# What you need to know about CBC and coagulation profile

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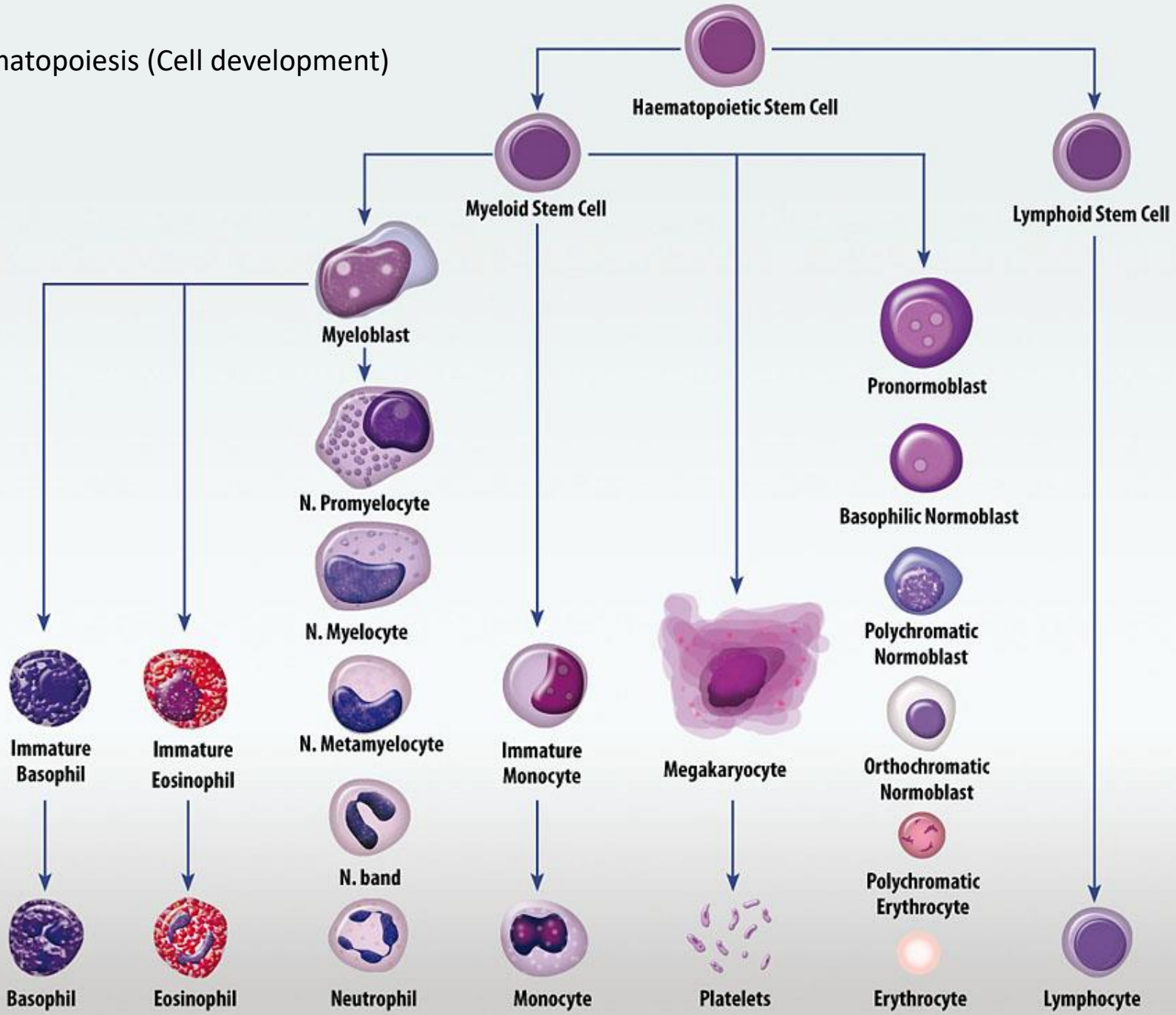
Slide credits to many contributors

# 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

# 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
  - Thalassaemia
  - Anaemia of Chronic disease

# 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

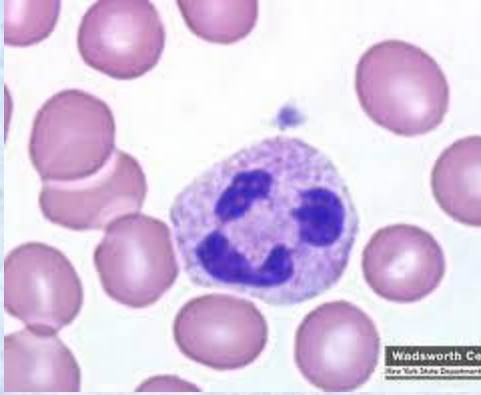
- Common causes:
  - Alcohol
  - Liver disease
  - B12 or folate deficiency
  - Thyroid disease
  - Some drugs (especially hydroxyurea)

# 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

# Neutrophils – Low



- Significant levels

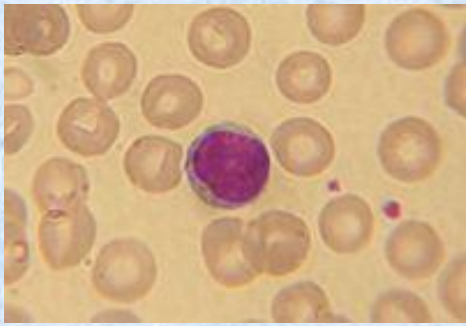
  < 0.5 x $10^9$/L (high risk infection)
- Most common causes
  - viral (overt or occult)
  - autoimmune/idiopathic
  - drugs

  Red flags
  - person particularly unwell
  - severity
  - lymphadenopathy, hepatosplenomegaly

# 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

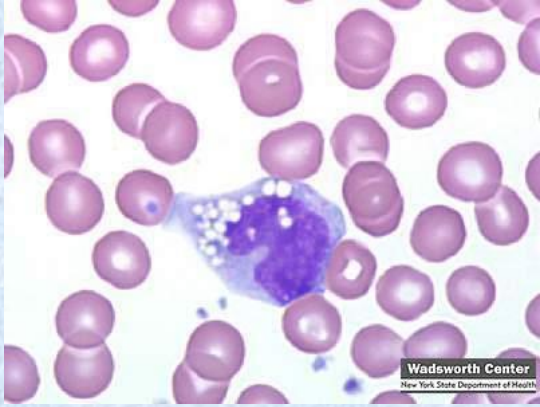


- Lymphocyte – Low
  - not usually clinically significant

- Lymphocyte – High
  - isolated elevated count not usually significant

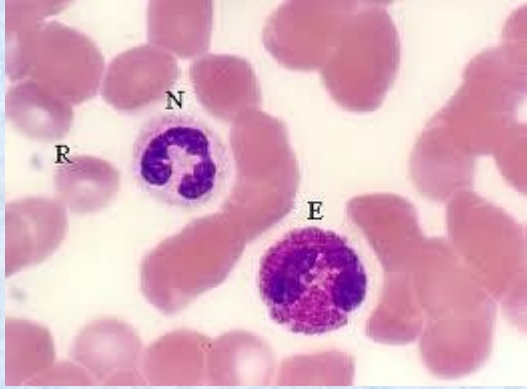
  Causes
    - acute infection (viral, bacterial)
    - smoking
    - hyposplenism
    - acute stress response
    - autoimmune thyroiditis
    - CLL

# Monocytes




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

# Eosinophils



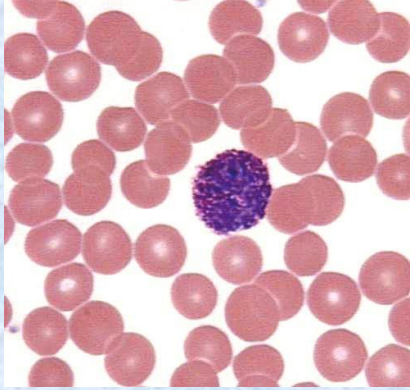

- Eosinophils – Low
  - no real cause for concern

- Eosinophils – High

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

  Rarer causes:
  - Hodgkins
  - myeloproliferative disorders
  - Churg-Strauss syndrome

# Basophils



- Basophils – Low
  - difficult to demonstrate/no clinical significance.
- Basophils – High Associated with
  - myeloproliferative disorders
  - other rare causes

# Platelets – Low

- Significant levels
  $< 100 \times 10^9/L$
- Most common causes
  - viral infection
  - idiopathic thrombocytopenic purpura
  - liver disease
  - drugs
  - hypersplenism
  - autoimmune disease
  - Pregnancy
  - Artificial → confirm on blood film
- Red flags
  - bruising
  - petechiae
  - signs of bleeding

# Platelets – High

- Significant levels

  > 500 x$10^9$/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 |

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 | | 442 | 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 |

## Patient Information

Patient #: --
Name: . ...

Age: 23
Sex: Male

### Request Information

Request #: **H12188065**
Doctor: **HASSANAIN**

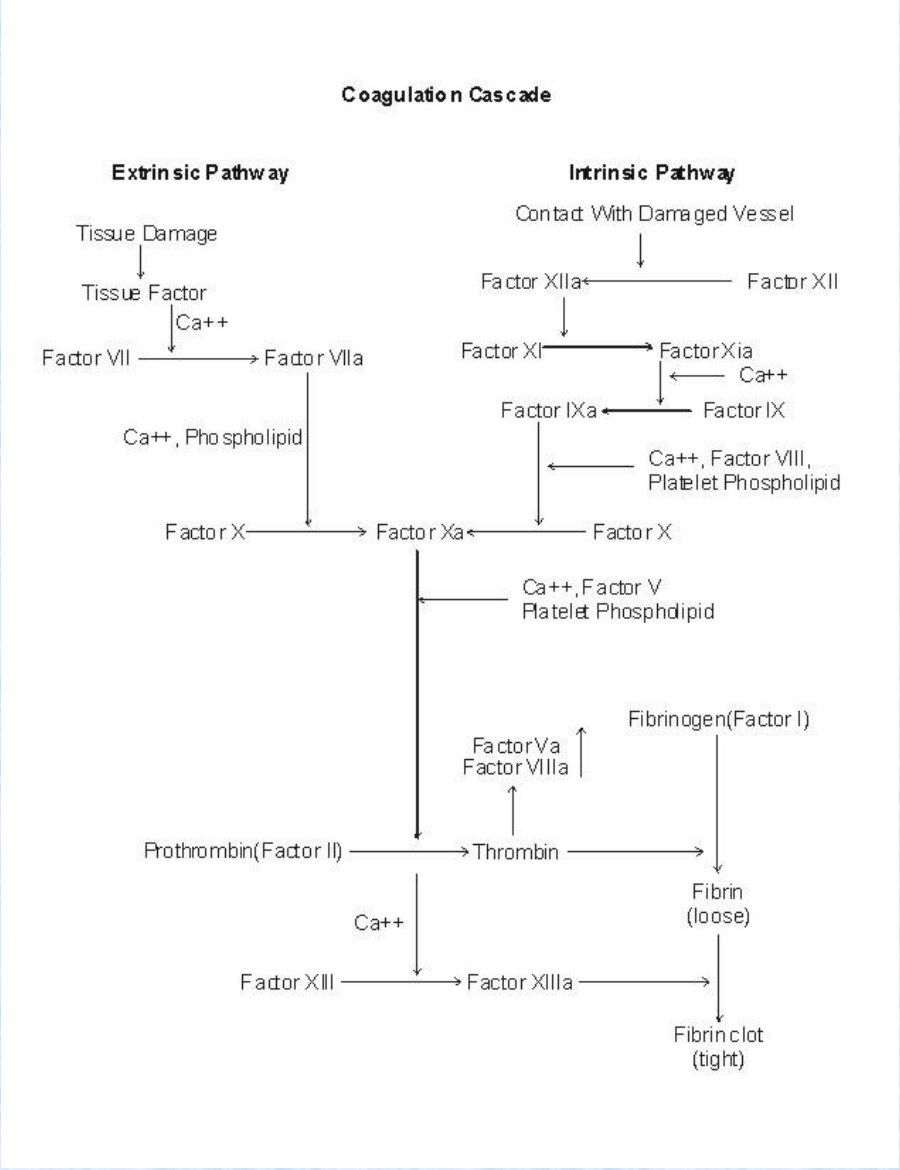
Date/Time Received: **07-12-2012 / 20:0**
Ward/Location: **SICU WARD**

### 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 |

PC 0

# Coagulation Cascade



- 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

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