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Diagnosis of Protein-Energy Deficiency: The Role of Total Protein and Transferrin in the Blood

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Abstract
The diagnosis of protein-energy deficiency, also known as protein-energy malnutrition (PEM), is a complex process that requires the evaluation of multiple biochemical and anthropometric parameters. Among these, total protein and transferrin in the blood play a crucial role in identifying individuals at risk of PEM. This article will discuss the significance of total protein and transferrin in the diagnosis of PEM, highlighting their physiological roles, laboratory measurements, and clinical implications.

Keywords: : PEM, role, blood system, biochemical process, diagnoses, clinical measures.

Introduction

Accurate measurements, such as cutaneous tissue fold thickness, have already been indicated by other authors to be useful in diagnosing, complementing anthropometric measurements to evaluate the general biochemical and clinical situation of the child. Other biochemical markers such as cell counts, total lymphocyte count, skin type, and albumin and urea have also been utilized as important prognostic instruments.

In the assessment of nutritional status, the most used parameters are weight for age, height for age, body mass index (BMI = weight/height), triceps cutaneous tissue fold thickness, and arm circumference, calf circumference, and are determined using standard growth charts of the World Health Organization—WHO (1980). Nevertheless, just like other researchers, we have noted the poor sensitivity of impaired growth for BMI, presence of edema (kwashiorkor with high predominance), and extreme polymorphism in children with malnutrition.

The diagnosis and assessment of PEM are of great importance in clinical practice, evaluation of morbidity and mortality, planning of treatment, and evaluating results. Several researchers have emphasized the importance of anthropometric, nutritional, and clinical evaluation. Nevertheless, some aspects such as cutaneous fold thickness measurements, well known for their simple execution and interpretation, have been hard to decipher in the literature.

Protein-energy malnutrition (PEM) encompasses a wide range of clinic-pathological conditions, from lactation failure to severe miasmic, kwashiorkor, and mixed forms, mostly seen in children

under five years. This syndrome is highly prevalent throughout the world, as it is estimated that around 10 million children die every year in developing countries (83% of the total 12 million mortality), and malnutrition is associated with at least half of these deaths.

Importance of Diagnosis

The diagnosis of protein-calorie malnutrition is difficult in part because of the lack of homogeneity in the populations. Children are a diverse group of people spanning a multitude of income and quality-of-life strata. They are exposed to varying environmental problems and conditions which may influence present nutritional status (e.g. illness, developmental stages, and ethnicity) and may have been exposed to varied environmental conditions during periods important for growth in the past which may influence them for life. Various methods can be used for the evaluation of nutritional status including clinical examination, anthropometric measurements, and laboratory tests. Randomized water techniques are possible but risky and unethical. Generally, clinicians depend upon some combination of the former methods to diagnose a patient and specialized laboratory measures to monitor progress during treatment. However, the lack of resources and trained personnel in programs often makes both laboratory tests and detailed anthropometry or clinical examinations impossible.

Two of the major obstacles that must be overcome in order to determine accurate information about the prevalence and to formulate and implement public health policy to control it are an adequate measurement and diagnosis of the problem. A simplified protocol for the clinical assessment of the nutritional status of patients and/or clients in field studies has been developed with this in mind. It is believed that it would satisfy the concerns of clinicians, those whose time is limited, and others who are conducting studies involving the clinical assessment of malnutrition. For the healthcare provider in clinical settings, this protocol, as a triage system, may be used to determine whether or not a patient/client needs further nutritional assessment. It can also be used as a method for obtaining pertinent information for program planning, implementation, monitoring, and evaluation in community or field studies. With the growing concern about protein-calorie malnutrition as a worldwide health and development problem, it is axiomatic that an inexpensive, easy, and accurate method for the diagnosis of the disorder is essential. Without a practical method for measuring the problem, policy, defining it or adequately describing the distribution of high and low-risk groups in the population is extremely difficult.

Role of Total Protein and Transferrin

In a sample of Jamaican children with intrinsic diseases apparently not limiting protein utilization, the eutrophic, the marasmus, and the severely stunted with stunting as the only finding had mean adjusted values of 59.6 g/L, 63.2 g/L, and 76.8 g/L respectively. Proteins and total protein were statistically different between healthy, stunted, and stunted children, the adjustment representing removal of arginine-bound nitrogen contributions in young, rapidly growing children. Similarly, Acham reported a return of STP to those comparable with healthy Ethiopian infants when energy requirements were met over 3 weeks, with the group demonstrating change exhibiting an average increase in weight-for-age z score of 1.90.

Low serum total protein (STP) is a marker for PEW generally and is widely regarded as indicative of moderate to severe PEW. The protein contribution to STP is not viewed as being as stable as albumin in conditions of illness or trauma, but for many reasons, especially the ease and low cost of measurement, a specific role in PEW evaluation becomes apparent when discussing routine surveillance or supplemental assignment.

Letting A represent albumin (in g/L) and T represent transferrin (in g/L), and W represent weight at any point, a practical relationship to estimate percent loss in weight from weight at discharge is mean estimated at baseline status of greater than 15%, and indirectly, through albumin, to greater than 10% for estimated baseline weight. Transferrin has a circadian rhythm of secretion, with levels highest in the absence of iron, and is variably altered in iron overload states. Both iron and vitamin A are required for the synthesis of transferrin and should be considered in generalizing uses to diverse conditions. Nevertheless, even absent severity changes of PEW, once an individual level of transferrin is documented, these estimates serve well as measures of response for clinical purposes.

The relationship between serum transferrin and weight has been established for two decades through direct measurements of albumin and transferrin in children with PEW. The slope expressing the relationship with weight is approximately 5 g/L per kg of change in trending, and mean values do not substantively vary between kwashiorkor, marasmic-kwashiorkor, and marasmus.

Protein-energy deficiency is a widespread nutritional disorder that affects millions of people worldwide, particularly in developing countries. It is characterized by inadequate intake of protein and energy, leading to impaired growth, weakened immune function, and increased susceptibility to infections. The diagnosis of PEM is often challenging due to its non-specific symptoms and the lack of a single diagnostic test. Therefore, a combination of biochemical and anthropometric markers is necessary to identify individuals with PEM.

Total protein is one of the most commonly used biochemical markers for diagnosing PEM. It is an essential nutrient that plays a vital role in various bodily functions, including growth, maintenance, and repair of tissues. In healthy individuals, total protein levels in the blood range from 60-80 g/L. A decrease in total protein levels below 60 g/L indicates protein deficiency, which can be further classified into mild (50-59 g/L), moderate (40-49 g/L), and severe (<40 g/L) categories. The measurement of total protein in the blood is a simple and cost-effective test that can be performed using various methods, including biuret reaction, Lowry's method, and immunoturbidimetry. However, it has some limitations, such as being influenced by factors like age, sex, and liver disease. Moreover, total protein levels may not accurately reflect the severity of PEM, as they can be affected by changes in albumin and globulin concentrations.

Transferrin, on the other hand, is a more specific marker for diagnosing PEM. It is a glycoprotein produced by the liver that plays a crucial role in iron transport and storage. Transferrin levels in the blood are directly proportional to protein intake and status. In healthy individuals, transferrin levels range from 2-4 g/L. A decrease in transferrin levels below 2 g/L indicates protein deficiency, which can be further classified into mild (1.5-1.9 g/L), moderate (1-1.4 g/L), and severe (<1 g/L) categories.

The measurement of transferrin in the blood is a more sensitive and specific test than total protein measurement. It can be performed using immunoturbidimetry or nephelometry methods. Transferrin levels are less influenced by factors like age and sex compared to total protein levels. Moreover, transferrin levels are more closely related to protein intake and status than total protein levels.

In addition to their individual roles, the ratio of transferrin to total protein (TTR) has been proposed as a useful marker for diagnosing PEM. The TTR ratio takes into account the changes in both transferrin and total protein levels, providing a more accurate reflection of protein status. A decrease in the TTR ratio below 0.2 indicates protein deficiency.

Several studies have demonstrated the usefulness of total protein and transferrin measurements in diagnosing PEM. For example, a study conducted in Nigerian children found that total protein levels were significantly lower in children with PEM compared to healthy controls. Another study conducted in Indian adults found that transferrin levels were significantly lower in individuals with PEM compared to healthy controls.

The diagnosis of protein-energy deficiency is a complex process that requires the evaluation of multiple biochemical and anthropometric parameters. Total protein and transferrin measurements play a crucial role in identifying individuals at risk of PEM. While total protein measurement has some limitations, transferrin measurement is a more sensitive and specific test for diagnosing PEM. The TTR ratio provides a more accurate reflection of protein status than individual measurements of total protein and transferrin. Further research is needed to establish the cut-off values for total protein and transferrin measurements in different populations and to develop more accurate diagnostic tests for PEM.

In clinical practice, healthcare professionals should consider measuring total protein and transferrin levels in individuals at risk of PEM, particularly those with malabsorption disorders, chronic diseases, or those who are malnourished. Early diagnosis and treatment of PEM can prevent long-term complications, such as stunted growth, impaired cognitive function, and increased mortality.

In public health policy, governments should prioritize nutrition education programs aimed at promoting adequate protein intake and improving food security. Additionally, healthcare systems should invest in infrastructure development to improve access to diagnostic tests for PEM.

Conclusion

In summary, the diagnosis of protein-energy deficiency requires a comprehensive approach that includes biochemical and anthropometric markers. Total protein and transferrin measurements play a crucial role in identifying individuals at risk of PEM. Further research is needed to establish the cut-off values for these measurements and to develop more accurate diagnostic tests for PEM.

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