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Common Sense Pathology

A REGULAR CASE-BASED SERIES ON PRACTICAL PATHOLOGY FOR GPs

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Full blood count

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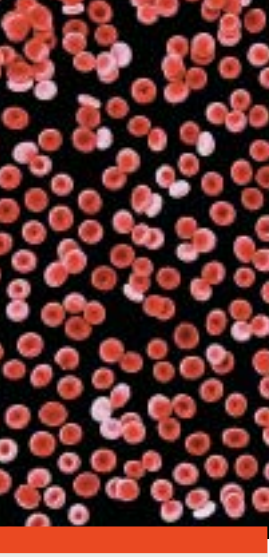

The full blood count

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Introduction

It is a conundrum GPs face on a daily basis — how to determine the nature and extent of diagnostic laboratory investigations required for the diagnosis and management of a given patient. Together with a comprehensive history and careful physical examination, the full blood count (FBC) or complete blood count (CBC) forms part of the primary assessment of a significantly unwell patient. That is not to say the test should be requested without sufficient indication. Obviously it would be unnecessary in a young, well man who twisted his ankle as he demounted from his bicycle. However, an elderly man, who twisted his ankle as he fell because he felt faint, may well need anaemia to be excluded as an underlying cause.

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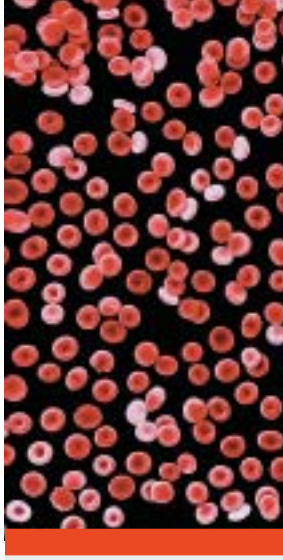
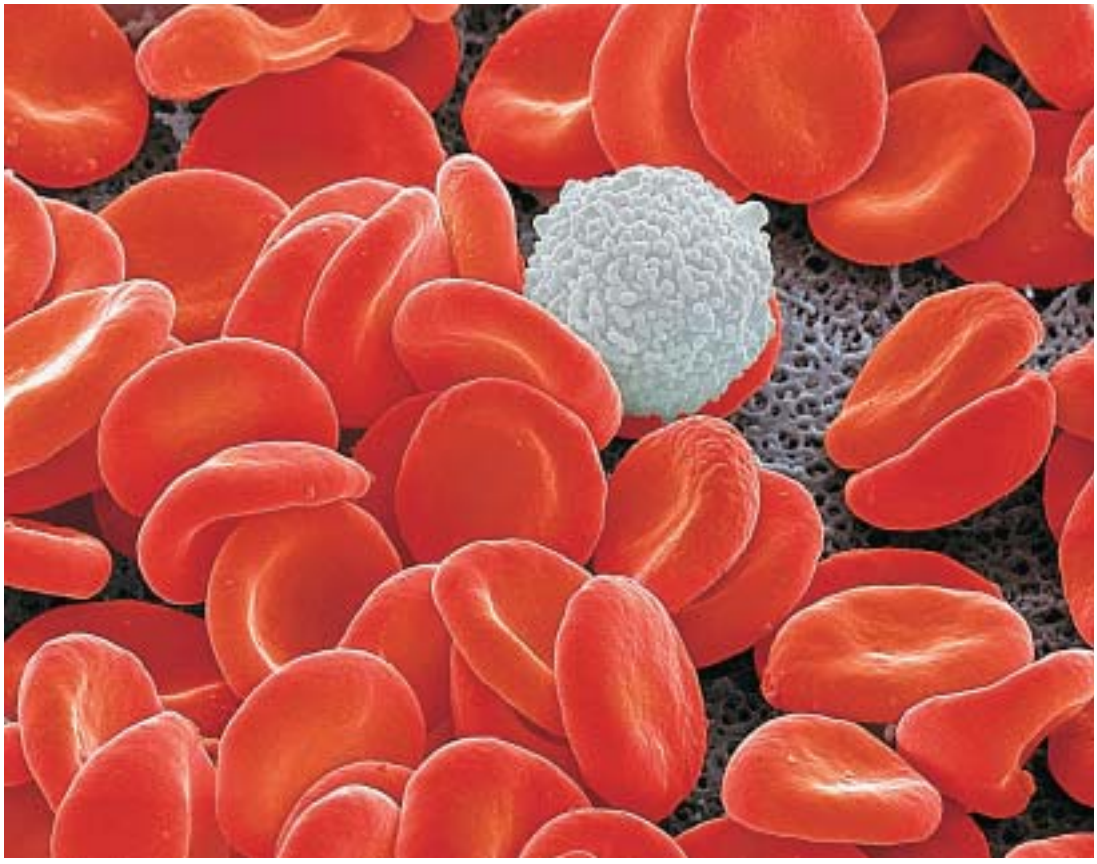
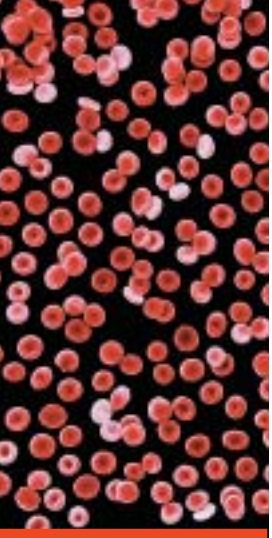




Together the bone marrow and blood form the largest body organ and to attempt to itemise the indications for requesting a FBC would be futile. The blood itself is composed of cellular elements suspended in a fluid vehicle that contains many non-cellular elements. The FBC provides a picture of the numbers, sizes, distribution and types of cellular elements present and, either alone or with the examination of a well-made blood smear, may reflect underlying disease of other body systems or may be diagnostic of haematological disease.

What do you get when you order a FBC?

With current technology the cellular counts obtained in almost all instances are extremely accurate. Inaccuracies may occasionally be seen if a sample is poorly collected, stored or transported. For example, red cells may be affected by heat or prolonged storage, and white cells may also disintegrate under similar conditions. Insufficient blood in a sample container may give erroneous results because of excess anticoagulant. Blood collected from a blood vessel being used for intravenous fluid administration is likely to be affected by dilution. Inaccuracies also may be caused by factors such as red cell agglutination (when the instruments count small clumps of red cells as one cell, which makes the red cell count too low and the mean cell volume too high) or the rare condition of platelet satellitism (when the platelets stick to the white cells and the instrument provides a suspiciously low platelet count). While such errors are infrequent, it is incumbent on the laboratory staff and the clinician to be alert to unexpected results. Most instruments used in pathology laboratories provide a reliable haemoglobin estimate; accurate red cell, white cell and platelet counts; a differential white cell count; and useful red cell parameters, such as the mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC). Many instruments also assess the red cell distribution width and platelet volume. This information may be sufficient for the clinician to arrive at a diagnosis by evaluating the FBC in conjunction with information from other sources (history, physical examina-



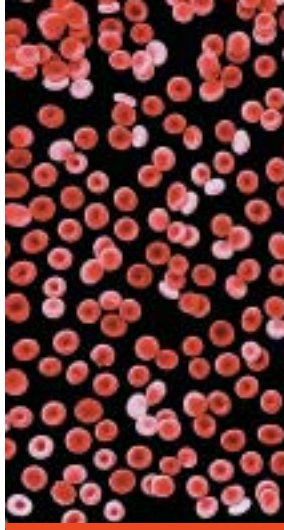
tion, other laboratory tests, radiology, etc). For instance, a patient with menorrhagia may have a marginally low haemoglobin level — say 106g/L, a MCV of 68fL, MCH 20pg and MCHC of 29.6 g/L — which is most likely caused by iron deficiency. A trial of oral iron therapy may be justified without examination of the blood film.

While the counts and red cell parameters will suffice to exclude serious disease in most cases, the examination of a well-made blood film by an experienced observer remains the most efficient and effective laboratory investigation in the assessment of the patient with an abnormal FBC. Even with a normal FBC, at times the film morphology will reveal important diagnostic and monitoring information. Consequently, the clinician may need to specifically request the examination of a blood film depending on the circumstances. Most laboratories have established criteria for film review whether requested or not, depending on the figures from the counter. To obtain the best and most instructive report, it is of paramount importance that the GP provide a relevant clinical history, including the reason for the request, as well as the patient's gender and age.

The reference intervals for adults — from *Dacie and Lewis Practical Haematology* — are used by most labora-

Reference intervals for adults

Red blood cell count	
Men	5.0 ± 0.5 x 10^{12}/L
Women	4.3 ± 0.5 x 10^{12}/L
Haemoglobin	
Men	150 ± 20g/L
Women	135 ± 15g/L
Packed cell volume (PCV) or haematocrit (Hct)	
Men	0.45 ± 0.05
Women	0.41 ± 0.05
Mean cell volume (MCV)	
Men and women	92 ± 9fL
Mean cell haemoglobin (MCH)	
Men and women	29.5 ± 2.5pg
Mean cell haemoglobin concentration (MCHC)	
Men and women	330 ± 15g/L
Red cell distribution width (RDW)	
As coefficient of variation	12.8 ± 1.2%
White blood cell count	7.0 ± 3.0 x 10^{9}/L
Differential white cell count	
Neutrophils	2.0-7.0 x 10^{9}/L (40-80%)
Lymphocytes	1.0-3.0 x 10^{9}/L (20-40%)
Monocytes	0.2-1.0 x 10^{9}/L (2-10%)
Eosinophils	0.02-0.5 x 10^{9}/L (1-6%)
Basophils	0.05-0.1 x 10^{9}/L (<1-2%)



tories as a guide and are provided here for ease of reference. Most laboratories establish their own normal values, but these will vary minimally from the values listed.

Values for normal infants and children are also listed in *Dacie and Lewis Practical Haematology.* The haemoglobin and red cell count are higher at birth than at any subsequent time. These parameters fall progressively until about two months and then rise gradually until puberty. The MCV is also high at birth and falls gradually to lower values by two months. White cell counts at birth are on the high side and fall gradually. Initially the main cells are neutrophils, but by the end of the first week lymphocytes are the predominant cell until about age five to seven when neutrophils take over again.

The difference in counts between men and women is evident from the table, and there is a further difference in pregnancy when there is an apparent fall in haemoglobin and red cell count caused by the physiological increase in plasma volume. Other physiological variations are minor, but do occur, for example, in athletes, in older people and at various altitudes.

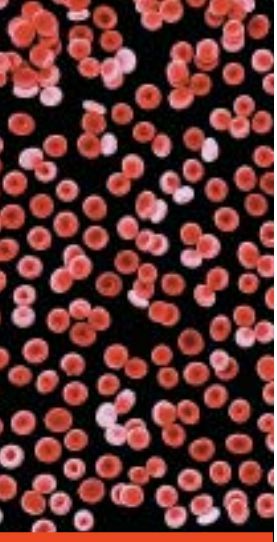
White cell variations are more random because people differ considerably in their white cell counts. Exercise, fear and pregnancy may elevate the white cell count. Normal platelet counts have a wide range and variations are again fairly random, but exercise is known to raise the count.

Case study one

The following cases show the pitfalls of relying on a haemoglobin level obtained in the surgery. All three patients were 42-year-old women with identical complaints (ie, tiredness and lethargy, not able to do the housework as readily, and with slight breathlessness). All women had menorrhagia and had had three pregnancies with three live births. The haemoglobin levels obtained with a bedside haemoglobinometer were 70g/L for each patient. The presumptive diagnosis was iron deficiency for all three women. The following results were obtained when a FBC was requested from the pathology laboratory.

Case study one

	Patient 1	Patient 2	Patient 3
Red cell parameters			
Haemoglobin	69g/L	72g/L	71g/L
Red cell count	4.08 x 10^{12}/L	2.13 x 10^{12}/L	1.87 x 10^{12}/L
Haematocrit	0.25	0.21	0.21
MCV	60fL	101fL	114fL
MCH	17pg	35pg	38pg
MCHC	280g/L	347g/L	334g/L
RDW	21.8 %	22.9%	16.9%
White cells			
White cell count	6.6 x 10^{9}/L	19.2 x 10^{9}/L	6.2 x 10^{9}/L
Neutrophils	3.5 x 10^{9}/L	1.9 x 10^{9}/L	5.5 x 10^{9}/L
Lymphocytes	1.8 x 10^{9}/L	2.1 x 10^{9}/L	0.6 x 10^{9}/L
Monocytes	0.8 x 10^{9}/L	0.0 x 10^{9}/L	0.1 x 10^{9}/L
Eosinophils	0.2 x 10^{9}/L		
Basophils	0.1 x 10^{9}/L		
Myelocytes		0.0 x 10^{9}/L	
Promyelocytes		0.0 x 10^{9}/L	
Blasts		15.2 x 10^{9}/L	
Platelets			
Platelet count	468 x 10^{9}/L	106 x 10^{9}/L	107 x 10^{9}/L



Film comment 1
Film consistent with iron deficiency anaemia, possibly caused by blood loss. Note mild thrombocytosis, possibly reactive.
Film comment 2
Anaemia and thrombocytopenia. Anisocytosis and poikilocytosis and hypogranular neutrophils. Blast cells exhibit Auer rods.

Film comment 3
Hypersegmented and giant neutrophils. Oval macrocytes, possibly megaloblastic haemopoiesis.

Just looking at the counts with the parameters available will guide the clinician to the possible diagnosis in each case. However, the comments made on examination of the film confirm the most likely diagnosis.
Patient 1 — true iron deficiency anaemia.
Patient 2 — acute myeloblastic leukaemia.
Patient 3 — megaloblastic anaemia caused by vitamin B12 or folate deficiency.

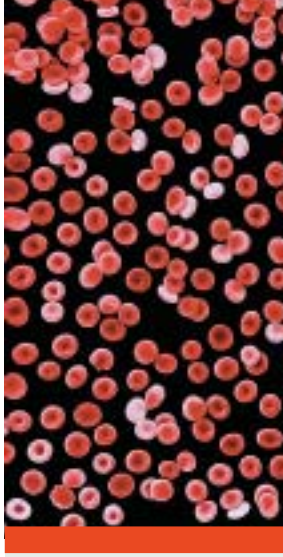
Case study two

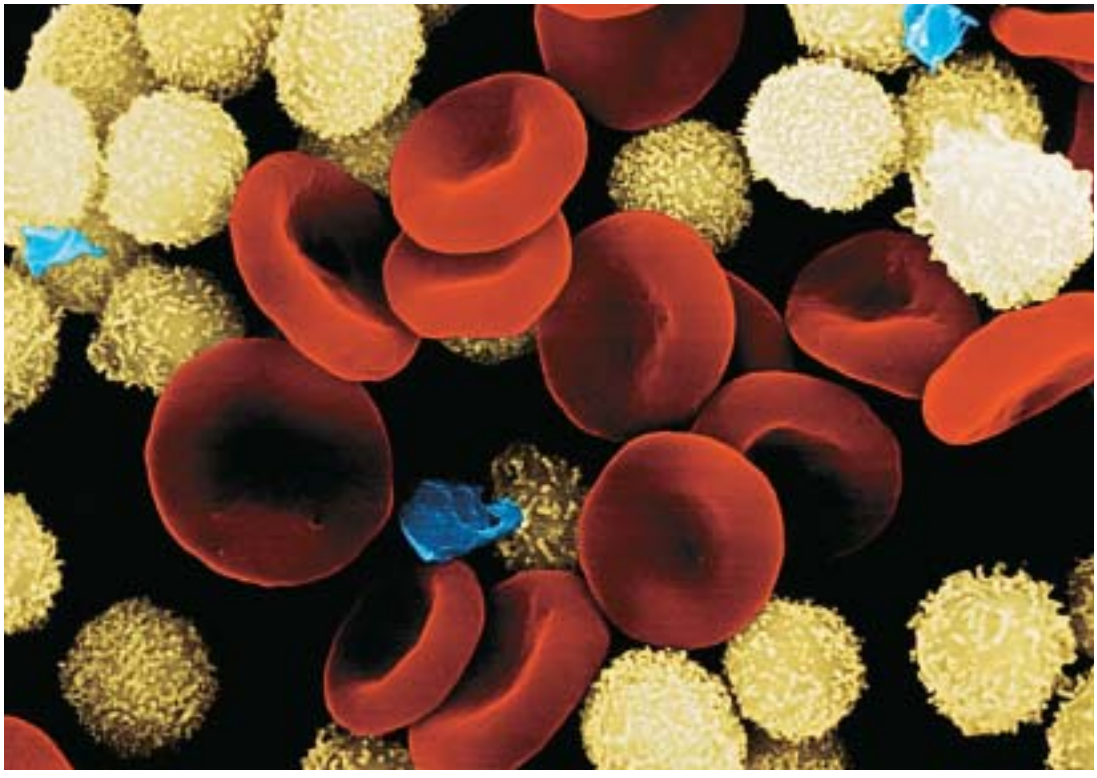
The cases on the facing page show the pitfalls of FBCs. These two 42-year-old patients both had a fever and swollen cervical nodes. Superficially, both patients' FBCs were similar.

Case study two

	Patient 4	Patient 5
Red cell parameters		
Haemoglobin	125g/L	124g/L
Red cell count	4.11 x 10^{12}/L	4.00 x 10^{12}/L
Haematocrit	0.38	0.38
MCV	93fL	94fL
MCH	30pg	31pg
MCHC	329g/L	330g/L
RDW	12.2%	16.8%
White cells		
White cell count	7.9 x 10^{9}/L	8.1 x 10^{9}/L
Neutrophils	2.7 x 10^{9}/L	3.3 x 10^{9}/L
Lymphocytes	4.3 x 10^{9}/L	4.6 x 10^{9}/L
Monocytes	0.5 x 10^{9}/L	0.1 x 10^{9}/L
Eosinophils	0.3 x 10^{9}/L	0.1 x 10^{9}/L
Basophils	0.0 x 10^{9}/L	
Platelets		
Platelet count	201 x 10^{9}/L	172 x 10^{9}/L

Film comment 4
Many atypical lymphocytes. Neutrophils show slight left shift. Red cell morphology within normal limits. ?infectious mononucleosis.





Film comment 5
Some atypical lymphocytes and smudge cells present. Red cell morphology within normal limits. ?lymphoproliferative disorder.
When the blood films were examined by an experienced observer, the appearance of the lymphocytes from the two patients was different and allowed the correct diagnosis to be made.
In these cases the blood films may not have been examined unless specifically requested. If haematological disease associated with enlarged lymph nodes is suspected, the clinician must remember to make a request for examination of the blood film.

Even with a normal FBC, the morphology may occasionally reveal important diagnostic information.

Summary

The blood is a large fluid organ and the FBC reflects many facets of underlying disorders, whether they be primarily haematological or not. For suspected haematological disorders, the FBC and film examination are essential components of the diagnostic workup. In most cases these will need to be supplemented by examination of the bone marrow. The non-haematological disorders leading to abnormal FBCs are too numerous to list. However, common examples include infective, neoplastic and inflammatory processes (eg, bacterial and viral infections, malaria, rheumatoid arthritis, chronic renal and hepatic disease, metastatic malignancy, etc).

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The Royal College of Pathologists of Australasia, Manual of Use and Interpretation of Pathology Tests, available www.rcpa.edu.au