Types of Anaemias and their Management

PSJ CE – Mandeville Hotel
April 27, 2014
Objectives

At the end of the presentations participants should be able to:

1. Define the term Haematopoiesis
2. Understand the diagnostic and laboratory parameters for evaluating Haematopoetics cells
3. Differentiate the types of Anaemias
4. Recommend and evaluate the treatment for the different types of Anaemias
5. The pharmacist role in the management of Anaemia.
Haematopoiesis

The formation and maturation of blood cells and their derivatives.

More than 6 billion cells produced per kilogram of body weight every 24 hours
Haematopoiesis

• Important to a wide array of physiologic functions
  – Haemostasis
  – Immunity
  – Oxygen delivery.

• Occurs primarily in the bone marrow
HEMATOPOIETIC SYSTEM

- Consists of three primary cell components:
  - Platelets
  - Erythrocytes – red blood cells
  - Leukocytes – white blood cells
    - neutrophils, eosinophils, basophils, monocytes/macrophages, lymphocytes, and plasma cells.
Bone Marrow

- Average human being has about 1.7L of bone marrow.

- Immature hematopoietic cells are found mainly in the bone marrow.
### Average (Normal Range) Adult Blood Cell Concentration

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td><strong>White cell count</strong></td>
<td>7,800 (4,400–11,300)</td>
</tr>
<tr>
<td><strong>Red cell count</strong> (× 106/mm³)</td>
<td>Male 5.21 (4.52–5.90)</td>
</tr>
<tr>
<td></td>
<td>Female 4.60 (4.10–5.10)</td>
</tr>
<tr>
<td><strong>Haemoglobin</strong> (g/dL)</td>
<td>Male 15.7 (14.0–17.5)</td>
</tr>
<tr>
<td></td>
<td>Female 13.8 (12.3–15.3)</td>
</tr>
<tr>
<td><strong>Haematocrit</strong></td>
<td>Male 0.46 (0.42–0.50)</td>
</tr>
<tr>
<td></td>
<td>Female 0.40 (0.36–0.45)</td>
</tr>
<tr>
<td><strong>Mean corpuscular volume</strong></td>
<td>(fl/red cell) 88.0 (80.0–96.1)</td>
</tr>
<tr>
<td><strong>Platelet count</strong> (cells/mm³)</td>
<td>311,000 (172,000–450,000)</td>
</tr>
</tbody>
</table>
Anaemia

• Definition:
  
  a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs.
Three approaches are commonly used to classify or describe Anaemias:
Morphologic Classification of Anaemias:

- **RBC MORPHOLOGY**
  - **NORMOCYTIC**
  - **Macrocytic** (MEGALOBLASTIC)
  - **MICROCYTIC**
Etiologic Classification of Anaemias:

ETIOLOGY

DEFICIENCY  CENTRAL  PERIPHERAL
Classification of Anaemias

PATHOPHYSIOLOGY

EXCESSIVE LOSS
EXCESSIVE DESTRUCTION
INTRA-RBC FACTORS
DECREASED PRODUCTION
EXCESSIVE BLOOD LOSS

ACUTE LOSS
- TRAUMA GI Bleed

CHRONIC LOSS
- GI Bleeding
- Menorrhagia
- NSAIDS Malignancy
Treatment of Acute Blood Loss

- Whole Blood
- Fresh-Frozen Plasma (FFP)
- Packed Red Blood Cells (PRBCs)
- Crystalloid Volume Expansion
  - (NaCl 0.9%)
Classification of Anaemias

**PATHOPHYSIOLOGY**

- **EXCESSIVE LOSS**
- **EXCESSIVE DESTRUCTION**
- **INTRA-RBC FACTORS**
- **DECREASED PRODUCTION**

Haemolysis
EXCESSIVE RBC DESTRUCTION

- RBC ANTIBODIES
  - Haemolytic transfusion reaction

- DRUGS
  - Drug-induced Haemolysis
  - Drug-induced Haemolysis
    - Cephalosporins*
    - Levofloxacin
    - Methyldopa
    - NSAID, Penicillin

- PHYSICAL TRAUMA
  - Artificial heart valve

- EXCESSIVE RBC REMOVAL
  - Hypersplenism
Terminologies

• **Haematocrit** - proportion of total blood volume that is composed of red blood cells. Indicates whether there is too few or too many red blood cells

• **Reticulocytosis** - where there is an increase in reticulocytes (immature red blood cell). It is commonly seen in anaemia. They are seen on blood films

• **Schistocytes** – fragments of red blood cells
Terminologies

- **Bilirubin** - a waste product of the normal breakdown of red blood cells. Higher level may indicate increase rate of RBC destruction.

- **Haemoglobinuria** – haemoglobin is found in abnormally high concentrations in the urine.

- **Haptoglobin** – bind & transport free hemoglobin to blood-forming organs. Binding with free hemoglobin causes serum (free) haptoglobin to decrease
Excessive RBC Destruction
- some consequences

- Increased free haemoglobin
- Decreased hematocrit
- Reticulocytosis (if chronic)
- Schistocytes on peripheral smear
- Increased indirect bilirubin
- Haemoglobinuria
- Decreased haptoglobin
Excessive RBC Destruction

Treatment

• Remove offending causes (drugs)
• Supportive care – transfuse PRN Hb < 8 Gm/dl
• Pain management
• Iron supplementation PRN if not transfused and if iron studies suggests deficiency
• Splenectomy if indicated, which warrants vaccination
Classification of Anemias

PATHOPHYSIOLOGY

EXCESSIVE LOSS

EXCESSIVE DESTRUCTION

INTRA-RBC FACTORS

DECREASED PRODUCTION
INTRA-RBC FACTORS

DISORDERS OF Hgb SYNTHESIS

SICKLE CELL THALASSEMIA

PORPHYRIAS

G6PD DEFICIENCY

Caution: NSAID, Tylenol, Sulfa drugs, Quinolones etc.
Sickled RBC
Thalassemia
Treatment of Disorders of Haemoglobin synthesis

- Supportive care
- Hydration (SSD)
- Analgesia (SSD)
- Transfusion
Classification of Anemias

PATHOPHYSIOLOGY

EXCESSIVE LOSS

EXCESSIVE DESTRUCTION

INTRA-RBC FACTORS

DECREASED PRODUCTION
Common Deficiencies that cause Anaemia

• Iron

• Vitamin B\textsubscript{12}

• Folate

Must differentiate to know how to treat properly.
Terminologies

Mean Corpuscular Volume (MCV)

- Focuses on the size of the cell itself
- Describes mean size of a single RBC
- Normal is 80 – 100fl **fl - femtoliter

Erythropoietin (EPO)

- The hormone that stimulates stem cells in the bone marrow to make more red blood cells. EPO is made by cells in the kidney. These cells release more EPO when blood oxygen levels are low.
Iron Deficiency Anaemia

- Decreased Hgb and haematocrit
- Decrease mean corpuscle volume (MCV) - microcytic
- Patients may or may not be symptomatic:
  - Koilonchia
  - Angular stomatis
  - Glossitis
  - Pica
Normal RBC

Microcytic RBC
Iron Deficiency Anaemia

• Further investigate

  – Ferritin = stored iron (low)

  – Serum iron = free in plasma (low)

  – Transferrin saturation = % of carrier protein saturated with iron (low)

  – TIBC = ability of transferrin to bind in vitro (high)

Several anaemias resemble iron deficiency anaemias. If ALL lab criteria are not met, the patient does NOT have iron deficiency anaemia.
Iron Deficiency Anaemia

Treatment

• Replace iron orally or parenterally (IV, IM)

  – Oral replacement
    • Consider salt form
    • Divided doses
    • Beware of decreased iron absorption
      – Food decreases absorption and F by 50%
    • Beware of drug-drug interactions
      – Quinolones
      – Thyroid hormones
        » Space 3-4 hours from iron
    • Iron needs acid to be absorbed.
    • Goal is 200mg elemental iron per day
Iron Deficiency Anaemia

Response to treatment

- HGB should increase by 1% to 2% weekly
- Reticulocytosis occurs within 3 – 4 days
- A haematocrit increase of <2% after 3 weeks is not acceptable
- Treatment to continue for 3 to 6 months (if losses cease)
Cobalamin (Vitamin B₁₂)

- Essential vitamin that is required for the development of red blood cells.

- Used to make the protective coating surrounding nerves (myelin sheath).

- Found mainly in animal based foods such as meat, poultry, milk products, eggs and fish.
Cobalamin (B\textsubscript{12}) Deficiency

- Decrease hemoglobin and haematocrit

- Increase MCV (>100fl) – *macrocytic*

- Body stores of cobalamin are very high compared to daily dietary intake

- Deficiency develops over years
Cobalamin (B$_{12}$) Deficiency

Who is at risk?

- Elderly with poor dentition
- Achlorhydric patients
- Strict vegetarians (vegans)
- Partial gastrectomy
Cobalamin (B\textsubscript{12}) Deficiency

- Further investigate
  - Decrease serum B\textsubscript{12} (cobalamin)
  - Mild leukopenia and thrombopenia maybe present
  - Decrease reticulocyte count
  - Neurologic or psychiatric abnormalities
  - Pernicious Anaemia (lack intrinsic factor)
    - Schilling test
Cobalamin (B$_{12}$) Deficiency-
TREATMENT

• If able to absorb B$_{12}$, 250mcg PO daily until normalization of haematologic parameters

• If pernicious Anaemia, 1000mcg IM daily 2-3 weeks, then 1000mcg IM weekly until normalization of hematologic parameters. Give 1000mcg IM monthly for life.
Cobalamin (B\textsubscript{12}) Deficiency - TREATMENT

• It is a medical myth that patients with pernicious anaemia can not be treated with oral B12. Dose of 1-2mg po daily x 1 to 2 weeks then 1mg po daily. Can result in adequate absorption. (d/t passive absorption which can occur if dose is high enough)

• Because of serious neurologic consequences of deficiency, both compliance and adequate response must be assessed and assured.
Caution!!

- Administration of FOLIC ACID in a $B_{12}$ deficient patient will reverse the macrocytosis but will NOT slow progression of neurologic damage.

- Always conform diagnosis with serum B12 levels.
Folate Deficiency

• Decrease Hgb and haematocrit

• Increase MCV (>100fl) - macrocytic

• Looks like B_{12} deficiency (need to differentiate)
Folate Deficiency

• Persons at risk are:
  – Elderly (poor dentition)
  – Alcoholic patients
  – Pregnant/lactating mothers w/o supplementation
Folate Deficiency

• Dietary insufficiency (lack of vegetables)
• Haemodialysis
• Drugs
  – Phenytoin
  – Rifampin
  – Barbiturates
  – Ethanol
  – Sulfasalazine or other chronic sulfonamide
    • e.g. Cotrimoxazole
Folate Deficiency

• Body stores of folate are not high compare to daily intake

• Deficiency can develop over weeks to months
Folate Deficiency

• Further investigate:
  – Low serum folate (perhaps)
  – Folate can be released from lysed cells into serum: serum conc. Will appear normal
  – Low RBC folate
Folate Deficiency –

Treatment

• RULE OUT B12 DEFICIENCY
• Administer 1 – 5mg folic po daily
• Assess
  – Recticulocytosis in 2 -4 days
  – Hbg should rise within 2 weeks
  – Hgb should be normal within two months
  – MCV will normalize over 2 months
Anaemia of Chronic Disease

- Associated with chronic illness of >2 months duration (may be less)

- Most strongly associated with inflammatory conditions or infections or malignancies
Pathophysiology of Anaemia of Chronic Disease

• Iron release from marrow is blocked

• Erythropoietin production (e.g. Anaemia of Chronic Renal Disease)

• RBC lifespan is shortened
Pharmacist role in the Management of Anaemia.

- Understand the different types of Anaemia
- How to differentiate types of Anaemia
- Know the different treatment regimens
- Be familiar with the different iron salts and their properties
- Make the correct treatment recommendation
THANK YOU