Acute Reversible Heart Failure in Severe Iron-Deficiency Anemia Associated with Hookworm Infestation in Uganda Africans

By K. Somers, M.B., B.Ch. (W’Rand), M.R.C.P., D.C.H.

Severe iron deficiency anemia is a common sequel to the heavy hookworm infestations prevalent in Uganda, and in some hypoxia can be so severe that heart failure supervenes. The clinical manifestations in 15 cases are described. Comment is made on reversible electrocardiographic changes.

Severe iron-deficiency anemia associated with hookworm infestation is common in Uganda and during the year 1957, accounted for 114 or 5 per cent of all adult medical admissions, excluding pediatrics, into Mulago Hospital.1

It is not intended in this communication to enter into the controversy over the role of the hookworm in the causation of the anemia,2–3 but it can be stated at the outset that experience at Mulago Hospital continues to confirm Lehmann’s findings4–7 that iron alone will not cure the anemia and that, in addition, removal of the hookworms will result in a rapid improvement.

Severe anemia from any cause may affect the heart by producing a hyperkinetic circulatory state with its manifestations of tachycardia, dyspnea, and edema.8 These are commonplace findings in severe anemia associated with hookworm infestation seen at Mulago. Furthermore, congestive failure due to the anemia is not uncommonly seen and this report is concerned with a study of heart failure in patients with severe anemia associated with heavy hookworm infestation.

Material and Methods

Diagnosis. It is difficult clinically to recognize congestive failure in severe anemia for the usual signs may have other interpretations. Thus, a raised venous pressure may be part of the physiologic mechanism maintaining a high cardiac output as shown by McMichael,9 and edema is common in uncomplicated anemia. Failure can only be diagnosed on a careful consideration of these signs as well as orthopnea, paroxysmal cardiac dyspnea and pulmonary edema, enlargement and tenderness of the liver, and gross cardiac enlargement with diastolic gallop rhythm. In the cases selected for study, a diagnosis of anemia associated with hookworm infestation was arrived at only where severe iron-deficiency anemia was associated with evidence of occult blood and hookworm ova in the stool and by the exclusion of other possible causes of anemia, e.g., esophageal varices associated with portal hypertension, malaria, and sickle-cell disease, all commonly encountered conditions in Uganda. Trowell’s dictum10 that the diagnosis of hookworm anemia can be absolute only in retrospect when the patient is discharged, fit and cured, was always borne in mind.

At physical examination, a careful note was made of findings in the cardiovascular system, and a total of 15 cases (table 1) were selected in whom there was no doubt about the presence of congestive failure and in whom no other concomitant cause for heart failure could be discovered. In each case with failure an x-ray of the chest and an electrocardiogram were taken before and after treatment. Hemoglobin levels were estimated weekly throughout stay in hospital.

Treatment. Treatment consisted of oral and intramuscular iron (‘‘Imferon’’), transfusions in severely ill cases if blood was available, and digoxin in desperate cases of failure. A low-salt ward diet was prescribed and patients were dewormed with tetrachlorethylene at hemoglobin levels of 45 per cent (6.3 Gm./100 ml.) or over. A single dose was sufficient but in 3 cases (cases 6, 10, and 12) a second dose was necessary because of the persisting worm load as judged from the continued presence of ova in the stools.

Observations. Of the 15 cases studied, 10 were male and 5 female, which roughly reflects the ratio of intake at Mulago Hospital. Their mean estimated age was 26.3 years, with a range of 5 to 50 years. The patients

From the Department of Medicine, Makerere College Medical School and The Medical Division, Mulago Hospital, Kampala, Uganda.
belonged to various tribal groups found in Kampala. Six were Ganda and 5 of the Ruanda-Urundi group.

An attempt to assess the duration of anemia had to be given up because the information obtained was unreliable. More accurate accounts of the duration of heart failure were noted when a definite immediate history of orthopnea, paroxysmal cardiac dyspnea, or spontaneous pain in the right hypochondrium due to hepatic distention was obtainable. On such estimates the duration of failure averaged 4.7 weeks, with a range of 1 to 8 weeks. None of the patients complained of symptoms of angina, which is perhaps analogous to the absence of coronary disease in the African in Uganda. Palpitations with discomfort in the left chest were, however, common complaints.

All the patients had systolic murmurs over the left sternal border or at the apex which either improved or disappeared after treatment. No diastolic murmurs were heard in any of the series. A diastolic gallop was heard in nearly all cases.

Investigations. The hemoglobin on admission averaged 19 per cent (2.7 Gm./100 ml.) and ranged from 8.1 to 33.3 per cent (1.1 Gm. to 4.6 Gm./100 ml.). Of the 12 cases whose electrocardiograms were taken, 9 showed abnormalities that reverted to normal after treatment. All the cases showed radiologic evidence of generalized enlargement of the heart and the reduction in size after treatment in case 6 is shown in figure 1. Two cases had pulmonary atelectasis followed by complete reexpansion in one (case 6) and recurrent pneumonia in the other (case 10) but in neither was it felt that atelectasis or infection contributed to the heart failure.

Necropsy Findings. Of the 5 deaths, 4 were preceded by sudden collapse within a few hours of admission. Three were examined

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**Table 1.—Clinical Data in Five Cases**

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Sex</th>
<th>Age</th>
<th>Duration of chronic congestive failure (wks.)</th>
<th>Hemoglobin on admission (Gm.)</th>
<th>Electrocardiographic changes</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>40</td>
<td>4</td>
<td>14 (2.0)</td>
<td>+</td>
<td>Cure</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>22</td>
<td>?</td>
<td>26 (3.6)</td>
<td>—</td>
<td>Death</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>26</td>
<td>8</td>
<td>11 (1.5)</td>
<td>+</td>
<td>Cure</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>50</td>
<td>4</td>
<td>—15*</td>
<td>NT</td>
<td>Death</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>24</td>
<td>6</td>
<td>27 (3.8)</td>
<td>+</td>
<td>Death</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>10</td>
<td>3</td>
<td>33 (4.6)</td>
<td>+</td>
<td>Cure</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>36</td>
<td>8</td>
<td>13 (1.8)</td>
<td>+</td>
<td>Death</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>5</td>
<td>4</td>
<td>14 (2.0)</td>
<td>+</td>
<td>Cure</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>40</td>
<td>4</td>
<td>21 (2.9)</td>
<td>—</td>
<td>Absconded</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>30</td>
<td>8</td>
<td>15 (2.1)</td>
<td>+</td>
<td>Cure</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>7</td>
<td>1</td>
<td>15 (2.1)</td>
<td>—</td>
<td>Cure</td>
</tr>
<tr>
<td>12</td>
<td>M</td>
<td>45</td>
<td>4</td>
<td>29 (4.1)</td>
<td>+</td>
<td>Cure</td>
</tr>
<tr>
<td>13</td>
<td>M</td>
<td>30</td>
<td>?</td>
<td>16 (2.2)</td>
<td>NT</td>
<td>Cure</td>
</tr>
<tr>
<td>14</td>
<td>F</td>
<td>22</td>
<td>?</td>
<td>26 (3.6)</td>
<td>NT</td>
<td>Death</td>
</tr>
<tr>
<td>15</td>
<td>M</td>
<td>7</td>
<td>2</td>
<td>8 (1.1)</td>
<td>+</td>
<td>Absconded</td>
</tr>
</tbody>
</table>

*Clinical estimate.

NT = not taken.

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![Fig. 1. Skiagrams showing general cardiac enlargement in cases 6 and 8. A. Before treatment; collapsed right upper lobe. B. After treatment of anemia.](image)
postmortem and in each case necropsy revealed a hookworm count of more than a thousand. All the internal organs showed marked pallor. The chambers of the heart, especially the left ventricle, were dilated and the heart muscle in 2 cases (cases 14 and 15) showed thrush-breast streaking. No coexistent cardiac lesions or evidence of endomyocardial fibrosis, a common cause of heart failure described from Uganda,11, 12, 31 was detected in any case. Pulmonary edema was noted in all the cases examined.

**Discussion**

Heart failure due to anemia is rare in Western communities, and Porter and James14 go so far as to state that if failure does occur in an anemic patient, the coexistence of an intrinsic cardiovascular disease is almost certain. In the East however, chronic severe anemia is known to be a not uncommon cause of heart failure.13, 16 Likewise in Africa, Beet17 has noted the frequent complication of heart failure in anemia occurring in Nigeria. In the study by Sanghvi et al.16 in India of 60 cases of severe anemia due to various causes, 20 were complicated by heart failure. In the majority the anemia was ascribed either to chronic malaria or hookworm infestation. In the Mulago series, evidence in favor of hookworm as the sole causative factor has been overwhelming, and malaria seems unimportant in the development of the anemia.

It is interesting to speculate why only a small number of our severely anemic patients develop heart failure. The answer lies perhaps with the chronicity rather than the severity of the anemia, an impression that seems logical in the knowledge that nutritional degenerative changes may occur in the cardiac muscle as a result of chronic hypoxia, reducing its reserve and predisposing to heart failure. If retrospective histories of weakness and tiredness could be relied upon to suggest the duration of anemia, what is now only a clinical impression might be confirmed further. In practice, however, the interrogation for such symptoms proved worthless and had to be abandoned.

**Fig. 2.** Electrocardiograms of case 3 showing low voltage and flat or inverted T wave in all leads before treatment and improvement after correction of anemia.

The factors of malnutrition and thiamine deficiency might be suggested as possible factors in the causation of heart failure in these cases. In our hookworm series, however, treatment with adequate diet, iron and vitamins alone will not cure. Moreover, the syndromes of nutritional heart disease and those amenable to thiamine,19 described from South Africa, are different in that anemia is not a striking feature of the illness.

Sanghvi et al.16 noted electrocardiographic changes in all their cases of severe anemia
with heart failure. In the series presented here, 12 had cardiograms taken, of whom 9 showed unequivocal abnormalities. The faults shown consisted of low voltage, depressed S-T segments, or flat or inverted T waves in left ventricular surface leads or their equivalents. As the anemia improved under treatment, these faults, as classically observed, were also corrected (fig. 2).

The high mortality figure is alarming. Characteristically, death was preceded by a sudden unexpected collapse for which no cause could be found at necropsy. Doubtless, most of these cases might have been saved by early blood transfusions, if blood was available immediately, and whenever possible it is now our policy to treat with packed-cell transfusions whenever compatible blood is available. It is not generally easy to obtain donor blood in Kampala.

The finding of hookworm loads in excess of 1,000 at necropsy and Tasker’s findings of a blood loss of 0.1 ml. of blood per worm per day makes the problem of hookworm disease in general more important than its cardiovascular effects suggest.

I am indebted to Dr. Grusin for the description “acute reversible heart failure in Africans” which I have borrowed for the title of this paper because it brings to mind the essentially preventable and curable aspects of another cause of heart failure in Africa.

SUMMARY

Fifteen cases of acute reversible heart failure associated with severe hookworm anemia have been studied. Clinical signs are discussed with special reference to the diagnosis of cardiac failure and reversible electrocardiographic abnormalities before and after treatment.

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I would like to thank Professor A. W. Williams and Dr. P. W. Hutton for encouragement and advice, and the Director of Medical Services, Uganda, for facilities at Mulago Hospital.

SUMMARIO IN INTERLINGUA

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K. SOMERS

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