World Applied Sciences Journal 10 (8): 972-974, 2010
ISSN 1818-4952

Need for High Protein Diet During Metabolic Stress

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Abstract: During metabolic stress, the amount of energy needed just to maintain minimal body function can augment by twenty-five to one hundred percent. After trauma, metabolic changes are associated with amplified nutritional requirements range from 1.2-2.0 g/kg/day; comprise 20-30% of total calories during stress. Recovery is enhanced when the patient receives adequate medical and nutritional care to prevent sepsis and organ failure. Special cases like burn wounds cause tremendous metabolic stress and have the greatest bearing on protein needs, increasing protein need seventy-five to one hundred percent.

Key words: Metabolic stress · High protein · Protein catabolism · Muscle wasting

INTRODUCTION

The term metabolic stress refers to the physiological effects of the conditions like critical illness, severe injury, infection, trauma, and major surgery. Metabolic stress affects the major body systems. It inhibits the ability of the immune system, slows wound healing, increases metabolic rate (hyper metabolism), protein catabolism, and muscle wasting. During metabolic stress, the amount of energy needed just to maintain minimal body function can increase by twenty-five to one hundred percent Recovery is enhanced when the patient receives adequate medical and nutritional care to prevent sepsis and organ failure. Metabolic stress occurs in three phases; 1) Ebb phase: metabolic stress begins & energy is conserved immediately following injury 2) Acute flow phase: energy requirements increase 3) Adaptive flow phase: healing process begins.

Malnutrition and muscle wasting are common features of many catabolic chronic diseases associated with impaired protein homeostasis.

Protein Catabolism: In a healthy 70-kg adult, about 280 g of protein is synthesized and degraded each day the majority of which are intracellular proteins [1, 2]. The balance between synthesis and breakdown is such that any alteration in the supply (intake) or demand (utilization) could drastically altered cell function.

In response to stress, the body secretes epinephrine, norepinephrine, cortisol and other hormones. The glucocorticoids (such as cortisol) have a catabolic action. That is, they suppress the synthesis of protein, glycogen and triglycerides. Instead, these are broken down into fatty acids, glucose and amino acids and mobilized from storage.

This process is necessary to counteract a stress. However, if the process is prolonged, the resulting catabolism is very damaging to the body and causes excessive tissue breakdown.

Muscle Wasting: Muscle wasting is defined as unintentional loss of body weight (5-10%) [3], do to accelerated muscle proteolysis resulting in loss of body cell mass. At the whole-body level, the unexplained loss of body weight with wasting may be associated with low food intake, high levels of energy expenditure or a combination of both. Protein and energy insufficiency are of concern primarily in circumstances where needs are not being met due to lower intake (low income, anorexia, prescription) in combination with stress conditions due to surgery, hospitalization and chronic diseases.

Accelerated muscle proteolysis is the primary cause of muscle wasting in many catabolic diseases such as diabetes mellitus, renal and liver failure, HIV infection and AIDS and cancer. In the case of protein deficiency, utilization of amino acids generated from endogenous tissue degradation, namely muscle, become the main source of amino acid supply for protein synthesis and the obligatory nitrogen losses [4].

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Need for Higher Intake of Dietary Proteins: Protein homeostasis takes place through a fine balance between the amino acid flow into the plasma pool coming from dietary intake and muscle protein degradation primarily and the amino acid flow out of the pool to be used for synthesis and catabolism.

- Protein malnutrition is usually caused by inadequate nutrient intake in conjunction with the stress response.
- Burn results in an increase in basal metabolic rate and urinary loss of nitrogen. Positive nitrogen balance must exist for new tissue to be synthesized. When dietary protein intake or total energy intake is adequate, protein and energy intake is sufficient to maintain tissue protein needs and the amounts of nitrogen entering and exiting the body are equal.
- An essential amino acid or indispensable amino acid is an amino acid that cannot be synthesized de novo by the organism (usually referring to humans) and therefore must be supplied in the diet.
- Glutamine is the body's most abundant amino acid and is involved in many physiological functions. Plasma glutamine levels decrease drastically following trauma. It has been hypothesized that this drop occurs because glutamine is a preferred substrate for cells of the gastrointestinal cells and white blood cells. Glutamine helps maintain or restore intestinal mucosal integrity.
- Arginine is also considered a conditionally essential amino acid. Barbul and colleagues showed that arginine supplements increased thymus weight in uninjured rats and decreased thymus involution from trauma [5]. In studies on humans and animals, arginine supplements increased nitrogen retention and immune function and improved wound healing.

Protein Requirement for Different Metabolic Conditions: After trauma, metabolic changes are associated with increased nutritional requirements range from 1.2-2.0 g/kg/day; comprise 20-30% of total calories during stress (Table 2).

Ensuring Optimal Protein Intake: Dietary parameters that affect the response to protein or protein-containing meals include composition of the specific protein, meal composition and amount or dose of the protein or amino acids ingested. Dietary protein handling is further influenced by timing of ingestion as well as the nutritional and physiological status of the individual

Table 1: Range of stress factor during injuries

Injury	Stress Factor (range)
Minor surgery	1.00 - 1.10
Long bone fracture	1.15 - 1.30
Cancer	1.10 - 1.30
Peritonitis/Sepsis	1.10 - 1.30
Severe infection/ multiple trauma	1.20 - 1.40
Multi-organ failure syndrome	1.20 - 1.40
Burns	1.20 - 2.00
Activity	Activity Factor
Confined to bed	1.2
Out of bed	1.3

Adapted from, ADA: Manual Of Clinical Dietetics. 5th ed. Chicago: American Dietetic Association; 1996 Long, C.L., *et al.*, JPEN, 1979; 3: 452-456

Table 2: Determining Protein Requirements for Hospitalized Patients

Stress level	No stress	Moderate stress	Severe stress
Calorie: Nitrogen	>150: 1	150-100:1	<100:1
% Protein/ Total Cal	< 15%	15-20%	>20%
Protein/ kg body weight (g/kg/day)	0.8	1.0-1.2	1.5-2.0

- Reports from the American Journal of Clinical Nutrition estimate that we need 2.5% of our daily calories from protein.
- The World Health Organization sets protein requirements at 4.5% of caloric intake per day for both men and women.
- The Food and Nutrition Board of the National Academy of Sciences gives a range of 4.5-6% as the range for the needs of protein for 98% of the US population.
- The National Research Council cites a figure of 8% of our daily calories needing to be coming from protein.

Protein supplements are a fast and efficient way to gain all your high protein diet needs. High-protein supplements are generally used for persons with infections. Appropriate use of short-term aggressive caloric supplementation can save lives. Two recent studies have suggested that at least half of elderly persons in hospitals receive insufficient calories to meet their basic needs. These patients have much worse outcomes than those who receive adequate calories. Also, recent studies show that elderly persons with hip fractures benefit from oral caloric supplements [6].

Among elderly patients with recent hip fracture, oral protein supplementation was associated with a more pronounced increase in IGF-I levels and a more favorable outcome, including attenuation of proximal femur bone loss and shorter stay in rehabilitation hospitals [7].

In a prospective study, the data on nitrogen balance suggest that elderly patients who had hip surgery needed at least eight days to return to anabolic status. The catabolic status prolongs unnecessarily because of inadequate intake of calories in the postoperative period. A minimum of 1.5 g of protein per kg of body weight would have been sufficient to offset the increased metabolic demands after the surgery [8].

DISCUSSION

Muscle proteolysis increases under conditions of acidosis, up-regulation of branched-chain ketoacid dehydrogenase presence of catabolic hormones (glucocorticoids, thyrotoxic states), insulin resistance, and multiple cytokines [IL-1, IL-6 and tumor necrosis factor). In contrast, factors that suppress muscle proteolysis and wasting, leading to a state of adaptation, include dietary protein deficiency with adequate energy intake, use of anabolic agents and resistance exercise training. The understanding of the biochemical adaptations that reduce protein degradation and improve nitrogen balance are important for the development of effective therapies to combat muscle wasting and improve protein homeostasis with catabolic illnesses. Various investigators have reported severe clinical and sub clinical malnutrition in many elderly patients on admission to medical and operative services [9]. Jensen *et al.* found a 29% prevalence of protein depletion in elderly patients who had been admitted for elective hip replacement. Other investigators have reported protein-calotrie malnutrition to be a risk factor for post operative complications, poor wound-healing and a prolonged stay in the hospital [10, 11].

Nutritional requirements increase during trauma. There is a high prevalence of protein-calorie malnutrition during metabolic stress. Poor enteral intake and prolonged catabolism in metabolic stress is associated with an increased risk of complications. Special cases like burn wounds cause tremendous metabolic stress and have the greatest bearing on protein needs, increasing protein need seventy-five to one hundred percent.

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