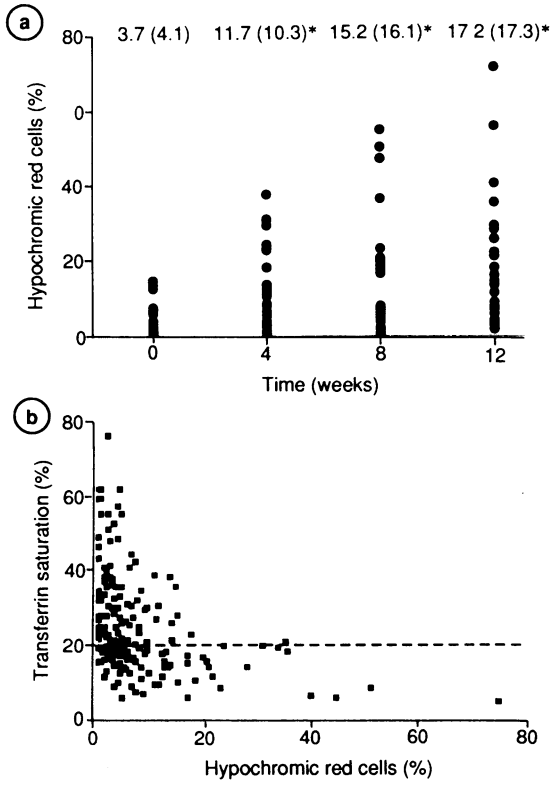


*(a) Progressive increase in percentage of hypochromic red cells after erythropoietin treatment in patients receiving dialysis. Data are also given as means (SD) for whole group; *p<0·05 compared with results for week 0 (paired t test). (b) Relation between transferrin saturation and percentage of hypochromic red cells in same patients during erythropoietin treatment*

poietin (10 units/kg daily for five days a week, 2000 units twice weekly, or 50 units/kg thrice weekly, depending on the centre). All except six patients received oral iron supplementation throughout the study. Blood samples were taken every fortnight for full blood counts including red cell indices (mean cell volume, mean cell haemoglobin, and mean cell haemoglobin concentration); serum ferritin concentration; transferrin saturation; and percentages of microcytic (cell volume <60 fl) and hypochromic (haemoglobin concentration <280 g/l) red cells, the upper limit of normal for both these measurements being 2·5%. Full blood counts and red cell analyses were determined with a Technicon H1 automated blood count analyser (Bayer Diagnostics, Basingstoke), which uses laser technology and flow cytometry to measure the volume and internal haemoglobin concentration of between 40 000 and 60 000 individual red cells.

The mean haemoglobin concentration rose from a pretreatment value of 62 (SD 8) g/l to 70 (9) g/l at four weeks, 79 (11) g/l at eight weeks, and 92 (13) g/l at 12 weeks. There were no changes during this time in mean cell volume (91·6 (5·1) fl to 93·5 (5·7) fl), mean cell haemoglobin (30·0 (2·3) pg to 29·6 (2·3) pg), or mean cell haemoglobin concentration (325 (17) g/l to 315 (13) g/l). Similarly, the percentage of microcytic red cells in the sample did not change and remained within the normal range (1·0% (0·8%) before treatment, 0·9% (0·7%) at four weeks, 0·8% (0·6%) at eight weeks, and 1·1% (0·8%) at 12 weeks). The proportion of hypochromic red cells progressively increased during the first 12 weeks of treatment (figure, a). In 15 patients the proportion was >2·5% before starting treatment, and in nine it was >20% after 12 weeks of treatment. Serum transferrin saturation and the percentage of hypochromic red cells showed a loose inverse correlation ($r=-0·47$; $p<0·001$), but in the 15 instances when the percentage of hypochromic red cells was >20% serum transferrin saturation was consistently <20% (figure, b). Serum ferritin concentration and the percentage of hypochromic red cells were not correlated ($r=-0·14$; $p=0·09$).

Five of the 14 patients who had >10% of hypochromic red cells at 12 weeks were treated with parenteral iron supplementation (2 ml iron dextran (Imferon, Fisons Pharmaceuticals, Loughborough) weekly for four weeks). In all cases the percentage hypochromia subsequently fell to within the normal range after six to 14 weeks, with a corresponding increase in the haemoglobin concentration.

Comment

Our method of detecting functional iron deficiency in patients given erythropoietin uses some of the recent technological advances in automated blood count analysers. The measurements reflect the iron content of circulating red cells, which is a more direct indicator of iron delivery to the developing erythron than is transferrin saturation or serum ferritin concentration. Furthermore, the test can be performed on the same sample as the full blood count and the results are immediate.

The proportion of hypochromic red cells progressively increased with erythropoietin treatment, in some instances running parallel with a fall in transferrin saturation and in others preceding it. The loose correlation between the two variables is probably due to the biological variability in transferrin saturation,[4] but in extreme cases (percentage of hypochromic red cells >20%) transferrin saturation was consistently in the range associated with iron deficiency (<20%).[1-3] In addition, the fact that the proportion of hypochromic red cells fell in association with improved haemoglobin concentration after intravenous iron—albeit in only five patients—is further evidence that the percentage of hypochromic red cells is a true indicator of iron insufficiency. Further studies are, however, required to evaluate this approach in more patients.

1 Eschbach JW, Downing MR, Egrie JC, Browne JK, Adamson TW. USA multicenter clinical trial with recombinant human erythropoietin. *Contrib Nephrol* 1989;**76**:160-5.
2 Macdougall IC, Hutton RD, Cavill I, Coles GA, Williams JD. Poor response to treatment of renal anaemia with erythropoietin corrected by iron given intravenously. *BMJ* 1989;**299**:157-8.
3 Van Wyck DB, Stivelman JC, Ruiz J, Kirlin LF, Katz MA, Ogden DA. Iron status in patients receiving erythropoietin for dialysis-associated anemia. *Kidney Int* 1989;**35**:712-6.
4 Cavill I. Diagnostic methods. *Clinics in Haematology* 1982;**2**:259-73.
5 Moreb J, Poportzer MM, Friedlandler MM, Konijn AM, Hershko C. Evaluation of iron status in patients on chronic hemodialysis: relative usefulness of bone marrow hemosiderin, serum ferritin, transferrin saturation, mean corpuscular volume and red cell protoporphyrin. *Nephron* 1983;**35**:196-200.

(Accepted 6 August 1991)

Departments of Nephrology and Haematology, Cardiff Royal Infirmary and University Hospital of Wales, Cardiff
Iain C Macdougall, MRCP, *clinical research fellow*
Ivor Cavill, FRCPATH, *senior lecturer in haematology*
Gerald A Coles, MD, *consultant physician*
John D Williams, MD, *reader in nephrology*

St Mary's Hospital, London
Barry Hulme, FRCP, *consultant physician*
Barbara Bain, FRCPATH, *senior lecturer in haematology*

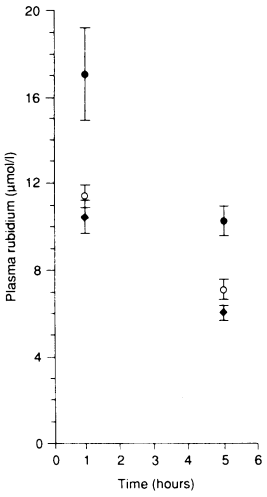
Western Infirmary, Glasgow
Ellon McGregor, MRCP, *registrar in nephrology*
Pamela McKay, MRCP, *registrar in haematology*

West Wales General Hospital, Carmarthen
Eric Sanders, FRCP, *consultant physician*

Correction

In vivo and in vitro sodium pump activity in subjects with thyrotoxic periodic paralysis

Several editorial errors occurred in the figure in this paper by A Chan and others (2 November, p 1096). The correct figure and legend are given below.



Plasma rubidium concentrations in six healthy subjects (●), eight thyrotoxic subjects (○), and seven thyrotoxic subjects with periodic paralysis (◆) after oral administration of rubidium chloride (8 mg/kg body weight). Vertical bars represent 95% confidence intervals