Case Study 4

Harry has had an accident while out walking his dog. On a tight bend, a car comes too close to the pavement and Harry falls into the ditch, badly cutting his leg. He bleeds quite badly before a passer-by calls an ambulance that takes him to hospital, where he is admitted for treatment.

Harry has lost so much blood that, on admission, he is prescribed a blood transfusion. He has become anaemic because of his haemorrhage. He has developed a tachycardia (fast heart rate), he is breathless and he is experiencing palpitations.

Discussion Questions

1. What is the normal red blood cell count for a healthy adult male?

2. Explain the physiological changes underlying each of Harry's symptoms.

Harry's blood is type O.

3. Explain why this blood type is sometimes called the 'universal donor'. Over the course of the next two or three weeks, Harry's blood cell count progressively rises.

4. Name the hormone that stimulates production of red blood cells, and describe how levels of this hormone are controlled.

Harry's leg wound is cleaned and stitched (sutured).

5. The bleeding has stopped because which organ has released its store of blood into the circulation, providing extra platelets for clotting?

6. What is the normal platelet count for a healthy adult male?

7. Describe the intrinsic and extrinsic pathways of coagulation, explaining the important differences between them.
8. Answer the following questions regarding blood clotting.

A. Fibrinogen is converted to fibrin by:
   a. Plasminogen
   b. Thrombin
   c. Factor XII (Hageman factor)
   d. Calcium

B. The enzyme responsible for fibrinolysis is:
   a. Plasmin
   b. Thrombin
   c. Fibrin
   d. Thromboplastin

C. Which of the following substances activates platelets?
   a. Thromboplastin
   b. Plasmin
   c. Serotonin
   d. Thrombin

D. Which vitamin is essential for the production of clotting factors?
   a. Vitamin C
   b. Vitamin B6
   c. Vitamin A
   d. Vitamin K

Answers

1. 4.5-6.5 million/ml of blood.

2. He is hypoxic because of his blood loss (i.e. there are not enough red cells left to carry enough oxygen to meet the body's needs) and to compensate for this, his heart rate rises to pump blood faster round the body, his respiration becomes fast and laboured to increase oxygen exchange in the lungs, and his palpitations (awareness of his heart activity) are likely to be due to the increased workload of his heart.

3. Blood group O has no antigens on the red cell surface to stimulate a transfusion reaction by anti-A or anti-B antibodies. However, it’s important to realise that although the ABO system is the most important in transfusion medicine, there are at least 20 other groups of red cell surface proteins which may be incompatible even if the ABO groups of donor/recipient are matched.
4. Erythropoietin, released by the kidney in response to hypoxia. Low blood oxygen levels increase erythropoietin release, which in turn stimulates red blood cell production in an attempt to increase oxygen transport.

5. Spleen

6. 200 000-350 000/ml of blood.

7. Both lead to activation of the final common pathway of blood clotting, but via two different biochemical pathways. The intrinsic pathway is triggered when exposed collagen in a damaged blood vessel wall activates clotting factors. The extrinsic pathway is triggered when the blood leaks through a damaged blood vessel and comes into contact with tissues outwith the circulation. Both ultimately lead to activation of factor X, which is the first step in the final common pathway.

8. A) B  
   B) A  
   C) C  
   D) D