Thalassemia in Jews from Kurdistan

By Y. Matoth, Z. Shamir and E. Freundlich

COOLEY'S ANEMIA has been reported to occur in members of a wide variety of non-Mediterranean races and ethnic groups. Most of these reports describe sporadic cases. In southern Italians and Greeks, on the other hand, this condition is widely distributed. These peoples, together with a few smaller and probably genetically related ethnic groups of the eastern Mediterranean area, have, until recently, constituted the only known major reservoir of thalassemia. Reports of a high incidence of thalassemia in Thailand and also in India have recently focused attention on Asia as another important source of this genetic abnormality.

The recent mass migration to Israel has afforded an opportunity of studying a number of racial groups from areas in Asia and Africa hitherto relatively inaccessible to medical study. During the past two years, seven cases of Cooley's anemia were diagnosed in children of Jewish immigrants from Kurdistan. The carrier state, thalassemia minor, was identified in members of the patients' families and also in a considerable proportion of Kurdish patients, hospitalized for other conditions, and in the latter's families.

The seven patients and their families to be presented in this paper are of interest because they provide evidence that a whole new ethnic group, Jews from Kurdistan, is affected by thalassemia, and that the frequency of this genetic abnormality in Kurdish Jews is comparable to that found in southern Italians and Greeks.

Clinical Material

The patients were observed in a general pediatrics department serving the population of Jerusalem and the adjoining rural area. Cases were not concentrated as a result of a special search. Some of the family studies are incomplete, owing to the rather primitive character of the families, their unwillingness to cooperate, and especially to their superstitious fear of giving blood for examination. Determinations involving the drawing of venous blood, such as the hematocrit and osmotic fragility, had to be given up in many cases. Later, the lower limit of osmotic fragility was determined by a screening method using finger blood.

Family histories are given with each case report. Relevant data of surviving members are summarized in table 1. Representative blood smears are illustrated in figure 2.
Case 1

S. S., a 2$\frac{1}{2}$ year old girl, has been observed since the age of 5 months. She was admitted because of acute diarrhea. The parents, immigrants from Kurdistan, were apparently healthy. Three of 4 older siblings died in Kurdistan in early childhood, having suffered from what was described by the primitive mother as "weakness and pallor." One 6 year old sister and a 1$\frac{1}{2}$ year old brother were apparently in good health.

On admission, at age 5 months, the patient weighed 4.3 Kg. She looked pale. The spleen was felt 3 cm. below the costal margin. The red cell count was 2.88 million, the hemoglobin 4.8 Gm. per cent, the hematocrit 18 per cent (MCV 62.5 cu $\mu$, MCH 16.6 $\gamma$, MCHC 28.6 per cent). The reticulocyte count was 3.6 per cent and the white cell count 42,000. The peripheral blood smear (fig. 1a) showed extreme poikilocytosis and hypochromia. The red cells were thin and empty; many were bizarre and fragmented, target or oval in form, and some were stippled. There were 40 nucleated red cells per 100 white cells, including many early normoblasts. The white cells showed a marked shift to the left, with many myelocytes. A bone marrow aspirate revealed marked erythroid hyperplasia with an M:E ratio of 1:3. The osmotic fragility was 0.42-0.20 per cent NaCl. Serum bilirubin varied between 0.7-2.1 mg per cent and reacted indirectly. Unitary urobilinogen was within normal limits. The Coombs test and Wassermann reaction were negative. Serum iron was 185 $\gamma$/100 c.c.

During the period of observation, the spleen gradually increased in size and reached the iliac crest when the child was 11 months old. The hemoglobin was maintained at a level of 6-8 Gm. per cent by transfusions of packed red cells every 5-6 weeks. The reticulocyte count varied between 9-13 per cent, and occasionally reached 20 per cent. Ferrous sulphate, 0.6 Gm. daily for 40 days, did not affect the hemoglobin level or the number and morphology of the red cells.

Bronchopneumonia and otitis media at the age of 11 months was accompanied by a drop in hemoglobin to 3.5 Gm. per cent. The reticulocyte count dropped to 0.5 per cent and the bone marrow showed a marked depression of erythropoiesis. When the infection subsided, the reticulocyte count rose to 7 per cent and marked erythropoiesis (M:E ratio 1:9) reappeared. In recent months blood transfusions have been given every 3-4 weeks to maintain a hemoglobin level of 5-6 Gm. per cent.

At age 2 years and 4 months the patient weighed 6.1 Kg. She did not sit up, stand or speak. She has a typical mongoloid facies. X-ray changes were absent on first admission and developed gradually. At age 2$\frac{1}{2}$ years, there was marked widening of diploe of the frontal bone with "hair on end" appearance (fig. 3). The distal ends of the femora were widened to an Erlenmeyer flask shape. A pathological fracture was seen in the left humerus (fig. 4).

Case 2

Sh. Zak., a 1$\frac{1}{2}$ year old girl, has been observed since the age of 4 months, when she attended the clinic because of an acute febrile illness. Except for occasional vomiting, she had been quite well for the first few months of life. Subsequently she failed to gain weight and became increasingly pale.

The parents, immigrants from Kurdistan, were in good health. Of 12 siblings 6 had died in Kurdistan in their first or second year of life. No information as to the cause of death was available except for the general statement by the primitive mother that "they were all pale and weak." Five other siblings, aged 14, 12, 6, 5 and 3 were apparently in good health.

On first admission at age 4 months, the child looked pale and undernourished. She weighed 3.8 Kg. The spleen was just palpable on deep inspiration. The liver was felt 3 cm. below the costal margin. The red cell count was 2.8 million, the hemoglobin 5 Gm. per cent, the hematocrit 24 per cent (MCV 86 cu $\mu$, MCH 18$\gamma$, MCHC 21 per cent). The reticulocyte count was 1.9 per cent and the white cell count 17,800. The peripheral smear (fig. 1d) showed extreme poikilocytosis. The red cells appeared thin, empty, and bizarre in shape. Fragmentation and polychromasia, numerous target cells and hypochromic macrocytes, and a few
| S.N. | Ages, years when studied | R.B.C.'s mil./cmm. | Hb | Hema-
| | | | tocrit % | MCV | MCH | MCHC % | Osmotic fragility % NaCl | Hypo-
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* denotes a significant result.
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* Determined on capillary blood.

stippled cells were found. Among the white cells were found numerous myelocytes. There were 28 nucleated red blood cells per 100 white cells, including many early normoblasts. A bone marrow aspirate showed erythroid hyperplasia with an M:E ratio of 1:1. The osmotic fragility was 0.42 ± 0.16 per cent NaCl. Serum bilirubin was 0.82 mg. per cent. Urinary urobilinogen was not increased. Fecal urobilinogen excretion was 44 Ehrlich units in 24 hours.
The Coombs test and Wassermann reaction were negative. The serum iron was 170 γ per 100 c.c.

The red cell count and hemoglobin level showed a slow but steady tendency to drop. Transfusions of packed red cells were given every 5-7 weeks to prevent the hemoglobin level from dropping below 5-6 Gm. per cent. The reticulocyte count varied between 4-6 per cent.

A low reticulocyte count and a more rapid drop in the red cell count were observed in the presence of intercurrent infections. Ferrous sulphate, 0.6 Gm. daily for 60 days, failed to effect any change in the course of the disease or in the morphology of the red cells.

At age 1 year and 3 months, the spleen and liver were 8 cm. and 4 cm. below their respective costal margin. The child weighed 4.9 Kg. She did not sit up or stand. The red cell count was 1.9 million, the hemoglobin 5.7 Gm. per cent and the reticulocyte count 7.8 per cent.

X-ray changes at age 1½ years included widening of the diploe of frontal bones and the base of anterior fossa. The borders of the distal portions of long bones were straightened and their trabecular structure was coarse.

Case 3

Z. N., a boy, developed fairly normally for the first 6 months of life. Subsequently he suffered from recurrent gastrointestinal disturbances. He failed to gain weight, and increasing pallor was noted by the mother. At the age of 8 months he was referred for admission because of anemia and hepatosplenomegaly.

The parents were immigrants from Kurdistan, apparently healthy. Five siblings died in Kurdistan in their infancy and early childhood. According to their primitive mother they were all "weak" and "pale". Two surviving siblings, aged 13 and 10, were apparently healthy.

At age 8 months the patient weighed 5.5 Kg. He looked pale with a slight yellowish tinge. There was a suggestion of a mongoloid facies. A soft systolic murmur was heard over the apex of the heart. The liver and spleen were felt 2 and 5 cm. below the costal margin respec-
tively. The red cell count was 2.54 million, the hemoglobin 5 Gm. per cent, the hematocrit 20 per cent (MCV 80 cu. μ, MCH 19.5 γ γ, MCHC 25 per cent). The reticulocyte count was 5 per cent and the white cell count 36,400. The smear (fig. 1b) showed extreme poikilocytosis, with many bizarre, fragmented and small cells, target and oval forms, and occasional stippled cells. The white blood cells included many young forms. There were 80 nucleated red cells per 100 white cells. The bone marrow showed erythroid hyperplasia with an M:E ratio of 1:2. The osmotic fragility was 0.46-0.22. The serum bilirubin and urinary urobilinogen were not increased. Fecal urobilinogen excretion was 78 Ehrlich units in 24 hours. The Coombs test and Wassermann reaction were negative.

The spleen gradually enlarged to 7 cm. below the costal margin. At age 1½ years the child weighed 6.5 Kg., did not stand nor talk. His red cell count and hemoglobin level dropped steadily but with varying degrees of rapidity, the drop being most marked during periods of infection. During the first 2 months following admission, he required transfusions every 2-3 weeks. In the subsequent 3 months his hemoglobin stabilized at a level of 6-7 Gm. without further transfusions. Later transfusions of packed red cells were given every 4-5 weeks. The reticulocyte count varied between 6-8 per cent. X-rays (fig. 5), taken shortly before death, showed typical coarse trabeculations in all long, short and flat bones, widening of distal portions of long bones, and a pathological fracture of the left humerus.

The child died at home of an intercurrent infection at the age of 1 year and 8 months. The important findings at autopsy were: thick skull bones, thickening of diploe and abundant red marrow; rib marrow hyperplastic; the spleen weighing 230 Gm., follicles small and not sharply demarcated; red pulp containing numerous foci of hematopoiesis, iron present in large quantities; liver weighing 620 Gm.; the sinuoids containing foci of active hemopoietic tissue including many megakaryocytes; hematopoietic tissue also present in lymph nodes, salivary, and thymus glands.

Case 4

J. L., a 14 month old boy, has been observed since the age of 7 months when he was referred to our clinic because of pallor, loss of appetite and failure to gain weight. During the first 6 months of life he had been quite well.

The patient was the first child of Kurdish parents born in Israel. Both parents were in good health. A younger sister, now 3 weeks old, was seen on the first day of life. She appeared normal on physical examination and her blood count was polycythemic.

When first seen at the age of 7 months, the child weighed 7.5 Kg. He looked pale. The spleen and liver were felt 6 cm. below their respective costal margins. The red cell count was 2.9 million, the hemoglobin 8 Gm. per cent, the hematocrit 23 per cent (MCV 80 cu. μ, MCH 27.5 γ γ, MCHC 35 per cent) and the reticulocyte count 4.4 per cent. The white cell count was 16,200. The peripheral blood smear showed extreme poikilocytosis. The red cells were bizarre in size and shape, with large oval targets and pear shaped forms predominating. Numerous oval and a few stippled cells were seen. There were 71 nucleated red cells per 100 white cells, including many early normoblasts. A bone marrow aspirate showed erythroid hyperplasia with an M:E ratio of 1:1. The osmotic fragility was 0.44-0.22 per cent NaCl. The serum bilirubin and urinary urobilinogen were not increased. Fecal urobilinogen excretion was 90 Ehrlich units in 24 hours.

In the following 7 months the spleen enlarged to 9 cm. below the costal margin. A typical mongolid facies developed. At one year of age the child weighed 7.9 Kg., did not sit up nor stand. During this period the red cell count and hemoglobin level dropped steadily and at times rapidly. Ferrous sulphate, 0.6 Gm. daily for 40 days, did not affect this drop. The MCV occasionally revealed macrocytosis (80 cu. μ on admission; 110 cu. μ one month later; 94 cu. μ another month later). Folic acid was therefore given for a period of 14 days without appreciable effect. To prevent the hemoglobin level from dropping below 5-6 Gm., the child was maintained on packed cell transfusions given every 3-4 weeks.

X-ray changes developed gradually. At age 14 months there was marked widening of diploe of frontal bones and thickening of roof of orbits. The distal ends of the femora were widened.
Case 5

Y. Zan., a 15 month old girl, was admitted 5 months ago because of fever and diarrhea of 8 days’ duration.

The parents, immigrants from Kurdistan, were apparently healthy. Two siblings died in Kurdistan aged 2 months and 5 years respectively. Three living siblings, aged 13, 8, and 3 years, were said to be healthy. However, when the family was studied, the younger sibling was found to be anemic. He will be reported on as Case 6.

On admission the child weighed 8.6 Kg. She looked pale. The spleen was felt 2 cm. below the costal margin. The temperature, 40 C on admission, returned to normal after 2 days. Blood cultures and agglutination reactions for typhoid and brucellosis, and thick smears for malaria were all negative. The red cell count on admission was 2.24 million, the hemoglobin 5.4 Gm. per cent. The reticulocyte count was 3.5 per cent. The white cell count was 23,000 with 80 per cent granulocytes, 37 per cent lymphocytes and 3 per cent monocytes. The red cells were hypochromic and showed extreme poikilocytosis, fragmentation, numerous large target and oval forms, polychromasia and occasional stippling. There were 2 normoblasts per 100 white cells. The osmotic fragility was 0.45-0.21 per cent NaCl. A bone marrow aspiration showed moderate erythroid hyperplasia. The indirect reacting bilirubin was slightly increased and urinary urobilinogen was increased on one occasion. The alkali resistant hemoglobin was 27 per cent. X-ray revealed no skeletal changes.

A blood transfusion brought the red cell count up to 3.5 million and the hemoglobin to 7 Gm. per cent. During the following month the red cell count varied between 2.7-3.12 million and the hemoglobin between 6.5 and 7.3 Gm. per cent. The reticulocyte count varied around 3 per cent and the nucleated red cells varied between 7 and 12 per 100 white cells. The white cell count remained high after the initial infection had subsided and varied between 12,000 and 18,000. The spleen remained enlarged. Ferrous sulphate, 0.6 Gm. daily, was given for 6 weeks. The red cell count following this period was 3.32 million and the hemoglobin 7.4 Gm. per cent. It remained unchanged for an additional 2 months.

Case 6

Ch. Zan., a 3 year old boy, is a brother of patient Y. Zan. At the time of the examination of the family he looked pale. The spleen was felt 2 cm. below the costal margin. The red cell count was 3.12 million, the hemoglobin 6.4 per cent and the hematocrit 24 per cent (MCV 77 cu. MCH 20 γ), MCHC 27 per cent). The reticulocyte count was 3.8 per cent. The peripheral blood smear (fig. 1e) showed very marked hypochromia, poikilocytosis, many bizarre and fragmented red cells, large target and oval cells, hypochromic macrocytes, polychromasia, and stippling. In hypotonic solutions hemolysis began at 0.45 and was not complete at 0.21 per cent NaCl. No increased urinalysis was seen on X-ray.

Ferrous sulphate was given for 6 weeks. The red cell count at the end of this period was 3.34 million, the hemoglobin 6.7 Gm. per cent and the hematocrit 26 per cent. Blood counts during the following 2 months were essentially the same and ranged around 3.5 million and the hemoglobin around 6.2 Gm.

Case 7

M. G., a 14 month old girl has been observed for 3 months. She was referred because of bouts of temperature of several months duration, occasional diarrhea and vomiting, and failure to gain weight. She was always a “delicate child”.

Both parents were born in Israel of immigrants from Kurdistan. They, as well as an older sibling, were apparently healthy. The child was small for her age and weighed 5.6 Kg. She looked pale, was alert and mentally well developed. She could sit up and stand. A hard spleen was felt 2 cm. below the costal margin. The liver was slightly enlarged. The red cell count was 1.66 million, the hemoglobin 5.3 Gm. per cent. The reticulocyte count was 2.2 per cent. The peripheral smear (fig. 1e) showed extreme poikilocytosis, many bizarre and fragmented cells, hypochromic macrocytes, large target and oval cells, and a few stippled cells. There were 30 nucleated red cells per 100 white cells. In hypotonic saline solutions hemolysis began at 0.42 per cent and was not complete at 0.21 per cent NaCl. Urobilinogen in the urine was not increased. The skeleton appeared normal on X-ray examination.
A transfusion of packed red cells raised the red cell count to 2.9 million and the hemoglobin to 9.4 Gm. per cent. During the following 2 months these values gradually dropped to 2.18 million and 5.3 Gm. respectively. Ferrous sulphate, 0.6 Gm. daily given for 4 weeks, failed to prevent this drop in the red cell count. When last seen, at age 14 months the child weighed 6 Kg. The liver was felt 5 cm. and the spleen 3 cm. below the costal margin.

**Discussion**

1. The Patients

Thalassemia can be expressed in a variety of clinical pictures ranging in severity from the rapidly progressive, fatal form, down to the asymptomatic carrier state. In this study, cases 1–4 corresponded to the extreme end of this spectrum whereas cases 5–7 occupied an intermediate position. In the first group of cases anemia, after being first noted around the sixth month of life, became rapidly progressive. It ended fatally in case 3, and in the remaining 3 cases a fatal outcome could be prevented only by frequent blood transfusions. The patients in the second group, on the other hand, seemed to have become compensated partially for their faulty blood formation. Although anemic, they achieved an equilibrium at a lower hemoglobin level. With respect to severity of the anemia, age of onset and the presence of large numbers of nucleated red cells in the peripheral blood (with the exception of case 6), these milder cases resembled the severe type of Cooley’s anemia more closely than the cases of mild anemia reported by Wintrobe et al.,9 Dameshek’s “target cell anemia” or the familial microcytic anemia of Strauss, Daland and Fox.10

Despite differences in severity, however, all 7 cases fulfilled the criteria for the diagnosis of Cooley’s anemia. Morphologically, they all presented a uniform picture, the outstanding feature of which was the extreme poikilocytosis, to a degree not found in any other condition. Pear-shaped, distorted, and fragmented red cells dominated the picture in blood films. Thin and empty poikilocytes contrasted sharply with the healthy looking donor cells, which always constituted a large proportion of the red cell population of patients under transfusion therapy. Target cells, especially of the large variety, hypochromic macrocytes and oval cells were found in large numbers. Increased medullary and extramedullary erythropoiesis was evidenced by polychromasia, reticulocytosis, the presence of stippled cells and large numbers of nucleated red cells in the peripheral blood, and by bone marrow erythroid hyperplasia. In the case that came to autopsy, there was an extensive erythropoietic activity in an enlarged spleen and in other organs. The MCH and MCHC were decreased in all cases, but the MCV was found to be low in only one case (case 1). In case 4 it even tended to be increased. This finding was unexpected in view of the thin and shadowy appearance of the red cells. Direct measurement of cell diameters was not feasible in view of the extreme poikilocytosis. In many smears, however, there seemed to be a preponderance of large cells, particularly large target cells and pear-shaped poikilocytes. An increase in cell size was thus combined with the decreased cell thickness to give a nearly normal cell volume. Further evidence of the thinness of the cells was provided by their increased resistance to hypotonic solutions and by the ease with which they assumed the target form in dried preparations. This predominance of large cells may well represent a variant of thalassemia peculiar to the racial group under discussion.
The life span of the red cells has been demonstrated to be shortened in Cooley’s anemia.\textsuperscript{12} Red cell survival studies were not done in our cases. Indirect evidence of increased blood destruction was, however, provided by the high values for fecal urobilinogen excretion, which was determined in cases 2, 3 and 4. The values found in these cases (44, 78 and 90 Ehrlich units in 24 hours respectively) were far above the normal range found for this age group.\textsuperscript{13, 14} These figures were even more significant when the respective hemolytic indices were calculated (250, 433 and 290 mg/100 Gm. hemoglobin).

The relationship between the presence of infection and the rate of drop in hemoglobin was of interest. Although nothing resembling a hemolytic or aplastic “crisis” was observed, infection, sometimes of an obscure nature, was always associated in these patients with decreased activity of the bone marrow and a steeper than usual drop in the hemoglobin level. During periods of freedom from infection, the drop in hemoglobin was more gradual and in case 3 it even stabilized at a constant level for a period of 3 months.

2. The Families

Family studies, though incomplete, showed typical changes in all members of the families of the patients in the “severe” group (cases 1–4). The tendency to high red cell counts in the presence of relatively low hemoglobin levels was conspicuous. Polycythemic red cell counts were found in some of the subjects. All blood films showed some abnormalities, the most striking of which were hypochromia and the presence of target and oval cells. These varied in numbers from case to case, some of the subjects showing predominantly target cells, others large numbers of oval cells with only few target cells, and still others both types of cells in almost equal numbers. These variations, to which Valentine and Neel\textsuperscript{15} drew attention, were also observed among members of the same family. Osmotic fragilities, when done, were low. The family histories were of interest. Although no exact information could be obtained as to the cause of death of the siblings who died in Kurdistan in their infancy or early childhood (see case reports), the number was very high (3 out of 4 in family S., 6 out of 12 in family Zak. and 5 out of 7 in family N.) even after the high infant mortality in that country is taken into consideration. At least some of the children may safely be assumed to have died of Cooley’s anemia. In family L., the patient was the first child. His younger sister showed polycythemia and target cells at birth. Her course remains to be followed.

The familial nature of the anemia in the second, milder, group is also amply documented. The findings in these 2 families were, however, not as consistent as in the first group. No abnormality could be detected in the father of patient M.G. (case 7) and only slight morphological blood changes were found in the mother of patients Ch.Zan and Y.Zan (cases 5 and 6), in whom, in addition, the lower limit of the osmotic fragility was normal. It should be added that doubts as to paternity have not been raised in these families since the strict moral code of Kurdish Jews precludes the possibility of extramarital relations.

The appearance of a relatively severe anemia in these children born to parents of whom one is an asymptomatic carrier and the other an apparently normal individual deserves to be commented on. To account for it, unless the “normal”
parent is assumed to be a carrier with an abnormality so slight as to avoid detection, the hypothesis of the transmission of thalassemia as an incomplete recessive character\textsuperscript{16} should be modified along the lines suggested for the sickle trait\textsuperscript{17} to allow for variations in the expression of the gene.

3. The Ethnic Group

Little is known of the origin and racial background of the Jews of Kurdistan. The first Jews to settle in that area, the Biblical Assyria, were exiles from Palestine. Later there is evidence of large Jewish communities in that country during the early Christian era.\textsuperscript{17} Admixture of non-Jewish blood is most likely and it is difficult to ascertain to what extent present-day Kurdish Jews represent the old Palestinian Jewish stock. Geographically, however, Kurdistan, with its inaccessible mountains and gorges, favored the isolation and preservation of several ancient racial groups. Many old traditions dating back to Biblical times have been preserved among Kurdish Jews, who speak a language, an old Aramaic dialect, quite distinct from the language spoken by their Kurdish neighbors. Kurdish Jews are an agricultural people and have lived in a number of villages and small towns along what is now the Turkish-Iraqi border. Their number before World War II was estimated at 16–18 thousand,\textsuperscript{19} a considerable proportion of which have since migrated to Israel.

The Kurdish population in the area served by this hospital is estimated at 15,000 at the most. It consists of a nucleus of older settlers in this country, the result of a steady trickle of Kurdish Jews to Palestine over the past 50 years (families L. and G.) and the majority of recent immigrants who came in since the formation of the state of Israel. All 7 cases were seen within two years. More cases are being diagnosed as physicians in this country become familiar with the picture of thalassemia.\textsuperscript{18} Older practitioners now recall several cases of a fatal anemia in infants, diagnosed as von Jaksch anemia, seen over the past 20 years in 2–3 families of the then small Kurdish community in Jerusalem. It is to be assumed that even more cases remain undiagnosed owing to the primitive status of the people.

A survey of the frequency of thalassemia in Kurdish Jews in the Jerusalem area is in preparation. Meanwhile, as previously mentioned, a number of individuals showing the typical hematological findings of Cooley’s trait were accidentally found on routine study of blood smears of Kurdish patients hospitalized for other conditions. Six of these families were available for study. In each case one parent and several siblings had a high red cell count with a relatively low hemoglobin level, hypochromia, target and oval cells in blood films and increased resistance to hypotonic solutions. Similar observations among adult patients were made by Dreyfuss,\textsuperscript{20} who studied in detail 3 Kurdish families with Cooley’s trait. Pending detailed statistical study, the available information on the incidence of the homozygous state responsible for the severe anemia permits of a rough estimate of the frequency of the thalassemia gene. If the incidence is assumed to be represented by the four known homozygous cases of this series, if the Kurdish population of the Jerusalem area is taken at its maximum figure of 15,000 and if allowance is made for the high birth rate of Kurdish Jews (putting it at the improbably high figure of 1,000 births per year)
THALASSEMIA IN JEWS FROM KURDISTAN

A frequency of 1 in 500 births can be calculated for the two year period in which these 4 cases occurred. This rough estimate, which probably represents a minimum value, may be compared with a frequency of 1 in 2368 births found by Neel and Valentine in Rochester, N. Y., for immigrants from Italy, mostly Sicilians and southern Italians, and their descendants.

Thalassemia seems to be not infrequent in the geographical area adjacent to Kurdistan. It has been reported in Bucharan Jews from the region of the Caspian Sea and recently in Persians. Information as to the occurrence of the thalassemia gene among non-Jewish groups in Kurdistan is lacking. Such information would be of great interest in determining whether thalassemia in Kurdish Jews merely reflects its occurrence in the general population of that area. If, however, thalassemia in Kurdistan is found to occur exclusively among Jews, then in all probability the gene was brought over into Kurdistan by the Biblical ancestors of Kurdish Jews from the large pool of the thalassemia gene in the eastern Mediterranean basin. In each case inbreeding must be considered an important factor in concentrating the gene in this small and isolated community.

SUMMARY

1. Seven cases of Cooley’s anemia in Jews from Kurdistan residing in the Jerusalem area are presented with family studies. Four homozygous cases were severe and progressive. One ended fatally and the remaining 3 were kept alive by frequent blood transfusions. Three heterozygous cases showed a milder course.

2. It is suggested on the basis of these and other observations that the Jews of Kurdistan constitute a hitherto unknown reservoir of the genetic abnormality responsible for Cooley’s anemia.

SUMMARIO IN INTERLINGUA

1. Es presentate septe casos de anemia de Cooley in judeos de Kurdistani qui habita le area de Jerusalem. In omne casos studios familial eseva executate. Quatro casos eseva homozyge, tres heterozyge. Le character del casos homozyge eseva sever e progressive. In un de illos le patiente moriva. In le tres alteres le patientes eseva mantenite in vita per frequentе transfusiones de sanguine. Le casos heterozyge eseva caracterisate per un curso minus sever.

2. Super le base de iste e altere observationes le autores postula le possibilitate que le judeos de Kurdistan representa un previemente non recognoscite reservoir del abnormalitate genetic que es responsable pro anemia de Cooley.

REFERENCES

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