

# The Full blood count and blood film (Haemogram)

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Wherever we are in the world there never seems to be enough money for healthcare provision. So the key is to make what resources we have go as far as possible. Any laboratory test that we request should always be preceded by the questions “*Why are we making the request, what are the possible results and what decisions might those results lead us to make?*” Then we should ask “*Have we gained all possible information from that test?*”

A simple examination of the blood (with an Erythrocyte Sedimentation Rate / ESR) is probably the best example of this approach. It may appear very limited but a great deal of information can be obtained about systemic disease. Most hospitals and health centres have the facilities for these tests.

The commoner blood count and blood film abnormalities can be considered under the headings of chronic disorders, infections and diseases of the various systems. (Primary haematological diseases are excluded from the present discussion).

## Chronic disorders

Chronic disorders are often associated with a mild normochromic (or slightly hypochromic) anaemia with a haemoglobin level of around 90 - 100 g/l (9 - 10 g/100ml). Other investigations may help to define the anaemia as one arising from a chronic disorder but such tests are not likely to be readily available in South Sudan: e.g. serum iron (reduced), transferrin (reduced) and ferritin (normal or raised). There is no response to haematinics (e.g. iron, folic acid).

Such chronic disorders include:

- Infections (viral, bacterial, parasitic)
- Kidney diseases
- Malignant diseases
- Collagen diseases (e.g. rheumatoid arthritis)

The situation may be complicated by additional causes of anaemia such as:

- Haemolysis in malaria and sickle cell disease,
- Iron deficiency in hookworm infestation or as a result of gastrointestinal bleeding caused by non-steroidal anti-inflammatory drugs used for rheumatoid arthritis,

- Folate deficiency in dietary deficiency or tropical sprue.

## Infections

Common viral infections (e.g. adenoviruses, rubella, infectious mononucleosis (Epstein Barr virus) and varicella zoster) often cause a fall in white blood cell numbers (leucopenia) and, less frequently, platelet numbers (thrombocytopenia). Serious consequences are rare but occasionally thrombocytopenia will cause bleeding, which can be particularly marked in the viral haemorrhagic fevers e.g. Ebola, Marburg, Lassa.

Infection with the human immunodeficiency virus (HIV) causes a wide variety of abnormalities, especially lymphopenia, neutropenia and thrombocytopenia. Anaemia is common. Bone marrow suppression can occur due to anti-retroviral drugs such as zidovudine.

Bacterial infections are typically associated with a neutrophil leucocytosis and raised ESR. Prolonged infection can result in an "anaemia of chronic disorder".

Septicaemia can lead to fragmented red cells on the blood film and thrombocytopenia as a result of disseminated intravascular coagulation (DIC).

Infection with Mycobacterium tuberculosis may produce a variety of haematological features:

- Miliary tuberculosis (TB) is often associated with a moderate normochromic or slightly hypochromic anaemia. Rarer occurrences include pancytopenia (low red cell, white cell and platelet levels), “leukaemoid reactions” (high white cell levels with variable numbers of immature white cells on the blood film) and leucoerythroblastic anaemia (where the blood film contains small numbers of immature white cells and immature red cells) due to myelofibrosis.
- Abdominal TB, with malabsorption, can lead to a megaloblastic anaemia, with macrocytes in the blood.

• The anti-TB drug isoniazid may cause a sideroblastic anaemia<sup>1</sup>. The blood film shows a wide variety of red cell sizes, ranging from hypochromic microcytes to normochromic macrocytes, often with small numbers of stippled red cells.

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<sup>1</sup> In sideroblastic anaemia there is an accumulation of iron in the marrow erythroblasts: this appears, with special stains, as granules around the nucleus. The cells are called sideroblasts.

Parasitic infections are especially common in the Tropics:

- Hookworm infestations can cause severe iron deficiency and a hypochromic microcytic anaemia.
- Helminthic infestation can produce eosinophilia.
- Malaria is one of the commonest causes of anaemia. Neutropenia often develops as the infection progresses, and a monocytosis occasionally occurs. Thrombocytopenia is especially common in the acute stages.
- The tropical splenomegaly syndrome produces hypersplenism and hence anaemia, neutropenia and thrombocytopenia.

### Diseases of the various systems

#### Gastrointestinal disease

The commonest problem is chronic blood loss leading to iron deficiency anaemia (hypochromic microcytic red cells). The underlying cause in the Tropics is likely to be hookworm infestation but peptic ulcer and gastrointestinal malignancy are also possibilities.

A malabsorption syndrome may present with a macrocytic anaemia (megaloblastic bone marrow) arising from folate and / or vitamin B12 deficiency. The cause in the tropics may be difficult to define although tropical sprue is always likely in a traveller from overseas. Malabsorption which is always worth considering in patients who have had previous gastrointestinal surgery, and which could have produced:

- Blind intestinal loops or anastomoses between loops
- Strictures
- Fistulae
- Extensive gut resection

These structural problems lead to an overgrowth of bacteria and thence to vitamin B12 deficiency ('blind loop syndrome'). A course of a broad spectrum antibiotic may be beneficial.

#### Liver disease

Chronic liver disease can produce a mild to moderate macrocytic anaemia. This may also be associated with target red cells on the blood film and a moderate reticulocytosis. Cirrhosis associated with portal hypertension can lead to hypersplenism and pancytopenia.

A mild macrocytosis without anaemia is common in patients who drink alcohol to excess. Chronic alcoholics often have a macrocytic anaemia which may be due to a variety of causes, including:

- Dietary folate deficiency
- Gastrointestinal blood loss
- Liver dysfunction
- Direct toxic effects of alcohol on the bone marrow, which can also cause neutropenia (predisposing to infection) and thrombocytopenia (increasing the risk of bleeding).

#### Renal disease

Chronic renal failure is usually accompanied by a normochromic anaemia. There is a shortened red cell life span and red cell production is reduced. In the later stages the blood film may show 'burr' cells (irregularly contracted red cells with spiny projections on the surface).

In malignant hypertension and some other causes of progressive renal failure associated with intravascular deposition of fibrin, a microangiopathic haemolytic anaemia occurs, with fragmented red cells on the blood film.

Anaemia is less commonly seen in chronic renal failure from polycystic kidneys because these kidneys produce excess erythropoietin. White cell and platelet counts are usually normal but uraemia causes platelet dysfunction and an increased bleeding tendency. Sometimes thrombocytopenia occurs, usually related to the underlying cause of the renal failure.

#### Respiratory disease

- Asthma, in common with other forms of atopy, can be associated with eosinophilia. Other respiratory pathology producing a raised eosinophil count includes aspergillus and ascariasis infection. Allergy to drugs used in the treatment of pulmonary infection, e.g. penicillin and sulphonamides, can also be responsible.
- Pertussis infection causes a lymphocyte leucocytosis.
- Bacterial pneumonia/acute bronchitis causes a neutrophil leucocytosis.
- Mycoplasma infection can cause a haemolytic anaemia (typically when the patient is recovering from the infection) due to the presence of a red cell antibody ('cold agglutinin'). This produces red cell clumping on the blood film.
- Chronic obstructive pulmonary disease and other causes of chronic hypoxia lead to secondary polycythaemia.

#### Endocrine disease

- Diabetic ketoacidosis often leads to a neutrophil leucocytosis even in the absence of infection. Renal failure arising from diabetes will bring the haematological problems described above.

## MAIN ARTICLES

- Hypothyroidism may be associated with a mild macrocytosis and irregularly contracted red cells ("gingerbread men") on the blood film.

### Malignant disease

Almost any haematological abnormality may be produced by a malignant disease. So an unexplained abnormal blood count or film, especially if associated with a raised ESR, should point to the possibility of a malignancy. Here are some common associations:

### The Erythrocyte Sedimentation Rate (ESR)

The ESR is a measure of the rate at which red cells fall to the bottom of an upright column of anticoagulated blood. It depends on many factors including the relative specific gravities of the red cells and the plasma. The latter is related to the level of fibrinogen, alpha 2 and gamma globulins. Therefore it is not surprising that a wide variety of conditions will affect the ESR. The generally accepted upper limits of normal (in mm in one hour at 17 - 23 degrees C) are shown in Table 2.

A raised ESR is not diagnostic of anything. It is a supportive indicator of "something wrong". It should arouse our suspicions to seek further. In addition the progress of certain diseases (e.g. rheumatoid arthritis) may be followed with serial ESR measurements.

So the message is that the "haemogram" should be carefully prepared and reported. IT CAN GIVE US MUCH USEFUL INFORMATION and significantly assist the diagnostic process when related to a carefully taken history and physical examination.

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**Table 1: Association of abnormal blood count or film with malignancy**

| "Haemogram" abnormality          | Malignancy association                              |
|----------------------------------|---|
| Anaemia of a chronic disorder    | All   |
| Hypochromic microcytic red cells | Gastrointestinal, cervix, uterus, kidney            |
| Leucoerythroblastic picture*     | Bronchus, breast, prostate, stomach, kidney.        |
| Polycythaemia                    | Kidney, liver, uterus.                              |
| Neutrophil leucocytosis          | All   |
| Leukaemoid reaction              | As for leucoerythroblastic picture.                 |
| Eosinophilia                     | Hodgkin lymphoma                                    |
| Lymphopenia                      | Lymphoma  |
| Monocytosis                      | All   |
| Thrombocytosis                   | All   |
| Thrombocytopenia (chronic DIC)   | Stomach and mucin-secreting tumours (colon, ovary). |

*[\* reflects bone marrow infiltration: anaemia, fragmented red cells, immature red cells and white blood cell precursors on the blood film]*

**Box 2: Upper limits of normal ESR for males and females**

| Age ranges (years) | Men | Women |
|--------------------|-----|-------|
| 17 - 50            | 10  | 19    |
| 50 - 60            | 12  | 19    |
| 60 - 70            | 14  | 20    |
| >70                | 30  | 35    |