

## Previous exam questions in ECG, oxygen uptake and physical exercise

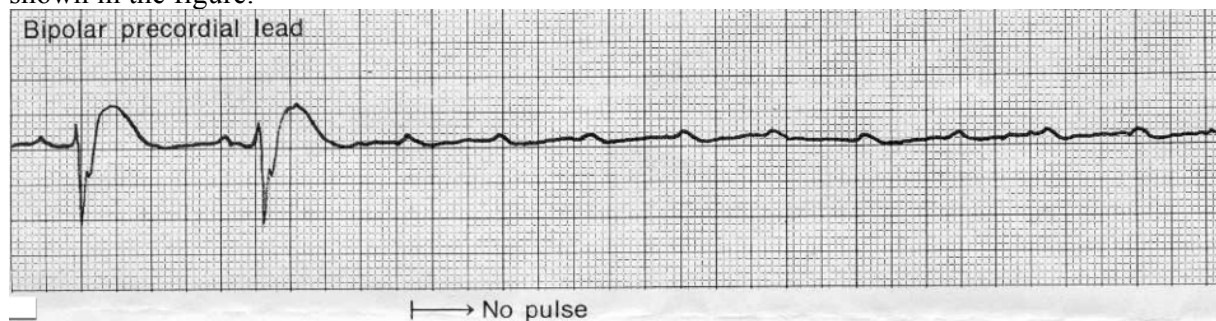
What happens with the cardiac pumping during the PQ interval?

- a) The atria contracts and fills the ventricles.
- b) The ventricles contract, in order to increase the pressure, without ejecting blood
- c) The ventricles eject blood into the aorta
- d) The ventricles relax and draws blood passively from the atria

When the mitral (bicuspid) valve closes, there is a click, a heart sound. When can this be heard in relation to the ECG?

- A The P-wave
- B The Q wave
- C In the middle of the QT-interval
- D The T-wave

A patient in the coronary care unit suddenly displays a change in the heart rhythm and pulse as shown in the figure.

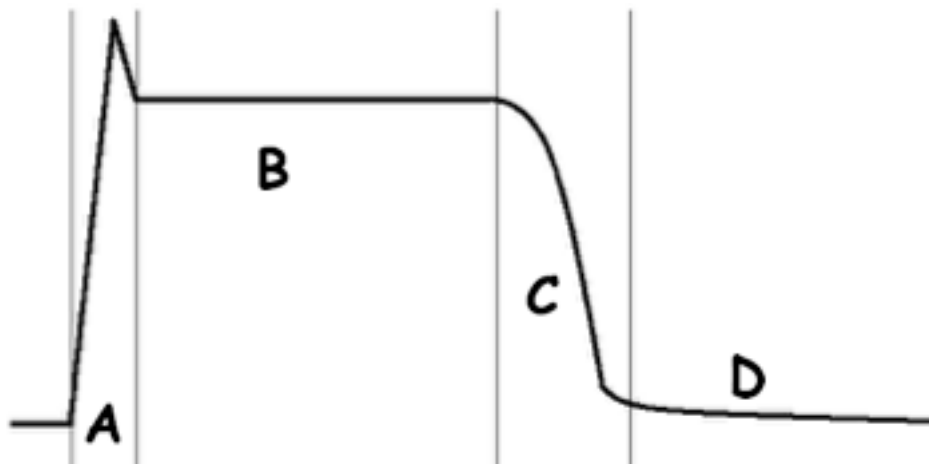
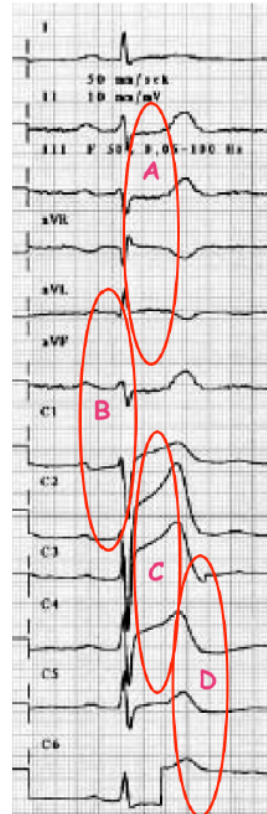


What is the mechanism?

- A The atria suddenly starts to beat in an uncoordinated manner
- B The AV-node suddenly stops conducting the impulses from the atria to the ventricles
- C The ventricles suddenly starts to beat in an uncoordinated manner
- D Nothing happens electrically, but the mechanic pumping stops abruptly

ST-elevation is a sign of an acute myocardial infarction. Which of the areas marks maximal ST-elevation?

- A) A
- B) B
- C) C**
- D) D



The diagram shows a schematic picture of a cardiac action potential.

Which of the phases corresponds to the T wave in the ECG?

- A) A
- B) B
- C) C**
- D) D

And which phase corresponds to the inflow of blood (filling of the ventricles)?

- A) A
- B) B
- C) C
- D) D**

Maximum oxygen uptake is a measure of aerobic fitness. What limits the maximal oxygen uptake in healthy individuals?

- a) The maximal pumping capacity of the heart
- b) The maximal ventilator capacity of the lungs
- c) The maximal gas diffusion capacity of the alveoli
- d) The anaerobic threshold of the muscles

Endurance training increases the maximal oxygen uptake. What is the factor that is increased by training, and thus responsible for increased fitness?

- A The Hemoglobin
- B The Arterial oxygen saturation (meaning more efficient oxygenation by the lungs)
- C The maximal heart rate
- D The maximal stroke volume

The ejection fraction is used as a measure of ventricular function. An endurance athlete has an end diastolic left ventricular volume of 250 ml. During rest, he has a normal cardiac output of 5.5 litres /min with a heart rate of 42 beats / min. What is the resting ejection fraction?

- A 66%
- B 59%
- C 52%
- D 48%

We do a heart catheterization at rest (cardiac output is the same as in 29), and measure a hemoglobin of 16.5 g/dl, an arterial oxygen saturation of 100%, and a mixed venous saturation of 70%. One gram of hemoglobin binds 1.4 ml of oxygen. The patient weighs 82 kg. What is his oxygen uptake during the procedure?

- A 3,5 ml/kg/min
- B 4,6 ml/kg/min
- C 10,8 ml/kg/min
- D 15,5 ml/kg/min

The ejection fraction is used as a measure of ventricular function. However, this has some limitations. Endurance training increases left ventricular volume and reduces heart rate. A certain (male) cross country skier has an end diastolic left ventricular volume of 250 ml. During rest, he has a normal cardiac output of 4.8 litres /min with a heart rate of 42 beats / min. What is the resting ejection fraction?

- A 78%
- B 58%
- C 46%
- D 32%

During exercise, he has the ability to increase the ejection fraction to 85%. End diastolic volume does not increase during exercise in the healthy. His maximal heart rate is 185 beats / min. What is his maximal cardiac output?

- A 7 l/min
- B 16 l/min
- C 32 l/min
- D 39 l/min

Maximum oxygen uptake ( $VO_{2max}$ ) is a measure of aerobic fitness. Oxygen uptake is related to cardiac output by the formula:  $VO_2 = CO \times O_2 \text{ extraction}$ . During maximal exercise, the oxygen extraction (= arteriovenous  $O_2$  difference) may be as high as 90% (i.e. arterial oxygen saturation of 100%, venous saturation of 10%). One gram of hemoglobin binds 1.4 ml  $O_2$ . Given a body weight of 85 kg and hemoglobin of 15.4 g/dl, what is then his  $VO_{2max}$ ?

- A 99 ml/kg/min
- B 89 ml/kg/min**
- C 79 ml/kg/min
- D 70 ml/kg/min

The ejection fraction is used a measure of ventricular function. A patient with heart failure has an end diastolic left ventricular volume of 250 ml. During rest, she has a normal cardiac output of 4.5 litres /min with a heart rate of 92 beats / min. What is the resting ejection fraction?

- A 49%
- B 36%
- C 24%
- D 20%**

We do a heart catheterization at rest, and measure a hemoglobin of 13.5 g/dl, an arterial oxygen saturation of 100%, and a mixed venous saturation of 70%. One gram of hemoglobin binds 1.4 ml of oxygen. The patient weighs 67 kg. What is her oxygen uptake during the procedure?

- A 3,5 ml/kg/min
- B 3,8 ml/kg/min**
- C 8,9 ml/kg/min
- D 12,7 ml/kg/min

The ejection fraction is used a measure of ventricular function. A patient has an end diastolic left ventricular volume of 250 ml. During a resting examination, she has a normal cardiac output of 4.5 litres /min with a heart rate of 90 beats / min. What is the resting ejection fraction?

- A) 80%
- B) 50%
- C) 25%
- D) 20%**

We do a heart catheterization at rest, and measure a hemoglobin of 10.5 g/dl, an arterial oxygen saturation of 100%, and a mixed venous saturation of 65%. One gram of hemoglobin binds 1.4 ml of oxygen. The patient weighs 58 kg. What is her oxygen uptake during the procedure?

- A) 2,3 ml/kg/min
- B) 3,5 ml/kg/min
- C) 4,0 ml/kg/min**
- D) 15,0 ml/kg/min

We do an oxygen uptake testing, and find that her maximal oxygen uptake is 15 ml/kg/min. During maximal effort, it can be assumed that her oxygenation is adequate (arterial saturation 100%), and extraction is 90% (mixed venous saturation 10%). What is her maximal cardiac output?

- A) 5,0 l/min
- B) 6,6 l/min**
- C) 8,7 l/min
- D) 13,2 l/min

Epidemiological studies shows that heart patients with an oxygen uptake of  $< 17$  ml/kg/min has a 10 year mortality of about 50% (Survival of 50%). Heart patients with oxygen uptake of  $> 28$  ml/kg min on the other hand, has a 10 year mortality of only 20% (survival of 80%). Interval training has been shown to be the most efficient way of increasing oxygen uptake, and increases the Oxygen uptake most. Studies at the NTNU have shown that high intensity interval training is feasible in all kinds of heart patients. In addition, it reduces risk factors most. Does that mean that interval training is the most efficient way of increasing survival in heart patients? (Only one answer is correct).

A) Yes, interval training increases maximum oxygen uptake most, and thus increases survival the most

B) Yes, Interval training reduces risk factors the most, and thus reduces mortality risk (increases survival) the most.

C) No, even if risk factors and oxygen uptake improves, that is no proof of improved survival

D) No, hard training will increase risk of training related deaths, and thus increase mortality (reduce survival).