Biochemical evaluation of nutrition

A large proportion of people in need of medical care are at immediate risk of malnutrition. At the same time, the state of nutrition has a significant influence on the course of the disease. A starving patient is more at risk of infectious complications, worse wound healing, formation of bedsores, worse repair of damaged organ functions, etc.

Assessment of nutritional status is important for early initiation and management of nutritional support. It is needed for an increasing number of sick people, because the development of medicine enables the treatment of previously fatal diseases and more and more people remain in a serious condition for many days. Eating disorders are very common; it is reported that about half of hospitalized patients suffer from or are at risk of varying degrees of malnutrition. Particularly at-risk groups include patients with cancer, inflammatory bowel diseases, in critical condition, or respiratory diseases =80-247-0320-3|publisher=Grada Publishing|year=2002|place=Prague|issue=1|extent=487|pages=175}}</ref>.

Starvation

From the point of view of the mechanism of formation and metabolic consequences, we can distinguish two basic types of malnutrition:

- **Simple starvation''** ***leads to a*** *marantic* type of malnutrition, characterized by insufficient coverage of both energy and protein consumption (*protein-caloric* type of malnutrition).
- **Stress starvation** leads to a **kwashiorkor** ***type of malnutrition in which a*** *protein deficit* predominates.

However, both mentioned types are only imaginary ends of a continuous range of possibilities.

Simple starvation

Marasmus

The simplest example of simple starvation is a situation where a healthy person stops eating for some external reason. In the first phase, during **short-term fasting'** (about 72 hours), glycogen breakdown is increased and then lipolysis is stimulated. Organs that are not dependent on glucose supply preferentially oxidize ketone bodies and free fatty acids. Glycemia necessary for brain and erythrocyte function is maintained by gluconeogenesis after glycogen is consumed.

During *long-term starvation*, protein catabolism increases in order to provide a substrate for gluconeogenesis. In general, however, metabolism is regulated in such a way that "proteins are conserved as much as possible". Lipolysis increases, leading to an overproduction of ketone bodies and ketonuria. Organs dependent on glucose gradually adapt to greater use of ketone bodies as an energy source, so protein catabolism gradually decreases (from the initial about 75 g of protein per day, i.e. about 300 g of muscle, to about 25 g of protein, i.e. about 100 g of muscle per day).

In addition to the reduced secretion of insulin, the production of hormones thyroid glands gradually decreases. Heat production and physical activity of a starving individual decrease.

Simple starvation leads to the **Marantic type of malnutrition'** (from the Greek *μαραινειν* = kill). Fat reserves are depleted, but proteins are saved as much as possible. In Marantic malnutrition, the concentration of albumin and other serum proteins does not change significantly (with the exception of transport proteins with a very short half-life such as prealbumin, transferrin or transcortin). The source of amino acids for gluconeogenesis is mainly skeletal muscle proteins. Persons affected by the marantic type of malnutrition are obviously emaciated, of a cachectic habit. It can be said that the metabolism works very economically and the supply of nutrients will lead to rapid realimentation.

Stress starvation

The development of stress starvation is more complex. Malnutrition is involved, but illness plays an important role - current infection, malignancy, injury, etc. Stress or inflammatory response overregulates energy metabolism towards catabolism, which can lead to kwashiorkor type of malnutrition even in a short period of time.

Metabolic changes during stress starvation will be clarified by consideration of the original goal of the stress response. Its purpose is generally the mobilization of energy for high physical stress (e.g. fighting, fleeing from a dangerous place), i.e. the rise of blood glucose. In addition, during the stress reaction, proteins are produced necessary for stopping bleeding and wound healing, repair of damaged tissue and non-specific humoral immunity - in general, we can say that it is acute phase reactants. In order to obtain amino acids for the synthesis of acute phase reactants, albumin and other short-term dispensable proteins are broken down, and their synthesis is simultaneously slowed down. A stress response is expedient if it is short-lived; we can simply say that previously it either helped to quickly get rid of a stressful situation (win a fight, escape, overcome an acute infection), or the affected individual died. Currentlymany patients are in a similar situation for a long time; the stress response in them loses its original meaning and is, on the contrary, metabolically disadvantageous.

The characteristic features of stress starvation are **increased gluconeogenesis'** and the development of **insulin resistance**, which can also lead to hyperglycemia. Proteins are the source of amino acids for gluconeogenesis. During stress starvation, the concentration of albumin in the serum decreases significantly, which leads to a decrease in oncotic pressure of the blood and the development of **hypalbuminemic swellings**. At the same time, lipids, including subcutaneous fat, are relatively spared. It is the preservation of subcutaneous fat associated with generalized swelling and ascites that leads to the fact that this type of malnutrition may not be apparent at first glance and the patient's nutritional status may be underestimated. The result of stress starvation is **kwashiorkor** - severe protein depletion, hypalbuminemic edema and ascites, and impaired glucose tolerance with relatively preserved fat reserves.


Kwashiorkor child's face

It is not enough to increase the supply of energy and amino acids to realiment during stress starvation. The increased supply of protein may not even be used at all due to overregulation of metabolism, but may only cause an increase in nitrogen load. The treatment of this type of malnutrition is therefore more complicated. For the most part, it focuses on the elimination of the provoking cause, or on the hormonal support of anabolism.

Biochemical examination of nutritional status

It is obvious that the state of protein metabolism will be a crucial data for assessing the state of nutrition, especially during stress starvation. Therefore, ``serum concentrations of proteins with different biological half-lives *are used as biochemical criteria of nutritional status. In addition, concentrations of ions, trace elements and vitamins can be evaluated.*

Albumin

Albumin has the longest half-life of the parameters used (about 18 days).
Its serum concentration provides information on protein turnover over the last 3 weeks or so and is used primarily to assess "baseline" and to decide whether to initiate nutritional intervention.

For more information see Plasma Proteins.

Cholinesterase and transferrin

Cholinesterase is a parameter that evaluates proteosynthesis in liver well. Its half-life is about 1 week. Transferrin has a similar meaning, but its serum concentration is also significantly affected by iron metabolism.

Prealbumin

Prealbumin is an alternative name for transthyretin, a thyroid hormone transporter. It is formed in the liver and has a biological half-life of 2 days. It is the **most used parameter'** for monitoring nutritional status and for tracking the success of nutritional intervention.

The serum concentration of prealbumin is determined immunoturbidimetrically. **Reference range** varies from 0.2 to 0.4 g/l in Prague|isbn=-|year=2007|place=Prague|publisher=General Faculty Hospital in Prague|issue=3|range=328|pages=129-130}}</ref>. Malnutrition is accompanied by a decrease in prealbumin, after successful refeeding, its concentration is quickly adjusted.

Retinol binding protein

Retinol binding protein *(*RBP*) has the ``shortest half-life* of the nutritional status parameters used - about 12 hours. Its serum concentration depends on the state of vitamin A stores and renal function, and it is also an expensive examination. It is therefore used selectively.

Links

Related Articles

- Malnutrition and withdrawal conditions
- Nutritional recommendations
- Disease from excess or deficiency of nutrients
- Evaluation of nutritional status

References

References

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