Physiological Response to Aerobic Exercise

- The rapid increase in energy requirements during exercise requires equally rapid circulatory adjustments to meet the increased need for oxygen and nutrients to remove the end-products of metabolism, such as carbon dioxide and lactic acid, and to dissipate excess heat.
- The shift in body metabolism occurs through a coordinated activity of all the systems of the body: neuromuscular, respiratory, cardiovascular, metabolic, and hormonal
- Oxygen transport and its utilization by the mitochondria of the contracting muscle are dependent on adequate blood flow in conjunction with cellular respiration.

Cardiovascular Response to Exercise

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Exercise Pressor Response

- Stimulation of small myelinated and unmyelinated fibers in skeletal muscle involves a **sympathetic nervous system (SNS) response**
- The SNS response includes **generalized peripheral vasoconstriction in nonexercising muscles** and **increased myocardial contractility**, an increased heart rate, and an increased systolic blood pressure. This results in a marked increase and redistribution of the cardiac output.
- The degree of the response equals the muscle mass involved and the intensity of the exercise.

Cardiac Effects

- The frequency of sinoatrial node depolarization increases, as does the heart rate.
- There is a decrease in vagal stimuli as well as an increase in SNS stimulation.
- There is an increase in the force development of the cardiac myofibers. A direct inotropic response of the SNS increases myocardial contractility.

Peripheral Effects

- *Net reduction in total peripheral resistance.*
- *Generalized vasoconstriction occurs that allows blood to be shunted from the nonworking muscles, kidneys, liver, spleen, and splanchnic area to the working muscles.*
- *A locally mediated reduction in resistance in the working muscle arterial vascular bed, independent of the autonomic nervous system, is produced by metabolites such as Mg*2+, Ca2+, ADP, and PCO 2
- .The veins of the working and nonworking muscles remain constricted.

Increased cardiac output

- *The cardiac output increases because of the increase in myocardial contractility, with a resultant increase in stroke volume, heart rate, blood flow through the working muscle,*
- *and an increase in the constriction of the capacitance vessels on the venous side of the circulation in both the working and nonworking muscles, raising the peripheral venous pressure.*
- ***Increase in systolic blood pressure. The increase in systolic blood pressure is the result of the augmented cardiac output***

Respiratory Response to Exercise

- Respiratory changes occur rapidly, even before the initiation of exercise.
- Gas exchange (O_2, CO_2) increases across the alveolar-capillary membrane by the first or second breath.
- Increased muscle metabolism during exercise results in more O_2 extracted from arterial blood, an increase in body temperature, increased epinephrine, and increased stimulation of receptors of the joints and muscles.
- Any of these factors alone or in combination may stimulate the respiratory system.
- Baroreceptor reflexes, protective reflexes, pain, emotion, and voluntary control of respiration may also contribute to the increase in respiration.
- Minute ventilation increases as respiratory frequency and tidal volume increase.
- Alveolar ventilation, occurring with the diffusion of gases across the capillary-alveolar membrane, increases 10- to 20-fold during heavy exercise to supply the additional oxygen needed and excrete the excess CO_2 produced.

QUESTIONS