FAMILIAL NON-SPHEROCYTIC HAEMOLYTIC ANAEMIA*

BY

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The three accepted and well-defined types of familial haemolytic anaemia are familial spherocytic anaemia, sickle-cell anaemia, and Mediterranean anaemia. Reports have appeared of other types of familial anaemia, some of which are undoubtedly haemolytic. A family is here described in which four members in three generations were found to have non-spherocytic haemolytic anaemias.

Case Histories

Case 1.—H. J., a cable operator, was found to have a mild hyperchromic anaemia at the age of 48 when operated on for a deflected nasal septum. The indirect Van den Bergh reaction was positive and the red-cell fragility normal. For 15 years he was treated as a case of pernicious anaemia but never achieved a normal count. In addition to liver, he was given large amounts of iron. At the age of 63 he came to be examined in this department. He was an intelligent man of good physique with no apparent developmental abnormalities. His skin was dry and of a dusky yellow, the duskeness being more marked on the exposed parts. There was no buccal or genital pigmentation. His facies showed mild mongoloid features. The liver edge was palpable 2½ in. below the costal margin and felt a little firm. The spleen was not felt. There was no icterus. The main blood findings are summarized in Table I. In stained preparations the red cells appear uniformly large and well coloured. Poikilocytes were rare; anisocytosis was slight; fair numbers of stippled cells were present, but polychromatocytes were not observed. Moderate numbers of target cells were seen; red-cell fragility was slightly diminished. He was group A Rh-positive. The urine contained a trace of albumin and an occasional red cell but no bilirubin. The faecal urobilinogen content was markedly raised, and the urinary urobilinogen was sometimes similarly raised. The radiological appearance of the femora, ribs, and long bones was normal, but thickening of the vault of the skull was present.

He was treated with a variety of parenteral and oral liver extracts, with folic acid, vitamin B₁₂, and crude marrow preparations, all without benefit. He remained in tolerably good health until January, 1951, when he died after a brief illness of what appeared to be bronchopneumonia and congestive cardiac failure. A post-mortem examination was not permitted.

Case 2.—V. T., aged 68, a sister of H. J., was admitted to hospital in 1946 for upper abdominal pain, and a macrocytic haemolytic anaemia was found. Ten years previously the gall-bladder had been removed for repeated gall-stone colic and pigment stones were removed. On admission she was very pale and the spleen was just palpable. The main blood findings are given in Table I. A fractional test meal showed the presence of free hydrochloric acid. The bone marrow was normoblastic and overactive. Her blood was group A Rh-positive. The direct Coombs test

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Table I

BLOOD FINDINGS OF THE FOUR CASES

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Period of Observation</th>
<th>Haemoglobin (Haldane) (100% = 14-5 g./100 ml.)</th>
<th>R.B.C. (m./c.mm.)</th>
<th>M.C.V. (μl.)</th>
<th>M.C.D. (μ)</th>
<th>Reticulocyte Count (% R.B.C.)</th>
<th>Saline Producing Maximum and Minimum Fragility (%)</th>
<th>Serum Bilirubin (mg.%)</th>
<th>Stippled Cells (% of R.B.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>June, 1948-Nov., 1950</td>
<td>66-90</td>
<td>2-3-3-67</td>
<td>99-125</td>
<td>7-9-8-9</td>
<td>4-5-19</td>
<td>0-2-0-32 0-4-0-44</td>
<td>0-8-2-25</td>
<td>0-4-9</td>
</tr>
<tr>
<td>2</td>
<td>Nov., 1946-Oct., 1948</td>
<td>54-86</td>
<td>1-9-3-5</td>
<td>113</td>
<td>—</td>
<td>9-10</td>
<td>0-28 0-44</td>
<td>1-2-0-8</td>
<td>Occasional</td>
</tr>
<tr>
<td>3</td>
<td>Oct., 1948-Mar., 1952</td>
<td>86-99</td>
<td>3-56-3-65</td>
<td>103-105</td>
<td>8-0</td>
<td>5-4-7-8</td>
<td>0-30 0-42</td>
<td>1-2</td>
<td>Not noted</td>
</tr>
<tr>
<td>4</td>
<td>April, 1952</td>
<td>105</td>
<td>5-5</td>
<td>84</td>
<td>6-9</td>
<td>24</td>
<td>0-22 0-44</td>
<td>2-1</td>
<td>Frequent</td>
</tr>
</tbody>
</table>
was negative, the thymol turbidity 2 units, the cephalin cholesterol test 3+, and the serum colloidal gold reaction 33210000. She was given a blood transfusion of 2 pints with benefit. During the following two years the blood condition remained fairly stationary without therapy, the haemoglobin being 10–11.6 g. % and the colour index 1.1–1.4.

**Case 3.**—E. J., aged 37, a shopkeeper, and a nephew of Cases 1 and 2, was investigated because his uncle said he was sallow. Anaemia had been suspected at the age of 21, when liver was given by mouth. He felt fit and appeared normal apart from slight sallowness. The liver did not seem to be enlarged. The spleen was not felt. The main blood findings are given in Table I. Blood smears showed moderate macrocytosis and a few target cells. Spherocytes were not seen. The thymol turbidity was normal. He was re-examined two years later, when the findings were almost identical.

**Case 4.**—H. G. T., aged 45, a business man, and the son of Case 2, was investigated for lassitude and found to have 24% reticulocytes and a raised serum bilirubin level, although not anaemic (see Table I). The red cells appeared normal in shape and size; some polychromasia was present and a fair number of cells showed basophilic stippling.

### Family History

The family tree is given in Fig. 1. The parents of Cases 1 and 2 were of old Cornish stock. The mother was healthy and lived to 84 years, but the father had always been yellow and died of congestive cardiac failure at the age of 45 (i).* He was said to have suffered from splenic anaemia. Of his 13 children two have been described. One other is said to have had periodic jaundice and to have died at the age of 46 of splenic anaemia (vi). Another was always sallow, was said to have had pernicious anaemia, and died of congestive cardiac failure at 55 years (iii). Two others were known to be sallow (ii and iv). In the third generation are Cases 2 (viii) and 4 (ix). Thus there are four known cases of haemolytic anaemia in the family, three subjects who were almost certainly affected and two subjects who were probably affected.

### Additional Investigations of Case 1

The gastric juice contained free hydrochloric acid. It was also shown to contain anti-anaemic principle by incubation with beef muscle and administration to an untreated case of pernicious anaemia in the manner described by Beebe and Wintrobe (1933), a reticulocyte response of 3% being achieved. A three-day fat balance showed 93% absorption. The following liver function tests were normal: serum colloidal gold, serum alkaline phosphatase, hippuric acid synthesis, and the pyramidon detoxification test (Bomford and Rhoads, 1941). The thymol turbidity varied from 2 to 5 units. The lycopene fragility (Singer, 1940), which is increased in spherocytic anaemias, was normal. The resistance of the red cells to saponin lysis (Ponder, 1934) was slightly decreased (resistance value 0.92). The mechanical fragility was estimated by the method of Shen, Castle, and Fleming (1944) modified by using 100 ml. Ehrlenmeyer flasks instead of tonometers and 30 4-mm. glass beads and 2 ml. of blood, the packed cell volume of which had been adjusted to 30 ml. It was a little increased, the results being:

<table>
<thead>
<tr>
<th>Test</th>
<th>Haemolysis</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>26/6/49</td>
<td>9.5%</td>
<td>7.8%</td>
</tr>
<tr>
<td>26/5/50</td>
<td>8.45%</td>
<td>6.2%</td>
</tr>
<tr>
<td>8/7/49</td>
<td>15.0%</td>
<td>11.5%</td>
</tr>
</tbody>
</table>

The myelogram showed erythropoiesis to be excessive and macronormoblastic. The diameter distribution curve of polychromatic normoblasts (Dacie and White, 1949) was moved to the right (mean corpuscle diameter, 10.05 μ). Twenty-three per cent. of orthochromatic normoblasts had a stippled cytoplasm. No autohaemolysins or autoagglutinins were demon

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* The numbers indicate the individuals in the family as set out in Fig. 1.
stratized, and the direct Coombs test was negative. Transfusion survival studies were unfortunately not possible, but in vitro experiments were performed. Ten per cent. sterile suspensions of washed red cells were made from both the patient and a normal control of the same group. The diluents consisted of saline, homologous plasma, and heterogenous plasma. Penicillin was added to each ampoule (approximately 200 units per ml. of suspension). The degree of haemolysis was estimated daily by direct visual comparison with individual sets of standard haemoglobin suspensions. The ampoules were shaken in a uniform manner after reading each day. In these experiments (Figs. 2 and 3) the affected subjects’ cells survived longer than normal cells both in their own and in normal plasma, while they did not survive as long as normal cells in 0.9% saline.

**Discussion**

Each of these four cases shows the features of a mild non-spherocytic haemolytic anaemia. All have increased reticulocytes and raised bilirubin levels. All are macrocytic except the last, which, paradoxically, showed the highest reticulocyte count. Basophilic stippling of the red cells was demonstrated in three of the cases. Splenomegaly was observed only in Case 2. Slight hepatic enlargement was present in Cases 1 and 2, both of which were older subjects. All four patients were described as being pale and sallow. Two complained of lassitude, one of slight bouts of shivering, and one of gall-stone colic. The increased rate of red cell destruction appears to be due to a defect in the red cells, of which stippling is probably an expression. The red cells of Case 1 have been shown to possess increased mechanical fragility, and to differ from normal cells in survival experiments in vitro. The increased survival of red cells in plasma is probably connected with their slightly flattened shape and is in keeping with their diminished saline fragility. The diminished survival of red cells in saline, with rapid initial haemolysis, may indicate an increased rate of red cell metabolism, rapid deterioration of red cells occurring when plasma nutrient is not present (Ellis and Ellis, 1950). In experimental lead poisoning it has been shown that the stippled cells are the defective cells, and that they increase greatly following splenectomy (McFadzean and Davis, 1947). In clinical lead poisoning stippled cells are more numerous in the marrow than in the peripheral blood. This was also found in Case 1. Kench, Gillam, and Lane (1942) have shown that in lead poisoning a disturbance in haemoglobin synthesis exists.

In this family the inherited defect appears to result in the production of an abnormal red cell
stoma, and possibly in the presence of an abnormal haemoglobin.

**Relevant Literature**

A case of non-spherocytic haemolytic anaemia with splenomegaly and a suggestive family history was described by Widal and Ravaut (1902). Thompson (1939) mentioned three families of haemolytic anaemia in which spherocytes were absent. Splenectomy was performed in several cases without benefit. Haden (1947) described two families in which eight patients were shown to have non-spherocytic haemolytic anaemias. In the first family spontaneous haemolysis was observed, while in the second a proportion of stippled cells were invariably found in affected subjects. Splenectomy in one member of the first family did not alter the course of the disease. Crosby (1950) described a family in which seven cases of normochromic and non-spherocytic haemolytic anaemia were found. The disease appeared to be transmitted as a Mendelian dominant, and to be associated in some cases with brachyphalangia and porphyria. Stippled cells were not a feature, but after splenectomy in one case the siderocyte count rose from 0.1% to 45%. Kaplan and Zuelzer (1950) described a family in which three siblings were found to have a chronic haemolytic anaemia. The red cells were normochromic yet had an increased volume. Oval cells were frequent in smears. Rundles and Falls (1946) described two families in which a hypochromic anaemia was present in association with splenomegaly and marked red cell deformity.

The family described in this paper resembles the second of Haden's two families and is similar to that of Kaplan and Zuelzer (1950), who demonstrated the presence of a red cell defect by transfusion survival experiments. They also noted hepatomegaly, thickening of the skull, and mongoloid facies, all of which were observed in Case 1. The family described by Crosby is also similar. He demonstrated a markedly impaired red cell survival time both in vitro and in vivo. The ineffectiveness of splenectomy in this type of case has been noted by Crosby and Haden.

**Summary**

Four cases of non-spherocytic haemolytic anaemia occurring in three generations of one family have been described, and reference has been made to five other possible cases in the family history. The red cells were macrocytic or normochromic and showed increased resistance to saline haemolysis. Stippled cells were observed in three cases. Apart from target cells, abnormal forms were not noted. In one case the mechanical fragility was found to be increased, and the survival of red cells in vitro was found to be abnormal. Neither sickling nor acid haemolysis could be demonstrated. Haemoglobinaemia was not found.
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Clinically the condition resulted in lassitude, pallor, yellow skin, pigment stones, mild jaundice, and mild hepatomegaly. It is considered that an inherited red cell defect is present in these cases, which differs fundamentally from that present in familial spherocytic anaemia. Reference has been made to similar cases described in the literature, in some of which splenectomy was performed without benefit.

I have to thank Professor W. Melville Arnott and Dr. E. Bulmer for access to the case notes of Case 2, and Dr. A. Brady for information regarding her subsequent progress; Drs. S. Shaw, D. G. Chalmers, and W. W. Walther for investigating Case 3 at my request; Drs. W. H. Cant and H. S. Baar for providing me with information regarding Case 4; and Dr. P. E. S. Palmer for the radiological opinion regarding Case 1.

REFERENCES

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