

Minute cardiac output

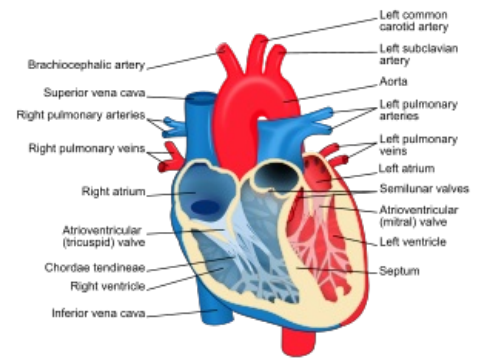
Cardiac output is the volume of blood pumped through the heart chamber per minute. **At rest**, this volume is about **5 l**, **under load** it can increase **up to 20 l**. Its value depends on the age, gender and training of the individual. The cardiac output of both chambers should be approximately the same in a certain period of time. Cardiac output can also be related to the size of the individual, which is why the **cardiac index** is determined, which is related to 1 m^2 of the body surface. Its average value is about **3.2 l/m²**.

Calculation

cardiac output = systolic volume X heart rate (MV = SV X F)

Control of cardiac output

Cardiac output depends on changes in heart rate or systolic volume. **Heart rate** is primarily controlled nervously, when the sympathetic system accelerates the heart rate (positive chronotropic effect) and the parasympathetic system slows down the heart rate (negative chronotropic effect). **Systolic volume** is significantly influenced by cardiac contractility. The force of heart contractions depends on the preload (preload – degree of filling of the heart with blood, the larger the volume in the heart before contraction, the stronger the contraction) and the afterload (resistance against which the heart works). This phenomenon is described by the Frank-Starling mechanism and this is a heterometric regulation (contractility depends on the initial length of the cardiac muscle fiber). The control of cardiac output also occurs through homeometric regulation, i.e. changes in the force of contraction independent of the initial length of cardiac muscle fibers. The autonomic nervous system including sympathetic and parasympathetic, catecholamines, xanthines, glucagon (which has a positive inotropic effect, i.e. increases the force of contraction) participates in this regulation. In the organism, these mechanisms are integrated to ensure adequate cardiac output.



Heart

Influence of various factors on cardiac output

Rise

- anxiety, nervousness
- body weight
- high temperature
- adrenaline

Decrease

- transition from a lying position to a standing position
- heart disease
- higher pressure in the intrapericardial cavity, which will limit the extent of cardiac filling

Measurement of cardiac output

Ficks method

It is based on the assumption that the amount of substance captured by the organ per time unit (minute) is equal to the product of the arteriovenous difference (difference between arterial and venous concentration of the substance) and blood flow.

Dilution method

A known amount of a dye (such as indocyanine green) or a radioactive isotope is injected into a vein, and then the concentration of this substance in a series of arterial blood samples is monitored. Cardiac output is equal to the amount of dye administered divided by its average concentration in the arteries during a single circulation. The substance used – must remain in circulation for the duration of the examination, but must not have undesirable hemodynamic effects. The essence is dilution = dilution of the indicator added to the bloodstream.

Thermodilution method

The indicator is a cold physiological solution that is injected into the right atrium, and at the same time the temperature change in the lung is registered. The magnitude of the temperature change is inversely proportional to the amount of flowing blood (the degree of dilution of the cold solution with blood). One of the advantages of this method is the harmlessness of the saline solution. This method uses a Swan-Ganz catheter.

Links

Related articles

- Determination of cardiac output

Source

- TROJAN, Stanislav. *Fyziologie - učebnice pro lékařské fakulty : Part 1..* 1. edition. Prague : Avicenum, 1988. 565 pp.
- GANONG, William F., et al. *Přehled lékařské fyziologie.* 1. edition. Jinočany : H & H, 1995. 681 pp. ISBN 80-85787-36-9.