СЕКЦІЯ XIV.
КОМП'ЮТЕРНА ТА ПРОГРАМНА ІНЖЕНЕРІЯ

HYPOTHYROIDISM

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Hypothyroidism is one of the most common endocrine diseases caused by an insufficient amount of thyroid hormones. In many countries, Hashimoto's disease, an autoimmune disease, is also a known factor.

Of course, with age, the likelihood of developing hypothyroidism increases, which is also true of goiter, so different types of the disease occur among 2-20% of older people. For example, according to the results of the Framingham study, 2.4% of men and 5.9% of women over 60 years of age have hypothyroidism because their TSH level exceeded 10 mIU/L. The NHANES study of 1999-2002 data showed that the probability of developing the disease in people aged 80 years and older was 5 times higher than the probability of the disease among people aged 12 to 49 years.

The proportion of women and men with the disease is different, as studies related to the gender of patients use different criteria. It is known that among women, it is more than 2-8 times more common.

In their research, NHANES also paid attention to the ratio of white and Mexican Americans, the number of patients among whom was 5.1%, and African Americans, who had less hypothyroidism - 1.7%, because they have lower average TSH levels.

The disease can develop asymptomatically or with barely noticeable signs and symptoms, as it can mistakenly indicate other diseases but is sometimes accompanied by a slowdown in physical and mental activity.

Symptoms of hypothyroidism are as follows:

- dry skin;
- fatigue;
- weight gain;
- loss of appetite;
- drowsiness;
- decreased sweating;
- intolerance to cold;
- constipation;
- impaired vision and hearing;
- hair loss;
- jaundice;

- goiter;
- pain in muscles and joints, weakness in limbs
- pallor;
- periorbital swelling;
- macroglossia
- hoarseness;
- decrease in systolic blood pressure and increase in diastolic blood pressure;
- bradycardia;
- pericardial effusion;
- abdominal distention;
- hypothermia;
- myxedema;
- hyporeflexia with delayed relaxation (pseudo myotonia)
- ataxia;
- paresthesias and nerve entrapment syndromes;
- menstrual and fertility disorders;
- memory impairment;
- depression;
- mental disability.

Hypothyroidism can be of the following types: primary, secondary, and tertiary.

Types of primary hypothyroidism:

- postpartum thyroiditis;
- subacute thyroiditis;
- chronic autoimmune thyroiditis;
- iatrogenic hypothyroidism;
- drug-induced hypothyroidism.

Secondary hypothyroidism is an endocrine disease in which the thyroid gland functions normally, but due to low TSH secretion produced by the pituitary gland, it does not receive sufficient stimulation, which is possible in the presence of other pituitary hormones. In tertiary hypothyroidism, which is rare, the amount of TSH is also insufficient due to abnormal secretion of thyrotropin-releasing hormone (TRH) by the hypothalamus.

Secondary or tertiary hypothyroidism can develop due to damage to the hypothalamic-pituitary axis, namely:

- TSH deficiency;
- Sheehan's syndrome;
- pituitary adenoma;
- drugs;
- congenital hypothyroidism type 4;
- resistance to TRH;
- tumors;
- lymphocytic hypophysitis.

By the way, according to some studies, there may be a link between low levels of vitamin D and autoimmune diseases: Hashimoto's thyroiditis and Graves' disease. Despite these test results, interventional observations do not support the benefits of supplementation. For example, a symptom of thyroid cancer may not necessarily be a certain value of vitamin D.

Hypothyroidism is one of the most common endocrine pathologies, and the number of patients is increasing over time. Despite the natural factors of the disease, it is worth noting

that surgical interventions on the thyroid gland, for example, due to cancer or thyrotoxicosis, can also cause endocrine complications.

The development of hypothyroidism can range from an asymptomatic state to a myxedema coma with multiple organ failure. Deficiency of thyroid hormone can have numerous consequences, as it is necessary for all metabolically active cells.

Usually, hypothyroidism becomes noticeable when mental and physical activity slows down or its symptoms are extremely nonspecific or less common: it can manifest itself in rough skin, cold intolerance, and decreased sweating.

At the onset of the disease, T3 levels are maintained by compensatory mechanisms. Due to a decrease in the amount of free thyroxine T4, the pituitary gland can increase the secretion of TSH, which is a factor in deiodinase activity and thyroid hyperplasia and hypertrophy, which in turn increases T3 levels.

As noted earlier, the level of third-generation TSH is one of the most prominent signs of the disease in primary hypothyroidism, with a normal range of 0.40-4.2 mIU/L.

Because the symptoms are nonspecific, the disease is difficult to detect in time. These signs of the disease include galactorrhea, fertility and menstruation disorders in women, and apnea secondary to macroglossia. Therefore, it is possible to confirm whether a person has hypothyroidism only with the help of clinical tests.

It is known that in many countries of the world, one of the most favorable factors for the development of hypothyroidism is Hashimoto's disease, an autoimmune disease associated with adequate consumption. Antibodies are more prevalent in women's bodies, especially with age. Congenital thyroid problems are less common, but it has been found that the disease can develop among relatives of the patient of the same line of kinship. In addition, 20-30% of siblings of patients have a genetic predisposition to this complication of thyroid behavior, and 50% of them have a higher level of thyroid antibodies. By the way, higher values of concordance are observed in monozygotic twins with autoimmune disease, ranging from 29 to 55%, compared to the number of such relationships among dizygotic twins, in which this value is no more than 7%.

The National Health and Nutrition Examination Survey (NHANES 1999-2002), which was conducted in the United States in 4392 people, showed that hypothyroidism, which is detected when the TSH value is more than 4.5 mIU/l, is developed in 3.7% of the population, but it is more common among women with a low body mass index and small body size at birth.

Iodine deficiency in the body can trigger the development of hypothyroidism. Its excess in seaweed, dietary supplements, and amiodarone can reduce the synthesis of thyroid hormones, which is known as the Wolf-Chaikov effect. The effect can be eliminated within 10-14 days in healthy people, but in patients who do not have sodium iodide importer iodine overload, which is useful in reducing the level of intracellular iodine and improving hormone secretion.

The sodium iodide importer downregulates quickly, so the Wolf-Chaikov effect is not long-lasting, but excessive iodine can cause severe hypothyroidism in people with subtotal thyroidectomy or autoimmune thyroiditis.

Iodine deficiency, which causes the development of the disease, is more common in less developed parts of the world, where this problem is solved by adding iodine to food. According to the World Health Organization (WHO), 30.6% of the population has iodine deficiency. The results were collected from 130 countries from January 1994 to December 2006. The WHO concluded that the normal concentration of iodine in urine ranges from 100 to 199 mcg/l, and for pregnant women - from 150 to 249 mcg/l.

It is known that 1 in 4000 newborns may have congenital hypothyroidism, which occurs due to improper development of the thyroid gland, so in many countries, this

disorder is checked during screening. For example, an infant may be born with cretinism due to iodine deficiency in the mother, which indicates severe hypothyroidism and is rare.

The insufficient amount of hormones produced by the gland has many consequences. There is a chance of developing insulin resistance. The size of the heart may increase, and its contractility may decrease. In addition, pericardial effusion may develop, heart rate may decrease, and cardiac output may decrease. Hypothyroidism can cause prolonged passage through the intestinal tract and achlorhydria. One meta-analysis found that 44,140 people had an association between hypothyroidism and non-alcoholic fatty liver disease (NAFLD). One of the consequences may be changes in high-density lipoprotein (HDL) cholesterol, which may be caused by modified metabolic clearance behavior and increased low-density lipoprotein (LDL) cholesterol and total cholesterol. There are also cases of delayed puberty, infertility, and menstrual irregularities, and it is necessary to check TSH levels. There is also a link between anemia and hypothyroidism; although it is not yet clear, there are studies that show that red blood cell production, which involves T3, T4, and TSH, can be impaired due to insufficient thyroid function.

The deficiency of hormones produced by the thyroid gland causes cold intolerance, muscle and joint pain, and increased anxiety, which in turn causes a negative impact on sleep or even insomnia in subclinical hypothyroidism, although no direct link between the disease and this problem has been found yet.

One of the most severe complications of undiagnosed or untreated hypothyroidism in people with stroke, myocardial infarction, or medical intervention is myxedema coma with hypothermia, cardiomegaly, ascites, hypercapnia, hyponatremia, cardiogenic shock, pericardial effusion, bradycardia, and mental health deterioration.

Another unexplored symptom is headache, which occurs in one-third of patients, but the relationship can be bidirectional, making it difficult to identify the actual root cause.

Another survey of 5,282 patients revealed another common consequence - "brain fog" in 905 people, which is characterized by fatigue, memory loss, and lack of energy.

According to the Tricarico study, the likelihood of recurrence of benign paroxysmal positional vertigo, especially in people with Hashimoto's thyroiditis and positive thyroid antibodies, is significantly higher due to hormone replacement therapy (HRT), which may indicate a link between vertigo and autoimmunity.

Observations also reflect the problems of sexual dysfunction among men due to hypothyroidism rather than antibodies causing the disease, which is expressed by delayed ejaculation, hypoactive sexual desire (HSD), and erectile dysfunction.

Insufficient thyroid hormones (TH) cause neurological complications in patients and cause impaired neurotransmitter synthesis, liver function, endothelial function, microhemocirculation, decreased nitric oxide synthesis, and imbalance of adipocytokines and proinflammatory cytokines.

Neurological disorders often occur among patients with hypothyroidism. The rapid disruption of anabolic and energy processes is caused by organic lesions. It is known that the development of the central nervous system takes place with the help of thyroid hormones, so their deficiency causes neurological disorders due to impaired physical and psychological health.

Neuropsychiatric disorders are common among patients with hypothyroidism. In addition to lethargy and drowsiness, patients complain of low mood, depression, and impaired memory and thinking.

Subclinical and manifest hypothyroidism is complicated by depression due to a decrease in the activity of 5-hydroxytryptamine in the CNS. It is in subclinical hypothyroidism that depression is more common than among people who have not been

diagnosed with this disease, so there is a higher likelihood of latent hypothyroidism among people with depression. Depression in endocrine disease is accompanied by panic and resistance to antidepressant treatment, unlike depression among people without the disease. The effectiveness of antidepressants can be increased by increasing the dose of triiodothyronine.

Because the disease starts ambiguously and has numerous symptoms and consequences, it is difficult to detect it in time for treatment. There are no universal ways to screen for hypothyroidism in adults, but the American Thyroid Association insists on testing every five years, starting at age 35, especially for patients such as women over 60, pregnant women, people with a history of neck radiation, type 1 diabetes, and autoimmune disease.

If hypothyroidism is suspected, the first step is to perform a third-generation thyroid-stimulating hormone (TSH) test, as it is sensitive in screening for primary hypothyroidism: if its value is higher than normal, it is necessary to check the value of free thyroxine T4 or free thyroxine index (FTG). In order to avoid false test results, it is recommended to stop consuming biotin 2 days before taking thyroid tests, as it affects the immunological parameters of hormones, which causes elevated test values.

In hypothyroidism, the test results may be characterized by an elevated TSH value (4.5-10.0 mIU/L) with a decreased T4 or FSH or, in the case of subclinical hypothyroidism, a normal T4 or FSH. Blood test results in patients may include anemia, dilutional hyponatremia, hyperlipidemia, elevated creatinine (reversible), creatine kinase, and transaminase levels.

Treatment of hypothyroidism means the cessation of clinical progression and removal of metabolic disorders, resulting in the achievement of normal values of thyroid-stimulating hormone (TSH) and free thyroxine (T4). At the same time, thyroid hormone is injected into the body to supplement endogenous production or to replace it. The disease is also treated with a daily dose of levothyroxine (LT4), but this method is not effective in all cases.

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