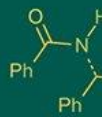


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Studies on status of total thyroxine (TT₄), age, body weight, breed and sex in hypothyroid associated neuromuscular disorders in dogs

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Abstract

The present study aimed to examine the status of age, body weight, breed and sex in hypothyroidism associated neuromuscular disorders in dogs. The study involved 21 hypothyroid dogs with neuromuscular disorders. The serum concentration of Total Thyroxine (TT₄) was measured using a RIA kit. The mean age and body weight at diagnosis of hypothyroidism associated neuromuscular disorders was found to be 6.83 ± 0.68 years and 21.26 ± 2.42 kg respectively. The highest affected breed was Labrador retriever followed by non-descript dogs. The encounter of hypothyroidism associated neuromuscular disorders was slightly higher but non-significant in females (52.38%, n=11/21) compared to males (47.62%, n=10/21).

Keywords: Radioimmunoassay (RIA), hypothyroidism and neuromuscular

Introduction

Hypothyroidism is the most commonly diagnosed hormonal disorder in dogs (Dixon, 2001) [5]. The global prevalence of this condition in canines is estimated to range between 0.20% and 0.80% (Catherine *et al.*, 2005) [3]. In India, the reported prevalence was 0.206% in Mumbai (Pawar, 2009) [21], 0.40% in Hisar (Gulzar *et al.*, 2014) [11] and 0.174% in Punjab (Kour *et al.*, 2020) [16].

The animal body is a highly intricate system, with its essential functions managed by two primary regulators: the nervous system and the endocrine system. While the nervous system operates through fast electrical and chemical signals to elicit immediate responses, the endocrine system uses chemical messengers to regulate functions more gradually but with prolonged effects (Vala *et al.*, 2013) [26].

Thyroxine plays a vital role in cellular respiration, promoting ATP production during aerobic metabolism by enhancing mitochondrial activity. It also boosts ATPase function, driving the ATP-dependent Na⁺/K⁺ pump. In hypothyroidism, diminished ATP levels and reduced ATPase activity impair the Na⁺/K⁺ pump, disrupting axonal transport. Studies have demonstrated decreased axonal transport in the sciatic nerves of hypothyroid rats, suggesting that hypothyroidism contributes to axonal degeneration and peripheral neuropathy (Jaggy *et al.*, 1994) [13].

As a result, hypothyroidism is associated with various neurological disorders, affecting cranial nerves, peripheral nerves, and the central nervous system. Common neurological symptoms in hypothyroid dogs include facial nerve paralysis, megaesophagus, peripheral vestibular disease, and lower motor neuron dysfunction. This dysfunction may manifest as generalized weakness, proprioceptive deficits, and reduced reflexes, potentially progressing to paraparesis or tetraparesis (Lathan, 2012; Ettinger *et al.*, 2016) [17, 6].

The use of Radio Immunoassay (RIA) for hormone measurement in veterinary clinical applications has been extensively explored in India (Dadke *et al.*, 2018; Roopali *et al.*, 2020; Galdhar *et al.*, 2021; Jayabhaye *et al.*, 2021; Galdhar *et al.*, 2022; Salutgi *et al.*, 2023; Kawade *et al.*, 2025) [4, 23, 7, 14, 9, 24, 15]. At Mumbai Veterinary College, the Department of Veterinary Clinical Medicine and Veterinary Nuclear Medicine, along with the radioisotope

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laboratory, has successfully established reference ranges for canine thyroid hormones, including T₃, T₄, and fT₄, through the use of RIA.

This study aims to assess the status of hypothyroidism associated neuromuscular disorders in dogs with respect to age, breed and sex.

Materials and Methods

Statutory approval

The present study was initiated after permission from the Institutional Ethics Committee for Veterinary Clinical Research (IEC-VCR) and Institutional Bio-safety Committee (IBSC) of Mumbai Veterinary College, Maharashtra Animal and Fishery Sciences University (MAFSU), Mumbai-India.

Selection of hypothyroid dogs

A total of 21 dogs of various breeds, suspected of clinical hypothyroidism associated neuromuscular disorders at the clinical setup of Mumbai Veterinary College, Parel-Mumbai, were ethically enrolled to measure thyroid profile. They consisted of 10 males and 11 females, with a mean age of 6.83 ± 0.68 year and mean body weight of 21.26 ± 2.42 kg respectively.

Hormonal analysis

Blood samples were collected from each dog (cephalic vein or saphenous vein). Serum samples for thyroid profile estimation were stored at -20°C until the time of analysis. Total Thyroxine (TT₄) was estimated using commercial RIA kits for human purposes manufactured by Immunotech s.r.o., Radiova 1122/1, 102 00 Prague 10, Czech Republic, Beckman Coulter Company. The analysis was conducted at the Radio Isotope Laboratory, Mumbai Veterinary College, Mumbai (India). TT₄ was measured as per the standard procedure outlined by the manufacturers. Each sample was assessed in duplicates giving paired observation. Quality control parameters viz. magnitude of control samples and recovery percentage were studied to validate the assay.

Age Groups

The dogs were auto age grouped using MS-Excel frequency distribution.

Diagnosis

Diagnosis of hypothyroidism was made on the basis of Total Thyroxine (TT₄) levels and response to replacement therapy.

Statistical analysis

The mean and standard error for each parameter of collected data was calculated and analyzed statistically for comparison as per the methods suggested by Snedecor and Cochran (2004) [25]. A nonparametric statistical analysis was also used for the analysis of the results.

Results and Discussion

Mean TT₄ concentration in hypothyroid dogs was found to be 9.45 ± 0.94 nmol/L.

The age distribution of dogs in the study showed that the highest proportion of affected dogs (33.33%) (n=7/21) belonged to the age group of >4.75 to ≤ 7.5 years. This was followed by dogs in the age range of >7.5 to ≤ 10.25 years (28.57%) (n=6/21), ≤ 2 years (14.29%) (n=3/21), >10.25

years (14.29%) (n=3/21), and >2 to ≤ 4.75 years (9.52%) (n=2/21) (Figure 1). The overall Mean $\pm$ SE age of hypothyroid dogs was recorded as 6.83 ± 0.68 years. Similar findings were reported by Panciera (1994) [20], who observed a mean age of 7.2 years at the time of hypothyroidism diagnosis. The present study's results align with those of Ettinger and Feldman (2000) [6], who noted an average diagnosis age of approximately 7 years, ranging from 0.5 to 15 years. Additionally, Dixon (2001) [5] and Kour *et al.* (2020) [16] identified hypothyroidism as a condition commonly affecting middle-aged dogs. Alone (2024) [1] also reported comparable findings, with a mean age of 6.48 years for hypothyroid dogs. Furthermore, Raja *et al.* (2021) [22] observed a higher prevalence of hypothyroidism in dogs over 5 years of age, which corroborates the findings of this study.

The current study recorded the highest number of hypothyroid dogs in the body weight groups >25.2 to ≤ 35.1 kg and >5.4 to ≤ 15.3 kg (n=7/21 each), followed by >15.3 to ≤ 25.2 kg (n=4/21), >35.1 kg (n=2/21), and ≤ 5.4 kg (n=1/21). The mean body weight of hypothyroid dogs was 21.26 ± 2.42 kg (Figure 2). The study recorded a body weight of ranging from 20 to 30 kg in nine dogs (n=9/21; 42.86%) and over 30 kg in four dogs (n=4/21; 19.05%). Similar observations were reported by Nachreiner *et al.* (2002) [18], Guglielmini *et al.* (2019) [12], Roopali (2020) [23], and Naveen (2024) [19]. Nachreiner *et al.* (2002) [18] identified a significant correlation between body weight and hypothyroidism, highlighting the importance of evaluating thyroid function in obese dogs.

Further, the study reported that Labrador Retrievers and non-descript dogs were the most frequently affected breeds, each representing 23.81% of the cases (n=5/21). These were followed by Lhasa Apso (9.52%, n=2/21), and other breeds, each accounting for 4.76% (n=1/21), including Doberman, Rottweiler, German Shepherd, Golden Retriever, Shih Tzu, Pakistani Bully, Cocker Spaniel, Cavalier King Charles Spaniel, and Boxer (Figure 3). Similar findings for Labrador Retrievers were reported by Gulzar *et al.*, (2014) [11] and Raja *et al.* (2021) [22]. Conversely, Kour *et al.* (2020) [16] observed the highest prevalence in Labrador Retrievers but the lowest in mongrels (mixed-breed dogs). The increased prevalence of Labrador Retrievers and non-descript dogs in this study might be linked to their larger population in the region due to owner preferences.

The present study included 21 hypothyroid dogs, comprising 10 males (n=10/21) and 11 females (n=11/21). Females exhibited a slightly higher but non-significant prevalence of hypothyroidism (52.38%, n=11/21) compared to males (47.62%, n=10/21) (Figure 4). Bell (2003) [2] and Raja *et al.* (2021) [22] also reported no significant gender difference in susceptibility to hypothyroidism, aligning with the findings of the present study. In contrast, Gulzar *et al.* (2014) [11] and Guglielmini *et al.* (2019) [12] observed a higher prevalence in females, while studies by Kour *et al.* (2020) [16] and Ghallab *et al.* (2021) noted a greater occurrence in males.

Among the males in this study, 9 (n=9/10) were intact and 1 (n=1/10) was castrated, whereas 4 (n=4/11) females were intact and 7 (n=7/11) were spayed. These findings align with the observations of Kour *et al.*, (2020) [16] for males and Panciera (1994) [20] for females. Panciera (1994) [20] noted that castrated males and spayed females are more predisposed to hypothyroidism.

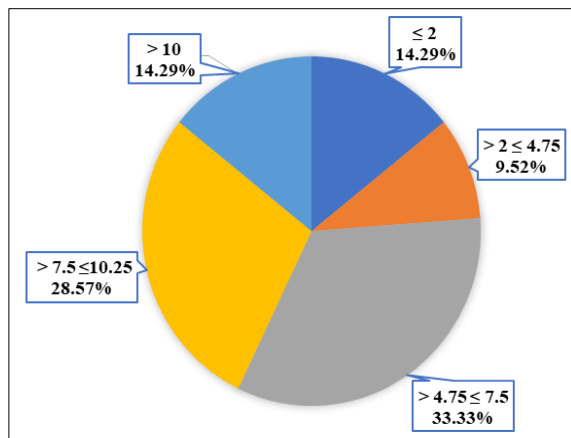


Fig 1: Age-wise distribution of hypothyroid dogs (year) (n=21)

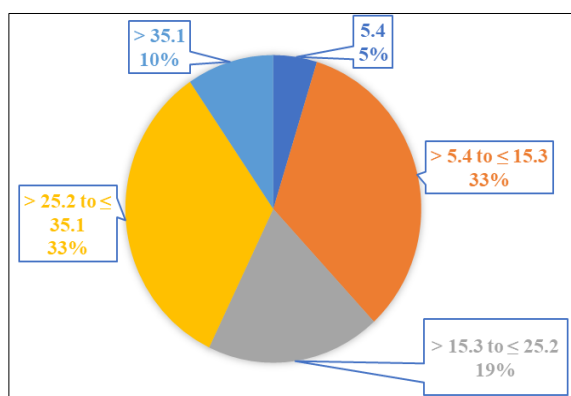


Fig 2: Body weight wise distribution of hypothyroid dogs (Kg) (n=21)

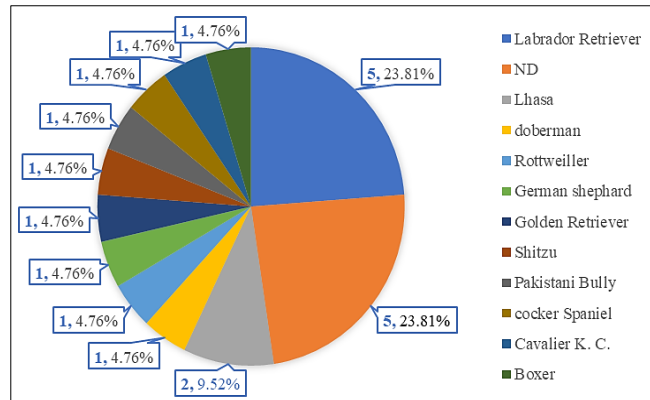


Fig 3: Breed-wise distribution of hypothyroid dogs (n=21)

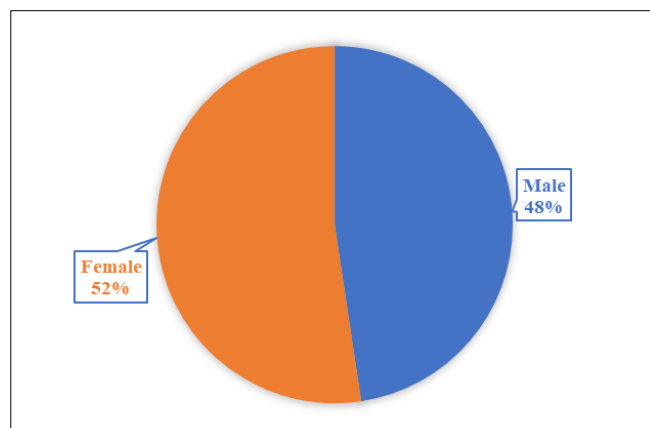


Fig 4: Sex-wise distribution of hypothyroid dogs (n=21)

Conclusion

This study offers important insights into the demographic and clinical aspects of hypothyroid dogs. The mean TT_4 concentration in affected dogs was 9.45 ± 0.94 nmol/L, with the highest prevalence observed in those aged >4.75 to ≤ 7.5 years (33.33%), followed by >7.5 to ≤ 10.25 years (28.57%), consistent with previous research identifying middle-aged dogs as the most vulnerable group. The mean body weight of hypothyroid dogs was 21.26 ± 2.42 kg, with most falling within the 20-30 kg range. This supports earlier studies indicating a link between body weight and hypothyroidism, highlighting the importance of thyroid function assessment in overweight dogs. Labrador Retrievers and non-descript dogs were the most frequently affected breeds, likely due to their higher population in the region. The study found an almost equal gender distribution. Furthermore, a greater proportion of affected females were spayed, aligning with prior findings suggesting an increased risk in sterilized dogs. Overall, the study enhances existing knowledge on canine hypothyroidism, emphasizing key risk factors such as age, body weight, breed, and reproductive status.

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Conflict of interest

The authors declare that there is no conflict of interest.

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