HYPOTHYROIDISM ASSOCIATED SYSTEMIC AND PERIPHERAL DISORDERS IN DOGS

D. Srikala¹, K. Satish Kumar²

ABSTRACT

Hypothyroidism is the most common endocrine disorder in dogs. The present paper puts on record various ailments associated with primary hypothyroidism caused by thyroxine ($T_4$) deficiency and peripheral disorders in euthyroid dogs, which mimic hypothyroidism. The study undertaken on 10,172 dogs presented at the clinics with skin and coat incongruity, revealed clinical manifestations suggestive of hypothyroidism in 182 (1.78%) dogs, out of which 47 (25.8%) dogs demonstrated significantly ($P \leq 0.01$) low level of total thyroxine ($T_4$) indicating primary hypothyroidism. The common clinical signs were bilateral alopecia (82.98%), rat-tail appearance (72.34%), dry and lusture less coat (68.08%), obesity (68.08%), exercise intolerance (78.72%), and lethargy (74.47%). Most of the cases were acquired hypothyroidism (97.87%), the rest (2.13%) were congenital. The disorders in primary hypothyroidism were related to dermatological (80.00%), metabolic (48.93%), ocular (31.91%), neuromuscular (25.53%), renal (17.02%), cardiovascular (14.89%), and musculoskeletal (4.26%) systems. The illnesses detected in euthyroid dogs constituted, demodicosis (31.11%), atopic dermatitis (19.26%), scabies (17.04%), food allergy (14.07%), flea allergy (9.63%), and hyperadrenocorticism (8.89%). Dermatological lesions in primary hypothyroidism revealed complications of Malassezia pachydermatis (36.6%), Demodex canis (14.89%), and Staphylococci and Escherichia coli bacteria (8.51%). Metabolic disorder displayed exercise intolerance, lethargy, obesity, and dyspnoea at rest. Ocular disorder manifested corneal lipidosis. Neuromuscular disorders constituted seizures, paraplegia, and facial paralysis. Renal disorder constituted poly urea with increased levels of blood sugar, BUN and serum creatinine. The common cardiovascular abnormality was dilated cardiomyopathy. Musculoskeletal disorder reflected lameness due to osteoarthritis. This paper portrays a chronicle of hypothyroidism associated disorders in dogs in India, which were not reported earlier.

KEY WORDS

Dog, Euthyroidism, Hypothyroidism, Systemic disorders, Thyroxine

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INTRODUCTION

Thyroid gland produces thyroid hormones, such as thyroxine (T\textsubscript{4}) and 3, 5, 3 triiiodothyronine (T\textsubscript{3}), needed for normal cellular metabolic function. A deficiency of thyroid hormones (hypothyroidism) resulting from impaired production of thyroid hormones makes the body vulnerable to insults by pathogens (Patterson and Frank, 2002).

Thyroid hormones have positive inotropic and chronotropic effects on the heart and have catabolic effects on muscle and adipose tissue, stimulate erythropoiesis and regulate both cholesterol synthesis and degradation. These are also essential for the normal growth and development of the neurologic and skeletal systems (Ferguson, 1994).

Naturally occurring hypothyroidism is a common disease in dogs. However, the clinical signs of hypothyroidism are vague and diffuse, and relatively of low accuracy in most biochemical tests (Diaz et al., 2007). The fact that many factors like non-thyroidal diseases, drugs, and normal physiological fluctuations can lower circulating thyroid hormone concentrations, many times the condition is misdiagnosed clinically (Chastain, 1990; Ferguson 1994).

The clinical manifestations of canine hypothyroidism have been well documented, but there is a dearth of literature on associated disorders of hypothyroidism in dog. The present paper puts on record for the first time from India, about various systemic disorders associated with hypothyroidism in canines.

MATERIALS AND METHODS

A total number of 10,172 dogs of various breed, sex, and age, presented with the history and signs suggestive of hypothyroidism to the small animal medical ward of Veterinary Hospital, Bhoiguda, Teaching Veterinary Clinical Complex, College of Veterinary Science, Rajendranagar, Hyderabad from April 2009 to March 2010, were considered for the study. The affected dogs were exhibiting common skin and coat abnormalities, such as bilateral alopecia, obesity, exercise intolerance and dyspnoea at rest. A few of them were showing unusual signs, suggestive of various systemic diseases.

The dogs were subjected to detail clinical examination, followed by assessment of thyroid profile using Lisa Elisa reader and washer. The dogs were also subjected to electrocardiography (BPL cardiart 1068) as per Tilley (1992), radiography (Heliophos-D 500 mA X-ray machine) as per Fagin (1988), and 2-d echocardiography (Ixos Vet, Doppler machine) as per Thomas et al. (1994).

RESULTS AND DISCUSSION

It was found that 182 out of 10,172 dogs (1.78%) showed clinical signs, suggestive of hypothyroidism, out of which 47 cases
(25.8%) had low (P ≤ 0.01) serum thyroxine (T₄) concentration, confirming primary hypothyroidism (Panciera, 1997). The overall prevalence was 0.46 percent (Table-1).

**Table-1. Thyroid profile of dogs.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normal dogs</th>
<th>Hypothyroid dogs</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT₄ (mcg/dl)*</td>
<td>3.22 ± 0.12</td>
<td>0.82 ± 1.06</td>
</tr>
<tr>
<td>fT₄ (ng/dl)</td>
<td>2.82 ± 0.56</td>
<td>0.64 ± 1.26</td>
</tr>
<tr>
<td>T₃ (ng/dl)</td>
<td>78.68 ± 0.08</td>
<td>78.68 ± 0.08</td>
</tr>
<tr>
<td>TSH (ng/ml)</td>
<td>2.26 ± 0.42</td>
<td>2.26 ± 0.42</td>
</tr>
</tbody>
</table>

Note: (1) The figures are presents as Mean±SEM.
(2) *Significant at P ≤ 0.01.

**Clinical signs:** The common clinical signs recorded in patients with suspected hypothyroidism were bilateral alopecia (82.98%), rat-tail appearance (72.34%), dry and luster less coat (68.08%), puppy like coat (17.02%), obesity (68.08%), exercise intolerance (78.72%), lethargy (74.47%), anaemia (27.60%), dyspnoea at rest (25.53%), pale mucosa (19.25%), corneal lipidosis (10.64%), goitre and lameness (10.64%), cyanosis (10.22%) and myxedema (9.86%). Auscultation of heart revealed bradycardia and arrhythmia in all dogs. Most of the cases were acquired hypothyroidism (97.87%), rest (2.13%) were congenital.

The clinical manifestations noticed in the present investigation were in agreement with Krishna murthy and Rajan (2002) and Satish kumar et al. (2007), who have reported that patchy or extensive alopecia, dry brittle hair coat, scaly lesions, hyperpigmentation, and bilateral symmetrical skin lesions were characteristic of hypothyroidism. Whereas, Fialkovikova et al., (2008) reported non-pruritic alopecia (alopecia X) on ventral thighs (bald thigh syndrome), rat tail appearance with brittle, dry and change in coat colour and scaling of skin are the characteristic skin and coat abnormalities of thyroid malfunction in dog.

**Disorders of primary hypothyroidism:** The disorders encountered in dogs with primary hypothyroidism are listed in Table-2.

**Table-2. Systemic disorders in hypothyroid dogs.**

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermatological disorder</td>
<td>38/47</td>
<td>80.00</td>
</tr>
<tr>
<td>Metabolic disorder</td>
<td>23/47</td>
<td>48.93</td>
</tr>
<tr>
<td>Ocular disorder</td>
<td>15/47</td>
<td>31.91</td>
</tr>
<tr>
<td>Neuromuscular disorder</td>
<td>12/47</td>
<td>25.53</td>
</tr>
<tr>
<td>Renal disorder</td>
<td>8/47</td>
<td>17.02</td>
</tr>
<tr>
<td>Cardiovascular disorder</td>
<td>7/47</td>
<td>14.89</td>
</tr>
<tr>
<td>Musculoskeletal disorder</td>
<td>2/47</td>
<td>4.26</td>
</tr>
</tbody>
</table>
**Dermatological disorder**

Dermatological disorders were very high (80%) in hypothyroidism. However, most of the cases (36/ 47, 76.59%) were associated with secondary skin infections involving Malassezia pachydermatis in malassezia-dermatitis (20/ 36, 55.56%, Figure-1), Demodex canis in demodicosis (7/ 36, 19.44%, Figure-2), and bacterial pyoderma (4/ 36, 11.11%, Figure-3).

Malassezia dermatitis showed seborrhoeic lesions with dry scales, mostly at the ventral abdomen and back (Figure-4). A few of them were showing moist eczematous lesions at the inguinal region (Figure-5). The dogs showing pustules and dry scabby lesions (Pyoderma) revealed complicity of Staphylococcus spp. and Escherichia coli bacteria on impression smear examination.

Myxedema (cutaneous mucinosis), as observed in our study (Figure-6) is a rare dermatological manifestation of hypothyroidism, characterized by non-pitting thickening of the skin, which might be due to deposition of hyaluronic acid in the dermis and accumulation of excessive amounts of mucopolysaccharides and protein in the dermis (Doering and Jensen, 1973).

Thyroid gland plays a critical role in regulating the body immune system, and hence, when it is depressed or compromised, the body becomes increasingly vulnerable to the assault of the pathogens, as is seen in Malassezia-dermatitis (Mayr, 2007) and recurrent bacterial infections of the skin such as folliculitis, pyoderma and furunculosis (Bansal et al., 2007). Chastain and Panciera (1995) had observed that hypothyroidism might impair neutrophil and lymphocyte function thereby causing abnormal systemic immune responses and alterations in local immunity resulting in pyoderma and other allergic dermatitis.

**Metabolic disorder:** Metabolic disorder was observed in 48.93% of the cases. Exercise intolerance and lethargy (Figure-7), obesity (Figure-8), and dyspnoea at rest (Figure-9) found in dogs with hypothyroidism, were in accordance with Greco et al. (1998). These abnormalities could be attributed to general metabolic disturbances that occur in impaired thyroid function or may be an indication of a neuropathy or myopathy (Mayr, 2007).

**Ocular disorder:** Ocular disorder was noticed in 31.91% of the cases. Corneal lipidosis was found to be the main ocular disease in hypothyroidism (Figure-10). Durieux et al. (2008) have reported that ocular changes were not common in hypothyroidism, but high levels of blood...
cholesterol and circulating fat could sometimes lead to ocular changes. Corneal dystrophy, an abnormal change in sclera, is such a sign. This is usually represented as a small white spot (sometimes a white circle) on the eye surface. In the present study, corneal lipidosis was the only ocular abnormality recorded and could be attributed to the said reason.

**Neuromuscular disorder**: Neuromuscular disorder was noticed in 25.53% of the cases. Seizures (Figure-11), paraplegia, and facial paralysis (Figure-12) were observed in 12 (25.53%) cases. These findings are in agreement with Jaggy et al. (1994), who stated that in hypothyroidism, nerves do not conduct electrical impulses normally. Sometimes single nerves (focal neuropathy) can get entrapped as they exit the skull or spinal cord as they (like other tissues) swell with myxedema. Pressure on these nerves can lead to paralysis of facial muscles and/or head tilt, bizarre eye motions, and balance disruptions. Seizures, disorientations, and circling may occur due to severe hyperlipidemia or cerebral atherosclerosis (Budsberg et al., 1993).

**Renal disorder**: Polyurea, observed in 5 cases (10.64%) were suffering from diabetes mellitus and cataract with high blood sugar level (341 mg/dl), whereas, 3 (6.38%) dogs were also showing bloody vomiting, anorexia, and oral ulceration. The mean BUN and serum creatinine levels of the dogs were 221 mg/dl and 29.50 mg/dl, respectively. It is reported that hypothyroidism is associated with several kidney diseases including glomerulonephritis (Basu and Mohapatra, 2012).

**Cardiovascular disorder**: The common cardiovascular abnormality noticed in the hypothyroid dogs was dilated cardiomyopathy (14.89%). Low voltage QRS complexes, ventricular premature complexes and bradycardia were the significant ECG abnormalities recorded in the present study, were in agreement with Gaalova et al. (2008). Cardiomegaly was the common radiographic abnormality among these dogs (Figure-13).

Dilated cardiomyopathy (DCM) of these dogs was confirmed by 2d-echocardiography and m-mode echocardiography (Figure-14), which revealed a significantly ($P \leq 0.01$) increased left ventricle end diameter at diastole (61.88 ± 0.26 mm) and systole (50.12 ± 0.24 mm) as compared to the diastole (37.98 ± 0.39 mm) and systole (26.55 ± 0.49 mm) in normal dogs.

The other dimensions viz., LVPWd (5.66 ± 0.54 mm), LVPWs (8.12 ± 0.58 mm), IVSd (4.96 ± 0.29 mm), IVSs (5.88 ± 0.54 mm) and
EPSS (9.12 ± 0.86 mm) noted on day zero were also significantly lower (P ≤ 0.05) than that of the dogs with secondary hypothyroidism (6.76 ± 0.22 mm, 9.27 ± 0.18 mm, 5.82 ± 0.23 mm, 6.97 ± 0.21 mm and 4.62 ± 0.16 mm, respectively). Further, ejection fraction (33.46 ± 1.22%) and fractional shortening (14.16 ± 2.04%) of these dogs were also significantly (P ≤ 0.05) less than the dogs with secondary hypothyroidism (65.88 ± 2.24% and 30.12 ± 0.26%, respectively).

Hypothyroid associated cardiovascular disorders observed in the present study were in agreement with Vressler et al. (2003).

Musculoskeletal disorders: Musculoskeletal disorder like lameness, limping and reluctant to move, and unable to bear weight was noticed in 2 (4.26%) dogs. The x-ray of these dogs revealed inflamed joints, particularly that of the carpal joint.

Hypothyroid dogs of the present investigation showed lameness of varied intensity. It is presumed that chronic pain due to osteoarthritis could have induced sufficient stress to alter thyroid function, although Paradis et al. (2003) had observed that the level of TT4 was not influenced by osteoarthritis in dogs, and suggested that arthritis need not to be considered as a factor influencing thyroid function evaluation in dogs. Our study contradicted this view.

Disorders of euthyroidism

The clinical findings of 135 out of 182 (74.2%) dogs were consistent with the symptoms of hypothyroidism (Table-2). These diseases were demodicosis (31.11%), atopic dermatitis (19.26%), scabies (17.04%), food allergy (14.07%), flea allergic dermatitis (9.63%), and hyperadrenocorticism (8.89%). These disorders could be confused with hypothyroidism (Ferguson, 1994). Thus, thyroid function test is essential to differentiate peripheral disorders (Pseudohypothyroidism) from disorders caused by primary hypothyroidism (Chastain, 1990).

Table-3. Peripheral disorders of hypothyroid dogs.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demodicosis</td>
<td>42</td>
<td>31.11%</td>
</tr>
<tr>
<td>Atopic dermatitis</td>
<td>26</td>
<td>19.26%</td>
</tr>
<tr>
<td>Scabies</td>
<td>23</td>
<td>17.04%</td>
</tr>
<tr>
<td>Food allergy</td>
<td>19</td>
<td>14.07%</td>
</tr>
<tr>
<td>Flea allergic dermatitis</td>
<td>13</td>
<td>9.63%</td>
</tr>
<tr>
<td>Hyperadrenocorticism</td>
<td>12</td>
<td>8.89%</td>
</tr>
<tr>
<td>Total</td>
<td>135</td>
<td>100%</td>
</tr>
</tbody>
</table>
Figure-1. Malassezia dermatitis.

Figure-2. Erythematous lesions in demodicosis.

Figure-3. Pyoderma.

Figure-4. Seborrhea in malassezia dermatitis.

Figure-5. Moist eczema in inguinal region in malassezia dermatitis.

Figure-6. Myxedema.
Figure-7. Exercise intolerance and lethargy.

Figure-8. Obesity.

Figure-9. Dyspnoea at rest with cyanosis of tongue.

Figure-10. Corneal lipidosis (white spot).

Figure-11. Seizure.

Figure-12. Facial paralysis.
CONCLUSION
From the present study it is concluded that hypothyroidism not only causes non-pruritic skin and coat abnormalities, but is also associated with secondary skin infections, dilated cardiomyopathy, facial paralysis and musculoskeletal disorders.

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Satish kumar, K et al. 2007. A clinical study on hypothyroidism in dogs. Intas Polivet, 8(I), 460-464.

