Cardiac Output and Its Determinants

Physiology 1 · Cardiovascular block · Lecture 7

Cardiac output

- Cardiac output is the volume of blood pumped by each ventricle per minute.
- Cardiac output equals heart rate multiplied by stroke volume.
- In a resting adult, cardiac output is approximately 5 liters per minute.

Stroke volume

- Stroke volume is the difference between end-diastolic volume and end-systolic volume.
- Ejection fraction is stroke volume divided by end-diastolic volume.
- A normal ejection fraction is about 55 to 70 percent.

Preload and the Frank-Starling mechanism

- Preload is the degree of ventricular stretch at the end of diastole.
- The Frank-Starling mechanism states that increased end-diastolic volume increases stroke volume.
- Greater stretch of cardiac muscle fibers produces a more forceful contraction.

Afterload

- Afterload is the resistance the ventricle must overcome to eject blood.
- Increased afterload decreases stroke volume when contractility is unchanged.
- Aortic stenosis and systemic hypertension both increase left ventricular afterload.

Contractility

- Contractility is the intrinsic strength of cardiac muscle contraction at a given preload.
- Sympathetic stimulation increases contractility through beta-1 adrenergic receptors.
- Positive inotropes increase contractility and shift the Frank-Starling curve upward.

Heart rate regulation

- The sinoatrial node sets the intrinsic heart rate.
- Parasympathetic stimulation through the vagus nerve slows the heart rate.
- Sympathetic stimulation increases the heart rate by increasing the slope of phase 4 depolarization.

Summary

- Cardiac output depends on heart rate, preload, afterload and contractility.
- Mean arterial pressure equals cardiac output multiplied by total peripheral resistance.