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## RESULTS OF INSTRUMENTAL STUDIES OF THE THYROID GLAND CONDITION IN DISEASED DOGS WITH HYPOTHYROIDISM AT THE BACKGROUND OF OBESITY

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The article presents the results of ultrasonography studies of the thyroid gland in domestic dogs suffering from hypothyroidism, and also differentiation depending on the degree of fleshing has been made. The research was conducted during 2018–2020 on the basis of veterinary clinics in Poltava and Kharkiv. During this time, 11 domestic dogs were examined, in which hypothyroidism was diagnosed during complex examination. These animals belonged to different breeds, had different sex and age. Depending on the degree of fleshing, the animals were divided into two experimental groups. The first group of animals had normal fleshing; the second one had a clinical symptom of obesity. After analyzing the obtained results, we registered more significant changes in the structure of the thyroid gland in dogs suffering from hypothyroidism in the first experimental group as compared with dogs with hypothyroidism at the background of obesity symptoms (the second experimental group). This was a 100 % increase in the gland echogenicity, a decrease in its size, uneven contours, as well as thickening of the organ capsule in 75 % of animals. A characteristic structural feature during ultrasonography of the thyroid gland in dogs with hypothyroidism at the background of obesity symptoms, was the presence of excessive amount of subcutaneous tissue in the study area, which significantly complicated the interpretation of the results. In these dogs only inhomogeneity of structure with the centers of the increased acoustic density was registered. More than half of the diseased dogs in the second group had decreased size of the gland; in the rest animals, the size of the organ did not change. It should be noted that a significant number of animals had an increase in the gland echogenicity, and the thickening of its capsule was found in less than half of the dogs in this group. The heterogeneity of the pancreas structure was common to all dogs suffering from hypothyroidism, regardless of the presence or absence of obesity. Increased echogenicity, decreased size of the thyroid gland, uneven contours and thickening of the capsule were more often visualized at hypothyroidism of dogs with normal fleshing. The latter may be due to the presence of excessive amount of subcutaneous tissue in the examination area of obese dogs.

**Key words:** hypothyroidism, obesity, ultrasonography, dogs.

РЕЗУЛЬТАТИ ІНСТРУМЕНТАЛЬНИХ ДОСЛІДЖЕНЬ СТАНУ ЩИТОПОДІБНОЇ ЗАЛОЗИ В СОБАК ЗА НАЯВНОСТІ ГІПОТИРЕОЗУ НА ТЛІ ОЖИРІННЯ

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У статті наведені результати ультрасонографічних досліджень щитоподібної залози у свійських собак, хворих на гіпотиреоз, проведено диференціацію залежно від ступеню вгодованості. Дослідження проводили впродовж 2018–2020 років на базі клінік ветеринарної медицини м. Полтави та м. Харкова. За цей час було досліджено 11 свійських собак, у яких під час комплексного обстеження встановлений діагноз гіпотиреоз. Ці тварини належали до різних порід, мали різну статеву та вікову приналежність. Залежно від ступеню вгодованості тварин розподілили на дві дослідні групи. Перша група тварин – з нормальною вгодованістю; друга – із клінічним симптомом ожиріння. Провівши аналіз отриманих результатів, ми зареєстрували більш значні зміни у структурі щитоподібної залози у хворих на гіпотиреоз собак першої дослідної групи порівняно із собаками за наявності гіпотиреозу на тлі симптому ожиріння (друга дослідна група). Це – стовідсоткове зростання ехогенності залози, зменшення її розміру, нерівність контурів, а також потовщення капсули органу у 75 % тварин. Характерною структурною особливістю під час ультрасонографії щитоподібної залози у собак, хворих на гіпотиреоз на тлі симптому ожиріння, була наявність надмірної кількості підшкірної клітковини в досліджуваній ділянці, що значно ускладнювало інтерпретацію результатів. Саме в цих собак відмічали лише неоднорідність структури із вогнищами підвищеної акустичної щільності. У понад половини хворих собак з другої групи відмічали зменшення розмірів залози; у решти – розмір органу не змінювався. Варто відмітити, що у значній кількості тварин спостерігали підвищення ехогенності залози, а потовщення її капсули встановили у менш, ніж половини собак цієї групи. Спільним для всіх собак, хворих на гіпотиреоз, незалежно від наявності або відсутності ожиріння встановлено неоднорідність структури підшлункової залози. Підвищення ехогенності, зменшення розміру щитоподібної залози, нерівність її контурів та потовщення капсули частіше візуалізувались за наявності гіпотиреозу в собак із нормальною вгодованістю.

**Ключові слова:** гіпотиреоз, ожиріння, ультрасонографія, собаки.

**Introduction**

It is believed that in most cases, the development of excessive body weight in animals causes a violation of the metabolism of the thyroid gland hormones [1]. The most significant effects on the concentration of the thyroid gland hormones in the blood serum are the activity of their metabolism and transportation [2]. There is a close link between the metabolism of proteins and thyroid gland hormones. This relationship is explained by the fact that the latter (T4 and T3) are almost completely bound to proteins [3]. Therefore, most disorders of protein conjugation, in the future, may affect the total concentration of thyroid gland hormones in the blood serum. These processes also cause a long half-life of T4 (10-16 hours) [4, 5]. The major proteins that interact with thyroid gland hormones are thyroxin-binding globulin, thyroxin-binding pre-albumin, albumin, and high-density lipoprotein (HDL) and HDL2. It should be noted that the half-life of T3 is much shorter than the previous one (up to 6 hours). For T3, the major transport proteins are albumin and thyroxin-binding globulin [1, 6]. Some researchers claim that the measurement of free hormones provides an accurate assessment of the thyroid gland status, as compared with the total concentration of hormones because only unbound (free) hormone can enter cells and be excreted [7, 8].

Measuring the total concentration of thyroid gland hormones in the blood serum is the most standard definition animal thyroid gland functioning [8]. Most often, the concentrations of T4 and T3 are established, in clinical practice their metabolites are determined quite rarely [9, 10].

When assessing the functional state of the thyroid gland in dogs, the concentration of total T4 is usually more reliable than the concentration of total T3. According to the literature in the blood serum of patients with hypothyroidism, the concentration of total T4 increases in almost everyone, although the concentration in the blood serum of total T3 is registered in a small number of dogs (15–50 %) and may be within physiological fluctuations for this species [8]. Probably, this can be explained by the peculiarities of T3 secretion by the thyroid gland, as there is a directly proportional connection with the increase in thyroid gland-stimulating hormone (TSH), which can often be registered for hypothyroidism [11, 12]. That is why it is expedient to

determine the concentration of T3 after determining the concentration of total T4 in the blood serum of animals, as the latter indicator has a higher sensitivity [13, 14].

Actually the thyroid gland secretes thyroxin 1 (1 tetrayodtyronin) and 1-triiodothyronine hormones [15]. Iodine that comes with food is actively involved in the synthesis of both hormones [16]. Iodine interacts with Tyrosine amino acid, resulting in the formation of compounds – mono- and diiodotyrosine (precursors of thyroid gland hormones). As part of a special protein - thyroglobulin in the follicles of the thyroid gland are deposited newly synthesized thyroxin and triiodothyronine. To release into the blood, hormones are cleaved from the protein by proteolytic enzymes. These processes are regulated by thyroid gland-stimulating hormone [17–19]. Because the body is a holistic system, the metabolism undergoes pathological changes due to a decrease in thyroxin levels. Similar changes occur in all types of metabolism, with the exception of lipid metabolism (increase in blood serum cholesterol, triglycerol, low and very low density lipoprotein fractions), which in turn leads to a clinical manifestation – increased fatness in sick animals as a basis for obesity symptoms [3, 7].

In addition to determining the functional state of the thyroid gland in dogs with hypothyroidism, it is important to study the structural changes of the body. Most often, ultrasonography examination is performed to assess the condition of the thyroid gland and surrounding tissues (lymph nodes, blood vessels) and determine the size of both parts of the gland [20]. But it should be remembered that sometimes, due to functional insufficiency, structural changes may not be identified [21]. The main indicators for instrumental research are neoplasms in this area, clinical signs of endocrine disorders, routine biopsy of thyroid gland tissue [2, 6, and 22]. Therefore, the use of instrumental research methods is relevant and helps in establishing the diagnosis.

In view of the above given information, *the aim* of the work was ultrasonography examination of the thyroid gland in overweight dogs with hypothyroid glandism.

The main *tasks were determined*: to conduct ultrasonography examination of the thyroid gland in dogs with hypothyroidism; ultrasonography examination of the thyroid gland in clinically healthy animals; compare the results.

### Materials and methods of research

We analyzed the reporting documentation and statistical processing of the obtained data of veterinary clinics in different cities of Ukraine, namely Poltava – veterinary clinics at the Department of Therapy named after Professor P. I. Lokes at Poltava State Agrarian Academy, VetTochka “PES+KIT”, “Vet Comfort”; Kharkiv – Veterinary Clinic “PES+KIT” for 2018–2020.

During the study, 11 domestic dogs were examined, in which a complex examination diagnosed hypothyroidism [23]. The animals belonged to different breeds, had different sexes (six females and five males) and age.

We took 15 domestic dogs for control without visible signs of any pathology.

With the diagnosis of hypothyroidism in dogs, we identified two groups: the first – with normal fleshing; the second – with a clinical symptom of obesity.

### Research results and their discussion

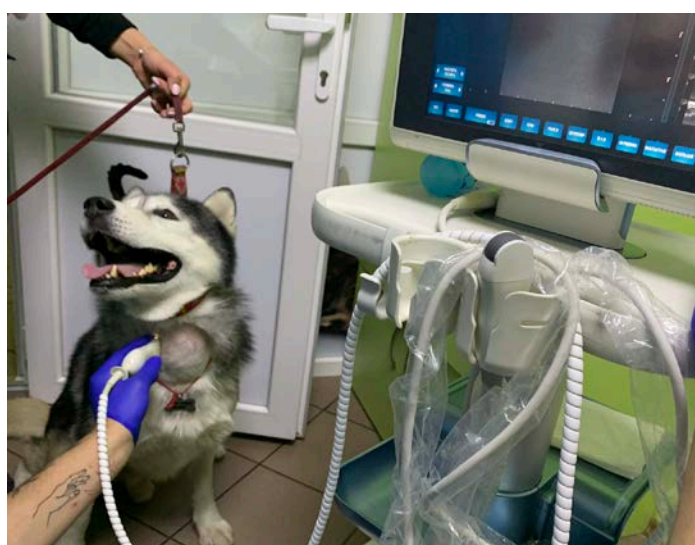
It is known that normally the thyroid gland of dogs has clear boundaries, homogeneous structure and characteristic structure [24, 25]. The study is performed in the area of the cranial third of the neck along the axis, slightly medially from the carotid artery and caudally from the larynx [26].

By analyzing the symptoms of the disease, we registered significant changes in the thyroid gland of dogs with hypothyroidism of the first experimental group (Table) in comparison with dogs with hypothyroidism at the background of obesity symptoms (second experimental group). This was a 100 % increase in the echogenicity of the gland, a decrease in its size, uneven contours, as well as thickening of the organ capsule in 75 % of animals. Normally, the thyroid gland in the transverse scan is visualized as a triangle, or has a rounded structure [21, 27].

A characteristic structural feature during ultrasound examination of the thyroid gland in dogs with hypothyroidism at the background of obesity symptoms, was the presence of excessive amount of subcutaneous tissue in the study area (Fig. 1), which significantly complicated the interpretation of the results [27]. In 100 % of dogs, only the heterogeneity of the structure with foci of high acoustic density was noted (Fig. 2).

*Ultrasonographic symptoms of the thyroid gland hypothyroidism in dogs*

Symptoms of the thyroid gland by ultrasound	Clinically healthy dogs, n=15		Hypothyroidism, the first group, n=4		Hypothyroidism, the second group, n=7	
	number	%	number	%	number	%
Increased echogenicity	0	0,0	4	100,0	5	71,4
Heterogeneity of structure	0	0,0	4	100,0	7	100,0
Homogeneity of structure	15	100,0	0	0,0	0	0,0
The size is not changed	15	100,0	0	0,0	3	42,9
Increase in size	0	0,0	0	0,0	0	0,0
The size is reduced	0	0,0	4	100,0	4	57,1
Uneven contours	0	0,0	4	100,0	7	0,0
Capsule thickening	0	0,0	3	75,0	3	42,9



*Fig. 1. Ultrasonography of the thyroid gland of a dog with hypothyroidism. Husky dog, age 9 years*



*Fig. 2. Ultrasonography picture of the dog's thyroid gland with hypothyroidism at the background of obesity (increased echogenicity, compaction of the structure). Husky dog, age 9 years*

Other symptoms were observed in a smaller number of animals as compared with the number of pathological changes in dogs of the first experimental group. In particular, in four of the seven diseased dogs (57.1 %) from the second group, a decrease in the size of the gland was registered; in the rest – the size of the body did not change. Meanwhile, in 71.4 % of animals there was an increase in the gland echogenicity, and thickening of its capsule was found in 42.9 % of dogs with hypothyroidism at the background of obesity.

Thus, during echosonography examination of dogs with hypothyroidism, it was found that, regardless of the presence or absence of obesity, a common symptom of structural disorders of the thyroid gland in 100 %



of animals was the heterogeneity of its structure. Increased echogenicity, decreased size of the thyroid gland, uneven contours and thickening of the capsule were more often visualized at hypothyroidism in dogs with normal fleshing. This may be due to the presence of excessive subcutaneous tissue in the study area in excessively obese dogs.

### Conclusions

It was found that 100 % of dogs with hypothyroidism at the background of obesity manifested heterogeneity of the thyroid gland. In 71.4 % of diseased animals there was an increase in the gland echogenicity, a decrease in its size (57.1 %) and thickening of the capsule (42.9 %).

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