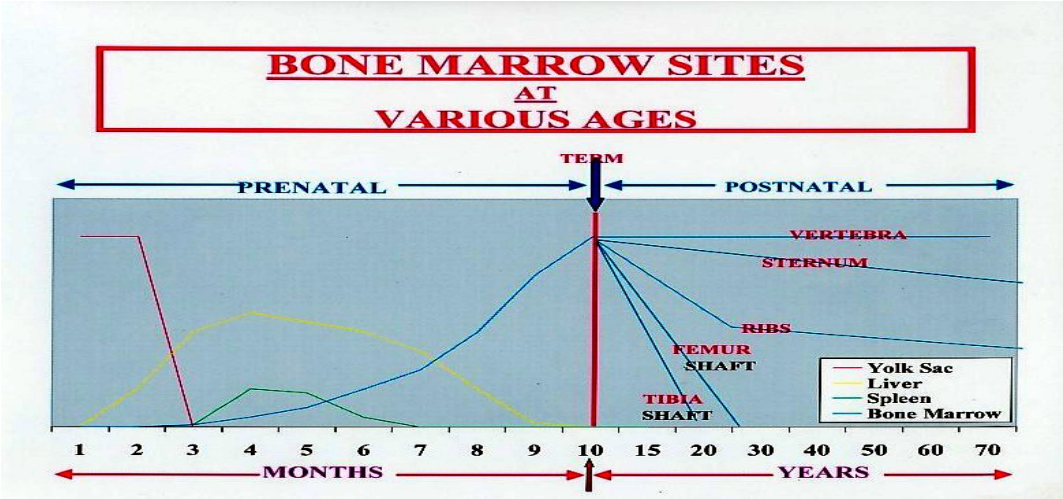
HEMATOLOGY

The first lecture HAEMATOPOIESIS AND CLASSIFICATION OF ANAEMIA



Site of Hemopoisis

0-6 week's → Yolk sac
6 weeks – 6 months → liver + spleen (fetal life)
6 months – adult life → Bone Marrow

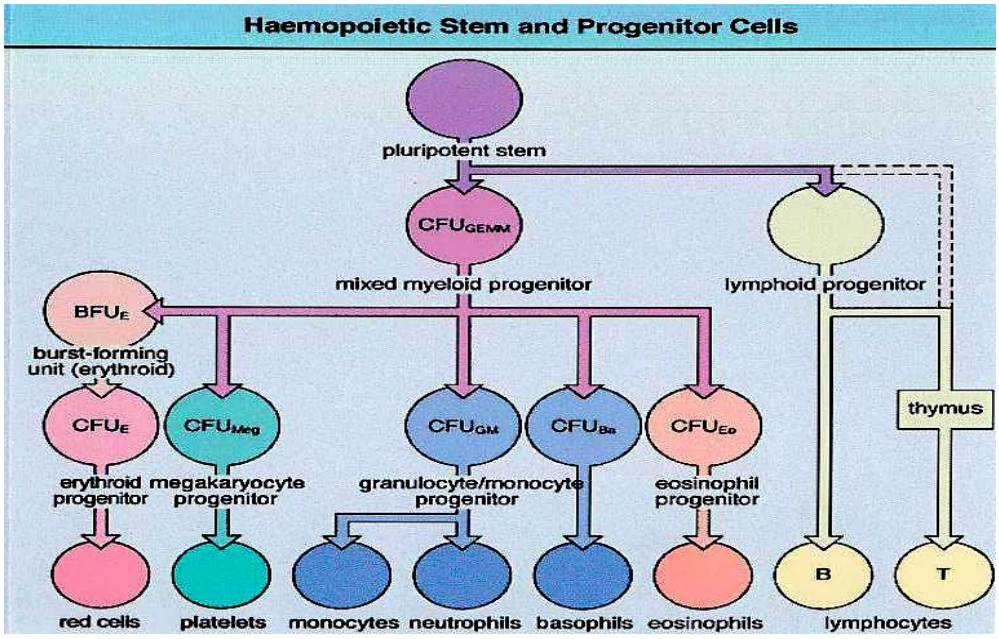
- ✓ IN Fetus ALL BONES
- ✓ IN Adults ONLY flat bones + the PROXIMAL end of LONG LIMB BONES

- ☒ In Fetus the Marrow is Highly CELLULAR
- ☒ In Adults 50% Marrow cells + 50% FAT

  - In Adults when blood is needed in Extra amount the cellular component of the marrow increases + viscera are involved e.g. " Liver and Spleen "

Stem cell

In the Bone Marrow a 'Pluripotent' stem cell gives rise to all blood cells
Proliferation and differentiation are stimulated by different Growth Factors e.g. GM-CSF Erythropoietin and Thromopoient



- Monocytes & neutrophils both originate from a common progenitor
- One pronormoblast gives 16 reticulocytes that gives 16 red cells
- Targets for erythropoiesis:
    - BFU_E
    - CFU_E
    - Pronormoblast

Neutrophilia

- ✓ Acute infections:
  Bacterial, viral, fungal, mycobacterial and rickettsial
- ✓ Physical stimuli:
  Trauma, electric shock, anoxia, pregnancy
- ✓ Drugs and chemicals:
  Corticosteroids, aetiocholanolone, adrenaline, lead, mercury poisoning, lithium
- ✓ Hematological causes:
  Acute haemorrhage, acute haemolysis, transfusion reactions, post-splenectomy, leukaemia and myeloproliferative disorders.
- ✓ Malignant disease:
  Carcinoma, especially of gastro-intestinal tract, liver or bone marrow
- ✓ Miscellaneous conditions:
  Certain dermatoses, hepatic necrosis, chronic idiopathic leucocytosis

Lymphocytosis

Non-Malignant causes

- ✓ Virus infections:
  Infectious mononucleosis
  Infectious lymphocytosis
  Cytomegalovirus infection
  Occasionally mumps, varicella, hepatitis, rubella, influenza
- ✓ Bacterial Infections:
  Pertussis
  Occasionally cat-scratch fever, tuberculosis, syphilis, brucellosis
- ✓ Protozoal infections:
  Toxoplasmosis
  occasionally malaria
- ✓ Other rare causes:
  Hyperthyroidism, congenital adrenal hyperplasia

Monocytosis

- ✓ Chronic bacterial infections:
  Tuberculosis, subacute bacterial endocarditis, brucellosis
- ✓ Other Specific Infections:
  Malaria, Kala-azar, trypanosomiasis, typhus, Rocky Mountain spotted fever
- ✓ Malignant diseases:
  Hodgkin's disease, carcinoma
- ✓ Leukaemia:
  Acute myeloid leukaemia, chronic monocytic leukaemia
- ✓ Neutropenias:
  Familial benign and severe neutropenia
  Cyclical neutropenia
  Drug-induced Agranulocytosis
- ✓ Miscellaneous:
  Cirrhosis, systemic lupus erythematosus, rheumatoid arthritis

Eosinophilia

- ✓ Allergic reactions:
  Asthma, hay fever, urticaria, angioneurotic oedema
- ✓ Parasitic Infestation:
  Tissue parasites – trichinosis, filariasis, visceral larva migrans, etc..
  Intestinal parasites – Ascaris, Taenia, etc. (less regularly)
- ✓ Skin disorders:
  Pemphigus, pemphigoid, eczema, psoriasis, (dermatitis herpetiformis)
- ✓ Drug hypersensitivity reactions:
  Especially iodides, penicillin, allopurinol, gold salts, tartrazine
  Loffler's pulmonary syndrome and Loffler's endomyocarditis
  Tropical eosinophilia (probably filarial)
- ✓ Malignant diseases:
  Especially Hodgkin's disease, carcinoma of ovary, lung stomach, angioimmunoblastic lymphadenopathy.
- ✓ Following irradiation or splenectomy:
  Hypereosinophilic syndromes
  Eosinophilic leukaemia
- ✓ Miscellaneous Conditions:
  Polyarteritis nodosa, ulcerative colitis, sardoidosis, scarlet fever, pernicious anaemia, chronic active hepatitis, eosinophilic granuloma, familial eosinophilia

Leukaemoid Reactions or LeucoerythroblasticAnaemia

- ✓ Severe infections, especially in children:
  a. Pneumonia, septicaemia, meningococcal meningitis
  b. Infectious mononucleosis, pertussis
- ✓ Intoxications:
  Eclampsia, severe burns, mercury poisoning
- ✓ Neoplasia:
  Especially with bone-marrow infiltration
- ✓ Severe haemorrhage or haemolysis

Neutropenia

- ✓ Drugs:
  Selective neutropenia
  Agranulocytosis (Aplastic anaemia)
- ✓ Infections:
  Viral – including hepatitis, influenza, rubella
  Bacterial – typhoid fever, brucellosis, miliary tuberculosis
  Rickettsial and protozoal infections (Sometimes)
- ✓ Megaloblastic anaemia:
  Vitamin B^{12} or folate deficiency
- ✓ Chronic neutropenia:
  Chronic idiopathic neutropenia
  Immune neutropenia
  Congenital neutropenias
  Cyclical neutropenia

- ✓ Hypersplenism:
  - Primary
  - In association with cirrhosis, Felty's syndrome, etc.
- ✓ Ionizing radiation and cytotoxic drugs:
  - Radiotherapy
  - Alkylating agents, antimetabolites, others
- ✓ Malignant disease:
  - Acute leukaemia
  - Leuco-erythroblastic anaemia due to metastatic carcinoma, multiple myeloma or lymphoma
- ✓ Micscellaneous conditions:
  - Systemic lupus erythematosus, myxoedema, hypopituitrism, iron deficiency, anaphylactic shock

<u>Lymphopenia</u>

Secondary Causes

- ✓ Loss:
  - Mostly from gut as in intestinal lymphangiectasia, Whipple's disease and rarely Crohn's disease
  - Thoracic-duct fistula
- ✓ Maturation:
  - Primary, or secondary to gut disease
  - Vit B12 or folate deficiency
  - Zinc deficiency
- ✓ Pharmacological agents:
  - Antilymphocyte globulin
  - Corticosteroids
  - Cytotoxic drugs
- ✓ Infections:
  - Severe septicaemias
  - Influenza, occasionally other virus infections
  - Colorado tick fever
  - Miliary tuberculosis
- ✓ Other miscellaneous conditions:
  - Collagen vascular diseases, especially SLE
  - Malignant disease
  - Other conditions with lymhocytotoxins
  - Radiotherapy
  - Graft-versus-host disease

Anemia

Definition:

It is a Reduction of the Hemoglobin Concentration of the peripheral blood below the lower limit of the reference range for the Age and Gender.

- ✓ Adult Males < 13.5 g/dl
- ✓ Adult Females < 11.5 g/dl

Cases of Anemia

- ✓ Reduction of plasma volume
- ✓ Increase in plasma volume
- ✓ Acute major blood loss

Clinical features

- ☒ It depends on speed of on set, severity and age
- ☒ If it is rapid it will have more symptoms
- ☒ Mild anime usually have no symptoms at rest

Symptoms

- ✓ Shortness of breath
- ✓ Weakness
- ✓ Lethargy
- ✓ Palpitation
- ✓ Headache
- ✓ Cardiac failure, angina, intermittent claudicating or confusion especially in elderly

Signs for anemia:

- ✓ Koilonychias → iron deficiency anemia
- ✓ Jaundice → hemolytic anemia
- ✓ Leg ulcers → sickle cell anemia

Reduction in Hb

⇩

Tissue hypoxia

⇩

Compensatory changes

Circulatory	Biochemical	Marrow
↑Hart rate and output Dilation of arterioles and ↑ rate of circulation This will lead to ↑ *tisse perfsion*	↑ 2,3 DPG in red cells This will lead to Affinity of Hb for O2 reduced in peripheral circulation and will lead to *easier transfer to tissue*	It will increase the production because of the increase in *Erythropoietin* production

Aetiology

Anemia is produced by four main mechanisms. They can be divide into two main sub-divisions

i. In the marrow
   - Actual diminution in productive marrow → Hypoplastic Anemia
   - Marrow unable to produce sufficient normal red cells usually due to deficiency of an essential factor e.g. iron and vit B12

ii. In the circulation
   - Excessive loss of RBCs due to hemorrhage → Acute post hemorrhagic anemia
   - Excessive destruction of RBCs by the macrophage system in the spleen → Hemolytic Anemia