

# Thyroid imaging in 53 cats with hyperthyroidism using technetium-99m as pertechnetate

Young-won Lee

College of Veterinary Medicine, Cornell University, Ithaca, NY 14850, U.S.A.

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**Abstract** : Thyroid imaging was performed in 53 hyperthyroid cats with technetium-99m as pertechnetate ( $^{99m}\text{TcO}_4$ ). Increased radionuclide accumulation was found in all cats. Thirty-four cats had bilateral enlargements of the thyroid glands and 14 cats had unilateral enlargements. Five cats had multi-focal accumulation of  $^{99m}\text{TcO}_4$  in the ventral neck or mediastinum. Conclusively, nuclear thyroid image is useful method in diagnosis of feline hyperthyroidism.

**Key words** : feline, hyperthyroidism, thyroid image,  $^{99m}\text{TcO}_4$ .

## Introduction

Hyperthyroidism is the most commonly recognized endocrine disorder of older cats and is usually caused by benign adenomatous hyperplasia of one or both thyroid lobes<sup>1,2</sup>.

A diagnosis of hyperthyroidism is usually made on the basis of historic and clinical features and is confirmed by documenting increased circulating concentrations of triiodothyronine ( $\text{T}_3$ ) and/or thyroxine ( $\text{T}_4$ )<sup>3</sup>.

Thyroid scintigraphy is one of the most common applications of nuclear imaging in veterinary medicine. Because of the number of older cats suspected of having hyperthyroidism, the use of scintigraphy has become an important method for evaluating feline disorder<sup>4-6</sup>. In veterinary medicine, sodium  $^{99m}\text{Tc}$ -pertechnetate has been used more extensively for thyroid imaging than radioiodine because of

the availability, low cost and radiation safety advantages<sup>7,8</sup>.

The purpose of this article is to introduce and describe the pattern of pertechnetate uptake in hyperthyroid cats.

## Materials and Methods

**Clinical materials** : Thyroid scans were performed on 53 cats presented to the Veterinary Medical Teaching Hospital at Cornell University between July 1998 and March 1999. All cats were referred for evaluation and treatment of hyperthyroidism. The cats had historical complaints of hyperthyroidism, including weight loss, polyphagia, polyuria/polydipsia, vomiting, and hyperactivity. All cats were evaluated by physical examination, basal  $\text{T}_4$  concentrations, and nuclear thyroid imaging.

**Nuclear imaging** : Cats were imaged using gamma camera fitted with a high resolution collimator (Siemens mobile

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Address reprint requests to Dr. Young-won Lee, Radiology Section, Veterinary Medical Teaching Hospital, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853, U.S.A.

LEM) with a 20% window and a setting of 140KeV. The gamma camera was connected to an Apple 8100 computer (Siemens ICON soft ware).

Thyroid scintiscans were performed after the intravenous injection of 74 to 111 MegaBequerels (MBq, 2 to 3 millicuries[mCi]) of sodium pertechnetate ( $^{99m}\text{TcO}_4$ ). Ventral and lateral (left or right) views of the neck were obtained 15 to 20 minutes after injection. The cats were restrained in ventral recumbency with the neck hyperextended.

Hyperthyroidism was based on the intensity of the thyroid gland(s) being greater than the intensity of uptake by the salivary glands<sup>9</sup>. The size and pattern of uptake in the thyroid glands were evaluated.

## Results

The cats ranged in age from 8 to 18 years ( $13.1 \pm 2.3$  years). Fifty-one cats were of mixed breeding (domestic short/long-haired) and 2 cats were Maine coon cat. Twenty cats were male, and 33 were female.

Basal serum  $T_4$  concentrations were increased in 46 cats from 4.4 to 21.4  $\mu\text{g}/\text{dl}$  ( $9.9 \pm 4.6 \mu\text{g}/\text{dl}$ ; normal range 1.5–4.0  $\mu\text{g}/\text{dl}$ ). The other cats had normal  $T_4$  concentrations.

Nuclear imaging : Results of radionuclide images are summarized in Table 1. All cats had abnormal nuclear images. Thirty-four cats had bilateral enlargements of the thy-

roid glands (Fig 1) and 14 cats had unilateral enlargements

Fig 1. Ventral pertechnetate image of hyperthyroid cat with bilateral enlargements of thyroid glands.

(Fig 2). Five cats had multi-focal accumulation of  $^{99m}\text{TcO}_4$  in the ventral neck or mediastinum (Fig 3).

Table 1. Scintigraphic findings

Case	Thyroid ( $^{99m}\text{TcO}_4$ )	$T_4$ values, $\mu\text{g}/\text{dl}$ (mean $\pm$ SD)
Bilateral intense thyroid uptake		
34 Cases (64%)	15 cases: Rt. > Lt. (44.1%)	9.9 $\pm$ 4.7
	11 cases: Rt. < Lt. (32.4%)	
	8 cases: Rt. = Lt. (23.5%)	
Unilateral intense thyroid uptake		
14 Cases (26%)	5 cases: Rt. side uptake (35.7%)	9.5 $\pm$ 3.2
	6 cases: Lt. side uptake (42.9%)	
	3 cases: indistinctness (21.4%)	
5 Cases (10%)	Multi-focal intense uptake	10.6 $\pm$ 5.7

Fig 2. Ventral pertechnetate image of hyperthyroid cat with unilateral enlargements of thyroid gland.

## Discussion

Scintigraphy (Nuclear imaging) is a noninvasive diagnostic procedure. A small amount of gamma-emitting radionuclide is administered to an animal, usually by intravenous in-

Fig 3. Ventral(A) and lateral(B) pertechnetate image of hyperthyroid cat with multi-focal intense uptake.

jection. The radionuclide may be given alone or tagged to other compounds so that it is selectively accumulated in or excluded from certain organs or tissues. When the radioactive material has been deposited in the organ or tissue of interest, a gamma scintillation camera is used to detect gamma rays emitted from the animals body and make images of the radionuclide distribution<sup>10</sup>.

Thyroid scintigraphy is used most often in veterinary medicine to evaluate hyperthyroid cats. The images allow assessment of thyroid hyperactivity, involvement of one or both thyroid lobes, presence of ectopic thyroid tissue, location of thyroid lobes in ectopic tissue, and estimation of the size and the relative activity of thyroid nodules<sup>8,11</sup>. In normal cats the thyroid gland appears on scintigrams as two well-defined focal areas of radionuclide accumulation in the cranial to middle cervical region. The two thyroid lobes are symmetrical and located side-by-side. Accumulation of pertechnetate in normal thyroid glands is similar to that in salivary glands<sup>9</sup>. In this study, all cats had abnormal thyroid image. Size and accumulation of <sup>99m</sup>TcO<sub>4</sub> of thyroid gland were larger and more intense than salivary gland. 34 cats (64%) had bilateral and 14 cats(26%) had unilateral en-

largement of thyroid gland. These results were similar to previous reports<sup>12</sup>.

Thyroid scintigraphy provides the image of the location and the relative activity of functional thyroid tissue. Thyroid scans provide an important adjunct to the measurement of serum thyroid hormone concentration when evaluating animals with suspected thyroid disease<sup>11</sup>. In this study, serum T<sub>4</sub> concentrations were increased in 46 cats. Seven cats had normal T<sub>4</sub> values with abnormal scintigrams. There are many reasons including cyclic value of T<sub>4</sub>, functional tissue traps pertechnetate, variable releases of hormone to blood, and effect of anti-thyroid drugs, for example Tapazol<sup>3</sup>.

Thyroid scintigraphy can be performed using either radioiodine (<sup>131</sup>I or <sup>123</sup>I) or <sup>99m</sup>Tc-pertechnetate. In veterinary medicine, thyroid scans usually are performed with <sup>99m</sup>Tc-pertechnetate because it is safer to use than <sup>131</sup>I and much less expensive than <sup>123</sup>I. Pertechnetate is distributed in the body in the similar manner to iodine, with accumulation in the thyroid glands, salivary glands, gastric mucosa, and coroid plexus. In the thyroid glands it is trapped like iodine but is not organified; that is, it is not metabolized into thyroid hormone. Studies in human thyroid cancer patients have shown

that  $^{131}\text{I}$  may be more sensitive in the detection of differentiated thyroid metastases, but pertechnetate generally yields excellent thyroid images. Radioiodine is preferred for quantitative thyroid uptake studies<sup>11,13,14</sup>.

Scintigrams of hyperthyroid cats may suggest the presence of carcinoma rather than adenoma when there is evidence of multiple nodules or pulmonary metastasis. Thyroid carcinoma is rare in cats. Histopathologic examination generally reports adenomas or adenomatous hyperplasia<sup>15</sup>. When cats presented with cervical masses, thyroid scintigraphy is a quick, noninvasive method to determine if the mass arises from the thyroid. No cats in this study had histopathologic examination of abnormal tissue. The scintigraphic patterns were consistent with benign adenomatous hyperplasia. Our study, extending into the thoracic inlet were seen in 5 cases.

It is suggested that a nuclear thyroid image is useful method in diagnosis of feline hyperthyroidism.

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