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Progress in studying polyunsaturated fatty acids in osteoporosis

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Abstract: Osteoporosis is a metabolic habit disease of the elderly with a high incidence in clinical practice. Age, gender, genetic, endocrine, nutrition, drugs and other factors are the important causes of osteoporosis, but its specific pathogenesis is not clear. In recent years, reports regarding the role of polyunsaturated fatty acids in osteoporosis have gradually increased. There is a correlation between osteoporosis and blood lipid disorders, and polyunsaturated fatty acids play a certain role in the occurrence and development of osteoporosis. Based on this, this paper primarily focuses on the research progress of polyunsaturated fatty acids in relation to osteoporosis.

1. Introduction

Osteoporosis (OP) is characterized by reduced bone mass and degradation of bone tissue fiber structure, which can easily increase the bone fragility. As a common metabolic bone disease, osteoporosis is becoming more prevalent in an aging society. The fractures and other complications induced by it pose a serious threat to the health of the elderly, contributing to a decline in their quality of life.

In recent years, the study of the inducing factors of osteoporosis gradually, gradually found that polyunsaturated fatty acids (polyunsaturated fatyy acids, PUFA) is closely linked with osteoporosis, polyunsaturated fatty acids for fatty acids, including n-3 and n-6, by adjusting the two intake content and proportion, can promote osteoporosis risk falling. This paper reviews the progress of major polyunsaturated fatty acids in osteoporosis.

2. The role of PUFA in the pathogenesis of osteoporosis

2.1 Regulation of inflammatory response cytokines

With the inflammatory reaction of the body, it is easy to aggravate bone loss, increase the risk of osteoporosis, and even cause fractures. Polyunsaturated fatty acids can regulate the synthesis of inflammatory reaction cytokines, and then can have a certain impact on bone absorption. In their study, Wang Qing et al. found that n-3 polyunsaturated fatty acids can regulate the level of postoperative inflammatory mediators in elderly patients with fracture, and thus promote the

significant improvement of the cellular immune function of the patients[1]. In their study, Liu Wenqing et al. proposed that n-3 polyunsaturated fatty acids can improve the level of inflammatory mediators in elderly fracture patients, and can also have a certain impact on T lymphocyte subsets[2]. Prostaglandin E2 (PGE 2) is a common proinflammatory factors, is associated with bone matrix generation, such as in the osteoporosis model mouse fatty acid synthesis, by fish oil to PPAR γ / NF- κ B inflammatory pathway, can improve its fatty acid synthesis, model mice PGE 2 content increased significantly, suggesting that unsaturated fatty acids can regulate the PGE 2 level of osteoporosis mice[3]. The main link of regulating PGE 2 generation is the level of epoxygenase (COX-2). PGE 2 can regulate the expression and activity of COX-2, and n-3 polyunsaturated fatty acids can be regulated by cyclooxygenase-2 signaling, mediate PGE 2 generation, reduce its generation, and then promote bone generation[4]. In their study, Wang Yu et al. found that the inhibition of COX-2 signaling pathway could reduce PGE 2 generation and help to promote bone formation[5].

2.2 Regulation of peroxisome-bioactivated receptor γ

PPAR involves three subtypes, among which PPAR γ is located in adipose tissue and can be detected by immunohistochemistry. PPAR γ can form heterodimers with the nuclear receptor retinoic acid receptor (RXR), and then act as a transcription factor to activate a variety of target factors, and then induce the expression of adipogenic genes and promote adipogenesis. Clinical studies found that osteoporosis decreased bone mass and bone marrow fat, prompted the release of fatty acids in fat cells, at the same time osteoblasts oxidation, unsaturated fatty acids can mediate in PPAR γ to coordinate signaling between bone and fat, and the bone marrow osteoblasts and fat cell differentiation play a regulatory role[6]. Some studies have found that polyunsaturated fatty acids are specific ligands for PPAR γ. When polyunsaturated fatty acids increase, the expression level of PPAR γ will increase continuously, which can increase the stromal cells in the bone marrow and reduce bone mass, which can increase the risk of osteoporosis [7].

2.3 Affects the bone marrow microcirculation

Polyunsaturated fatty acids have a certain influence on bone marrow microcirculation. They can lead to bone marrow ischemia and hypoxia, continuously decreasing bone cell metabolism and ultimately inducing osteoporosis. This is primarily because these unsaturated fatty acids can increase hyperlipidemia, affect vascular endothelial hormones, and disrupt the normal function of vasodilation and contraction. These disruptions exacerbate vascular endothelial damage, increase vascular permeability, promote thrombosis, and ultimately cause bone marrow microcirculation disorders [8].

With polyunsaturated fatty acids, can cause three acylglycerol levels in the blood increased trend, if the liver is difficult to conduct a comprehensive transformation, will cause three acylglycerol accumulation in liver cells, and prompted very low density low lipoprotein combined with fat ball, easy in peripheral vascular formation fat embolus, bone microvascular obstruction, to bone pressure, and increase the risk of bone microcirculation dysfunction[9]. Clinical studies have found that the hyperlipidemia caused by the increase of polyunsaturated fatty acids will continuously increase the blood viscosity, and then reduce the deformation ability of red blood cells, and can easily cause microcirculation congestion, and increase the risk of bone marrow microcirculation disorder[10].

3. The role of PUFA in the treatment of osteoporosis

3.1 Results of the animal studies

In a clinical study, Fang Xiang et al. treated the hormone femoral head necrosis model mice, Found that osteoprotegerin (OPG) can be regulated during treatment, On the expression levels of nuclear factor- κ B receptor-activated factor ligand (RANKL), nuclear factor- κ B receptor-activating factor (RANK), phosphatidyl inositol-specific phospholipase C γ 2 (PLC γ 2), cathepsin K (CTSK), and tartrate acid phosphatase (TRAP), By treatment that is able to inhibit the inflammatory responses mediated by RANKL, And then reduce the degree of necrosis of the femoral head[11]. ROUT Sushant Kumar In their study, et al. made the mold of fracture mice, evaluated the degree of decimal fracture healing after 2 weeks, 3 weeks and 4 weeks respectively, and proposed that endogenous n-3 polyunsaturated fatty acids can accelerate fracture healing in mice, which is one of the nutritional factors to promote fracture healing[12]. Deng xiang yuan in the study of mice skeletal muscle inflammation and n-3 polyunsaturated fatty acids, found that n-3 polyunsaturated fatty acids can promote mice antioxidant capacity, exhaustion mice fatigue improved, mainly because of n-3 polyunsaturated fatty acids can exhaust mice skeletal muscle inflammation formed the effective inhibitory effect[13]. Bai in the study of successful osteoporosis mice take Antarctic krill oil, fish oil and arachidonic acid oil method of intervention, through the study, n-6 P polyunsaturated fatty acids and n-3 polyunsaturated fatty acids can improve lipid metabolism disorders of osteoporosis mice, and Antarctic krill oil play a better effect, and n-6 PUFA arachidonic acid will increase lipid metabolism disorder in mice[14]. Wang kai in research for osteoarthritis mice take ethyl ester type fish oil intervention, after analysis, ethyl ester type fish oil can promote Acan, Col2α1 mRNA expression level, maintain the normal phenotype of cartilage tissue, and can reduce the mTOR mRNA expression level, inhibition of chondrocytes, at the same time can accelerate the process of autophagy, to maintain the homeostasis of cartilage[15]. Liu Qiqi in the study based on the mouse LPS stimulation, after intervention of interleukin 6 and RANKL mRNA expression after the first increase, RANKL and p-AKT protein expression after the first increase decrease, and at different time points of the two genes, protein expression level compared with LPS stimulated mice at a higher level, that the anti-inflammatory activity and polyunsaturated fatty acids, when the changes can improve the inflammation level[16]. In general, most animal experiments have found that polyunsaturated fatty acids can reduce bone loss and maintain bone mass. The association between specific n-3 PUFA and n-6 and n-3 PUFA ratio and osteoporosis needs to be further studied.

3.2 Clinical study results

In recent years, the relationship between polyunsaturated fatty acids and bone metabolism has not only been studied in animal studies, but also focused on the positive effects of n-3 PUFA such as docosahexaenoic acid (DHA) and unsaturated fatty acids (EPA) in the treatment of clinical osteoporosis. In their study, Huang Zexiao et al. proposed that n-3 PUFA level and femoral head muscle weakness, which is an independent protective factor causing quadriceps muscle weakness in patients after total knee replacement, and may be a significant association for the inhibition of inflammatory cytokine levels by n-3 PUFA[17]. In the study, Ning Weihong et al. administered dessumab in postmenopausal patients with osteoporosis femoral neck fracture. After 6 months of application, the amplitude of bone density loss was continuously reduced, and its effect could reach up to 1 year, which had a good inhibitory effect on bone resorption[18]. Wen-long xu of femoral diameter fracture with osteoporosis patients gold day capsule combined alendronate treatment, found to patients with serum osteocalcin, serum alkaline phosphatase, bone resorption markers

against tartrate acid phosphatase 5b bone metabolism index to effectively improve, at the same time can reduce patients pain, to improve the quality of life[19]. Dai Jiale in the study of female postmenopausal osteoporosis treatment, 60 patients randomly divided into two groups, the observation group give alendronate combined salmon calcium drop injection treatment, can reduce patients with bone turnover, and to inhibit bone loss, and can improve the bone density, the effectively relieve the bone pain, and improve the quality of postmenopausal osteoporosis women life[20]. Xiao-yong ma in the study of 300 cases of postmenopausal osteoporosis treatment, the study found that patients take bisphosphonate + bone nutrition + Chinese medicine + nutrition comprehensive treatment effect is the most ideal, help enhance patients with bone density, reduce bone loss, can improve bone metabolism, reduce body pain, has a positive effect on bone health, and has achieved good treatment effect[21]. In her study, Liang Qiongxian found that fish oil can inhibit the level of inflammatory factors and adjust the blood calcium concentration, which can promote the continuous improvement of bone mineral level, mainly because the increase of polyunsaturated fatty acid intake will promote the improvement of bone density[22].

4. Conclusion

To sum up, polyunsaturated fatty acids and osteoporosis are closely related, most reports suggest that n-3 PUFA can promote osteogenic effect, and n-6 PUFA can promote osteoclastic effect, at the same time through the animal experimental results can be found that polyunsaturated fatty acids on osteoporosis mice have good regulating effect, can promote the inflammation level decline, and improve bone density. The clinical research results also found that patients with osteoporosis intake can improve the bone loss of bone mass in patients, and then improve the level of bone metabolism. In future research, it is also necessary to explore the role of different types of polyunsaturated fatty acids in the occurrence, development and treatment of osteoporosis patients, in order to provide more reference for the treatment of clinical osteoporosis patients and ensure that more osteoporosis patients get scientific, effective and safe treatment.

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