Red cells, serum iron and total iron-binding capacity in three population groups in Natal

P. BRAIN

Summary

Male blood donors from three population groups (Indian, Black and White) who showed neither microcytosis nor levels of serum ferritin or transferrin saturation suggestive of iron deficiency were matched in 3s, 1 from each population, for age, number of previous blood donations, and serum ferritin. Three groups of individuals of similar iron status were thus obtained, in whom mean serum iron and total iron-binding capacity as well as red cell indices were compared. The Indian group had smaller red corpuscles, and more of them, than either of the other groups; they also had significantly higher mean total iron-binding capacity. The Black group had a lower mean level of serum iron than the other two, coupled with a total iron-binding capacity greater than in the Whites but less than in the Indians; as a result, both the Indian and Black groups had a lower mean transferrin saturation than the Whites. The mean level of haemoglobin was significantly lower in the Black group than in the other two. It is unlikely that any of these differences is due to iron deficiency.

Design of the study and results

Complete data were available for 361 Indians, 268 Whites, and 152 Blacks. All subjects with serum ferritin or transferrin saturation levels below the point at which erythropoiesis is affected by iron deficiency, namely a ferritin level less than 12 μg/ml, or transferrin saturation less than 15%, or both, were excluded from further study; 130 Indians, 25 Whites, and 6 Blacks were so excluded. The remaining subjects, comprising 231 Indians, 243 Whites and 146 Blacks, had the distribution of MCV shown in Fig. 1. Sixteen of these Indians, or 6,9% of the Indian total, had an MCV of less than 80 μl; the figure for Whites was 6 (2,5%) and that for Blacks 2 (1,4%). Since thalassaemia minor is known to occur in Indian migrants to Britain, and since preliminary work had shown that it certainly occurs also among Natal Indians, all subjects with an MCV of less than 80 μl were excluded from further analysis. This left 215 Indian, 144 Black and 237 White subjects, who were divided into three groups by matching individuals as closely as possible in 3s, 1 from each population, for age, number of previous blood donations, and serum ferritin level. It proved possible to construct three groups of 78 individuals each, and the findings (means and standard deviations) for these are shown in Table I. Above the horizontal line are the indices for which they were matched, to indicate the closeness of matching; below it are the other indices, which were not taken into consideration at all when matching the individuals.

Subjects and methods

The subjects were male voluntary blood donors, or prospective donors, presenting themselves at clinics of the Natal Blood Transfusion Service in Durban and surrounding districts at or near sea level. No donor is rewarded, and none is less than 18 years of age. All samples were collected in the morning. Red cell counts were determined with a Coulter Model ZB 1 counter, and haemoglobin levels with a Coulter photometer. Packed cell volume (PCV) was determined directly by microhaematocrit, not calculated by the counter, and MCV was calculated from this haematocrit and the red cell count provided by the counter. Serum iron and TIBC were estimated with a commercial kit (Hyland Ferro-Chek). Serum ferritin was estimated by an enzyme-linked immunosorbent assay (ELISA) developed by the Natal Blood Transfusion Service.

In a previous study it was shown that Indian blood donors with haemoglobin levels similar to those in the White and Black population groups nevertheless had a significantly lower mean corpuscular volume (MCV), coupled with a significantly higher red cell count, than subjects from the other two groups. Subsequent unpublished work showed that they also had notably higher total iron-binding capacity (TIBC). Since reduced MCV and increased TIBC are well-known effects of iron deficiency anaemia, to which the Indian population of Natal is known to be subject, a further study was undertaken to determine whether this could be the cause of the observed differences.

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**TABLE I. SERUM IRON, TOTAL IRON-BINDING CAPACITY, AND RED CELL INDICES IN INDIAN, BLACK AND WHITE MALES MATCHED FOR AGE, NUMBER OF PREVIOUS DONATIONS, AND SERUM FERRITIN LEVEL (N = 78 IN EACH GROUP) (MEAN VALUES, WITH SD IN BRACKETS)**

<table>
<thead>
<tr>
<th>Age</th>
<th>Indian</th>
<th>Black</th>
<th>White</th>
<th>Significance: P</th>
<th>I/B</th>
<th>I/W</th>
<th>B/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>26,9 (8,2)</td>
<td>28,0 (8,7)</td>
<td>26,6 (8,0)</td>
<td>0,05</td>
<td>NS</td>
<td>0,05</td>
<td></td>
</tr>
<tr>
<td>Previous donations</td>
<td>5,2 (6,5)</td>
<td>5,1 (6,0)</td>
<td>5,0 (6,1)</td>
<td>0,01</td>
<td>0,0001</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Serum ferritin (µg/l)</td>
<td>65 (47)</td>
<td>69 (51)</td>
<td>67 (45)</td>
<td>0,01</td>
<td>0,01</td>
<td>0,01</td>
<td></td>
</tr>
<tr>
<td>Serum iron (µg/dl)</td>
<td>122 (37)</td>
<td>109 (35)</td>
<td>121 (34)</td>
<td>0,01</td>
<td>0,0001</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>TIBC (µg/dl)</td>
<td>358 (54)</td>
<td>327 (62)</td>
<td>311 (46)</td>
<td>0,01</td>
<td>0,0001</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Transferrin saturation (%)</td>
<td>34 (10)</td>
<td>34 (12)</td>
<td>40 (12)</td>
<td>0,01</td>
<td>0,01</td>
<td>0,01</td>
<td></td>
</tr>
<tr>
<td>Haemoglobin (g/dl)</td>
<td>15,3 (1,1)</td>
<td>14,9 (0,9)</td>
<td>15,3 (0,9)</td>
<td>0,01</td>
<td>NS</td>
<td>0,01</td>
<td></td>
</tr>
<tr>
<td>PCV (l/l)</td>
<td>46 (3,0)</td>
<td>45 (2,5)</td>
<td>45 (2,6)</td>
<td>0,01</td>
<td>0,01</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>30 (1,9)</td>
<td>31 (1,6)</td>
<td>31 (1,5)</td>
<td>0,001</td>
<td>0,0001</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>91 (6)</td>
<td>93 (5)</td>
<td>92 (5)</td>
<td>0,01</td>
<td>0,05</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Red cell count (x 10^12/l)</td>
<td>5,1 (0,4)</td>
<td>4,8 (0,3)</td>
<td>4,9 (0,3)</td>
<td>0,0001</td>
<td>0,001</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

NS = not significant at P = 0.05.

**Discussion**

The selection of individuals for the study must first be justified. Clearly those with iron deficiency severe enough to affect red cell indices had to be eliminated; this was done by considering both the serum ferritin level, which is a good indication of total body iron stores, and the transferrin saturation. If, as I suspect, most of the Indians in Fig. 1 in the tail of the histogram (MVC < 80 fl) have a variety of thalassaemia minor, they should also be excluded. Pearson et al. have shown that an MCV of less than 79 fl, as determined by the Coulter counter, is a reliable screening level for thalassaemia minor of both the alpha and beta varieties. There is, unfortunately, no easy way of certainly identifying heterozygotes for α-thalassaemia, which is relatively common among Indian migrants to the UK. Preliminary work here has shown that only a minority of non-iron-deficient Indian subjects with an MCV of less than 80 fl have the proportionately increased haemoglobin A, levels characteristic of the β-thalassaemia trait. The great majority of subjects with either kind of thalassaemia minor will, however, be eliminated by taking a lower limit for the MCV of 80 fl. This criterion will unquestionably also eliminate some normal individuals with small red cells, but if normal Indians do in fact have smaller red cells than subjects of the other two groups, then proportionately more of them will be thus eliminated, and if the subjects remaining still prove to have a lower MCV, it will be more certain that the phenomenon is a real one.

The reason for determining the haemacrit directly, rather than allowing the Coulter counter to calculate it, is that some drift in the MCV as determined by the particular counter in our laboratory had been shown to occur. Whether this was a calibration problem or due to some peculiarity of the machine is uncertain. No allowance was made for trapping of plasma in the calibration problem or due to some peculiarity of the machine is uncertain. No allowance was made for trapping of plasma in the

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Idiopatiese hemochromatose met hipopituitarisme en kardiomiopatie

'n Gevalbespreking

J. RABIE

Opsonning

'n Drie-en-dertigjarige man met idiopatiese hemochromatose wat voorkom met kongestiewe hartversaking en hipopituitarisme word gerapporteer. Die spektrum van simptome en teken's van hemochromatose word kortliks bespreek.


Idiopatiese hemochromatose is 'n relatief seldsame en oorerflike siekte met 'n voorkomssyfer van 1/10000. Daar is 'n aangebore afwyking in die metabolisme waar die beheermeganismes van yster-absorpsie van die maagdermkanaal abnormaal maak. Met oortollige opname van yster uit die diët en met beperkte uitskiding ontwikkel daar 'n geleidelike ophoping van ferririen en hemosiderien in die lewer en ander organe, wat lei tot toenemende fibrose. Hierdie ophoping vind geleidelik plaas en na jare mag die hoeveelheid yster 20 - 40 keer bo normale vlakke vermeerder het, voor die kliniese beeld herken word.

Gevalbespreking

'n Drie-en-dertigjarige Blanke man her in Mei 1981 met moegheid, toenemende buikongemak en harrkloppings aangemeld. Daar was roenemende buikongemak, veral in die rechter-hipochondrium. Tydens Januarie 1981 is die pasiënt endokrinologies ondersoek vir 'n vermoedelike roes rand van J. S. Marais Mediese Sentrum 103, Blanckenbergstraat, Bellville, KP

J. RABIE, M.B. CH.B., L.K.L. (S.A.)

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