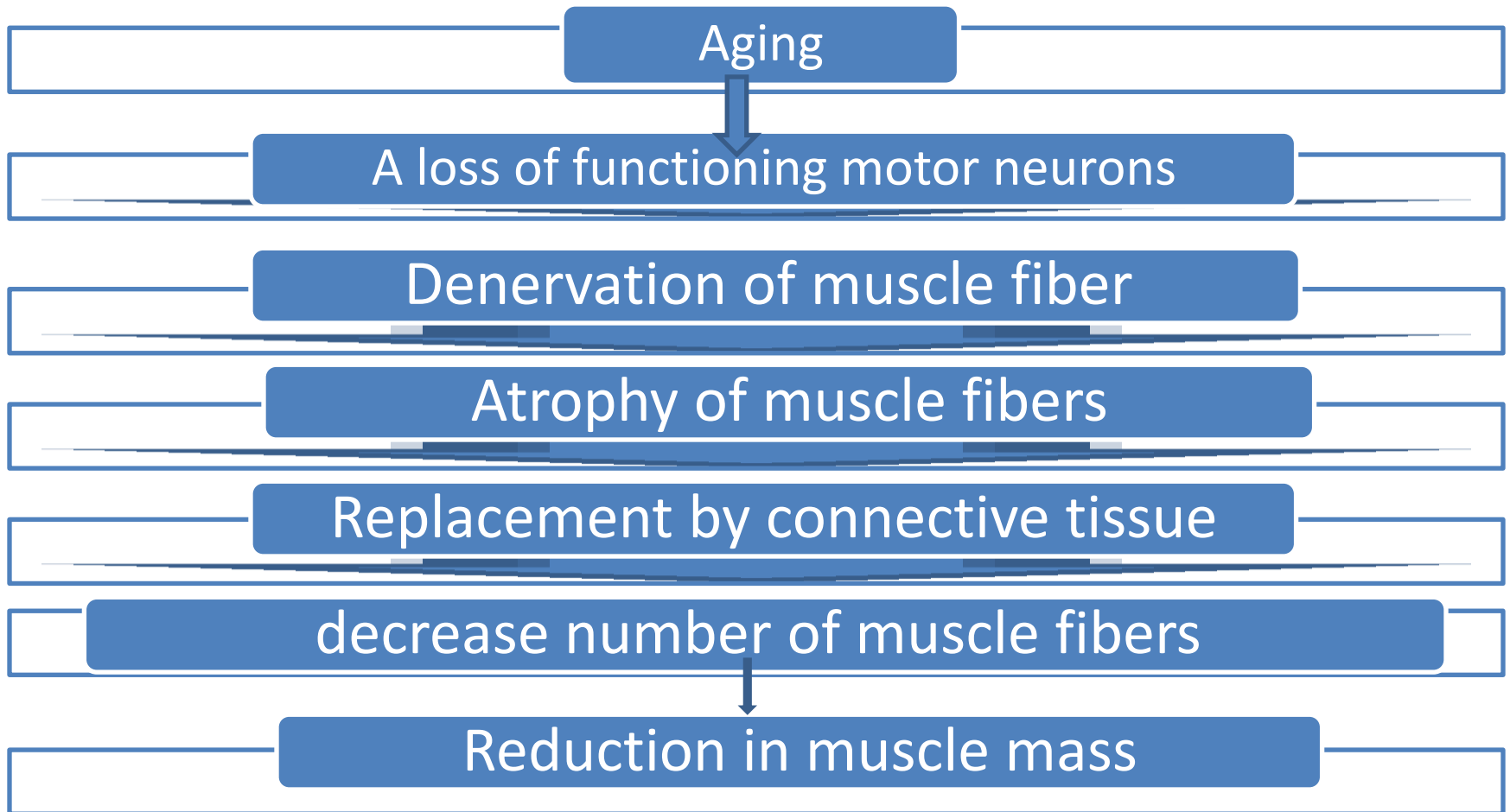
-E.g.: elderly complaint of **shortness of breathing** while going upstairs.

Age-related Changes in Musculoskeletal system

- **Muscles**

- ↓ muscle strength associated with decline in major function even ADLs. The overall age-related strength loss ranges from 24-45%.
- Beginning at 30, The rate of decrease is similar for both males and females
- ↓ muscle mass occurs with age → ↓ activity & disuse atrophy → further ↓ in muscle mass and strength
- Some of this muscle-wasting is due to **diminished growth hormone production** but exactly how much is due to aging versus disuse is unclear.

Possible mechanism of reduction in muscle mass



Age-related Changes in Musculoskeletal system

- With age, **sarcopenia** (↓ muscle mass & contractile force) is associated with increased fatigue & risk of falling (so may compromise ADLs).
- Sarcopenia affects all muscles including, for example,
 - the respiratory muscles (↓ efficiency of breathing)
 - GI tract (constipation).
- Decrease in muscle flexibility & endurance

Age-related Changes in Musculoskeletal system

- **Bone/Tendons/Ligaments**

- Gradual loss of bone mass (bone resorption > bone formation) starting around age 30 years.
- Decreased water content in cartilage

Decreased water in the cartilage of the intervertebral discs results in ↑ compressibility and ↓ flexibility. This may be one reason for loss of height.

- There is also some decrease in water content of tendons & ligaments contributing to ↓ mobility.

Aging Changes skin

- The skin wrinkles, loses elasticity and a decline in cell replacement occurs.
- Skin heal more slowly .
- Fat under the skin starts to get thinner and less stretchy → The skin becomes thinner & tears easily.
- Vitamin D production declines.
- Skin develops spots
- Does not keep body cool in the heat due to less perspiration(sweating) with age

Questions

Q1:- True or false :

1- The greater number of functioning cells per organ the greater the vitality.

2- Sarcopenia is decrease creased muscle mass & increased contractile force.

3- The skin becomes thinner & tears easily due to decrease in muscle mass under the skin .

Q2: *What is the different between age related changes & pathological changes ?*

ANY Q?

