Indian J. Vet. Med. Vol. 46, No. 1, 2026 pp. 20-23

Studies on thyroid dysfunction in dogs using radioimmunoassay

Dadke Anand Rajshekhar[1], Galdhar Chandrakant Narayanrao[2], Gaikwad Rajeev Vasantrao[3], Garud Kaustubh Vidyadhar [4], Kumarasamy J [5]

Department of Veterinary Clinical Medicine, Ethics and Jurisprudence & Veterinary Nuclear Medicine.
Mumbai Veterinary College Parel Mumbai-12 (India)
Maharashtra Animal and Fishery Sciences University, Nagpur.
[1]M.V. Sc., student
[2]Professor and Radiological Safety Officer,
[3]Professor and Head of Department,
[4]Associate Professor,
[5]Scientific Officer, Radiation Medicine Center, Bhabha Atomic Research Center, Mumbai-12

Abstract

Fifty-nine clinically healthy dogs, 35 dogs with non-thyroidal illness and 13 suspected clinically hypothyroid dogs were included in the study. Reference ranges were established for thyroid hormone concentrations (TT4, TT3 and fT4) from 59 clinically healthy dogs by RIA. Blood samples were collected from 107 dogs (59 Healthy, 35 Non-thyroidal illness and 13 Hypothyroid) and assessed for thyroid hormone concentration using RIA. Mean (range) values established for TT4, TT3 and fT4 in the present study as 29.67±1.43 nmol/l (11.71-49.26 nmol/l), 1.03±0.02 nmol/l (0.68-1.40 nmol/l) and 9.07±0.52 pmol/l (4.06-18.72 pmol/l) respectively. In geriatric age group thyroid hormone concentration decreased compared to younger dogs. There was non-significant effect of sex on thyroid hormone concentration. TT4 concentration of dogs on homemade diet was lower compared to dogs on commercial and mixed type of diet. Dogs clinically suspected with hypothyroidism had low concentration of thyroid hormone (TT4-18.46±3.20, TT3-0.56±0.07, fT4- 5.68±1.24) as compared to dogs with non-thyroidal illness (TT4-21.78±1.85, TT3-0.85±0.05, fT4-7.80±0.69) and clinically healthy dogs (TT4-29.67±1.43, TT3-1.03±0.02, fT4-9.07±0.52).

Keywords: Thyroid, Radioimmunoassay, TT4, TT3 and fT4

Introduction

Primary hypothyroidism occurs due to either lymphocytic thyroiditis, idiopathic thyroid atrophy, neoplasia or immune destruction of thyroid follicular cells. RIA is considered as the best assay to estimate hormones as compared to Enzyme-linked immunosorbent assay (ELISA)and CLIA. Analysis of animal samples by CLIA method yielded lower concentration of T_4 compared to RIA (Singh et al., 1997). The specificity, reproducibility and sensitivity of thyroid testing is more in RIA and has ability to estimate small molecule in biological samples (Goldsmith, 1975). The present study was planned with an objective to establish data of TT_4, TT_3 and fT_4 in clinically healthy dogs (n=59) using RIA.

Material and Methods

Present study was approved from Institutional Ethics Committee for clinical research (Project Approval No: IEC-VCR/2018/10 Dated: 26.02.2018) and Institutional Bio-safety Committee (Project Approval No: IBSC, Resolution No: 2.2; Dated:15.12.2017) of Mumbai Veterinary College, Mumbai, Maharashtra Animal and Fishery Sciences University, Nagpur. Maharashtra, India. Total 59 healthy dogs referred to Bai Sakrabai Dinshaw Petit Hospital, Mumbai, Parel-12 (M.S, India) and Teaching Veterinary Clinical Complex (Goregaon and Parel) Mumbai (M.S, India) were selected. Healthy dogs were assessed on the basis of anamnesis, routine clinical examination, and assessment of hemato-biochemical profile. Total 59 healthy dogs, 35 dogs with non-thyroidal illness and 13 suspected hypothyroid dogs were included in the study after due consent from their owners. Age of 59 healthy dogs ranged from 1-12 years (Median=2 years) and Weight from 1.6-45 Kg (Median=24 kg). Among 59 apparently healthy dogs, 35 were males and 24 were females. To appraise hormonal status in non-thyroidal illness and hypothyroidism, thyroid hormone profile was also studied in 35 non-thyroidal illness dogs (altered complete

*Corresponding author: chgaldhar@gmail.com

blood count, liver function test, kidney function test and lipid profile) and 13 clinically hypothyroid dogs (symptoms of lethargy, bilateral alopecia, rat-tail and obesity). For estimation of hormonal status, ready to use RIA kits supplied by Board of Radiation and Isotope Technology (BRIT, Government of India) was used. For TT_4 and TT_3 methods described by manufacturer were followed. However, for fT_4 partial modification was undertaken (One extra wash before addition of tracer to remove traces of proteins) by keeping rest of procedure as per methods described by manufacturer.

Results and Discussion

Mean concentration of TT_4, TT_3 andfT_4 of healthy dogs were 29.67±1.43, 1.03±0.02 nmol/l and 9.07±0.52 pmol/l respectively. Established reference range for TT_4,TT_3 and fT_4 concentration was 11.71-49.26 nmol/l, 0.68-1.40 nmol/l and 4.06-18.72 pmol/l respectively. Mean and range concentrations of TT_4, TT_3 and fT_4 hormone in study was found to be in accordance with internationally published reference ranges. Non-significant ($p<0.05$) difference was recorded in concentration of TT_4, TT_3 and fT_4 in all age groups. A trend of gradual increase in thyroid hormone concentration was recorded from age group 1-3 years to 6-9 years. Moreover, after 9 years, there was non-significant decrease in concentration of thyroid hormone. This suggests that in older age there is decrease in thyroid hormone concentration. A non-significant ($p<0.05$) difference was recorded in concentration of thyroid hormone in males (TT_4-29.70±1.90; TT_3-1.02±0.04 and fT_4-8.61±0.61) and females (TT_4-29.65±2.23; TT_3-1.06±0.03 and fT_4-9.74±0.94). This suggests that thyroid hormone concentration does not changes as sex differs.

The concentration of TT_4 for dogs fed on homemade diet, commercial diet and mixed diet were 21.88 ± 2.08 nmol/l, 31.15 ± 2.57 nmol/l and 34.23±1.94 respectively. As far as diet wise status of thyroid profile is concerned, a significant ($p<0.05$) difference was recorded in TT_4 concentration, howeverTT_3 and fT_4 concentration differed non-significantly ($p<0.05$). Median baseline serum TT_4 concentration of hypothyroid dogs (19.31nmol/l) was lower than value of clinically healthy dogs (28.09nmol/l) and dogs with non-thyroidal illness (21.88nmol/l). Mean (Range) TT_4 concentration of non-thyroidal illness and hypothyroid dogs was found to be 21.78 ± 1.85 nmol/l (2.28-40.86) and 18.46 ± 3.20 nmol/l (6.89-44.91). TT_4 concentration of healthy dogs (29.67± 1.43) was significantly higher ($p<0.05$) than hypothyroid dogs (18.46 ± 3.20) however nonsignficant difference ($p<0.05$) was recorded in dogs with non-thyroidal illness (21.78 ± 1.85) and healthy dogs. There was overlap in total thyroxine hormone concentration in healthy dogs, dogs with non-thyroidal illness and hypothyroid dogs. Median baseline serum TT_3 concentration of hypothyroid dogs (0.58nmol/l) was lower than value of clinically healthy dogs (1.04nmol/l) and dogs with non-thyroidal illness (0.86nmol/l). Mean TT_3 (Range) concentration of non-thyroidal illness and hypothyroid dogs was found to be 0.85 ± 0.05 nmol/l (0.31-1.30) and 0.56 ± 0.07 nmol/l (0.19-0.96). TT_3 concentration of healthy dogs (1.03 ± 0.02) was significantly ($p<0.05$) higher than hypothyroid dogs (0.56 ± 0.07) and signficant ($p<0.05$) difference was recorded in dogs with non-thyroidal illness (0.85 ± 0.05) and healthy dogs. Box plot showed difference in thyroid hormone concentration in healthy dogs and hypothyroid dogs. Median baseline serum fT_4 concentration of hypothyroid dogs (4.12pmol/l) was lower than value of clinically healthy dogs (7.97pmol/l) and dogs with non-thyroidal illness (6.95pmol/l). Mean fT_4 (Range) concentration of dogs with non-thyroidal illness and that in hypothyroid dogs was found to be 7.80 ± 0.69 pmol/l (3.73-14.79) and 5.68 ± 1.24 pmol/l (0.49-13.77). fT_4 concentration of healthy dogs (9.07±0.52) was significantly higher than hypothyroid dogs (5.68±1.24) however non-signficant difference ($p<0.05$) was recorded in dogs with non-thyroidal illness (7.80±0.69) and healthy dogs. There was overlap in free thyroxin hormone concentration in healthy dogs, dogs with non-thyroidal illness and hypothyroid dogs.

Study recorded age wise changes in thyroid hormones. TT_4, TT_3 and fT_4 concentration increased upto 9 years of age whereas it decreased in group of 9-12 years of age. Percent decrease in old age for TT_4, TT_3 and fT_4 was recorded to be 12.96, 4.00 and 7.94 respectively. This might be because of relationship between increase in glucocorticoids and decrease in serum TT_4 during aging. Possibility is suggested that increase in glucocorticoid may suppress thyroid hormone secretion (Gonzalez & Quadri, 1988). A non-significant ($p<0.05$) difference was recorded in concentration of thyroid hormone in males and females. The above findings were in accordance to published work which suggests that concentration of thyroid hormones when compared on the basis of sex without considering specific stage of reproductive cycle has no apparent effect on serum thyroid hormone concentrations (Reimers et al., 1990). Changes in sex can occur with respect to reproductive status as estrogen concentration has effect on Thyroid

Binding Globulin (TBG) synthesis (Franklyn, Ramsden, & Sheppard, 1985). Diet wise comparison of thyroid hormone revealed that dogs fed on homemade diet had lower TT_4 concentration than dogs on commercial and mixed diet. Author feels that lower concentration of thyroid concentration in homemade diet could be because of relatively low concentration of total protein, iodine and minerals in homemade diet as compared to commercial diet. Mean TT_4 concentration of non-thyroidal illness and hypothyroid dogs decreased from healthy dogs by 36.23% and 60.73% respectively. Mean TT_3 concentration of non-thyroidal illness and hypothyroid dogs decreased from healthy dogs by 17.47% and 45.63%. Mean fT_4 concentration of non-thyroidal illness and hypothyroid dogs decreased from healthy dogs by 14.00% and 37.37%.This suggests marginal decrease in thyroid hormonal profile in dogs suffering from non-thyroidal illness and maximum decrease in dogs with hypothyroidism as compared to healthy dogs.

Acknowledgement

Funding for this project was provided by central assistance grants available at Mumbai Veterinary College. Authors are thankful to Associate Dean, Mumbai Veterinary College for providing needful facilities.

References

Belshaw, B.E. and Rijnberk, A. 1979. Radioimmunoassay of plasma T4 and T3 in the diagnosis of primary hypothyroidism in dogs. J. Am. Anim. Hosp. Assoc. 15: 17–23.

Berson, S.A. and Yalow, R.S. 1959. Application of radioimmunoassay to hormone measurement. J. Clin. Invest. 38: 1996–2016.

Boretti, F.S., Sieber-Ruckstuhl, N.S., Willi, B., et al. 2006. Comparison of the biological activity of recombinant human thyroid-stimulating hormone with bovine thyroid-stimulating hormone and evaluation of recombinant human thyroid-stimulating hormone in healthy dogs of different breeds. Am. J. Vet. Res. 67: 1169–1172.

Bromel, C., Pollard, R.E., Kass, P.H., et al. 2006. Comparison of ultrasonographic characteristics of the thyroid gland in healthy small-, medium-, and large-breed dogs. Am. J. Vet. Res. 67: 70–77.

Catherine, J. and Scott-Moncrieff, R. 2010. Hypothyroidism. In: Ettinger, S.J. and Feldman, E.C. (eds.), Textbook of veterinary internal medicine: diseases of the dog and cat. WB Saunders, Philadelphia, PA, pp. 1535–1544.

Côté, E. 2015. Clinical veterinary advisor: dogs and cats. 3rd edn., Elsevier Health Sciences, St. Louis, MO.

Eckersall, P.D. and Williams, M.E. 1983. Thyroid function tests in dogs using radioimmunoassay kits. J. Small Anim. Pract. 24: 525–532.

Ferguson, D.C. 1994. Update on diagnosis of canine hypothyroidism. Vet. Clin. North Am. Small Anim. Pract. 24: 515–539.

Franklyn, J.A., Ramsden, D.B. and Sheppard, M.C. 1985. The influence of age and sex on tests of thyroid function. Ann. Clin. Biochem. 22: 502–505.

Goldsmith, S.J. 1975. Radioimmune assay: review of basic principles. Semin. Nucl. Med. 5: 125–152.

Gonzalez, E. and Quadri, S.K. 1988. Effects of aging on the pituitary–thyroid axis in the dog. Exp. Gerontol. 23: 151.

Kantrowitz, L.B., Peterson, M.E., Melián, C., et al. 2001. Serum total thyroxine, total triiodothyronine, free thyroxine, and thyrotropin concentrations in dogs with non-thyroidal disease. J. Am. Vet. Med. Assoc. 219: 765–769.

Kemppainen, R.J. and Birchfield, J.R. 2006. Measurement of total thyroxine concentration in serum from dogs and cats by use of various methods. Am. J. Vet. Res. 67: 259–265.

Larsson, M.G. 1988. Determination of free thyroxine and cholesterol as a new screening test for canine hypothyroidism. J. Am. Anim. Hosp. Assoc. 24: 209–217.

Meyer, D.J., Coles, E.H. and Rich, L.J. 1992. Veterinary laboratory medicine: interpretation and diagnosis. WB Saunders, Philadelphia, PA.

Miller, A.B., Nelson, R.W., Scott-Moncrieff, J.C., et al. 1992. Serial thyroid hormone concentrations in healthy euthyroid dogs, dogs with hypothyroidism, and euthyroid dogs with atopic dermatitis. Br. Vet. J. 148: 451–458.

Morré, W.A., Panciera, D.L., Daniel, G.B., et al. 2017. Thyrotoxicosis induced by excessive 3,5,3′-triiodothyronine in a dog. J. Am. Vet. Med. Assoc. 250: 1427–1431.

Nelson, R.W. 1997. Use of baseline thyroid hormone concentrations for diagnosing canine hypothyroidism. Canine Pract. 22: 39–40.

Panciera, D.L. 1990. Canine hypothyroidism. Part I: Clinical findings and control of thyroid hormone secretion and metabolism. Compend. Contin. Educ. Vet. 12: 689–696.

Paradis, M., Lepine, S., Lemay, S., et al. 1991. Studies of

various diagnostic methods for canine hypothyroidism. Vet. Dermatol. 2: 125–132.

Peterson, M.E., Melian, C. and Nichols, R. 1997. Measurement of serum total thyroxine, triiodothyronine, free thyroxine, and thyrotropin concentrations for diagnosis of hypothyroidism in dogs. J. Am. Vet. Med. Assoc. 211: 1396–1402.

Randolph, J.F., Lamb, S.V., Cheraskin, J.L., et al. 2015. Free thyroxine concentrations by equilibrium dialysis and chemiluminescent immunoassays in hypothyroid dogs positive for thyroglobulin antibody. J. Vet. Intern. Med. 29: 877–881.

Reimers, T.J., Concannon, P.W. and Cowan, R.G. 1982. Changes in serum thyroxine and cortisol in dogs after simultaneous injection of TSH and ACTH. J. Am. Vet. Med. Assoc. 180: 923–925.

Reimers, T.J., Lawler, D.F., Sutaria, P.M., et al. 1990. Effects of age, sex, and body size on serum concentrations of thyroid and adrenocortical hormones in dogs. Am. J. Vet. Res. 51: 454–457.

Sauvé, F., Paradis, M., Refsal, K.R., et al. 2003. Effects of oral administration of meloxicam, carprofen, and a nutraceutical on thyroid function in dogs with osteoarthritis. Can. Vet. J. 44: 474–479.

Singh, A.K., Jiang, Y., White, T., et al. 1997. Validation of nonradioactive chemiluminescent immunoassay methods for the analysis of thyroxine and cortisol in blood samples obtained from dogs, cats, and horses. J. Vet. Diagn. Invest. 9: 261–268.

Snedecor, G.W. and Cochran, W.G. 2009. Biometry: the principles and practice of statistics in biological research. 8th edn., Iowa State University Press, Ames, IA.

Received : 12.03.2026 **Accepted : 12.05.2026** **Published : 30.06.2026**