بسم الله الرحمن الرحيم

ANEMIA IN PROTEIN ENERGY MALNUTRITION (P.E.M.),
ERYTHROCYTE PROTOPORPHYRIN AS A DIAGNOSTIC MEANS.

MSC THESIS OF PEDIATRICS SUBMITTED BY :

Dr. SAMIRA ABDEL HAMID MOHAMED SHOKROF.
M.B.B. Ch.

SUPERVISORS

PEDIATRICS DEPARTMENT : PROF. AHMED SAMY KHALIFA.

... PATHOLOGY DEPARTMENT :
... PROF. ... SAYED

FACULTY OF MEDICINE
AIN SHAMS UNIVERSITY.

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ABBREVIATIONS

Protein Energy Malnutrition	P.E.M.
Free Erythrocyte Protoporphyrin	F.E.P.
Haemoglobin	Hb
Packed cell volume	P.C.V.
Mean corpuscular volume	MCV
Mean corpuscular haemoglobin	MCH
Mean corpuscular haemoglobin concentration	MCHC
Red Blood Cells	RBCs
Vitamin	Vit.
Concentration	Conc.
Kwashiorkor	KWO
Marasmus	M.
Deficiency	def.
Group	gp.
Percentile	p.
Estimation	est.

CONTENTS

INTRODUCTION AND AIM OF WORK

During the past three decades it has become clear that protein malnutrition is a major cause of death and disability throughout the tropics. Its severest effects are on infants and young children.

Protein Energy Malnutrition (P.E.M.) is prevelant among children in EGYPT (Morcos 1966), in its most advanced stage it is usually associated with anaemia (El Nabaway et al 1961)

Anaemia in malnourished children is a major public health problem involving children of the developing countries of the tropics and subtropics (Foy & Kondi 1957).

Iron deficiency is the commonest cause of anaemia, nutritional megaloblastic anaemia also being quite frequent (Agarwal et al 1980) Khalifa 1981).

The diagnosis of iron deficiency may be done by red cell morphology, calculation of red cell indices, estimation of serum iron, iron binding-capacity and serum ferritin. The latter might be affected by other factors as infection and liver disease "KHALIFA 1981"

Estimation of red cell protoporphyrin has been used to diagnose iron deficiency before the development of overt hypochromic anaemia (De Gruchy 1978). The red cell protoporphyrin is increased, values ranging from 100-600 Ug/dl (normal 20-40 Ug/dl). The protoporphyrin accumulate in the red cells as there is insufficient iron to combine with it to form haem.

The aim of the present work is to determine the percentage of iron deficiency anaemia in P.E.M. and to assess the value of determination of protoporphyrin in this aspect.

PROTEIN ENERGY MALNUTRITION

Protein energy malnutrition P.E.M. is defined by WHO (1973) as a range of pathological conditions arising from coincident lack, in varying proportions of proteins and calories, occuring most frequently in infants and young children and commonly associated with infections. As the pathogenesis varies from country to country (Mc Laren 1976) so will the clinical picture, including haematological changes.

Different classifications were given in the past to assess the various forms of malnutrition.

I. Classification Mainly depending on weight :-

Gomez (1956) classified P.E.M. into 3 grades depending on weight per age as a percentage of expected weight.

Table (1) : Gomez classification of weight / age

% of expected weight per age	Level of P.E.M.
90 %	Normal
89 - 75 %	First degree
74 - 60 %	Second "
60 %	Third "

In 1966. Jelliffe similarly divided P.E.M. according to weight/age but into 4 levels as follows :

Table (2) : Jelliffe classification of P.E.M. children according to weight/age.

% of expected weight per age	Level of P.E.M.
91%	Normal
90 - 81%	First degree
80- 71%	Second "
70 - 61%	Third degree
60%	Fourth "

Both, Gomez and Jelliffe classifications, consider normal those children weighting more than 90% of expected weight per age, while cases of 60% or less are considered to be nutritional marasmus and cases presenting with oedema, regardless the weight are considered Kwashior Kor (KWO).

Another classification was given by Garrows (1966) in which he classified P.E.M. according to % weight per age, but took into consideration the presence or absence of oedema.

The author considered the child to be severly malnourished if he is 70% or less of expected wieght per age.

Table (3) : Garrows classification of severe forms of P.E.M.

% weight of standard	OEDEMA	
	Present	Absent
70 - 60 %	- KWO	Undernourishment
60 %	- Marasmic-KWO	Marasmus

Later Wellcome (1970) gave similar classification to that of Garrows except that all children weighting more than 80% of expected weight per age (which approximate the third percentiles of Harvard standard) are considered normal.

Table (4) : Wellcome classification of P.E.M. children :-

% weight of standard	OEDEMA	
	Present	Absent
80 % - 60 %	KWO	Under nourish-ment.
60 %	Marasmic-KWO	Marasmus

II. The classification taking length into consideration :

Jelliffe (1966) suggested a classification of weight per length, exactly similar to that of weight per age. But this index will give no consideration to nutritional dwarfism, where weight per length is normal but both are markedly below the expected for age.

TABLE (5) : Jelliffe classification of weight per length

% expected weight per length	Level of P.E.M.
90 %	Normal
90 - 81%	First level
80 - 71%	Second Level
70 - 61%	Third Level
60% or less	Fourth level

Later on, Mclaren (1972) suggested, classification taking into consideration weight, length and age.

III. Other Anthropometric measurements :

Different measures have been used for assessment of nutritional status such as weight per head circumferance. per age and chest per head circumferance ratio < 1. Shukry et al (1973) found that arm circumferance per age is highly correlated with weight per age, but weight per head circumferance did not show high correlation.

ANAEMIA IN PROTEIN ENERGY MALNUTRITION

In clinical practice, anaemia is usually defined as a haemoglobin concentration or packed cell volume below the normal range. The normal range is usually defined by reference to population studies.

Haemoglobin levels vary widely in different countries, dependent upon nutritional status, the incidance of haemoglobin-opathies and the incidance of such diseases as malaria and various particular infestations.

A WHO scientific group in 1968 proposed that anaemia should be considered to exist when haemoglobin was below certain specific levels established according to age, and 11g/100 ml (g/dl) was taken as a critical level. Several authors like to stress the concept of physiological anaemia, by which is meant the gradual drop in haemoglobin after birth to a minimum level by the age of three months, after which haemoglobin levels rise again with increasing age (Wasfy 1975, Matoth et al, 1971). This drop is more noticeable in infants of developing countries. In the more affluent societies such physiological anaemia does not occur any more (Figure 1) showing that it was partly nutritional in origin (Abdel Fatah et al 1974)

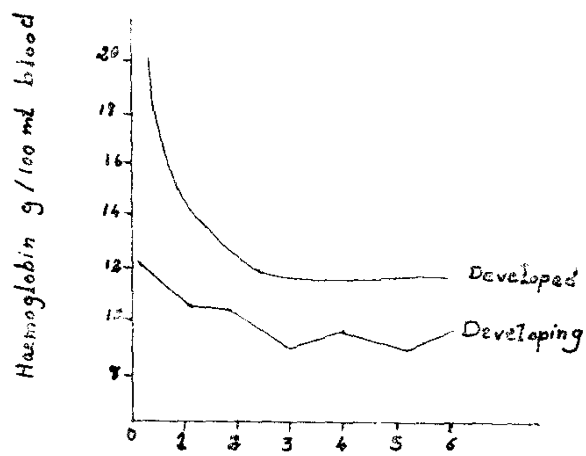

Figure 1 : Physiological drop of haemoglobin concentration in early infancy. Note the differance between developed and developing countries.

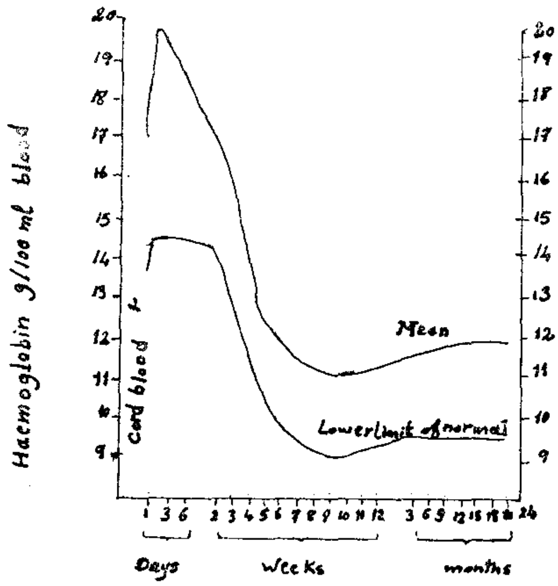

Figure 2 : Haemoglobin concentration in the first two years of life (after Black & Barkhan 1974)

The levels of haemoglobin below which anaemia should be diagnosed are shown in Figures 2 and 3 and compared with WHO (1972) recommendation in table 6

Age	WHO 1972	Age	Burman 1979
6 m - 2 y	11	2 m - 2 y	9.5
		2 - 5 y	10.5
6 - 14 y	12	5 - 9 y	11
Adult ♀	12	Girls 9-18 y	11.5
Adult ♂	13	Boys 9-13 y	11.5
		Boys 9-18 y	13.5

Table 6 Recommended Haemoglobin levels below which anaemia is considered to be present (g/dl)

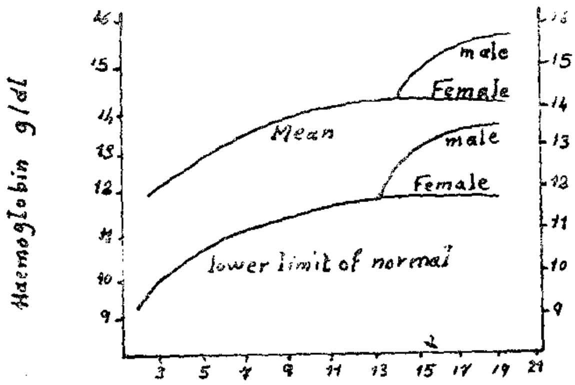

Fig. 3 : Haemoglobin concentration between 2 years and adult life after Black of Barkhan 1974)

Specific nutrient deficiencies may produce anaemia and iron, folic acid, Vitamin B12 and Vitamin E will be discussed - Protein, copper vitamin C., Vitamin A, riboflavin and selenium deficiencies may also produce anaemia but there is no conclusive evidence that these nutrients paly an important role in haemopoiesis. These deficiencies are commonly associated with P.E.M. and infection so that anaemia may not be directly related to these nutrients.

A nutritional anaemia must meet two simple criteria "Herbert 1980"

1) Deficiency or lack of the nutrient alone may produce the anaemia and 2) providing the nutrient must correct the anaemia.

By these criteria, some anaemias that appear nutritional really are not. The anaemia of copper deficiency for instance, requires this metal for correction and can be produced in infants by feeding a copper deficient diet that is also protein and iron deficient and produces generalised mal nutrition. It has not been produced by a diet lacking only copper and children with Menkes disease, copper deficiency do not become anaemic. It is therefore not generally counted among the nutritional anaemias . The anaemia of protein calorie malnutrition on the other hand,