Possible Role for Serum Urea and Calcium in the Confirmation of Protein Energy Malnutrition in Pregnant Women in Enugu Metropolis of Nigeria

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Abstract

This study investigated the potentials of serum urea and calcium as biological markers in the confirmation of Protein energy malnutrition (PEM) in pregnant women. Hundred and two (102) pregnant women were divided into two groups based on their level of serum total protein and serum albumin (known indicators of PEM), while fifty (50) non-pregnant women were recruited to form the third group as control. Serum total protein, serum albumin, urea and calcium levels were estimated in all the subjects using standard methods, and comparisons were made. The results showed a marked decrease in urea (23.40 ± 2.75) and calcium (10.00 ± 0.55) concentrations in subjects with low serum total protein and albumin that correlated positively and significantly with serum total protein and serum albumin. r = +0.681, P<0.05 and r = +0.246, P<0.05 respectively. This study also implicated Parity and gestational age of pregnancy as factors that aggravate PEM in pregnant women. Healthcare providers may therefore include urea and calcium estimation in their antenatal routine for checking PEM in pregnant women.

Keywords: PEM, Total protein, calcium, urea, pregnancy

Introduction

Protein energy malnutrition may be defined as the cellular imbalance between the supply of nutrients (macronutrients and micronutrients) and energy and the body's demand for them to ensure growth, maintenance and specific functions (Lin & Santoro, 2003;Hadi Atassi,2019**)**. The term Protein energy malnutrition (PEM) applies to a group of related disorders that include marasmus, kwashiorkor and intermediate states of marasmus-kwashiorkor (Hadi Atassi, 2019). Protein energy malnutrition develops in adults and children whose consumption of protein and energy is insufficient to satisfy the body's nutritional needs. In some cases there is pure protein deficiency when a persons' diet provides energy but lacks the protein minimum and in energy deficiency in

case of starvation when diet does not provide sufficient energy. It may also occur in persons who are unable to absorb vital nutrients or convert them into energy essential for healthy tissue formation or organ function in cases of chronic disease (Smith, 2002).
There are three clinical forms of Protein energy malnutrition:

a. Kwashiokor - resulting from protein deficiency
b. Marasmus - resulting from near starvation with energy deficiency.
c. Marasmic-kwashiokor - resulting from dual deficiency of energy and protein. (Abdelaziz, 2014).

Pregnancy is a normal physiological process associated with major alterations affecting every organ, system and metabolic pathway, therefore biochemical parameters are significantly altered as a result of these major changes. Values of biochemical parameters may change as the pregnancy advances from first to third trimesters and to delivery and then return towards normal during post-partum period. The clinical manifestations of PEM in pregnancy include gross weight loss leading to insufficient weight gain in pregnancy, Oedema, Dermatitis and Anaemia. The effects are weak immune system leading to high risk of infections and giving birth to low birth weight babies and sometimes maternal mortality.

These wide spectrums of clinical manifestations are conditioned by:

a. Relative intensity of protein and energy deficit
b. The severity and duration of the deficiencies
c. The association of the deficiency with other physiological conditions such as diseases and infections.

The diagnosis for PEM includes the following:

1. Nutritional history
2. Physical examination – including: BMI weight, Anthropometric measurement to determine body mass and body fat distribution.
3. Biochemical and laboratory test.

a. Serum total protein, serum Albumin (known biomarkers of PEM)
b. Total lymphocyte count.

4. Other laboratory and biochemical tests may be carried out as confirmatory especially in borderline cases (Morley, 2004).

Protein energy malnutrition (PEM) is a major antenatal health care challenge in the developing world including Nigeria. PEM is diagnosed by taking anthropometric measures and by the administration of oral questionnaires. This leaves out, possibly, some pregnant women who though may be Protein energy malnourished but appear physically normal. The physiological processes and changes in pregnancy can be aggravated by PEM leading to nutrient deficiency states with adverse physiological and biochemical consequences for both mother and newborn. This makes PEM the

most widespread and disabling public health problems among women in developing countries like Nigeria. There is therefore the need to take further steps in evaluating the nutritional health status of pregnant women to avoid the clinical effects and complications of PEM.

Materials and Methods

Equipment: Bench centrifuge, spectrophotometer and water bath (All from Gallenkamp)

Reagents: All the chemicals used in this study were kits of analytical grade.

Study subjects: A total of (152) one hundred and flighty two subjects were involved in this study. A total of (102) one hundred and two were pregnant women attending antenatal clinic at the Parklane Specialist Hospital Enugu, Enugu State. (50) Fifty volunteer subjects were non-pregnant and non-lactating women. The age range of the subjects was 20 - 40years. The pregnant subjects were in different gestational stages of pregnancy and have different parity.

Collection of blood samples: 10mls of blood samples were collected from each subject by vein puncture into clean, dry glass tubes. The blood was allowed to clot and centrifuged at 5000 rpm for 10mins. The separated serum was collected into clean, dry glass tube.

Sample analysis: Sample analysis was carried out using high performance enzymatic colorimetric commercial kits (All from Biosystems Reagent and Instrument, Barcelona, Spain).

a. Serum Total Protein was determined by the Biuret method (Gornal *et al*., 1949)
b. Albumin was determined by qualitative method using (BCG) Bromocresol Green (Doumas *etal*., 1971).
c. Serum Urea was determined by the urease-salicylate enzymatic method (Tobacco *et al*., 1971).
d. Serum Calcium was determined by reacting sample with methylene blue in alkaline medium(Gindler and King, 1972; Barnett *et al*., 1973).

Statistical analysis: Data was analyzed using the SPSS for windows version 11.00 (SPSS Corporation IL). Difference between the means were separated using one way ANOVA while correlations between parameters were calculated using the Parsons Correlation Coefficient. Difference in means with P Values $\leq$ 0.05 were accepted as significant. Data were presented as means $\pm$ standard deviation.

Results

Table 1: Mean values for parameters measured

Biochemical Tests	Subjects Studied		
	Pregnant women with low serum total protein and albumin N=52	**Pregnant women with normal serum total protein and albumin N =50**	**Non pregnant women with normal serum total protein and albumin N=50**
Serum Total Protein Albumin Urea Calcium	46.75 ± 2.25 34.95 ± 1.51 23.40 ± 2.75 10.00 ± 0.55	64.05 ± 3.81 53.23 ± 4.35 25.95 ± 2.22 9.00 ± 0.56	73.89 ± 2.29 58.40 ± 3.87 23.05 ± 3.10 10.19 ± 0.51

Table 2: Effect of age on parameters measured

Biochemical tests	Pregnant women with low serum total protein	Pregnant women with normal serum total protein	Non pregnant women with normal serum total protein
AGE < 25 Serum Total Protein Urea Calcium	 47.87 ± 2.26 23.25 ± 2.92 8.70 ± 0.55	 66.99 ± 4.28 24.20 ± 2.30 9.66 ± 0.68	 74.07 ± 3.99 26.83 ± 1.81 9.77 ± 0.65
AGE 25 – 33 Serum Total Protein Urea Calcium	 47.58 ± 2.23 23.72 ± 2.80 8.82 ± 0.60	 66.70 ± 3.79 24.72 ± 2.20 9.87 ± 0.51	 74.14 ± 2.75 24.74 ± 3.22 9.80 ± 0.47
AGE > 33 Serum Total Protein Urea Calcium	 47.88 ± 2.28 22.43 ± 2.35 8.50 ± 0.35	 66.22 ± 3.11 24.25 ± 2.29 9.86 ± 0.62	 74.47 ± 3.24 25.59 ± 3.24 9.48 ± 0.53

Table 3: Effect of parity on parameters measured

BIOCHEMICAL TESTS	**PARITY** :1 – 2	**PARITY:** 3 – 4	**PARITY:** 5 or More
Ages:	21 – 26	26 – 30	31 – 40
Serum Total Protein	64.39 ± 10.25	64.51 ± 12.32	58.54 ± 12.28
Urea	24.45 ± 2.89	24.36 ± 2.76	23.93 ± 2.78
Calcium	9.35 ± 0.74	9.54 ± 0.68	9.38 ± 0.79

Table 4: Effect of stage of pregnancy in trimesters on parameters measured

BIOCHEMICAL TESTS	**FIRST TRIMESTER**	**SECOND TRIMESTER**	**THIRD TRIMESTER**
Ages:	25 – 30	25 – 30	21 – 30
Serum Total Protein	74.19 ± 2.87	52.16 ± 7.86	57.90 ± 10.47
Urea	25.06 ± 3.15	22.97 ± 2.95	24.05 ± 2.52
Calcium	9.74 ± 0.50	9.22 ± 0.74	9.31 ± 0.78

Discussion

Table 1 shows the mean values for serum Total Protein, serum Albumin, Urea and Calcium in the studied subjects. The result revealed that calcium and urea positively and significantly correlated with serum total protein and serum Albumin, $r = + 0.681$, $p < 0.05$ and $r = t\ 0.246$, $p < 0.05$) respectively. The implication is that calcium and urea levels increase with serum total protein and serum Albumin and vice versa. These factors are pointers to PEM and agree with the fact that in PEM there is a marked reduction in urea synthesis leading to low serum urea concentration and a low serum Calcium concentration due to low serum albumin as Calcium binds to albumin.

Table 2 shows effect of age of subjects studied on serum total protein, urea and calcium. There was no significant difference in the means of serum total protein of mothers in different age groups. ($p> 0.05$). A test of correlation revealed that age correlated significantly with parity ($r = + 0.545$, $p < 0.05$) and no other parameter measured ($p > 0.05$) in each case. Therefore age may not be a factor in PEM. This agrees with earlier studies which suggested that PEM is a consequence of dietary deficiency and is prevalent among "Vulnerable age groups" (Torun and chew, 1994) (McGanity et al 1994).

Table 3 shows effect of parity on serum total protein, urea and calcium. There was a significant difference between the mean serum total protein of mothers who have 1-2, 3-4, and 5 or more children ($P < 0.05$). A Test of correlation revealed that parity correlated negatively with serum total protein ($r = 231$, $P < 0.05$) but positively and significantly with age ($r = + 0.545$, $p < 0.05$). The implication therefore is that parity may be a contributing factor in PEM.

Table 4 shows the effect of stage of pregnancy on serum total protein, urea and calcium. The serum total protein levels of mothers at different stages of pregnancy were found to be significantly different ($P < 0.05$). Stage of pregnancy in trimesters was found to correlate negatively and significantly with serum total protein ($r = - 0.402$, $p < 0.05$) and calcium ($r = - 0.288$, $p < 0.05$) only. This suggests that stage of pregnancy affects serum total protein and calcium levels and may be a factor in PEM. This agrees with earlier studies which suggested that calcium levels fall gradually during pregnancy from first to third trimester (Allen and Wood, 1994).

Conclusion

In this study, there was a marked decrease in urea (23.40 ± 2.75) and calcium (10.00 ± 0.55) concentrations in subjects with low serum total protein and albumin that correlated positively and significantly with serum total protein and serum albumin. $r = +0.681$, $P<0.05$ and $r = +0.246$, $P<0.05$ respectively. Thus, serum total protein and serum albumin which are known indices of Protein Energy Malnutrition (PEM) was found to correlate significantly and positively with urea and calcium concentrations and therefore have been implicated in this study as indices for PEM.

Recommendation

It is therefore recommended that biochemical assessment of urea and calcium apart from physical examination and anthropometric measurement be included as a component of antenatal /prenatal care. This will establish the nutritional status of the pregnant mothers, identify a biochemical manifestation of PEM, determine whether they are at risk of complications and also help in monitoring nutritional status during treatment.

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