incision or manual stretching of the cervix has been recommended (Browne, 1949). These procedures, however, have a limited application and are fraught with hazard. In such cases, therefore, it is probably wiser to transfer the patient to hospital.

Malpositions of the Foetal Head.—Since, as has been pointed out by Freeth (1950), it is unwise to assume that the occiput is necessarily anterior, it is essential to determine the position of the foetal head before applying the forceps. For this it is usually recommended that an ear be sought or, failing this, that the nape of the neck be identified (Browne, 1949). These measures, although possessing a high degree of accuracy, have the disadvantage that full anaesthesia is necessary for their proper application. This objection no longer obtains if use is made of the suture lines to determine the position of the occiput. These landmarks can easily be reached in most patients, and with practice a high degree of accuracy in their identification may be obtained. Late in labour caput formation may obscure these features to some extent, though in all but exceptional cases they can usually be made out with time and patience. If doubt still exists a good case can be made for examination under anaesthesia, the whole hand being passed into the vagina. Such a measure should, however, in no way commit the obstetrician to immediate delivery if the position of the head or the state of the cervix implies that this course would be unsafe.

Conclusions and Summary

An attempt has been made to determine the causes and assess the dangers, both to the mother and to the foetus, of "failed forceps deliveries."

The importance of these emergencies lies mainly in the fact that they represent a small subgroup of that category of deliveries loosely termed "difficult forceps" in which essentially the same conditions and the same dangers exist. Thus, as Fletcher Shaw (1928) pointed out, for every case in which failure occurs there must be many in which delivery is accomplished only after prolonged and dangerous traction, often through an incompletely dilated cervix.

The amount of maternal disability and foetal loss in these cases must be considerable. In consequence, every effort should be made to reduce the extent of this hazardous intervention.

Thirty-seven cases of "failed forceps deliveries" admitted to the Norfolk and Norwich Hospital are reviewed.

In over half of the multiparae consideration of the past obstetric history might have provided grounds for suspecting dystocia.

The causes of failure at the initial attempt at delivery were malpositions of the foetal head, incomplete cervical dilatation, and disproportion. This last factor, however, was not a common finding in the present series.

In a considerable proportion of cases (35.1%) delivery ultimately presented no particular problems.

Suggestions for the earlier recognition of the causes of failure have been discussed.

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SICKLE-CELL ANAEMIA IN THE ACCRA DISTRICT OF THE GOLD COAST*

A REVIEW OF TWENTY CASES

BY

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It has been found impossible, in reviewing the literature, to assess the incidence of sickle-cell anaemia either in America or in Africa. The incidence of sickle-cell anaemia to the sickle-cell trait has been reported in America to vary from 1:2 (approximately) (Winsor and Burch, 1945) to 1:71 (Switzer and Fouché, 1948), with many intervening estimates. These figures show great disparity, but they do prove that sickle-cell anaemia is relatively common in America when it is remembered that approximately 900,000 negroes in the United States exhibit the trait (Beacham *et al.*, 1950).

On the other hand, the majority of writers in Africa regard sickle-cell anaemia as rare, in spite of the fact that the incidence of the trait in the African native may be more than double that of the American negro (Gelfand, 1944; Murray-Lyon, 1944; Beet, 1947; Robertson and Findlay, 1947; Mackey, 1949; Raper, 1950; Lehmann, 1951; Jelliffe and Humphreys, 1952; *British Medical Journal*, 1952). Smith (1943), however, estimated the incidence of the anaemia to the trait to be 1:5 in Nigeria, and Lambotte-Legrand (1951) stated that 6% of trait-positive Africans in Leopoldville suffered from sickle-cell anaemia. Foy *et al.* (1951), in Kenya, did not describe any cases, but stated that there were four cases of sickle-cell anaemia in the 13 trait-positive Africans examined, and concluded that the anaemia was commonest among infants and newborn babies. This statement, however, requires confirmation, as it has been shown that the neonate may be protected against sickle-cell anaemia (Watson, 1948; Edington, 1952), and there are only three reports in the literature of sickle-cell anaemia occurring under the age of 4 months (Cohen *et al.*, 1947; Frazier and Rice, 1950; Heldrich, 1951). Thus the part that the sickling phenomenon plays in the morbidity and mortality rates of the African native has still to be assessed.

I have diagnosed sickle-cell anaemia in 33 instances. Only one examination was possible in 13 patients, however, and these are consequently not considered in this review.

The following investigations were employed to discover those who were suffering from sickle-cell anaemia. (1) One patient was discovered on routine surveys of the population in which 2,255 Africans were examined and questioned. The findings are shown in Table I. It is not intended to discuss these surveys in detail. (2) Patients in the Gold Coast Hospital in whom a sickling test had been requested and found positive were examined. Of 60 sickling-positive patients investigated four were considered to be suffering from sickle-cell anaemia. (3) Patients in the Gold Coast Hospital showing many target cells in the peripheral blood smear on which routine differential counts were being performed

*This paper is based on part of a thesis submitted for the degree of M.D. of the University of Glasgow.

TABLE I.—Incidence of the Sickle-cell Trait in 2,255 Africans, Showing Age, Sex, and Type of Group Examined

Age Group	Type of Group	Persons Examined		Males		Females	
		No.	Sickling	No.	Sickling	No.	Sickling
Newborn	Newborn	384	71	211	44	173	27
8-12 yrs.	School-children	200	36	100	19	100	17
12-24 "	Boys	327	48	327	48		
16-26 "	Nurses	428	90	85	12	343	78
Adults	Anaemia	123	9			123	9
"	Pregnancy	413	75			413	75
"	Patients	125	21	62	11	63	10
All ages	Villagers	255	57	113	22	142	35
	Total	2,255	407 (18%)	898	156 (17.4%)	1,357	251 (18.4%)

were examined. Of 50 patients investigated two were considered to be suffering from sickle-cell anaemia.

The remaining 13 cases were discovered among patients referred to me by medical colleagues as suspected cases for investigation.

Diagnosis of Sickle-cell Anaemia

The diagnosis of sickle-cell anaemia in Gold Coast Africans is not an easy task, as their "normal" values in clinical medicine are unknown. Colbourne *et al.* (1950), in an attempt to discover the "normal" clinical findings, thoroughly investigated a village of 255 inhabitants in the Southern Gold Coast. The diseases from which these villagers suffered are shown in Table II.

TABLE II.—Incidence of Diseases in a Village of 255 Inhabitants

Condition	%	Condition	%
Ancylostomiasis	52	Malarial parasitaemia	32
Ascariasis	76	Signs of malnutrition	26
Enlargement of liver	33	Schistosomiasis	9
" spleen	46	Streptocerciasis	21
Guinea-worm infection	52	Yaws	75
Herniae	10	Sickle-cell trait	22

The blood counts and the haemoglobin and haematocrit values fell much below the standards regarded as normal in Britain. Malaria, liver disease, malnutrition, ancylostomiasis, and bilharzial infection are all capable of causing anaemia, and may all be found in one individual. The haematological findings in Africans suffering from anaemia may thus not be clear-cut. In one individual there may be present both a haemolytic factor (malaria) and a macrocytic factor (liver disease and malnutrition) in addition to an iron deficiency (ancylostomiasis and schistosomiasis). I thus had difficulty in deciding the criteria necessary for the diagnosis of sickle-cell anaemia. In the surveys it was decided primarily to rely mainly on the history given by the individual and to investigate thoroughly all cases in which a history of recurrent attacks of joint pain, vague ill-health, or jaundice was given. In addition, individuals showing more than 4% of target cells in peripheral blood smears were investigated, as Diggs and Bibb (1939) found these cells in all the 47 cases of sickle-cell anaemia they discussed. The method of discovering patients suffering from sickle-cell anaemia employed in the survey is open to criticism, but in the one girl in whom sickle-cell anaemia was diagnosed the history was dramatic and was not simulated by any of the other individuals examined and questioned. It should be noted that acute rheumatism is extremely rare in the Gold Coast.

Sickle-cell anaemia was not finally diagnosed unless the following criteria were fulfilled: (a) sickling of the erythrocytes; (b) signs of increased haemolysis in the peripheral blood with a persistently raised reticulocyte count; (c) lack of response of the haemolytic anaemia to antimalarial therapy; (d) a low erythrocyte sedimentation rate and lack of response of the joint pains to salicylate therapy; and (e) absence of any other condition which might be responsible for the haemolytic anaemia.

Methods Employed in the Investigation

The rapid bacterial method (Robinson, 1945) was used throughout to detect the presence of sickling. Haemoglobin was estimated by Sahli's method, using two haemoglobino-meters which were afterwards kindly calibrated by Dr. J. V. Dacie at the Postgraduate Medical School, Hammersmith, and Dr. J. N. Marshall Chalmers at St. George's Hospital. The packed cell volume was estimated by centrifuging oxalated venous blood (Wintrobe's method) in a haematocrit tube at 3,000 r.p.m. for 30 minutes. Red- and white-cell counts were performed in three sets of pipettes which were checked against each other and against normal individuals (European). They consistently gave similar results, and it is not felt that grave inaccuracies have resulted. Reticulocytes were counted by the coverslip method, using an alcoholic solution of brilliant cresyl blue. Five hundred cells were counted. Target cells were enumerated on a thin blood smear stained by Leishman's method.

The 500 cells were counted by moving transversely across the centre of the smear and the percentage of target cells to the nearest whole number was calculated. Serum bilirubin was estimated by the use of a Lovibond's comparator. Coombs's test was performed, using dried anti-human-globulin serum supplied by the Ministry of Health Blood Group Reference Laboratory. The erythrocyte sedimentation rate was estimated in the manner described by Wintrobe (1947). No correction for anaemia was made. The bromsulphthalein excretion test was performed with a dosage of 2 mg. per kg. and blood was withdrawn at the end of 30 minutes. An alkalized portion of the serum was compared with prepared known percentage standards and acidified serum. The standard three-tube Kahn test was employed. Routine blood culture, Widal, and Weil-Felix tests were performed when considered necessary. It was not possible to perform investigations requiring the use of a colorimeter. The faecal urobilinogen output or haemolytic index was not calculated. Schlesinger's test was employed to detect urinary urobilin and the resultant colour was compared with a normal standard.

Review of the Cases

Three females and 17 males, representing six Gold Coast tribes, were considered to be suffering from sickle-cell anaemia (see Table III).

TABLE III.—Age and Sex Groups of 20 Cases of Sickle-cell Anaemia

Sex	No.	Age in Years					
		0-5	6-10	11-20	21-30	31-40	Over 40
Male	17	—	3	8	4	1	1
Female	3	—	2	—	—	1	—

In only five cases was it possible to examine both parents, and they all showed the sickling phenomenon. In another case one parent was available for examination and the erythrocytes also sickled. None of the parents were found to be suffering from sickle-cell anaemia. Twenty-three siblings were examined and five were considered to be suffering from sickle-cell anaemia; three of these five were in one family. The results of the examination of the families agreed with the homozygous theory of the inheritance of sickle-cell anaemia (Neel and Valentine, 1947).

Previous Histories

The previous histories in all cases were strikingly similar. A history of severe recurrent attacks of pain in the larger joints of the limbs was given. The first attacks had occurred in "infancy" in 12 instances, and the latest onset of the attacks occurred at the age of 7½ years. The present number of attacks a year varied from "continuous" to nil, the latter in an African male nurse, aged 44, who stated that the attacks had ceased at the age of 35. In nine

instances it was stated that the attacks became less severe as the patient became older, and in ten the attacks of joint pain were associated with cold weather. Wintrobe (1947) does not mention that sickle-cell anaemia may become less severe with age, but cold weather was regarded as a possible factor in precipitating the acute episodes of sickle-cell anaemia by Graham (1924) and Berk and Bull (1943).

In the Gold Coast, however, cold weather is associated with the rainy season and with an increase in the mosquito population and a corresponding increase in malarial infection. Knisely and Bloch (1942) described massive intravascular agglutination in vivax and falciparum malaria with local haemoconcentration and tissue anoxaemia resulting from the clumping of the erythrocytes. Similar findings were reported in the one case of sickle-cell anaemia they examined. Malaria may thus act as the "trigger" mechanism in precipitating a crisis in sickle-cell anaemia. Intravascular sickling could be produced by the local anoxaemia caused by the malaria parasite, with resultant increased stasis, increased sickling, and a further increase in the local tissue anoxaemia. A vicious circle would thereby be established. The history of a decrease in the number of attacks as the patient becomes older is also compatible with the theory that malaria may be a precipitating factor in the crises—the attacks lessening in frequency as the patient's premunition to malaria develops. It is suggested that in the Gold Coast the association between cold weather and the acute episodes of sickle-cell anaemia are in all probability associated with the greater incidence of malarial infection found during the rainy season.

Symptomatology

Seven of the 20 patients did not complain at the time of examination. The symptoms, in order of frequency, were: joint pains (11), fever (9), nausea (9), headache (5), abdominal pain (4), pains in the limbs (4), pain in the chest and lumbar pain (2), weakness (2), yellow eyes (2), eye complaints (2), dizziness (1), leg ulcer (1), and palpitation (1). In general the symptoms are those usually described in the literature. The eye complaints were, however, unusual, and microaneurysms of the retinal vessels were found in these two patients (Edington and Sarkies, 1952).

Clinical Signs

Eleven of the patients were asthenic and resembled the type of habitus described by Winsor and Burch (1944a, 1944b) with a short trunk and long slender limbs and fingers. "Tower" skull was noted in two patients and mongoloid features in a further two. Jaundice was noticeable in nine and scars of leg ulcers in seven. Active leg ulcers were present in one patient only. The elbow-joint was swollen in one patient and the small joints of the fingers in another.

The heart was considered to be enlarged clinically in five patients. Systolic bruits were present at the mitral area in four and at the pulmonic area in one. The blood pressure was consistently low. The incidence of cardiac complications in this series (25%) is lower than that usually reported, and figures as high as 95% have been recorded (Winsor and Burch, 1945).

Enlargement of lymph nodes was not a striking feature, but small rubbery cervical nodes were palpable in eight patients.

The liver and spleen were palpable in eight and 11 patients respectively. In only one patient was hepatic insufficiency marked, and the bromsulphthalein retention was 35% at the end of 30 minutes. The hepatic insufficiency gradually improved without improvement in the anaemia or in the signs of increased haemolysis. The aetiology of hepatic insufficiency in sickle-cell anaemia is obscure, but has already been described in five patients by Henderson (1950). The diagnostic importance of a palpable liver or spleen in the Gold Coast African is difficult to assess. "Normally" in children the liver may be palpable in 58%, and the spleen in 86%. In adults the figures are lower, and are in the region of 21 and

24% respectively (Colbourne *et al.*, 1950). The spleen in sickle-cell anaemia is enlarged in the younger age groups and diminishes in size with the progress of the disease until only a fibrosed remnant with a characteristic histopathological picture may be found. The spleen in races living in a hyperendemic malarial area follows a similar course, but the histological appearances are different and the small size of the fibrosed spleen in sickle-cell anaemia is not seen. In my opinion no reliance can be placed on enlargement of the spleen or liver as diagnostic points in sickle-cell anaemia in the Gold Coast African.

As already noted two patients revealed aneurysms of the retinal vessels, and dilated and tortuous retinal vessels were observed in a further two.

Blood Findings

The types of anaemia found in the 20 cases were normocytic orthochromic in 7, normocytic hypochromic in 4, macrocytic orthochromic in 1, macrocytic hypochromic in 4, microcytic orthochromic in 3, microcytic hypochromic in 1. These findings are discussed below. The haemoglobin varied from 4 to 14.2 g. per 100 ml. of blood, with a mean of 10.1 g.; the packed cell volume from 14% to 41%, with a mean of 31%; and the white blood cells from 5,400 to 25,300 per c.mm., with a mean of 11,000.

The most striking and constant feature, however, was the presence of numerous target cells in the thin blood smears of each patient. They varied from 32 to 87%. Sickle- or oat-shaped cells were seen in 10 instances and nucleated red cells in 14. The thin smear of one patient contained more nucleated red cells than white. Anisocytosis and poikilocytosis were features of the severe cases only. The reticulocytes varied from 3.4 to 25% and the serum bilirubin from 0.8 to 14 mg. per 100 ml. of blood. The Coombs test was negative in the nine instances in which it was performed. Howell-Jolly bodies were seen in three instances and Cabot's rings in one. The erythrocytes in all instances were more resistant to hypotonic saline than normal controls. The E.S.R. varied from 3 to 40 mm. in the hour, with a mean of 14.

The haematological findings in these cases agree closely with the reported findings of Diggs and Bibb (1939), who reviewed 44 cases. The procedure with the least number of variables in routine haematology is the packed cell volume. Unfortunately this does not hold in sickle-cell anaemia. The rapidity and degree of sickling vary from patient to patient, and the replacement, in varying proportions, of the flexible biconcave disk by a rigid oat- or sickle-shaped cell cannot but influence the packed cell volume. This change also influences the sedimentation rate of the erythrocytes, which is low in sickle-cell anaemia (Bunting, 1939; Diggs and Bibb, 1939; Altmann, 1945). The variation in the types of haemolytic anaemia diagnosed can be explained by this variability of the packed cell volume, from which the absolute values, used in the classification of the anaemia, are calculated. It should also be noted that Diggs (1932), discussing the blood picture in 74 cases of sickle-cell anaemia, stated that sickled cells in a blood smear were the exception rather than the rule. In this series sickled cells were seen in 10 instances only.

Examination of the Bone Marrow

Table IV illustrates the findings in nine patients in whom sternal marrow puncture was performed. The marrow in all cases was of thin consistency, and marrow fragments could not be satisfactorily separated from blood. The recorded results are therefore those of the "haemomyelogram." The nomenclature adopted is that of Israëls (1948). At least 500 cells were counted, and the results are shown in percentages. The cells enumerated under the heading "macronormoblast" resembled superficially the megaloblast, but the nuclear chromatin was clumped in blocks and could not be mistaken for the fine network arrangement of the true megaloblast.

Sickled cells were rarely seen in smears, and target cells were much more common, although in no case did they

TABLE IV.—Results of Marrow Biopsy Differential Counts in Percentages

	Case 1	Case 2	Case 4	Case 5	Case 7	Case 10	Case 11	Case 14	Case 19
Haemoglobin in g./100 ml. . .	9.1	6.1	7.5	7.5	9.0	7.7	4.0	6.6	14.2
P.C.V.	26%	21%	22.5%	26%	25%	26%	14%	22%	40%
W.B.C. per c.mm.	9,000	6,600	14,200	23,000	14,000	5,400	10,000	25,200	6,200
Haemocytoblast	—	0.2	0.4	0.1	0.5	0.2	2.2	0.6	—
Proerythroblast	2.6	3.8	1.6	4.0	2.0	0.6	10.2	5.2	3.6
Normoblast:									
Early	3.2	6.6	2.0	3.0	4.0	1.2	3.6	8.6	4.0
Intermediate	1.8	11.6	5.6	8.0	14.0	14.0	8.2	12.0	7.0
Late	48.6	28.8	50.0	30.0	20.0	18.0	36.4	31.2	28.2
Mitotic	0.8	1.8	3.2	2.0	1.0	—	6.4	3.0	1.2
Macronormoblast:									
Early	—	—	—	—	—	—	—	—	—
Intermediate	—	—	0.2	—	—	—	1.6	—	—
Late	1.6	1.0	7.0	2.0	—	1.2	3.4	4.4	0.2
Myeloblast	—	—	—	1.5	0.5	0.4	2.0	—	2.0
Promyelocyte	1.0	0.8	0.4	2.5	6.0	3.0	5.0	—	6.2
Neutrophil:									
Myelocyte	0.2	1.0	1.0	3.0	3.0	8.0	5.6	0.4	8.2
Metamyelocyte	2.0	3.4	1.4	8.0	20.0	16.0	7.4	3.0	12.4
Polys	25.0	34.2	18.0	22.0	21.0	26.0	2.8	22.4	20.0
Eosinophils (total)	3.0	0.6	—	1.5	1.0	2.0	1.4	2.0	2.0
Basophils (total)	—	1.0	—	0.5	—	0.2	—	0.2	0.2
Lymphocytes	9.0	5.0	6.0	11.0	5.0	8.4	3.4	6.0	4.8
Monocytes	0.2	0.2	0.2	0.5	0.5	0.8	0.4	0.8	—
Plasma cells	1.0	—	3.0	0.4	1.5	—	—	0.2	—
Megakaryocytes	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Myeloid-erythroid ratio . . .	1:1.2	1:1.3	1:3.3	1:1.2	1:3.1	1:6.1	1:2.8	1:2.3	1:1.1

approach the numbers seen in peripheral blood smears. Nucleated red cells were never seen in sickled form in direct smears, although it is known that they are capable of sickling (Herrick, 1910; Sydenstricker, 1924a, 1924b; Diggs and Bibbs, 1939; Watson, 1948).

Malaria parasites were not detected in any of the marrow smears. In all cases a normoblastic hyperplasia was present; the myeloid-erythroid ratio varied from 1.6:1 to 1:3.3.

Radiology

Radiological changes which were considered to be due to sickle-cell anaemia were found in 9 out of the 17 patients who were x-rayed. Two mechanisms are thought to be involved in the production of the radiological changes described in sickle-cell anaemia: (a) hyperplasia of the bone marrow producing non-specific lesions which have been described in other haemolytic anaemias, the most important being Cooley's; and (b) lesions produced in bone by the blockage of blood vessels by sickled erythrocytes, with consequent infarction.

Lesions due to hyperplasia of the bone marrow were seen in nine patients and infarctive lesions were present in three. Absence of a well-defined outer table of the skull with perpendicular trabecular striations radiating outwards from the inner table, giving the "hair-on-end" appearance, was the most common lesion, and was seen in eight patients. A generalized mottling of the ribs with trabeculation in

the direction of the long axis and enlargement of the heart were seen in two instances. Infarctive lesions in the femora (see Fig.) were noted in four patients, and changes in the tibia and fibula in one.

Treatment

Antimalarial treatment with mepacrine hydrochloride, 0.1 g. thrice daily for five days, followed by proguanil, 0.1 g. thrice daily for five days, was given to the 20 patients without relief, and crises occurred in two patients who were on suppressive proguanil therapy. Salicylates and aspirin did not relieve the joint pains or arrest the condition. Liver and iron therapy had apparently no effect on the anaemia.

In two cases splenectomy was considered for the mechanical relief that was thought might follow removal of the grossly enlarged spleen. It was felt, however, that, in view of the poor results of splenectomy in sickle-cell anaemia recorded in the literature and the absence of readily available blood for transfusion, the risks involved were not justified. One of these patients died some months after discharge from hospital. The cause of death could not be ascertained.

It was considered that the various treatments described above had no effect on the course of the disease in any patient.

Many drugs have been prescribed in sickle-cell anaemia, but few, if any, have proved of value. Diggs (1934) reviewed the literature and personally treated seven cases. Iron, copper, liver, and hog's stomach were therapeutically useless. Murphy and Shapiro (1945) confirmed these findings and added anticoagulants, blood transfusion, and salicylates to the list. Oxygen therapy has also been reported to have little effect on the crises (Hughes *et al.*, 1940). Leivy and Schnabel (1932) and Torrance and Schnabel (1932) believed that the administration of alkali and potassium sulphocyanate relieved the crises, and Grek and Findlay (1951) thought that oxygen inhalation combined with nicotinic acid given intravenously was of help if administered early in the acute crisis. Josephs (1938) reported that the injection of normal plasma or of a protein-free plasma concentrate reduced the rate of blood destruction in patients suffering from sickle-cell anaemia. Kaplan and Lewis (1949) confirmed these findings, but the effect was transitory and tended to reversal with repeated injections.

Course of the Disease

These patients have been followed up for periods varying from two months to four years. Only one patient has died. The remainder have been observed in and between crises. All grades of severity of the anaemia were seen, but even

Antero-posterior and lateral views of left femur, illustrating an infarctive lesion. Accentuated growth lines can also be distinguished. Case 2.

when the haemoglobin was as high as 14.2 g. per 100 ml. signs of increased haemolysis were constantly present in the peripheral blood and urobilin was present in excess in the urine. One boy aged 16 lost 95 days from school in five acute attacks in the 1948-50 period, and only 18 days in two acute attacks in the 1950-2 period. It would seem that the condition tends to improve with advancing years.

Differential Diagnosis

In the 20 patients investigated a clinical "triad" of a history of recurrent joint pains, many target cells in the peripheral blood smear, and sickling of the erythrocytes has invariably been associated with signs of increased haemolysis in the peripheral blood. In my opinion three important conditions have to be considered in the differential diagnosis. These are acute rheumatic fever, a chronic haemolytic anaemia due to malaria, and so-called "Mediterranean anaemia."

The absence of sore throat, palpable nodules, or joint swellings, or evidence of valvular disease of the heart, with, in many instances, a normal sedimentation rate, eliminates the possibility that this condition is a rheumatic manifestation. In addition there was no response to salicylate therapy.

Malaria parasites were detected in the blood of only four patients and there was no haematological or symptomatic response to malaria therapy in any of the 20 patients. In addition, in five instances the spleen was not palpable and the history of recurrent attacks of joint pain given by these patients was striking, and was not simulated by any of the many hundreds of Africans examined and questioned—all of whom were developing or had developed premunition to malaria. From these facts it is felt that malaria can be excluded from the list of possible diagnoses.

It is difficult to exclude Cooley's anaemia, as, apart from the sickling of the erythrocytes, sickle-cell anaemia and Cooley's anaemia may present an almost identical blood picture in fixed films. Many patients showing target cells in peripheral blood smears were investigated, however, and in no instance was the syndrome described in these 20 patients found in the absence of the sickling phenomenon.

Discussion

If the homozygous theory of the inheritance of sickle-cell anaemia is correct, and if the incidence of the trait in the population of the Accra District of the Gold Coast is taken to be approximately in the region of 19%, by calculation the incidence of the anaemia should be 1%.

I examined 2,255 Africans and diagnosed sickle-cell anaemia in only one instance, giving an incidence of approximately 0.05%. This figure is, however, completely fallacious, as multiparous women, mothers at term, and newborn infants were included in the survey. It is most probable that the incidence of sickle-cell anaemia in mothers at term and in multiparous women is extremely low, as, excluding the mortality from the anaemia in the younger age groups, the primigravida may die suddenly before term in an acute sickle-cell crisis (Edington, 1951). It is also unlikely that the newborn child suffers from sickle-cell anaemia.

In addition, in the surveys the age groups most likely to exhibit the active disease (infancy and early childhood) were, unavoidably, not examined. It is perhaps significant that, in the group of 200 young schoolchildren examined, whose ages ranged from 8 to 12 years, one girl was found to be suffering from sickle-cell anaemia—an incidence of 0.5%. Although I have reviewed only 20 cases in this article, sickle-cell anaemia has now been diagnosed in 33 instances and the sickling phenomenon has been considered to be the cause of death at 13 necropsies (to be published). It can thus be stated that sickle-cell anaemia is not rare in the Accra District of the Gold Coast. It has not been possible to assess the incidence of sickle-cell anaemia, but

I consider that the calculated incidence of 1% may well be correct, which would agree with the homozygous theory of the inheritance of sickle-cell anaemia.

Summary

In the Accra District of the Gold Coast 2,255 Africans were examined for the presence of the sickle-cell trait and the anaemia. Sickling of the erythrocytes was present in 407 instances—an incidence of 18.1%. No ill effects were attributed to the presence of the trait in 406 Africans. The remaining African girl was suffering from sickle-cell anaemia.

The case reports of 20 patients suffering from sickle-cell anaemia are discussed. It was found that, in the Gold Coast, a history of recurrent attacks of pain in the larger joints and the presence of many target cells in the peripheral blood smear was invariably associated with sickling of the erythrocytes and signs of increased haemolysis in the peripheral blood. The importance of malaria as a "trigger" mechanism in initiating the crises of the anaemia is considered.

It is concluded that sickle-cell anaemia is not rare in the Accra District of the Gold Coast.

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