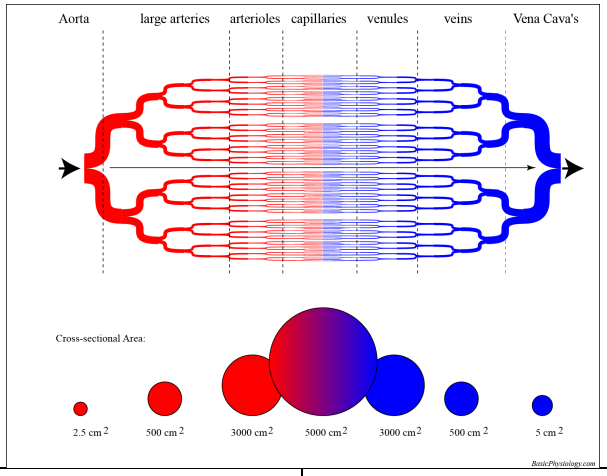
B.7.1. Cardiac Shock

Definition: Cardiovascular shock (= cardiac shock) is an acute failure to perfuse adequately the organs and the tissues in the body.

A. Background of Shock:



1. This diagram shows the cross section through the vascular system. At the beginning, in the aorta, its cross-section is very small (2.5 cm^2). As one moves forward towards the capillaries, then the vessels do become narrower, but the number of vessels increases much more. Therefore, the cross-sections of all these vessels (the "sum") increase a lot.	2. The cross section of all the capillaries together is a total of 5000 cm^2, compared to only 2.5 cm^2 for the aorta (2000x!).
3. Therefore, because there are so many more smaller vessels and capillaries in the body, this may cause a problem.	4. If they were all wide open, their total cross section would be much more than the cross section of the aorta.
5. In fact, if all the blood vessels were all wide open at the same time, then the blood volume (approx. 5 litres) would easily fit in the small vessels and the blood pressure would drop to zero!	6. In order to avoid that, the arterial and venous vessels must **always** show some degree of vasoconstriction.
7. **Shock** is the condition when the blood pressure is too low.	8. To be precise: this is called **cardiovascular shock**, to distinguish this from other types of shock such as psychological shock.

B. Types of Shock:

1) Problems with the heart: **cardiogenic** shock
2) Problems with the blood volume: **hypovolemic** shock
3) Problems with the vessel wall tension: **anaphylactic** shock and **septic** shock.

B1. Cardiogenic Shock (the Heart):

The heart can no longer pump properly due to:

a) Myocardial infarction: a (large) part of the left ventricle is no longer working (= dead)
b) Myocarditis: inflammation/infection of the heart makes the muscle weaker
c) Arrhythmias (disturbance in the rhythm): then there is not enough time during diastole for filling the ventricles.
d) Other cardiac causes (valvular, tamponade, etc)

B2. Hypovolemic Shock (Blood Volume):

1. External Fluid Loss:	**2. Internal** Fluid Loss:
a) Haemorrhage (bleeding) b) Diarrhoea (cholera) c) Vomiting (babies) d) Dehydration (sunstroke) e) Burns (> 20% of the body surface)	a) Crushing injuries b) Pancreatitis c) Internal bleeding (ruptured spleen for example)

B3. Anaphylactic Shock and Septic Shock (Blood Vessels):

1. **Anaphylactic** Shock:	2. **Septic** Shock:
Extreme vasodilation due to an intense allergic reaction (insect bite, allergic to medicine such as penicillin, etc.).	Extreme vasodilation due to bacterial infections and the entry of bacteria and their toxic products (=endotoxins) inside the blood.

C1. Compensated Phase: Immediate Response

1. Nervous system: Decrease in parasympathetic and increase in sympathetic activity.	2. Hormones: Increases in Angiotensin II, adrenaline and vasopressin (=ADH)
3. Cardiac response: - Increased chronotropy (tachycardia) - Increased inotropy (contraction force)	4. Vascular Response: Vasoconstriction in muscles, gut, skin and kidney -> increase in the Peripheral

	Resistance.
5. **BUT**: Reduced perfusion in these organs also leads to acidosis, weakness, oliguria (=decreased urine output) and pallor.	6. Skin: The skin becomes wet, cold and pale due to the increased sympathetic stimulation.

C2. Compensated Phase: Intermediate Response

1. Vascular Fluid Shift: Up to 500 ml can be transfused back into the vascular system.	2. **BUT**: This will produce a temporary anaemia (= less oxygen transported, which is bad) but also reduce viscosity (=less work for the heart, which is good!)

C3. Compensated Phase: Long Term Response

1. Kidney: Reduction in renal excretion and increase in fluid intake (thirst)	2. Liver: Increase in liver glycolysis (induced by adrenal and sympathetic stimulation) -> more blood proteins -> increase in oncotic pressure
3. Bone Marrow: Increased production in red blood cells.	

D. Physical Signs of impending Shock:

It may be interesting to know (and understand) the physical signs of an impending cardiovascular shock:

1) Skin is pale, cold and sweaty
2) Pulse is rapid and weak
3) Breathing is rapid and shallow
4) Urine output is decreased or even stopped
5) General muscle weakness
6) Reduced mental awareness or confusion
7) Mean arterial pressure may be normal or reduced (last sign to be affected)

E. Ultimately: Decompensated Phase (= irreversible)

1. If the blood loss is too high and /or fluid replacement is started too late: then **irreversible** damage will occur to several organs or systems.	2. The most at risk are: 1) Myocardium 2) Tubular necrosis (kidneys) 3) Cardiac failure 4) Multi-organ failure

	Ultimately: **Death**