Hematology

Problem Based Learning

☑ Sheet ☐ Slide ☐ Handout

Number: 1.

Subject: Introductory to Clinical Hematology

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Price:

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- This sheet was written according to section 2 recording.

- Most of the mentioned facts are not required to be memorized just to be understood.

In this system we have 15 clinical scenarios that we should be able to solve by the end, but for now we will talk about them briefly with some related notions.

We should make use of our basic science knowledge in physiology, pathology, microbiology etc., to be able to detect and diagnose the underlying disease or disorder.

We will not solve the scenarios now but we will do so in about 4 week after we finish this system to test our knowledge about it.

The doctor said that the things mentioned today will be like Chinese letters “we will not understand most of it” but day by day we will recognize these subjects as we go through the lectures

- **The Hematological diseases are classified in to:**

Benign hematology, malignant hematology, hemostasis, thrombosis.

- **Benign** hematology like:
  1. Hemophilia
  2. Thrombophilia
  3. Anemia
  4. Benign WBC disorders
  5. Benign bone marrow disorders
  6. Peripheral destruction/ sequestration

- **Malignant** hematology like:
  1. Leukemia
  2. Lymphoma
  3. Plasma cell myeloma
  4. Myelodysplastic syndrome "MDS"

  Notes:

  1. Leukemia is classified into Acute and Chronic.

  2. Lymphoma is a neoplasm of Lymphocytes, in other words a malignant Lymphocytes. (While the rest of white blood cells malignancies are called leukemia)

  3. Most leukemia cases appear in the bone marrow and circulate in the blood, while in lymphomas most cases appear in lymph nodes then spread across the body.

  4. Lymphoma is of **Two** types generally speaking:
     a. Hodgkin's Lymphoma "HL" b. Non-Hodgkin's Lymphoma "NHL"

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- **CBC "Complete Blood Count" components:**

Laboratory Diagnosis

	Men	Women
Hemoglobin (g/dL)	14-17.4	12.3-15.3
Hematocrit (%)	42-50%	36-44%
RBC Count (10^6/mm^3)	4.5-5.9	4.1-5.1
Reticulocytes	1.6 ± 0.5%	1.4 ± 0.5%
WBC (cells/mm^3)	~4,000-11,000	
MCV (fL)	80-96	
MCH (pg/RBC)	30.4 ± 2.8	
MCHC (g/dL of RBC)	34.4 ± 1.1	
RDW (%)	12-15%	

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- **RBC Count:** amount of red blood cells in the blood, normal range in males is between 4.7-6.1 million cells/microliter, while in female is 4.2-5.4 million cells/microliter.
  - High amount of RBC is called **Erythrocytosis**, while an increment in all types of blood cells is called **Polycythemia!**
  - Low amount of RBC is an indicator of Anemia which can be caused due to low production of RBCs or an increased destruction rate.

- **MCV:** "mean corpuscular volume" is the average volume of red blood cells, normal range is 80-96 fL/cell, less than 80 is called Microcytosis while above 96 is called Macrocytosis.

- **RDW:** "red blood cell distribution width" is another important thing to pay attention to, normal range is 12-15%, if it's higher then there is wide variation, a condition called Anisocytosis "RBC are unequal of size"

- **WBC Count:** total number of white blood cells in the blood, normal number of cells is between 4,500-11,000/microliter.
  - High amount of WBCs "leukocytosis" indicates infection or Inflammation.

- Low amount of WBCs "Leukocytopenia" a result of bone marrow failure due to different reasons.

- Or we could have normal count of cells but have abnormal function which leads to immunodeficiency.

❖ **Platelet Count:** total number of platelets in the blood, normal number of platelets is between 150,000-400,000/microliter.

- Low count of platelets "less than 150,000" is a condition called Thrombocytopenia resulted from increased destruction or decreased production of platelets.

- High count of platelets "more than 400,000" is called Thrombocytosis if an inflammation is the underlying cause, if not then it's Essential Thrombocythemia "rare" from myeloproliferative disorders due to abnormal function of the cellular element of the bone marrow (sustained megakaryocyte proliferation)

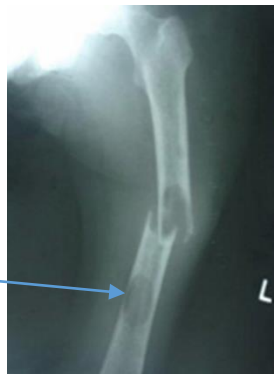
❖ **Plasma Protein:** normal amount is between 6-8.3 g/dL

- High Plasma Protein leads to Hyper-viscosity syndrome
- Low Plasma Protein means low coagulation factors –> Bleeding ☹

- **Now we begin with the Cases:**

Case 1:

68 years old,
Back pain for several months.
Fractured his leg 2 days ago.
In the X ray there is also a pathological fracture

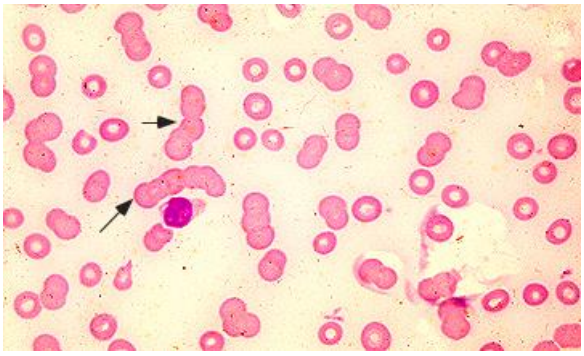


Any elder patient "above 50" with low back pain we have to rule out metastatic disease to the bone breast or prostate or multiple myeloma in addition to spinal disc problems

Hemoglobin 7.3 g/dL, WBC count is 8,600, platelet count is normal, ESR is 120 mm/hr which is very high “erythrocyte sedimentation rate normal range under 20-30”.

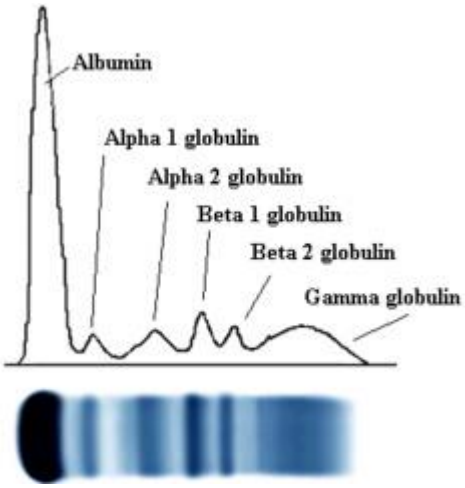
Blood urea nitrogen is 115 mg/dL very high “normal range 30-40”.
Creatinine 3.2 “normal is 1” which means acute renal failure.
Total serum protein is high, calcium level is high 13 mg/dL “normal “5-10”
Normal ranges here were mentioned by the doctor yet some of them are not quite accurate!

Blood film shows multiple erythrocytes lining up together in a form called **Rouleaux formation** which is a characteristic of plasma cell disorders



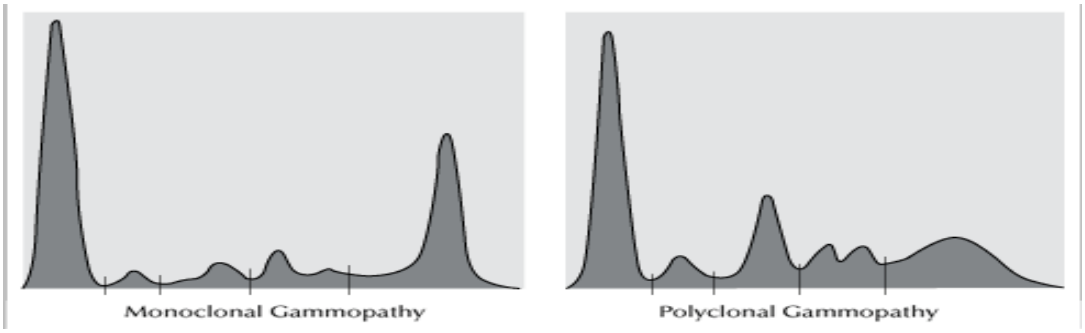
Serum protein electrophoresis:

To show the albumin and globulin amounts in the blood serum, the protein electrophoresis of a normal person looks like this->



If there is a spike in the gamma globulins then this indicates for plasma cell disorders,

If it was a clear spike then its origin is from one type of cell “monoclonal”, if there was a wide base then this means its origin is from many types of cells “polyclonal”



In our case we have a narrow based gamma spike “M spike” which is a characteristic for multiple myelomas or plasma cell disorders.

So to diagnose multiple myeloma we have to have the right settings which are:

An elderly patient male or female, low back pain
high calcium, high creatinine, high serum protein
take an electrophoresis test to see the gamma globulins and check the blood film for Rouleaux formation

Case 2:

Elderly 68 years old male,
Presented with loss of balance and paresthesia in the hand and feet for 8 months.

Patient is type 2 diabetic and alcoholic.

Physical examination showed a short-termed memory loss and an absence of vibration sensation and proprioception in the toes and ankles, he was positive for Romberg test when he closes his eyes.

Hemoglobin is 9.7 g/dL, MCV 105 fl/cell, white and platelet counts are normal he is “Macrocytic”

Blood film has a hypersegmented neutrophil which is a characteristic for B12 deficiency so when we have high MCV and patient is anemic and hypersegmented neutrophil the patient then is diagnosed with B12 deficiency

Case 3:

62 years old male patient,

Presented with fatigue, pallor, progressive shortness of breath and generalized weakness “symptoms of anemia”.

Hemoglobin is 9.7 g/dL “anemic” MCV 69 fl/cell “normal 80-96” RDW is 18%

*When there is low hemoglobin and low MCV then the patient have Iron deficiency anemia or Thalassemia trait (thalassemia minor), if the RDW is normal then it is Thalassemia trait if it’s high then it’s Iron deficiency anemia.

Blood film shows pallor in the red blood cells which indicates for hypochromic iron deficiency anemia

Also to confirm iron deficiency anemia we have to do iron studies like serum iron levels, serum ferritin levels and total iron binding capacity.

The doctor stated a point that in a case like this the elderly people are not suppose to be iron deficient so when we see a patient with these symptoms we have to rule out malignancy first, this patient could be bleeding from gastric cancer, or bleeding from colonic cancer

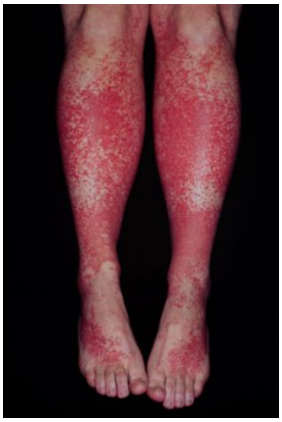
So to complete your work up, any patient above the age of 50 with iron deficiency anemia should have an upper and lower Endoscopy to detect any tumor there

Case 4:

40 year old lady with one week history of fever and confusion.

Physical examination shows the patient is febrile, temperature is 38.2 C

Have a lot of what's called "Petechial rash"



Lab studies shows creatinine level of 5.3 mg/dL which is very high "renal impairment"

Hemoglobin is 12, platelet count 19,000!

Blood film shows normal looking RBC and abnormal "fragmented" RBC this pathology is called MAHA "MicroAngiopathic Hemolytic Anemia"

When we see fragmented RBC we have 3 to 4 possible diagnoses we'll learn about them later on

Case 5:

64 male patient

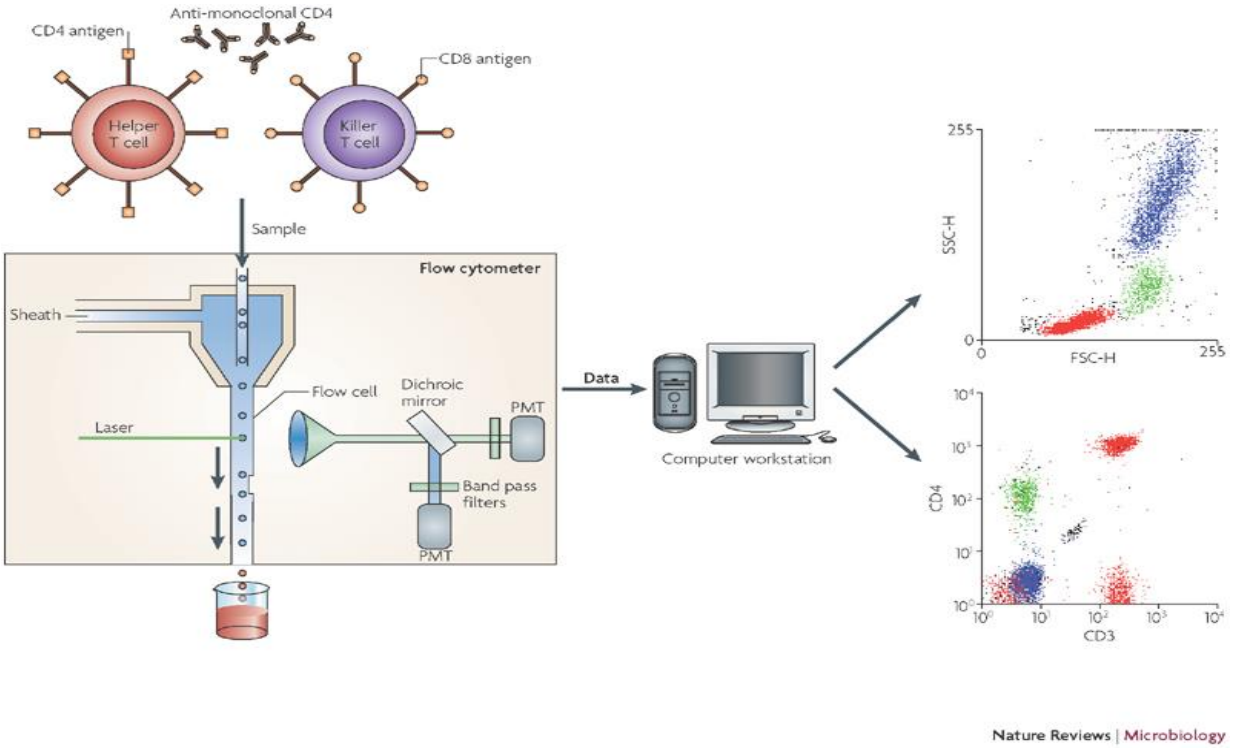
CBC shows elevated WBC count while being worked up for hernia repair.

Physical examination shows lymphadenopathy, spleen is palpable.

Hemoglobin is 14 g/dL, WBC count is 22000 which is high and most of the cells are lymphocytes "75%"

Blood film shows mature lymphocyte and "Smudge cells", if we see smudge cells then there is only one diagnosis which is Chronic Lymphocytic Leukemia! "CLL"

- **Flow Cytometry** is used to know what type of lymphocyte clusters present based on the type of cell membrane protein on its surface like CD5, CD22, CD23 etc.



And in this case we can make our diagnosis based on the flow Cytometry results which showed a monoclonal, mature B-cell population that is positive for CD5 and CD23 and negative for CD 10.

Case 6:

36 years old female with a right breast cancer.

Admitted for mastectomy, before doing the surgery patient should have PT and PTT blood test “PT: prothrombin time, PTT: partial thromboplastin time”.

The patient have normal PT but PTT is very high 120s, but on further questioning she denied any history of bleeding.

Based on these physiologic factors we will know what is the factor deficient and the diagnosis for this lady.

Case 7:

30 years old male patient

Presented with worsening productive cough for one month,

Physical examination showed small non tender lymph nodes in the axillae, and the tip of the spleen is palpable,

Lab result shows this person is anemic with hemoglobin of 8 g/dL, WBC count is 67,000, platelet count is very low 36,000 “thrombocytopenia”,

Blood film shows lymphoblasts (leukemia)

Case 8:

41 years old male presented with one month of increasing generalized weakness and easy fatigability, epigastric pain but with no vomiting.

Exam was significant for splenomegaly but with no lymphadenopathy.

Hemoglobin is 10.2, WBC count is 78,000, platelet is very very high 890,000!

Case 9:

57 years old male patient

Evaluated for 3 month history of progressive fatigability, shortness of breath and weakness (symptoms of anemia)

Physical examination shows splenomegaly,

Hemoglobin is 9 g/dL, his stool was negative for occult bleeding,

Blood film shows a significant nucleated red blood cells

Case 10:

63 years old patient diagnosed with CLL

Evaluated because of increasing dyspnea on exertion (which is a manifestation of anemia),

Currently taking no medication,

O physical examination the patient is afebrile, pale conjunctivae, with scattered axillary and inguinal lymphadenopathy that are unchanged since his last examination 1 year ago,

Hemoglobin is 6.2 g/dL (one year ago was 14.2), platelet and WBC counts are normal but reticulocyte count is high 10% "when reticulocyte count is high this means that the patient is hemolytic"

In the blood film we see Spherocytes "sphere shaped RBC", when we see spherocytes there are only two possibilities, either **Hereditary Spherocytosis** or **Autoimmune Hemolytic Anemia**

Case 11:

26 years old male with hemoglobin of 4.0!

Evaluated for two weeks history of:

Progressive fatigue, dyspnea on exertion, vague and non exertional chest discomfort, mild cough,

Takes no medication, was a carpenter and does a lot of exercise but not anymore

Hemoglobin is 4.8 g/dL, hematocrit is 13% very low, reticulocyte count is zero! "No blood formation, BM failure".

X ray shows anterior mediastinal mass,

*When a patient have an anterior mediastinal mass and low hemoglobin this could only mean one diagnosis we will know it later on

Case 12:

33 years old female with low grade fever, night sweats, generalized malaise, and weight loss for the past 2 months.

The last three are called “B symptoms”

Physical examination shows non tender cervical and supraclavicular lymphadenopathy,

Lymph node biopsy shows a very characteristic pathological finding which we will learn about later

Case 13:

8 years old kid

Presented with unexplained large bruises over the skin,

Physical examination shows no sign of anemia

Hemoglobin is 14 g/dL, WBC count is normal, platelet is low “thrombocytopenic”, PT,PTT are normal, but bleeding time is 19 minutes “normal time is 3-10 minutes”.

Blood film shows very huge size of platelet! We will know what that means later.

Case 14:

69 years old lady with hip replacement 10 days ago, presented with swollen right leg,

Doppler ultrasound was done to check blood flow, artery flow was normal but the vein was blocked “DVT” so an anticoagulant drug is needed.

Case 15:

77 years old

Checked in for non-Hodgkin lymphoma treatment with coronary artery disease diagnosed with diffuse large cell lymphoma with bulky lymphadenopathy,

Started with chemotherapy and after three days the patient presented in the ER with symptoms of severe fatigue, nausea, vomiting, abdominal pain,

high potassium 5.3 mEq/L, low calcium 8.1 mg/dL, high phosphates, LDH very high 28000, uric acid is high,

These symptoms are called “tumor lysis syndrome”.

Cases are over…!

We will take these 15 scenarios once again in detail next time after we have taken all the physiology, biochemistry, pathology and histology lectures

Le Fin.

Don’t let anyone dim your light simply because it’s shining in their eyes ☺