

Review

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Nutrition in Pediatric Nephrotic Syndrome

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Alireza Eskandarifar,^{1*}
Ahmad Fotoohi,²
Sayed Yousef Mojtahedi³

¹Pediatric Nephrologist, Faculty of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran.

² Medical Student, Student Research Committee, Kurdistan University of Medical Sciences, Sanandaj, Iran.

³Pediatric Nephrologist, Tehran University of Medical Sciences, Tehran, Iran.

***Corresponding Author**

Alireza Eskandarifar, MD. Kurdistan University of Medical Sciences, Sanandaj, Iran.

Email: are1372@gmail.com

Nephrotic Syndrome is a collection of symptoms due to glomerular damage, characterized by proteinuria ≥ 3.5 g/day or a protein-creatinine ratio ≥ 2 . From an etiological point of view, there are three forms of nephrotic syndrome, including congenital, primary, and secondary. The first sign of the disease is periorbital edema, especially in the morning. Diagnostic confirmation is done through evaluation of urine protein, serum electrolytes, BUN, Cr, Albumin, and cholesterol. The main treatment goals of nephrotic syndrome are decreasing proteinuria, preventing complications, and protecting the renal function via appropriate drugs and diet.

The main objective of this study was to review diets required in nephrotic syndrome in children: Protein at a dose of 0.8 mg/kg/day is the most effective diet in nephrotic patients. Low-fat diets (calorie intake $< 30\%$ and cholesterol ≤ 200 mg/day) can improve hyperlipidemia. Salt and water intake should be restricted in the range of less than 2 gr/day and 1-1.5 liters/day, respectively. Nephrotic syndrome patients have iron, copper, zinc, and calcium deficiency due to increased urine protein excretion or concomitant metabolic disorders.

Nephrotic syndrome, Diet, Pediatrics

Keywords: Nephrotic syndrome; Diet; Pediatrics; Nutrition.

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Introduction

Nephrotic Syndrome is a collection of symptoms due to glomerular damage, characterized by proteinuria ≥ 3.5 g/day or a protein-creatinine ratio ≥ 2 . Albumin forms 80% of the urine protein excretion and other components include immunoglobulins, complements, binding proteins, and coagulative factors. Hypoalbuminemia (≤ 2.5 gr), edema, and hyperlipidemia (cholesterol ≥ 200) are the classic triad of nephrotic syndrome. It is more frequent in male children. It may be seen at any age, but it is more common in the age range of 2-5 years. Its prevalence is between 1 to 3 cases in every 100000 children.

Etiology

From an etiological point of view, there are 3 forms of nephrotic syndrome, including congenital, primary, and secondary. -Congenital: The congenital form occurs in the first 3 months of life, and can be due to primary causes (involvement of some genes, e.g. NPHS1, NPHS2, WT1, and LAMB2) or secondary causes like TORCH infections.

-Primary: Primary or idiopathic nephrotic syndrome is the most common form in children and minimal change disease is the most frequent subtype.

-Secondary: Secondary nephrotic syndrome occurs due to systemic diseases like SLE, HSP,

vasculitis, malignancies, infection, and drugs.

Clinical manifestations

The first sign of the disease is periorbital edema, especially in the morning, that worsens overtime and progresses to generalized edema, pleural effusion, edema of the genitalia, and ascites.

Diagnosis

A diagnosis of nephrotic syndrome is confirmed by evaluation of urine protein, serum electrolytes, BUN, Cr, Albumin, and cholesterol.

Treatment

The main treatment goals of nephrotic syndrome are decreasing proteinuria, preventing complications, and protecting the renal function through the use of appropriate drugs and diets. The main goal of diet modification in the nephrotic syndrome is to reduce the signs and symptoms like edema and hyperlipidemia, and to replace matters excreted in the urine. To achieve this goal, we should pay special attention to the calories, protein, lipid, minerals, and vitamins of the designed diet.

Diet

Protein

The metabolic disorder in the nephrotic syndrome includes discharge of protein reserves of the plasma and tissues. A review of the literature shows that high-protein diets (2-3 mg/kg/day) cannot increase the plasma level of albumin and only increase the urine protein level. Moreover, a high-protein diet can cause glomerular hypertrophy and hyperfiltration, resulting in more glomerular damage.

However, a low-protein diet (e.g. 0.8 mg/kg/day) may cause a significant decrease in the urine protein level and a significant increase in the serum albumin level, which is the reason why recommend a low-protein diet (e.g. 0.6-0.8 mg/kg/day).

In addition to the amount of protein, its source and compound are important, too. In fact, plant proteins have less effect on glomerular permeability and hemodynamics than animal proteins. Reviews show that soybean may significantly decrease proteinuria and improve blood lipids.

-Protein at a dose of 0.8 mg/kg/day is the most effective diet in nephrotic patients. At least more than 50% of the protein should be from high-value sources (e.g. white meat, fish, dairy products, and soybean). In case of excessive urine protein excretion ($\geq 3g$), administration of

1 gr protein for each gram excretion is recommended.

- A calorie intake of 30-35 kcal/kg/day in adults and 100 kcal/kg/day in children is very important to prevent the use of protein as a source of energy.

Lipid

In a patient suffering from nephrotic syndrome, hyperlipidemia occurs due to excessive lipid synthesis and disrupted lipid metabolism. Nephrotic syndrome has a marked effect on triglyceride and cholesterol. The level of LDL and VLDL usually increases while the level of HDL remained unchanged or decreases. The severity of these disturbances depends on the severity of proteinuria. Hyperlipidemia may accelerate

kidney damage in addition to increasing the risk of cardiovascular diseases. For this reason, correction of hyperlipidemia is one of the treatment goals in nephrotic syndrome. Many studies have shown that low-fat diets (calorie intake $< 30\%$ and cholesterol $\leq 200mg/day$) can improve hyperlipidemia by 25% in adults, but there is not enough evidence in children. In addition to the amount, the quality and type of the lipid are very important, too. For example, fish oil omega 3 has a beneficial effect on the cardiovascular system and can decrease systolic blood pressure, triglyceride level, and risk of sudden death. In one study, Fish oil administration (15 gr.) reduced TG and VLDL significantly and increased LDL level moderately. Most of these studies have been done in IgA nephropathy patients, indicating that omega 3 has anti-inflammatory effects through inhibition of cytokines synthesis and can prevent disease progression.

-In nephrotic syndrome patients, fat consumption should be limited and the proportion of unsaturated fats should increase. High cholesterol foods include red meat, yolk, fried foods, and fast foods. If the diet cannot control hyperlipidemia, statins should be considered. Although most studies have shown the useful effects of fish oil, especially in IgA nephropathy, these beneficial effects have not yet been proven in nephrotic syndrome. Although fish oil has no side effects, physicians should leave the decision to their patients because of its bad smell.

Fluid and salts

Edema is an important clinical manifestation in children with nephrotic syndrome. There are two theories of overfilling and underfilling about

the pathophysiology of edema neither of which has been proven definitely. The involvement of each of these two theories seems to depend on the edema severity.

Edema occurs due to water and salt retention and water and salts restriction is the main treatment method. The amount of salt should be restricted in a range of less than 2 grams/day and water consumption should be limited to less than 1-1.5 liters/day. In case of no recovery, diuretic therapy should be considered. It is recommended that weight loss should not exceed 0.5 to 1 kg/day because of the risk of thromboembolism.

Minerals and vitamins

Nephrotic syndrome patients have iron, copper, zinc, and calcium deficiency due to increased urine protein excretion or metabolism disorders. For example, increased excretion of ferritin as an iron transporter may cause iron deficiency anemia. On the other hand, released iron from transferrin can produce free oxygen radicals that can harm the tubulointerstitium. For these reasons, iron should be administered carefully. Urine excretion of erythropoietin can exacerbate the patient's anemia

Almost 95% of copper is carried by ceruloplasmin in the serum. For this reason, any increase in the urine excretion of ceruloplasmin can cause copper deficiency. Copper deficiency has no clinical manifestations in most of the nephrogenic syndrome cases and does not require treatment.

Zinc deficiency in nephrotic syndrome is due to hypoalbuminemia, excessive excretion, and intestinal absorption disorders. Clinical manifestations of zinc deficiency in nephrotic syndrome are not clear yet, but studies have shown that administration of copper at a dose of 10 mg/day reduces the recurrence rate of nephrotic syndrome.

Vitamin-D deficiency in nephrotic syndrome is common and causes hypocalcemia, hyperparathyroidism, and decreased bone density. Bone density is even worsened due to the use of corticosteroids in nephrotic syndrome. For this reason, it is recommended that patients on corticosteroid therapy receive 1000 IU vitamin D and 500 mg/day calcium for 12 weeks

Conflict of Interest

None declared

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