Understanding Basic Haematology Results
Transfusion Study Day
6th November 2012

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Haematology and Biochemistry Departments

North Devon District Hospital

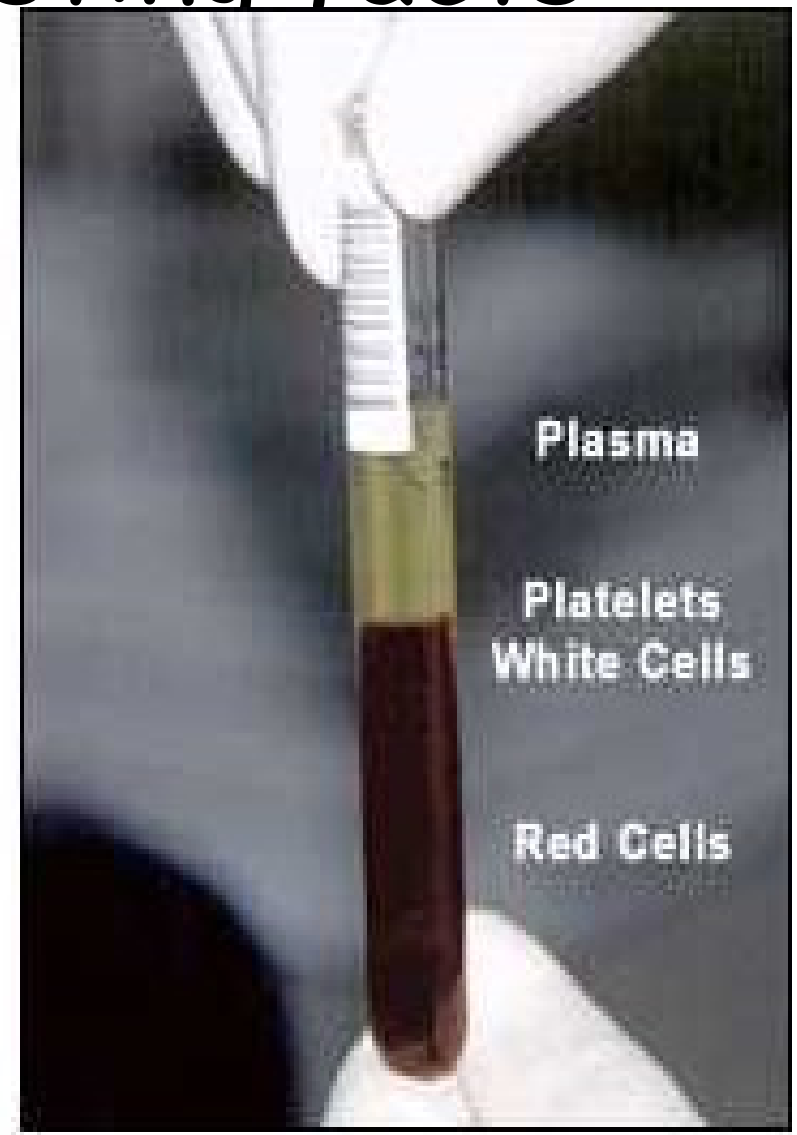
Objectives

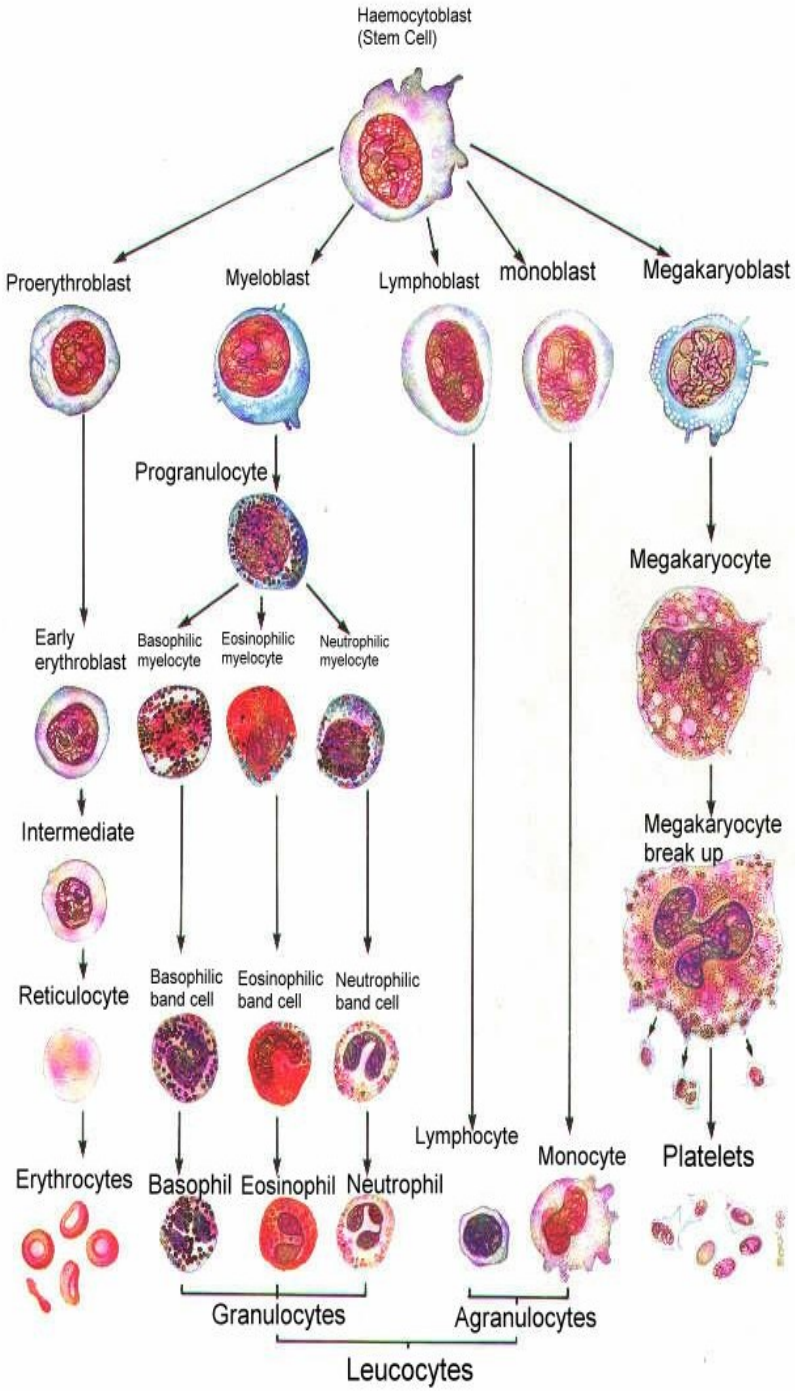
- After this session, we will know a bit about:

- what the relevant tests are
- what they tell us
- commonest causes of clinically significant abnormal results

Interesting facts

- A person of average height and weight will have approximately 4.6 litres of blood
- Blood accounts for about 8% of body weight.
- Approx 2 million red blood cells are made and destroyed each second





Haematopoiesis

All blood cells are produced from a common precursor cell, in the bone marrow.

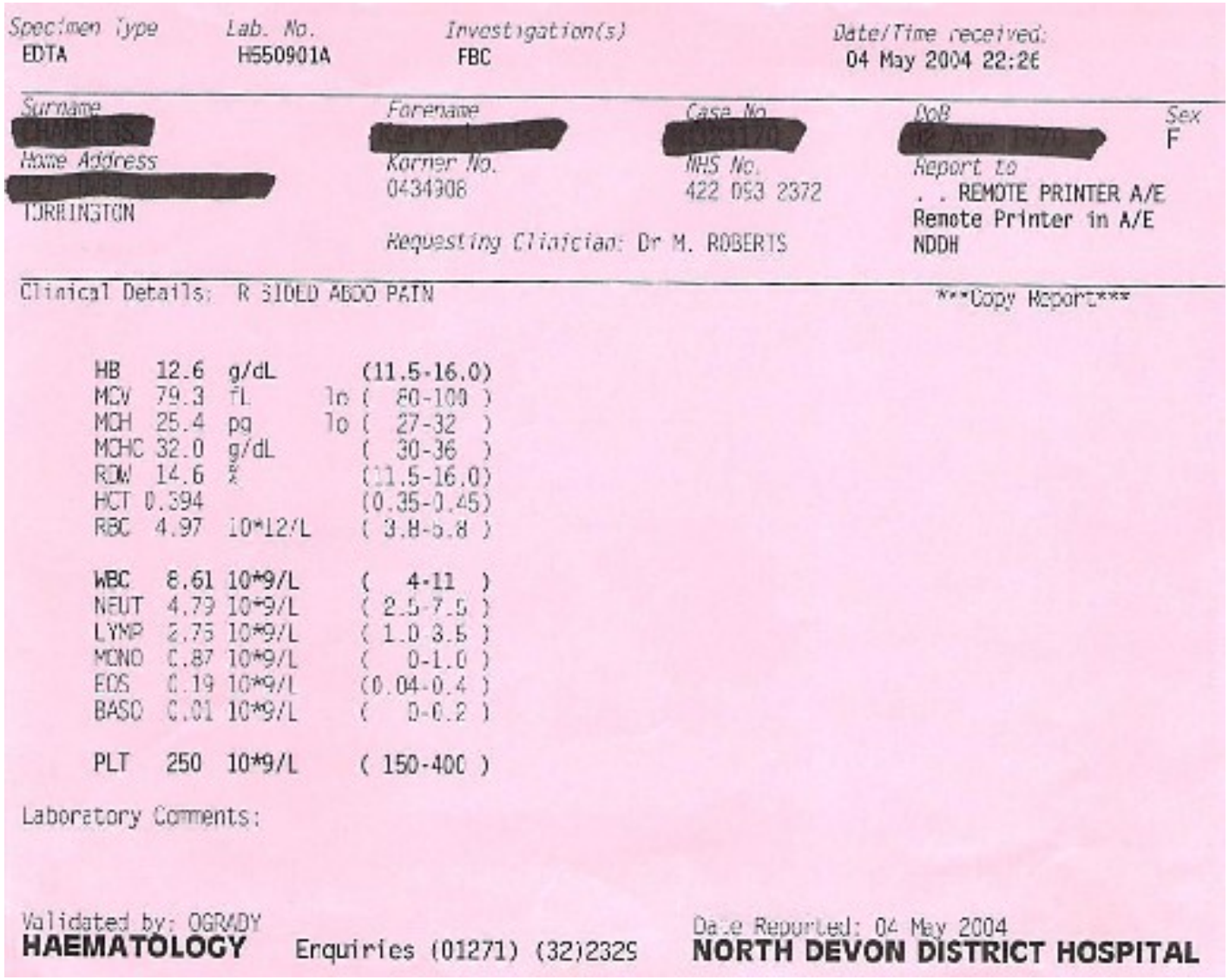
(haematopeitic stem cell)

The Full Blood Count

- Main Haematology investigation
- Increase 2-5% annually – chemo etc.
- "Blood function Test"
- Comprises haemoglobin, white cell count and platelet count

- What else?

Example report



Specimen Type: EDTA
Lab. No.: H550901A
Investigation(s): FBC
Date/Time received: 04 May 2004 22:26

Surname: [redacted]
Forename: [redacted]
Case No: [redacted]
DoB: [redacted]
Sex: F

Home Address: [redacted]
TORRINGTON

Korner No.: 0434908
NHS No.: 422 093 2372

Report to
. . REMOTE PRINTER A/E
Remote Printer in A/E
NDDH

Requesting Clinician: Dr M. ROBERTS

Clinical Details: R SIDED ABDO PAIN

Copy Report

HB	12.6	g/dL		(11.5-16.0)
MCV	79.3	fL	lo	(80-100)
MCH	25.4	pg	lo	(27-32)
MCHC	32.0	g/dL		(30-36)
RDW	14.6	%		(11.5-16.0)
HCT	0.394			(0.35-0.45)
RBC	4.97	10*12/L		(3.8-5.8)
WBC	8.61	10*9/L		(4-11)
NEUT	4.79	10*9/L		(2.5-7.5)
LYMP	2.75	10*9/L		(1.0-3.5)
MONO	0.87	10*9/L		(0-1.0)
EOS	0.19	10*9/L		(0.04-0.4)
BASO	0.01	10*9/L		(0-0.2)
PLT	250	10*9/L		(150-400)

Laboratory Comments:

Validated by: OGRADY
HAEMATOLOGY
Enquiries (01271) (32)2329
Date Reported: 04 May 2004
NORTH DEVON DISTRICT HOSPITAL

- Red blood cell parameters:

- MCV - mean (red) cell volume -fL
- MCH - mean (red) cell haemoglobin - g/dL
- RDW - red (cell) distribution width - %
- HCT - haematocrit
- RBC - red cell count - 10^12/L

- Normal ranges for red cell indices (applying to north Devonians!):

- Hb Male 13-17; Female 11.5-16
- RBC Male 4.5-6.5; Female 3.8-5.8
- Hct Male 0.4-0.55; Female 0.35-0.45
- MCV 80-100
- RDW 11.5-16

Haemoglobin

- Carries oxygen to all tissues
- Contained within red cells
- Fairly important!
- Accurate measurement vital
  - pre-anaesthesia

Haemoglobin

- **Reduced level (anaemia) found in:**
  - iron deficiency
  - vitamin B12/folate deficiency
  - malabsorption
  - bleeding/post surgery
  - pregnancy
  - renal failure
  - mechanical or autoimmune cell damage (haemolysis)
  - secondary to other illnesses, e.g. leukaemia, cancer, rheumatoid
  - and their treatments (myelosuppression)

Iron Deficiency Anaemia

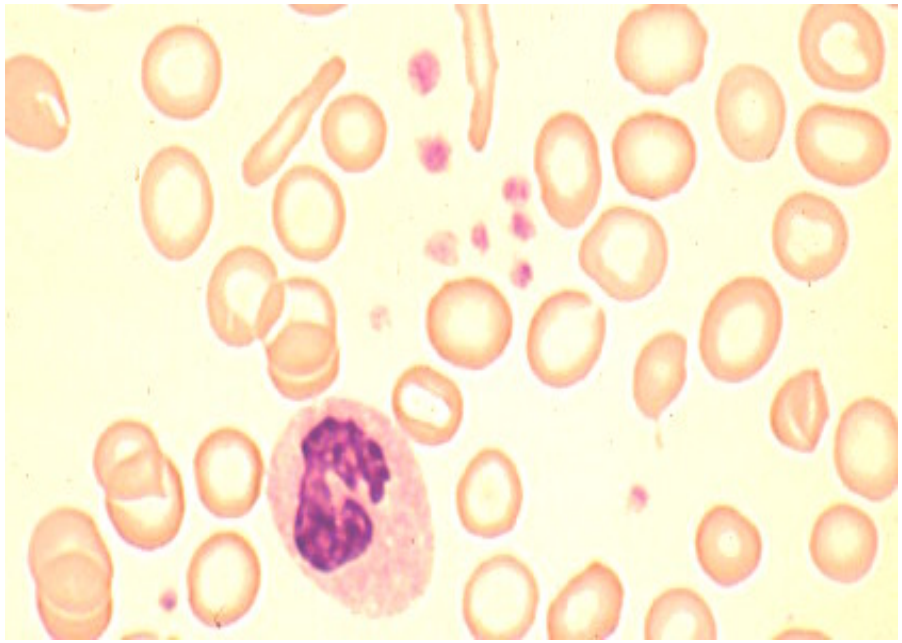
- The most common blood disorder
- Characterised by:
- low Hb
- low MCV
- low MCH
- Normal / low RBC
- Normal / high RDW

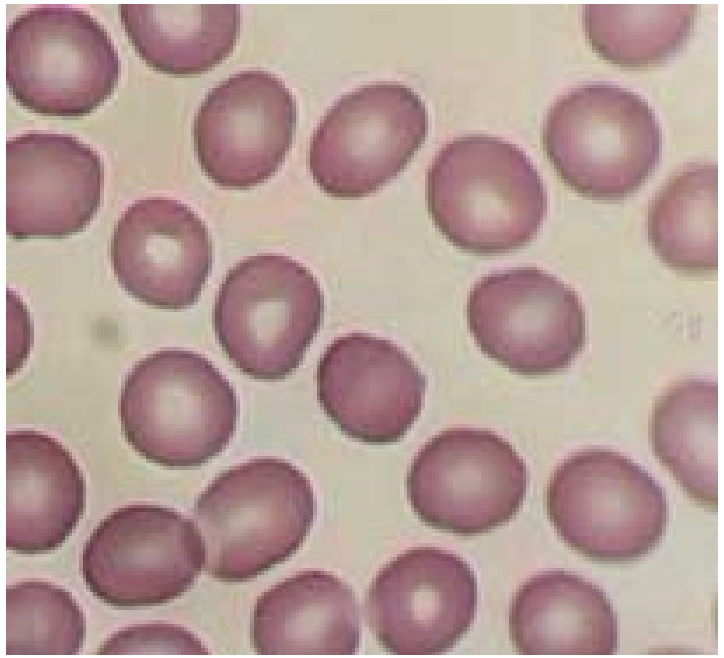
IRON DEFICIENCY

Treatment IRON - not transfusion

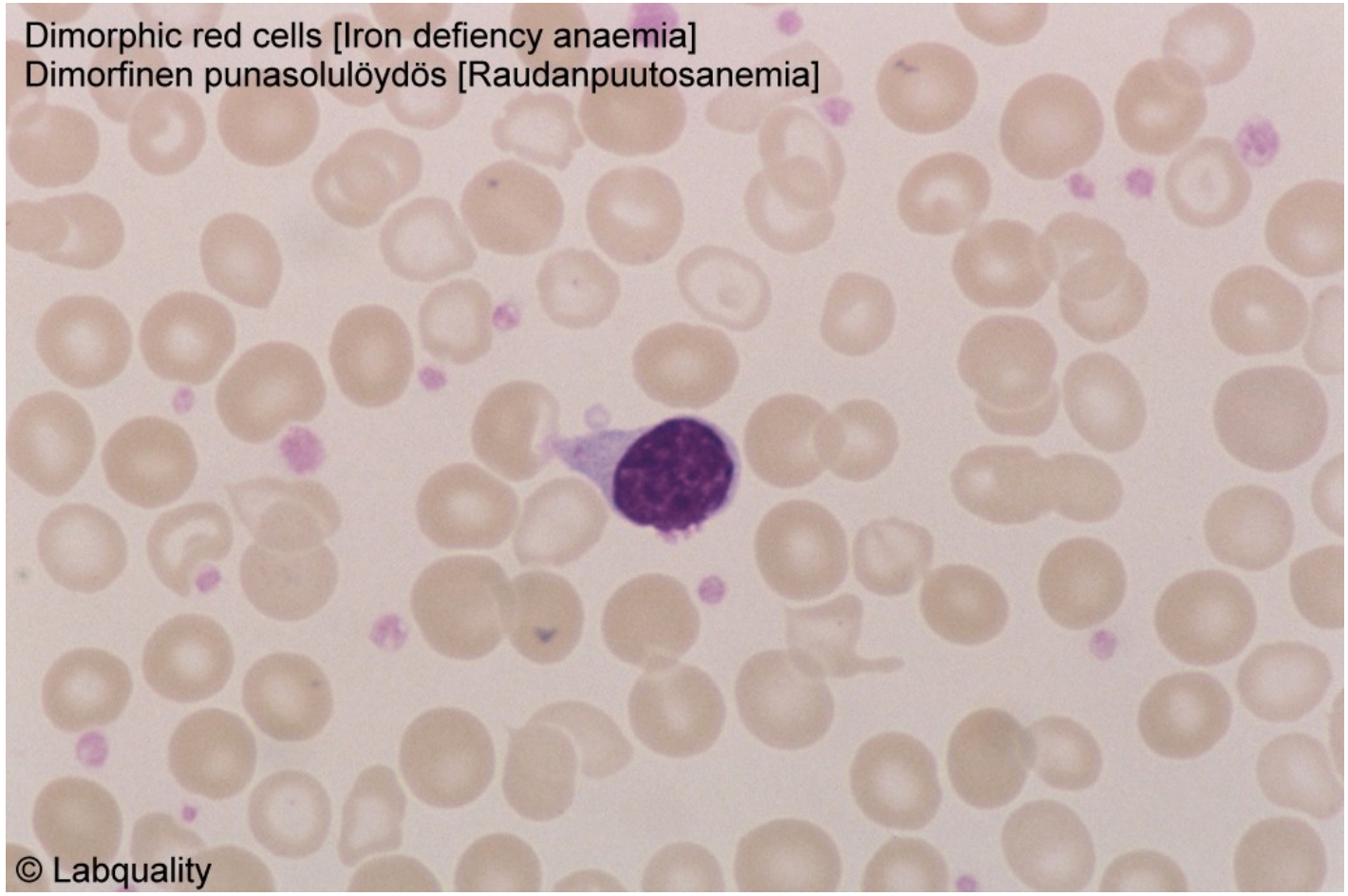
Iron deficiency

- Iron deficient red cells vs. normal





Iron deficiency



Vitamin B12/folic acid deficiency

- More common in the elderly
- Characterised by:
- low Hb
- high MCV
- High RDW
- low RBC
- low WBC/ platelets

Vitamin B12/folic acid deficiency

- Very few, very large red cells

Vitamin B12/folic acid deficiency - P.A.

- Pernicious anaemia was treated by eating raw liver as this is very rich in vitamin B12 and passive absorption sufficient
- The more wealthy soaked it in Port first!
- Now B12 is given intramuscularly
- No need for I.F.

PERNICIOUS ANAEMIA -VITAMIN B12 DEFICIENCY

LOW HAEMOGLOBIN

RAISED MCV

LOW VITAMIN B12 - FAILURE TO ABSORB

OTHER AUTO- IMMUNE DISORDERS

Treatment Vitamin B12 - not transfusion

Use of RBC indices

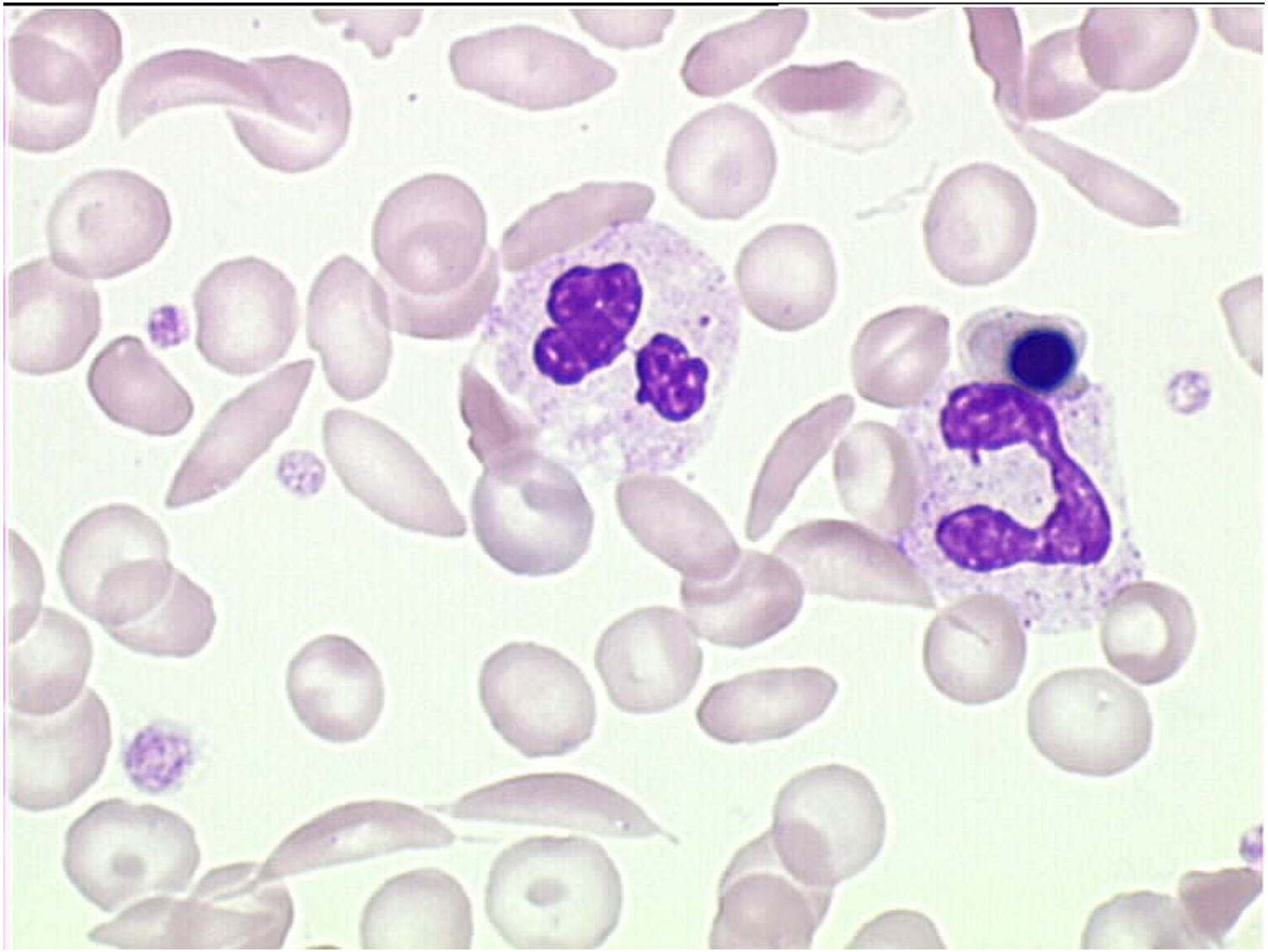
- MCV - low in iron deficiency, some thalassaemias
- High in B12/ folate deficiency, liver disease, some thyroid disorders
- RDW - normal if all RBCs the same size
- Increased if there is a significant variation within a patient

Sickle cell anaemia

- Caused by a single amino acid substitution - Hb S
- Irreversibly crystallises in reduced O_2 levels
- Deforms red cell, hence 'Sickle'
- Cells cannot pass oxygen or move through capilliaries - pain, hypoxia, death
- Confers protection against malaria
- Treated with transfusion and O_2
- Check any risk patient before anaesthesia!
- Rapid test available – 20 min

- Sickled red cells - electron microscope

- 'Sickled' red cells - light microscope

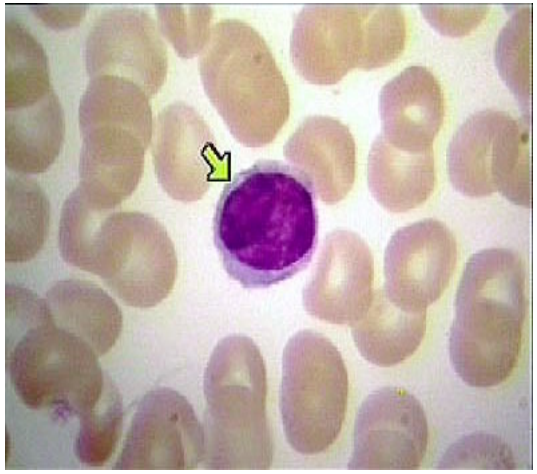


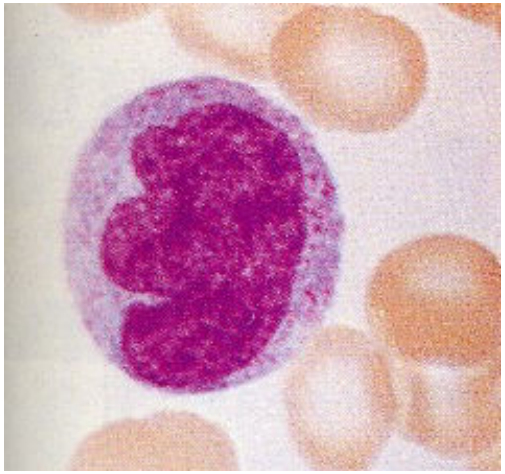
Increased haemoglobin

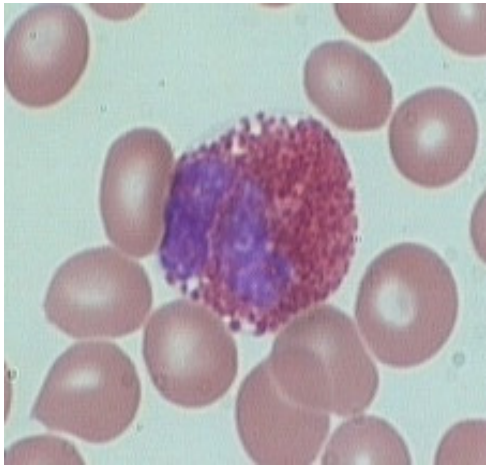
- Causes:
- Cardiorespiratory disorders
- Altitude
- Polycythaemia rubra vera
- Dehydration
- Newborns
  - due to nature of Hb F

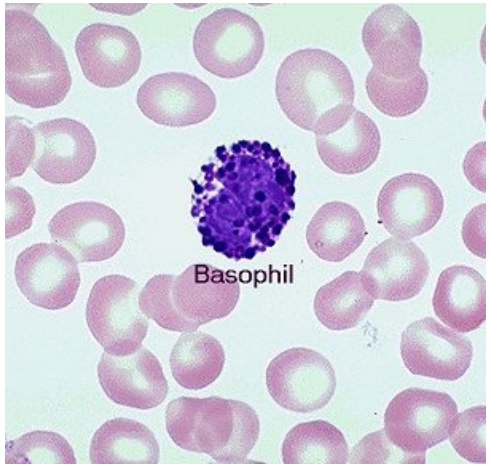
White cells (LEUCOCYTES)

- 5 types circulating in health:
- Neutrophils
- Lymphocytes
- Monocytes
- Eosinophils
- Basophils
- Otherwise known as the WBC differential. All 10^9/L





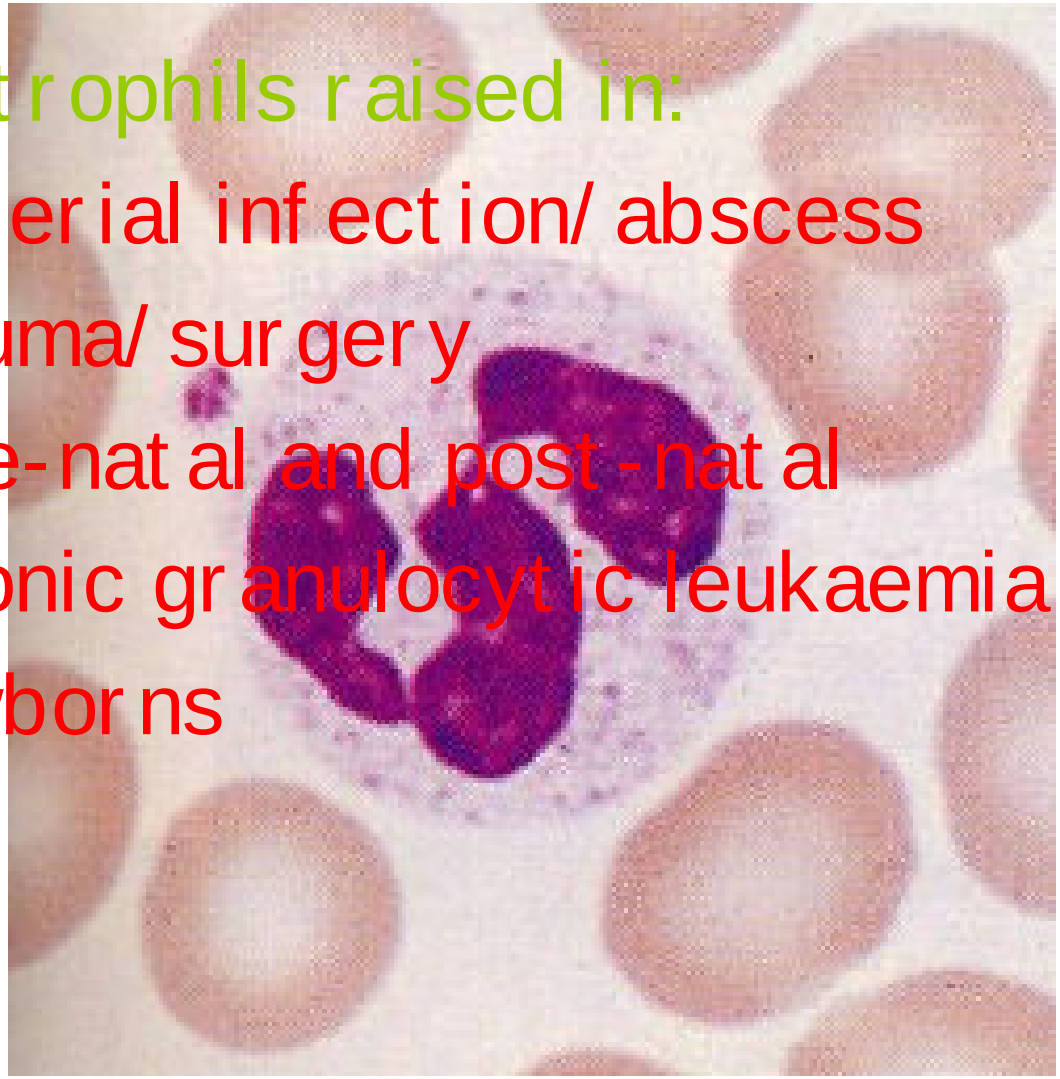



Basophil

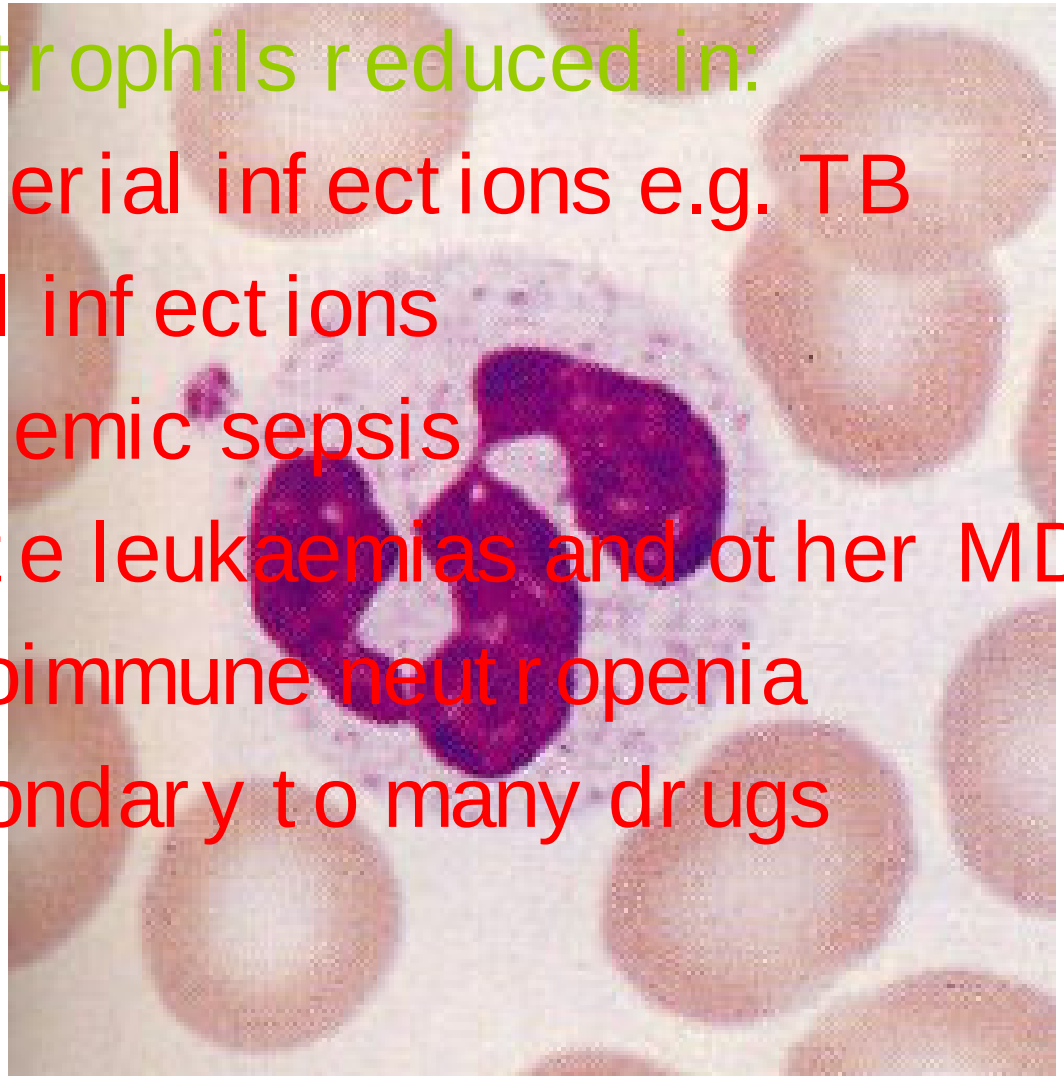
- Normal ranges white cells:

- Neutrophils 2.5-7.5
- Lymphocytes 1.0-3.5
  - Higher in children under 10 years old
- Monocytes 0-1.0
- Eosinophils 0.04-0.4
- Basophils 0-0.1

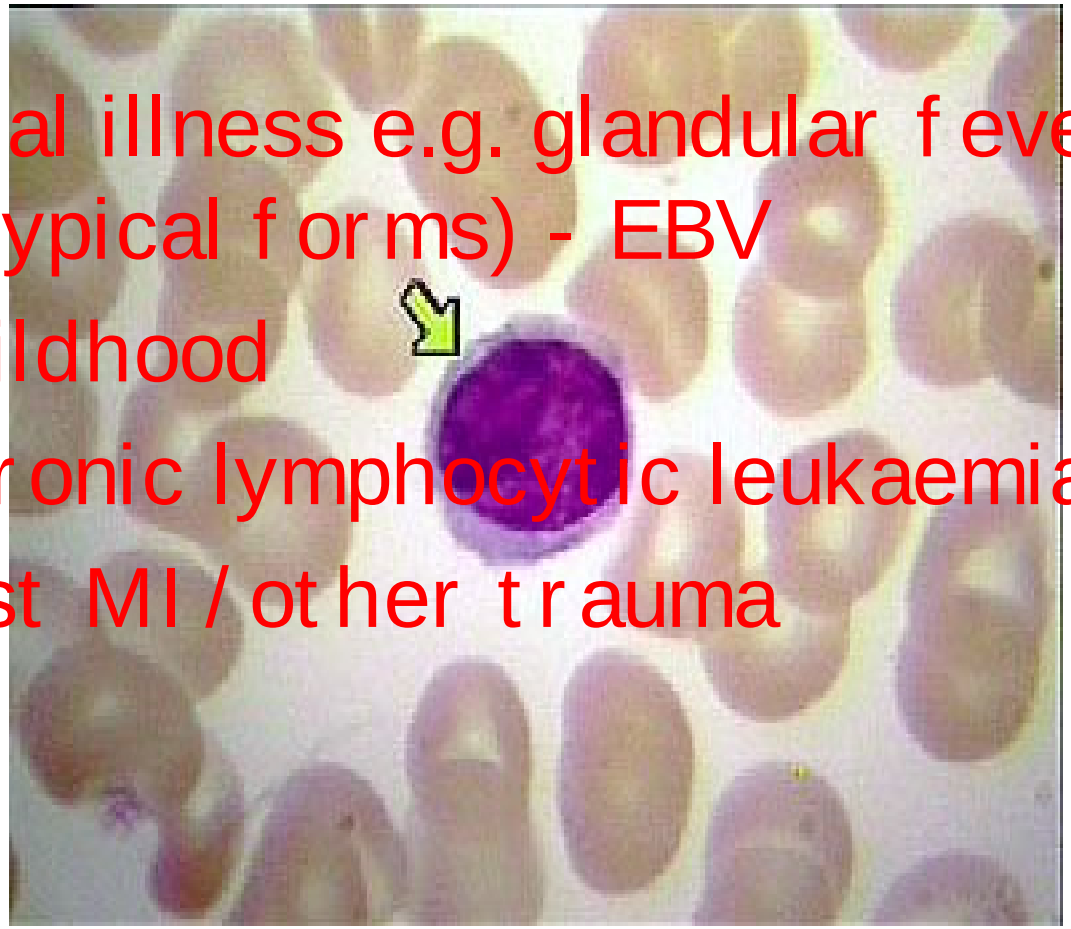
- Neutrophils raised in:
- Bacterial infection/ abscess
- Trauma/ surgery
- Ante-natal and post-natal
- Chronic granulocytic leukaemia
- Newborns



- Neutrophils reduced in:
- Bacterial infections e.g. TB
- Viral infections
- Systemic sepsis
- Acute leukaemias and other MDS
- Autoimmune neutropenia
- Secondary to many drugs

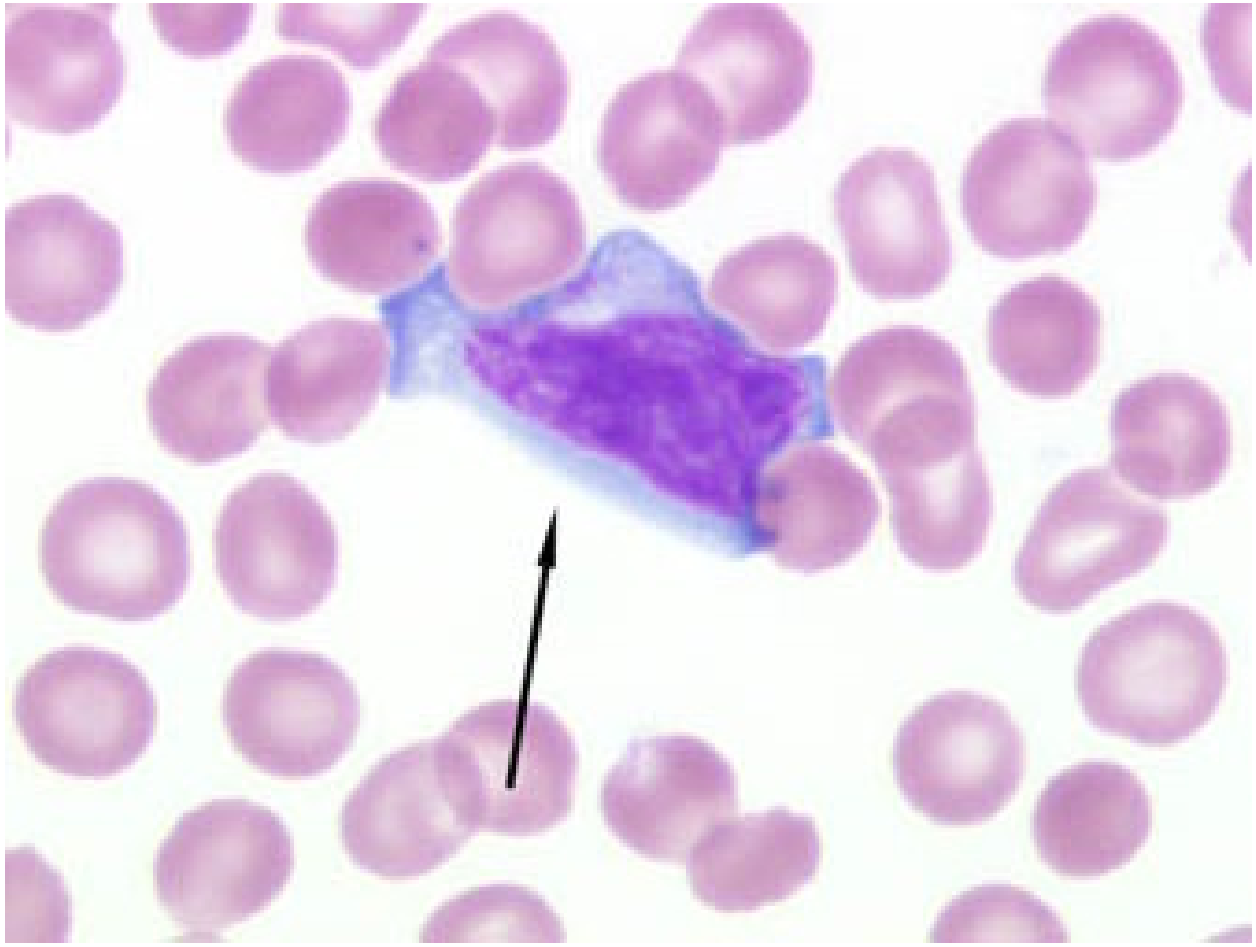


- Lymphocytes increased in:



- Viral illness e.g. glandular fever (atypical forms) - EBV
- Childhood
- Chronic lymphocytic leukaemia
- Post MI / other trauma

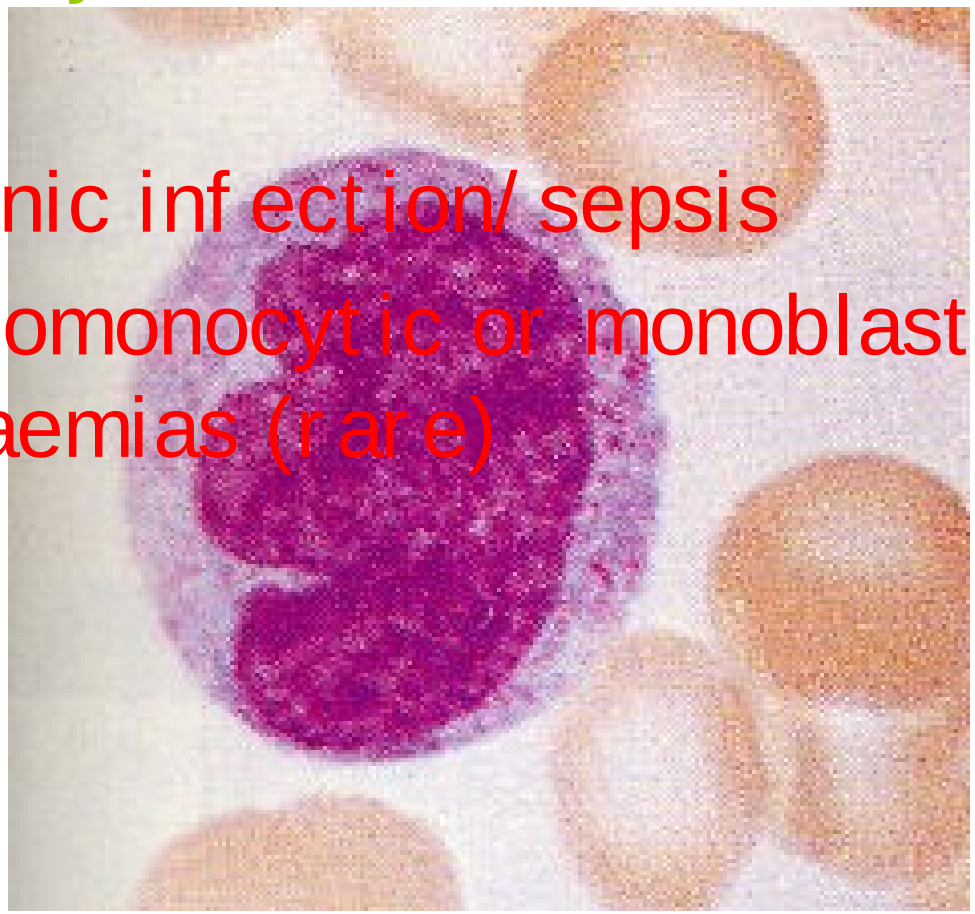
- Glandular fever atypical lymphocyte (Downey cell)



- Lymphocytes reduced in:

- Very few situations, but the HIV virus destroys the CD4 lymphocytes

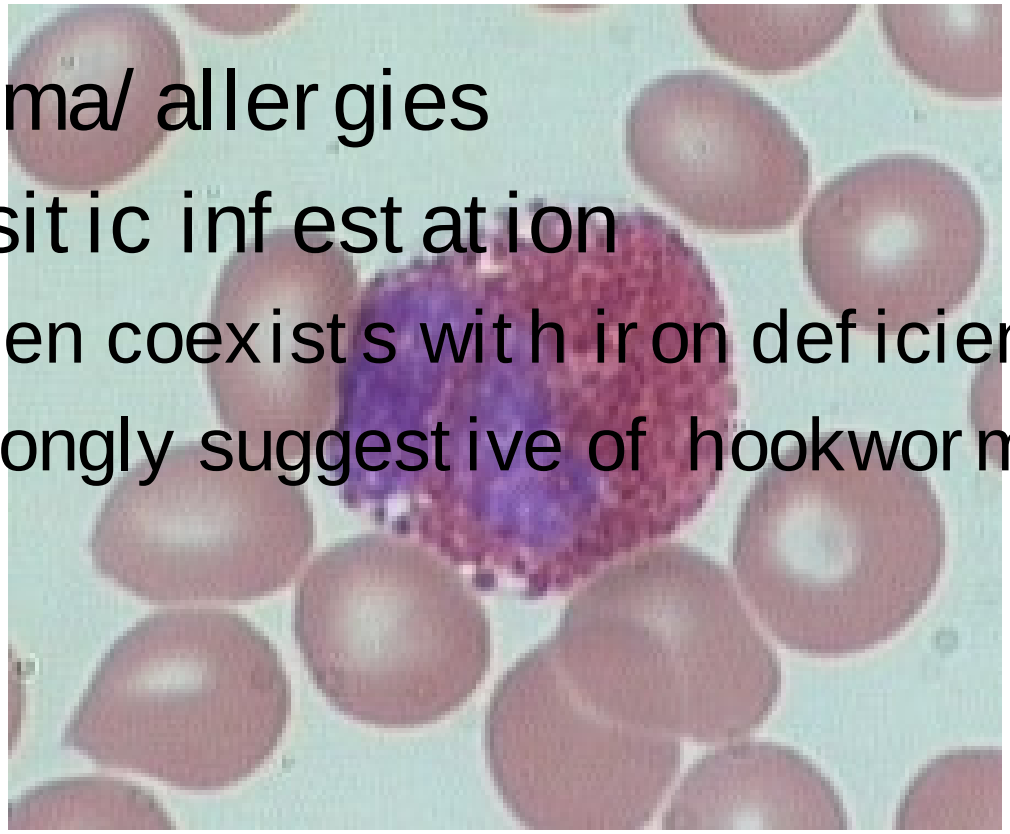
- Monocytes increased in:



- Chronic infection/sepsis
- Myelomonocytic or monoblastic leukaemias (rare)

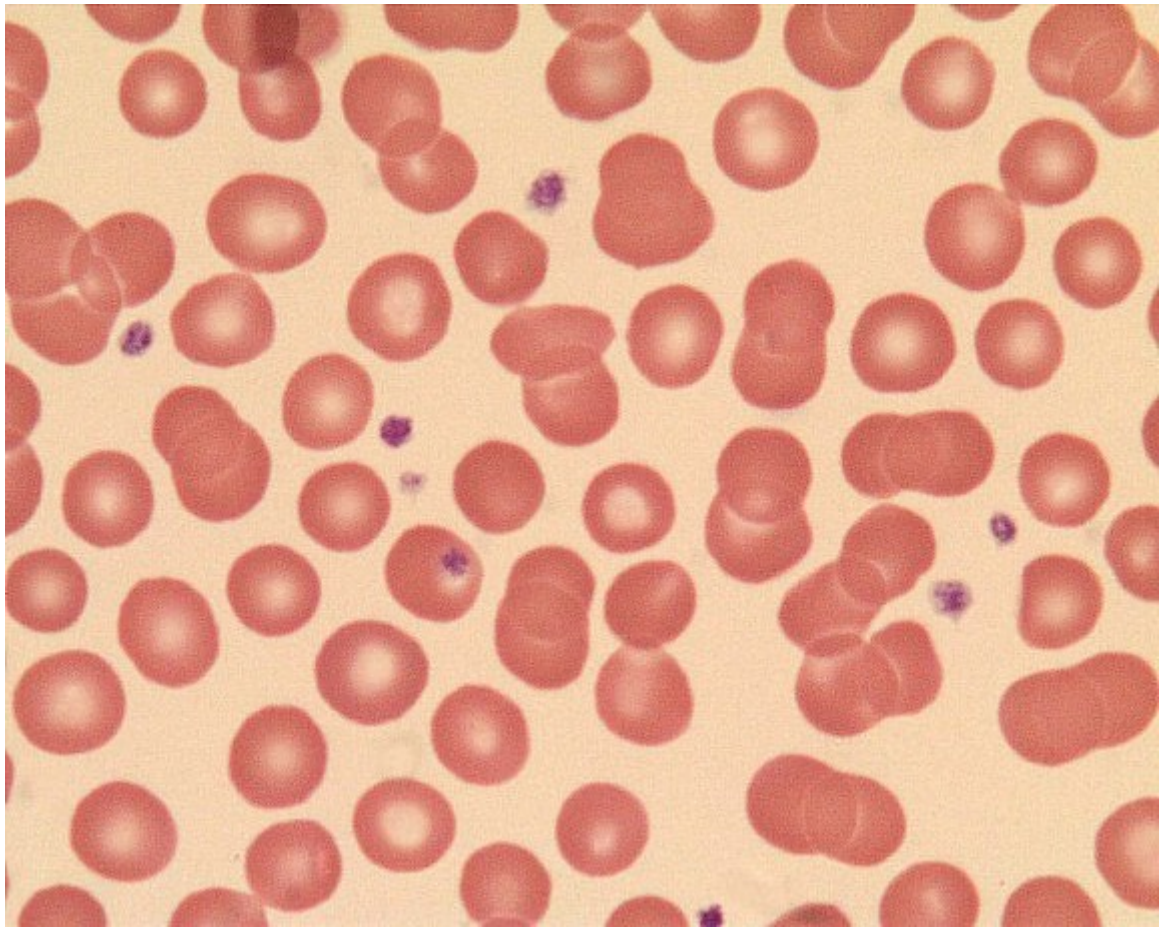
- Eosinophils increased in:

- Asthma/ allergies
- Parasitic infestation
  - often coexists with iron deficiency
  - strongly suggestive of hookworm

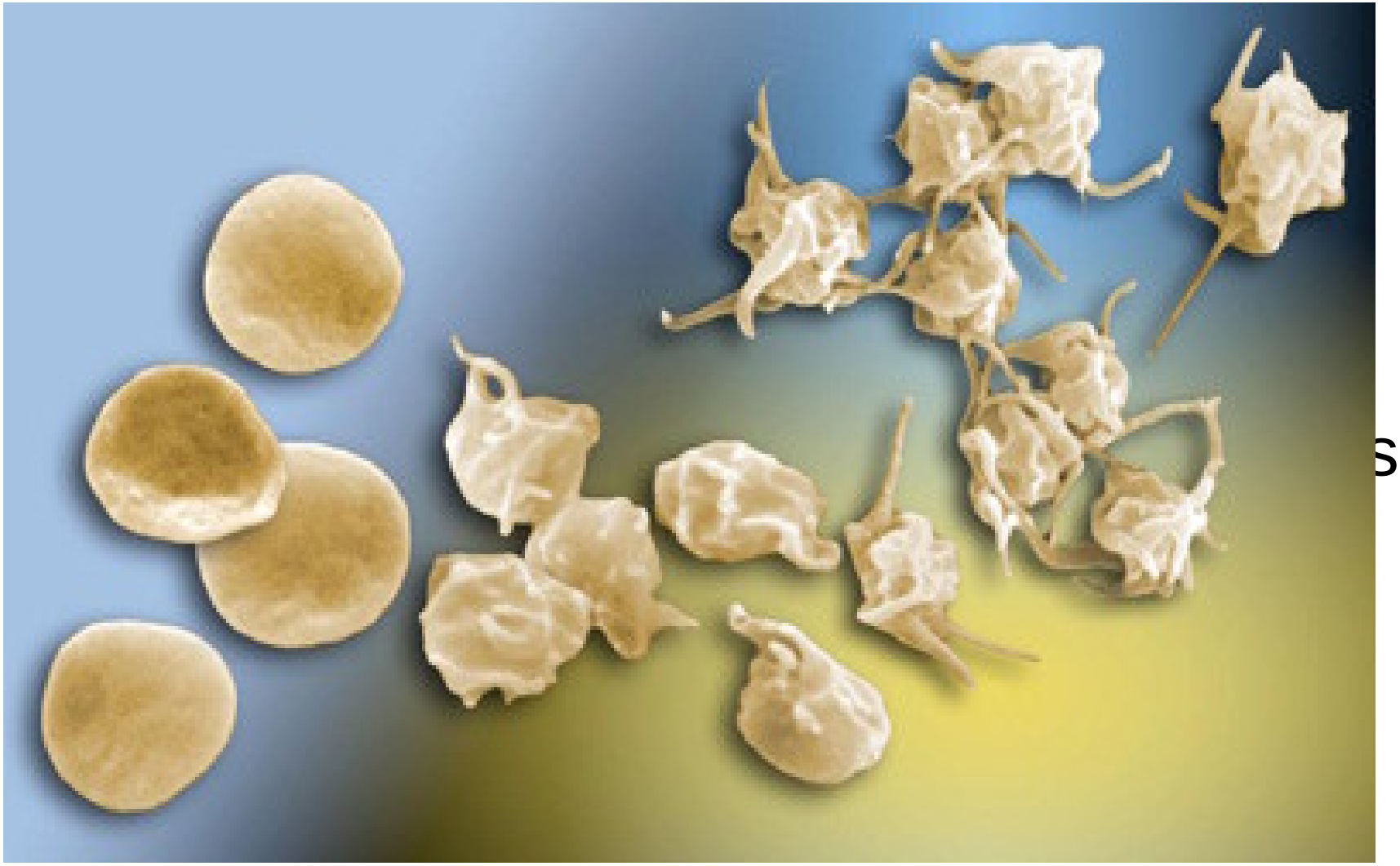


Platelets

- Normal range for platelets:
  - 150 - 400 x 10^9/L



Platelets



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- Platelet count increased in:

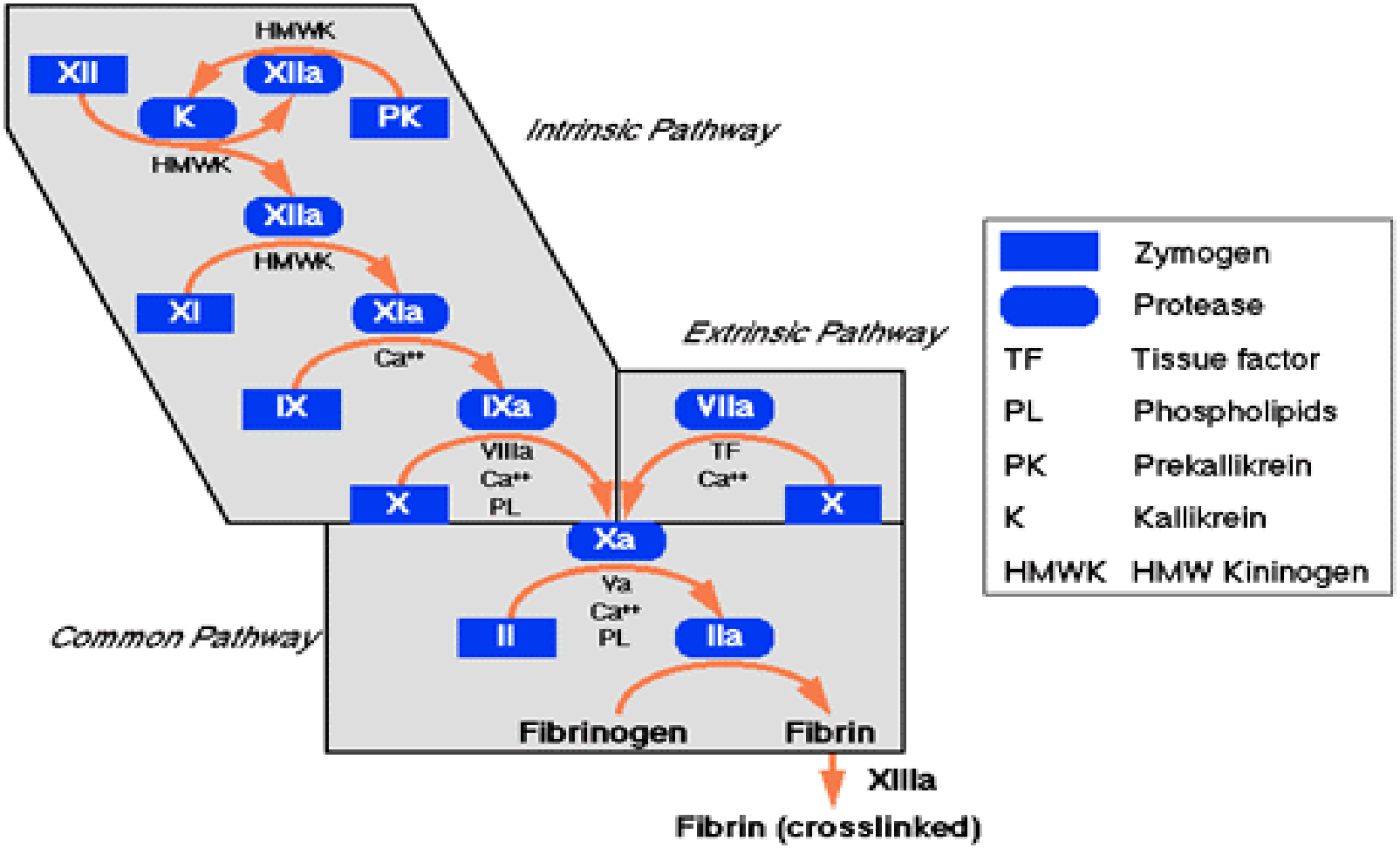
- Essential thrombocythaemia (ET)
- CGL
- Response to bleeding or other conditions e.g. malignancy, inflammation

- Platelet count decreased in:

- Clotted sample/ platelet clumping
- Idiopathic Thrombocytopenic Purpura
- Viruses e.g. Parvo, G.F.
- Alcoholics
- Acute leukaemias
- D.I.C.
- Chemotherapy or other Rx

Blood Coagulation

Simple coagulation 'cascade':



- Routine tests used in pre-op assessment of coagulation mechanism:

- (Platelet count)
- Prothrombin time ⇨ INR
- APTT
- Fibrinogen

- Prothrombin time measures extrinsic coagulation pathway
- Factors made by liver
- Monitors oral anticoagulation (Warfarin, phenindione, dindevan)
- Also used in liver disease/ ODs
- The INR is derived from this test

- APTT measures intrinsic coagulation pathway
- Used to monitor IV anticoagulation (unfractionated heparin - NOT clexane)
- and screen for factor deficiencies e.g. haemophilia

Any Questions?

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Thanks for listening!