



Physiology
OF THE CARDIOVASCULAR SYSTEM

Venous Return & Cardiac output

Venous Return

Venous return is the quantity of blood flowing from large veins into the right atrium each min.

Factors controlling venous return

Skeletal muscle pump → ↑ venous return

Pressure drop during inspiration → ↑ venous return

↑ Blood volume → ↑ venous return

↑ Pressure gradient → ↑ venous return

↑ Venous pressure → ↑ venous return

Gravity → ↓ venous return

Veins

Veins hold most of blood in body (70%) & are thus called capacitance vessels

Have thin walls

stretch easily to accommodate more blood without increased pressure = higher compliance

Have only 0 -10 mm Hg Pressure

Depends on

Blood volume & venous pressure

Venoconstriction caused by Sympathetic

Skeletal muscle pumps

Pressure drop during inhalation

Venous return curve

It relates venous return to right atrial pressure

Venous return is decreased when:

The right atrial pressure (RAP) is increased

Pumping capability becomes diminished

The nervous circulatory reflexes are absent

In Valsalva manoeuvre (forceful expiration against a closed glottis) the intrapleural pressure become positive which is transmitted to the large veins in the chest

Plateau in the venous return curve at negative atrial pressures caused by:

When the RAP falls below zero, no further increase in VR and a plateau is reached.

The value for right atrial pressure at which venous return is zero is called the mean systemic pressure or mean circulatory pressure which is the pressure that would be measured throughout the cardiovascular system if the heart were stopped.

Effect of blood volume on mean circulatory filling pressure

When the blood volume ranges from 0 to 4 L, all of the blood will be in the unstressed volume (the veins), producing no pressure, and the mean systemic pressure will be zero. When blood volume is greater than 4 L, some of the blood will be in the stressed volume (the arteries) and produce pressure

Cardiac Output

It is the volume of blood ejected from the right or left ventricle per minute = 5 L./min. at rest.

C.O. = Heart rate x Stroke volume

Stroke volume is the volume of blood ejected from each ventricle per beat = 70 mls /beat at rest.

Heart rate at rest = 72 beats /min.

Normal Values of Cardiac Output at Rest and During Activity

Cardiac output is the quantity of blood pumped into the aorta each minute by the heart

Venous return is the quantity of blood flowing from veins into the right atrium each min

Cardiac output varies widely with the level of activity of the body. The factors affecting cardiac output are:
(1) Body metabolism
(2) Exercise
(3)Hyperthyroidis m.
(4) Age
(5) Pregnancy
(6) Increase body temperature.

Resting cardiac output for men is 5.6 L/min, but for women is about 4.9 L/min (but the average cardiac output for the resting adult is 5L/min)

Regulation of Heart Rate

Increased heart rate by

- 1- Sympathetic nervous system
-Crisis
-Low blood pressure
- 2- Hormones
-Epinephrine
-Thyroxine
- 3- Exercise
- 4- Decreased blood volume

Stretch receptors in right atrium trigger increase in heart rate through increased sympathetic activity

Atrial Reflex

Also called Bainbridge reflex
Adjusts heart rate in response to venous return

Decreased heart rate by

- Parasympathetic nervous system
- High blood pressure or blood volume

Cardiac index

It relates the cardiac output to body surface area

Thus relating heart performance to the size of the individual

The unit of measurement is liter per minute per square meter of body surface area (L/min/m²).

Measurement Of C.O.

@Portfolio Companies

The Direct Fick's Method

It states that, the amount or volume of any substance taken up by an organ or by the whole body is equal to=
(The arterial level of the substance – the venous level) X blood flow.

Blood Flow= Amount
(Arterial level – Venous level)