The main symptoms in diseases of hematopoiesis. General blood test.

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Blood – a fluid connective tissue with matrix (plasma) and formed elements (cells) involved in:

1. Transport of dissolved substances (gases, nutrients, hormones, wastes)
2. Regulation of pH and ion composition
3. Restriction of fluid losses at injury sites (clotting)
4. Defense against toxins and pathogens (leukocytes)
5. Stabilization of body temperature

Hemopoiesis

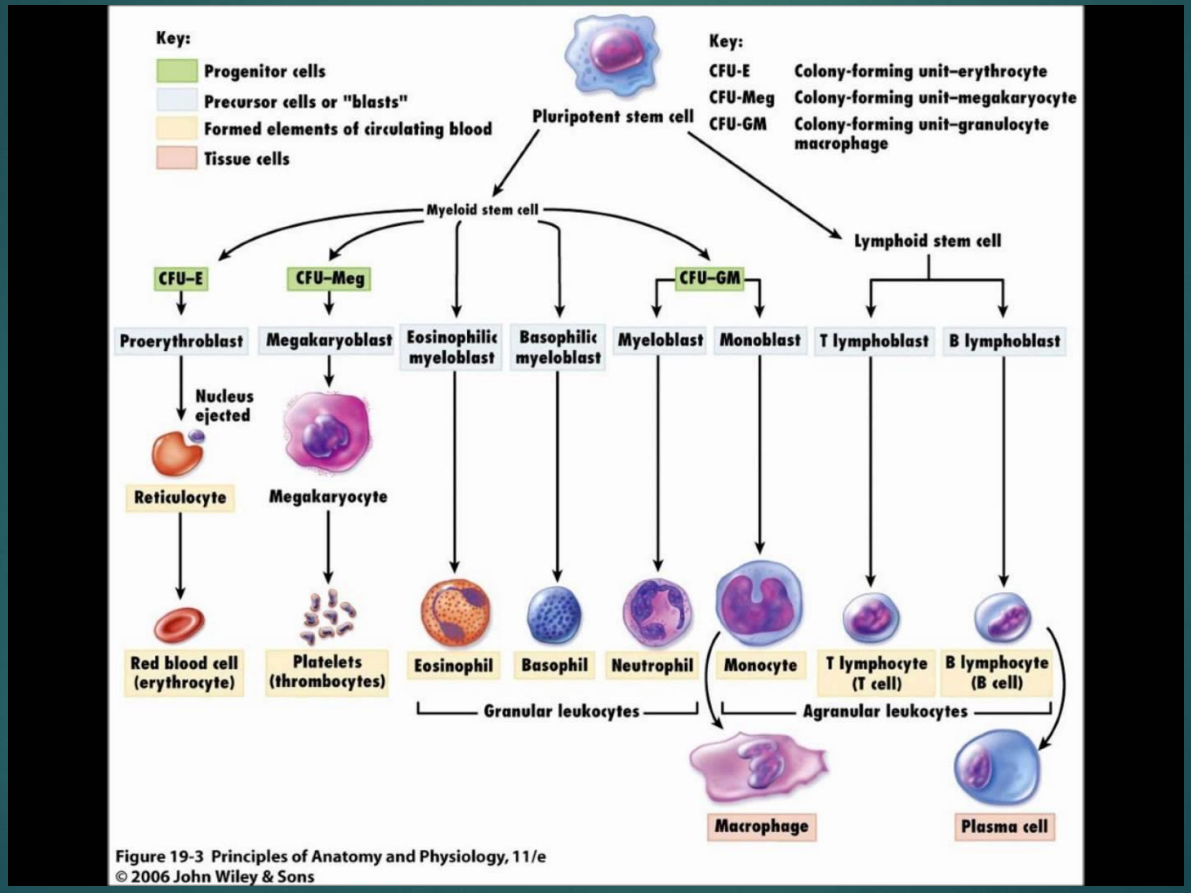
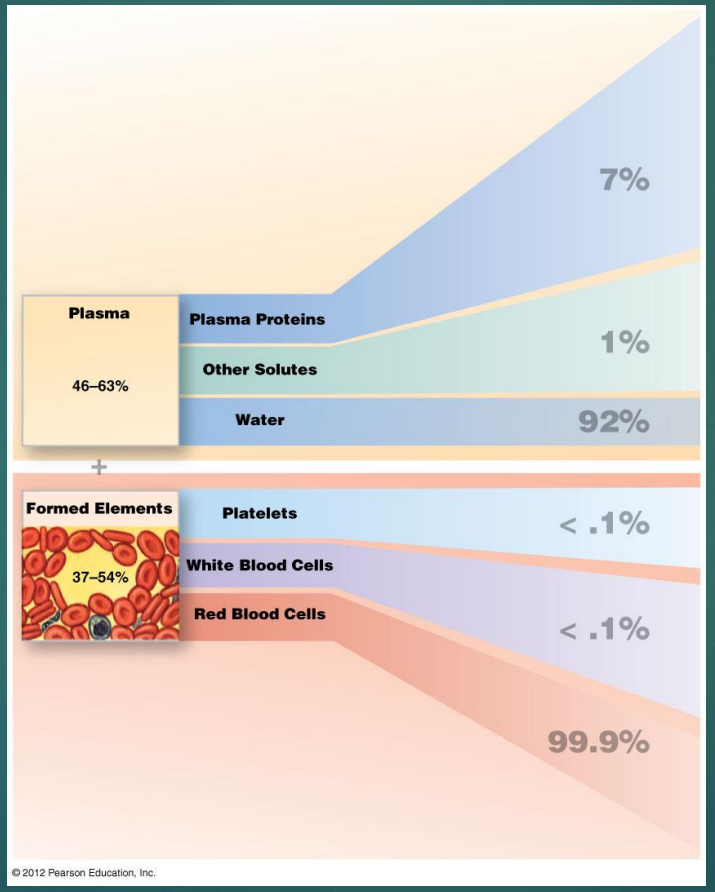


Figure 19-3 Principles of Anatomy and Physiology, 11/e

Physical Characteristics of Blood

pH = 7.4
Temp. = 38ºC
Vol. = 4 - 6 liters
(~7% body wt.)
High viscosity



Clinical manifestation of blood diseases

- Syndrome of anemia
- Hemorrhagic syndrome
- Myelodysplastic syndrome (syndrome of hemoblastosis)

Symptoms of Blood Disorders

- Blood disorders can cause various symptoms in almost any area of the body. Most commonly, symptoms are caused by decreases in the blood components.
- Decreased red blood cells and hemoglobin can cause symptoms of anemia, such as fatigue, weakness, and shortness of breath.
- Decreased white blood cells or immune system proteins can cause recurrent fever and infections.
- Decreased platelets or blood clotting factors can cause abnormal bleeding and bruising.

Occasionally, symptoms may relate to increases in blood components.

- Increased red blood cells can cause thickening of the blood (increased blood viscosity) and thereby cause headache and a red complexion (plethora).
- Increased immune system proteins also can cause thickening of the blood (increased blood viscosity).
- Increased platelets or blood clotting factors can cause inappropriate excessive blood clotting (thrombosis).

- Blood disorders can make any bleeding worse. People with blood disorders may experience excessive bleeding following dental procedures or have very heavy menstrual periods.

Some symptoms are more suggestive of a blood disorder.

- Blood clot (phlebitis), usually in a leg (most often causing swelling, redness, and/or warmth of the leg or shortness of breath)
- Petechiae (a fine pin-point red skin rash) caused by too few platelets
- Blood blisters in the mouth (caused by too few platelets or clotting problems)
- Swollen lymph nodes caused by white blood cell cancers (such as leukemias or lymphomas)
- Pallor (pale skin) caused by anemia
- Pica (eating of ice, dirt, or clay) suggests iron deficiency anemia

Red blood cell parameters evaluated by CBC include

- Number of red blood cells (red blood cell count, RBCs)

Male: 4.5 – 6.3 million, female: 4.2 – 5.5 million in 1 microliter of whole blood

Proportion of blood made up of red blood cells (hematocrit, Hct) Male: 40 – 54. Female: 37 – 47.

- Amount of hemoglobin (the oxygen-carrying protein in red blood cells) in the blood (hemoglobin, Hb). Male: 130 – 160 g/l. Female: 120 – 140 g/l.
- Average size of red blood cells (mean cellular volume, MCV)
- Variability of size of red blood cells (red cell distribution width, RDW)
- Amount of hemoglobin in an individual red blood cell (mean cellular hemoglobin, MCH)
- Concentration of hemoglobin in an individual red blood cell (mean cellular hemoglobin concentration, MCHC)

Anaemia

•- in the peripheral blood can appear erythrocytes of different size (poikilocytosis, poikilocythemia), different shape (anisocytosis),

•- different level of colouring (hyperchromatism and hypochromatism),

•- erythrocytes with inclusions (Jolli's corpuscles, Kabo's rings),

•-nuclear erythrocytes (erythroblasts, normoblasts, megaloblasts).

Changes of RBC size

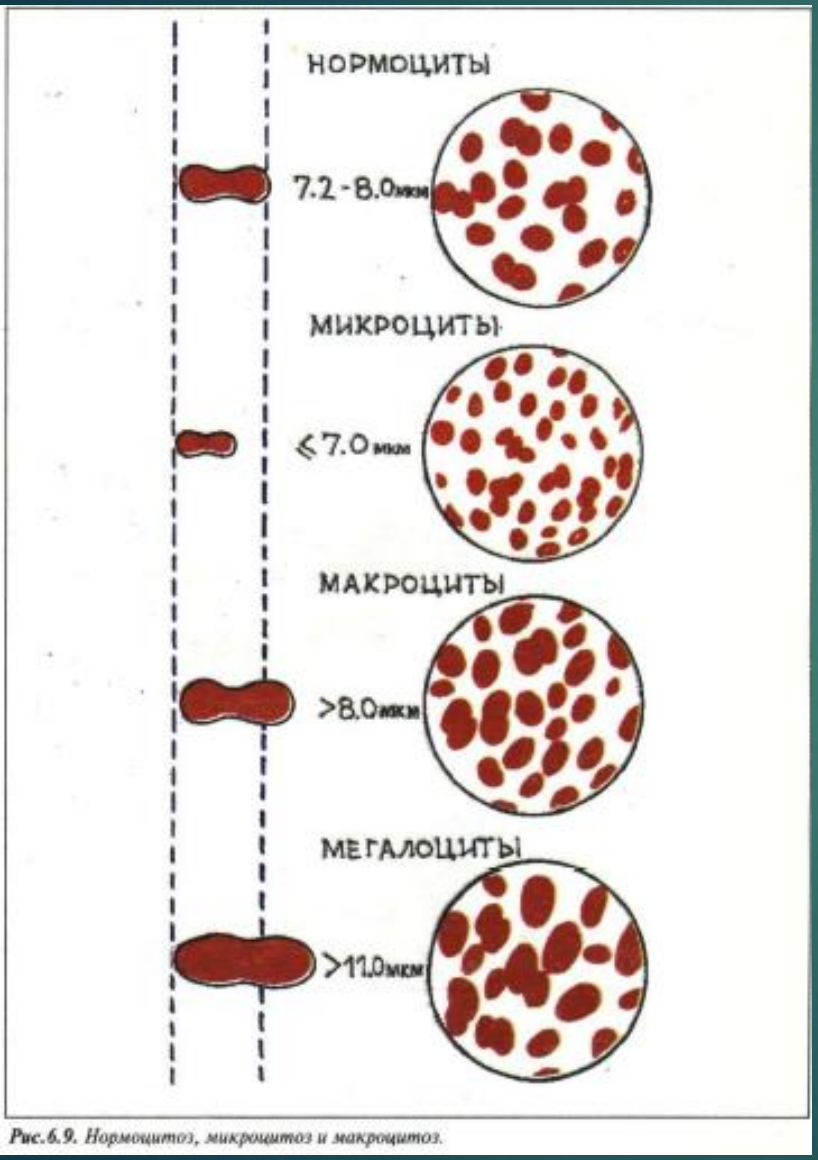


Рис. 6.9. Нормоцитоз, микроцитоз и макроцитоз.

- Normocytes (7,2-8,0)
- Microcytes (< 7,0)
- Macrocytes (>9,0)
- Megalocytes (11,1 – 15)

Changes of RBC shape

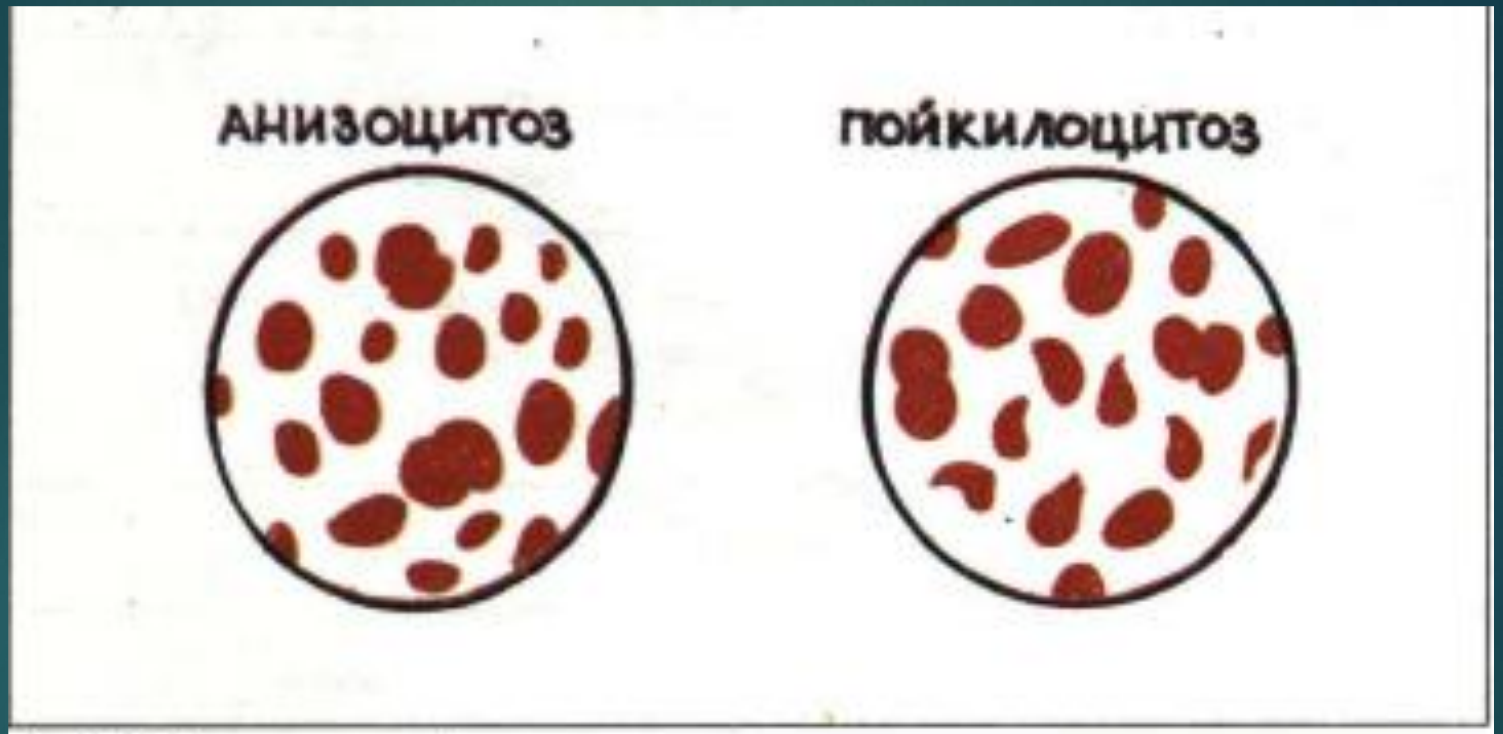


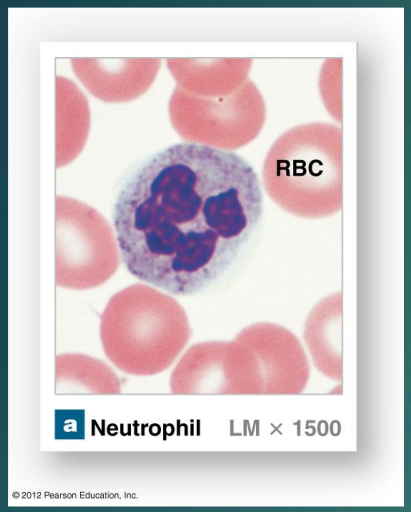
Рис. 6.10. Анизоцитоз и пойкилоцитоз.

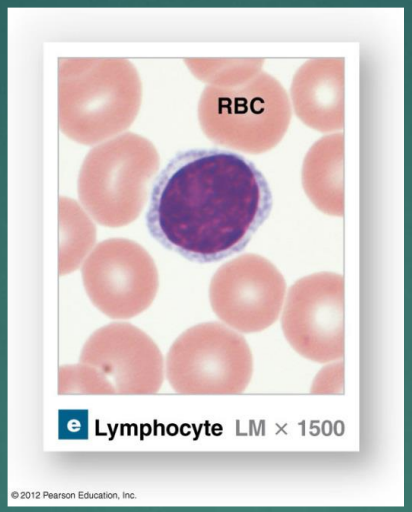
ANISOCYTOSIS POIKILOCYTOSIS

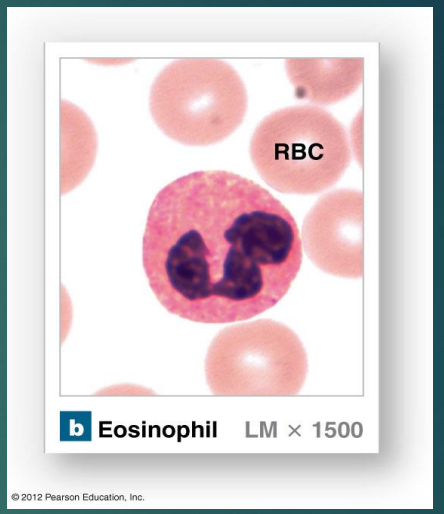
White blood cell parameters evaluated by the CBC include the

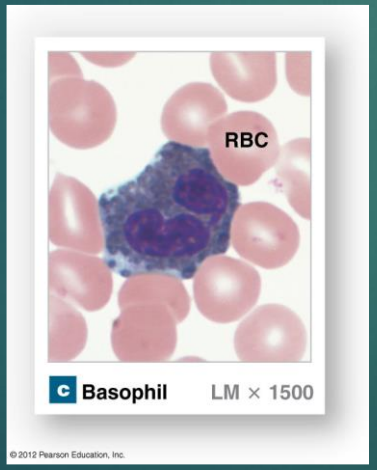
- Total number of white blood cells. 6-9 G/l (10^9/l)
- Percentages and numbers of the different types of white blood cells
- Counting the number of white blood cells of each type (differential white blood cell count) can suggest to a doctor possible causes of a change in the total white blood cell count.
- To provide more information about the white blood cells, the doctor can examine these cells under a microscope. The microscopic examination can identify features of the cells that are characteristic of certain diseases. For example, large numbers of white blood cells that have a very immature appearance (blasts) may indicate leukemia (cancer of the white blood cells).

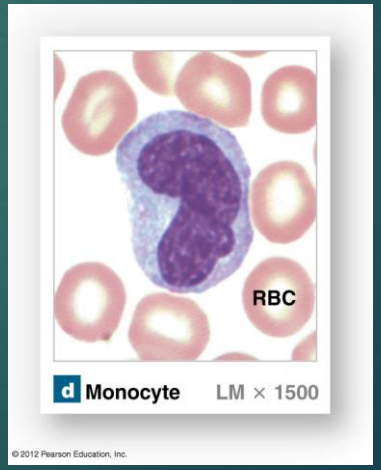
Types of Leukocytes









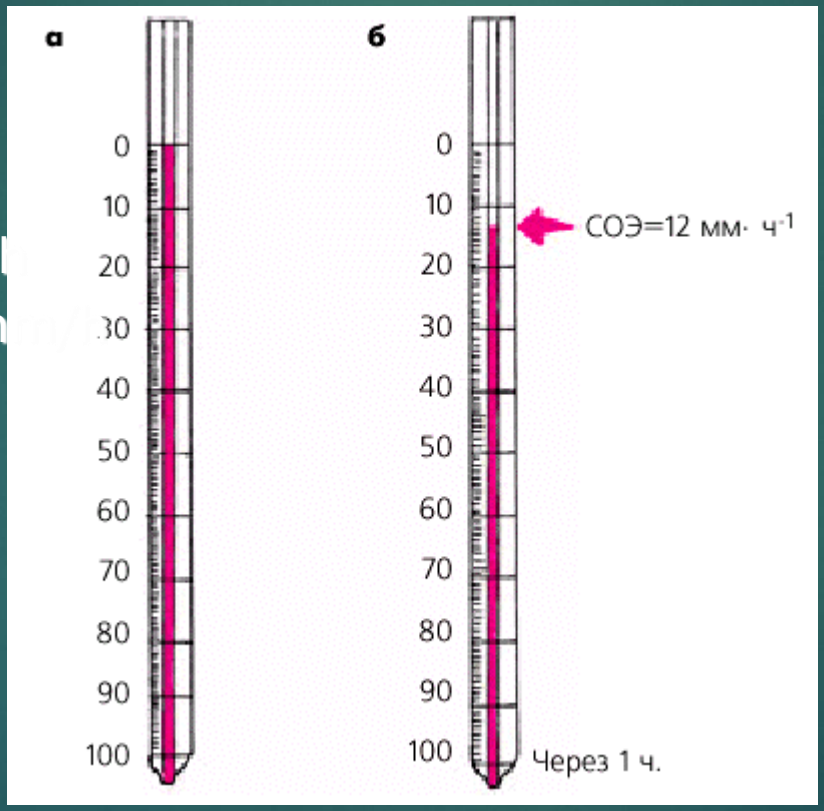


Platelets are also counted as part of a CBC.

- The number of platelets is an important measure of the blood's ability to form blood clots (forming blood clots is the body's protective mechanism for stopping bleeding). Too few platelets may impair blood clotting. A high number of platelets (thrombocytosis) can lead to excessive blood clotting in small blood vessels, especially those in the heart or brain. However, in some disorders, a high number of platelets may paradoxically result in excess bleeding.

Erythrocyte sedimentation rate (ESR)

- Men 2–10 mm/h
- Women 4–15 mm/h



Measures of proteins and other substances

- For example, in multiple myeloma, certain bone marrow cells, called plasma cells, become cancerous and produce unusual antibody (immunoglobulin) proteins (including Bence Jones proteins) that can be measured in blood and urine.
- Erythropoietin is a protein made in the kidneys that stimulates the bone marrow to produce red blood cells. The level of this protein can be measured in the blood. Levels of iron and certain vitamins (for example, B12 and folate) that are necessary for the production of healthy blood cells also can be measured.

A doctor can take two different types of bone marrow samples:

- Bone marrow aspirate: Removes fluid and cells by inserting a needle into the bone marrow and sucking out (aspirating) fluid and cells
- Bone marrow core biopsy: Removes an intact piece of bone marrow using a coring device (similar to a large diameter needle)

The bone marrow aspirate shows

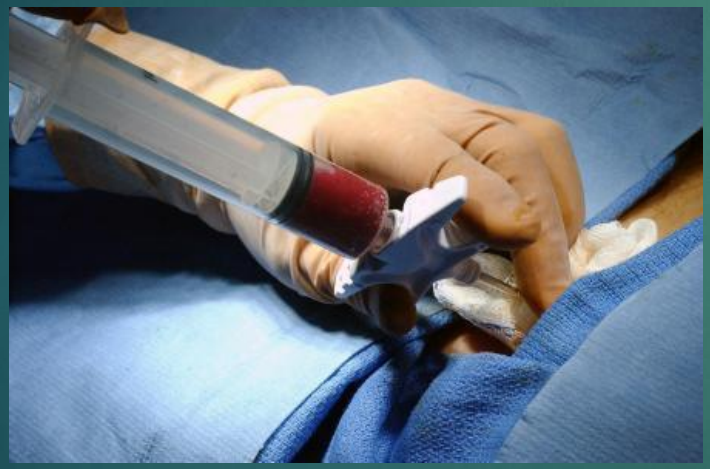
- what cells, normal and abnormal, are present in the bone marrow and provides information about their size, volume, and other characteristics. Special tests, such as cultures for bacteria, fungi, or viruses, chromosomal analysis, and analysis of cell surface proteins can be done on the sample.

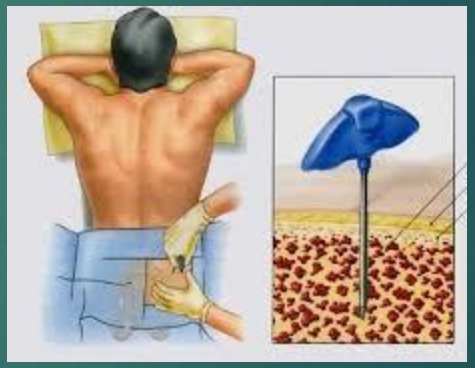
- The core biopsy removes an entire piece of bone marrow and shows not only what cells are present but also how full the bone marrow is with cells and where the cells are located within the marrow.

(A small core of intact bone marrow is removed with a special bone marrow biopsy needle and sliced into thin sections that are examined under a microscope.)

Although the aspirate often provides enough information for a diagnosis to be made, the process of drawing the marrow into the syringe breaks up the fragile bone marrow. As a result, determining the original arrangement of the cells is difficult.

When the exact anatomic relationships of cells must be determined and the structure of the tissues evaluated, the doctor also does a core biopsy.





Blood typing must be done before blood can be transfused

Blood type is determined by whether certain antigens (complex sugar or protein molecules that can trigger an immune response) are present on the surface of red blood cells. Blood cell antigens include blood group antigens A and B and Rh factor.

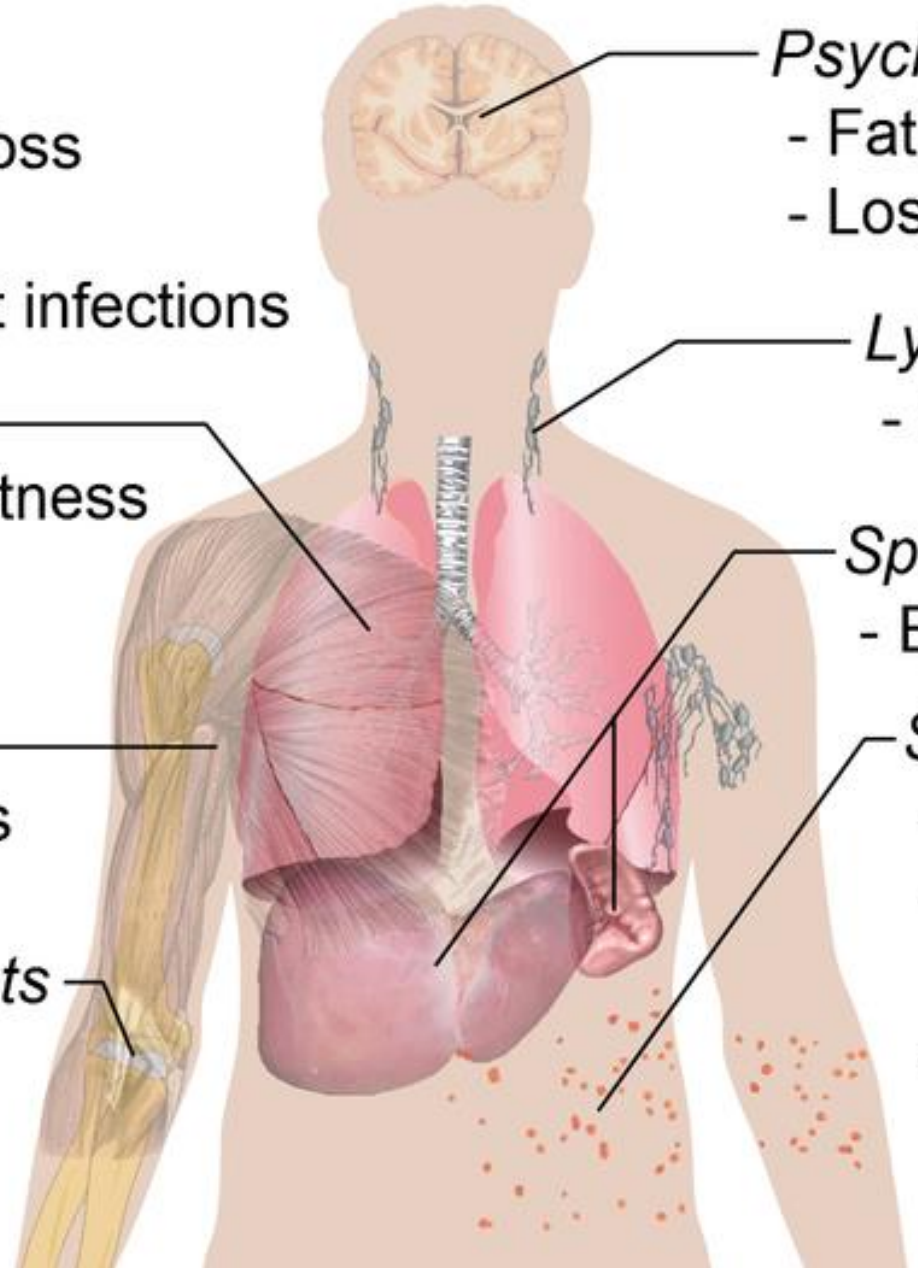
The four main blood types are A, B, AB, and O (distribution in general population)

- A: Antigen A (but not B) is present. (40%)
- B: Antigen B (but not A) is present. (10%)
- AB: Antigens A and B are present. (5%)
- O: Neither antigen A nor B is present. (45%)

Also, blood may be Rh-positive (Rh factor is present on the surface of the red blood cells, 85% of people) or Rh-negative (Rh factor is absent, 15% of people).

Common symptoms of

Leukemia



Systemic
- Weight loss
- Fever
- Frequent infections

Psychological
- Fatigue
- Loss of appetite

Lymph nodes
- Swelling

Lungs
- Easy shortness of breath

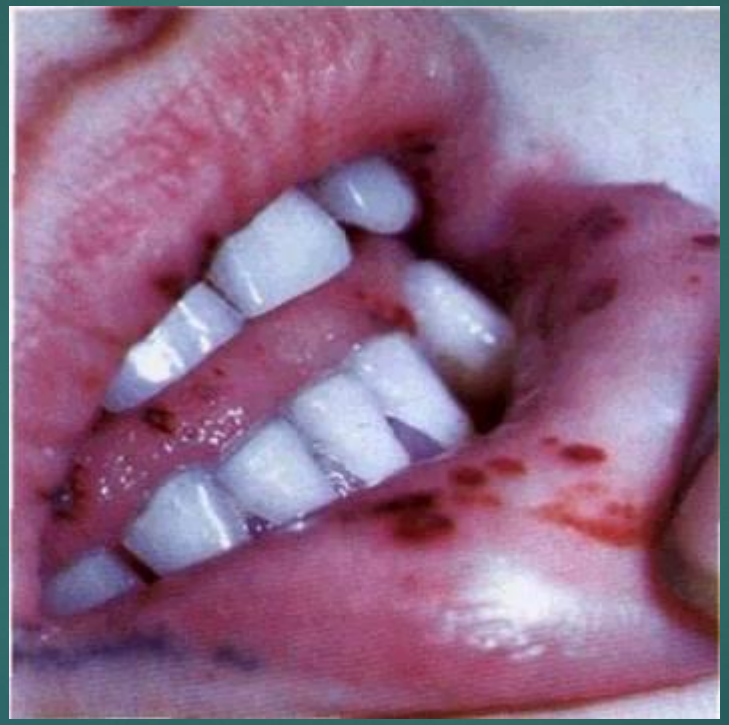
Spleen and/or liver
- Enlargement

Muscular
- Weakness

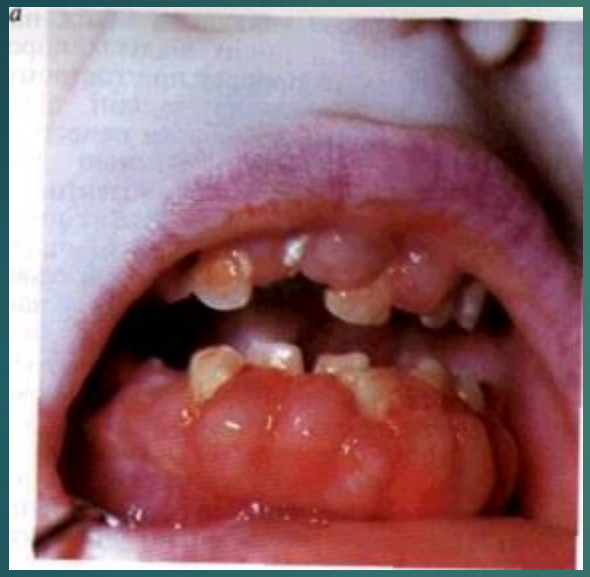
Skin
- Night sweats
- Easy bleeding and bruising
- Purplish patches or spots

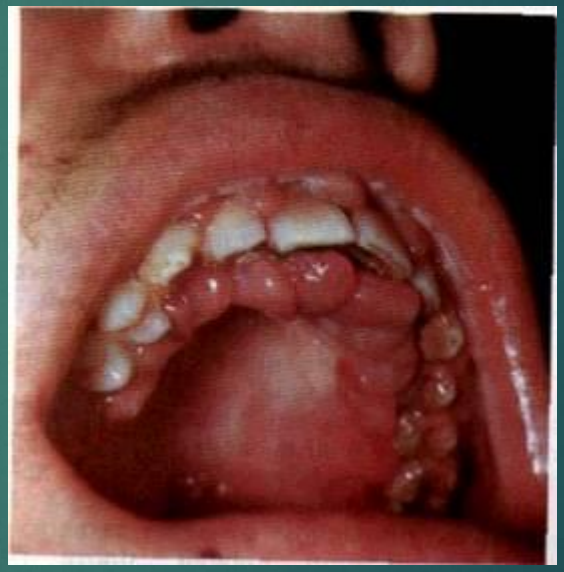
Bones or joints
- Pain or tenderness

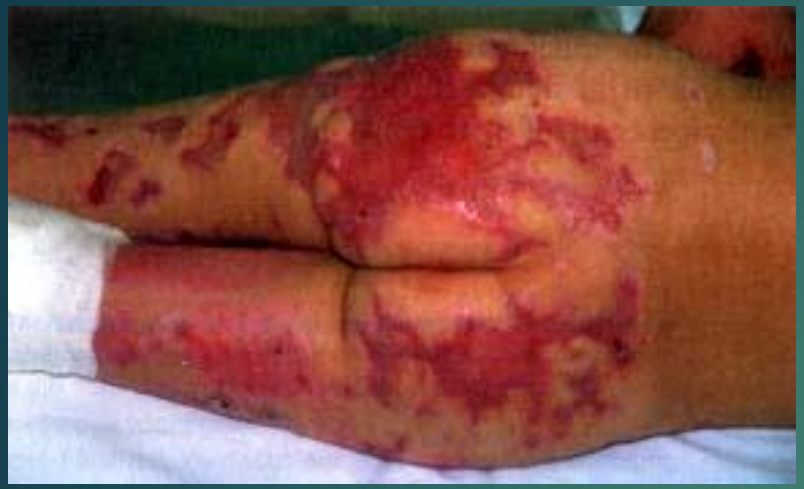
Acute leucosis, haemorragic syndrome

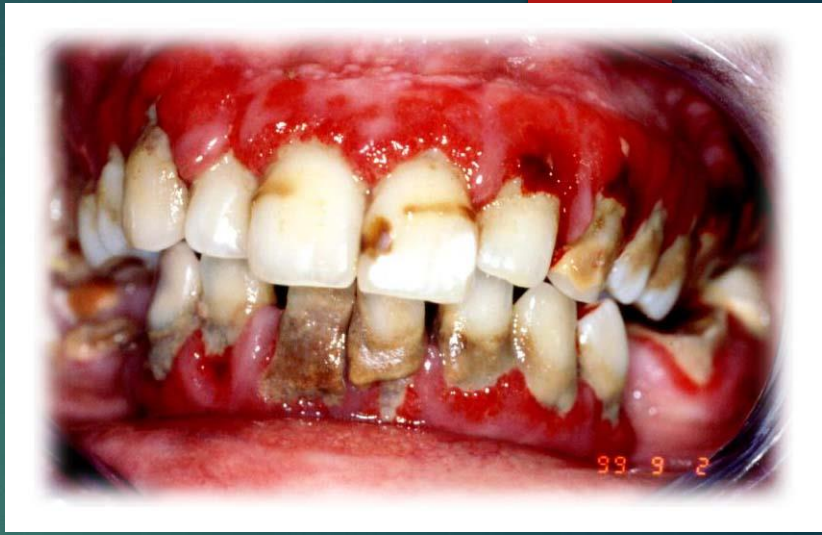


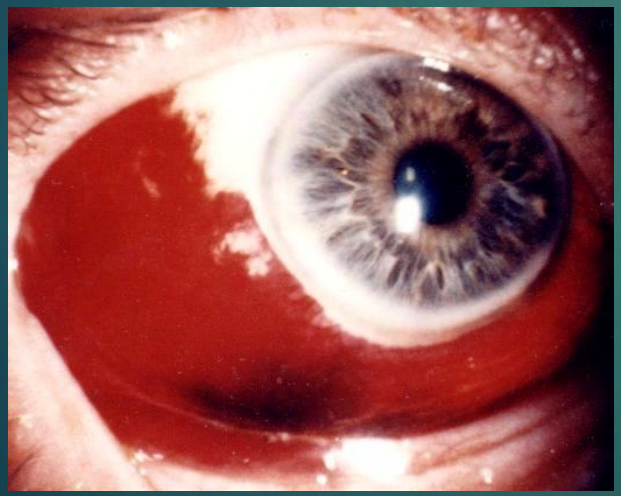
Acute leucosis, hyperplasia syndrome

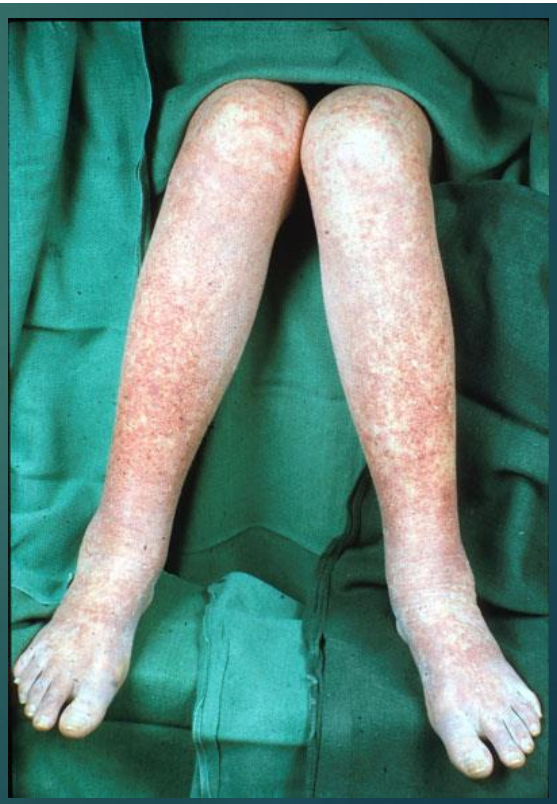


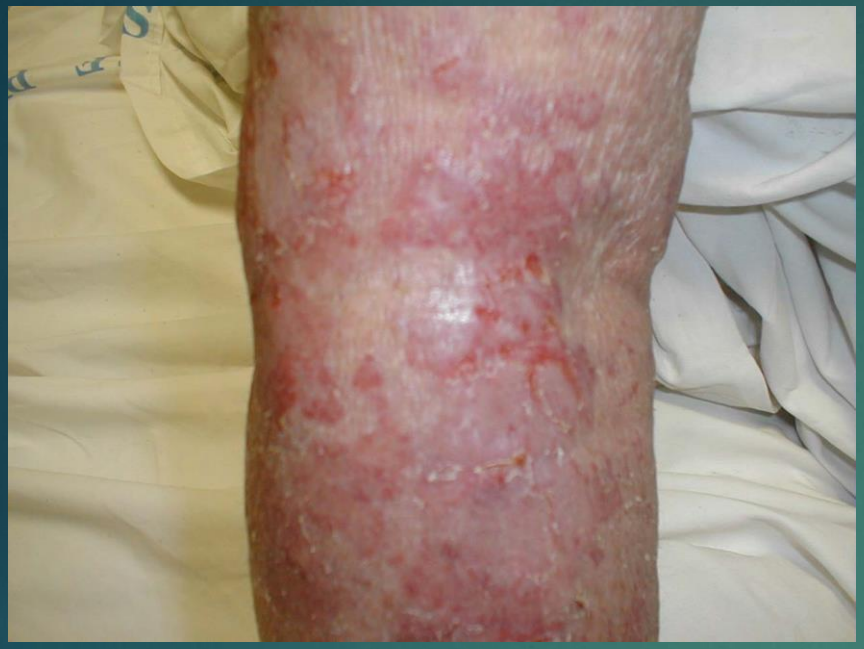


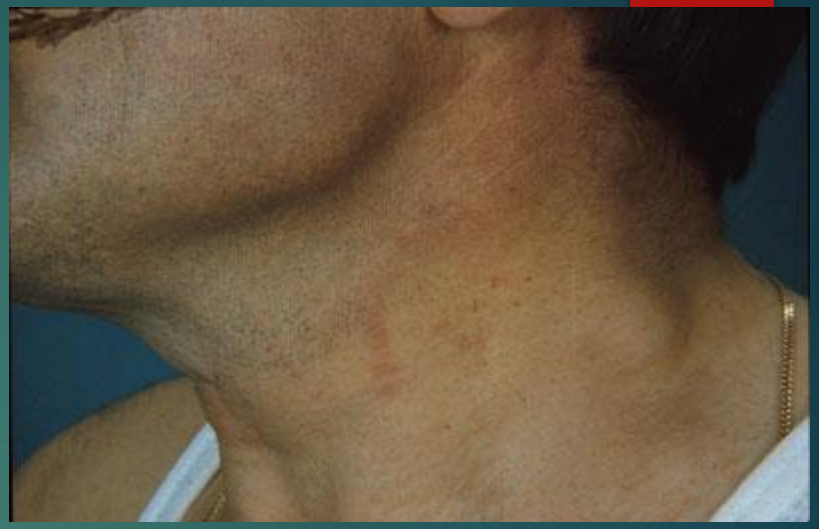


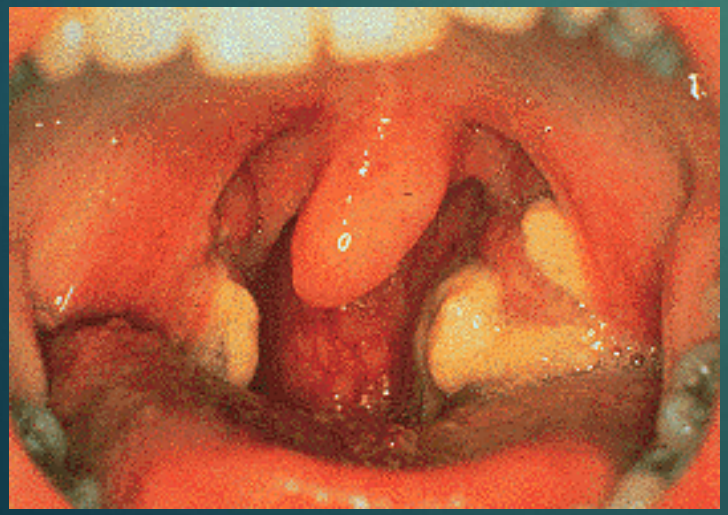


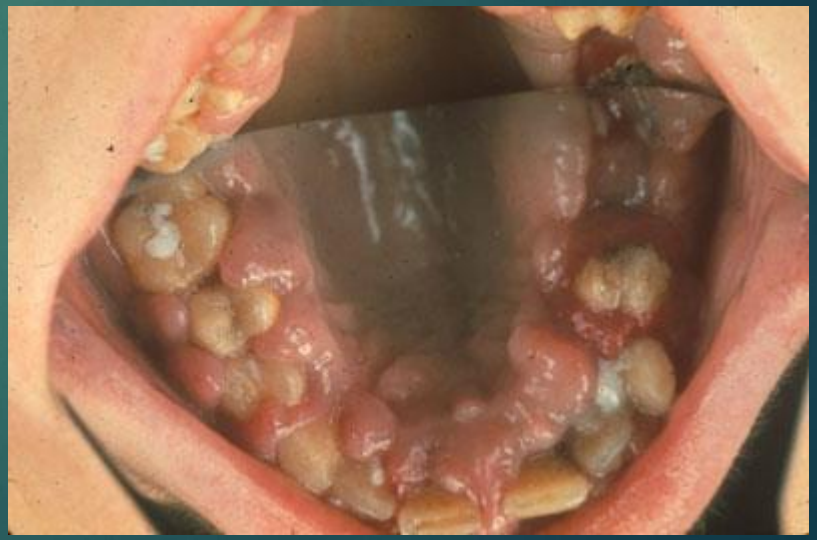




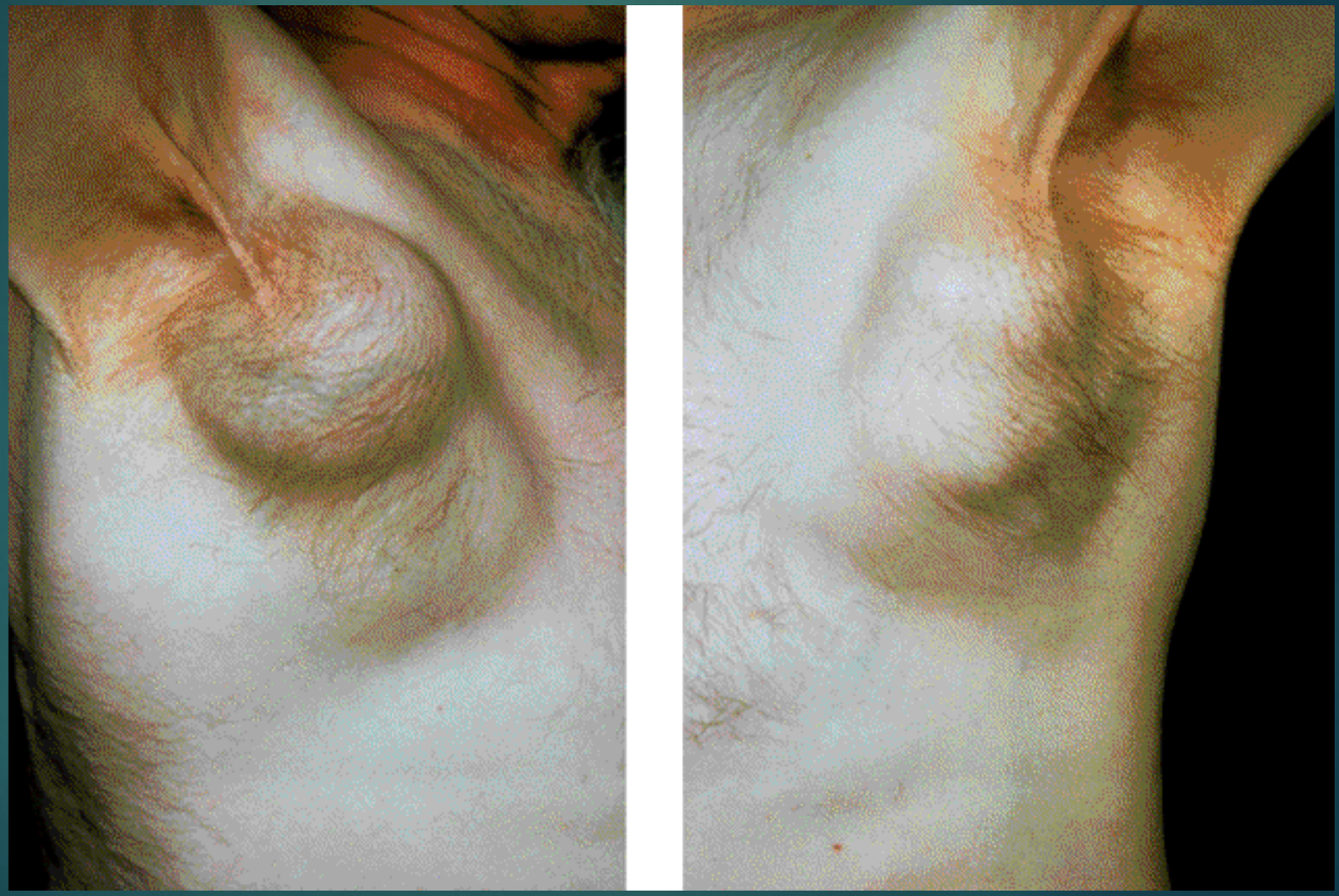


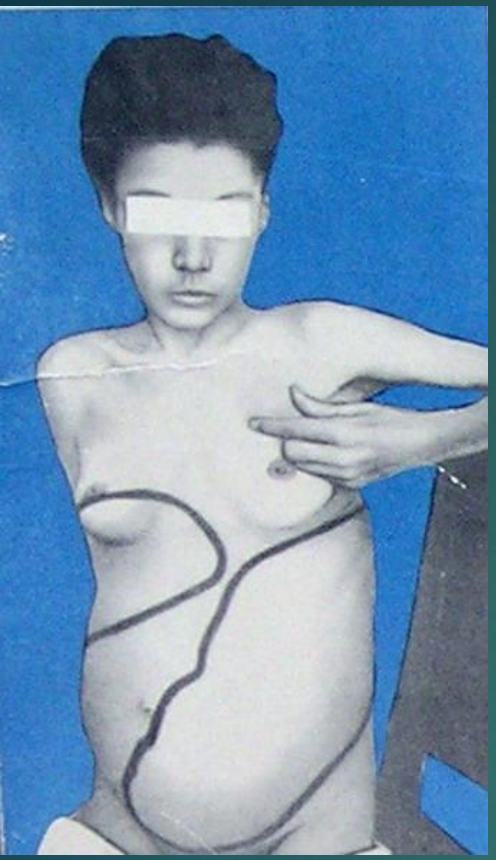


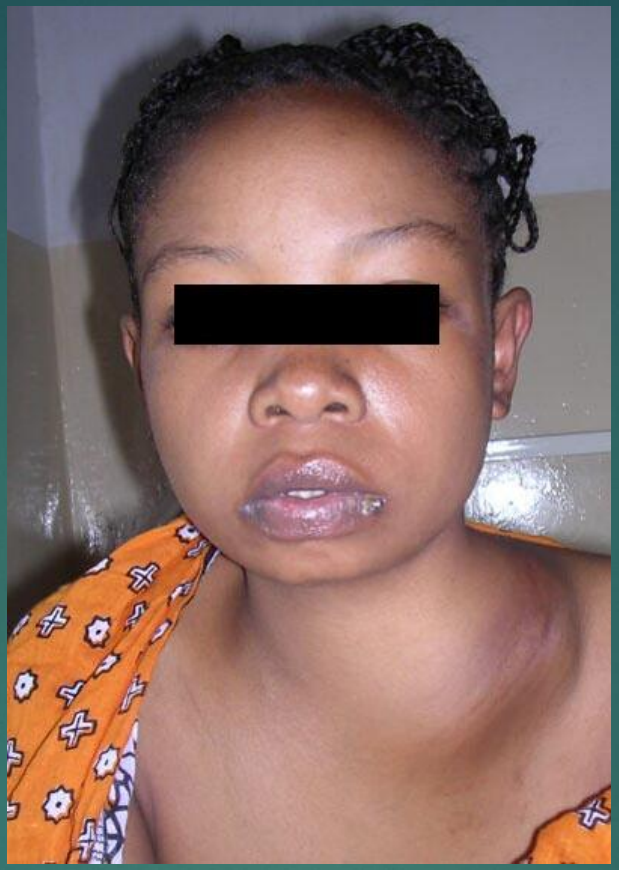


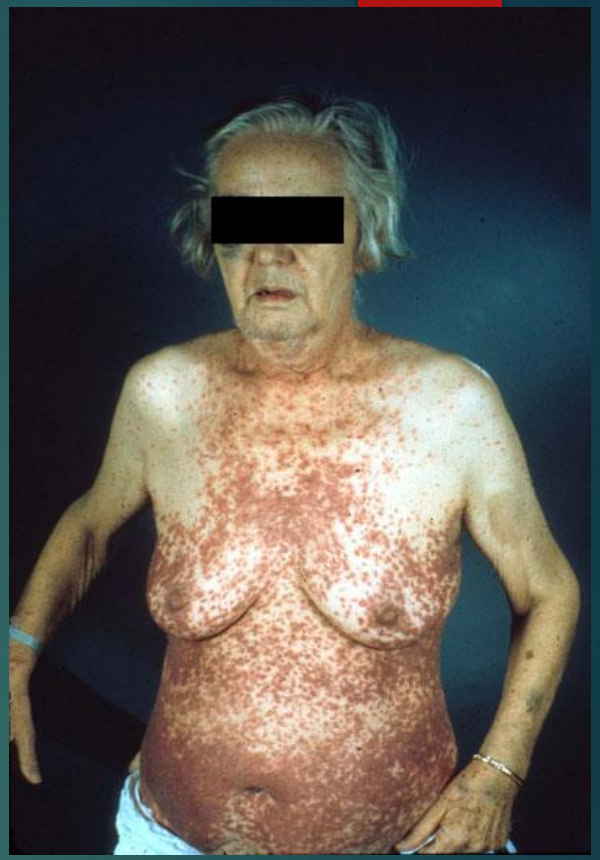


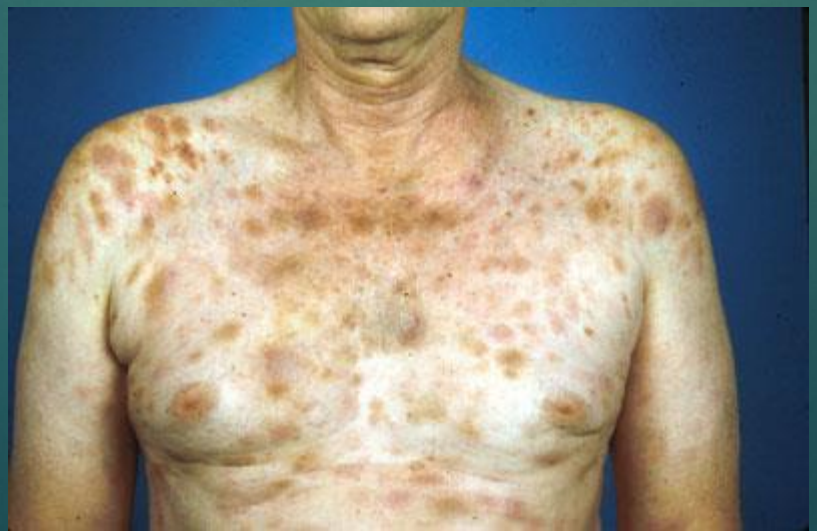
ChLL Physical Findings



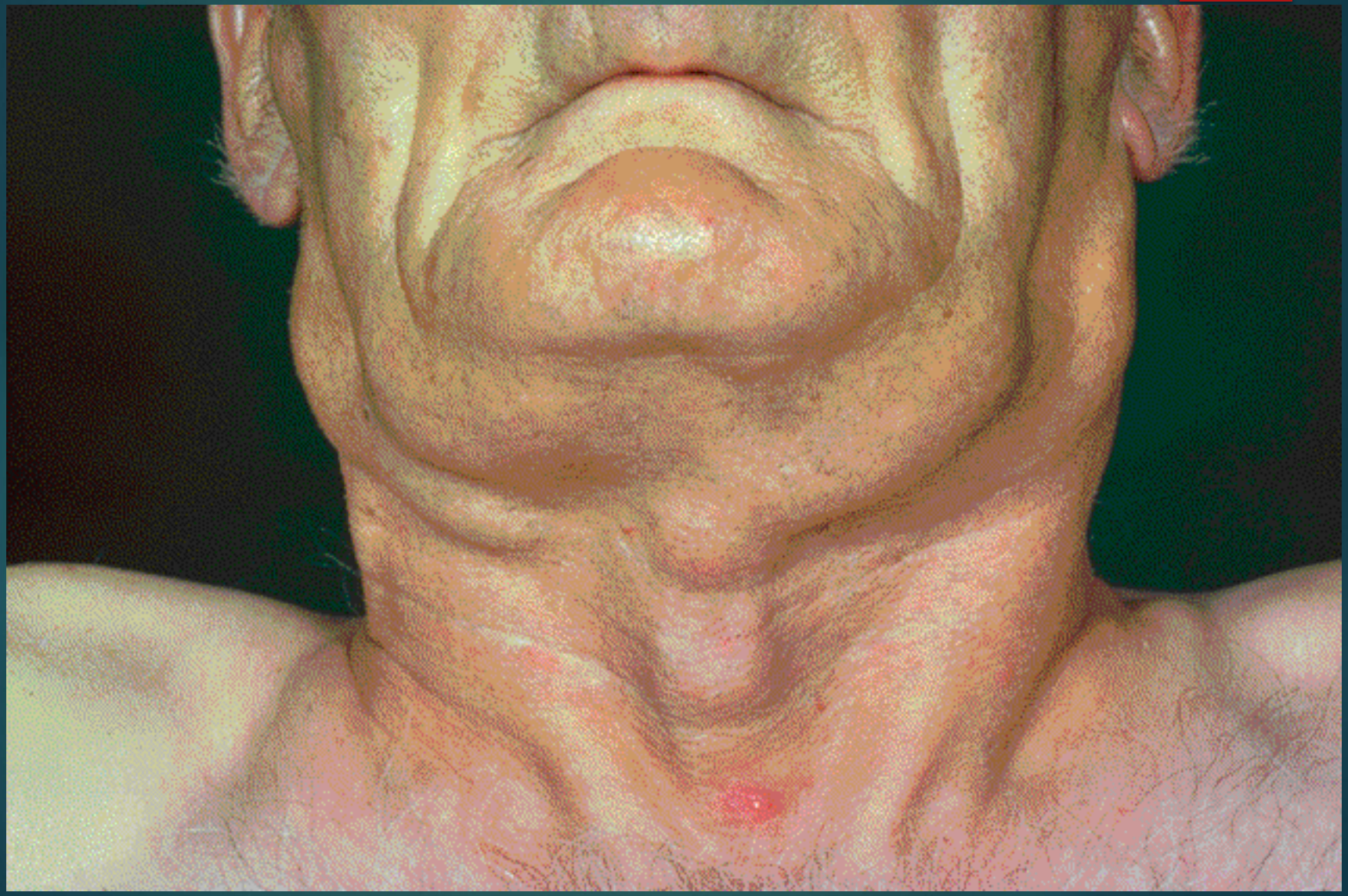




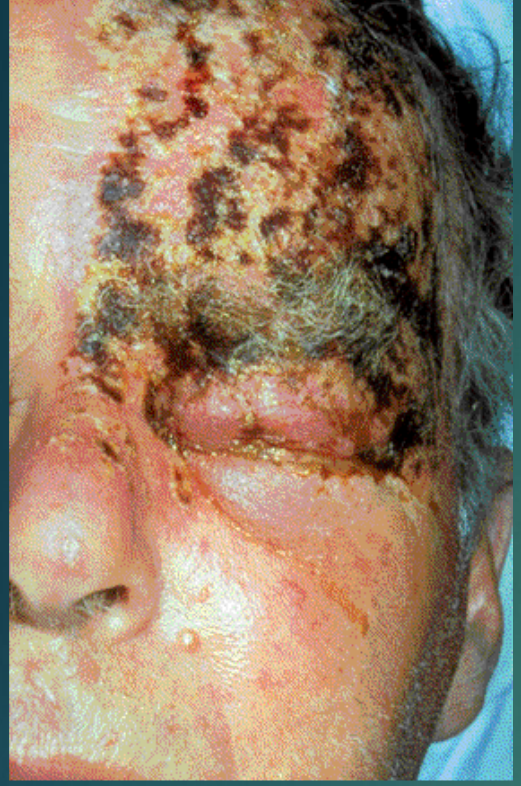


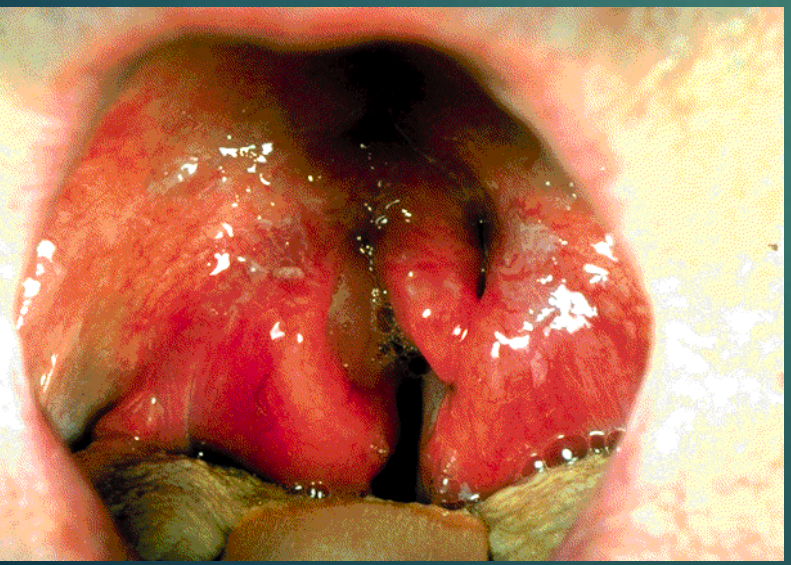


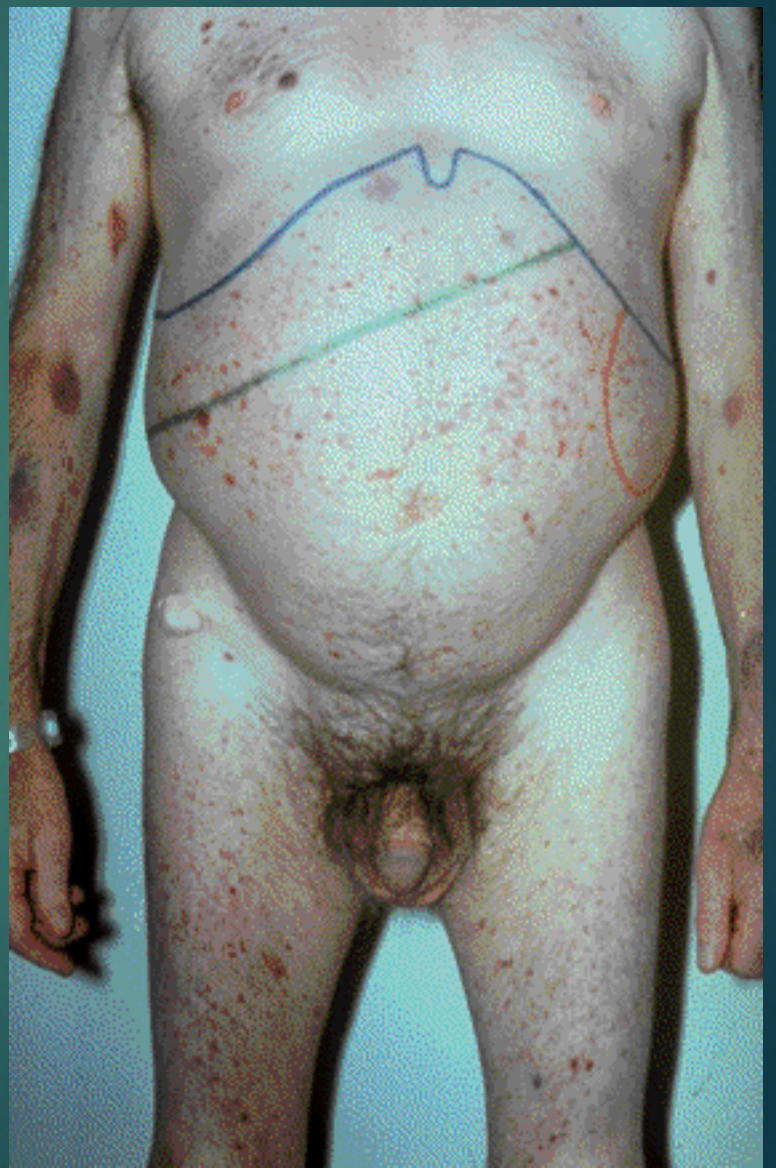
ChLL Physical Findings

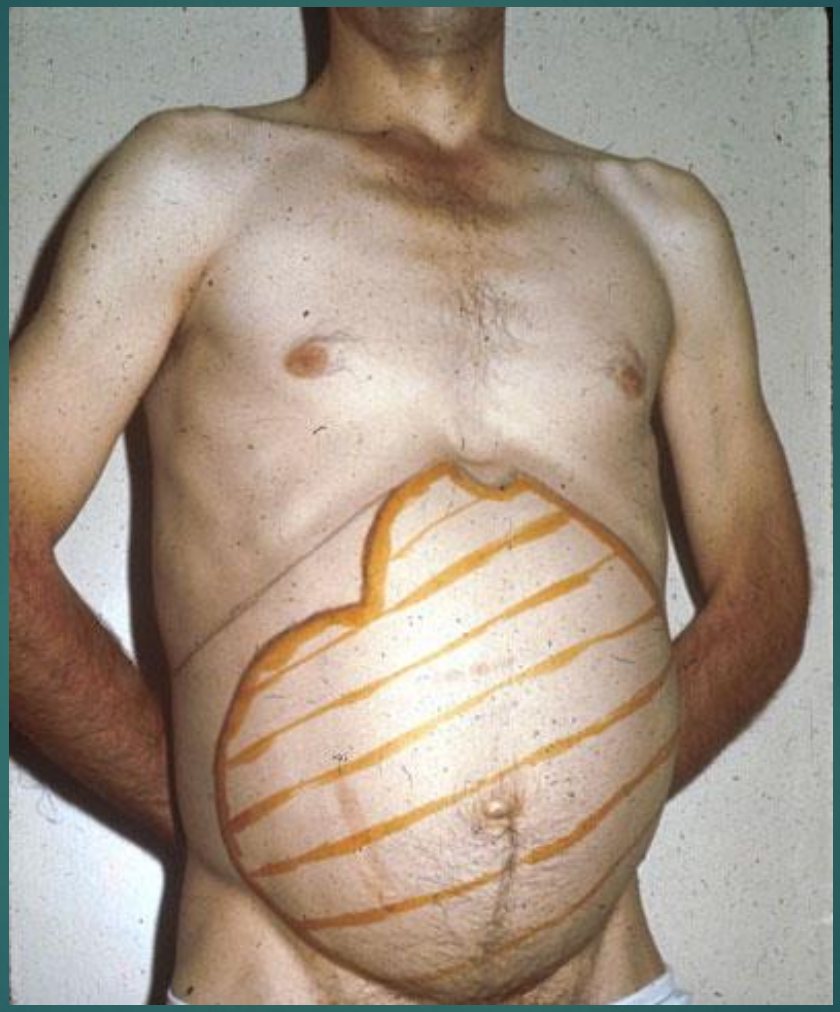


CLL – Physical Findings









DEFINITION

- **Hemoblastosis – neoplastic clonal diseases of hemopoetic system.**

- Them subdivide on two big groups — leucosis and hematosarcomas.
- **Leucosis (leukemias) - tumors of hemopoetic system with primary localization in a bone marrow**
- **Hematosarcomas — tumours of hemopoetic system with primary extramarrow localization**

- Leucosis divide on acute and chronic on the basis not the clinical characteristic, but morphological features of the tumoral cells making a substratum of leucosis.
- At acute leucosis a tumor substratum are so-called blast cells, at chronic — ripen and mature cells.

Leukemias are subtyped into:

- Lymphoid (affecting lymphoid progenitor cells);
- Non-lymphoid (affecting all non-lymphoid lineages (erythroid, granulocytic, monocytic, and megakaryocytic)).

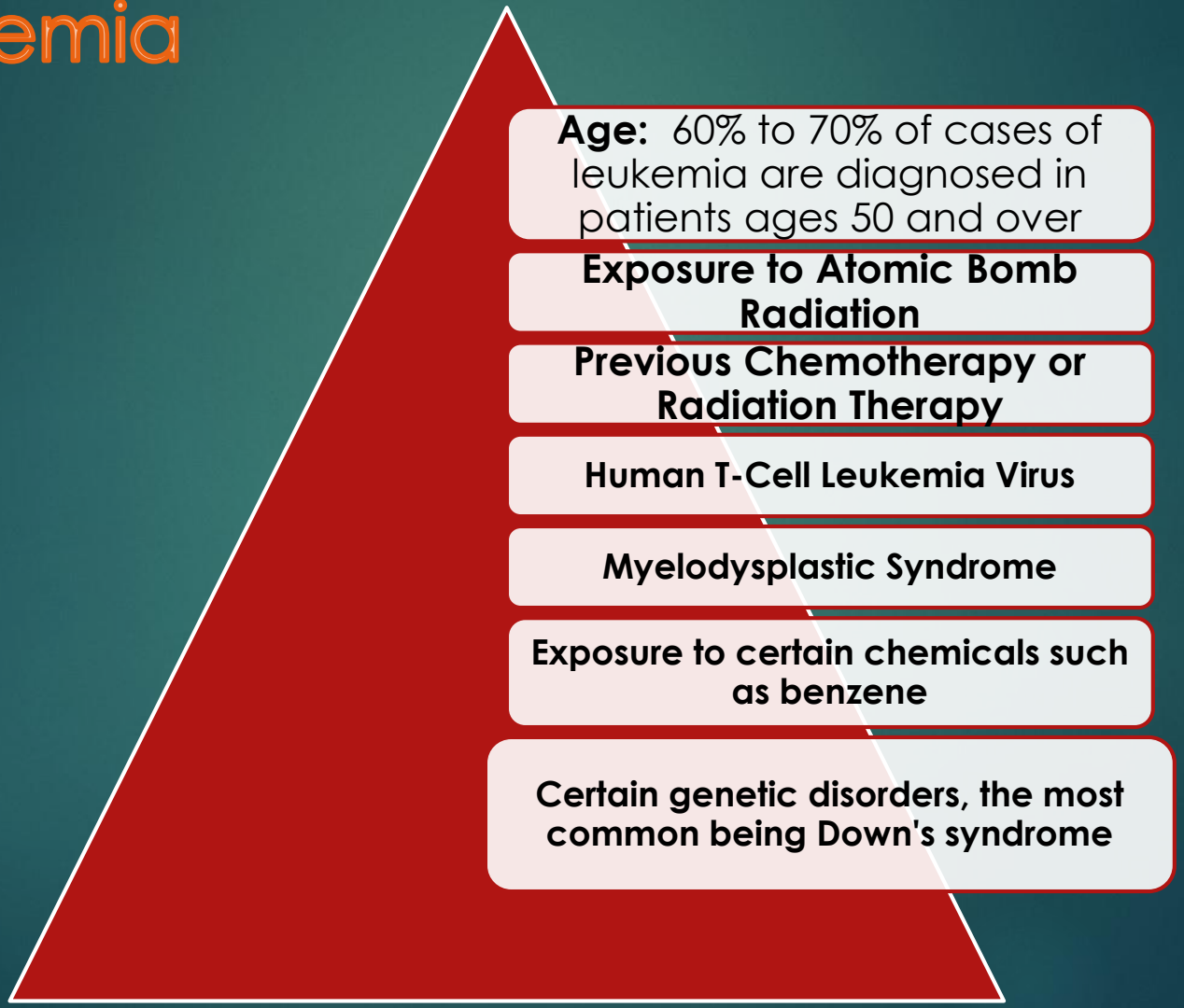
Mielo- and lymph proliferative syndrome (hemoblastosis)

Chief complains:

- High fever
- Profuse sweating
- Chills
- Pronounce weakness
- Pain in bones, hypochondrias
- Pain in throat (necrotic tonsillitis)
- Skin itching
- Enlargement of lymph nodes


In the course of the disease, there are three stages:
1) Starting - diagnosed retrospectively.
2) Stage of the developed clinical picture.
3) End-stage.

Causes and Risk Factors for Leukemia



Age: 60% to 70% of cases of leukemia are diagnosed in patients ages 50 and over

Exposure to Atomic Bomb Radiation

Previous Chemotherapy or Radiation Therapy

Human T-Cell Leukemia Virus

Myelodysplastic Syndrome

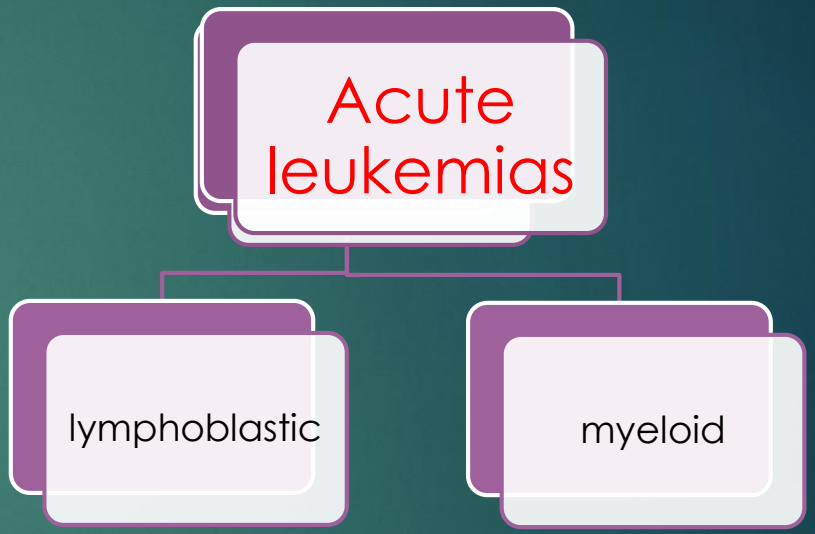
Exposure to certain chemicals such as benzene

Certain genetic disorders, the most common being Down's syndrome

In peripheral blood in acute haemoblastosis blast cells are also found.

For acute leukemia characterized by the absence of transitional forms between unripened blasts and mature elements (so called leukemic blast crisis or failure).

Acute leukemias are malignant course.



Blood test of a patient with acute leukemia

- Erythrocytes – 1,4 T/l
- Haemoglobin 35 g/l
- Colour index – 0,8
- Thrombocytes – 100 G/l
- Reticulocytes – 1 ‰
- Leucocytes – 300 G/l
- Basophils – 0 %
- Eosinophils – 0 %
- Blasts – 70 %
- Band neutrophils – 0 %
- Segmented neutrophils 15 %
- Lymphocytes – 10 %
- Monocytes – 5 %
- Erythrocyte sedimentation rate (ESR) – 51 mm/h

Normal blood count

- Erythrocytes – 4,5 T/l
- Haemoglobin 146 g/l
- Colour index – 0,9
- Leucocytes – 7,9 G/l
- Eosinophils – 3 %
- Band neutrophils – 3 %
- Segmented neutrophils 67%
- Lymphocytes – 20 %
- Monocytes – 7 %
- Erythrocyte sedimentation rate (ESR) – 9 mm/h

Puncture of a bone marrow

- **The increase in sternal puncture of blasts cells more than 30 % completely confirms diagnosis of AL**

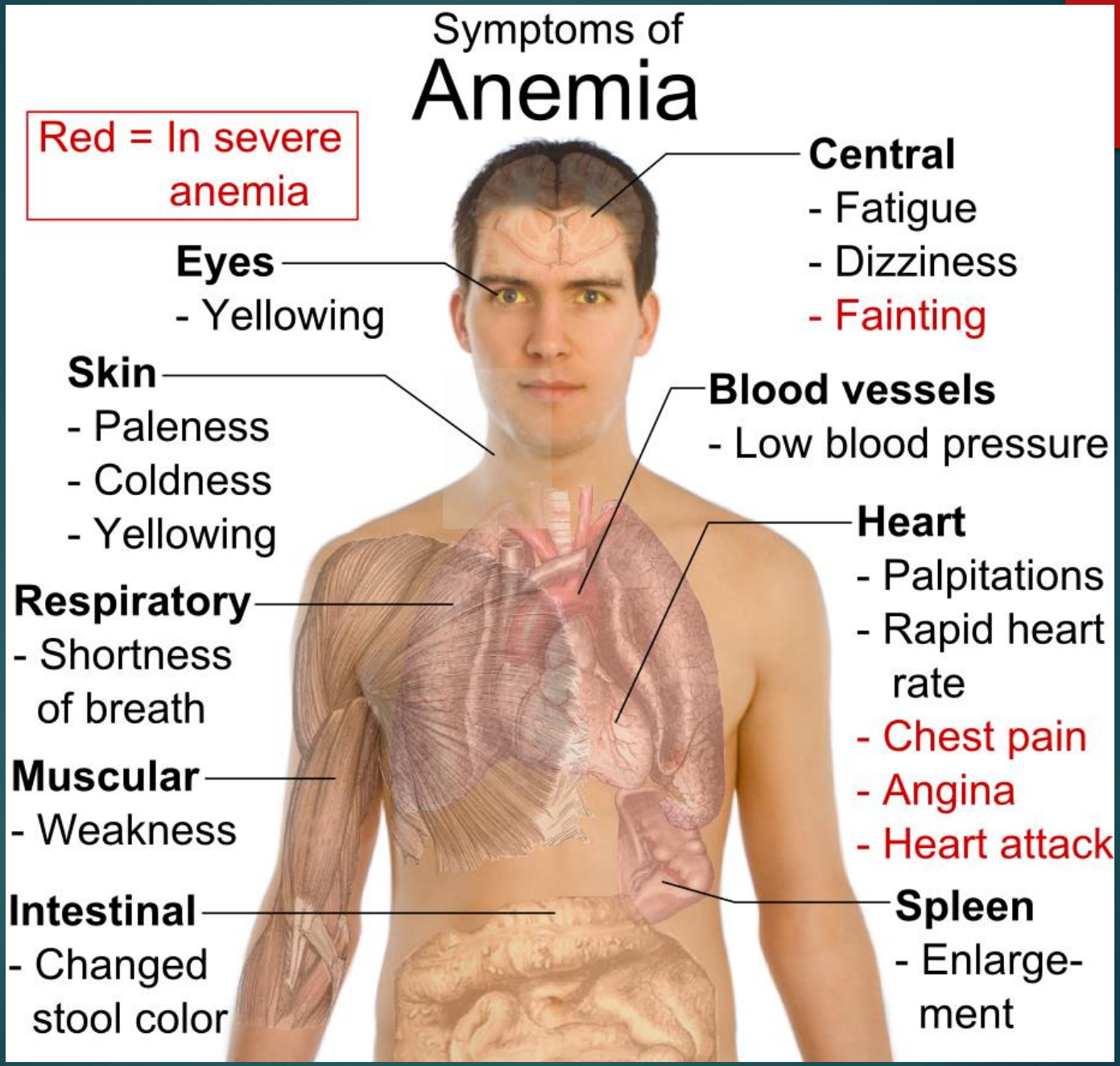
Chronic leukemias are characterized by the growth of differentiated (mature) cells, a relatively benign course.

They are divided into myeloid and lymphoblastic.

During chronic leukemia using **two stages**:

1) benign or monoclonal - it lasts years and is easy to drug correction;

2) or a malignant polyclonal - chronic leukemia transformed into sharp blasts appear. Transition to another stage occurs suddenly and is called blast crisis.


Symptoms of
Anemia
Red = In severe anemia
Central
- Fatigue
- Dizziness
- Fainting
Eyes
- Yellowing
Skin
- Paleness
- Coldness
- Yellowing
Blood vessels
- Low blood pressure
Heart
- Palpitations
- Rapid heart rate
- Chest pain
- Angina
- Heart attack
Respiratory
- Shortness of breath
Muscular
- Weakness
Intestinal
- Changed stool color
Spleen
- Enlarge-ment

Syndrome of anemia

Chief complains:

- Weakness
- Fatigue
- Vertigo
- Exertion dyspnoe
- Palpitation
- Loss of work capacity
- Poor appetite
- Fever (sub febrile)
- Perverted taste – eats chalk, earth, coal etc.
- Olfaction changes – like strong smells (petrol etc.)

General appearance of p-t of Fe^{++} deficiency anemia

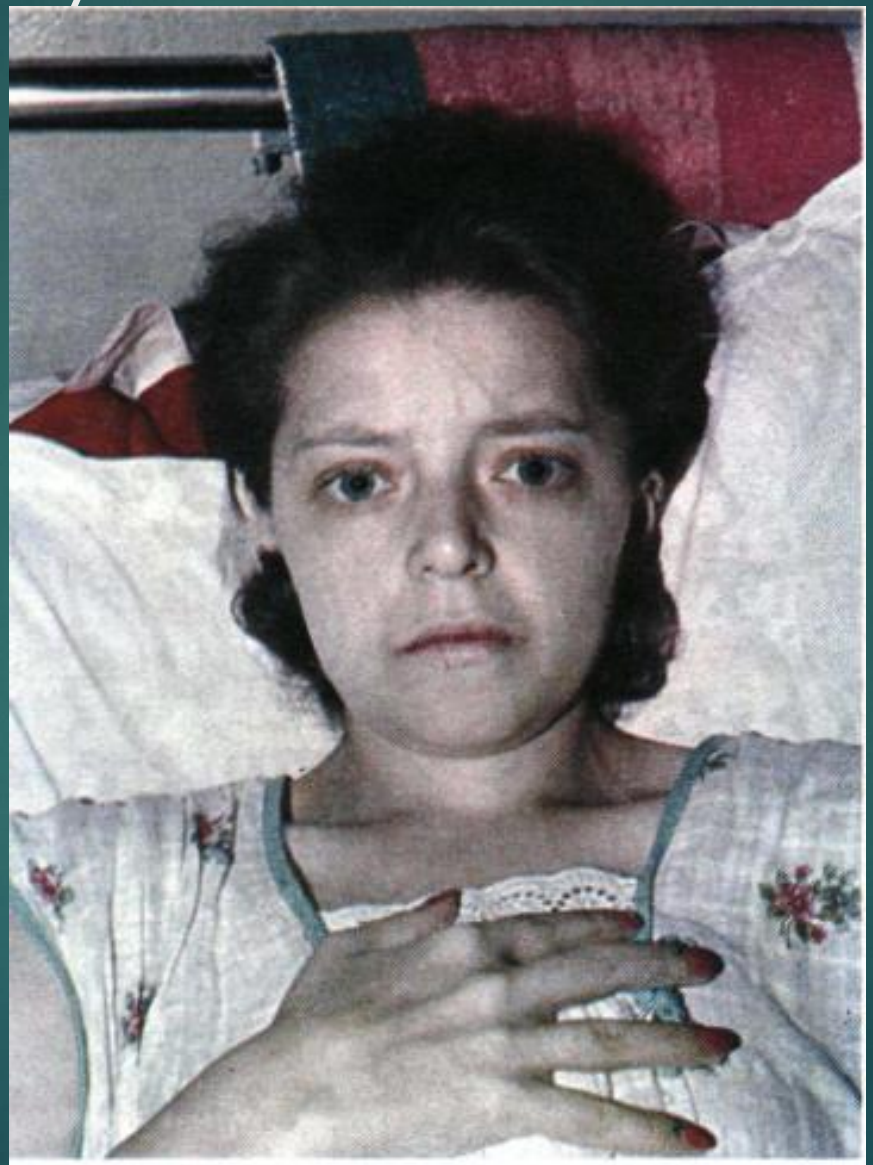
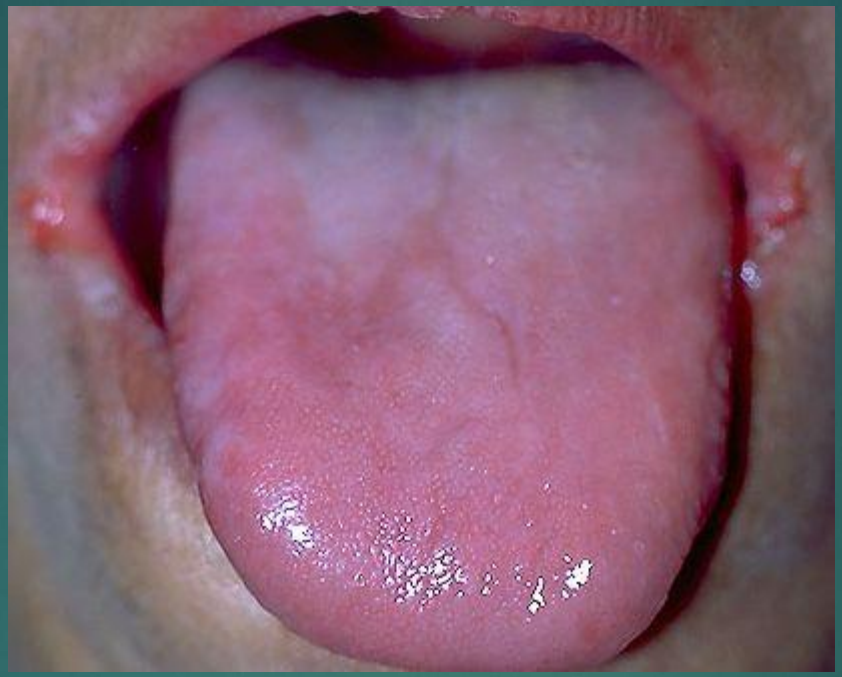
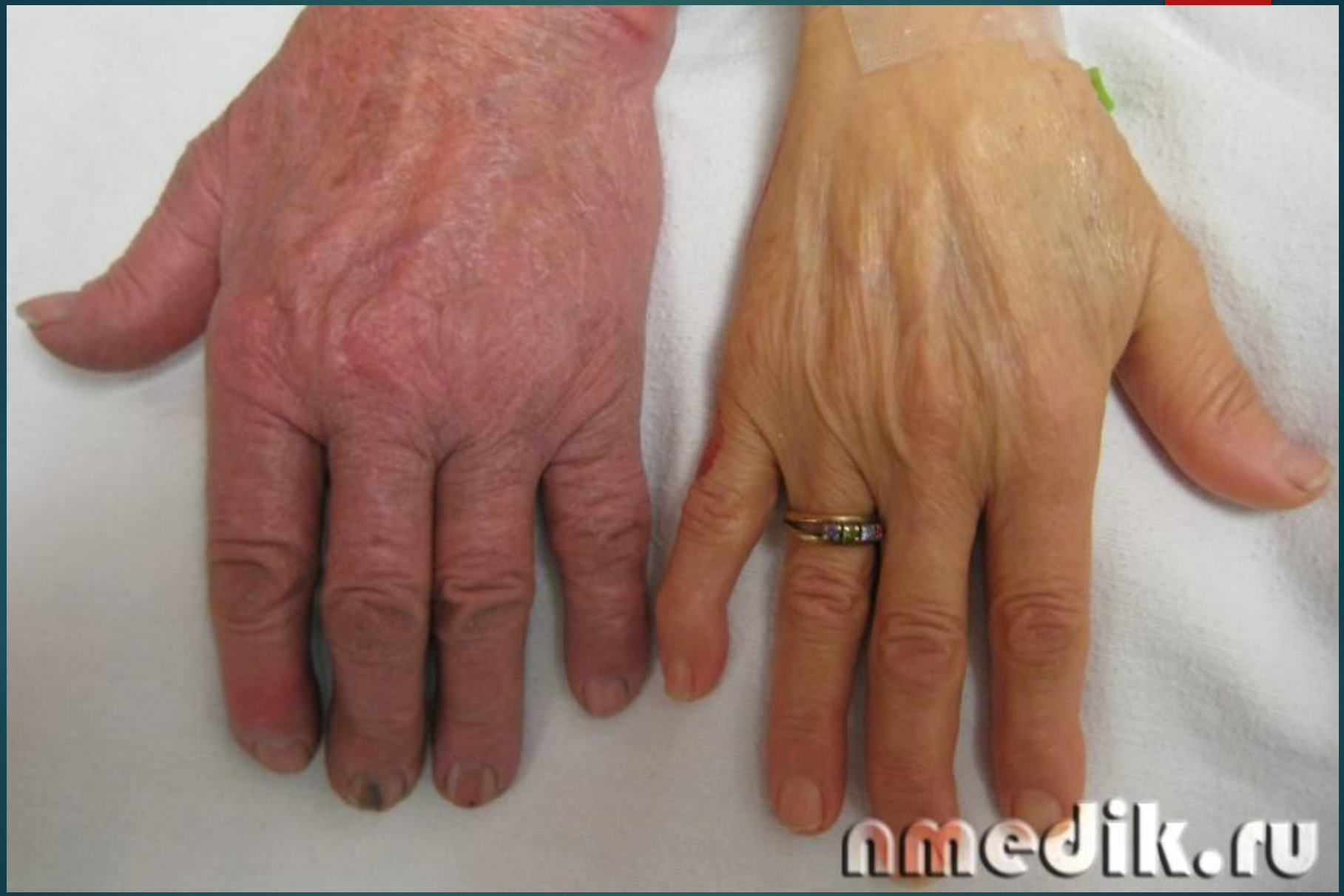


Рис. 6.7. Внешний вид больной с железодефицитной анемией.

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- **Myeloproliferative diseases**, in which is the pronounced ability of abnormal bone marrow hemopoetic cells to differentiate is still preserved (include chronic myeloleukemia etc.).
- **Myelodysplastic syndromes**, belonging to the group of clonal disorders of stem cells and declare themselves by defects of maturation, which in turn result in the ineffective hemopoiesis and increase risk of the development of acute myeloblastic leukemia.

Clinical picture

- proliferative syndrome
  - hepatosplenomegaly
  - hemorrhagic diathesis
- anemic syndrome
- leukemic infiltration in a skin (leukemides)
  - Bones-articulate syndrome (ossoalgias, arthralgias)
  - intoxication syndrome
  - expressed weakness
  - decrease in weight of a body
  - purulent-inflammatory changes

- **Hemorrhagic diathesis (HD) –** group of the diseases characterized of higher bleeding without expressed damage of a vascular wall or insignificant it traumatization.

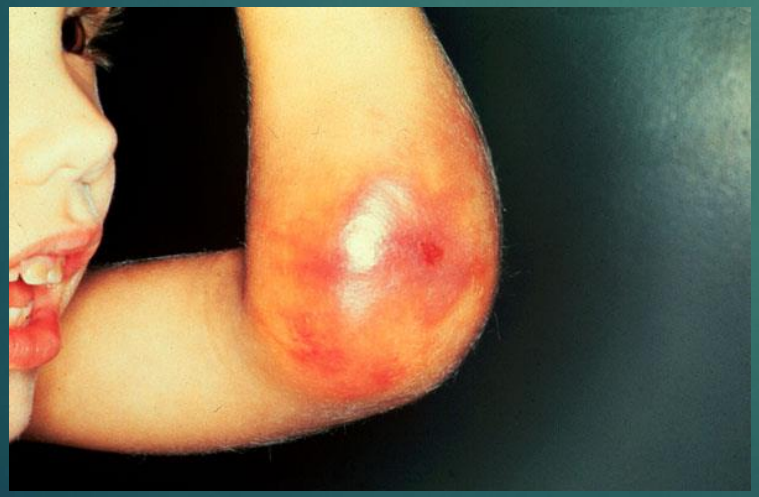
Classification

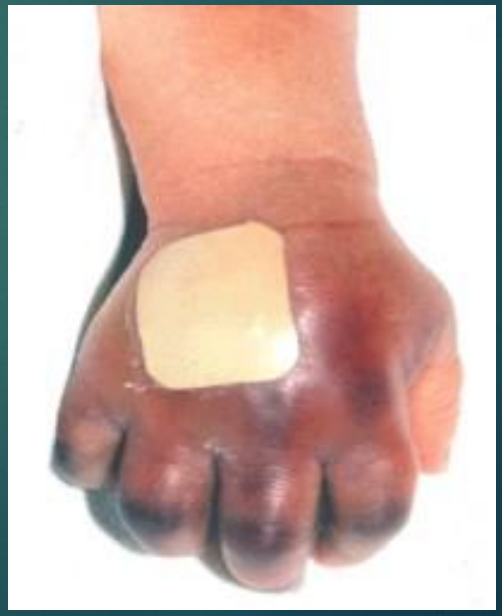
- **Thrombocytopenia**
- **Thrombocytopathy (Willebrand's disease)**
- **Coagulopathy (hemophilia)**
- **Angiopathy (vasopathy)**
- **Superfluous fibrinolisis (at treatment with thrombolytics, defect of plasmin inhibitor or surplus of the plasminogen activator)**
- **Syndrome of DIC**

Classification of hemorrhages types (1975, Barkagan)

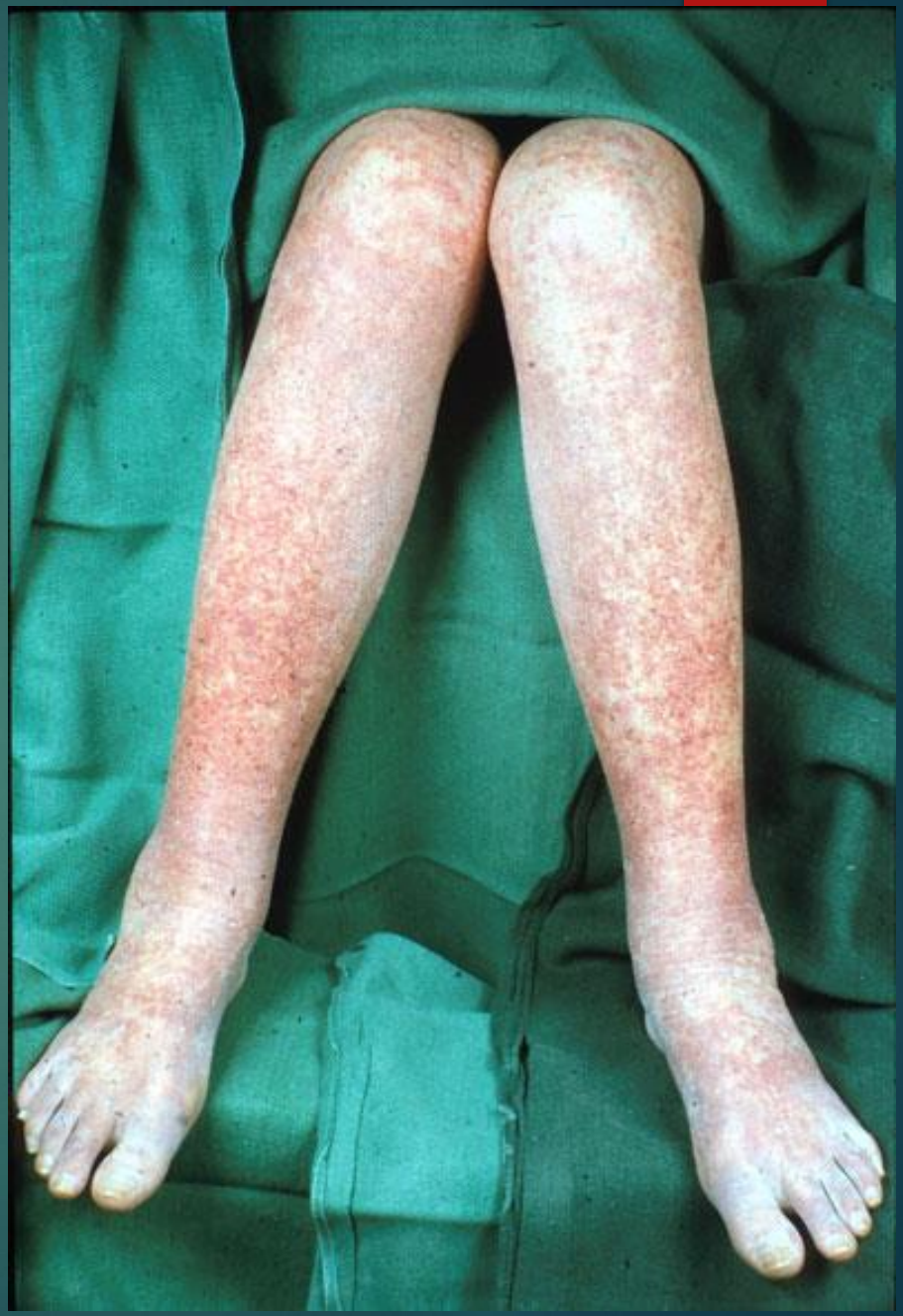
- Microcirculatory (petechial –spotty)
- Hematomas
- Mix (microcirculatory – hematomas)
- Vasculit –purpural
- Angiomatous

- Hematoma type: massive hypodermic hemorrhages, under aponeurosis, hemarthrosis. It is long, difficult for stop bleeding during operation, can be if small traumas.

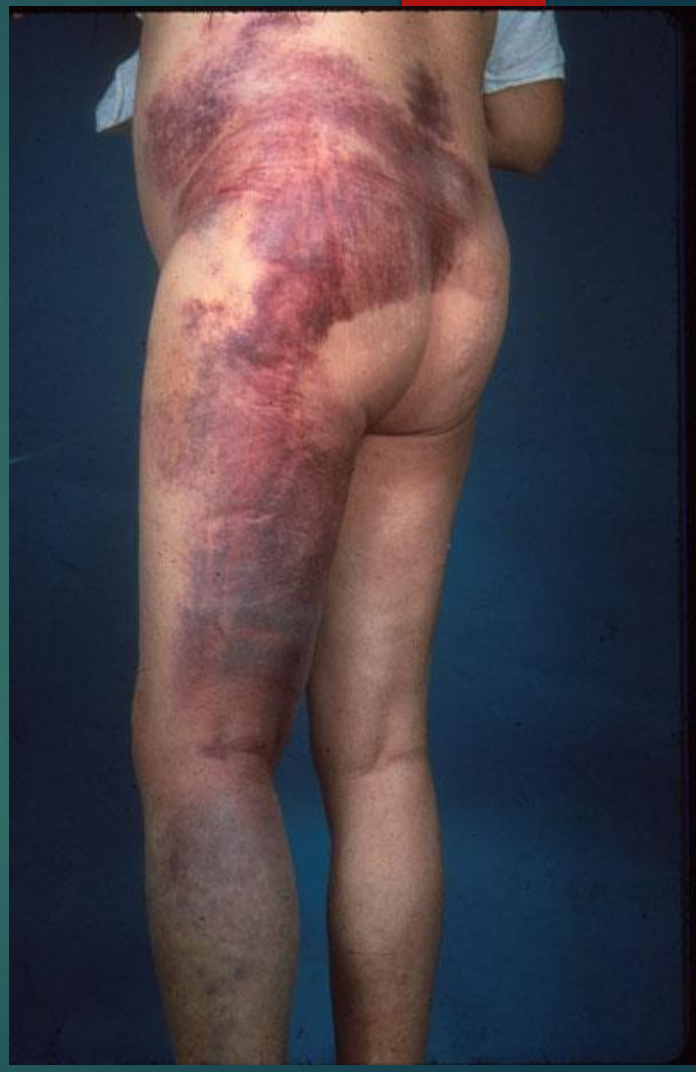




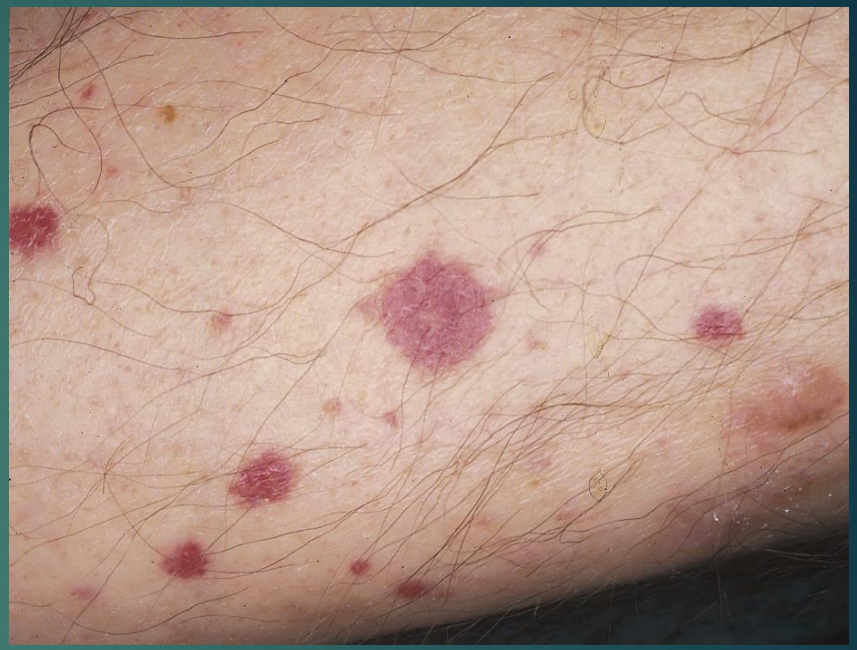
- Petechial-spotty (microcirculatory) symmetric character, on extremities and in places of bigger traumatization



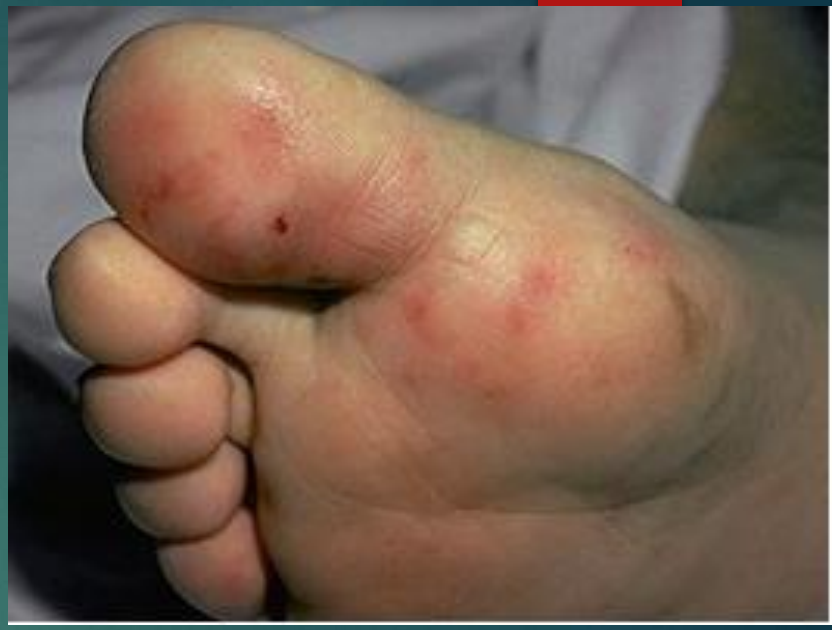
The mixed type (bruise-hematomas) - Degree of hemorrhages is more petechial, but hematomas not such big (is not present hemarthrosis). Are damaged thrombocytes and plasma factors.

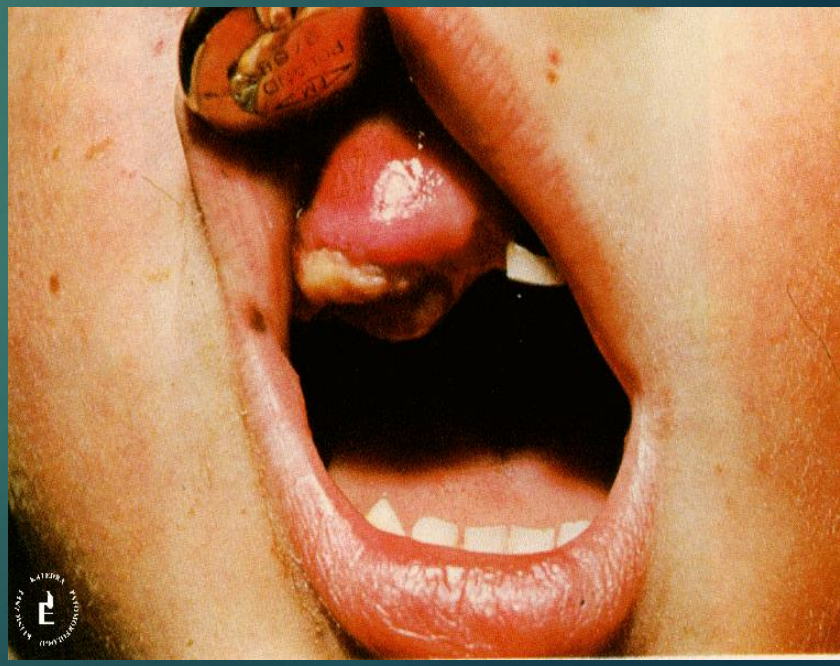


- Vasculit - purpural (vascular) small dot hemorrhages, protrude over a surface of a skin (in a basis lies vasculitis). An example - illness of Shonlein-Henoch



- <u>The angiomatous type -</u> at a pathology of a wall of a vessel – there is defect of subendothelial structures or collagen structures of a wall of a vessel. Nasal bleedings, bleedings in abdominal cavity. Thus almost there are not enough changes in plasmocytar and thrombocytar link (in humoral link a few pathology – illness of Rendu - Osler).





Estimation of system of a hemostasis
1. Vascular-thrombocytar

- Thrombocytes 180 - 320X10^9/l
- Bleeding time (method of Duke) 2 - 5 min
- Retention (adhesion) of thrombocytes 20 - 55 %
- Aggregation of thrombocytes 10 - 60 sec

Permeability of capillars

Konchalovsky test (plait symptom)

Occurrence 0 - 10 petechia on a site of a forearm in width of 5 cm at compression of a shoulder with cuff at pressure 50 mm Hg within 15 minutes.

Test of Rumpel-Leede

Absence of petechia after 5-minute imposing of a cuff on shoulder at pressure is no more 10-20 mm Hg

Rumpel-Konchalovsky Test

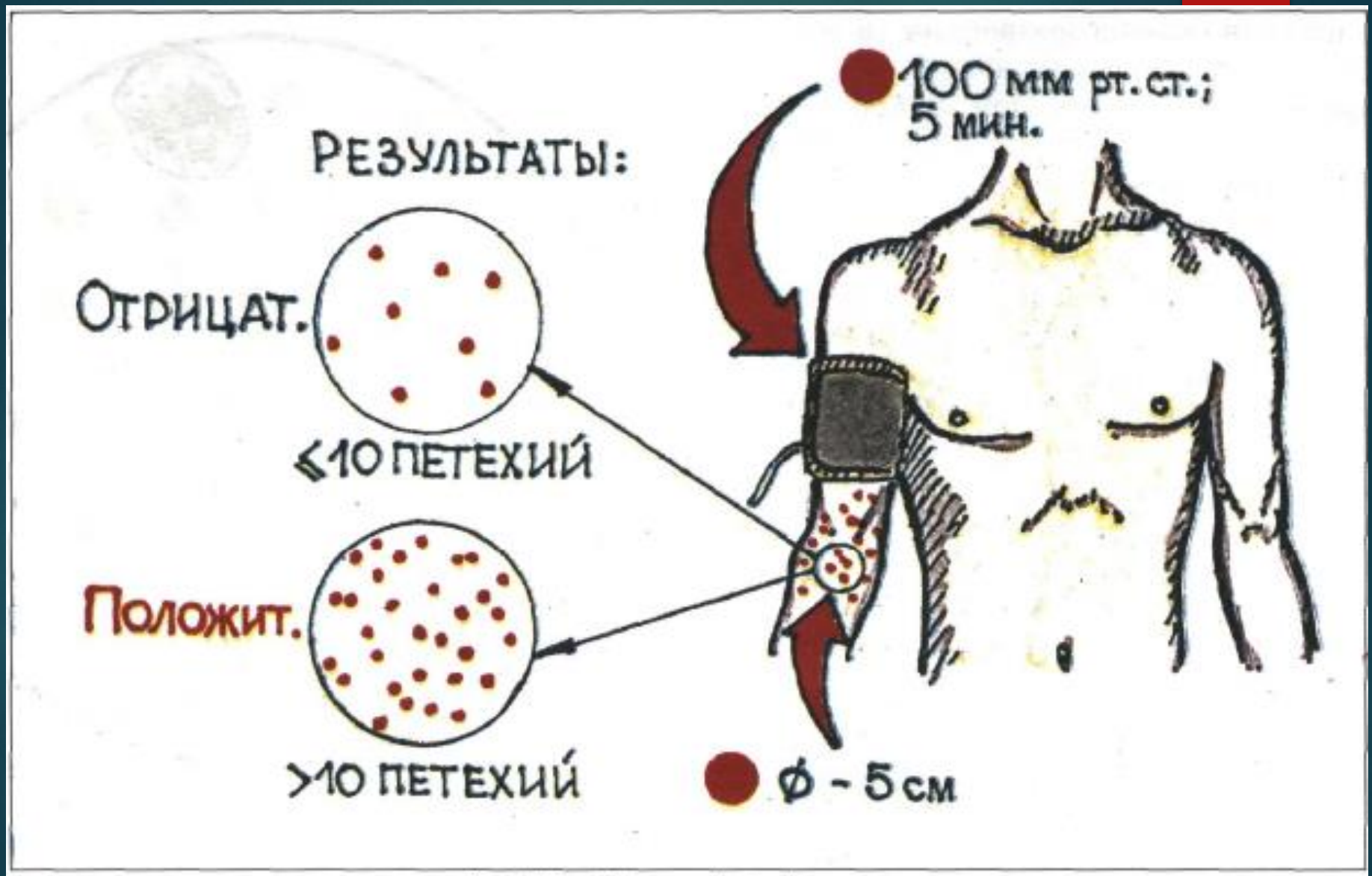
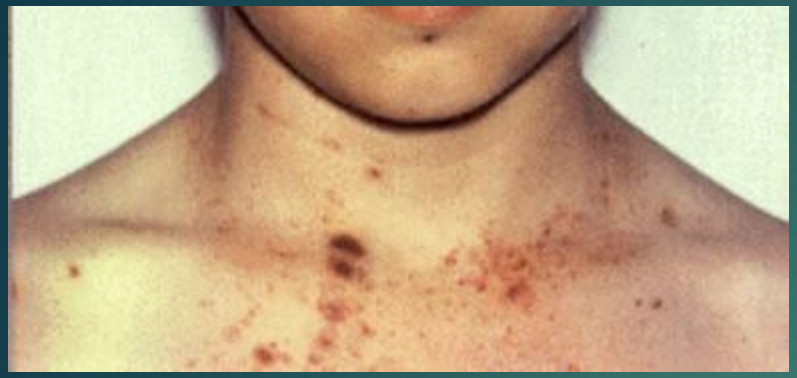
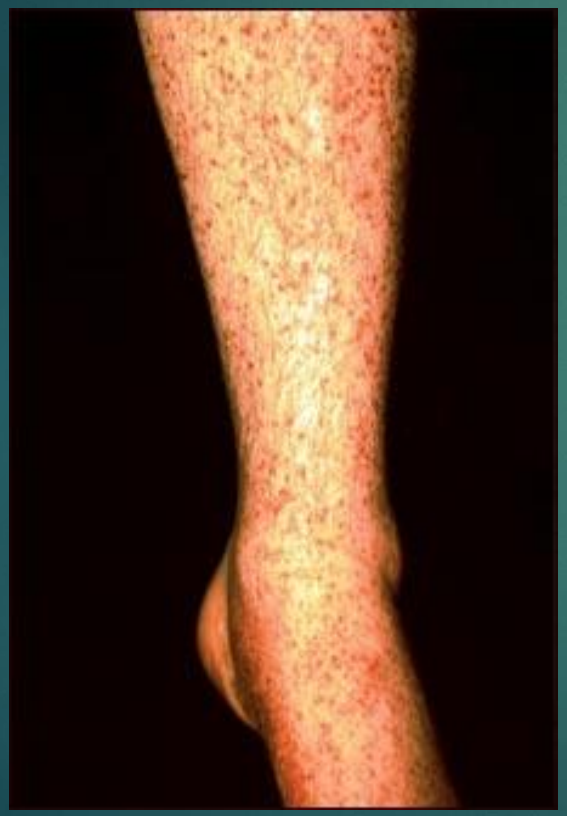


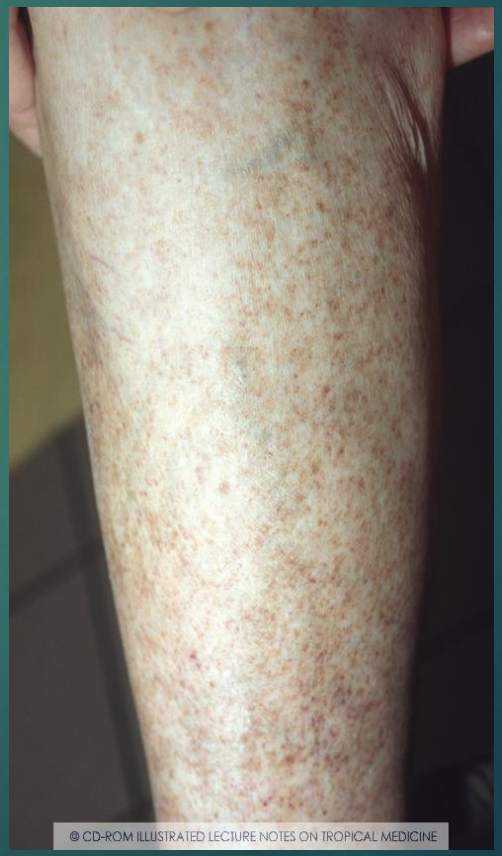
Рис. 6.13. Проба Румпель — Лееде — Кончаловского.

2. Coagulative (plasmatic)

- (Lee-White) time of coagulation 6 - 8 min
- Fibrinogen 2 - 4 g/l
- Thrombin time 30 sec
- Activated time of blood recalcification 50 - 70 sec
- Activated partial thromboplastin time 30 - 40 sec



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Coagulopathy

Happen hereditary and acquired

- The hereditary:
  Hemophilia A (83 - 90 %)
  Hemophilia B
  Hemophilia C
  Lack of the factor of Hageman
  Illness of Willebrand

- The acquired:
  Infectious diseases
  Mechanical jaundices
  Diseases of liver
  Illnesses of kidneys
  Mieloproliferative diseases
  DIC-syndrome
  Medicamentous