IRON DEFICIENCY ANAEMIA IN BANTU INFANTS, AND ITS ASSOCIATION WITH KWASHIORKOR

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Other than a reference made in 1948 by Altmann and Murray[1] to 4 cases of anaemia in kwashiorkor with a microcytic blood picture, iron-deficiency anaemia in Bantu children in South Africa has received very little attention in the literature. It has been suggested[2] that this form of anaemia is rare in the South African Bantu on account of the apparently high intake of iron, derived from iron utensils used in the preparation of their food. At Baragwanath Hospital, Johannesburg, however, severe iron-deficiency anaemia is encountered in Bantu children, and it is the purpose of this communication to draw attention to its occurrence in this group, to stress the relationship to kwashiorkor, and to report the favourable response of the anaemia to therapy with intramuscular iron.

DIAGNOSTIC CRITERIA

In the series of cases here reported, iron-deficiency anaemia was diagnosed when the haemoglobin value was less than

10 g.%, the mean corpuscular haemoglobin concentration (MCHC) was 30% or lower, and hypochromic erythrocytes were present in the blood. Children suffering from chronic infection or blood loss were excluded from the study. The distinction between iron-deficiency anaemia and the hypochromic anaemia which may accompany chronic infection was made largely on clinical grounds, since the differentiation of sideropenic and non-sideropenic forms of hypochromic anaemia is not easy in infants, because changes cannot be detected in iron stores in the bone marrow. Infection was often the reason for admission to hospital of children with iron-deficiency anaemia, but only cases where infection was of but a few days' duration were included in the study. Patients in whom iron deficiency was associated with megaloblastic anaemia were excluded.

RESULTS

The features of 60 cases occurring in children admitted to the paediatric wards fulfilling the above diagnostic criteria are presented.

1. *Age.* The ages of the infants and children ranged from 3 months to 3½ years, but 82% of cases occurred between 6 and 18 months of age.

2. *Seasonal incidence.* Cases occurred at all times during the year, with the distribution as follows: 4 in January, 1 in February, 7 in March, 4 in April, 4 in May, 6 in June, 8 in July, 2 in August, 4 in September, 8 in October, 9 in November and 3 in December.

3. *Perinatal factors.* Six infants (10%) had been premature. In none of the cases was there a history of haemolytic or haemorrhagic disease of the newborn or of cord haemorrhage.

4. *Feeding history and the iron content of the feeds.* Of the 60 cases, 4 were breast-fed at the time of admission to hospital and were receiving complements of meat, vegetables, porridge and milk; 46 were fed on maize porridge and water, with occasional supplements of milk, vegetables and meat; and 10 received maize porridge only. In order to assess the frequency of the use of iron pots in the preparation of the infants' feeds by the local Bantu population, 300 mothers attending the out-patient department were questioned. None of these used iron pots, all the cooking utensils employed being either enamel or aluminium, but 10% admitted to the use of iron tins for the souring of porridge after cooking. The iron content of some of the maize mixtures on which malnourished children were fed (chosen at random) has been determined (Table I). The total daily iron intake varied between 2·1 and 4·5 mg. (mean 2·9 mg.).

TABLE I. IRON CONTENT OF FEEDS GIVEN TO BANTU INFANTS AND CHILDREN

Age (mths.)	*Type of Feed*	*Feed Analysed*			*Volume of Feed per Day (oz.)*	*Iron Intake per Day (mg.)*
		Volume (ml.)	*Dry weight (g.)*	*Iron Content (mg.% of dry weight)*		
21	Maize meal and water	220	13·77	2·1	22	2·5
18	Maize meal and water	210	25·44	4·0	27	4·5
15	Maize meal and water	180	17·73	3·0	30	2·7
12	Maize meal and dilute milk	113	19·70	2·1	25	2·8
9	Maize meal and dilute milk	190	27·57	2·3	25	2·1

5. *Features of malnutrition.* Only 6 of the 60 children investigated were in a reasonable state of nutrition. The remaining 54 were malnourished, all showing depigmentation of hair; acute nutritional dermatosis was present in 20, 24 were oedematous, and 17 were markedly wasted. All were under-weight for age.

6. *Admission diagnosis.* In 12 infants (20%) anaemia was the diagnosis on admission. Many children were admitted with more than one diagnosis. The other diagnoses were as follows: Malnutrition 33, gastro-enteritis 25, pneumonia 15, rickets 5, whooping cough 3, heart failure 2, congenital heart disease 1, glandular fever 1, and acute arthritis 1.

7. *Peripheral blood.* The haemoglobin value ranged from 3·6 to 9·9 g.% (mean 8·13 g.%) and the MCHC from 22 to 30% (mean 28·6%). The deficiency in haemoglobin often did not parallel that in the MCHC or the degree of hypochromia of the red cells in the smears. With haemoglobin values greater than 9·0 g.% the red cells often exhibited marked hypochromia. The degree of anisopoikilocytosis was usually moderate, with cigar-shaped poikilocytes often prominent. A slightly raised reticulocyte count was a common finding, the counts on admission ranging from 1 to 8%. Platelets were present on the smears in normal number. The leucocyte picture frequently reflected the condition which had brought the child to hospital.

8. *Bone marrow.* Puncture of the tibial or iliac crest was carried out in 17 random cases. The marrow specimens were generally very cellular, and an erythroid reaction was noted in all cases where the myeloid-erythroid ratio was determined; the ratio was less than 1·5:1 in all. The polychromatic and pyknotic normoblasts showed evidence of iron deficiency; the degree generally paralleled that of the anaemia and hypochromia of the red cells, and was often very conspicuous. The normoblasts were small and deformed, and contained very little cytoplasm. The myeloid series was usually normal.

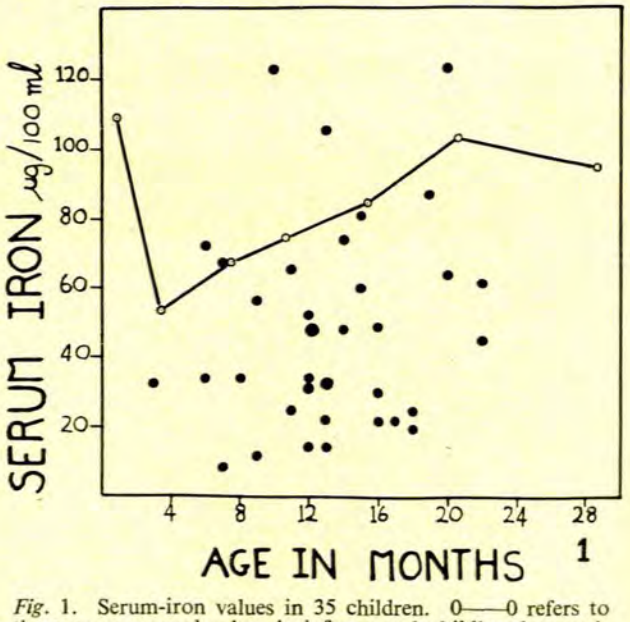

Fig. 1. Serum-iron values in 35 children. 0——0 refers to the average normal values in infancy and childhood according to Sturgeon (1954).

9. *Serum iron.* Serum iron was determined in 35 random cases, before any iron therapy. These values are shown (Fig. 1) against the average normal values during infancy according to Sturgeon.[3] In 10 infants serum iron was 30 μg. per 100 ml. or less.

10. *Treatment*

The cases were divided into 3 groups, according to the treatment.

(*a*) *No specific haematinics:* 19 infants with anaemia, usually of moderate degree, received no iron therapy. Rise in haemoglobin value on ward diet occurred in less than 50% of these cases. The reticulocyte response was never greater than 5% and a rise in haemoglobin was usually not accompanied by rise in MCHC or diminution in the degree of hypochromia of the erythrocytes in the blood smears.

(*b*) *Oral iron:* 13 infants were treated with a colloidal iron preparation in a dose of 90 mg. metallic iron daily. We could not assess the response in 3 of these patients because 2 of them were given blood transfusions and 1 had intramuscular iron added early in the course of therapy. Of the remaining 10 patients treated, only 4 showed a significant rise in haemoglobin (Fig. 3); one case showed a fall in haemoglobin from 8·2 to 6·5 g.%. In one case the haemoglobin level rose from 8·1 to 8·4 g.% after 30 days' treatment with oral iron, and when this was changed to intramuscular iron therapy the haemoglobin level rose to 10·4 g.%, 10 days after the first injection.

Seven of the 10 cases in whom haemoglobin responses were assessed had reticulocyte responses assessed concurrently (Fig. 2). The maximum observed reticulocyte response was only 9% after 15 days of therapy with oral iron.

(*c*) *Intramuscular iron:* 25 infants were treated with an intramuscular iron-dextran* preparation. The dosage was calculated on the initial haemoglobin level, the total amount administered varying between 150 and 450 mg. The effect of therapy could be satisfactorily assessed in 15 cases. All 15 responded as judged by a rise in haemoglobin of at least 2 g.% or reticulocyte response of greater than 10%, or both. The reticulocyte responses in the cases treated with intramuscular iron are contrasted in Fig. 2 with those who received oral iron, and the haemoglobin increments in Fig. 3. The reticulocyte response on intramuscular iron was often very marked, and was usually apparent by the 3rd or 4th day after the first injection, the maximum count being reached on the 5th or 6th day. In only 1 infant, where the initial haemoglobin value was 8·8 g. per 100 ml., was reticulocytosis after therapy not observed. The results of treatment with intramuscular iron are often remarkable. In 2 infants with initial haemoglobin values of 3·6 and 4·4 g.% the haemoglobin had risen to 9·9 and 10·8 g.% respectively by the 15th day of therapy. (Of the other 10 cases, one, a child admitted with acute liver necrosis, died on the 4th day of therapy, 1 child received a blood transfusion as well as iron, and in 8 follow-up was inadequate.)

* Imferon, Bengers Laboratories.

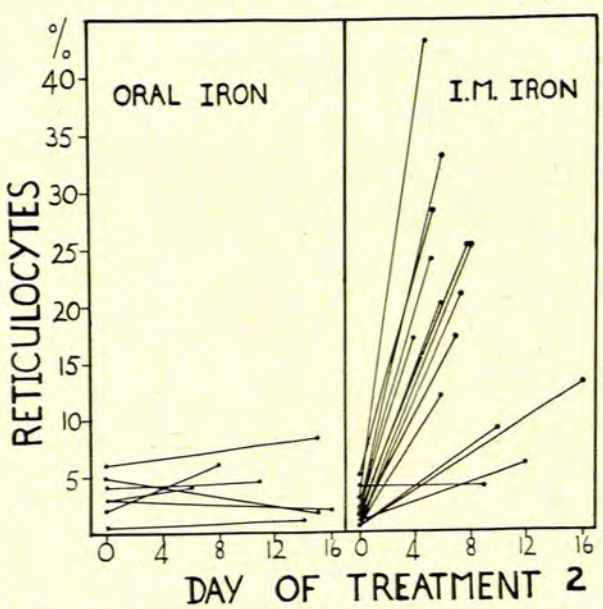

Fig. 2. Reticulocyte response to oral iron, and to intramuscular iron.

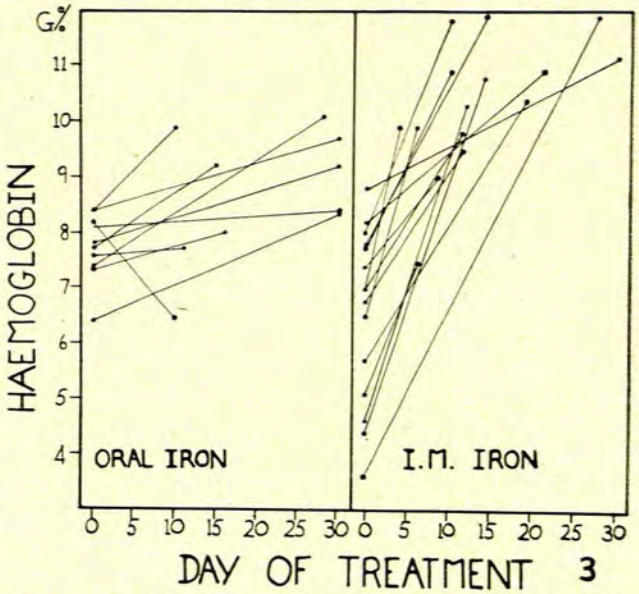

Fig. 3. Haemoglobin increment after treatment with oral iron, and intramuscular iron.

DISCUSSION

The exact role of a number of aetiological factors in the pathogenesis of iron-deficiency anaemia in infancy remains undecided. In the premature infant, rapidity of growth associated with a defective prenatal iron store (small red-cell mass) leads to a high incidence of iron-deficiency anaemia. Prematurity does not appear to be of much direct significance in the aetiology of the present group of cases, only 5% of them being premature. Diminished iron stores at birth is probably not a significant factor in our cases. The infant's iron stores reside mainly in his haemoglobin, and haemoglobin concentration at birth does not differ significantly in the 2 groups. (Although the birth weight of the newborn Bantu may be slightly less than that of the White population, the difference is not significant.) Other possible aetiological factors, such as jaundice of the newborn and haemorrhage

from the cord or elsewhere, do not play any part. There is no obvious seasonal incidence.

Nutritional factors, however, are of prime importance. Only half the infants were breast fed for as long as 3 months. The foods onto which the children had been weaned, with only an occasional exception, contained no adequate source of iron. The results of the determination of the iron content of the maize feeding mixtures employed (Table I) indicates that the iron intake of the Bantu infant with kwashiorkor falls short of the recommended dietary allowance. Iron cooking utensils are not in use in this urban Bantu population. Even assuming that normal absorption of 10% of the dietary iron occurs, the daily iron assimilated is deficient. In addition, absorption of iron in malnourished infants is probably poor. Low vitamin-C intake[4] and the frequent occurrence of hypochlorhydria[5] and of diarrhoea, probably all result in poor absorption of oral iron. The main cause of the iron-deficiency anaemia accompanying kwashiorkor would thus appear to be deficient iron intake, possibly aggravated by poor absorption.

The possibility of poor absorption of iron in kwashiorkor may explain why the treatment of iron-deficiency anaemia with oral iron in these cases has been found to be unsatisfactory. The results of oral iron therapy were unpredictable and were far inferior to those obtained with intramuscular iron. Moreover, oral iron may aggravate the gastro-intestinal disturbance commonly present in kwashiorkor. Ward diet without additional iron therapy did produce a rise in the haemoglobin in some cases, but not in the MCHC, and the degree of hypochromia did not diminish.

Intramuscular iron was found to be effective in 11 out of 12 cases of kwashiorkor reported by Trowell and Simpkiss[6] from Uganda, and the present study confirms the satisfactory results obtained with this preparation. Kwashiorkor as seen in South Africa as opposed to Central Africa is not complicated by helminthic infestation or malaria. In the present series no case was encountered where iron deficiency anaemia did not respond to treatment with intramuscular iron. With the intramuscular route it is possible to provide the child with iron stores, a factor of considerable significance in that the child with kwashiorkor, on discharge from hospital, may return to his previous poor dietary pattern.

CONCLUSIONS AND SUMMARY

The clinical and haematological findings and response to treatment in 60 Bantu children with iron deficiency anaemia are presented.

Of these 60 cases 54 showed the features of kwashiorkor.

The maize mixtures almost universally employed in the feeding of Bantu infants are often deficient in iron.

The serum-iron content, determined in 35 children, was generally low.

The results of the treatment of the anaemia with oral iron are unpredictable. The response to treatment with intramuscular iron was highly satisfactory in all the cases in which treatment could be assessed. Therapy with intramuscular iron is suggested as the treatment of choice of the iron-deficiency anaemia investigated.

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