**Blood** (chapter 13) **Page 1**

## Blood

The liquid connective tissue that transports substances throughout the body

• Blood transports nutrients and oxygen to the cells and carries away

the cell’s CO2 and other wastes

• Blood also contains cells and proteins that fight infections

• Blood is composed of plasma (a liquid) and the formed elements

(the blood cells)

Fig 13.1

Plasma

The liquid part of the blood; It transports dissolved molecules

• The plasma is about 55% of the total blood volume

• Mostly water, with the following dissolved molecules:

• Salts (ions/electrolytes)

√ Examples: Na+, K+, Ca2+

• Nutrients and monomers

√ Examples: Glucose, fatty acids, amino acids

• Cellular wastes

√ Examples: CO2, urea

• Proteins

√ Examples: Albumin (a blood protein for osmotic

balance and pH buffering), antibodies, and clotting

proteins

• Hormones

Fig 13.1, table 13.1

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Formed elements (blood cells)

The cells suspended in the plasma

• The blood cells are about 45% of the total blood volume

• There are three major blood cell types: Red blood cells, white blood

cells, and platelets.

• Red blood cells (RBCs, erythrocytes) = Blood cells that carry O2

√ Flat round cells with an indent on each face

√ No nucleus or other major organelles

√ RBCs are filled with the protein hemoglobin, which binds O2

√ They are the most numerous of the formed elements

• White blood cells (WBCs, leukocytes) = Blood cells that fight infections and cancer

√ There are five white blood cell types

• Platelets = Tiny irregular shaped cells that involved in blood clotting

Figs 13.2 and 13.3; table 13.2

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Formation of blood cells

All blood cells are formed from stem cells in the red marrow of

bones

• Mostly in ribs, sternum, pelvis, and skull bones

• Blood cell formation is controlled by hormones

√ Erythropoietin (EPO) increases RBCs production

√ Cytokines and interleukins increase WBC prduction

Fig 13.4; table 15.7

Anemia

Weakness due to inability of blood to carry sufficient O2

Possible causes of anemia:

• Lack of iron in diet

√ Hemoglobin uses iron to bind the oxygen it carries

• Loss of erythrocytes through bleeding

• Chemotherapy

• Hemolytic (bursting RBCs) diseases

√ Examples: Malaria, sickle cell anemia

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Hemostasis

The series of events that stops blood from flowing out of a broken

blood vessel

• Hemostasis begins with platelets binding to the exposed collagen in

the connective tissue around the vessel

(1) Vasocontriction (constriction of the blood vessel) occurs to slow

blood flow

• Vasoconstriction is caused by molecules secreted from

the platelets bound to the collagen

(2) A platelet plug forms

• The platelets in the cut stick to the collagen and to each other

(3) Coagulation (formation of a solid clot that stops the bleeding and

covers the break until the tissues are repaired)

• The blood clot is a web of fibrin protein with trapped RBCs

and platelets

• Fibrin = A large sticky protein made by linking smaller

fibrinogen proteins together

• Thrombin = The blood enzyme that links fibrinogen together

to make fibrin

√ Thrombin is made from prothrombin (an inactive

precursor)

√ Molecules secreted from torn cells and tissues

activate a series of clotting factor proteins, which in

turn activate prothrombin to become thrombin

• Serum = The liquid left in a blood sample after it has clotted

(plasma without fibrinogen)

Figs 13.7, 13.8, 13.9; table 13.4

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Disorders of hemostasis:

• Inability to stop bleeding

√ Causes: Hemophilia (genetic lack of a clotting factor),

deficiency in vitamin K, low platelet count

• Thrombus = A clot that forms in an unbroken blood vessel

√ Embolus = Anything that can block a blood vessel, such as a

dislodged thrombus that travels in the blood stream

√ Myocardial infarctions are usually caused by a thrombus

blocking a coronary artery that is already partially blocked by

plaque

Fig 13.9; table 13.5

Thrombolytic drugs

Medicines that dissolve a thrombus

• Given to patients to dissolve an existing thrombus (to treat a heart

attack, stroke, or pulmonary embolism)

Anticoagulant (blood thinners)

Medicines that inhibit hemostasis

• Given to patients to prevent thrombus formation (to reduce the risk

of heart attack or stroke)

• Examples: Coumadin, heparin, aspirin

Fig 13.9; table 13.5

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Antigen

Molecules (usually proteins, carbohydrates, and lipids on the surface

of a cell) that the immune system can interact with

• Foreign antigen = A molecule that does *not* occur naturally the body

√ The immune system attacks cells that have foreign antigens

using proteins called antibodies

• Self antigen = A molecule that does occur naturally in the body

√ The immune system does not attack cells that have self

antigens

Fig 15.8

Blood types (blood groups)

Different types of blood caused by different antigens on RBCs

• There are 3 major antigens that can be found on RBCs:

√ A antigen , B antigen, and Rh antigen

• There are 8 possible blood types, based on which antigens are found

on the person's RBCs\*

√ A+, A-, B+, B-, AB+, AB-, O+, or O-

\* O = Neither A nor B antigen is present

\* + = Rh antigen is present, - = No Rh antigen

Table 13.3

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Blood transfusion

Giving blood to a patient

• Transfusion mismatch = Giving a patient a transfusion of blood that

has a foreign RBC antigen to that patient (can be fatal)

√ The RBCs with foreign antigen are lysed by the patient’s

antibodies

√ The cellular debris clogs the patient’s blood vessels

• Never give a patient blood cells that have a foreign RBC antigen to

that patient

Fig 13.5; table 13.3

A method of finding safe blood types for transfusion to a patient

(1) Make a table of all 8 blood types

(2) Write the patient’s blood type next to the table

(3) Below the patient’s blood type, make a list of the antigens that are

foreign to the patient

√ These are all the antigens that the patient does **not** have

(4) On the blood type table, cross out any blood types that have any of

the patient’s foreign antigens

(5) The not-crossed out blood types are safe to give to the patient