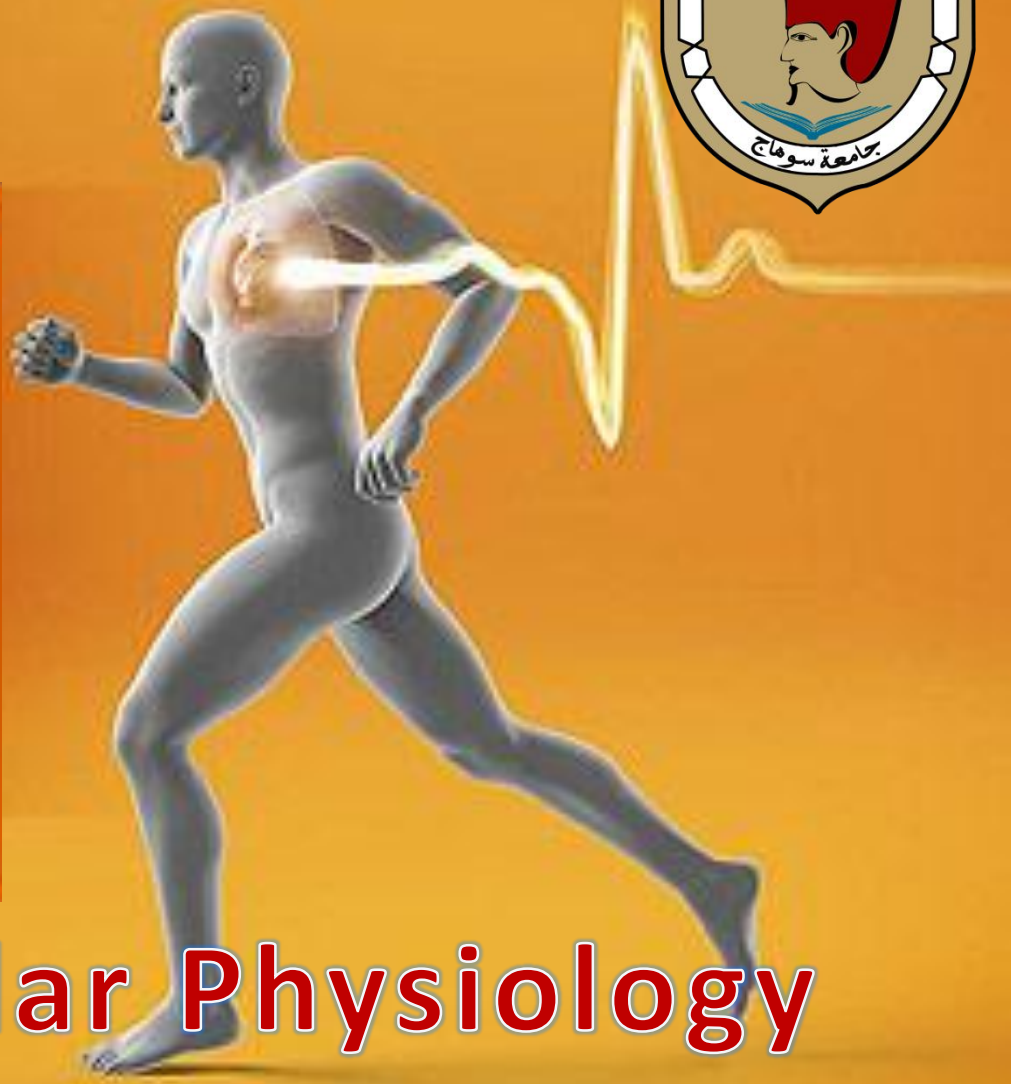
Lecture No. 41

Cardiovascular reflexes and effect of exercise

By

Dr. Mohammad Ashraf



Cardiovascular Physiology

Learning objectives

- **After the lecture, students should be able to:**
  - Describe the Intrinsic and extrinsic reflexes, central and autonomic control of CVS.
  - Describe the effect of **exercise** and **posture** on CVS.

Introduction

- An adequate O_2 supply is essential for performance of muscular exercise.
- The resting O_2 consumption (=250 ml/min) may increase 20 times or more during exercise.
- The skeletal muscles at rest receive about 20% of the COP. This increases to 80-90% during exercise.
- The circulatory adjustments during exercise aim at increasing the muscular blood flow.
- This can be increased as result of both:
  - Systemic circulatory changes.
  - Local changes in active muscles.

Systemic circulatory changes

During muscular exercise the following systematic changes occur:

1) **Increase cardiac output**

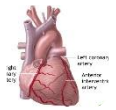
Through an increase in both SV & HR

2) **Increase arterial blood pressure**

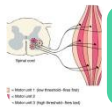
Through an increase in COP & changes in PR

Causes of increased SV during exercise

1- increase preload

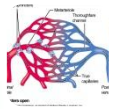


Sympathetic activity → venoconstriction → increased venous pressure → increasing VR to the heart.



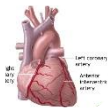
Skeletal muscle pump

Increase rate and depth of respiration

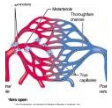


Arteriolar dilatation at skeletal muscles

2- increased contractility



Sympathetic stimulation



Increase in VR (Starling law)

Causes of increased heart rate during exercise

1. • ***Sympathetic stimulation*** by impulses from the cerebral cortex and hypothalamus
2. • **Increase the venous return (**by Bainbridge reflex).
3. • **Hyperventilation**
4. **Stimulation of chemoreceptors**
5. **Alam smirk reflex**
6. **Adrenaline secretion**
7. **Increase body temperature.**

increased ABP during exercise

- ABP is α COP (SV & HR) and PR
- ↑ SV → ↑ SBP mainly
  while; HR and PR mainly affect the DBP
- During exercise, SV ↑ → ↑ SBP
  DBP changes according to the type of exercise.

- In exercises requiring **isotonic contractions,** the arterioles at skeletal muscles dilate → ↓ PR → ↓ DBP (water hammer pulse results).

- In exercises requiring **isometric contractions,** all the arterioles are constricted and compressed by the contracting muscles → ↑ DBP.

- In areas other than skeletal muscles, generalized vasoconstriction occurs specially in blood vessels supplying the GIT and skin so blood is redistributed to the active areas (skeletal muscles and the heart).

- When the exercise is prolonged and body temperature increases, cutaneous VD occurs to help heat loss. This decreases the blood flow to the skeletal muscles and fatigue is likely to takes place.

Causes of generalized VC during exercise

1	• Stimulation of chemoreceptors
2	•Sympathetic activity.
3	•Emotions.
4	Adrenaline secretion
5	Loven's reflex

Local changes in active muscles

There is VD of the muscle arterioles: that increases the skeletal muscle blood flow.

Causes of VD of skeletal muscle blood vessels:

- **Sympathetic stimulation**
- **Accumulation of the vasodilator metabolites (K^+ and adenosine)**
- **Local hypoxia (↓ O_2), hypercapnia (↑CO_2) and acidic metabolites as lactic acid (↑ H^+)**
- **Excess heat liberated during exercise**

Local changes in active muscles

Relaxation of the precapillary sphincters

↓

More blood flow to the muscles

↓

increase in the capillary pressure

↓

widening of pores

↓

increase filtration of plasma carrying O_2 and nutrients to the contracting muscles.