# ANAEMIA IN PREGNANCY AND THE PUERPERIUM— A TWO YEAR PROSPECTIVE SURVEY

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Anaemia is still the commonest medical disorder to occur in pregnancy. Its incidence varies in different countries depending on the state of nutrition of the population and on the frequency of bacterial and parasitic infestation.

In Singapore there has been no recent work to suggest the prevalence or causes of anaemia seen in pregnancy. This paper reports on the results of a two year prospective survey on the incidence and causes of anaemia seen in patients admitted into the Government Obstetric Units of the Kandang Kerbau Maternity Hospital (KKMH). The survey included a study of the possible differences in the patterns of anaemia as seen in the three major ethnic groups, Chinese, Malays, Indians (includes Pakistanis) that make up the population of Singapore.

## METHODS

Routine haematological studies were carried out with standard techniques as described by Dacie and Lewis, 1963. Bone marrow smears were stained by May-Grunwald-Giemsa and by Perls's method for assessment of iron stores. Serum iron values were determined by the method of Ramsay, 1954. Serum protein levels were determined by the biuret method. Haemoglobin electrophoresis was carried out on filter paper using a barbitone buffer of pH8·6. Alkali resistant haemoglobin was determined by the method of Singer et al, 1951. Starch block analysis was carried out by the technique of Kunkel et al, 1957.

## PROCEDURE

Patients admitted into the Obstetric Units of the KKMH during the period January 1965 to December 1966 who were found to have a haemoglobin level of less than 10 gm.% were included in the survey and immediately referred to the authors for clinical assessment and further haematological investigations. From every patient a 2ml. sample of venous blood was taken into EDTA and submitted for the following investigations—haemoglobin, total red, total white and differential, reticulocyte and platelet counts. The haematocrit and red cell indices were determined. Peripheral blood films were prepared for every case and examined by one of the authors. The blood from each case was also routinely examined for the presence of haemoglobin H and Heinz inclusion bodies, and for alkali resistant and abnormal haemoglobins. The ABO and Rhesus blood groups, Direct Coomb's Test, serum iron and total protein levels were determined for every case. Marrow examinations were performed on all cases in which the peripheral blood picture suggested a pathology other than iron deficiency or some additional pathology complicating iron deficiency. A routine examination of the urine and of the stools for ova was carried out on all cases.

## RESULTS

## INCIDENCE OF ANAEMIA

During the two year period of study a total of 1,434 patients admitted into the obstetric unit were found to have a haemoglobin level of less than 10 gm.%. Of these, 6 were Eurasians who were excluded from the study because of the small numbers. Of the remaining 1,428 patients, 776 (54·4%) were Chinese; 363 (25.4%) were Indians and Pakistanis; and 289 (20.2%) were Malays.

During the same period there was a total of 77,880 deliveries in the Hospital, of which 61,409 (78·9%) were Chinese; 6,023 (7·7%) were Indians; and 10,448 (13·4%) were Malays.

The overall incidence of anaemia among patients admitted into the hospital was 1·84% or 1 in 54 deliveries. The incidence of anaemia of pregnancy among Chinese was 1·26% or 1 in 79 compared to 2·76% or 1 in 35 for Malays and 6·03% or 1 in 17 deliveries for Indians.

TABLE 1

SHOWING THE ETHNIC DISTRIBUTION OF THE SINGAPORE POPULATION, THE NUMBER OF DELIVERIES IN KKMH AND THE INCIDENCE OF ANAEMIA OF PREGNANCY

| Ethnic Group | S'pore Population December 1965 | | KKMH Deliveries 1965-1966 | | Anaemia of Pregnancy | | Incidence of Anaemia |
|---|---|---|---|---|---|---|---|
| | Total No.* | Percentage | Total No. | Percentage | Total No. | Percentage | |
| CHINESE | 1413·2 | 76·8 | 61,409 | 78·9 | 776 | 54·4 | 1·26% 1 in 79 deliveries |
| INDIAN | 155·2 | 8·5 | 6,023 | 7·7 | 363 | 25·4 | 6·03% 1 in 17 deliveries |
| MALAY | 271·3 | 14·7 | 10,448 | 13·4 | 289 | 20·2 | 2·76% 1 in 35 deliveries |
| TOTAL: | 1839·7 | 100·0% | 77,880 | 100·0% | 1428 | 100·0% | 1·84% 1 in 54 deliveries |

*Total number in thousands.

Fig. 1 compares the proportion of the 3 major ethnic groups in the Singapore population in December 1965 with that of the total number of deliveries in KKMH during1 965/1966 and that of the series of cases with anaemia of pregnancy. It will be seen that the proportion of the 3 ethnic groups delivering in the hospital was approximately the same as that of the Singapore population. The proportion of Chinese among the series with anaemia of pregnancy was lower than that of the general population or of the number of deliveries in hospital. The proportion of Indians and Malays in the series with anaemia of pregnancy was higher than the proportion in the general population and that of the total number of deliveries, suggesting a greater liability on the part of the Malay and Indian patients to develop anaemia of pregnancy compared to the Chinese.

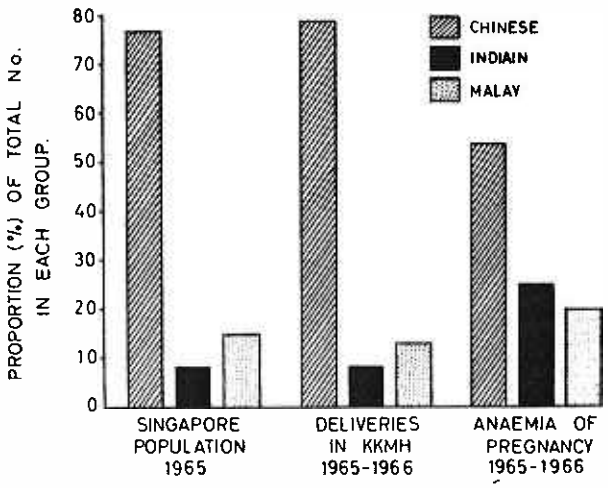


Fig. 1. Comparison of proportion of 3 ethnic groups in Singapore population with the deliveries in KKMH and series with anaemia of pregnancy.

## INCOME STATUS

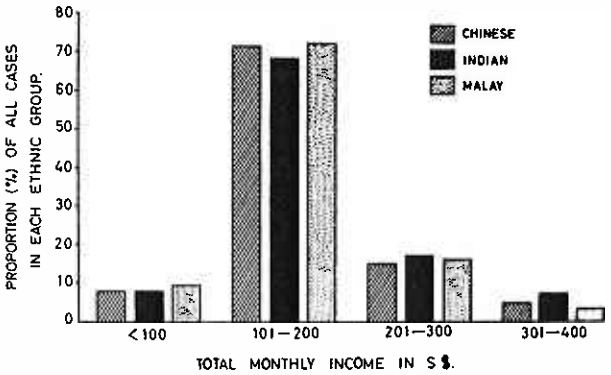


FIG. 2. INCOME STATUS.

The total monthly income of the patient and her family was inquired of every case. The majority, 70%, had a total family income of between $101 to $200 per month. About 15% of cases had a total family income of between $200 to $300 per month, whilst only 5% had a total family income of over $300. Approximately 10% of patients had a total family income of less than $100 per month. There were no significant differences in the economic status of the patients in three ethnic groups to account for the increased liability of the Malay or Indian patients to develop anaemia.

## AGE INCIDENCE

The age distribution of the series of cases with anaemia of pregnancy is shown in Fig. 3. The majority of the patients were between the ages of 21 years and 40 years. The number of patients below 31 years was approximately the

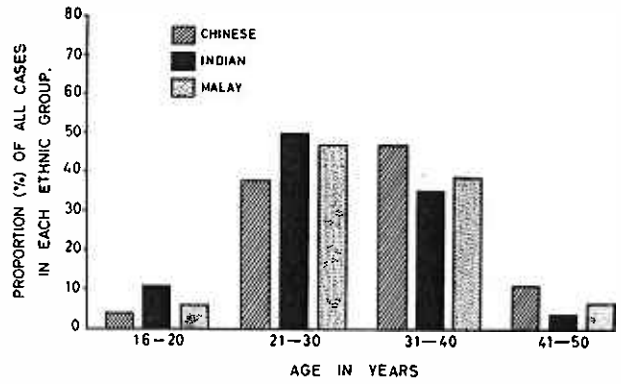


FIG. 3. AGE INCIDENCE.

same as the number above. 6·3% of patients were below 20 years and 8·8% over 41 years. There was no evidence to suggest a greater liability for the older age groups to develop anaemia of pregnancy.

The Indian patients on the whole belonged to a slightly younger age group as 61% were between the ages of 16 to 30 years compared to 42% for Chinese and 53% for Malays.

## PARITY

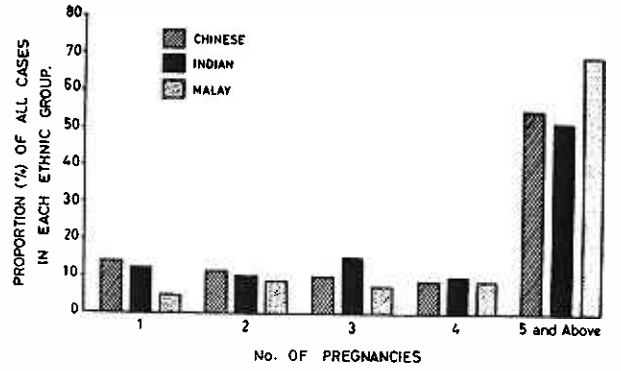


FIG 4. PARITY.

There was a significantly larger proportion of Chinese and Malay primigravidae in the series compared to the Indians. Approximately 10% of all 3 ethnic groups were represented in each parity group between two to four. The proportion that were para 5 or more was 70% for Malays, 55% for Chinese and 53% for Indians. No less than 210 (14·7%) patients were para 10 and above, the maximum was para 16. The survey confirms the observation that there is a greater liability to develop anaemia with increasing parity.

## PERIOD OF GESTATION AT DIAGNOSIS

A significant finding was the large proportion of cases (44%) that were first discovered to be anaemic after their delivery. This was especially noticable among the Malays and Chinese where 54% and 48% of the cases respectively were first found to be anaemic between one to seven days postpartum.

16% of Malays and Chinese and 22% of Indians were admitted with anaemia late in pregnancy, between 37 to 40 weeks, a period when therapeutic measures often do not have time to take full effect and blood transfusions have to be administered to bring the haemoglobin up to a safe level to meet the possible complications of delivery. Less than 5% of cases were diagnosed before the 24th. week and only

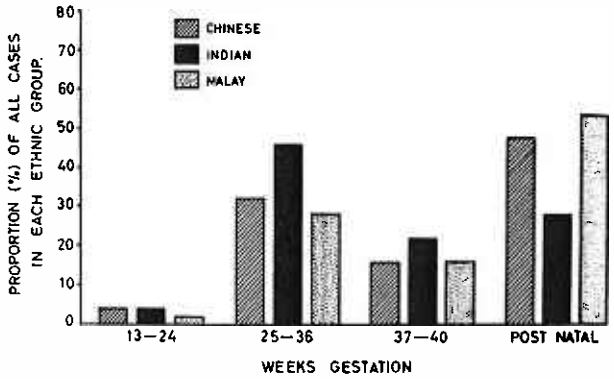


FIG. 5. PERIOD OF GESTATION AT TIME OF DIAGNOSIS

one case was admitted with a low haemoglobin before the 12th. week. There was a significantly larger proportion of Indian patients discovered to be anaemic early in pregnancy compared to the Malays or Chinese.

## AETIOLOGICAL DIAGNOSIS

A total of 175 (12·3%) patients had anaemia which was attributable solely to ante-partum or postpartum haemorrhage. The incidence of haemorrhage was lowest among the Indians with 10 cases (2·8%) compared to 122 (15·7%) cases for Chinese and 43 (14·9%) cases for Malays. Haemorrhage was a contributory factor in the development of anaemia in 170 other patients

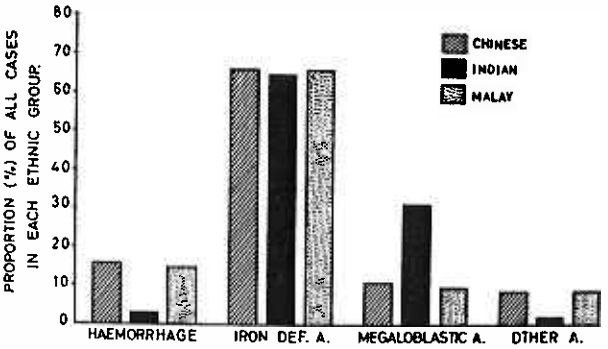


FIG 6. ETIOLOGICAL DIAGNOSIS.

wth iron deficiency anaemia and 14 patients with a megaloblastic anaemia.

Iron deficiency anaemia was the commonest cause of anaemia encountered in the study. There were no differences in the incidence of iron deficiency anaemia among the Chinese (65·8%), Indians (65·0%) or Malays (66·1%). If anaemia due solely to haemorrhage was excluded the overall incidence of iron deficiency anaemia in the series would be 74·9%.

227 patients or 15·9% of the whole series were diagnosed as having a megaloblastic anaemia confirmed by marrow examination. The overall incidence of megaloblastic anaemia of pregnancy was 227 cases out of 77,880 deliveries or 1 in 343 confinements. The study showed marked differences in the incidence of megaloblastic anaemia among the 3 ethnic groups. The incidence of megaloblastic anaemia was highest amongst the Indians with 115 cases (31·7%) compared to 30 cases (10·4%) for Malays and 82 cases (10·6%) for Chinese.

Taking into consideration the total number of deliveries in the hospital of each ethnic group, the incidence of megaloblastic anaemia was 1·91% or 1 in 52 confinements for Indians, 0·13% or 1 in 749 confinements for Chinese and 0·29% or 1 in 348 confinements for Malays. The detailed analysis of the megaloblastic anaemia will be the subject of a separate report.

The breakdown of the 96 (6·2%) cases with anaemia of miscellaneous origin is given in Table II.

Many of these disorders may occur quite fortuitously but in the large group of haemolytic anaemias the extra demands of pregnancy have often revealed a previously unsuspected condition. Some of these will be discussed in detail later.

TABLE II

ANAEMIA DUE TO MISCELLANEOUS CAUSES

| Diagnosis | No. of Cases |
|---|---|
| Thalassaemia Trait | 27 |
| Pre-eclamptic Toxaemia | 23 |
| Haemoglobin E Trait | 16 |
| Haemoglobin H Disease | 8 |
| Urinary Infection | 6 |
| Rheumatic Heart Disease | 4 |
| Congenital Spherocytic Anaemia | 3 |
| Auto-Immune Haemolytic Anaemia | 3 |
| Aplastic Anaemia | 2 |
| Chronic Infection | 2 |
| Congenital Elliptocytosis | 1 |
| Acute Haemolytic Anaemia | 1 |
| | 96* |

*Total number includes 11 presenting originally as a megaloblastic anaemia.

## ABO BLOOD GROUP RELATIONSHIP

The ABO and rhesus blood groups of the patients in the series were compared with that of a control series of 27,052 blood donors, Chan, 1962. There was no significant association between the liability to develop anaemia of pregnancy and the ABO blood system. The proportion of rhesus (CDE) negative patients in each ethnic group generally agreed with that found in our donor panel.

## INITIAL HAEMOGLOBIN LEVELS

80% of the series had haemoglobin levels between 6·1-10·0 gm.% at the time of diagnosis. There were very little differences in the initial

TABLE III

COMPARISON OF ABO BLOOD GROUP DISTRIBUTION IN PATIENTS WITH ANAEMIA OF PREGNANCY WITH CONTROL SERIES OF BLOOD DONORS

| | | ABO Blood Group in Percentages | | | |
|---|---|---|---|---|---|
| | | O | A | B | AB |
| CHINESE | Anaemia of Pregnancy (660 patients) | 43·0 | 26·1 | 25·0 | 5·6 |
| | Control Series (15,262 donors) | 43·53 | 25·99 | 24·99 | 5·48 |
| MALAYS | Anaemia of Pregnancy (227 patients) | 38·8 | 26·9 | 26·0 | 8·4 |
| | Control series (5,461 donors) | 38·42 | 25·07 | 29·23 | 7·29 |
| INDIANS | Anaemia of Pregnancy (276 patients) | 39·5 | 23·6 | 30·4 | 6·5 |
| | Control series (5,000 donors) | 39·02 | 21·02 | 33·60 | 6·36 |

TABLE IV

AVERAGE SERUM IRON VALUES IN MICROGRAM %

| | Chinese | Indians | Malays | Series |
|---|---|---|---|---|
| Haemorrhage | 109 (89) | 139 (6) | 105 (27) | 40·0 (122) |
| Iron Deficiency | 48 (385) | 49 (187) | 48 (139) | 118·5 (711) |
| Megaloblastic Anaemia | 154 (81) | 157 (112) | 184 (29) | 173·8 (222) |
| Others | 154 (53) | 100 (2) | 146 (24) | 140·1 (79) |

Figures within brackets denote number of patients

haemoglobin levels between the 3 ethnic groups. The average initial haemoglobin for Indians in the series was 7·3 gm.% compared to 7·4 gm.% for Chinese and 7·5 gm.% for Malays. 20% of cases when first seen had haemoglobin levels of 6·0 gm.% and below, 30 of whom had levels between 2·1-4 gm.%.

There was a slightly larger proportion of Indians among those with a haemoglobin level of less than 6 gm.%. This was found to be associated with the larger proportion of Indian patients with a megaloblastic anaemia of pregnancy. Among all 3 ethnic groups, patients with a megaloblastic anaemia generally presented with lower initial haemoglobin values than those with anaemia due to haemorrhage or iron deficiency.

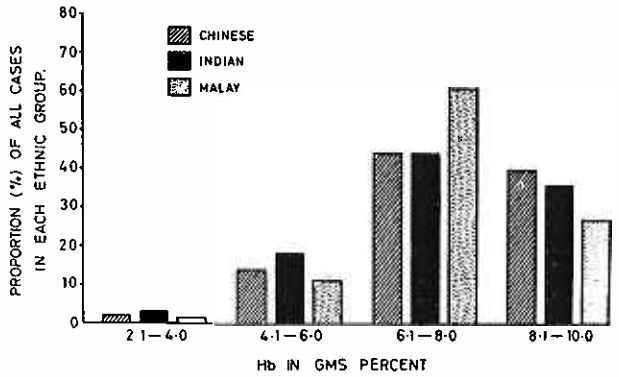


FIG 7. INITIAL HAEMOGLOBIN LEVELS AT TIME OF DIAGNOSIS

The average haemoglobin level for all patients with megaloblastic anaemia was 6·6 gm.% compared to 7·5 gm.% for haemorrhage or iron deficiency anaemia.

## SERUM IRON VALUES

Serum iron values were available for 608 Chinese, 307 Indians and 219 Malay patients. Serum iron estimations were not carried out or were found to be unreliable in the other patients because of a definate history of having received iron therapy before admission. The mean values are shown in Table IV. There were very little differences in the mean serum iron values among the 3 ethnic groups. The average serum iron was 110 mcg.% for patients with anaemia due to haemorrhage, 48·6 mcg.% for patients with iron deficiency anaemia and 173.8 mcg.% for patients with a megaloblastic anaemia.

## HOOKWORM INFESTATION

Routine faecal examination for ova showed that 12·6% of Chinese had hookworm infestation. The incidence of ankylostomiasis was lower for Malays, 7·6% and for Indians 6·1%. The higher incidence of ankylostomiasis among Chinese was found to be due to the larger proportion of Chinese patients who were living in rural areas and on vegetable farms.

## SERUM PROTEIN VALUES

Serum protein estimations were carried out on 285 Chinese, 147 Indians, and 89 Malay patients. The average total protein value was 7·1 gm.% for Malays, 7·0 gm.% for Indians and 6·9 gm.% for Chinese. Within each ethnic group it was noticed that cases with a megaloblastic anaemia tended to have slightly lower total protein values compared to the average, Table V.

TABLE V

MEAN TOTAL PROTEIN VALUES IN GM. %

| | Chinese | Indians | Malays |
|---|---|---|---|
| Haemorrhage | 6·9 (47) | 7·5 (2) | 7·1 (17) |
| Iron Deficiency | 7·0 (180) | 7·3 (78) | 7·2 (47) |
| Megaloblastic | 6·6 (39) | 6·6 (67) | 6·9 (15) |
| Miscellaneous | 6·9 (19) | - | 7·1 (10) |
| Series | 6·9 (285) | 7·0 (147) | 7·1 (89) |

Figures within brackets denote number of patients

13·4% of Chinese, 12·2% of Indians and 6·8% of Malays had serum protein levels of less than 6 gm.%, Fig. 8. In all these patients the hypoproteinemia was associated with either an iron deficiency or a megaloblastic anaemia indicating the general state of malnutrition that existed in these patients. Response to treatment was generally slow and required protein supplements to the diet.

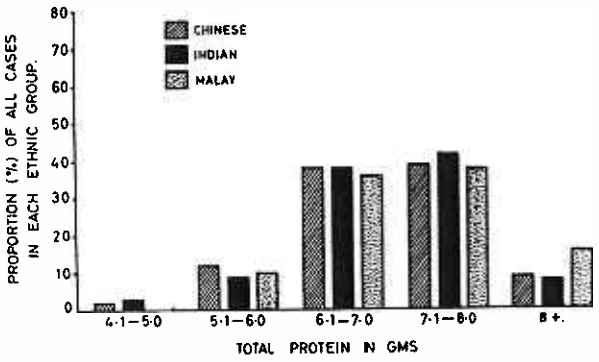


FIG 8 SERUM PROTEN VALUES

## INCIDENCE OF TWIN PREGNANCY

There were 97 twin pregnancies in the series with anaemia giving an overall incidence of 6·79% or 1 in 15 confinements. The incidence of twin pregnancy in the hospital is 1 in 118 confinements, Sinnathuray, 1966, thus showing the increased predisposition of mothers with multiple pregnancy to develop anaemia. There were small differences in the incidence of twin pregnancies between the 3 ethnic groups. The incidence among Malays was 1 in 14; among Chinese 1 in 12; and among Indians 1 in 36 confinements.

The overall incidence of twins for patients with iron deficiency anaemia was 7·25% or 1 in 14 confinements compared to 4·69% or 1 in 21 confinements for patients with a megaloblastic anaemia.

## URINARY INFECTION

30 patients with anaemia were found to have a urinary infection complicating pregnancy. In 5 of these the urinary infection was the sole pathology responsible for the development of anaemia. The anaemia in these cases was of a mild to moderate degree between 5·3 gm.% and 9·2 gm.%. The blood film showed a normochromic normocytic picture with a normal MCHC. Marrow examinations revealed a normoblastic erythropoiesis with normal or slightly increased iron stores. Treatment with iron or folic acid did not produce any improvement in the anaemia. Elimination of the infection with the appropriate antibiotic resulted in a gradual return of a haemoglobin to normal values.

The urinary infection was usually low grade and asymptomatic, manifested by the presence of increased numbers of pus cells on microscopic examination of the urine. A positive culture for pathogenic organisms was obtained in a few of these cases.

## TOXAEMIA OF PREGNANCY

There were 189 cases of pre-eclamptic toxaemia associated with anaemia in the series giving an incidence of 13·2% among patients with anaemia of pregnancy. The incidence of pre-eclamptic toxaemia among patients with iron deficiency was 13·75% and 9·69% among patients with megaloblastic anaemia.

17 patients with anaemia had pre-eclamptic toxaemia unassociated with any iron deficiency or megaloblastic erythropoiesis. The anaemia was of mild to moderate degree of a normochromic normocytic type with a normal MCHC. Serum iron values were normal or slightly high. Marrow examination showed a normoblastic erythropoiesis with normal or increased iron stores.

## CLINICAL ASPECTS

The symptoms and physical signs are common to any severe anaemia of slow onset and generally give no indication of the etiology. The only possible exceptions are the presence of icterus, sore red tongue, marked anorexia and diarrhoea which in the absence of other causes usually suggest a megaloblastic anaemia.

The majority of the patients with mild anaemia usually did not have any specific symptoms at all and it was only when the haemoglobin level fell below 8·0 gm.% that symptoms like weakness, listlessness and easy fatiguability began to appear. It must however be mentioned that many patients presenting with a haemoglobin of less than 5 gm.% did not complain of any discomfort at all.

Koilonychia was present in 24% of patients with iron deficiency anaemia, in 8·3% of whom it was present in a moderate to marked degree. An atrophic tongue was found in 20% of patients, in a good proportion of whom there was also evidence of cheilosis and angular stomatitis. Enlargement of the spleen was present in only 4 cases of iron deficiency anaemia.

Oedema not due to toxaemia of pregnancy was noted in approximately 5% of the cases. In the majority the oedema was associated with a varying degree of hypoproteinemia. Oedema was noted to be more commonly associated with megaloblastic anaemia than with iron deficiency anaemia. A mild degree of peripheral neuritis as shown by diminished sensation and reflexes over the extremities was noted in a very small proportion of cases. None of the cases with megaloblastic anaemia had symptoms or signs suggestive of a subacute combined degeneration of the cord.

## MATERNAL MORTALITY

There were 2 maternal deaths due to cardiac failure complicating anaemia in this series. Both cases were admitted as emergencies after delivery at home, not having received any previous antenatal care.

## THALASSAEMIA TRAIT

There were 27 cases of thalassaemia minor among the series, the majority of whom were Chinese, 24 cases, with 1 Malay and 2 Indians. The incidence of thalassaemia trait among Chinese patients with anaemia of pregnancy is 3·09%, an incidence of 1 in 32 confinements.

The majority of patients presented with a hypochromic microcytic blood picture but in addition usually had a slightly increased degree of aniso and poikilocytosis with basophilic stippling and an occasional target cell. The haemoglobin levels of these patients ranged from 3·8-9·6 gm.% with a mean of 8·4 gm.%. The reticulocyte count ranged from 1-5% with a mean of 3·5%.

The serum iron levels of these patients ranged from 24 mcg.% to 288 mcg.% with a mean of 141 mcg.%.

Small amounts of alkali resistant foetal haemoglobin were demonstrated in 11 cases ranging from 1%-3·8% with a mean of 2·7%. In 16 other patients no foetal haemoglobin could be demonstrated. Starch block analysis for haemoglobin $A_2$ carried out in duplicate revealed raised levels in all cases. The $A_2$ values ranged from 3·2%-7·5% with a mean of 4·9%. The levels of haemoglobin $A_2$ in 75 blood donors ranged from 1·3% to 3·0% with a mean of 2·4%.

18 of the patients were treated as iron deficiency anaemia in the first instance and were only subsequently referred for further investigation when they were found to fail to respond to treatment. 5 patients originally presented with a megaloblastic anaemia of pregnancy confirmed by marrow examination but were subsequently shown to be cases of thalassaemia trait by haemoglobin electrophoresis.

Family studies were carried out on 11 patients, in 9 of whom similarly affected members of the family were discovered.

## HAEMOGLOBIN E TRAIT

16 patients, all Malays, were found to have varying amounts of haemoglobin E on electrophoresis. The proportion of haemoglobin E on starch block analysis ranged from 9·0%-67% with a mean of 37%. The majority of patients did not have any foetal haemoglobin except for 3 with levels of 3·6%, 4·1% and 6·1% respectively. One patient had 91·7% of haemoglobin E and 3·6% of foetal haemoglobin with traces of haemoglobin A. Family studies were not available for this case as patient was uncooperative. This is either a case of homozygous haemoglobin E disease or more likely haemoglobin E thalassaemia.

The haemoglobin level of these patients ranged from 5·3-9·9 gm.% with a mean of 8·4 gm.%. The reticulocyte count ranged from less than 1% to 7·6%. In the majority the reticulocyte count was normal.

The blood picture in all these cases was not diagnostic apart from a varying degree of hypochromia usually because of the coexistent iron deficiency. Target cells, ansio and poikilocytosis were not prominent features. 3 patients had a megaloblastic marrow.

Serum iron values ranged from less than 20 mcg.% to 177 mcg.% with a mean of 85 mcg.%. 7 patients had serum iron levels of below 70 mcg.%.

Apart from the one case with haemoglobin E thalassaemia or homozygous haemoglobin E disease, all the other patients are examples of haemoglobin E trait complicated by haemorrhage, iron deficiency or megaloblastic anaemia. The condition appears to occur in Malays only and the incidence is 5·5% or 1 in 18 among Malays with anaemia of pregnancy.

## HAEMOGLOBIN H THALASSAEMIA

8 patients, 7 Chinese and 1 Malay, were found to have haemoglobin H thalassaemia. The patients presented with a moderate to severe degree of anaemia ranging from 4·4-8·3 gm.% with a raised reticulocyte count of between

2-7%. The peripheral blood picture in all instances was very characteristic with gross hypochromia, marked aniso and poikilocytosis with many target cells. Fragmented cells, spherocytes and nucleated red cells were invariably present. The MCHC was invariably low, between 23-29%.

Incubation of the blood with brilliant cresyl blue revealed the characteristic haemoglobin H inclusion bodies in the red blood cells of these cases. This was further confirmed by paper and starch block analysis. Foetal haemoglobin was absent in all except 2 cases in whom levels of 0·6% and 2·9% were recorded. The percentage of haemoglobin H on starch block analysis ranged from 4·0%-7·3%.

Serum iron values were always high ranging from 181-350 mcg.% with a mean of 261 mcg.%. The marrow examination revealed a frankly megaloblastic reaction in all except 2 cases. Marrow iron was usually greatly increased. The spleen was slight to moderately enlarged in 5 patients, in 3 others the spleen was not palpable. Enlargement of the liver was present in 2 patients.

## DISCUSSION

The level of haemoglobin concentration below which the pregnant mother is considered as anaemic varies among different workers. Paintin, 1962, from studies on the total red cell volume of 26 primigravidae with uncomplicated pregnancy concluded that anaemia should be diagnosed if the haemoglobin falls below 10·0 gm. per 100 ml. from the 28th. week onwards. Lawrence, 1962, likewise considers a haemoglobin level below 10 gm. per 100 ml. denotes anaemia whilst Barnes, 1965, states that whenever the haemoglobin level falls below 80% during pregnancy it should be accepted that anaemia is present. Solomons and co-workers, 1962, however considered pregnant patients having haemoglobin levels of below 14·2 gm. per 100 ml. to be anaemic. The present trend in the management of pregnancy anaemia appears to be that treatment should always be applied if the haemoglobin falls below 10·0 gm.%, Lancet, 1963.

Accepting a level of 10·0 gm.% as the lower limit of normal in pregnancy, the overall incidence of anaemia in the series of patients admitted into KKMH between January 1965 to December 1966 was 1·84% or 1 in 54 confinements. Recently, Lourdenadin, 1964, reporting on a series of 1,066 cases of anaemia in pregnancy seen in Kuala Lumpur between 1957 to 1961 found an incidence of 2·2% of deliveries with haemoglobin levels of below 6·5 gm.%.

The incidence of anaemia as recorded in this survey is probably lower than the true incidence for a number of reasons. Firstly, not every patient found with a haemoglobin of less than 10·0 gm.% was admitted into hospital for treatment. Many of those with haemoglobin levels of between 8-10 gm.% were treated as outpatients in the antenatal clinics. Secondly, haemoglobin estimations were not routinely carried out on all cases admitted for delivery, especially if the patient did not appear anaemic or there was no reason for the doctor to suspect any possible complications during labour. Thirdly, routine haemoglobin estimation after delivery was not carried out for every patient except for those where there had been a complication like haemorrhage or surgical intervention.

The survey recorded a higher incidence of anaemia among Malays, 1 in 35 confinements; and Indians, 1 in 17, compared to the Chinese 1 in 79 confinements. The higher incidence of anaemia among Indian patients compared to Chinese and Malays is in agreement with the findings of Tasker et al, 1956. This high incidence among Indians was found to be due to the greater prevalence of megaloblastic anaemia among these patients.

There were no differences in the socio-economic status of the Indians compared to the Chinese or Malays. Mean serum iron and serum protein values were about the same for the 3 ethnic groups suggesting that malnutrition was not more prevalent among the Indians. There was no evidence to suggest an increased incidence of any associated medical condition, toxaemia of pregnancy, urinary infection, or of twin pregnancy to account for the greater liability of the Indian patients to develop anaemia of pregnancy.

From the brief dietary histories available it would appear that the higher incidence of megalobastic anaemia among the Indians may be related to the different dietary pattern either in the choice of foodstuff or in the method of preparation.

The higher incidence of anaemia among Malays compared to the Chinese was found to be due to the larger proportion of Malays who were grande multips.

The frequent occurrence of iron dificiency anaemia, 74·9%, found in the series agrees with observations of workers elsewhere and with that of Lourdenadin, 1964, in Malaya who found

that 76.2% of the series had a microcytic anaemia. The incidence of iron deficiency anaemia was similar for the 3 ethnic groups in spite of the higher incidence of hookworm infestation among Chinese.

Any chronic infection is liable to depress the synthesis of haemoglobin. In pregnancy, the commonest form of chronic infection encountered is infection of the urinary tract which may on its own be responsible for the development of anaemia or may aggravate an already pre-existing iron deficiency or megaloblastic anaemia. Giles and Brown, 1962, found urinary infection to be twice as common among anaemic patients as among normal pregnant women. Our experience in this survey does not suggest a higher incidence of urinary infection among patients with anaemia of pregnancy compared to that encountered in routine obstetric practice in the hospital. Evidence of urinary infection should however be looked for in every patient that has an unexplained anaemia or shows a sub optimal response to adequate therapy.

The frequent occurence in the series of toxaemia of pregnancy, 13·2%, agrees with the observations of other workers, Gatenby and Lillie, 1960, and Giles and Shutteleworth, 1958. Barnes, 1965, states that the incidence of pre-eclamptic toxaemia is about three times as high as encountered in routine obstetric practice although no reasons have been forwarded by any of these authors to explain the association. Whether anaemia per se predisposes to the development of toxaemia or whether the anaemia is secondary to the toxaemia has never been definately established and merits further study.

This survey revealed a larger number of patients with thalassaemia trait and haemoglobin H thalassaemia among the Chinese, and haemoglobin E trait among the Malays. Similar findings were recorded by Wong and Cheng, 1965.

In patients with haemoglobin E trait, the condition is usually a-sympatomatic and is discovered only because of the routine haemoglobin electrophoresis carried out. In the case of the patients with thalassaemia trait the majority were diagnosed as iron deficiency anaemia in the first instance and later referred because of the failure to improve to treatment. In the others, routine electrophoresis of the haemoglobin showed suspiciously high haemoglobin $A_2$ levels which were subsequently confirmed by starch block analysis.

All these patients with thalassaemia trait had a mild to moderate degree of anaemia during pregnancy put improved considerably after delivery when the haemoglobin levels returned to the 9-12 gm.% region.

The diagnosis of haemoglobin H thalassaemia was usually made because of the very characteristic blood picture and the demonstration of haemoglobin H inclusion bodies in the red cells. The majority of patients with haemoglobin H thalassaemia had very low haemoglobin levels throughout pregnancy necessitating repeated transfusions of blood. The haemoglobin levels of these patients settled at between 7-9 gm.% after delivery.

The high proportion of cases with haemolytic anaemia presenting originally with a megaloblastic anaemia is worthy of note. 2 of the 3 patients with congenitial spherocytosis, 5 out of 7 patients with haemoglobin H thalassaemia, 5 out of 27 patients with thalassaemia trait and 2 out of 16 patients with haemoglobin E trait presented with a megaloblastic anaemia in the first instance.

This association of a haemolytic anaemia with a megaloblastic marrow was originally reported by Chanarin and co-workers, 1959, and has been recognised with increasing frequency in patients with anaemia of pregnancy and occult haemolytic disease, Fullerton and Watson-Williams, 1962.

## SUMMARY

A study of the prevalence, etiology, and clinco-haematological features in 1,428 patients with anaemia of pregnancy seen in the KKMH during 1965/1966 has been made. The overall incidence of anaemia below 10·0 gm.% is 1·84% or 1 in 54 confinements. The paper records and discusses the variation in incidence and etiology of anaemia in the 3 major ethnic groups.

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