Role of Nutrition in the Management of PCOS

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INTRODUCTION

- Polycystic ovary syndrome (PCOS) represents the most common female endocrinopathy, affecting nearly 15% to 18% of women of reproductive age[1].
- It is defined as a heterogeneous group with different phenotypes, thus challenging the treatment[1].
- Higher hormone levels, gut microbiome composition, and plasma metabolomics are related to the PCOS phenotypes[1].
- Precise recommendations should be implemented to prevent the occurrence of metabolic complications, since women with PCOS are predisposed to developing endometrial and ovarian cancer.[1]

LIFESTYLE CHANGES

- Lifestyle changes remains the first-line of treatment for the management of women with PCOS[1].
- Regular physical activity, maintaining appropriate body weight, following healthy dietary patterns and avoiding tobacco use is important to prevent and treat metabolic disorders[1].
- Nutritional counseling remains a focus while treating patients with PCOS[1].

DIET

- Low glycemic index (LGI) diets decrease homeostatic model assessment for insulin resistance (HOMA-IR), fasting insulin, total and low-density lipoprotein (LDL) cholesterol, triglycerides, waist circumference and total testosterone without affecting fasting glucose, high-density lipoprotein (HDL) cholesterol, weight or the free androgen index.[1]
- LGI diet, punitive restrictions and/or physical activity, and the supplementation of omega-3 have shown to increase HDL, sex hormone-binding globulin (SHBG) synthesis, and reduction in body fat[1].
- LGI diets have been shown to reduce ghrelin and increased glucagon in women with PCOS[1].
- Thus LGI diet is an effective, acceptable and safe intervention for relieving insulin resistance (IR), and thus professional dietary advice is a must for patients with PCOS[1].
- The ketogenic diet (KD) improves the menstrual cycle, reduces blood glucose and body weight, improves liver function and treats fatty liver in women with PCOS, and liver dysfunction in obese individuals[1].
- The initial focus must be on the eating pattern and the macronutrient content of the diet instead of promoting healthy eating and weight loss too quickly in these patients[2].
- Limiting nutrient intake or increasing calorie expenditure will help gain an energy deficit in these patients. Calorie deficit of about 200 kcal/day will prevent weight gain and promote weight loss in the longer term. A deficit of 500 kcal/day is required for the average person to lose 0.5 kg/week, while doubling the value further double the weight loss/week[2].

SUPPLEMENTATION

Vitamin B3

- Insufficient supply of vitamin B3 causes the development of inflammatory conditions, leading to the associated diseases and the increased risk of cardiovascular syndromes[1].
- Women with PCOS who are treated with metformin chronically, to normalize glycemia may show deficiencies in thiamine and cobalamin[1].
- Thus supplementing with thiamine, activates transketolase, which inhibits the mechanisms of damaging blood vessels and reduces the risk of cardiovascular diseases[1].

CoQ10

- Coenzyme Q10 (CoQ10) supplementation for 8 weeks has a beneficial effect on inflammatory and endothelial dysfunction markers in overweight and obese patients with PCOS[1].

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Vitamin D

- Vitamin D increases insulin synthesis and release, which increases insulin receptor expression and increases the insulin response to glucose transport. It indirectly influences carbohydrate metabolism by normalizing extracellular calcium and parathyroid hormone concentration and also affects the expression of the genes of the metabolic pathways affecting systemic inflammation by inhibiting the synthesis of proinflammatory cytokines, which may contribute to the occurrence of IR[1].
- When 20,000 IU of cholecalciferol is given to women with PCOS, weekly carbohydrate metabolism is improved and fasting glucose, triglycerides, and estradiol is reduced[1].
- It also improves the menstrual frequency[1].

Inositols

- Administration of myo-inositol may bypass the side effects experienced with metformin. It increases insulin sensitivity, normalizes androgens in the blood, improves glycemia and affects numerous features of metabolic syndrome[1].
- Inositols (both isomers, both given separately and in combination) also have the potential to restore spontaneous ovulation and improve fertility in women with PCOS[1].
- Thus supplementation with inositol is a safe and effective form of PCOS therapy, which improves the development of ovarian follicles, oocyte maturation, and stimulation of pregnancy[1].

Berberine

- Berberine possesses good hypoglycemic and hypolipidemic effects, reduces body weight and is an effective insulin sensitizer.
- It decreases steroid hormone synthesis and the expression of ovarian aromatase by acting on the hypothalamic-pituitary-ovarian axis and improves the ovulation rate and the regulation of menstruation, thus increasing the pregnancy and live birth rates[1].
- Its side effects are transient and mild (constipation, nausea), thus it may be a safe and promising compound for the treatment of PCOS patients[1].

Chromium

- Chromium improves diabetes in patients with PCOS by enhancing the insulin signaling pathway, increasing the activity of adenosine monophosphate-activated protein kinase, and increasing cellular glucose uptake[1].

Zinc

- Supplementation with zinc and selenium may be beneficial in some patients with PCOS[1].
- Zinc supports lipid and glucose metabolism and fertility by intracellular signaling and structural functions[1].
- Low zinc intake in obese people can cause hyperinsulinemia, increased low-grade inflammation, and a worsened lipid profile[1].
- Zinc deficiency has a role in the pathogenesis of PCOS and thus may be a prognostic marker of PCOS[1].

Selenium

- Selenium causes a lower level of C-reactive protein (CRP) and has anti-inflammatory and antioxidant properties[1].

Omega-3 Fatty Acid

- Omega-3 fatty acid lacks in the diet of PCOS women. Polyunsaturated fatty acids (PUFAs) improve the reproductive performance in PCOS by boosting the expression of steroidogenesis enzymes[1].

Thus, a balanced diet and a healthy lifestyle should be the first element of PCOS therapy[1].

HERBS SUPPORTING TREATMENT

Since a balanced diet is the most important treatment for PCOS, herbs infusions such as *Aloe vera*, cinnamon (*Cinnamomum verum*), green tea (*Camellia sinensis*), and chamomile (*Matricaria chamomilla*), and white mulberry (*Morus alba*) would complement the therapy[1].

As these herbs can regulate lipid and carbohydrate metabolism they can be used by all phenotypes of PCOS women[1].

Green tea and marjoram: Herbs like green tea and marjoram (*Majorana hortensis*) can improve hormonal levels, ovaries weight, insulin sensitivity, antioxidants, and anti-inflammatory parameters[1].

Green mint: Green mint (*Mentha spicata* L.) has an antiandrogenic effect and restores follicular development in ovarian tissue[1].

Licorice smooth: Licorice smooth (*Glycyrrhiza glabra*) has antiandrogen and estrogen-like activity. Its root is

effective in reducing excess testosterone as it blocks the conversion of androstenedione. However, licorice has the potential to induce hypertension, hypokalemia, and metabolic alkalosis thus not suitable for people with high cortisol levels[1].

Serenoa repens, C. sinensis, Rosmarinus officinalis,* and *G. glabra: *S. repens, C. sinensis, R. officinalis,* and *G. glabra* have also been shown to lower androgen levels and inhibit androgenetic alopecia[1].

Vitex agnus-castus: *V. agnus*-castus regulates the menstrual cycle[1].

Flaxseed lignans: Flaxseed lignans are the well-known dietary phytoestrogens. The lignan content of flaxseed (*Linum usitatissimum*) modulates relative levels of circulating sex hormones and their metabolites[1].

Turmeric: Turmeric (*Curcuma longa*), and specifically curcumin, reduces oxidative-stress-related complications in patients with PCOS[1].

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