Cardiovascular System

Biochemistry

1. What mechanism maintains a relatively constant ATP pool in the heart mitochondria?

2. Which apolipoproteins (i.e. A, B, or C) are associated with which diseases?

3. What are the 3 major substrates for cardiac metabolism?

4. What are 3 minor substrates for cardiac metabolism?

5. In carbohydrate metabolism in the heart, what is the key regulatory enzyme that catalyzes the 1st committed step (i.e. the phosphorylation of fructose 6-phosphate to fructose 1,6-bisphosphate) in the glycolytic pathway?

6. From what source is NAD+ derived from?

7. What is the relationship between hexokinase and glucokinase?

8. What transporters bring glucose into cardiac cells?

9. Insulin and myocardial ischemia cause what?

10. What is the major limitation of energy metabolism by myocardium?

11. What 2 factors determine oxygen consumption by myocardium?

12. Does the heart generate ATP from aerobic or anaerobic means?

13. ATP is used in the heart for what?

14. Why would hypophosphatemia result in muscle weakness and impaired cardiac function?

15. Besides raising LDL, triglycerides, and lipoprotein-a, what other affects do trans-fatty acids have on the cardiovascular system?

16. Which minerals are associated with lowering blood pressure?

17. B vitamin deficiency is associated with what cardiovascular disease?

18. What polyphenol is associated with lowering blood pressure and has anti-oxidant, anti-platelet, and anti-inflammatory properties?

Embryology

19. What embroyological layer does the heart arise from?

20. The heart and the great vessels come from what cell line?

21. At what point do vasculogenesis and angiogenesis, blood vessel development, begin?

22. Where does vasculogenesis and angiogenesis happen?

23. How does the heart tube form?

24. By the end of the third week what does the primordial cardiovascular system look like?

25. The superior vena cava is developed out of what structure?

26. What 4 main segments compose the inferior vena cava?

27. From what does the aorta and the pulmonary trunk develop?

28. The aorta and the pulmonary truck are formed when in gestation?

Answers

1. Phosphocreatine shuttle. This shuttle is the intracellular energy shuttle that transports phosphates from the mitochondria.

2. Apo-A-V with hypertriglyceridemia

   Apo-B100 with hypobetalipoproteinemia

   Apo-C-II with hyperchylomicronemia

   Apo-C-III with hypertriglyceridemia

3. Fatty acids

   Glucose

   Glycogen breakdown

   Glucose and glycogen are used in glycolysis. Fatty acids are used in fatty acid beta oxidation. Both pathways produce NADH which the electron transport chain then uses to make ATP

4. Lactic acid

   Ketones

   Intramuscular triglycerides

   These 3 substrates can all create Acetyl CoA (which enter the TCA cycle and oxidation phosphorylation to make ATP).

5. Phosphofructokinase 1

6. Niacin. NAD stands for nicotinamide adenine dinucleotide.

7. They are isozymes. Isozymes are enzymes with the same function but different chemical structures.

8. GLUT 1 and GLUT4. These are the 2 main glucose transports for the heart specifically.

9. An up regulation of GLUT4 transporters. Insulin signals glucose uptake by binding to insulin membrane receptors that causes a cascade effect. This eventually leads to GLUT4 being expressed on the plasma membrane.

10. Coronary blood flow delivering oxygen to the myocardium

11.

    (1) Wall tension in the heart that must be overcome e.g. during isovolumic contraction

    (2) Isotonic contraction to eject the blood

12. Both. Cardiac tissue usually relies on aerobic respiration. However, during times of insufficient oxygen, the heart can also utilize anaerobic respiration. 98% of ATP is derived from oxidative means

13. -70% of ATP is used for contraction and 40% is used for ion pumps

14. Without a proper supply of both ADP and phosphate, then the Krebs Cycle cannot produce ATP

15. They promote inflammation, endothelial dysfunction, insulin resistance, visceral adiposity, and arrhythmias

16. Magnesium, calcium, and potassium. These minerals help vasodilate to lower blood pressure.

17. Cardiomyopathy

18. Flavonoids. They have been shown to decrease reactive oxygen species.

19. Mesoderm. Mesoderm also gives rise to skeletal muscle, red blood cells, and other smooth muscles.

20. The mesenchymal cells in the cardiogenic area. Mesenchymal cells are multipotent stem cells that can differentiate into various cell types (like myocytes, adipocytes, and osteoblasts).

21. At the beginning of the third week.

22. In the extraembryonic mesoderm of the yolk sac, allantois, and chorion. Mesoderm gives rise to new vessels and heart structures.

23. endothelial-lined channels, known as the endocardial heart tubes, fuse together to form the heart tube

24. The heart is represented by the heart tubes and is joined by blood vessels from the embryo and extraembryonic membrane

25. The right anterior cardinal vein and the right common cardinal vein

26.

    (1) hepatic segment; from the hepatic vein and sinusoids

    (2) prerenal segment; from the right subcardinal vein

    (3) renal segment; from the subcardinal-supracardinal anastomosis

    (4) postrenal segment; from the right supracardinal vein

27.

    (1) The bulbar ridges fuse and become an aorticopulmonary septum

    (2) This aorticopulmonary septum then divides the bulbus cordis and the truncus arteriosus into 2 arterial channels

    (3) These 2 channels become the aorta and the pulmonary trunk

28. Between week 5 and 6

29. 7 weeks after the last known menstrual period, also known as week 5 in fertilization age terms

30.

    (1) The umbilical vein delivers oxygenated blood

    (2) After bypassing the liver, the blood moves from the ductus venosus into the IVC and the right atrium

    (3) It enters the left atrium and ventricle through the foramen ovale

    (4) It enters the pulmonary truck at the same time via the ductus arteriosus

    (5) After it enters the lung and the peripheral body through the aorta, it is passed back to the placenta due to the umbilical arteries