



## Lecture Notes: Blood

### I. Introduction

#### A) Blood: Liquid Connective Tissue

(1) Components:

(a) Matrix:

(b) Cells:

- 1) Erythrocytes
- 2) Leukocytes
- 3) Thrombocytes

#### B) General Functions

(1) \_

- (a) Respiratory gases
- (b) Nutrients
- (c) Salts/ions
- (d) Cellular wastes

(2) \_

- (a) Antibodies
- (b) Phagocytosis
- (c) Clotting

(3) \_

- (a) Body fluid pH
- (b) Body temperature

#### C) Plasma

(1) **Water:**

- (a) universal solvent
- (b) Absorbs heat

(2) **Salts** (ions)

- (a) Osmotic balance
- (b) pH buffering
- (c) Examples:  $\text{Na}^+$ ,  $\text{Cl}^-$ ,  $\text{K}^+$ ,  $\text{Ca}^{+2}$ , bicarbonate

(3) **Proteins**

- (a) \_\_\_\_\_ osmotic balance, buffer
- (b) \_\_\_\_\_ clotting
- (c) \_\_\_\_\_ defense

(4) **Transported substances:**

- (a) Nutrients (monomers and vitamins)
- (b) Metabolic waste (urea)
- (c) Respiratory gases

(d) hormones

## D) Formed elements

### (1) Erythrocytes:

#### (a) Structure

- 1) Biconcave disc
- 2) Nonnucleated
- 3) Filled with Hemoglobin

#### (b) Function: transport respiratory gases

- 1) Oxygen O<sub>2</sub>
- 2) carbon dioxide CO<sub>2</sub>

### (2) Leukocytes:

(a) **Diapedesis:** capable of moving out of blood vessels to enter body tissues to carry out function

#### (b) Granulocytes

- 1) Cytoplasmic granules contain chemicals used in functions

#### 2) Agranulocytes

##### a) Lack cytoplasmic granules

### (3) Granulocytes:

#### (a) Neutrophils

- 1) 3-7 lobed nucleus
- 2) 40-70% WBC
- 3) Granules
- 4) \_

#### (b) Eosinophils

- 1) Bilobed nucleus
- 2) 1-4% WBC
- 3) \_

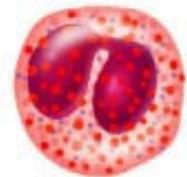
#### (c) Basophils

- 1) U or S-shaped nucleus
- 2) 0-1% WBC

- Neutrophils



- Eosinophils



- Basophils



3) \_

(4) **Agranulocytes:**

(a) **Lymphocytes**

- 1) Large, spherical nucleus
- 2) Very little cytoplasm
- 3) 20-45% WBC

4) Immunity

- a) \_\_\_\_\_ produce antibodies
- b) \_\_\_\_\_ viral, cancer, tissue rejection

(b) **Monocytes**

- 1) Kidney-shaped nucleus
- 2) 4-8% WBC
- 3) \_

**Agranulocytes**

- Lymphocytes



- Monocytes



E) Blood Cell Formation

- (1) Red Bone Marrow of spongy bone
- (2) Infants: all bones
- (3) Adults: skull, ribs, sternum, vertebrae and pelvic bones

(4) \_

- (a) Mitotic cells
- (b) Undifferentiated cells that give rise to other cells that can differentiate into other specific cell types

(5) \_

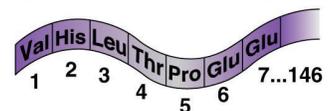
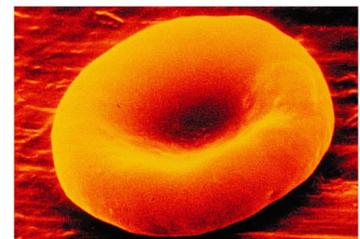
- (a) Extremely large cells pinch off bits of cytoplasm and membrane
- (b) Results platelet/thrombocytes

(6) \_

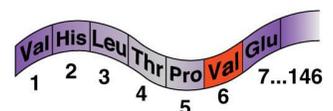
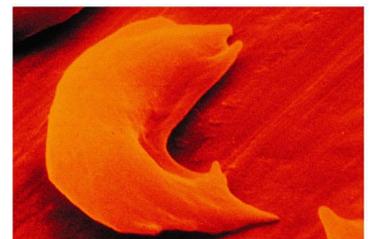
- (a) Hormone produced by kidney
- (b) Produced in response to low oxygen
- (c) Results in increased RBC production

(7) \_

- (a) Condition where body not getting enough oxygen
- (b) Pernicious anemia (deficient vitamin B-12)
- (c) Lack hemoglobin (dietary deficiency folic acid)
- (d) Sickle-cell anemia (mutation in hemoglobin gene)



(a) Normal hemoglobin



(b) Sickle cell hemoglobin

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F) \_ clotting—fast/localized

- (1) Blood vessel damaged--Damaged cells release molecules and exposed collagen that  
—
- (2) Vascular Spasms Smooth muscle of blood vessel wall constricts to  
—
- (3) Platelet Plug Formed-temporary seal
- (4) Simultaneously, clotting cascade begins—series of chemical reactions of blood proteins
- (5) **Clotting Cascade/coagulation**

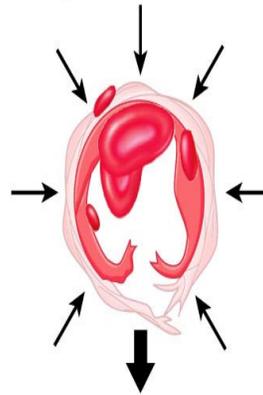
- (a) **prothrombin** Inactive enzyme (circulates in blood) that's activated by injured tissues
- (b) **thrombin** Active enzyme—builds fibrin mesh
- (c) **Fibrinogen:** inactive blood protein

(d) **fibrin:** mesh seals damaged area by trapping RBCs until blood vessel repaired

(6) **Anticoagulants:**

- (a) \_\_\_\_\_ blocks platelet aggregation preventing platelet plug formation
- (b) \_\_\_\_\_ blocks thrombin—fibrinogen fails to be activated/converted to fibrin
- (c) \_\_\_\_\_ interferes with Vitamin K activity (liver enzymes cannot produce clotting plasma proteins)

**Step 1: Vascular Spasms**

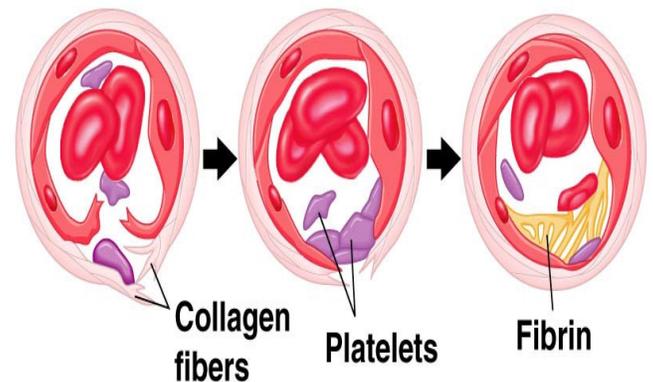


**Step 2: Platelet Plug Formation**

Injury to lining of vessel exposes collagen fibers; platelets adhere

**Step 3: Coagulation**

Fibrin clot with trapped red blood cells



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## G) Blood Typing

- (1) \_\_\_\_\_ surface molecule that identifies cells (recognition markers) and causes an immune response
- (2) \_\_\_\_\_ blood proteins produced by the lymphocytes that binds a specific antigen
- (3) \_\_\_\_\_ antibody binds antigen causes clumping of the red blood cells, clogs small blood vessel
- (4) ABO Blood groups: based on a specific carbohydrate group (antigen) attached to the surface of red blood cell

- (a) Type A
  - 1) A Antigen
  - 2) Anti-B Antibodies

- (b) Type B
  - 1) B Antigen
  - 2) Anti-A Antibodies

- (c) Type AB
  - 1) A and B Antigen
  - 2) Type O
  - 3) Anti-A and Anti-B antibodies

(d) **Universal blood donor**

(e) **Universal blood recipient**

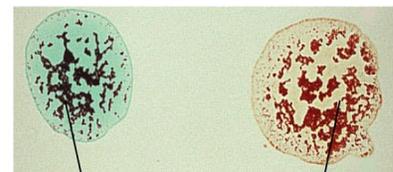
**Blood being tested**

**Serum**

**Anti-A**

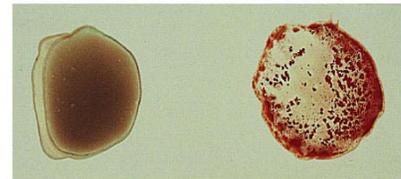
**Anti-B**

**Type AB (contains antigens A and B); agglutinates with both sera**



**Agglutinated RBCs**

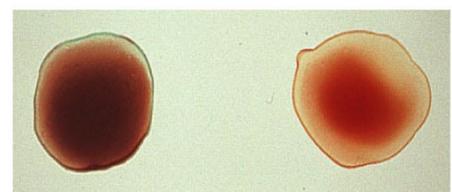
**Type B (contains antigen B); agglutinates with anti-B serum**



**Type A (contains antigen A); agglutinates with anti-A serum**



**Type O (contains no antigens); no agglutination occurs**



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(5) **Rh Factor**

(a) Rh antigen on RBCs

(b) Anti-Rh antibodies only made upon exposure to antigen

(c) **problem: mom Rh- and baby Rh+**

(1) fetal blood mixes with moms last stages of pregnancy

(2) 1<sup>st</sup> Rh+ child normal, mom produces anti-Rh

(3) 2<sup>nd</sup> Child, anti-Rh antibodies cross placenta and cause agglutination (hemolytic disease of newborn)

(4) mom injected RHOGAM-injection of antibodies that binds child's RBC Rh antigen preventing mom from producing own antibodies