



THE OCCURRENCE OF HYPOTHYROIDISM IN DOGS IN ELVERUM, NORWAY

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ABSTRACT

Hypothyroidism is the most common endocrinopathy in the dogs resulting from triiodothyronine (T_3) and thyroxine (T_4) deficiency. Deficiency of thyroid hormones is associated with metabolic and dermatological effects. Hypothyroidism can therefore significantly impact on the life quality of dogs. Several risk factors have been reported for hypothyroidism in dogs. The work focuses on the prevalence of hypothyroidism in predisposed breeds of dogs, and risk factors for the development of the disease. In a retrospective study, 24 patient records of 15 breeds of dogs diagnosed with hypothyroidism from Anicura Elverum Dyrehospital in Elverum, Norway, during 2021 were selected and categorized according to the breed. Dog's breeds with the highest prevalence of hypothyroidism were concluded to be: English Setter, English Cocker Spaniel, and the Gordon Setter. Out of 24 dogs, five patient records from the most prevalent breeds were selected, and compared according to age, gender, and whether they were neutered, and body condition scoring. Our results showed, that increased age, and overweight (body condition score of 6–9), are risk factors for dogs living with hypothyroidism.

Key words: dog breed; hypothyroidism; patient record

INTRODUCTION

Hypothyroidism is the most common endocrinopathy in the dog. It can be congenital and acquired, where acquired being the most common form of hypothyroidism in dogs [15]. Hypothyroidism is most prevalent in middle-aged dog, with medium-to large breed dogs being the most susceptible. Many breeds have been shown to be predisposed to hypothyroidism, which include: the English Setters, Rhodesian Ridgeback, Golden Retrievers, Doberman Pinchers, Dachshunds, Miniature Schnauzers, Cocker Spaniels, and the Irish Setters [9]. Hypothyroidism occurs when the thyroid gland fails to produce adequate amounts of the thyroid hormones thyroxine (T_4) and triiodothyronine (T_3) [14].

Hypothyroidism can occur due to destruction of the thyroid gland itself, decreased stimulation by thyroid-stimulating hormone (TSH) from the pituitary gland, or failure in any steps of the thyroid hormone synthesis. Hypothyroidism has been classified on the basis of the site of destruction. Primary hypothyroidism is caused by an abnormality of the thyroid gland, secondary due to decreased secretion of TSH, and tertiary due to deficiency of TRH [7]. Primary hypothyroidism is an acquired endocrine disease, and it is the most commonly seen form of hypothyroidism in dogs. In dogs, the most prevalent cause of primary hypothyroidism is autoimmune lymphocytic thyroiditis, and non-inflammatory idiopathic follicular atrophy [14]. Thy-

roglobulin (TgAA) is most common autoantibody found in serum of hypothyroid dogs with lymphocytic thyroiditis.

The destruction of the thyroid gland typically occurs over a long period of time and typically progress slowly. As a result of the disease's slow progression, owners might not recognize the clinical symptoms until the condition has progressed to a more serious stage. In an adult dog, the clinical signs of deficiency of thyroid hormones are related to a decreased cellular metabolism, and manifestations that appear on the skin. Symptoms of classic cases of adult-onset hypothyroidism include lethargy, and weakness, and dullness of mental attitude. Dermatologic findings may include nonpruritic bilateral symmetric alopecia, or recurrent skin infections after a reasonable course of antimicrobial therapy.

Hypothyroidism has been shown to be predisposed in many different breeds of dogs. Moreover, the development of hypothyroidism in canines has been linked to a number of different risk factors. These include, neutering, and obesity among others [9]. There is a higher incidence of the disease in dogs that are middle-aged or elderly and the average age at the time of the first diagnosis is approximately 7 years. On the other hand, a younger age at the time of the initial diagnosis has been documented in certain high-risk breeds and in dogs whose hypothyroidism tests positive for thyroglobulin autoantibodies (TbAA) [10, 12].

The risk of diagnosis of hypothyroidism varies widely across the breeds, and predisposing factors.

The aim of this study was to determine the risk factors for the development of hypothyroidism in predisposed breeds of dogs by a retrospective study of clinical records.

MATERIALS AND METHODS

In this retrospective study, 24 anonymized patient records of dogs diagnosed with hypothyroidism were collected from Anicura Elverum Dyrehospital and Veterinærhuset AS, Norway in 2021.

RESULTS

Errors

The results presented in this paper are based on studying case reports collected from a private veterinary clinic

in Norway. Due to the limited geographical area, the results obtained cannot represent an international prevalence of hypothyroidism in dogs. Also, since the database of the veterinary clinic used for this study does not allow for research further back than 2018, some cases may have been missed.

Prevalence of hypothyroidism in breeds of dogs

In total, 24 dogs have been reported with hypothyroidism. Based on the results of dog records, the breeds with the higher prevalence of hypothyroidism were: English Setter, English Cocker Spaniel, Gordon Setter, and Nova Scotia Duck Tolling Retriever, and Pyreneer. Out of the 24 dogs included in the study, each of these breeds represented as three and two individuals each, being of a total of 56 % of all dogs included in the study (Table 1).

Table 1. The occurrence of hypothyroidism in dog breeds

Breed	Occurrence (%)
English Setter	12
English Cocker Spaniel	12
Gordon Setter	12
Nova Scotia Duck Tolling Retriever	12
Pyreneer	8
Tibetanian terrier	4
German shephard	4
Longhaired collie	4
Miniature schnauzer	4
Shetland sheepdog	4
Field Spaniel	4
Dunker	4
Samojed	4
Akita	4
Bernese mountain dog	4

Table 2 shows the age and gender data of dogs diagnosed with hypothyroidism.

Cases of selected individuals

Out of all 24 dogs included in the study, five patient records of dogs of different breeds with the highest prevalence of hypothyroidism, were included in a more detailed study. To estimate if there are any similarities between the dogs when it comes to onset of the disease, serum levels of thyroid hormones and TSH, and body condition score (BCS), and clinical presentation and identify risk factors for hypothyroidism. The following dog breeds were included in the study: English Setter, English Cocker Spaniel, Gordon Setter, Nova Scotia Duck Tolling Retriever, and Pyreneer.

Table 2. Breed, age and gender and/or neutered of dogs diagnosed with hypothyroidism

Individual	Breed	Age (years)	Gender and/or neutered
Patient 1	English Setter	5.5	Female
Patient 2	English Setter	7.5	Female
Patient 3	English Setter	12	Male (neutered)
Patient 4	English Cocker Spaniel	6.5	Female
Patient 5	English Cocker Spaniel	8	Female
Patient 6	English Cocker Spaniel	8.5	Female
Patient 7	Gordon Setter	11.5	Female
Patient 8	Gordon Setter	11	Male
Patient 9	Gordon Setter	14	Male
Patient 10	Nova Scotia Duck Tolling Retriever	8	Male
Patient 11	Nova Scotia Duck Tolling Retriever	8	Male (neutered)
Patient 12	Nova Scotia Duck Tolling Retriever	6	Male
Patient 13	Pyreneer	6.5	Male
Patient 14	Pyreneer	6	Female
Patient 15	Tibetanian terrier	5	Female (neutered)
Patient 16	German shepherd	8	Female
Patient 17	Longhaired collie	9	Male (neutered)
Patient 18	Miniature schnauzer	2	Female
Patient 19	Shetland sheepdog	10	Female
Patient 20	Field Spaniel	10.5	Male (neutered)
Patient 21	Dunker	2.5	Male
Patient 22	Samojed	5	Female
Patient 23	Akita	10	Male
Patient 24	Bernese mountain dog	4.5	Male

Case 1

Patient one was English Setter (Table 3). Since this dog was brought to the clinic for the first clinical examination on an earlier date than that we could get access to, the exact age of diagnosis is not known. The dog was a 5.5 years old intact female that was brought to the clinic three times in a span of two years to determine whether the dosage of levothyroxine natrium was correct.

Table 3. Clinical course of patient 1

	1st visit	2nd visit	3rd visit
Anamnesis	Blood test for determination of correct dosage of treatment	Blood test for determination of correct dosage of treatment	Blood test for determination of correct dosage of treatment
Clinical examination	BCS: 6/9 Dry/dull skin	BCS: 5/9	BCS: 5/9 Skin is improving
Blood parameters	TSH: 4.97 ng.ml ⁻¹ Free T ₄ : 22.3 pmol.l ⁻¹ Total T ₄ : 16.7 nmol.l ⁻¹	TSH: 3.50 ng.ml ⁻¹ Free T ₄ : 32.4 pmol.l ⁻¹ Total T ₄ : 27.0 nmol.l ⁻¹	TSH: 1.21 ng.ml ⁻¹ Free T ₄ : 30.9 pmol.l ⁻¹ Total T ₄ : 28.3 nmol.l ⁻¹
Treatment	Forthyron Vet Tab 400 µg.kg ⁻¹ : ½ tbl two times a day	Forthyron Vet Tab 400 µg.kg ⁻¹ : increased to 3/4 tbl two times a day	Same dosage as last visit

BCS – body condition score; TSH – thyroid-stimulating hormone

Case 2

Patient two was a English Cocker Spaniel (Table 4). The dog was 6.5 years old intact female. The exact date of diagnosis was unknown.

Table 4. Clinical course of patient 2

	Clinical visit
Anamnesis	Blood test for determination of correct dosage of treatment
Clinical examination	The dog was clinically healthy
Blood parameters	TSH: 1.98 ng.ml ⁻¹ Free T ₄ : 37.7 pmol.l ⁻¹ Total T ₄ : 41.2 nmol.l ⁻¹
Treatment	Forthyron Vet Tab 400 µg.kg ⁻¹ : ½ tbl two times a day

TSH – thyroid-stimulating hormone

Case 3

Case number three, was a Gordon Setter (Table 5). As with the previous cases, the exact date of diagnosis was not known as the dog's first visit to the clinic was previous to the time frame of case reports in the database that we had access to. The dog was 11.5 year old intact female that was brought to the clinic at two occasions.

Table 5. Clinical course of patient 3

	1st visit	2nd visit
Anamnesis	Owner wanted to discuss further treatment	The dog was more active than before start of the treatment
Clinical examination	The dog was not examined this day	Black dandruff all over the coat
Blood parameters	Not examined	TSH: < 0.03 ng.ml ⁻¹ Free T ₄ : 28.1 pmol.l ⁻¹ Total T ₄ : 32.2 nmol.l ⁻¹
Treatment	Forthyron Vet Tab 200 µg.kg ⁻¹ : 1.5 tbl two times per day.	Same dosage as 1st visit as the dog was responding well

TSH – thyroid-stimulating hormone

Table 6. Clinical course of patient 4

	1st visit	2nd visit (4 days later)	3rd visit (6 weeks later)	4th visit (1.5 years later)	5th visit (1 year later)
Anamnesis	Severe pruritus all over the body, truncal alopecia	Owner wanted to discuss further treatment	The dog was not pruritic anymore and overall health is improved	Blood serum thyroxine level control	Spots of dandruff on the ears and ventral abdomen
Clinical examination	BCS: 7/9 Dull haircoat, dry patches of skin all over the body	The dog was not examined	BCS: 6/9 Skin has improved	BCS: 6/9 Skin and coat look healthy	BCS: 5/9 Slight pruritus on ventral abdomen
Blood parameters	TSH: 1.04 ng.ml ⁻¹ Free T ₄ : 25.2 pmol.l ⁻¹ Total T ₄ : 23.2 nmol.l ⁻¹	Blood parameters not examined	TSH: < 0.03 ng.ml ⁻¹ Free T ₄ : 39.3 pmol.l ⁻¹ Total T ₄ : 43.8 nmol.l ⁻¹	TSH: 0.04 ng.ml ⁻¹ Free T ₄ : 45.4 pmol.l ⁻¹ Total T ₄ : 50.2 nmol.l ⁻¹	TSH: < 0.03 ng.ml ⁻¹ Free T ₄ : 36.7 pmol.l ⁻¹ Total T ₄ : 43.8 nmol.l ⁻¹
Treatment	No thyroid specific treatment started	Forthyron Vet Tab 400 µg.kg ⁻¹ : 1.5 tbl two times a day	Forthyron Vet Tab 400 µg.kg ⁻¹ : 1.5 tbl two times a day	Same dosage as last visit	Same dosage as last visit

BCS – body condition score; TSH – thyroid-stimulating hormone

Table 7. Clinical course of patient 5

	1st visit	2nd visit (10 days later)	3rd visit (6 weeks later)	4th visit (12 weeks later)	5th visit (11 months later)	6th visit (2 years later)
Anamnesis	Non healing wounds, lethargy, weight gain	Secondary pyometra has developed	The dog is improving	Blood test control of thyroxine levels	More lethargic, scabs all over the skin	Euthanized
Clinical examination	BCS: 7/9 thickened skin on ventral abdomen, secondary pyometra on ventral abdomen	BCS: 7/9 some weight has been reduced, secondary pyometra on ventral abdomen	BCS: 6/9 skin has improved, no signs of pyometra	BCS: 5/9 skin looks healthy	BCS: 5/9 scabs on ventral abdomen, secondary pyometra	
Blood parameters	TSH: 2.18 ng.ml ⁻¹ Free T ₄ : 5.7 pmol.l ⁻¹ Total T ₄ : < 9.0 nmol.l ⁻¹	Blood parameters not examined	TSH: 0.99 ng.ml ⁻¹ Free T ₄ : 55.2 pmol.l ⁻¹ Total T ₄ : 36.9 nmol.l ⁻¹	TSH: 0.14 ng.ml ⁻¹ Free T ₄ : 77.2 pmol.l ⁻¹ Total T ₄ : 70.8 nmol.l ⁻¹	TSH: 0.03 ng.ml ⁻¹ Free T ₄ : 60.4 pmol.l ⁻¹ Total T ₄ : 52.8 nmol.l ⁻¹	
Treatment	Forthyron Vet Tab 400 µg.kg ⁻¹ : 1 tbl two times a day	Same dosage as last visit	Forthyron Vet Tab 400 µg.kg ⁻¹ : 1.5 tbl two times a day	Same dosage as last visit	Same dosage as last visit	

BCS – body condition score; TSH – thyroid-stimulating hormone

Case 4

Case four was an 8 years old intact male of Nova Scotia Duck Tolling Retriever breed (Table 6). The dog had a total of five visits at the clinic over a span of approximately three years. Hypothyroidism was diagnosed after the first visit to the clinic.

Case 5

Case five was a 6.5 years old intact male of Pyriner breed (Table 7). The dog was brought to the clinic due to the dog being more lethargic than normal, being on weight reducing feed without any weight reduction and non-healing wounds on the body. Hypothyroidism was diagnosed at the first visit to the clinic.

DISCUSSION

Hypothyroidism is the most common endocrinopathy in dogs [7]. The disease is characterized by the slow destruction of the thyroid gland with subsequent clinical signs that are typical [9].

Hypothyroidism manifests a variety of clinical signs as a results of the reduced metabolic performance of all organ systems in the body [1]. One of the most prevalent clinical signs reported by owners is the reduced level of activity and weight gain despite having a decreased appetite [2]. Furthermore, dermatological signs such as a dry and dull haircoat, bilateral symmetrical alopecia, tail alopecia, seborrhea and hyperpigmentation of the skin has also been reported [3]. Nevertheless, since different breeds have dissimilar hair growth cycles and morphologies of the hair follicles, the dermatological signs can manifest differently among breeds [6].

It has been discovered that hypothyroidism in dogs can be congenital and acquired, in which acquired hypothyroidism is the most common [10]. With acquired hypothyroidism, the most commonly seen form in dogs, is primary autoimmune lymphocytic thyroiditis [5]. Primary autoimmune lymphocytic thyroiditis is characterized by the destruction of the thyroid gland with subsequent decreased secretion of the thyroid hormones thyroxine (T_4) and triiodothyronine (T_3) [14].

There are several risk factors associated with the development of hypothyroidism in dogs [9].

The occurrence of hypothyroidism in the breeds that have been shown to be predisposed have been either proved, or denied in different studies. In a study done by Ringstad et al. [13], several different breeds were recorded as the ones with the highest prevalence of the development of hypothyroidism in Norway. The breeds of highest prevalence were concluded to be: Schnauzers, Eurasiers, Dunkers, and English Setters, whereas the breeds of lowest prevalence were Rottweiler, Dachshund, German Shepherds, and Border Collies. On the other hand, in a study done by Kour et al. [8] in India, the breeds with the highest incidence of hypothyroidism were: the Labrador Retriever, Pug, Samoyed, Dachshund, and German Shepherds, and the breeds of least prevalence were: Pitbull, Shih Tzu, and the Mogrel. Comparing of the results of these studies, some breeds such as the Dachshund, have shown to have both increased and decreased amounts of prevalence. Similarly, according to these studies, the predisposition of hypothyroidism in certain breeds of dogs can also correlate to a geographical point of view [8, 13]. In a study done by O'Neill et al. [10] twenty four different breeds of dogs were recorded as the ones with the highest prevalence of the development of hypothyroidism in UK. The breeds of highest prevalence were concluded to be: the Standard Doberman Pincher, Tibetan terrier, and the Boxer, whereas the Pug, Yorkshire Terrier, Shih-Tzu and Jack Russell Terrier were the most protected breeds. In addition, there were also two common breeds without any recorded hypothyroidism diagnosis cases: Cavachon, and Cavapoo.

The breeds of dogs that were included in current work results based on clinical records were: the English Setter, English Cocker Spaniel, Gordon Setter, Nova Scotia Duck Tolling Retriever, Pyreneer, Tibetanian Terrier, German Shepherds, Longhaired Collie, Miniature Schnauzer, Shet-

land Sheepdog, Field Spaniel, Dunker, Samoyed, Akita and Bernese Mountain Dog. Out of all these breeds of dogs, the breeds that had the highest prevalence of hypothyroidism were: the English Setter, English Cocker Spaniel, Gordon Setter, Nova Scotia Duck Tolling Retriever, and Pyreneer. According to the breeds that have been shown to have a higher prevalence of developing hypothyroidism: the English Setter, and the English Cocker Spaniel correlated well with this as these breeds represented as 12 % each out of all the breeds included in the study. However, since the total cohort of dogs included in the study only included 24 individuals with 15 different breeds in a limited geographical area, the overall occurrence of hypothyroidism in predisposed dogs cannot be fully estimated.

These dogs were also categorized according to: age, gender, and whether the animal had been neutered or not. The average age of all dogs included in the study was 7.2 years of age. This correlates well with the results of previous studies, as the mean age of all dogs diagnosed with hypothyroidism has been shown to be middle to older aged dogs [10, 12]. O'Neill et al. [10] stated that the increasing age above 7 years was independently associated with having hypothyroidism, with increasing odds ratios for every advancing age category, which was expected given that hypothyroidism is a life-long, but rarely lifespan-limiting condition.

Previous studies of hypothyroid dogs have reported conflicting information on sex and neuter status. Neutering has been associated with increased risk of hypothyroidism in some studies [11], although this was not supported by UK study [3]. The study of 2,105 dogs with diagnosed hypothyroidism from 905,553 dogs in 2016 in UK reported that neutered dogs of both sexes have shown increased odds of diagnosed hypothyroidism, with the odds ratio (OR) being slightly higher for neutered females (OR 1.46) compared to neutered males (OR 1.31). However, the 95 % of confidence intervals overlapped between the entire animals of both sexes and between the neutered animals of both sexes, suggesting that sex *per se* is not associated with predisposition to hypothyroidism in dogs. It is possible that removal of sex steroids may impact the immune function and increase the risk of developing hypothyroidism. However, it is important to note that causality cannot be safely inferred from these studies because the timing of neutering was not considered. There is evidence that neutering at least 150 days prior to diagnosis was associated

with hypothyroidism and other immune-mediated diseases [15].

In our study of 24 hypothyroid dogs, 21 % of patients were neutered dogs of both sexes and 46 % dogs were females.

Obesity has been discovered to be a known risk for the development of hypothyroidism in dogs, characterized by the effect of leptin on the hypothalamic-pituitary-thyroid axis [2]. In a study done by O'Neill et al. [10], it was discovered that many of the dogs that were diagnosed with hypothyroidism were either obese or overweight, which can further pinpoint a correlation between obesity and the development of hypothyroidism.

Although, one of the major clinical signs of hypothyroidism is weight gain without the presence of an increased appetite, which means that the result of that exact study cannot prove that the dogs included in the study acquired hypothyroidism as a result of obesity [9]. However, it is possible, that larger, and/or obese dogs have an increased risk for developing hypothyroidism rather than the reverse direction of causality [4]. In consequence, further studies are required to investigate the timeline for weight changes and hypothyroidism in dogs in more detail.

In our study of clinical records of hypothyroid dogs, we have shown that, a body score condition (BSC) of 6–9/9 was determined which is considered overweight, or too heavy prior to therapy. After starting the hormonal therapy of dogs with hypothyroidism, the BSC was adjusted to 4–5/9, which refers to an ideal body weight.

The initial diagnosis of hypothyroidism in dogs is based on the interpretation of low levels of total thyroxine (T_4), and free thyroxine T_4 , and increased levels of TSH in blood serum [1]. A normal TSH, free T_4 , and total T_4 effectively rules out the possibility of hypothyroidism. Moreover, this will not confirm the diagnosis and further testing by performing a TSH stimulation test will prove the diagnosis [5].

Additionally, the detection of hypothyroidism in predisposed dog breeds through genetic testing is of high interest. Unfortunately, there is not known specific genetic test that can detect the prevalence of hypothyroidism in dogs [6].

CONCLUSIONS

In conclusion, the detection of hypothyroidism in predisposed breeds of dogs can be conducted through studies on larger pools of dogs. Also, because most of the studies done to evaluate the prevalence of hypothyroidism in predisposed breeds of dogs are investigated in specific geographical areas, the overall prevalence can only be done by comparing the results of different studies. In addition, since the work results of the study are based on the diagnosis of hypothyroidism through blood tests of hormones, the inheritance of the disease cannot be concluded.

Several studies, including this study, have shown that specific breeds, especially: English Setter, Gordon Setter, and the Cocker Spaniel, had the highest incidence of the disease. These results can help owners of the predisposed breeds of dogs and veterinary surgeons to diagnose and treat this endocrinopathy earlier.

Moreover, there might be a link between inheritance and predisposition of the disease, but this has not been proven to date. Since hypothyroidism is a disease that progresses slowly and the average age of diagnosis is of three years or more, further genetic testing of the predisposed breeds is of high interest in the field of veterinary medicine in order to try and decrease high prevalence of the disease in dogs overall.

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Received April 4, 2024

Accepted May 17, 2024