Therapeutic Management of Hypothyroidism in Dogs

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ABSTRACT

The present study was conducted at the Veterinary Clinical Complex of NTR College of Veterinary Science, Gannavaram, from March to November 2023, found a hospital prevalence of hypothyroidism at 0.45% (27/5957). Ten hypothyroid dogs (Group II) treated with Levothyroxine (0.02 mg/kg daily) had significantly ($p<0.01$) lower pre-therapeutic mean TT4 (8.42±1.15 nmol/L) and FT4 (0.37±0.09 ng/dL) levels compared to healthy controls (Group I), with significant ($p\leq0.01$) improvement after therapy. Haemato-biochemical analysis revealed a significant increase ($p<0.05$) in haemoglobin, PCV and TEC, along with a significant ($p<0.05$)decline in ALP, cholesterol and triglyceride levels after therapy, emphasising the importance of levothyroxine in canine hypothyroidism.

Keywords: Hypothyroidism, Levothyroxine, Radioimmunoassay, Thyroxine

INTRODUCTION

Hypothyroidism represents a clinical syndrome resulting from decreased circulating levels of the active thyroid hormones (T3 and T4) and it is widely recognized as one of the most prevalent endocrine diseases in dogs with a significant impact on their health and well-being (Roopali *et al.,* 2020).It is categorised as primary hypothyroidism if the abnormality lies within the thyroid gland itself, while secondary hypothyroidism involves dysfunction of the pituitary gland and tertiary hypothyroidism implies abnormalities within the hypothalamus (Gulzar *et al.,* 2014). Further, it is either congenital or acquired, depending on the age at which it develops. Primary hypothyroidism accounts for about 95% of diagnosed cases, with lymphocytic thyroiditis and idiopathic follicular atrophy accounting for approximately 50% of diagnosed cases each (Ettinger *et al.,* 2017). Dogs with primary hypothyroidism typically present with clinical signs that are vague and nonspecific, often overlapping with symptoms of dermatologic and metabolic disorders (Travail *et al.,* 2024). Diagnosing hypothyroidism in dogs is challenging due to the similarity of its clinical signs with those of various other diseases (Kour *et al*., 2021). Synthetic thyroid hormone replacement (sodium levothyroxine) is the treatment of choice for canine hypothyroidism (Boretti *et al.,* 2022). The purpose of the study is to emphasize the crucial role of sodium levothyroxine supplementation for successful therapeutic management of hypothyroidism in dogs.

MATERIALS AND METHODS

During the study period from March 2023 to November 2023, a total of 5,957 dogs were presented to the Veterinary Clinical Complex, NTR College of Veterinary Science, Gannavaram. Among them, 27 dogs were confirmed to have hypothyroidism. Out of these, ten dogs were selected for therapeutic study and were treated with oral administration of Levothyroxine at an initial dose of 0.02 mg/kg body weight once daily (Ettinger *et al.,* 2017). The owners were requested to visit at regular intervals (once in two weeks) after the initiation of therapy and the efficacy of therapy was assessed based on clinical and laboratory response. Blood and serum samples were collected six hours

after post-pill administration of Levothyroxine, and thyroid hormones, along with haemato-biochemical parameters, were estimated (Tappin, 2014). The dose of Levothyroxine was adjusted based on clinical and hormonal response. The haemato-biochemical findings were estimated before therapy and after complete recovery of hypothyroid dogs. The results obtained were subjected to statistical analysis as per the methods described by Snedecor and Cochran (1994) using SPSS 20.00 version, employing independent sample t-tests and paired sample t-tests for comparison purposes.

RESULTS AND DISCUSSION

The therapeutic success was judged based on the findings of satisfactory clinical response accompanied by the assessment of thyroid hormones and haemato-biochemical changes in hypothyroid dogs following treatment with Levothyroxine.

Clinical response in hypothyroid dogs

In Group II, all ten dogs exhibited dermatological signs. Following the initiation of therapy, gradual improvement was observed, with dermatological signs resolving in two dogs (20%) by six weeks, 60% (6/10) by eight weeks, 90% (9/10) by ten weeks, while all the dogs were normal by 12 weeks after initiation of therapy. The delayed improvement of dermatologic signs and hair re-growth in hypothyroid dogs after the initiation of therapy was in agreement with Tresamol *et al.* (2013).

Six dogs were lethargic initially, while improvement was noticed in two dogs (33.33%) was observed by two weeks, 83.33% per cent (5/6) of the dogs became active by four weeks, and the activity improved in all six dogs (100%) by six weeks. This finding was supported by Jaiswal *et al*. (2018), who hypothesized that this could be considered as an early indicator to confirm the diagnosis of hypothyroidism cases.

Initially, seven out of 10 hypothyroid dogs were overweight. The body weight decreased in 14.28% (1/7) of dogs by four weeks, 42.85% (3/7) of dogs by six weeks, 57.14% (4/7) by eight weeks, and 85.71% (6/7) by 10 weeks, whereas one dog (14.29%) was obese even after 12 weeks of therapy. The rapid improvement in metabolic signs and slow resolution of dermatologic signs were similar to the observations of Jaiswa *et al.* (2018) and attributed these clinical signs to decreased metabolic rate and decreased heat generation in hypothyroid dogs.

Haematological response in hypothyroid dogs

In hypothyroid dogs, there was a significant reduction ($p < 0.05$) in the mean ± SE levels of haemoglobin, PCV and TEC when compared to the healthy control group. After therapy, these parameters improved significantly ($p < 0.05$), gradually returning to values similar to those of the healthy controls. By the end of treatment, there was no significant difference ($p > 0.05$) between the post-therapy hypothyroid dogs and the healthy controls, which reflects an overall positive response to Levothyroxine supplementation. Significant improvement in RBC count within two weeks of commencing THRT was also reported by Dixon *et al*. (2002). Thyroid hormones enhanced erythropoiesis through the hyperproliferation of immature erythroid progenitors and increased secretion of erythropoietin (EPO) by inducing erythropoietin gene expression (Kour *et al*., 2021).

The mean ± SE of TLC levels in hypothyroid dogs was significantly high ($p<0.01$), which decreased significantly ($p<0.01$) after therapy. The decrease in T-cell function and humoral immunity might contribute to secondary bacterial, fungal, or parasitic infections, consequently leading to an increase in the total leukocyte count (Roopali *et al.*, 2020 and Kour *et al.*, 2021). On the contrary, Srikala and Kumar (2014) reported no significant difference in TLC in hypothyroid dogs when compared to healthy controls.

The pre-therapeutic mean ± SE of neutrophils and lymphocytes varied significantly (p<0.05) with healthy control and post-therapeutic values, while no significant difference was observed between healthy and post-therapeutic values. These findings were in accordance with Roopali *et al*. (2020), who reported neutrophilia and stated that it might be due to secondary bacterial infections, such as pyoderma or Malassezia or could be associated with chronic systemic illness.

Table 1: Haematological parameters in healthy (Group I) and hypothyroid dogs (Group II) before and after treatment

Parameter	Healthy dogs (n=8)	Hypothyroid dogs (n=10)	
		Pre treatment	Post treatment
Haemoglobin (gm/dL)	14.88 ± 0.57	12.05 ± 0.86*	14.43 ± 0.38#
Packed cell volume (%)	39.75 ± 0.70	33.61 ± 2.04*	39.20 ± 1.17#
Total erythrocyte count (x 10^6/mm^3)	6.30 ± 0.24	4.99 ± 0.26*	5.76 ± 0.18#
Total leucocyte count (x 10^3/mm^3)	11.71 ± 0.46	14.76 ± 1.16**	10.55 ± 1.20##
Differential leucocyte count			
Neutrophils (%)	66.25 ± 1.64	72.70 ± 1.99*	68.40 ± 1.29#
Lymphocytes (%)	31.88 ± 1.64	24.80 ± 2.25*	29.10 ± 1.20#
Monocytes (%)	1.25 ± 0.31	1.80 ± 0.51	1.80 ± 0.36
Eosinophils (%)	0.63 ± 0.26	0.70 ± 0.26	0.70 ± 0.30

* Means significantly (P<0.05) differ with control group
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Serum biochemical response in hypothyroid dogs

The serum biochemical parameters were evaluated and compared with the pretherapeutic values to assess the effect of thyroid hormone replacement therapy. The most common abnormalities noticed in dogs affected with hypothyroidism were elevation of alkaline phosphatase, serum triglycerides and hypercholesterolemia (Table 2).

A significant increase (p<0.05) in the mean ± SE of ALP values (IU/L) was observed in hypothyroid dogs before therapy when compared to healthy controls. A highly significant decline (p<0.01) in mean ALP value was recorded after therapy. The post-therapeutic mean ± SE of ALP values did not vary significantly (P>0.05) of the healthy control. Restoration of euthyroidism with oral levothyroxine therapy might have resolved ALP values (Le Traon *et al.,* 2009). This finding was in accordance with Kour e*t al*. (2021) who opined that elevation of liver enzymes in hypothyroidism might be due to degenerative hepatopathy and myopathy caused by fatty infiltration and hyperlipidaemia. In contrary Ryad *et al*. (2020) reported normal values of ALP in hypothyroid dogs and reported that biochemical alterations may not exist in hypothyroid dogs.

The mean ± SE of serum cholesterol concentrations in hypothyroid dogs before therapy was significantly higher (p<0.01) than healthy controls. Highly significant decline

(p<0.01) in serum cholesterol values suggested rapid restoration of lipid metabolism after therapy (Dixon *et al*., 2002). Though significant improvement was noticed in serum cholesterol values after therapy, the values were significantly (p<0.01) higher than healthy controls. Hypercholesterolemia in hypothyroid dogs was documented by previous researchers (Kim *et al*., 2012 and Jaiswal *et al*., 2018). According to them, hypercholesterolemia in hypothyroid dogs was due to impaired lipid metabolism, including synthesis, mobilization, and degradation, resulting in accumulation of plasma lipids and the potential for development of atherosclerosis. On the contrary, Rezaei *et al.* (2015) recorded normal cholesterol values in dogs with hypothyroidism.

The serum triglyceride concentration was significantly higher (p<0.05) in hypothyroid dogs than in healthy controls, which declined significantly (p<0.01) after therapy. The higher serum triglycerides(mg/dL) as observed in dogs affected with hypothyroidism were attributed to reduced lipase activity, resulting in impaired plasma clearance. Rapid improvement in lipid metabolism might have resulted in a reduction in values after therapy. This finding aligns with the report of Mitrevska *et al.* (2023).

Table 2: Serum biochemical parameters in healthy (Group I) and hypothyroid dogs (Group II) before and after treatment

Parameter	Healthy dogs (n=8)	Hypothyroid dogs	
		Before treatment (n=10)	After treatment (n=10)
Glucose (mg/dL)	77.76 ± 1.31	78.93± 3.22	78.84 ± 2.59
Total bilirubin (mg/dL)	0.36 ± 0.03	0.42 ± 0.03	0.41 ± 0.03
ALT (IU/L)	44.24 ± 1.07	43.23 ± 3.75	41.89 ± 2.74
AST (IU/L)	47.31 ± 0.81	43.92 ± 2.37	42.27 ± 1.99
ALP (IU/L)	49.35 ± 1.68	74.86 ± 10.66*	47.31 ± 5.75##
Total protein (g/dL)	7.16 ± 0.06	7.15 ± 0.17	7.09 ± 0.14
Albumin (g/dL)	3.55 ± 0.06	3.44 ± 0.14	3.45 ± 0.10
Globulin (g/dL)	3.61 ± 0.10	3.71 ± 0.19	3.64 ± 0.16
A: G	0.99 ± 0.05	0.94 ± 0.07	0.97 ± 0.06
Creatinine (mg/dL)	0.95 ± 0.06	1.01 ± 0.08	0.97 ± 0.07
BUN (mg/dL)	18.46 ± 1.24	21.94 ± 2.19	21.20 ± 1.85
Cholesterol (mg/dL)	136.11± 4.32	274.84 ± 27.84**	221.98 ± 25.41**##
Triglycerides (mg/dL)	79.38 ± 7.81	114.02 ± 9.35*	91.37 ± 8.72##
Calcium (mg/dL)	10.57 ± 0.26	10.07 ± 0.15	10.50 ± 0.11#
Phosphorus (mg/dL)	3.84 ± 0.05	3.94 ± 0.13	3.96 ± 0.06

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Hormonal response in hypothyroid dogs

The mean ± SE values of total T4 and free T4were significantly lower (p< 0.01) in hypothyroid dogs when compared with the healthy control, which improved significantly (p<0.01) after therapy (Table 3). These observations were in accordance with Jaiswal *et al*. (2018).

Table 3: Thyroid profile in healthy (Group I) and hypothyroid dogs (Group II) before and after therapy

Parameter	Group I (n=8)	Group II (n=10)	
		Pre treatment	Post treatment
Total T4 (nmol/L)	34.86 ± 4.30	8.42 ± 1.15**	42.26 ± 2.50##
Free T4 (ng/dL)	0.96 ± 0.05	0.37 ± 0.09**	0.96 ± 0.03##
Total T3 (ng/ml)	0.72 ± 0.04	0.79 ± 0.10	1.09 ± 0.14*
TSH (µIU/ml)	0.02 ± 0.01	0.01 ± 0.00	0.06 ± 0.01##*

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Recovery pathway in hypothyroid dogs

The response to treatment was variable with complete recovery by 12 weeks of therapy. Out of 10 dogs affected with hypothyroidism, 10.00 per cent (1/10) of the dogs exhibited complete recovery by six weeks, 20.00 per cent (2/10) by eight weeks and 70 per cent (7/10) by ten weeks. While all the dogs achieved complete recovery by 12 weeks of therapy. The average time taken for complete recovery was recorded as 70.00 days.

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