What you need to know about CBC and coagulation profile

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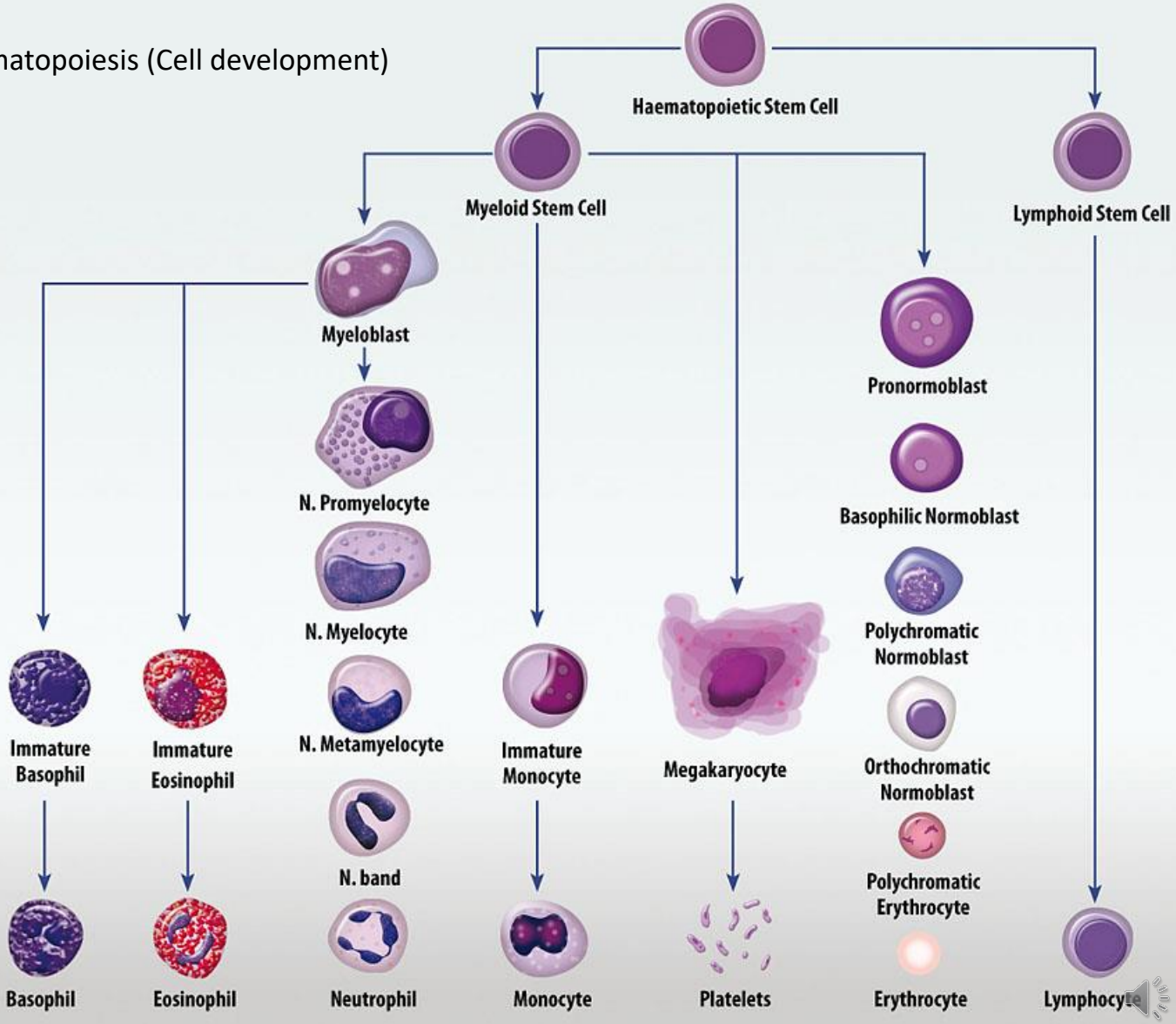
Slide credits to many contributors

Objectives

- Practical approach to CBC
- How to approach coagulation defect

- CBC is one of the commonest investigation we use and you need to understand it.
- Many items listed , some of them tell the same information in different way.
- Most of the CBC now done in automated way

Haematopoiesis (Cell development)



- WBC and diff
- RBC
- HB
- Htc
- MCV
- MCH
- MCHC
- Plat and MPV

- ESR
- Blood film
- RDW
- Retics

- *Any stress to the body can increases your WBC , it could be elevated with asthma without presence of infection or steroid.*
- *High lymphocyte in viral infection or CLL.*
- *Hemoglobin you should always Look to the MCV and specify if it's microcytic , Normocytic or macrocytic . and you should never mentioned it's Anemia only!.*
- *The comments one that you are gonna deal with is IDA.*

Some formula for interest

- MCV = Hct (L/L) ✔ 1,000/red cell count (10^12/L)
- MCH = hemoglobin (g/L)/red cell count (10^12/L)
- MCHC =hemoglobin (g/dl)/Hct (L/L)

Interpret results in clinical context

- All haematology results need to be interpreted in the context of a thorough history and physical examination, as well as previous results.

History and clinical examination

- Important features of history and clinical examination:
  - pallor, jaundice
  - fever, lymphadenopathy
  - bleeding/bruising
  - hepatomegaly, splenomegaly
  - frequency and severity of infections, mouth ulcers, recent viral illness
  - exposure to drugs and toxins
  - fatigue/weight loss

Low haemoglobin

- Useful to use MCV to classify the anaemia
  - Microcytic, MCV < 80 fl
  - Normocytic, MCV 80 – 100 fl
  - Macrocytic, MCV > 100 fl

Microcytic Anaemia

- The three most common causes for microcytic anaemia are:
  - Iron deficiency *: Sleeve gastrectomy ,menorrhagia and pregnancy*
  - Thalassaemia
  - Anaemia of Chronic disease

If I bring you a gentleman at age 60 think of GI bleeding

Normocytic anaemia

- The causes of normocytic anaemia include:
  - Bleeding
  - Early nutritional anaemia (iron, B12, folate deficiencies)
  - Anaemia of renal insufficiency
  - Anaemia of chronic disease/chronic inflammation
  - Haemolysis
  - Primary bone marrow disorder

Macrocytic anaemia

- Common causes:
  - Alcohol
  - Liver disease
  - B12 or folate deficiency
  - Thyroid disease
  - Some drugs (especially hydroxyurea)

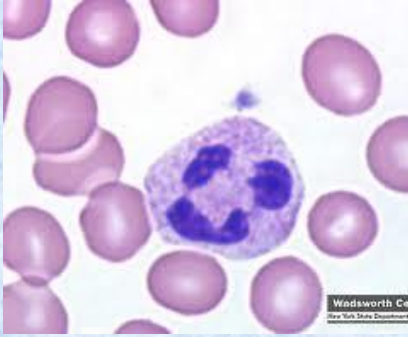
High haemoglobin

- ⇧ Hb often accompanied by ⇧PCV

- Can reflect decreased plasma volume (eg: dehydration, alcohol, cigarette smoking, diuretics) or
- Increased red cell mass (eg polycythaemia)
  - This can be primary or secondary

It could be true or pseudo,
Pseudo is due to dehydration.
True is due to increase red cell mass and the classical example is Polycythaemia (Rubra) Vera and for diagnosis you need JAK2 testing

Neutrophils – Low



- Significant levels

  < 0.5 x 10^9/L (high risk infection)

- Most common causes
  - viral (overt or occult)
  - autoimmune/idiopathic
  - drugs *Like chemotherapy*

Red flags

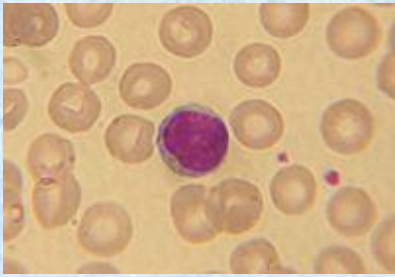
- person particularly unwell
- severity
- lymphadenopathy, hepatosplenomegaly

- *The Classical example for Neutropenia typically associated with Lymphopenia is HIV.*
- *Neutropenia is at high risk of infection and medical emergency so you need to cover the patient with antibiotic because the patient can end up with septic shock in less than 24h.*

Neutrophils – High

- Most common causes
  - infection/inflammation
  - Necrosis/malignancy
  - any stressor/heavy exercise
  - Drugs
  - CML
- Red flags
  - person particularly unwell
  - Severity
  - presence of left shift or blast

Lymphocytes

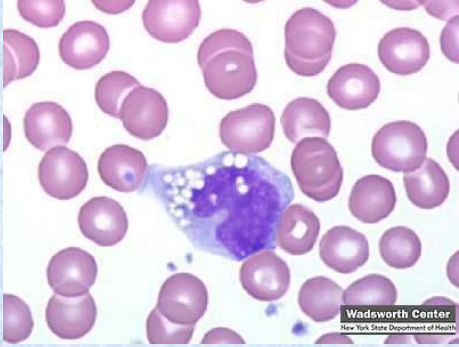


- Lymphocyte – Low
  - not usually clinically significant

- Lymphocyte – High
  - isolated elevated count not usually significant

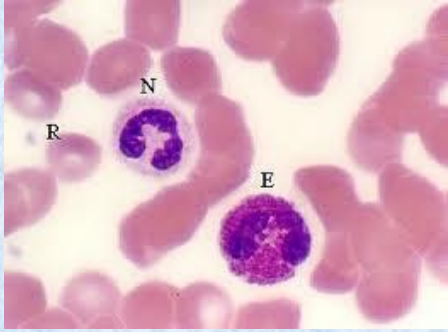
  Causes
    - acute infection (viral, bacterial)
    - smoking
    - hyposplenism
    - acute stress response
    - autoimmune thyroiditis
    - CLL

Monocytes



- Monocytes – Low
  - not clinically significant
- Monocytes – High
  - usually not significant
  - watch levels > 1.5 $x10^9$/L more closely

Eosinophils



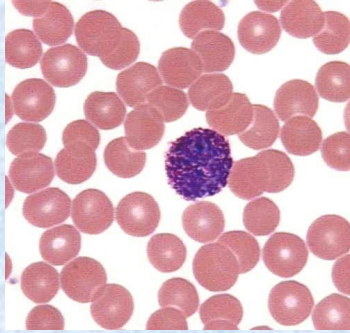
- Eosinophils – Low
  - no real cause for concern

- Eosinophils – High

  Most common causes:
  - allergy/atopy: asthma/hayfever
  - parasites (less common in developed countries)

  Rarer causes:
  - Hodgkins
  - myeloproliferative disorders
  - Churg-Strauss syndrome *Autoimmune disorder*

Basophils



- Basophils – Low
  - difficult to demonstrate/no clinical significance.

- Basophils – High Associated with
  - myeloproliferative disorders *Classically the CML*
  - other rare causes

Platelets – Low

- Significant levels
  < 100 x10^9/L
- Most common causes
  - viral infection *Typically in pediatrics and they recover quickly*
  - idiopathic thrombocytopenic purpura
  - liver disease
  - drugs
  - hypersplenism
  - autoimmune disease
  - Pregnancy
  - Artificial → confirm on blood film
- Red flags
  - bruising
  - petechiae
  - signs of bleeding

- *We should look to how deep is the number what I mean by that ITB .We don't give them therapy unless they are actively bleeding or it's significantly low below 30*
- *gestational thrombocytopenia completely benign and it doesn't cause bleeding*

Platelets – High

- Significant levels

  > 500 x10^9/L
- Most likely causes
  - reactive conditions eg infection, inflammation
  - pregnancy
  - iron deficiency
  - post splenectomy
  - essential thrombocythaemia

Patient #: [redacted]
Name:

Age: 58
Sex: Male

EDTA Whole Blood - *SAMPLE: 1*

1	WBC	H	32.20	x10.e9/L	4 - 11
2	RBC		5.61	x10.e12/L	4.7 - 6.1
3	HGB		161	g/L	130 - 180
4	HCT		46.1	%	42 - 52
5	MCV		82.2	fl	80 - 94
6	MCH		28.6	pg	27 - 32
7	MCHC		349	g/L	320 - 360
8	RDW		14.2	%	11.5 - 14.5
9	HDW		0.0	g/L	0 - 0
10	PLT		182	x10.e9/L	140 - 450
11	MPV		7.2	fl	7.2 - 11.1
12	PDW	L	0.0	%	20 - 70
13	PCT	L	0.0	%	0.150 - 0.320
14	%NEUT	L	17	%	40 - 75
15	%LYMP	H	81	%	20 - 45
16	%MONO	L	2	%	3 - 9
17	%EOS		0	%	0 - 6
18	%BASO		0	%	0 - 1
19	%BAND		0	%	0 - 4
20	%ATYP		0	%	-
21	%Metamyelocytes		0	%	0 - 0.0001
22	%Myelocytes		0	%	0 - 0.0001
23	%Promyelocytes		0	%	0 - 0.0001
24	%BLAST		0	%	-
25	#NEUT		5.47	x10.e9/L	2 - 7.5
26	#LYMP	H	26.08	x10.e9/L	1 - 5
27	#MONO		0.64	x10.e9/L	0.2 - 0.8

- *58 patient came to do a hernia surgery and he is completely healthy:*
- *The only abnormality is leukocytosis*
- *Asymptotic ,full mature lymphocyte called Smudge cell and this is classical for CLL.*
- *Most patients will not require any therapy unless they progress or start to be symptomatic*

- *29 admitted to the ICU after RTA, present with active bleeding and require multiple blood transfusion*
- *neutropenia was drug induced , such as penicillin*

Patient #:
Name:

Age: 29
Sex: Male

1	WBC	L 3.4	x10.e9/L	4 - 11
2	RBC	L 3.20	x10.e12/L	4.7 - 6.1
3	HGB	L 91	g/L	130 - 180
4	HCT	L 27.7	%	42 - 52
5	MCV	86.5	fl	80 - 94
6	MCH	28.4	pg	27 - 32
7	MCHC	329	g/L	320 - 360
8	RDW	H 21.6	%	11.5 - 14.5
9	HDW	0.0	g/L	0 - 0
10	PLT	447	x10.e9/L	140 - 450
11	MPV	L 6.7	fl	7.2 - 11.1
12	PDW	L 0.0	%	20 - 70
13	PCT	L 0.0	%	0.150 - 0.320
14	%NEUT	L 31.9	%	40 - 75
15	%LYMP	H 62.4	%	20 - 45
16	%MONO	4.6	%	3 - 9
17	%EOS	0.3	%	0 - 6
18	%BASO	0.8	%	0 - 1
19	%BAND	0.0	%	0 - 4
20	%ATYP	0.0	%	-
21	%Metamyelocytes	0.0	%	0 - 0.0001
22	%Myelocytes	0.0	%	0 - 0.0001
23	%Promyelocytes	0.0	%	0 - 0.0001
24	%BLAST	0.0	%	-
25	#NEUT	L 1.1	x10.e9/L	2 - 7.5
26	#LYMP	2.1	x10.e9/L	1 - 5
27	#MONO	0.2	x10.e9/L	0.2 - 0.8
28	#EOS	0.0	x10.e9/L	0.0 - 0.8

- *Male patient at age 23; present with feeling unwell to the ER*
- *Blast will suggest presence of acute leukemia*

Patient Information

Patient #: --
Name: . ...
Age: 23
Sex: Male

Request Information

Request #: H12188065
Doctor: HASSANAIN
Date/Time Received: 07-12-2012 / 20:0
Ward/Location: SICU WARD

Result of Request No. 'H12188065'

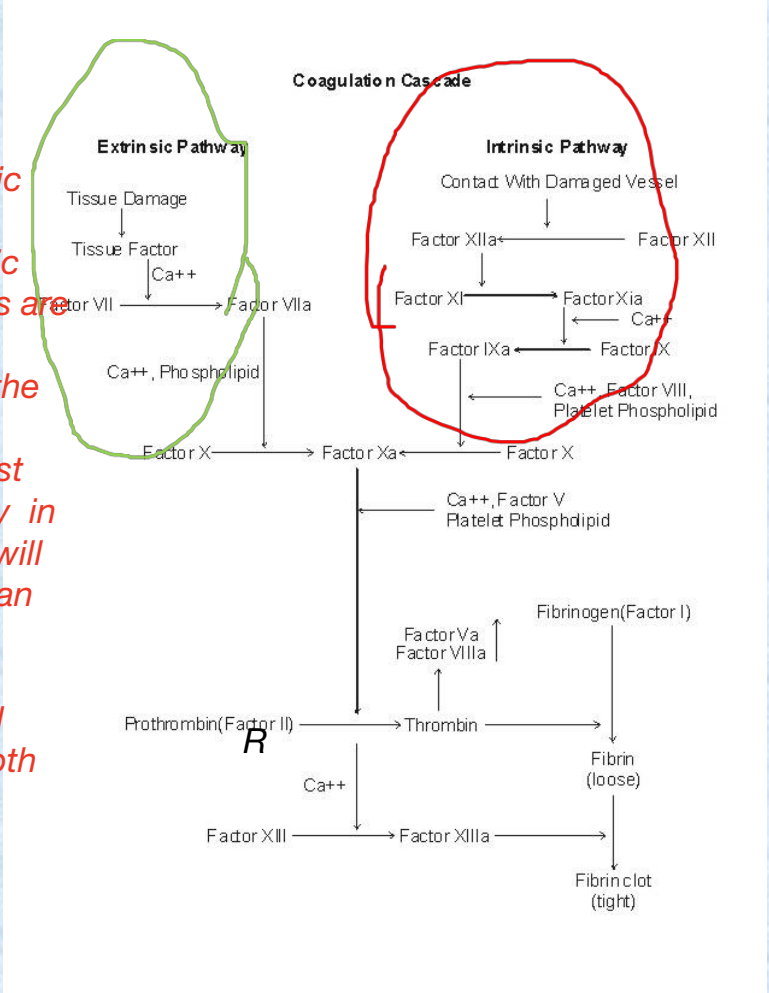
#	Test	Result	Unit	Range
EDTA Whole Blood - SAMPLE: 1				
1	WBC	H 14.0	x10.e9/L	4 - 11
2	RBC	L 3.21	x10.e12/L	4.7 - 6.1
3	HGB	L 101	g/L	130 - 180
4	HCT	L 29.4	%	42 - 52
5	MCV	91.5	fl	80 - 94
6	MCH	31.6	pg	27 - 32
7	MCHC	346	g/L	320 - 360
8	RDW	H 19.1	%	11.5 - 14.5
9	HDW	0.0	g/L	0 - 0
10	PLT	224	x10.e9/L	140 - 450
11	MPV	7.7	fl	7.2 - 11.1
12	PDW	L 0.0	%	20 - 70
13	PCT	L 0.0	%	0.150 - 0.320

RC 0

Coagulation Cascade

- *MCQ:*
- *Heparin = intrinsic*
- *Warfarin= extrinsic*

- *INR measures extrinsic pathway*
- *aPTT measure intrinsic*
- *All coagulation factors are coming from the liver except factor 8 from the endothelium*
- *Factor 7 is the shortest half life and that's why in liver disease the INR will be affected earlier than than aPTT*
- *Any problem with common pathway will result in prolonged both INR and aPTT*



- http://www.hopkinsmedicine.org/hematology/Coagulation.swf

Prolonged PT is seen in

Vitamin K deficiency

Warfarin therapy

Liver disease

Prolonged PTT is seen in

von Willbrand,

hemophilia

Heparin therapy

Antiphospholipid syndrome

- *Inhibit phospholipids binding to coagulation factors*

Prolonged PT and PTT is seen in deficiencies of the final common pathway factors such as factor V, prothrombin, fibrinogen, or factor X. Liver disease, DIC.

No all bleeding problems can be explained by this but most of it.

Thank you