Cardiac Output Regulation

Stroke Volume x Heart rate

70mL/beat x 70 beats/min = 5 L/min

Regulation of Heart Rate

**Autonomic Nervous System**

- **Increase in HR**
  - Sympathetic nervous system
    - Via cardiac accelerator nerves
  - Increases HR by stimulating SA node
    - Norepinephrine release (accelerates depolarization of SA node)

- **Decrease in HR**
  - Parasympathetic nervous system
    - Via vagus nerves
  - Slows HR by inhibiting SA node
    - Acetylcholine release (slow sinus discharge)
Threshold potential = Inherent SA node pacemaker activity
Threshold potential = SA node pacemaker activity on parasympathetic stimulation
Threshold potential = SA node pacemaker activity on sympathetic stimulation

**Figure 9.24**

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**Regulation of Stroke Volume**

**Strength of Cardiac Contraction**

- Strength depends upon length-tension relationship

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**Figure 9.25**

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Regulation of Stroke Volume

**End Diastolic Volume**
- Frank-Starling mechanism
  - Greater preload results in stretch of ventricles and in a more forceful contraction
  
  ![Frank-Starling curve on sympathetic stimulation](image)

Other Factors affecting SV:
- Average aortic blood pressure
  - Pressure the heart must pump against to eject blood (“afterload”)

- Strength of the ventricular contraction
  - Contractility
    - Increased contractility results in higher stroke volume

Regulation of Stroke Volume

Other Factors affecting SV:
- The Skeletal Muscle Pump
  - Rhythmic skeletal muscle contractions force blood in the extremities toward the heart
  - One-way valves in veins prevent backflow of blood