

Anaemia: causes and treatment

AUTHOR Ken Campbell, FIBMS, CertHMS, is clinical information officer, Leukaemia Research Fund.

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Anaemia is a common pathological condition and it is important that all nurses are aware of its signs and symptoms. It can be detected by screening and, in most instances, readily and cheaply treated. Identifying the underlying cause of the anaemia is vital, as this will ensure that the patient receives appropriate treatment, which can have a significant impact on quality of life.

Anaemia is one of the most common pathological conditions encountered in primary care. Its consequences, although mild in most cases, are potentially very severe. It can be detected by screening and, in most instances, treated readily and cheaply.

It may serve as a warning of various potentially fatal disorders and, depending on the underlying cause, of disease processes leading to irreversible changes in vital organs and tissues. All nurses should be aware of the nature of anaemia and how it can be detected. This includes having a knowledge of the following:

- Its signs and symptoms and the types of laboratory diagnosis available;
- The screening and preventive measures available;
- When a diagnosis of anaemia should be a trigger for investigation of other potentially serious diagnoses.

Anaemia occurs as a consequence either of deficiencies in the production of mature circulating red blood cells (RBCs) or of excessive loss or destruction of these cells. All forms of anaemia can be classified on the basis of the balance between these two processes.

Alternatively, classification can be determined on the basis of the morphology of the RBCs, which can give valuable indications of the underlying cause.

It is important to stress that anaemia is not a disease, but a pathological state consequent upon an underlying disease; for example, nutritional deficiency (iron deficiency), inherited abnormality of haemoglobin synthesis (sickle cell disease, thalassaemia), or haemorrhage (colon cancer).

The impact that anaemia may have on a person's quality of life and general health is considerable, especially for older people. A recent report shows that the condition can contribute to a general decline in the physical performance of older people, with loss of capacity for independent living (Phenninx et al, 2003). The effects of iron deficiency on different groups are shown in Box 1.

The World Health Organization has estimated that, globally, at any one time, 2,088 billion people have anaemia (UNICEF et al, 2001). Figure 1 indicates the prevalence of anaemia in at-risk groups.

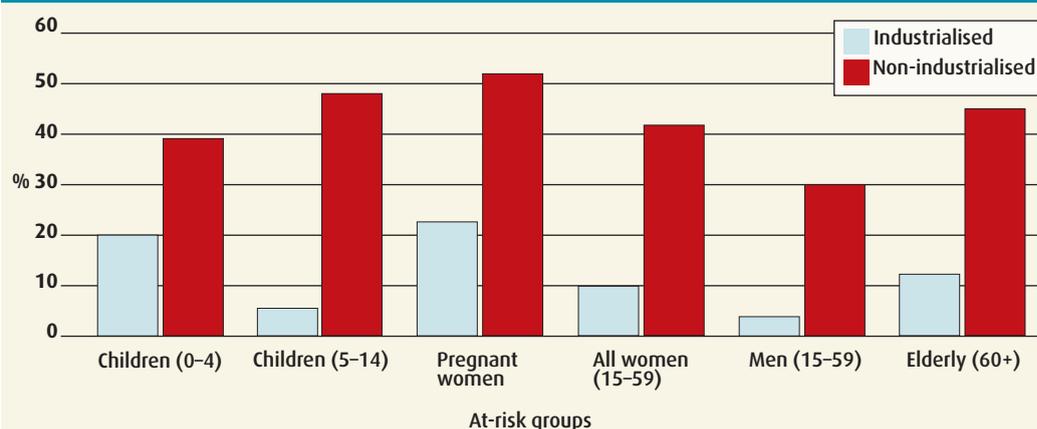
The biology of a red blood cell

A red blood cell or corpuscle (also known as an erythrocyte) is an anucleate biconcave disc, of approximately 8.5 microns in diameter and 90 femtolitres in volume. The expulsion of the nucleus during development and its biconcave shape mean the cell is flexible enough to pass through blood vessels, which may be as narrow as three microns in diameter.

RBCs are produced in the bone marrow in response to the secretion of erythropoietin, a process called erythropoiesis. Erythropoietin is produced principally in the kidneys, which is why the incidence of anaemia in patients with renal disease is high.

The mature erythrocyte is essentially a bag of haemoglobin, which is the oxygen-carrying component of the blood. RBCs possess enzyme pathways capable of utilising glucose to produce adenosine triphosphate which, in return, is required to maintain haemoglobin in a reduced

FIG 1. PREVALENCE OF ANAEMIA IN AT-RISK GROUPS, 1990–1995 (UNICEF ET AL, 2001)



BOX 1. THE EFFECTS OF IRON DEFICIENCY ON DIFFERENT GROUPS

- Impairs cognitive performance, behaviour and physical growth of infants, pre-school and school-age children.
- Impairs the immune status and increases morbidity from infection in all age groups.
- Affects function of the gastrointestinal tract and endocrine system in all age groups.
- Increases absorption of toxic heavy metals, such as lead, in children.
- Diminishes the capacity for physical activity and work performance in adolescents and all age groups.
- Iron deficiency anaemia during pregnancy:
 - Increases perinatal risks for both mother and neonate;
 - Increases overall infant mortality.

state and to preserve the structural integrity of the red blood cell membrane. Red blood cells that are defective in one or more of these energy-producing pathways are susceptible to early destruction in the reticuloendothelial system.

The normal lifespan of an RBC is about 120 days once it has entered the circulation; mature red blood cells lack a nucleus and protein synthetic capacity. Immature RBCs, which are those that have just left the marrow, retain portions of endoplasmic reticulum. This can be seen by using special staining techniques.

These cells are called reticulocytes and their numbers in the circulation provide a valuable measure of erythropoietic activity. Reticulocytes have a bluish tinge on a standard blood film; the presence of unusually large numbers of these cells is termed polychromasia.

Haematinics

Certain nutrients, known as haematinics, are necessary for the normal formation of RBCs, and most, although not all, are vitamins (Fishman et al, 2000). However, the most commonly deficient nutrient is iron. Other nutrients necessary to avoid anaemia include folic acid, and vitamins A, B₂ (riboflavin), B₆ (pyridoxine), B₁₂, C and E. Vitamins A, B₂ and C can enhance the absorption and/or utilisation of iron, thus preventing or mitigating the effects of iron deficiency.

Folate and vitamin B₁₂ are necessary to prevent a form of anaemia called megaloblastic anaemia. An absence of folate or B₁₂ means that the individual's DNA cannot replicate effectively. However, although this affects all dividing cells, the rapid turnover of RBCs means that anaemia is an early symptom.

Early recognition and effective treatment of megaloblastic anaemia can prevent irreversible damage to the central nervous system when B₁₂ deficiency is present.

Vitamin B₆ may be effective in the treatment of some forms of sideroblastic anaemia, a condition in which, although adequate iron is present, the RBCs cannot incorporate iron into haemoglobin.

Pathophysiology

Definition of anaemia

Anaemia is primarily defined in terms of levels of haemoglobin – a lower than normal haemoglobin level signifies anaemia. Other measures, such as red cell count and packed cell volume can only be regarded as indicative of possible anaemia. There is no universally agreed definition of anaemia, since normal ranges vary according to age, gender and possibly to racial background. However, the World Health Organization (UNICEF et al, 2001) recommends the following levels as normal:

- Males – 13g/dl;
- Females – 12g/dl;
- Pregnant females – 11g/dl;
- Children aged six months to five years – 11g/dl;
- Children aged six to 11 years – 11.5g/dl;
- Children aged 12 to 14 years – 12g/dl.

Signs and symptoms

The symptoms of anaemia relate essentially to a loss of oxygen delivery to the tissues. There may be specific symptoms relating to the underlying cause of the anaemia; for example, neurological symptoms caused by B₁₂ deficiency or nail deformities in iron deficiency. However, it is the symptoms of anaemia itself that are discussed in this article.

There are very effective compensatory mechanisms that can mitigate the impact of anaemia if its onset is gradual (Hébert et al, 1997). Clinically, this is of great importance because if a patient has well-compensated anaemia with good oxygen delivery to the tissues, then transfusion of stored blood may overwhelm the compensatory mechanisms leading to a severely hypoxic condition. In a patient with concurrent cardiac disease this may prove fatal.

Mild anaemia

Detecting the physical signs of anaemia is a very subjective process. For example, a patient with mild anaemia may appear a little pale, but this is often difficult to assess because the detection threshold is about 10g/dl. However, pallor of the conjunctival membranes is significant (Sheth et al, 1997).

In young children, palm pallor is preferred to eyelid pallor as a clinical diagnostic sign owing to the frequency of conjunctivitis, which causes redness even in people with anaemia (UNICEF et al, 2001).

In patients with mild anaemia, the only symptom that is obvious to an observer may be fatigue on exertion.

Moderate anaemia

Moderate anaemia may cause a greater degree of fatigue and pallor than mild anaemia; it may also cause breathlessness on exertion. When the breathlessness is

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severe it is known as ‘air hunger’. These patients may experience light-headedness and faints. Moderate or severe anaemia may lead to fluid retention and hence to swollen ankles.

Severe anaemia

When severe anaemia has arisen very slowly, with good physiological adaptation, patients may show surprisingly few symptoms. I have encountered an older female patient with a haemoglobin level of 4g/dl (about one-third the normal level), whose only complaint was that she found the climb up the hill to the hospital a little tiring. A similar degree of anaemia resulting from an acute bleed or haemolytic episode would render most people moribund; in a patient with concurrent heart disease it could prove fatal. Laboratory investigations are therefore essential to confirm the diagnosis.

Laboratory investigations

During an investigation for suspected anaemia, it is essential to undertake a full blood count (FBC). This set of tests includes:

- Haemoglobin estimation, which will confirm or exclude anaemia;
- Red blood cell count and indices, which may suggest the cause of anaemia;
- White cell and platelet counts, which will further serve to define any pathology present.

The results of the FBC will normally guide the choice of further tests for specific causes, such as levels of haematinics and haemoglobinopathies (inherited disease where production of haemoglobin is abnormal).

Haemoglobin

A reduced circulating haemoglobin level is the defining feature of anaemia. In screening programmes, near-patient testing may be performed using a hand-held screening unit (Van Schenck et al, 1986). It is vital that equipment is properly maintained. In addition, it is essential that it is calibrated against a reference method or machine.

Red blood cell properties and indices

Values calculated from measured properties of red cells may be important in determining the cause of anaemia. Measured values are the RBC count and the mean cell volume (MCV); that is, the mean size of the RBCs. From these values the machine calculates the packed cell volume (PCV) or haematocrit; this may be expressed as a percentage or, more commonly, as a volume in litres.

A measure of the spread of size of RBCs, called the red cell distribution width (RDW), is also given by modern cell-counting machines.

This is valuable because the MCV alone cannot distinguish between mixed sized and homogeneous populations of red cells.

Where a calculated PCV is not available it may be directly measured by spinning a blood sample in a centrifuge. When a measured MCV is not available it is calcu-

BOX 1. ANAEMIA: CLASSIFIED BY CAUSE

DIMINISHED PRODUCTION

Nutritional anaemia

- Iron deficiency
- Folate deficiency
- Vitamin B₁₂ deficiency

Haemoglobinopathy

- Sickle cell disease
- Other abnormal haemoglobins
- Thalassemias

Marrow failure

- Aplastic anaemia
- Marrow infiltration: malignancy – metastatic/haematological
- Myelofibrosis
- Myelodysplastic syndrome

Renal failure

- Multifactorial
- Anaemia of chronic disease
- HIV infection

EXCESSIVE LOSS OR DESTRUCTION

Bleeding

- Acute
- Chronic

Haemolysis (red cell destruction)

Intrinsic (internal causes)

- RBC membrane abnormality
- Enzyme defects

Haemoglobinopathy

Extrinsic

- Immune
- Mechanical (trauma to RBC)
- Infection, for example malaria

lated by dividing the PCV by the RBC. The remaining indices are calculated from the measured values.

The mean cell haemoglobin (MCH) is calculated by dividing the haemoglobin (Hb) level by the RBC count and is expressed as picograms (pg). MCH is a function of red cell numbers and haemoglobin concentration, which is influenced by the size of the red cells. A more robust measurement is the mean cell haemoglobin concentration (MCHC), which is derived from the Hb level and the haematocrit. This assesses how well-haemoglobinised the RBCs are.

Blood film

The appearance of the RBCs on a well-made and stained blood film can provide significant diagnostic indications regarding the cause of anaemia in a given patient. Certain appearances are virtually diagnostic of specific causes, for example:

- In iron deficiency anaemia there are commonly long, thin red cells, sometimes called 'pencil cells';
- In sickle cell anaemia the characteristically deformed red cells are usually, but not always, evident.

Other information may also be derived from the film. For example, in renal and hepatic disease the RBCs have a characteristic abnormal appearance which, if remarked upon in the blood count report, may lead the clinician to ask for further tests.

Classification of anaemia

There are two main systems of classification of anaemia: morphological and aetiological. Morphological classification is based on the results of the full blood count and the blood film. It is a useful distinction, because this information is available at the time of diagnosing the anaemia and it may guide further investigations, which will in turn indicate the appropriate therapy.

The aetiological classification requires the results of all investigations to be available. It is of limited clinical use but is of great importance in epidemiological surveys.

Morphological classification

Anaemia can be macrocytic, normocytic (usually also normochromic), and microcytic (usually hypochromic). In macrocytic anaemia, the MCV is significantly higher than normal. The most common forms of macrocytic anaemia are nutritional and result from vitamin B₁₂ or folate deficiency. Liver disease and alcohol excess can also cause macrocytic anaemia.

In normocytic and normochromic anaemia, RBC size and MCHC respectively are normal. These types of anaemia occur as a result of chronic disease, renal disease and acute blood loss.

In microcytic anaemia the RBCs are small, while in hypochromic anaemia they are pale (poorly haemoglobinised with a low MCHC). The most common cause of this type of anaemia is iron deficiency. Anaemia from chronic disease may be of this type.

Haemoglobinopathies usually cause microcytosis (the presence of microcytes in the blood) and hypochromasia (the reduction of concentration of haemoglobin in each cell, making them pale), as do sideroblastic anaemia and lead poisoning

Aetiological

The aetiological classification of anaemia can be divided into two broad categories: defective or diminished production of RBCs and loss of RBCs from the circulation (as a result of haemorrhage or haemolysis). Many types of anaemia include elements of both processes but usually one predominates (Box 2).

Treatment and nursing management

Treatment of anaemia is normally directed at the underlying cause. For example, dietary supplements will be given for nutritional anaemia, immunosuppression for aplastic anaemia and immune haemolysis. In cases where the underlying disease is intractable to therapy, such as haemoglobinopathies or myelodysplastic syndrome, treatment is supportive. Transfusions may be necessary to allow activities of daily living.

Because the body has no mechanism for excretion of excess iron, multi-transfused patients may suffer serious illness as a result of iron overload. However, this may be overcome by the use of drugs that bind iron and allow its excretion (Porter, 2001).

Drug treatment

The drugs most frequently used in the treatment of anaemia are haematinics, which are used specifically to treat nutritional anaemias. Foremost among these is iron; indeed it is common for pregnant women in the developed world to receive routine iron supplementation. It must be remembered that iron preparations are toxic, therefore care must be taken to keep them away from young children.

A potentially very harmful practice is administering folate without confirmation of the underlying cause of megaloblastic anaemia. High doses may cause correction of vitamin B₁₂ deficiency anaemia, but they do not offer protection against the neurological damage caused by deficiency of this vitamin (Hoffbrand and Provan, 1997).

The introduction of recombinant human erythropoietin (a synthetic preparation of erythropoietin) offered the first cause-specific treatment for anaemia associated with cancer and with renal disease (Spivak, 2000).

Implications for nursing care

In the primary care setting, nurses are most likely to encounter anaemia in children and premenopausal women who are iron deficient (Farrell and LaMont, 1998; Irwin and Kirchner, 2001). When iron-deficiency anaemia is encountered in postmenopausal women or in men of any age it should trigger investigations for occult blood loss or other underlying pathology.

Many patients with cancer report that the most debilitating effect of the disease is fatigue; frequently, although not always, this is secondary to anaemia and can be mitigated by use of erythropoietin. In addition to the effects on quality of life, there is evidence that survival in some forms of cancer may be adversely affected by even a moderate degree of anaemia (Gillespie, 2003).

Nurses may be able to have a positive impact on the quality of life of these patients by focusing attention on the need to correct their anaemia. A full blood count is a relatively inexpensive, minimally invasive procedure that has the potential to detect many different pathological conditions before they become symptomatic. It can also detect anaemia in the early stages, and should be part of any well-person screening programme. ■

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