EBMT European Society for Blood and Marrow Transplantation

Relevance of haematological values, sensitivity levels- focusing on Full Blood Counts (FBC)

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No conflict of interest

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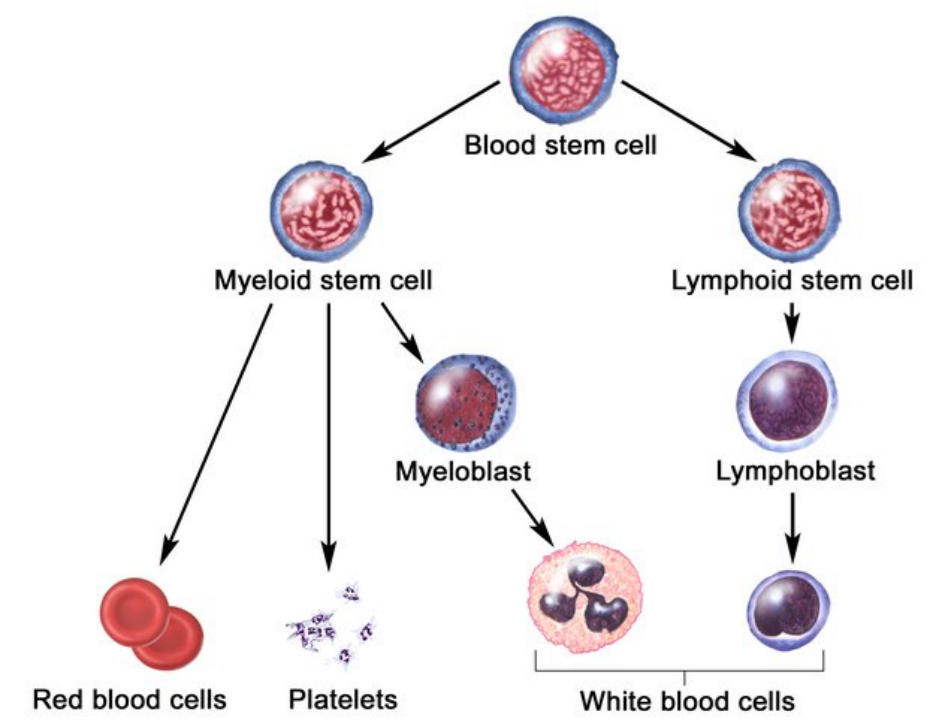
Agenda/Learning Outcomes

- What is included in a Full Blood Count (FBC)
- Normal ranges
- Use of FBC in:
  - Diagnosis
  - During treatment
  - Transplant
  - Engraftment

Full Blood Count

Looking at the number of cells
that are produced by stem cells
which are found in the bone marrow

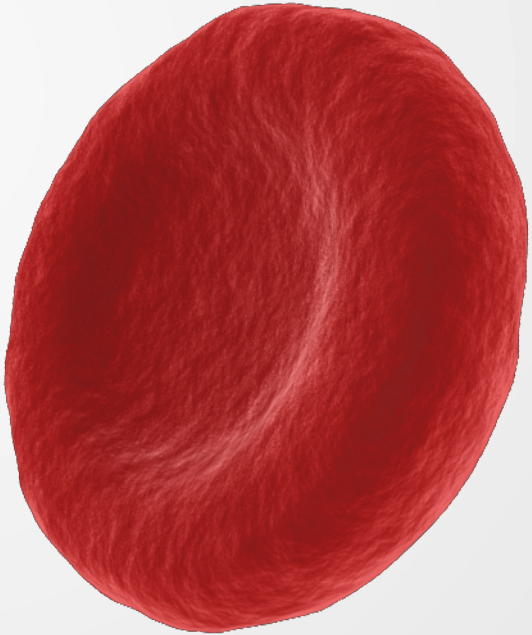
Stem cell=Mother cell



RED CELLS
Haemoglobin (Hb)

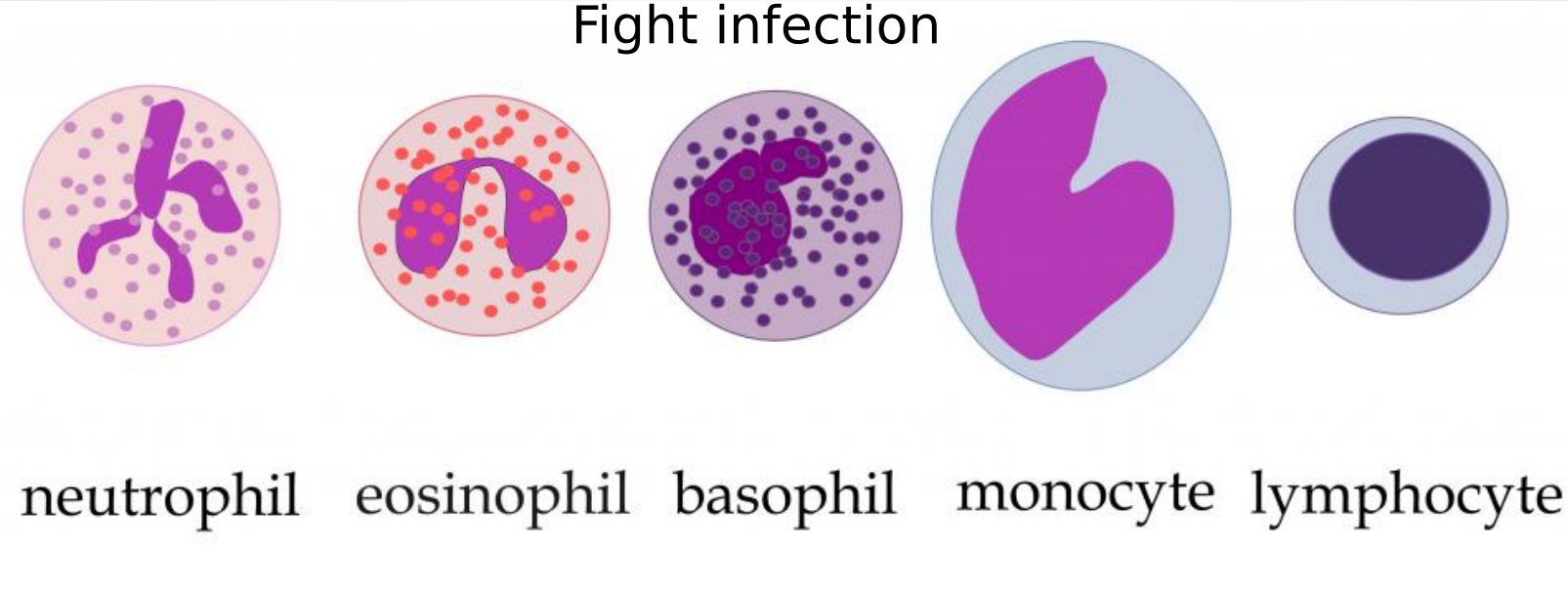
- Normal Hb levels are **130-180g/L (in men) and 120-165g/L (in women)**

Carries oxygen around the body



WHITE BLOOD CELLS (WBC)

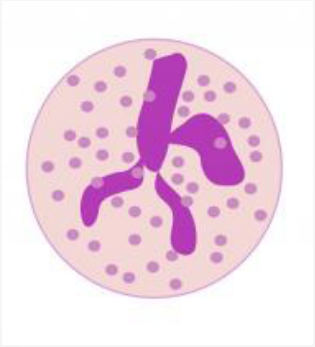
- A normal total white blood cell level is 4-11 10^9/l

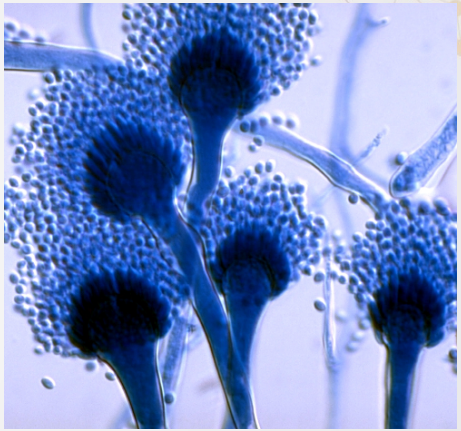


Neutrophil

A normal neutrophil level is **2.0-8.0 x10^9/L**

Bacteria Streptococcus

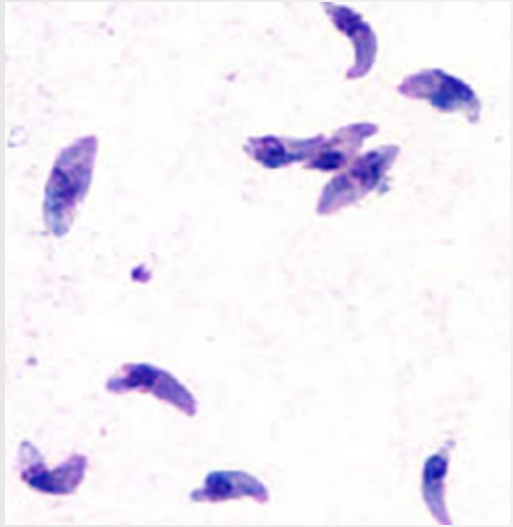


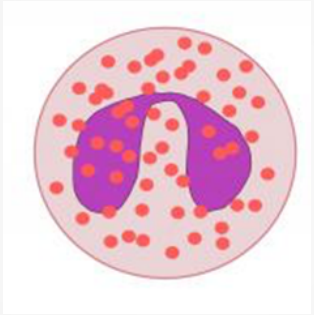


Fungus Aspergillus

- 60-70% of the circulating white blood cells
- They are usually first responders to microbial infection
- Their activity and death in large numbers form pus

Eosinophil



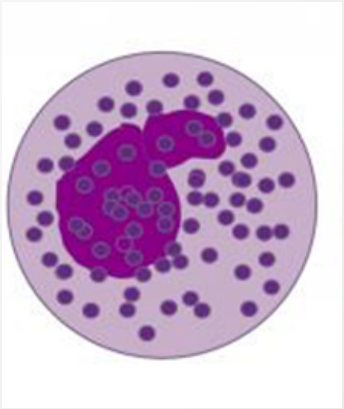


Parasites **Toxoplasma**

- Inflammatory cells in allergic reactions
- 2-4% of the WBC total

Basophil

- Allergic and antigen response
- 0.5% of the WBC total count
- They excrete two chemicals that aid in the body's defences:
- Histamine
- Heparin.

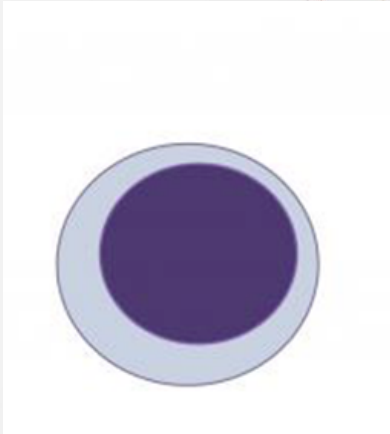


Monocyte

- Similar vacuum cleaner (phagocytosis) function as neutrophils
- Present pieces of pathogens (bacteria, fungus etc) to T cells so that the pathogens may be recognised **again** and killed

Lymphocyte

- Much more common in the lymphatic system than in blood
- **B cells, T cells and Natural killer cells**
- Highly specialised defender cells
- These selected cells then quickly multiply, creating an army of identical cells to fight the infection. Special types of T- and B-cells 'remember' the invader, making you immune to a second attack.
- In particular viral infections,



Platelets

Normal platelet count 150-400 10^9/l

- Clots the blood
- Stops bleeding

Meet the patient Lucy

- 35 YO Female presented to GP feeling generally unwell FBC results show
- Hb: 10
- WBC: 13.8
- Neuts: 2.09
- Plts: 148

Think…

- The slightly low HB could just be anemia, check some other blood tests, Iron, folate, Vitamin b12 all help produce the red blood cells

- High WBC, sign of infection? Check CRP

Full Blood Count use in diagnosis.

- Abnormal FBC results however leads to a referral to a haematologist who completes film and bone marrow.
- Diagnosis of Acute Myeloid Leukemia is made

- Lucy goes on to have a course of chemotherapy treatment

Monitoring of FBC during treatment

- Chemotherapy targets all rapidly dividing cells

- All 3 cell lineages are affected often leading to pancytopenia

What are the acceptable ‘low counts’

- When should they treated?
- How should they be treated?

Red Cells

- <80 10^9/l
- Unless bleeding, feeling symptomatic
- Fatigue, dizzy, thumping in ears
- Short of breath

- Specific to each patient
- Support with a blood transfusion

Platelets

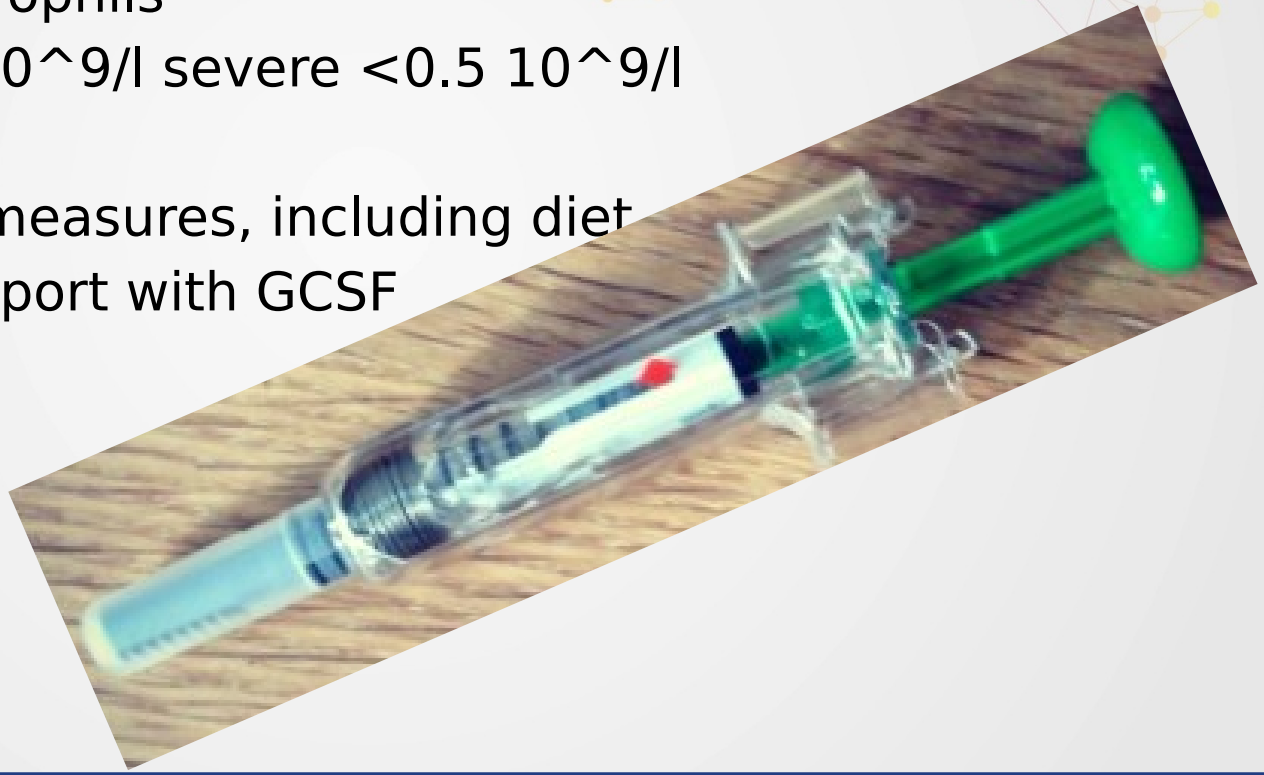
- <20 10^9/l

- Would support with a platelet transfusi
- <20 – high risk of bleeding/ haemorrha
- Actively bleeding
- Septic
- Going for a procedure line insertion endoscopy >50

White Cells

- In particular neutrophils
- Neutropenia <1 10^9/l severe <0.5 10^9/l

- Infection control measures, including diet
- If appropriate support with GCSF



Lucy

- Lucy is at home following a course of chemotherapy.
- She calls the hospital saying she had her last chemotherapy 10 days ago and has a temp of 38c and feeling short of breath
- Advised to come to hospital immediately

Blood Results

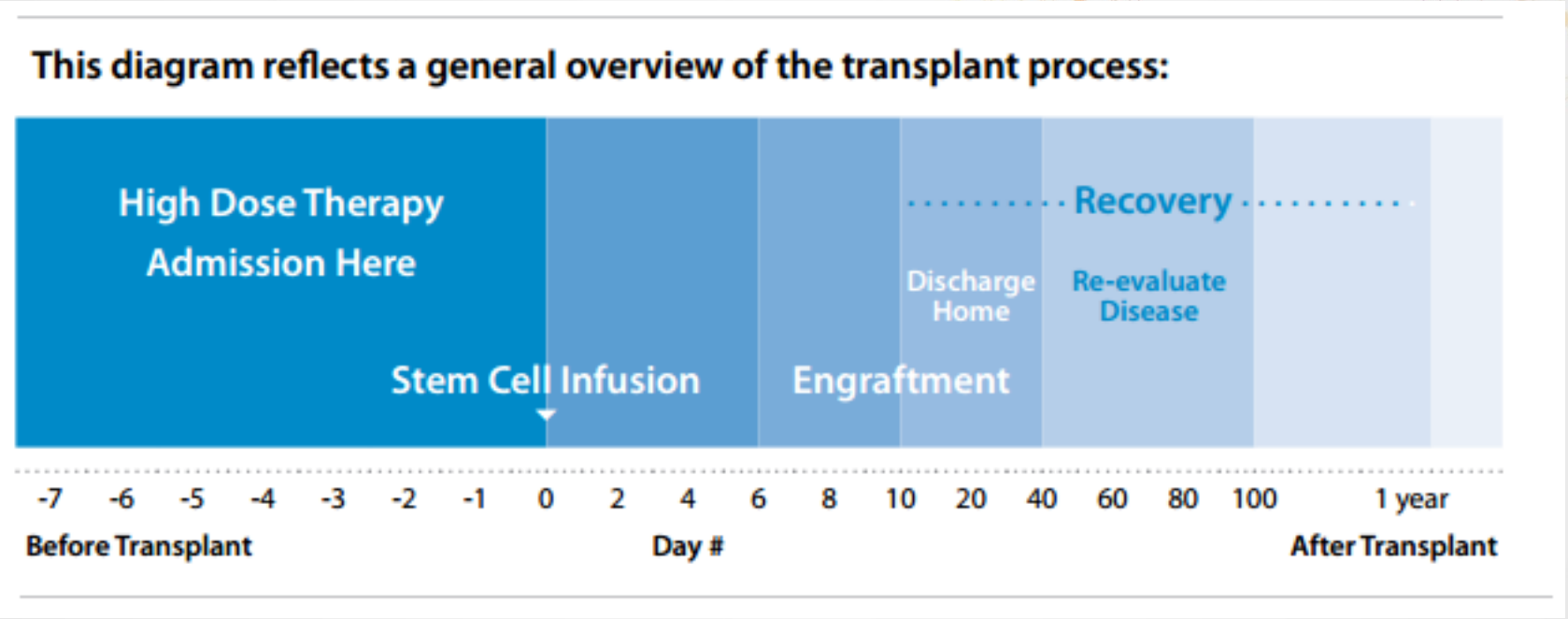
- FBC taken
- Hb: 79, platelets: 12, neutrophils: 0.1
- Treated with IV antibiotics for neutropenic sepsis
- Platelet and blood transfusion given

Post Chemotherapy

- We would expect the marrow to regenerate FBC counts pick up and be stable

Can go on to next course of treatment, which for Lucy will be an allogeneic transplant.

Bone Marrow Transplant Time Line

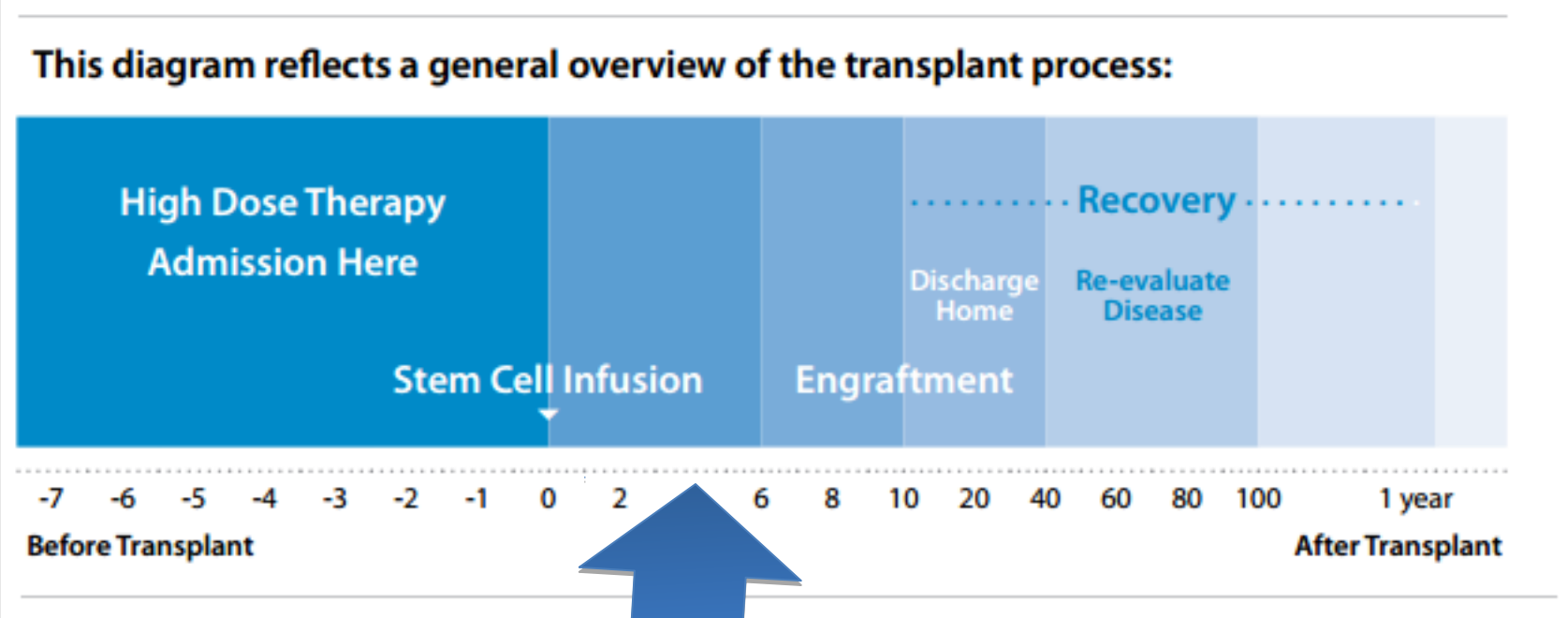


FBC during BMT

- Course of chemotherapy is given to prepare the marrow- Clear the marrow. Usually about 7 days
- The objective of conditioning therapy is to:
  - destroy the patient’s stem cells to make ‘space’ in the bone marrow cavity for the donor cells.
  - kill any residual cancerous (malignant) cells.
  - suppress the patient’s immune system to reduce the risk of graft rejection.

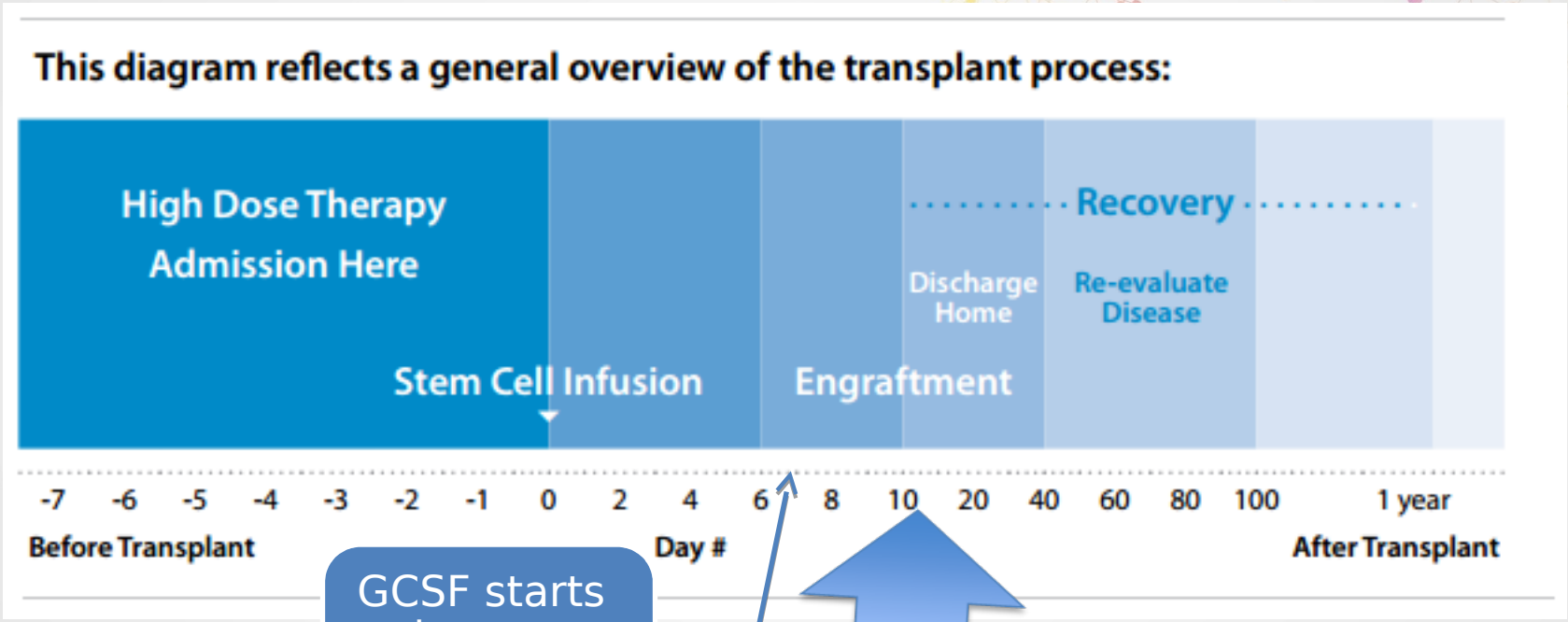
- We would expect counts to be stable until the effects of the treatment takes hold

When would we expect FBC to drop..



- Expect pancytopenia
- Support the patient

Engraftment



Engraftment

- After the transplant, the donor stem cells make their way to the bone marrow. There they will start to grow and mature into normal blood cells
- **This is called engraftment**
- Engraftment of the stem cells usually takes around 10 to 20 days, depending on the type of stem cells used- but this is likely to be different for different patients

Neutrophil Engraftment

- The first of three days with neutrophil count > 0.5 x 10^9/L
- This is when the patient can be discharged.

Platelet Engraftment

- Platelet engraftment was defined as the first of three consecutive days post-transplant **unsupported** platelets, with counts >20, 10^9/l

- No platelet transfusion for 7 days above 20 for 3days. Makes this difficult to document/confirm… contact blood bank to check

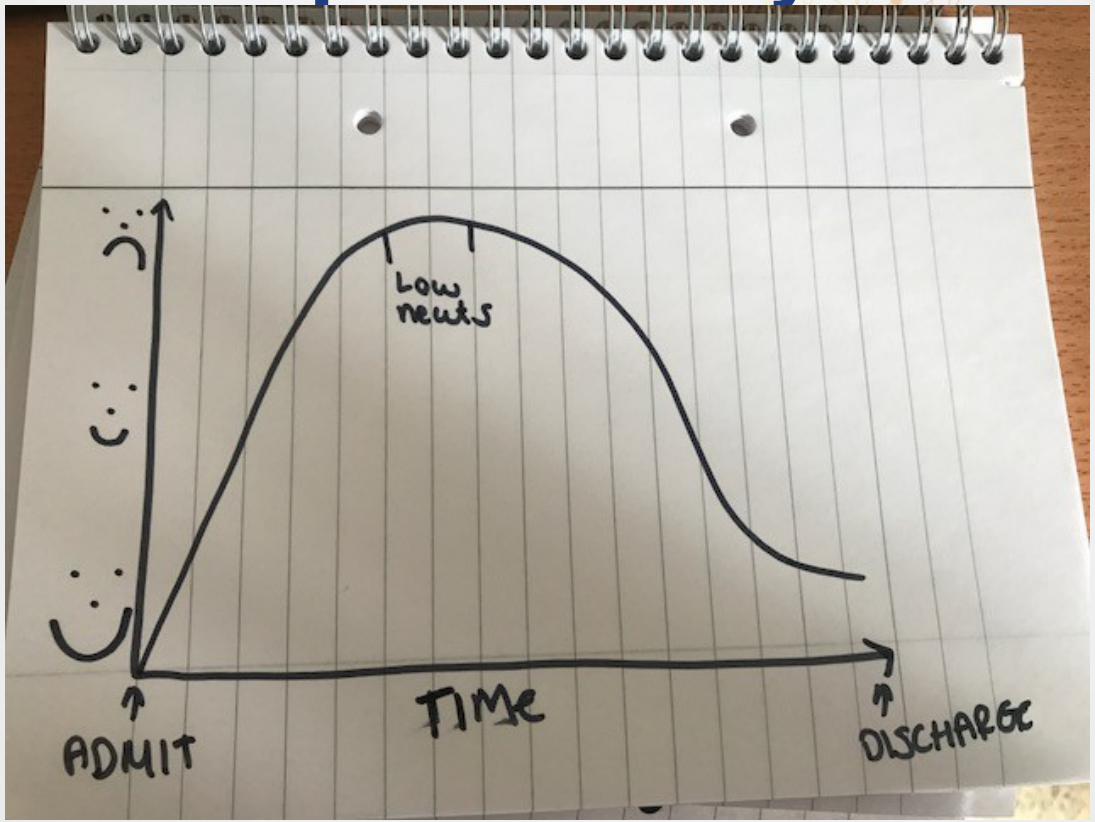
Engraftment Time

- CD34 count
- Cell source (BM vs PB vs cord)
- Conditioning (MAC vs RIC)
- Infection
- Immunosuppression
- Use of medication
- Age

Lucy

- Had 10/10 CMV and ABO matched allogeneic transplant.
- Limited complications during inpatient stay. Expected and treated infections
- FBC:
- On Admission day -7 Hb111, WBC 3.85, Plts 230, neuts 2.35 (recovered from last chemo)
    - Day 0 Hb 94. WBC 2.76 Plts 158 neuts 2.63
    - Day+7 Hb 81, WBC 0.06 Plts 34 neuts 5.95
- Engraftment happened over days +11 neuts 0.75, +12 1.54, +13 5.95
- Discharged day +13

How does the patient feel during their inpatient stay



Aim of the BMT

- The final endpoint is a fully functioning bone marrow producing normal cell lines for red blood cells, white blood cells and platelets, including all of the different types of white cells - lymphocytes, granulocytes and monocytes
- No malignant cells

Continued FBC monitoring post BMT

- Twice weekly immediately post BMT
- This reduces down.
- May still require blood product support and high risk of infection.

Fluctuation of FBC counts post BMT

Continued lifelong monitoring

- Disease relapse - change in FBC count can be first sign, prompt us to do a bone marrow
- Graft loss or failure - falling counts - primary and secondary
- Chimerism testing - % donor cells v own cells

FBC in Autologous Transplant

- Autologous – Own cells are used
- Harvested previously and stored ready for use

- Allows us to give really high dose chemotherapy
- Causing FBC to drop – probably beyond repair
- Rescue with harvested stem cell allowing the FBC to recover

Remember and take home:

Its not all about the numbers

Treat the patient not the number

FBC and patient relationship

Not so simple really!

Conclusion

- FBC is such a ~~simple~~ test but it tells us so much
- Can point us in many directions for patient treatment

Thanks for listening.

ANY QUESTIONS?