MUSCLE BLOOD FLOW AND ITS REGULATION DURING EXERCISE

BY

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INTRODUCTION

• Most stressful condition of circulatory system — very strenuous exercise
• Blood flow can increase more than 20 folds the normal
• Total muscle blood flow in healthy young adult under normal conditions — less than 1L/ min
• During heavy exercise — 20L/min
FUNCTIONS OF THE CARDIOVASCULAR SYSTEM DURING EXERCISE

• The cardiovascular system serves five important functions during exercise:

1. Delivers oxygen to working muscles
2. Deoxygenates blood by returning it to the lungs
3. Transports heat from the center to the skin
4. Delivers nutrients and fuel to active tissues
5. Transports hormones
CVS PARAMETER THAT ALTER DURING EXERCISE

1. HEART RATE
2. STROKE VOLUME
3. CARDIAC OUTPUT
4. BLOOD FLOW
5. BLOOD PRESSURE
RATE OF MUSCLE BLOOD FLOW

• During rest: 3-4 ml/min/100g
• During extreme exercise in well conditioned athlete: 50-80 ml/min/100g i.e. 15-to-25 folds increase
INTERMITTENT FLOW DURING MUSCLE CONTRACTIONS

• Flow increases and decreases with each muscle contraction

• Cause: lower flow during muscle contraction phase because of compression of blood vessels

• During strong tetanic contraction--- sustained compression of blood vessels, blood flow stops, also weakens contraction
OPENING OF MUSCLE CAPILLARIES

• During strenuous exercise all dormant capillaries open up decreasing the distance of O2 and nutrients from muscle fiber
LOCAL REGULATION OF BLOOD FLOW THROUGH SKELETAL MUSCLE

Rapid use of O2 in muscle activity

Decreased O2 conc. In muscles. Tissues

Local arteriolar vasodilation

One of the most important factors affecting local regulation—reduction of oxygen in muscle tissue.
LOCAL REGULATION OF BLOOD FLOW THROUGH SKELETAL MUSCLE

• Vasodilation occurs because:
  • Arteriolar walls cannot maintain contraction in absence of O2
  • Release of vasodilator substances
    • Most known – Adenosine
    • Others – Potassium ions, ATP, lactic acid, CO2
NERVOUS CONTROL OF MUSCLE BLOOD FLOW

• Sympathetic vasoconstrictor nerves secrete nor epinephrine
• Medullae of adrenal glands also secrete nor epinephrine
• Effect of both types of nor epinephrine is to decrease blood flow
• Important in circulatory shock and stress periods
CIRCULATORY READJUSTMENTS DURING EXERCISE

1. Mass discharge of the sympathetic nervous system

2. Increase in arterial pressure

3. Increase in cardiac output
EFFECTS OF MASS SYMPATHETIC DISCHARGE
BRAIN

Onset of exercise

Vasomotor center

muscle

Parasympathetic discharge

muscle

Initiate mass sympathetic discharge

↓ Heart rate

Arterioles are strongly contracted except Brain and heart.

Muscle walls of veins are contracted
INCREASE ARTERIAL PRESSURE
Sympathetic activity

vasoconstriction

Pumping activity of heart

Mean systemic filling pressure

Arterial pressure From 20-80mmHg
THANK YOU