

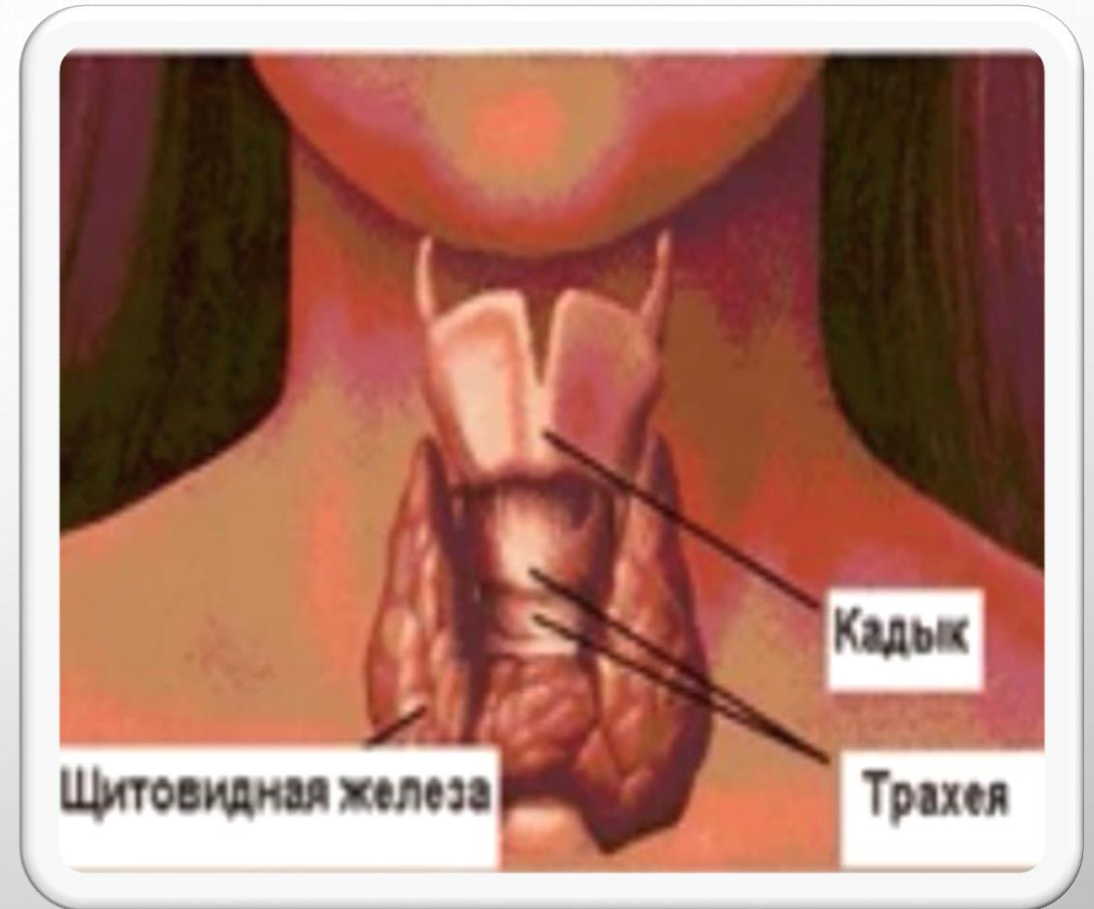


LABORATORY DIAGNOSTICS OF THE THYROID GLAND



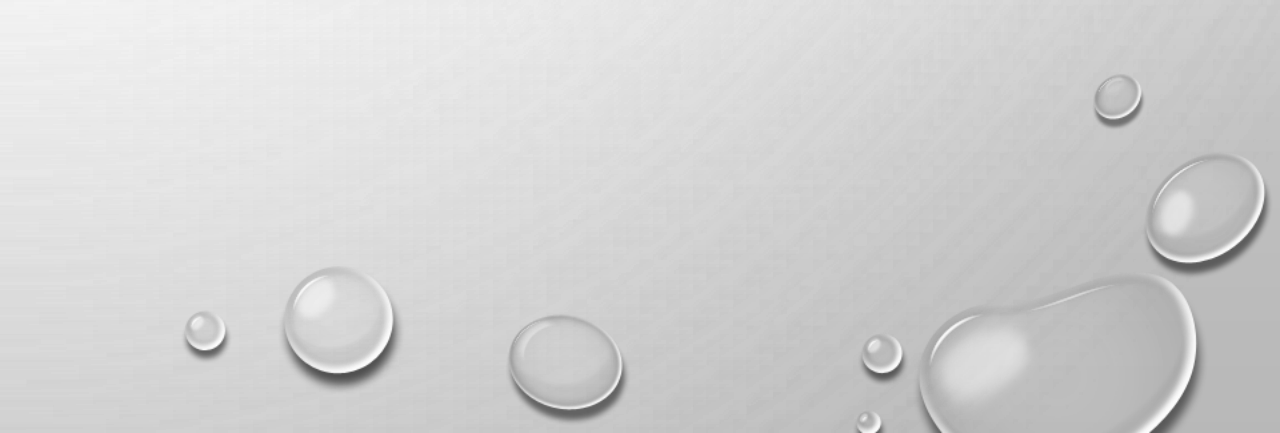
Structure of the thyroid gland

The thyroid gland has been a very important gland among the endocrine glands, performing various regulatory functions. The gland is butterfly-shaped and is located in the neck area, in front of the trachea, and in the lower part of the larynx. It consists of two lobes and has a weight of 12 - 25 g in adult individuals.





THE NORMAL AMOUNT OF THYROID HORMONES IN THE BLOOD DEPENDS ON:

- FROM THE NORMAL FUNCTION OF THE THYROID GLAND;
 - FROM THE FACT THAT FOOD CONTAINS ENOUGH IODINE FOR THE FORMATION OF THYROID HORMONES;
 - FROM THE NORMAL FUNCTION OF THE PITUITARY GLAND AND THE ADEQUATE AMOUNT OF THYROTROPIC HORMONE;
 - FROM THE NORMAL FUNCTION OF THE HYPOTHALAMUS AND THE NORMAL AMOUNT OF TYROLIBERIN.
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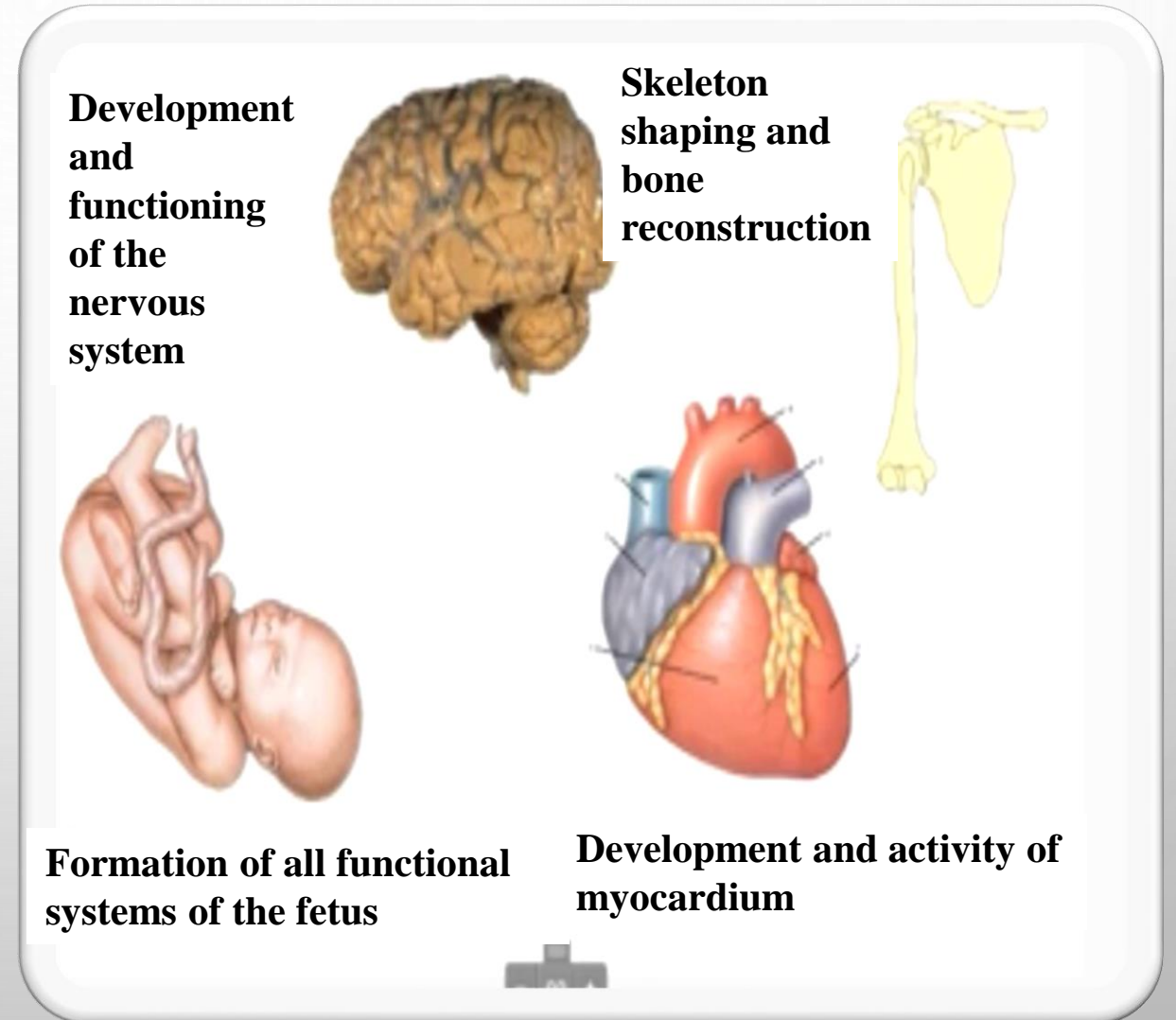
THE MAIN FUNCTIONS OF THYROID HORMONES :

Participates in the development of the nervous system and the performance of its functions;

Participates in the formation of the skeleton and bone remodeling;

Participates in the formation of the entire functional system of the fetus;

Participates in the development of the myocardium and the performance of its functions.



The most common diseases of the thyroid gland

- Diseases of the thyroid gland in terms of prevalence occupy the second place among endocrine diseases after diabetes mellitus;

- Womens get sick more often;

- According to statistics, 20% of women develop thyroid problems in the postpartum period.



Diagnosis of diseases of the thyroid gland

Refers to diseases of the gland:

- Hyperfunction of the gland
- Hypofunction of the gland;
- Enlargement of the gland;
- Malignant tumor of the gland;
- Autoimmune damage to the gland.



Organ, tissue and system	Hypothyroidism	Hyperthyroidism
1	2	3
In the entire organism level	Decreased protein synthesis affects growth (stunting)Reduction of metabolic processes, basic exchange and body temperatureHypercholesterolemiaDry, thick skin	Acceleration of protein catabolism and negative nitrogen balanceAn increase in basic exchange and body temperatureHypocholesterolemiaExophthalmos, moist skin
CNS	Mental retardation in children (cretinism)Drowsiness, lethargy, sluggishness, apathySensitivity to coldAn increase in the duration of reflexes	Acceleration of mental processesInsomnia, wakefulness, anxiety, agitationSensitivity to heatShortening of reflexes
Cardiovascular system	A decrease in the minute volume of blood, heart failure, bradycardia, arterial hypotension	Increased minute volume of blood, tachycardia.An increase in systolic blood pressure as a result of an increase in the work of the heart - secondary arterial hypertension

Digestive system	Decreased food intake Constipation Decreased absorption of glucose	Increased food intake Diarrhea Increased absorption of glucose
Skeletal muscle	Weakness, hypotonia	Weakness, tremor, decrease in muscle mass due to increased protein catabolism
Immune system	Development of immunodeficiency conditions, weakening of resistance to infectious diseases	Development of immunodeficiency conditions, weakening of resistance to infectious diseases (due to acceleration of protein catabolism)
Adipose tissue	Obesity due to reduced energy loss	Fat tissue volume reduction, weight loss
β -adrenoreceptors	A decrease in their number on the surface of cells Decreased sensitivity to adrenaline	An increase in their number on the surface of cells Increased sensitivity to adrenaline
Enzymes	Decrease of activeness of the mitochondrial oxidative enzymes, Na^+ , K^+ - adenosinetriphosphatase, nicotinamide-adenine dinucleotide phosphate malate dehydrogenase, α -glucose phosphate dehydrogenase, etc.	Decrease of activeness of the mitochondrial oxidative enzymes, Na^+ , K^+ - adenosinetriphosphatase, nicotinamide-adenine dinucleotide phosphate malate dehydrogenase, α -glucose phosphate dehydrogenase, etc.

Laboratory diagnosis of thyroid gland diseases

The determination of thyroid function usually includes the following 4 tests:

- *Total thyroxine (T4)* – determination of serum thyroxine concentration. This includes protein-bound inactive thyroxine and free active thyroxine;
- *Free thyroxine (FT4)* – determination of free (biologically active) thyroxine concentration in serum;
- *Total triiodothyronine (T3)* – determination of total triiodothyronine concentration in serum. It consists of protein-bound (inactive) and free (active) triiodothyronine;
- *Thyroid-stimulating hormone (TSH)* – determination of serum concentration of TSH, a pituitary hormone.

Diagnosics of diseases of the thyroid gland

Laboratory studies



Ultrasound of the thyroid gland

Thyroid biopsy



Laboratory studies

Through these studies, one can determine the level of hormone synthesis and the activity of the endocrine glands.



AGE	TTH (MKME/ML)	T4 GENERAL (NMOL/L)	T4 FREE. (PMOL/L)	T3 GENERAL (NMOL/L)
Newborns	11,6 – 35,9	105 - 290	21 – 49	0,84 – 3,63
Children:				
2 days	8,3 – 19,8	83 – 303	21 – 38	1,95 – 3,63
3 days	1,0 – 10,9	110 – 285	19 – 37	0,81 – 3,39
1 weeks	1,2 – 5,8	93 – 247	18 – 35	0,65 – 1,90
2 weeks		88 – 225	18 – 35	0,59 – 1,84
3 weeks		94 – 259	17 – 33	0,77 – 2,15
1 month		112 – 243	16 – 33	1,10 – 3,10
6 months	0,7 – 6,4	103 – 210	15 – 29	1,43 – 3,17
1 year old	0,7 – 6,4	92 – 189	14 – 23	1,75 – 3,50
5 years old	0,7 – 6,4	89 – 173	13 – 23	1,80 – 3,10
10 years old	0,7 – 6,4	71 – 145	12 – 22	1,70 – 3,10
15 years old	0,7 – 6,4	64 - 149	12 - 23	1,50 – 2,80
Adults:				
Younger than 60	0,3 – 4,0	50 – 150	10 – 25	1,0 - 3,0
Older than 60	0,5 – 7,8	65 - 135	10 - 18	0,62 – 2,79
Pregnant women:				
1 three-month	0,3 – 4,5			
2 three-month	0,5 – 4,6			
3 three-month	0,8 – 5,2	79 - 227		

THYROTROPY HORMONE (TTH or TSH)

TSH is considered as the main criterion in the laboratory assessment of thyroid gland function. If there is a suspicion of a change in the hormonal activity of the gland, the diagnosis should be started with the determination of TSH. TSH is a glycoprotein that is synthesized in the anterior part of the pituitary gland and stimulates the synthesis of thyroglobulin, the formation and secretion of thyroid hormones. TSH secretion is very sensitive to changes in serum T3 and T4 concentrations. A 15-20% decrease or increase in this concentration causes reciprocal changes in TSH secretion (the principle of feedback).

The presence of dependence on the formation and secretion of TSH from the effect of drugs, the daily rhythm of changes in the TSH level, the state of stress and the presence of somatic diseases in the patient should be taken into account when examining the results of the examination.

Clinical significance of TTH determination:



- acromegalia;
- Cushing's syndrome;
- chronic renal failure;
- cirrhosis of the liver;
- from the effects of certain medicinal substances;
- during secondary amenorrhea.

•TTH decreases in these processes.

Clinical significance of TTH determination:



**during primary and secondary;
hypothyroidism**

- **in the swelling of the pituitary;**
- **resistance to thyroid hormones;**
- **In Hashimoto's disease;**
- **In postpartum hypothyroidism.**

TTH increases in these processes.

Determination of TTH during pregnancy



in the first trimester of pregnancy, TTH is less than normal;

-in the second and third trimester of pregnancy, TTH gradually returns to normal, while free T4 sometimes decreases.

The total determination of T3 and T4 does not matter, that is, it is non-informative.



Significant changes in the thyroid gland during pregnancy

In the first trimester of pregnancy (between 8 and 14 weeks), thyrotropic activity of the pituitary gland decreases, as the level of CG increases, which leads to the fact that the daTTH is less than normal (usually not less than 0.1 mME/l). Usually this is noted as the norm (in 18% of women). In the second and third trimester, the amount of TTH reaches the norm.

A decrease in TTH in the first trimester leads to a slight increase in free T4, which is called transitory thyrotoxicosis and is accompanied by nausea, vomiting. Estrogens activate the synthesis of thyroxine-binding globulin (TBG) in the liver, while reducing its excretion. As a result, the concentration of total T4 and T3 increases. Pregnancy can cause postpartum thyroiditis to develop. Pregnancy is a powerful factor that increases thyroid function.

In order for the fetus to develop normally (especially at the initial stage of embryogenesis), the thyroid gland the amount of their hormones should be at a normal level. Too much or too little secretion of these hormones can lead to impaired fetal development.

-It should be remembered that in the first half of pregnancy, in 20% of women in the norm, TTH decreases.

-Total T4 and T3 are slightly more than the norm (the determination of these indicators is not informative).

-Of great importance is the determination of the amount of free T4 during thyrotoxicosis and hypothyroidism. In this case, urgently, the dose of the drug should be changed.

Thyroxine (T4)

general

(combined with transporter proteins)

free

(it is 0.03% of the total)

- it is 0.03% of the total;
- the maximum concentration is around 8-12 O'clock in the morning;
- minimum concentration from 23 to 3 o'clock;
- examination should be carried out in the morning, on an empty stomach;
- in older individuals, free T4 is usually reduced;
- diagnostics of the functional state (hypo –or Hyper) of the thyroid gland should be carried out;
- during the treatment period, the patient's condition should be under control (thyrostatic therapy).

Thyroxine (T4)

T4 is an important analytical parameter;

Total T4- 99,97%

Hormone that connects the thyroid-75%

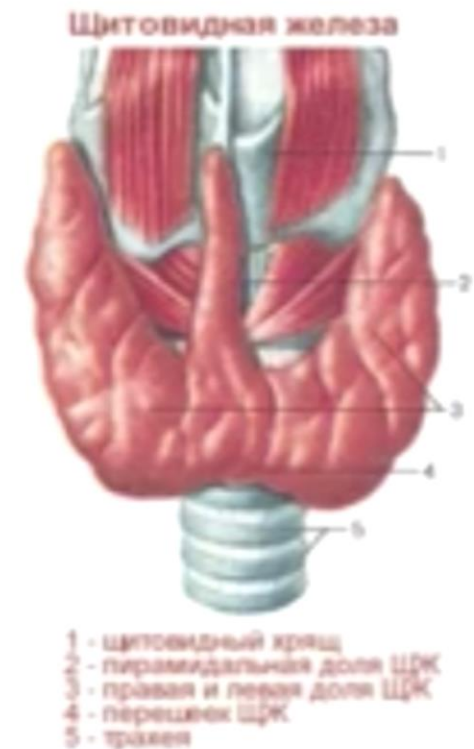
Indications for the appointment of T4:

-to determine the hyper - or hypofunction of the gland;

-to control treatment.

The fact that the concentration of total T4 exceeds the reference limits is considered a pathology of the connecting protein, and not thyroid dysfunction.

When the indicator of free T4 is unsatisfactory, it is necessary to determine the total T4.



Free T4

By means of the free hormone T4 - it is possible to accurately determine the actual thyroid status Free T4-0.02-0.05%.

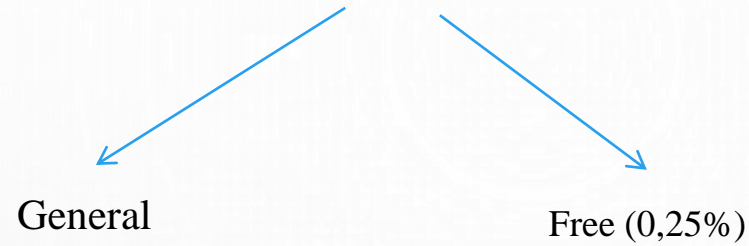
At the initial stage of hypothyroidism, the amount of free T4 decreases more quickly than total T4.

A decrease in free T4 is observed:

- in primary hypothyroidism;
- in autoimmune thyroiditis;
- when the thyroid gland is expelled;
- when taking preparations containing iodine;
- during thyrostatic therapy;
- in secondary hypothyroidism;
- in the genetic forms of dishormonogenesis.

(T3) TRIODTHYRONINE

It is formed from T4 in peripheral tissues (liver and kidneys)



Thyroid is the main metabolically active form of hormones:

- Laboratory tests should be carried out in the morning on an empty stomach;
- It is very important for differentiating thyroid diseases;
- The increase in the amount of free T3 is very characteristic of the initial stage of diffuse toxic goiter and nodular goiter;
- Its concentration is lower in women than in men;
- Despite the fact that T4 is normal in elderly people and those with severe somatic diseases, the amount of T3 is reduced;
- As a compensator in iodine deficiency, the amount of total T3 is increased.

Triiodothyronine (T3)

- T3 accounts for 5% of the thyroid hormones circulating in the blood;
- 97.7% of this hormone is combined with proteins, and 0.1-0.3% is free
- The affinity of the hormone T3 is 10 times lower than that of T4;
- 15-20% of the circulating T3 hormone in the blood enters the thyroid

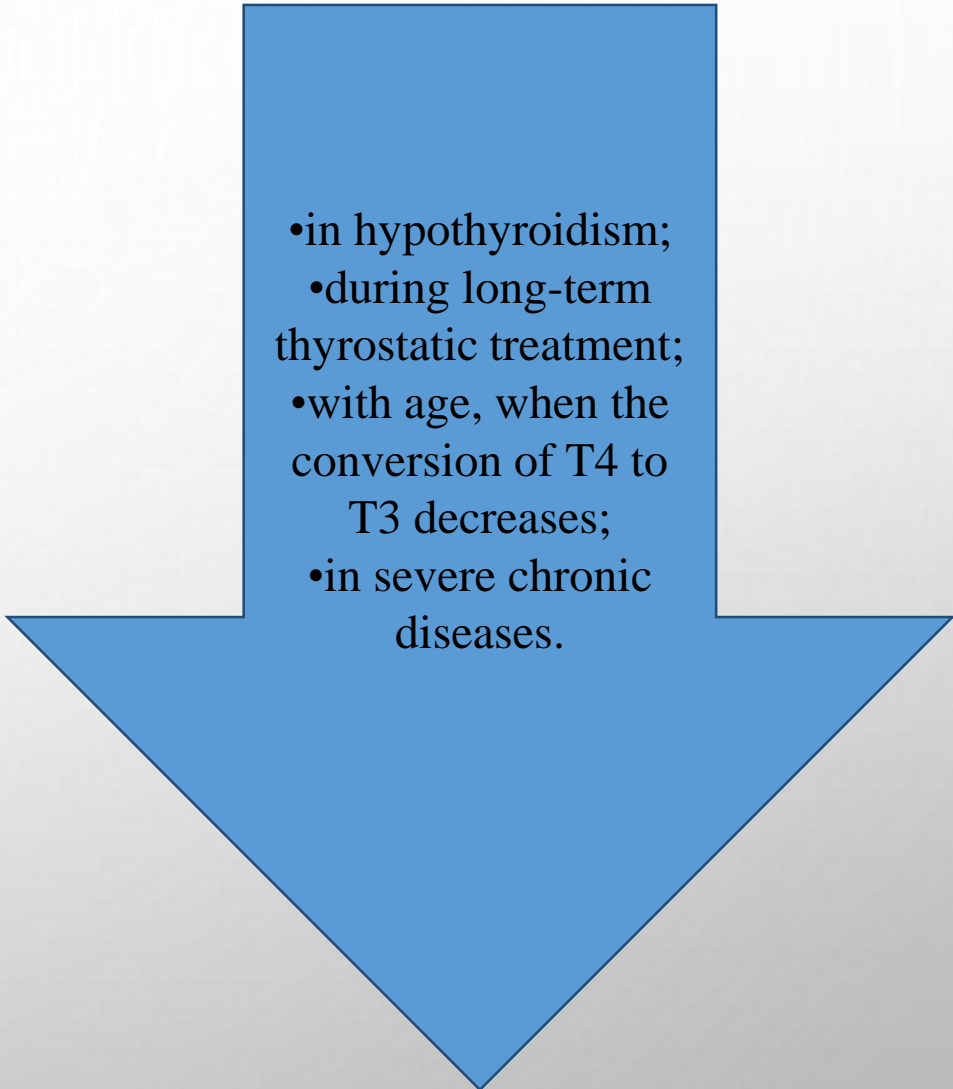
gland;

the rest is formed as a result of the deiodination of T4.

Indications necessary for the determination of T3:

- When hyperthyroidism is suspected;
- When the amount of connective protein changes;
- When one-to-one knots are formed.

A decrease in T3 is observed:

- 
- in hypothyroidism;
 - during long-term thyrostatic treatment;
 - with age, when the conversion of T4 to T3 decreases;
 - in severe chronic diseases.

THYROXINE-BINDING GLOBULIN

It is a glycoprotein with a molecular weight of 54 kDa;

Synthesized in the liver;

- It is the main protein that binds thyroid hormones;

The main functions of this protein:

- When the amount of hormones changes, it regulates their free fractions;

- Reduces the excretion of thyroid hormones from the body (through the liver, kidneys);

- Regulates the delivery of hormones to the periphery;

It is quite important to calculate the T4/ TBG coefficient in plasma. This is because through it the differential diagnosis between hypo - and hyperthyroidism is carried out. In hypothyroidism, the coefficient decreases by 3 times, and in hyperthyroidism it increases by 2 times.

THYROXINE-BINDING GLOBULIN (TBG)

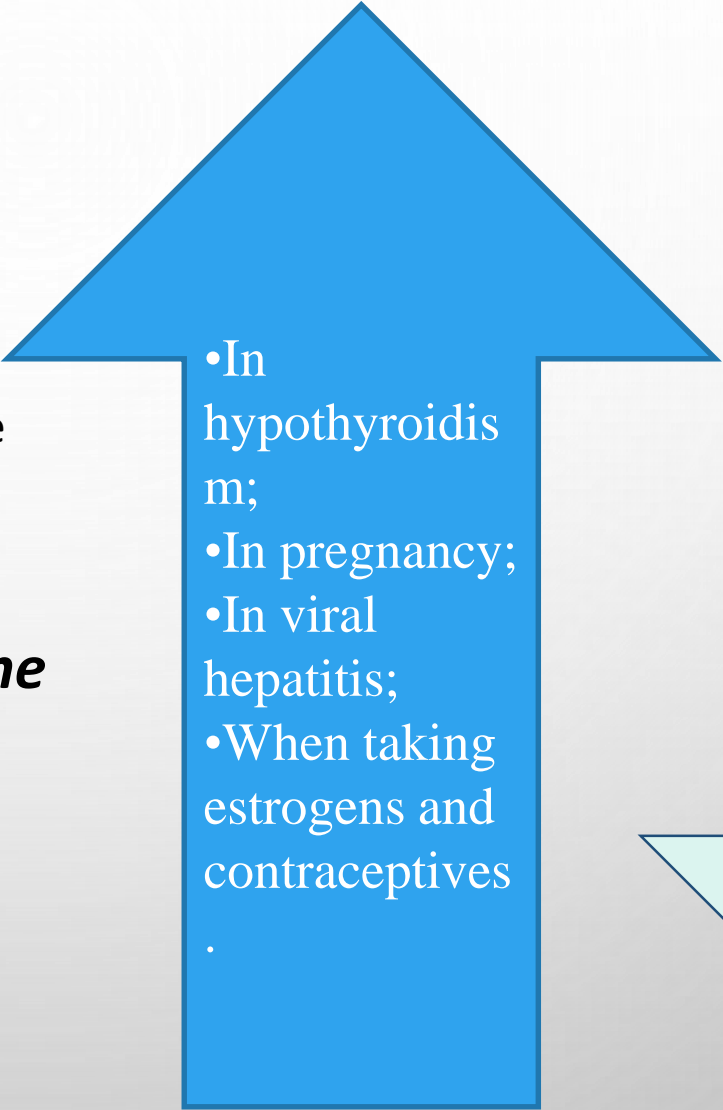
This protein is synthesized in the liver;

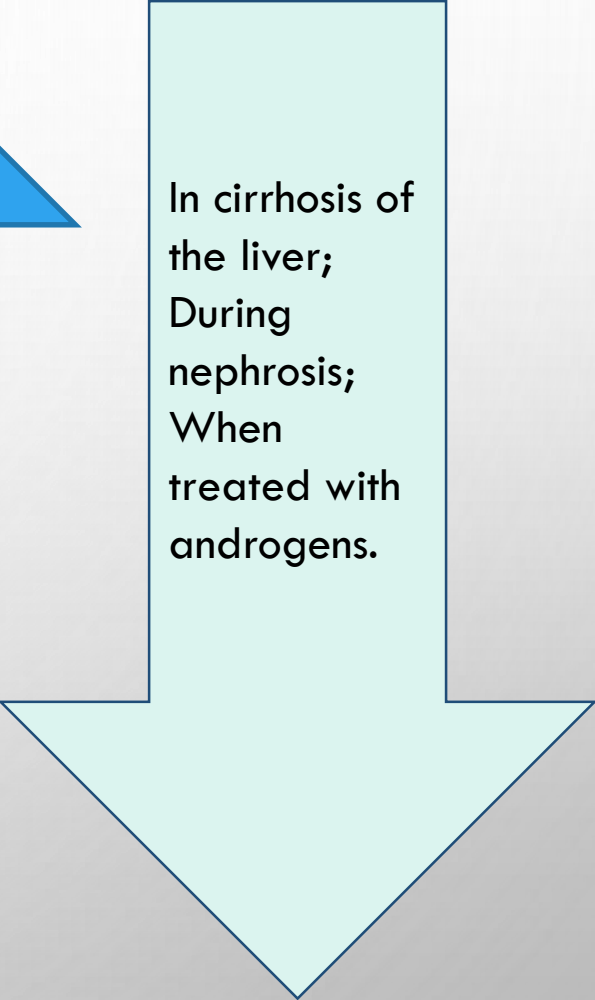
-- Combines 75% of T3 and T4 hormones;

Indications necessary for the determination of this protein:

- Detecting hereditary anomalies of protein synthesis;
- Conducting differential diagnosis in patients with endocrine pathology.

An increase in the protein that binds thyroxine is observed:

- 
- In hypothyroidism;
 - In pregnancy;
 - In viral hepatitis;
 - When taking estrogens and contraceptives.



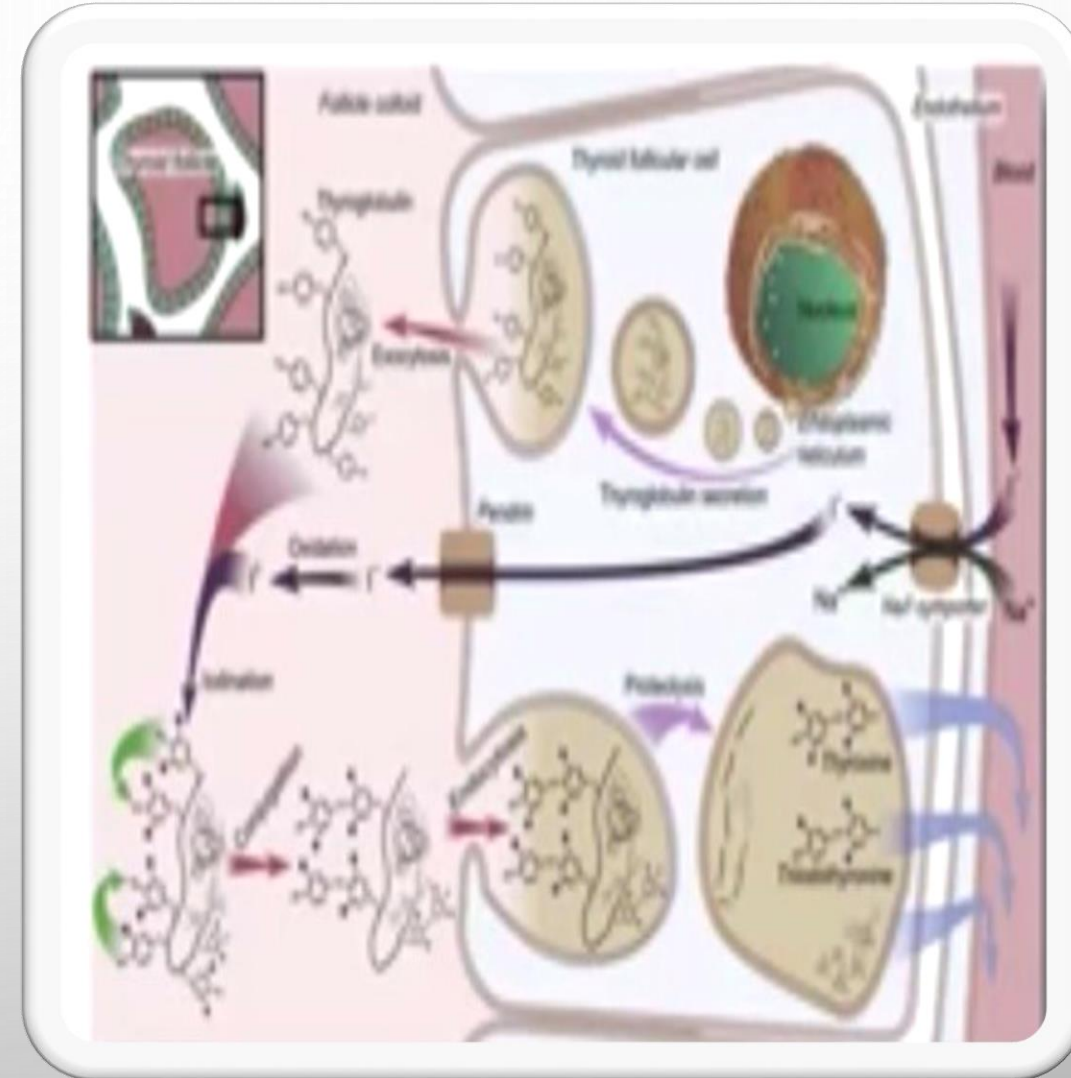
In cirrhosis of the liver;
During nephrosis;
When treated with androgens.

Thyroglobulin (TG)

TG-is synthesized in follicular cells of the thyroid gland under the influence of thyrotropic hormone.

This hormone is considered a precursor of thyroxine and other iodthyronines.

An increase in thyroglobulin indicates a violation of the completeness of the hematofollicular barrier. It is observed mainly in pathologies accompanied by a violation of the structure of the gland and iodine deficiency.



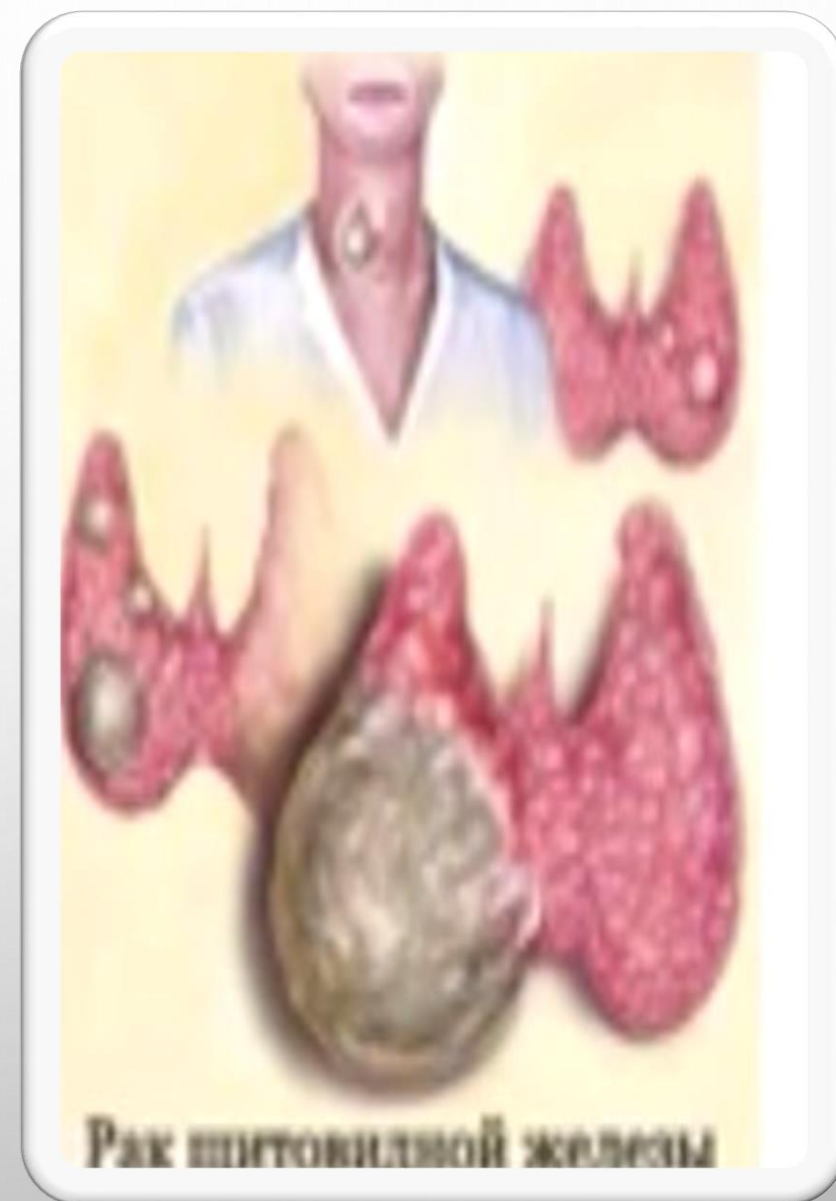
INDICATIONS FOR THE APPOINTMENT OF THYROGLOBULIN (TG):

- Carcinoma of the thyroid gland (medullary cancer is exceptional);
- detection of relapse or metastasis in operated patients ;
- evaluation of the effectiveness of radiodtherapy;
- metastasis of lung and bone cancer of unknown origin.

To differentiate drug hyperthyroidism from true endogenous hyperthyroidism, it is necessary to prescribe thyroglobulin.

It makes no sense to prescribe thyroglobulin to differentiate benign and malignant tumors of the thyroid gland.

TG	Immulite 1000/2000
Sample volume	50 mkl
Analytical sensitivity	0.2 nq/ml
Working range	0.2-300 nq/ml



APPOINTMENT OF THYROGLOBULIN AFTER RADICAL TREATMENT

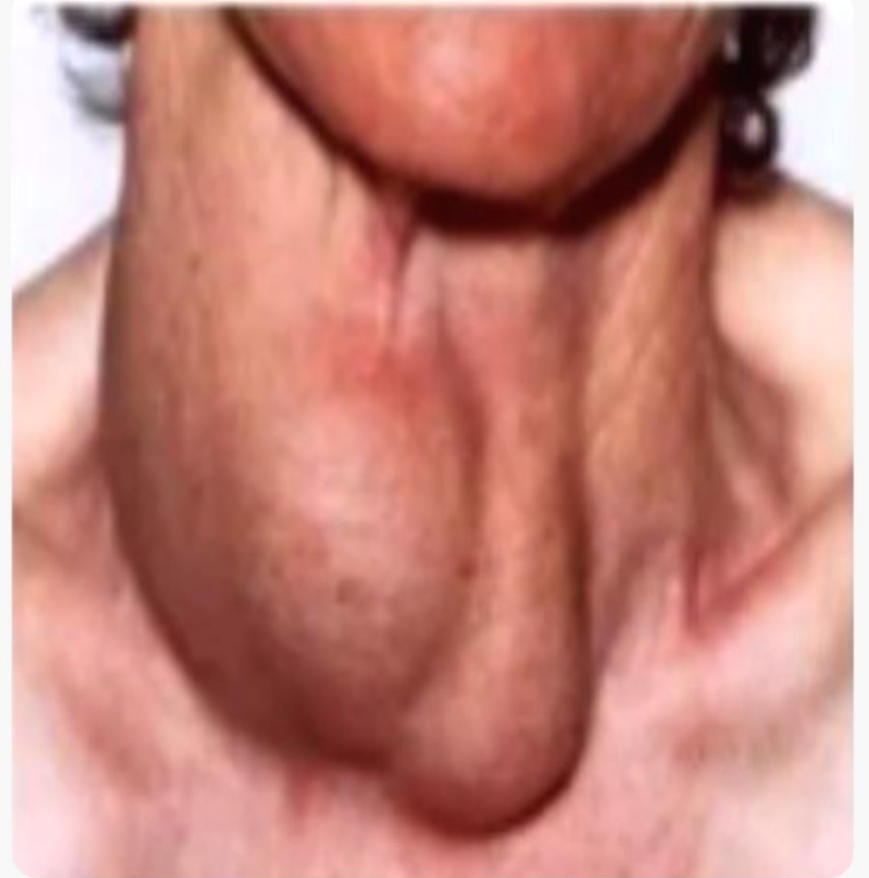
It is necessary to prescribe TG in 2-3 weeks after suppressive therapy with thyroid hormones.

A decrease in TG confirms the absence of metastases.

And the increase in TG indicates the spread of the process.

Calcitonin

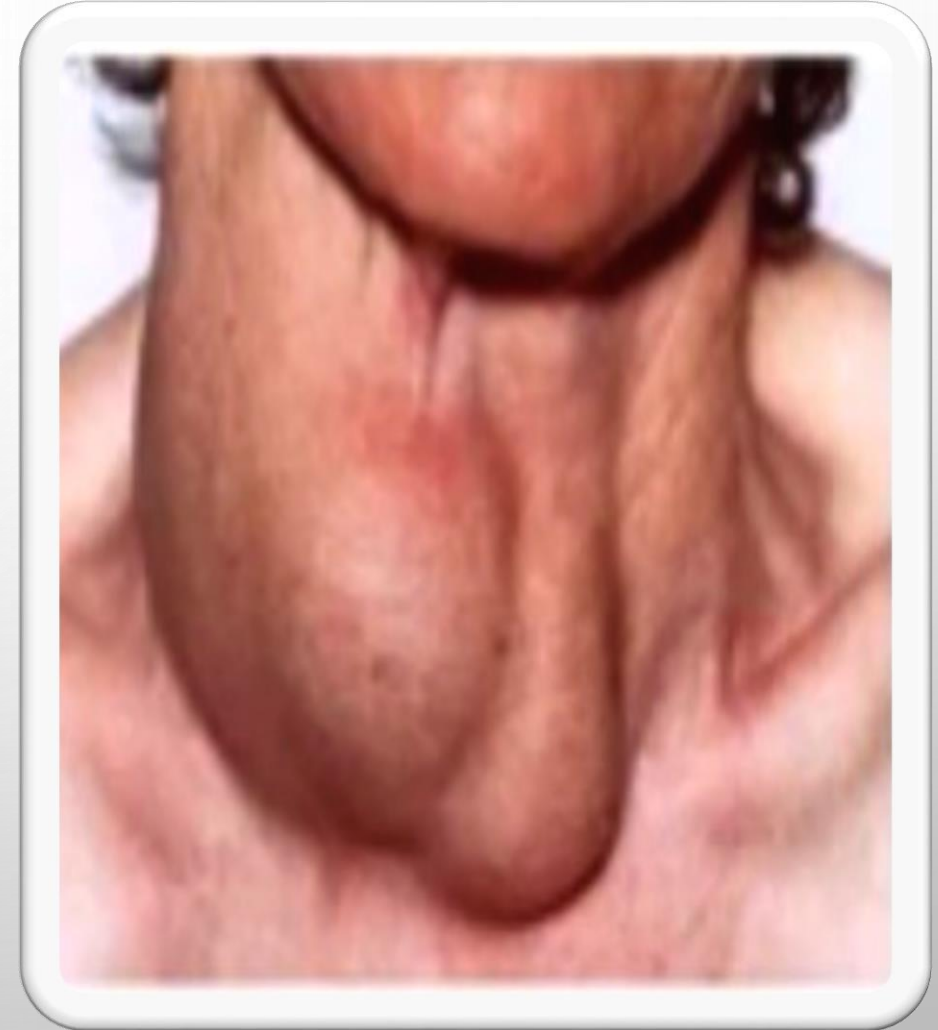
- Marker of medullary carcinoma of the thyroid gland;
- An increase in the amount of calcitonin after removing the tumor indicates that the operative intervention is non-radical or metastasis develops;
- Rapid increase in calcitonin after operative intervention indicates relapse of the disease;
- It is also necessary to prescribe calcitonin in family members of a patient with carcinoma of the thyroid gland.



Calcitonin

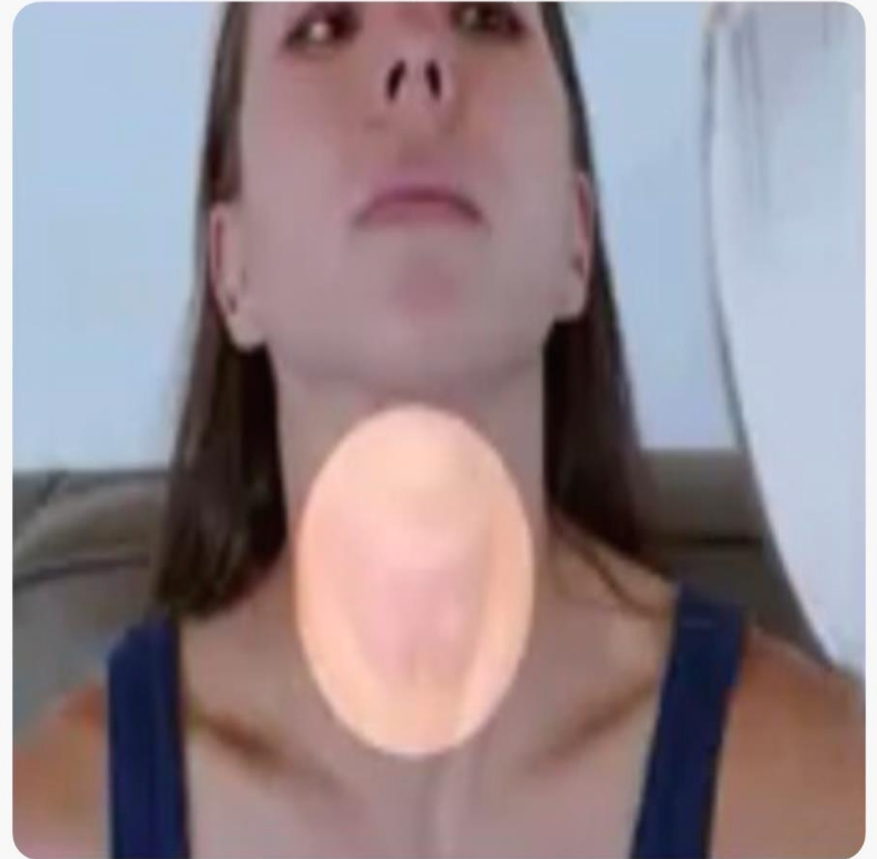
An increase in calcitonin is observed:

- in chronic renal failure;
- in uremia;
- in pseudohyperparathyroidism;
- in carcinoid syndrome;
- in alcoholic cirrhosis;
- in pancreatitis;
- in leukemia and myeloproliferative diseases;
- in chronic inflammatory diseases;
- in thyroiditis.



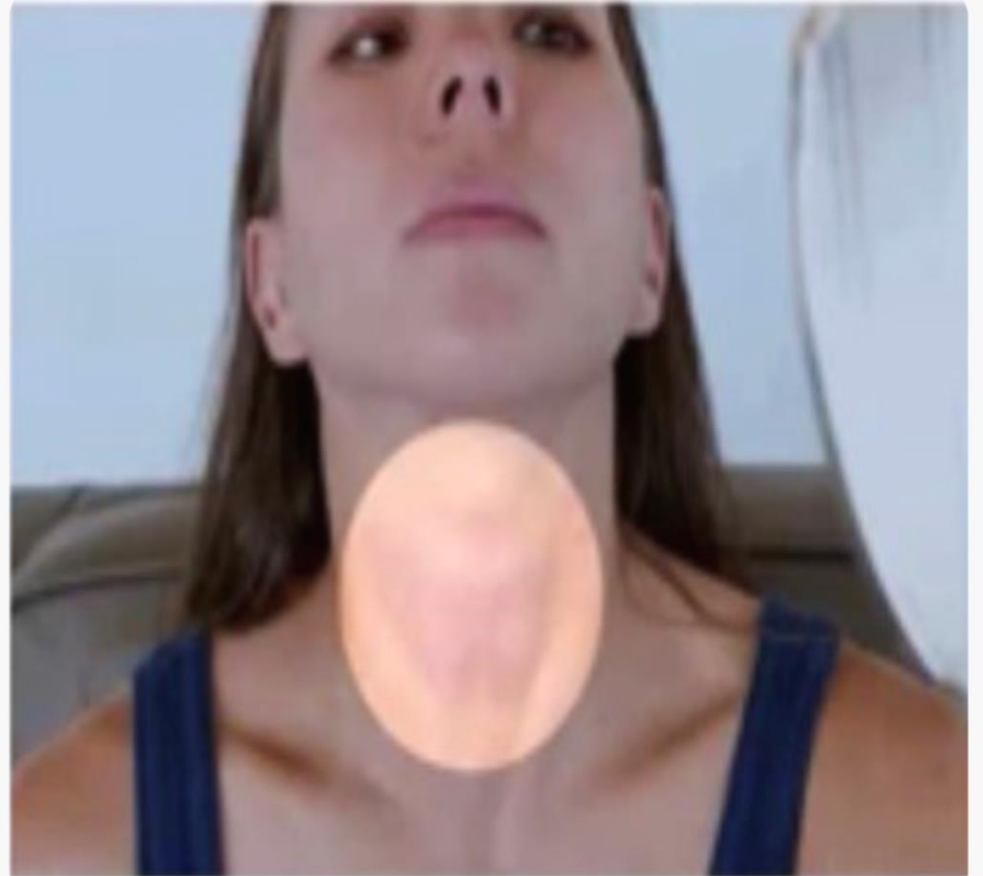
MARKERS OF AUTOIMMUNE DISEASES

- autoantibodies against thyroglobulin;
- autoantibodies against thyroperoxidase;
- autoantibodies against the receptor of thyrotropic hormone.



MARKERS OF AUTOIMMUNE DISEASES

Autoimmune diseases are the reaction of the body's immune system to its organs and tissues. In case of autoimmune diseases of the thyroid gland, follicular cells are damaged, and autoantibodies (lymphocytes) form inflammation of the gland.



AUTOANTIBODIES AGAINST THYROGLOBULIN

The thyroid gland is damaged ———> thyroglobulin enters the bloodstream ———> the immune response is activated ———> specific antibodies are synthesized.

Diagnostic significance:

- chronic Khashimato thyroiditis;
- high titer of antithyroglobulin in the mother of a newborn.

Instruction to its appointment:

- after radical treatment of cancer patients

Anti-TG	Immulate 1000/2000	Centaur CP/XP
Sample volume	5mkl	40mkl
Working range	20- 3000 ME/ml	10- 500 ME/ml
Analytical sensitivity	2,2 ME/ml	10 ME/ml

AUTOANTIBODIES AGAINST THYROPEROXIDASE

Clinical diagnostic significance:

- Antithyropoxidase is considered a marker of diseases with a genetic predisposition.
- During Khashimoto, sensitivity increases by 90-100%, and in Graves disease-by 85%.
- **Indications for the appointment of antithyropoxidase:**
- Autoimmune thyroiditis;
- Hyperthyroidism of newborns;
- Congenital hypothyroidism;
- Goiter with euthyroid;
- Failure to bring pregnancy to the end and failure of fertilization.



ANTIBODIES AGAINST RECEPTORS OF THYROTROPIC HORMONE

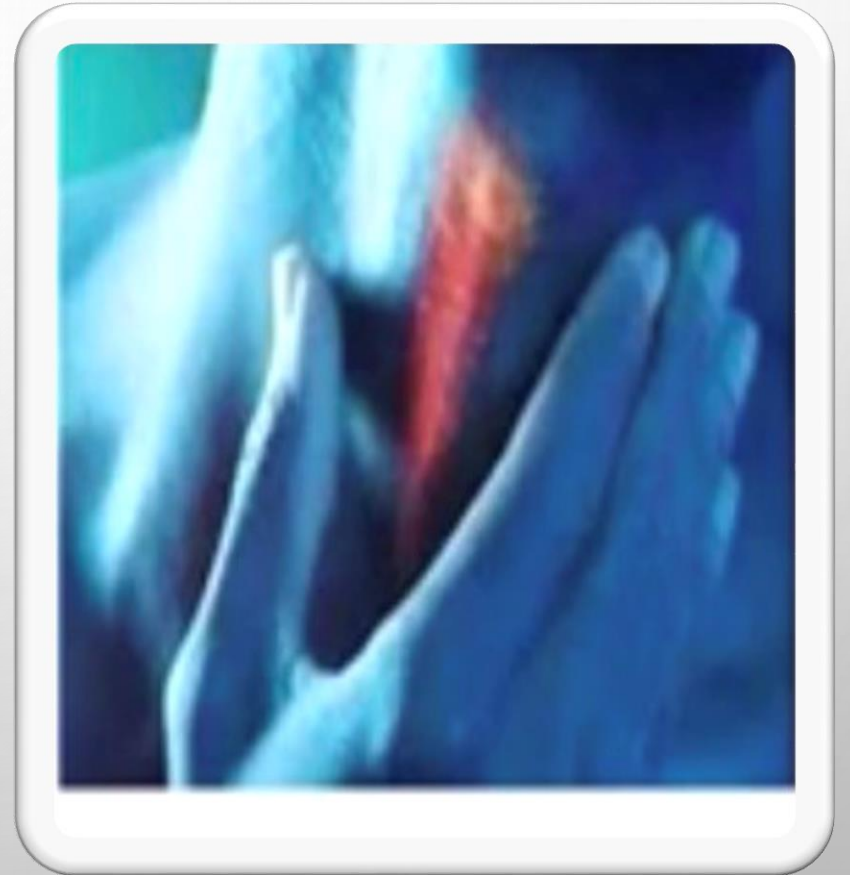
It is a marker of diffuse toxic goiter (Grave's disease).

Indications for the appointment of antibodies:

Relapses of hyperthyroidism during Graves disease;

In the differentiation of goiter with euthyroid from autoimmune thyroiditis;

- When there is a risk of pathology in the thyroid gland of the fetus or newborn.

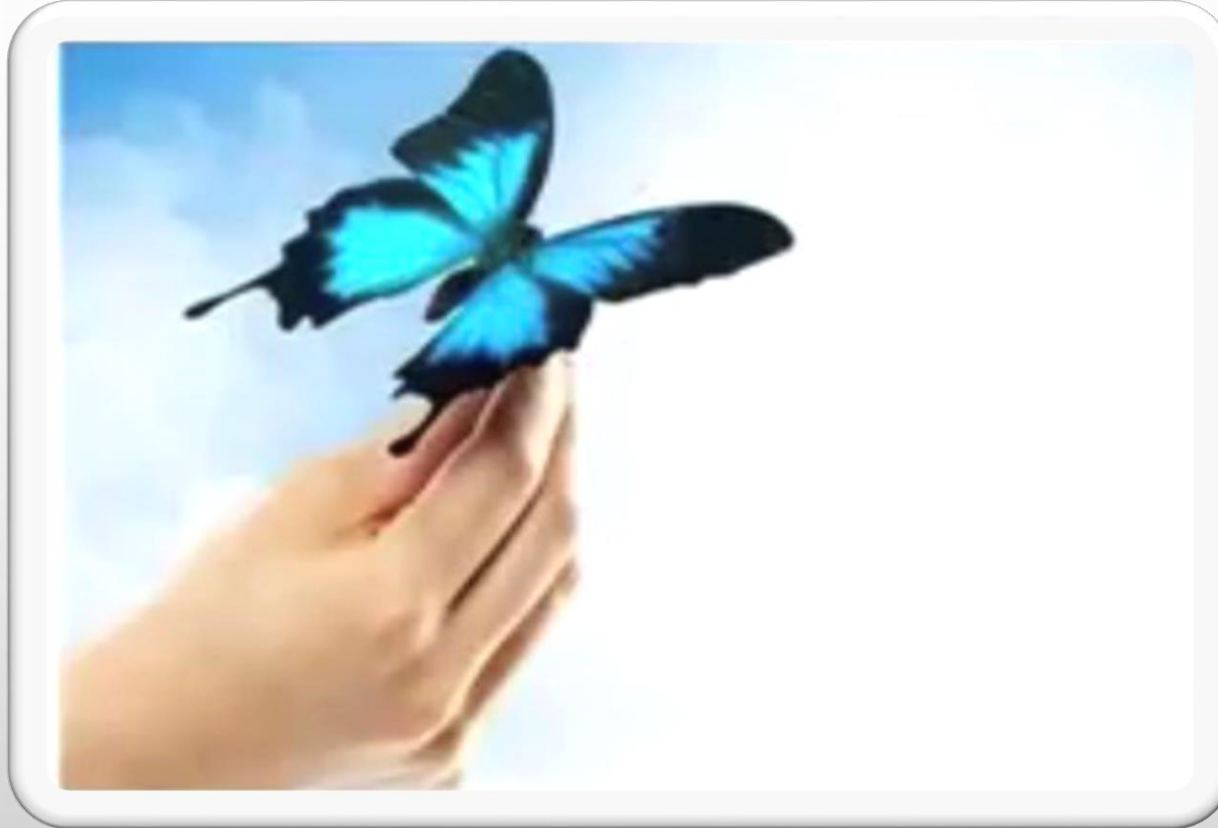


-Laboratory studies are the most effective method of diagnosing and preventing thyroid diseases.

-the tests carried out are very extensive, this also allows a more accurate study of the work of the thyroid gland and timely detection of diseases that may occur.



THANKS FOR YOUR ATTENTION.



Be healthy