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A review of the use of protein components in food for special medical purposes for cancer patients under the background of "mass health industry"

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Abstract: The cancer prevalence rate in China is rising year by year, while many cancer patients are suffering from protein malnutrition. The application of food for special medical purposes is a better nutritional treatment method, which can effectively reduce the incidence of malnutrition in tumor patients. However, at the present stage, China lacks special medical food for tumor, which leads to the unsatisfactory effect of nutritional treatment. Through reviewing the development of food for special medical purposes for cancer, and collecting and comparing the effects of various amino acids on tumor metabolism, this paper advocates introducing proteomics and molecular pharmacology ideas into design of special medical food for tumor. Based on the analysis of amino acid metabolism in the process of tumor development, this paper also introduces the specific methods and benefits of modifying the nitrogen source of protein components directly. These can achieve the effect of tumor immune nutrition regulation therapy, greatly reducing the incidence of malnutrition in tumor patients and improving the survival rate of them, which reduced hospital stay and medical expenses, consistent with the concept of developing the mass health industry in China. Therefore, more in-depth research and full use of the protein components in special medical food for tumor can improve the level of cancer treatment and accelerate the construction of mass health industry in China.

Keywords: Food for special medical purposes; Protein components; Nutritional metabolic regulation therapy; Mass health industry.

1. Introduction

By the 21st century, malignant tumors have become a major health problem and cause of death among humans. According to Tumor Nutrition Professional Committee of Chinese Anti-Cancer Association, the overall incidence of malnutrition among inpatient cancer patients in tertiary hospitals in China is as high as 80% while the nutritional treatment rate of cancer patients is only 34%. Considering that more patients with advanced cancer in my country spend their last days in primary hospitals, the incidence of malnutrition in cancer patients in my country may be higher and nutritional treatment rates may be lower. It is suggested that the nutritional status of cancer patients in China is worrying and needs to be paid great attention and actively responded to. In recent years, many studies have found that 20% to 40% of cancer patients often die from protein-malnutrition and its related complications, rather than the disease itself. ~ As a result, nutrition treatment to tumor patients is important. Food for special medical purposes (FSMP) may be the most suitable source of energy and protein for patients whose diet is insufficient. And the direct design of protein components in FSMP can also achieve the functions of nutritional metabolic regulation therapy. Comprehensively improving the understanding of the importance of tumor nutrition, practicing the principle of first-line treatment in clinical work, and vigorously developing FSMP in China, especially for cancer, can not only improve the overall level of tumor treatment, but also save medical treatment cost in China.

2. Food for special medical purposes

2.1. Definition of food for special medical purposes

Food for special medical purposes (FSMP) is a type of formula food specially processed and prepared to meet the special needs of people with dietary restrictions, digestive and absorption disorders, metabolic disorders or other specific disease states.

Special medical food can improve the malnutrition status of patients. It has functions such as immune regulation, reducing oxidative stress, maintaining gastrointestinal function and structure, reducing inflammatory response, and promoting wound healing, which can ultimately improve patient survival, shorten hospital stay, reduce related costs, and reduce readmissions, etc.

2.2. Development of FSMP in China

FSMP first entered China in the 1980s in the form of enteral nutrition preparations. Because it is regulated as a drug and can only be marketed after drug registration, it is difficult for foreign medical food to enter the domestic market. There is also a lack of relevant system standards for FSMP in China, resulting in the slow development of the domestic special medical food industry.

According to statistics from the Chinese Center for Disease Control and Prevention and IHME, the number of deaths from cancer accounts for a large part of the total number of deaths and shows a younger trend. Due to the gradual improvement of regulations and the increasing awareness of the public and medical institutions about clinical nutrition intervention, FSMP has become an emerging field of the nutrition and

health industry in the past few years, and is regarded as a new blue ocean in the field of general health in China.

3. Nutritional Oncology

3.1. Physiological status of tumor patients

Although the etiology of malignant tumor has not been fully elucidated, more and more studies~ have shown that malignant tumor is a metabolic-related disease. The metabolism of nutrients in tumor cells has its own distinctive characteristics. These discoveries have brought about a revolution in tumor prevention and tumor diagnosis, and also promoted a leap in tumor treatment--Nutritional therapy and metabolic regulation therapy.

The changes of physiological metabolism in patients with malignant tumors mainly include the loss of skeletal muscle protein is accelerated, and part of the decomposed muscle protein is taken up by the tumor, and the rest is used as a gluconeogenesis precursor or for the liver to synthesize acute phase protein, which leads to an increase in the overall protein turnover rate, accelerated energy consumption, and ultimately protein calorie malnutrition, impairing resistance to antitumor therapy.

3.2. The importance of nutritional oncology with protein components

Tumor cells have a high degree of metabolic heterogeneity that is significantly different from normal cells, the malnutrition of tumor patients is significantly different from that of other disease patients~, requiring that FSMP for tumor patients must be suitable for the metabolic characteristics of tumors and meet the requirements of nourishing normal cells and starving tumor cells. Meta-analysis found that high-protein tumor-specific food for special medical purposes can better improve the nutritional status (body weight) of tumor patients treated with radiotherapy combined with chemotherapy (hereinafter referred to as radiotherapy and chemotherapy). The therapeutic effect of special medical food is not as good as that of tumor-specific special medical food. It is suggested that tumor patients, especially tumor-bearing patients, need tumor-specific food for special medical purposes. It can be seen that cancer patients are always accompanied by protein energy malnutrition, which shows the great significance of protein components.

4. Protein components in FSMP

4.1. Special tumor nutrition metabolism modulation therapy

In addition to providing energy and nutrients for the host, protein components in FSMP have the potential to correct or interfere with tumor metabolism, inhibit tumor growth, and play a therapeutic role in regulating nutrient metabolism.

What we can do with protein components is that: First of all, limiting certain specific amino acids, such as methionine, cystine, serine and glycine, etc. Secondly, replacing certain amino acids. For example, replace methionine with homocysteine, replace arginine with guanidine, etc. Last but not least, inhibiting inflammatory reactions. For example, increasing asparagine levels significantly improved CD8+ T cell activation and tumor killing, whereas restricting asparagine uptake by restrictive diet significantly inhibits the activity of T cells and immune effector function.

It is believed that tumor nutritional metabolism regulation therapy will become a powerful tool for tumor treatment, and become a hot spot and direction for the development and research of tumor-specific FSMP.

4.2. Main ways of designs of FSMP

At present, researchers tend to directly combine protein components, such as direct mixing, sieving mixing, mineral chelation and spray drying, while this paper creatively introduces the idea of combining proteomics and molecular pharmacology to directly modify the nitrogen source in protein components.

4.2.1. Removing methionine

In normal cells, methionine uptake and metabolism are involved in many cellular biological functions, which coordinate cellular nucleotide synthesis and redox status. In many cases, these functions are associated with the pathogenesis of cancer. During abnormal proliferation, tumor cells will take up a large amount of methionine. As a result, methionine in FSMP should be removed.

4.2.2. Removing cysteine

Cysteine in tumor cells not only provides energy for the proliferation of tumor cells, but also mediates tumor growth by regulating the signal transduction of tumor cells. Recent studies have shown that in some cases, cysteine deficiency can hinder the proliferation, migration and diffusion of cancer cells. At the same time, cysteine starvation therapy has also proved effective in the mouse cancer model.

4.2.3. Removing serine and glycine

Serine or glycine metabolism is very important for tumor growth, and there are interactions between its key metabolic pathways or metabolic enzymes and tumor factors. For example, deficiency of serine not only leads to blocked glycine synthesis, but also affects tumor cell growth and nucleotide synthesis. However, in contrast to the effect of glycine deficiency on tumor cells, the blocked mitochondrial glycine biosynthesis pathway severely affects tumor cell proliferation. Removal of serine from the diet is extremely important for inhibiting the growth of tumor cells.

4.2.4. Replacing arginine with guanidine

Arginine has a variety of biological functions in metabolism and signaling pathways and is required for tumor cell synthesis of protein synthesis, having an important impact on the growth of tumor cells. Most tumor cells are exogenous arginine-dependent, so FSMP can be added guanidine, which undergoes a series of catabolism to form arginine. This practice can not only ensure the protein intake of tumor patients, but also inhibit the growth of tumor cells.

4.3. General advantages of direct modification of protein components

With the deepening of research, it is found that compared with normal cells, tumor cells are more demanding and dependent on amino acids. Therefore, the way of treating tumors by targeting amino acid metabolism is more effective, and the damage to normal cells is less. FSMP with protein components modified specifically can not only ensure to provide patients with sufficient energy and protein, but also regulate the tumor microenvironment and immune cell function of patients, which is a promising means of nutritional therapy and metabolic regulation therapy for tumor.

5. Conclusion and research recommendation

Although China is vigorously developing the big health industry, the demand for nutritional metabolic regulation therapy and FSMP for cancer is far from being met, failing to improve the quality of life of cancer patients and reduce financial pressure. As a result, the idea of article of combining proteomics and molecular pharmacology is introduced into the research and development of FSMP, whose nitrogen source in the protein module is directly modified. This innovative method can lead production of FSMP to be more in line with the nutritional and metabolic treatment of tumors, thus accelerating the realization of the goal of mass health industry in China of "improving the survival rate of 62% of patients, shortening the hospital stay by 21%, reducing the number of re hospitalization by 30%, and reducing the complications by 60%".

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