



What's HOT about Hyperthyroidism?

Exploring the Latest Advancements in Feline Hyperthyroidism Treatment with Radioactive Iodine Therapy

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Internal Medicine Resident

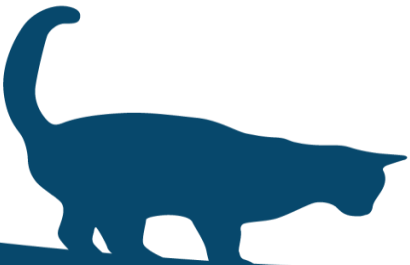




Understanding Feline Hyperthyroidism

Introduction to Hyperthyroidism

- Increased production of thyroid hormones
- 97% = functional adenoma or adenomatous hyperplasia
- 3% = functional thyroid carcinoma
 - ~ 71% will have regional lymph node or lung metastases
- Generally indistinguishable on physical examination
- Now the most commonly encountered endocrine disorder of middle-aged to older cats in Australia and New Zealand
- Age
 - Median age of 12–13 years
 - 5% of cats are <10 years old
- Breeds and genders affected equally





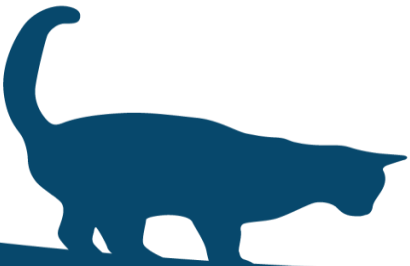
Understanding Feline Hyperthyroidism



How is hyperthyroidism diagnosed?

Combination of:

1. Clinical Signs
2. Physical examination findings
3. Clinicopathological abnormalities





Understanding Feline Hyperthyroidism

Diagnosis – History and Physical Examination

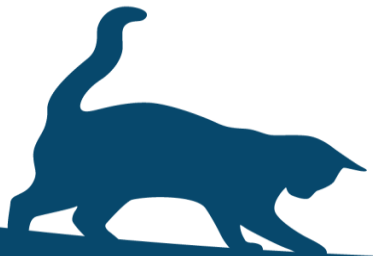
Weight loss	85–95%
Polyphagia	60–75%
Polyuria/polydipsia	45–60%
Increased activity, anxiety	30–55%
Vomiting	30–45%
Dyspnea, tachypnea, or panting	20–35%
Diarrhea	15–20%
Large fecal volume	10–20%
Decreased appetite	5–10%
Decreased activity	5–10%
Weakness	5–10%

Clinical Signs

Large thyroid gland	80–95%
Thin (low body condition score)	60–70%
Hyperkinesia	50–65%
Tachycardia	50–60%
Heart murmur	35–55%
Unkempt hair coat, matting, alopecia	15–30%
Gallop rhythm	15–25%
Aggressive	10–15%
Hypertension	10–15%
Increased nail growth	5–10%
Congestive heart failure	1–2%

Physical examination findings

**‘Apathetic hyperthyroidism’ is noted in 10% of hyperthyroid cats
They show hyporexia, listlessness and lethargy instead
Due to concurrent non-thyroidal illness**





Understanding Feline Hyperthyroidism

Diagnosis – Physical Examination

Severe

Huge

Intrathoracic

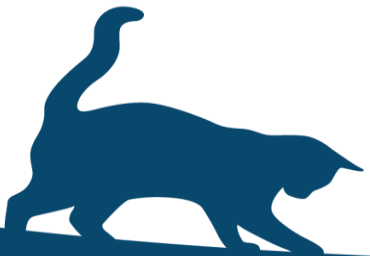
Multifocal disease

Refractory to **A**ntithyroid **D**rugs

May help clinically identify cats
with severe disease or
suspected thyroid carcinoma

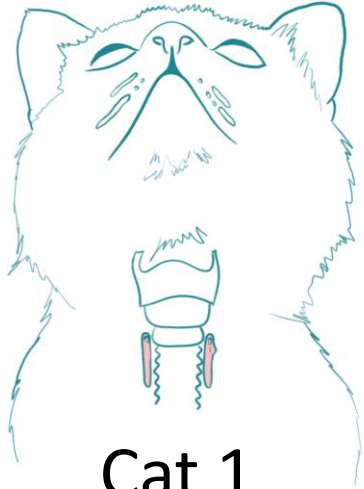


A definitive diagnosis is made
with histopathology only





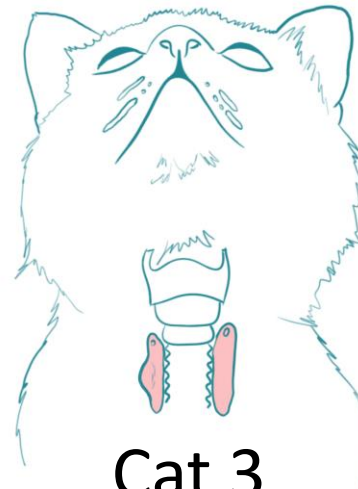
Understanding Feline Hyperthyroidism



Cat 1



Cat 2



Cat 3

Which cat has the thyroid carcinoma?

♦ A: Cat 1

♦ B: Cat 2

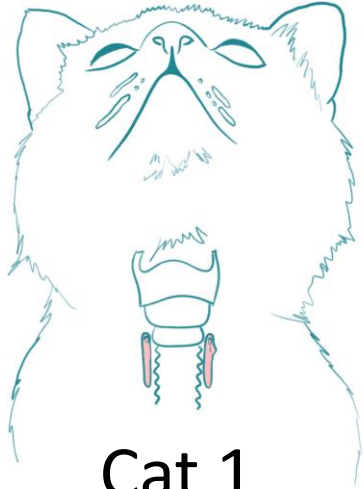
♦ C: Cat 3

♦ D: Any of the above





Understanding Feline Hyperthyroidism



Cat 1



Cat 2



Cat 3

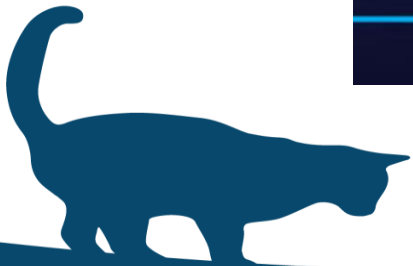
Which cat has the thyroid carcinoma?

♦ A: Cat 1

♦ B: Cat 2

♦ C: Cat 3

♦ D: Any of the above





Understanding Feline Hyperthyroidism

Diagnosis – Clinicopathology

Complete blood count

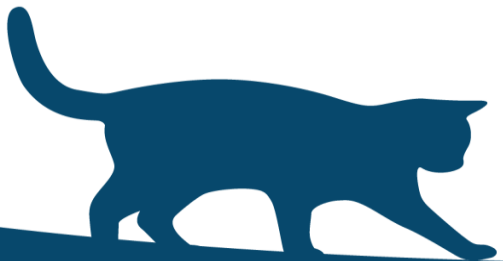
Erythrocytosis	30–55%
Anemia	1–5%
Lymphopenia	15–40%
Eosinopenia	15–35%
Leukocytosis	15–20%

Complete urinalysis

Specific gravity >1.040	40–60%
Specific gravity <1.015	3–6%
Proteinuria (high protein:creatinine > 0.4)	30–70%

Serum chemistry profile

High alanine aminotransferase (ALT)	80–90%
High alkaline phosphatase (ALP)	60–75%
High aspartate aminotransferase (AST)	30–45%
Azotemia	20–25%
Hyperglycemia	15–20%
Hyperphosphatemia	10–20%
Hyperbilirubinemia	3–4%
Low vitamin B12 (cobalamin)	13–23%





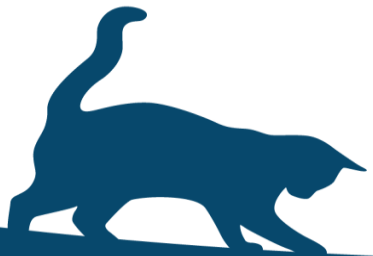
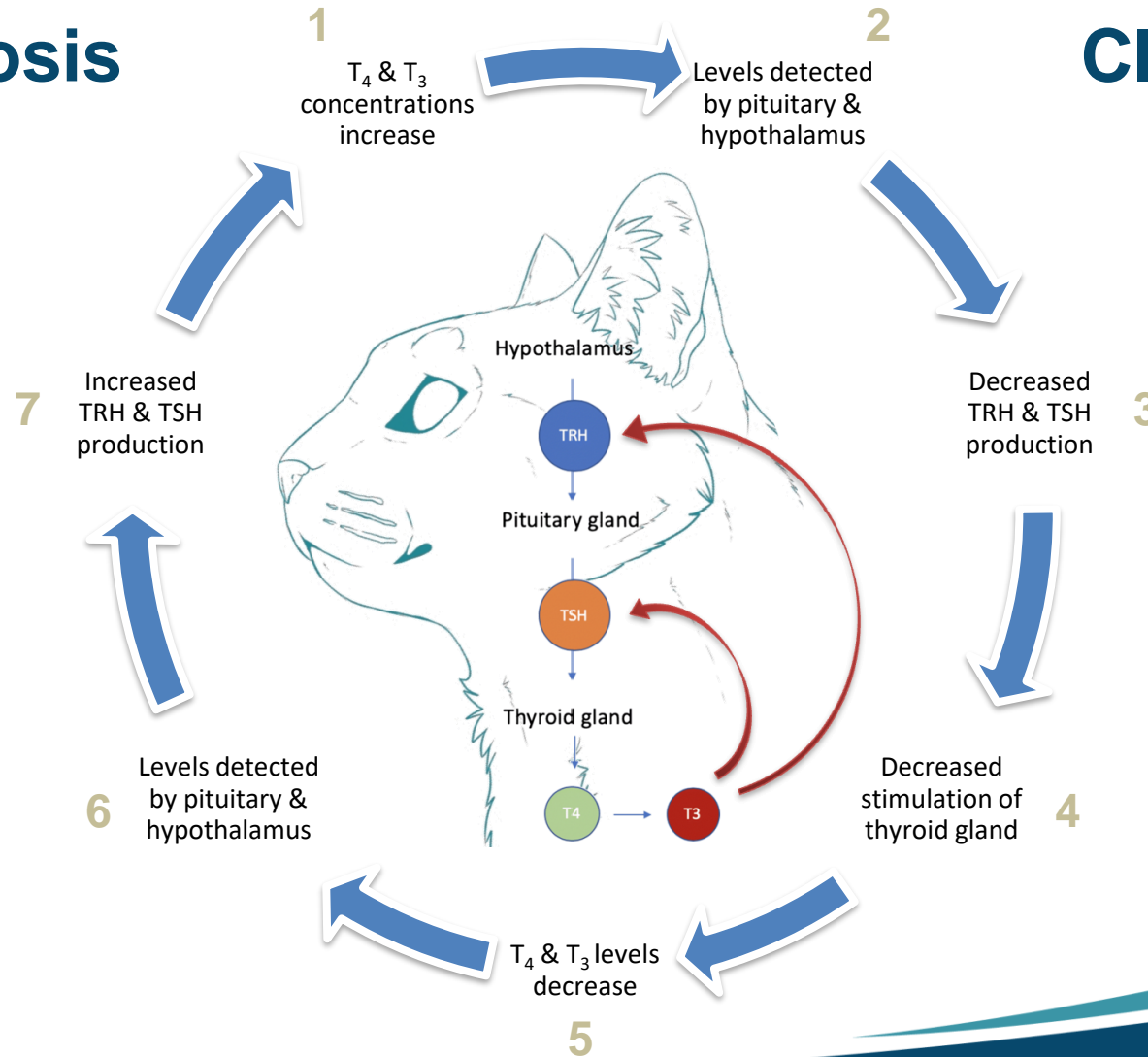
Understanding Feline Hyperthyroidism

Diagnosis

Clinicopathology

Normal thyroid physiology

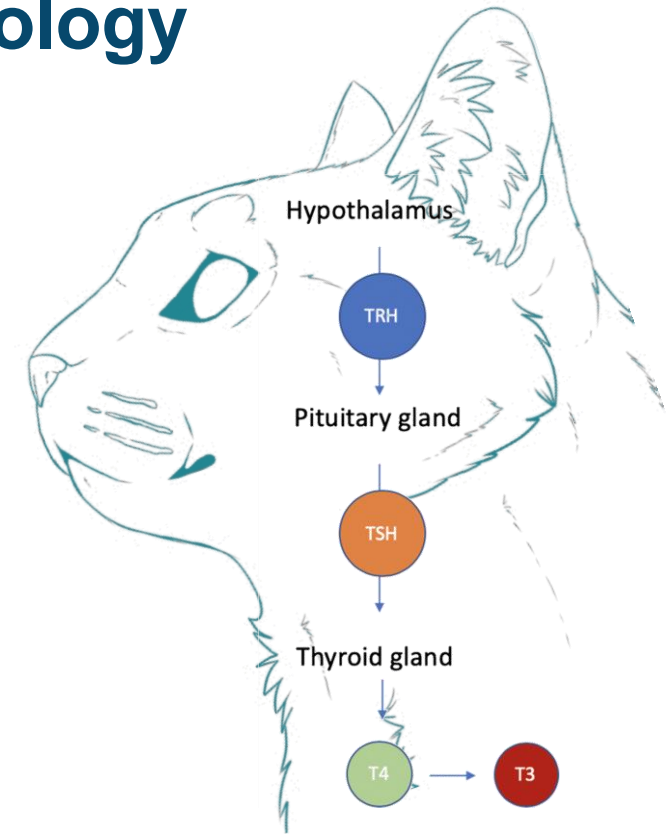
Negative feedback loop





Understanding Feline Hyperthyroidism

Diagnosis – Clinicopathology



	LOW	REFERENCE INTERVAL	HIGH	Clinical signs?	High TT ₄ ?
Overt Hyperthyroidism	TSH		TT4 fT4	✓	✓
Occult Hyperthyroidism	TSH	TT4 fT4		✓	✗
Subclinical Hyperthyroidism	TSH	TT4 fT4		✗	✗
Euthyroidism	TSH	TT4 fT4		✗	✗
Non-Thyroidal Illness	TSH	TT4 fT4			





Treatment Options



Thyroidectomy



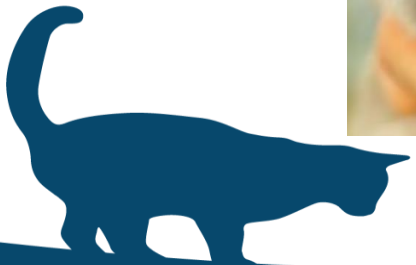
**Radioactive
Iodine (I^{131})**



**Anti-Thyroid
Medications**



**Iodine
Restricted
Diets**





Treatment Options



Advantages	Disadvantages	Advantages	Disadvantages
<p>Inexpensive in the short term</p> <p>Reversible</p> <p>No hospitalisation required</p> <p>Adverse effects: uncommon</p>	<p>Possibly expensive long term</p> <p>Daily dosing required</p> <p>Lifelong treatment required</p> <p>Adverse effects in 15% of cats</p> <p>Predisposes to thyroid carcinoma</p>	<p>No tableting required</p>	<p>Cannot be fed ANY other food</p> <p>Cannot be fed to euthyroid cats</p> <p>Indoor cats only</p> <p>Predisposes to thyroid carcinoma</p>





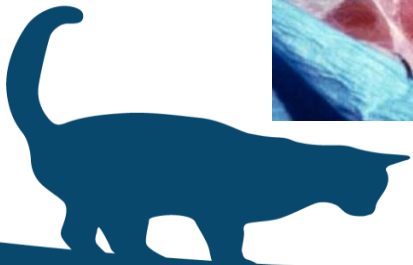
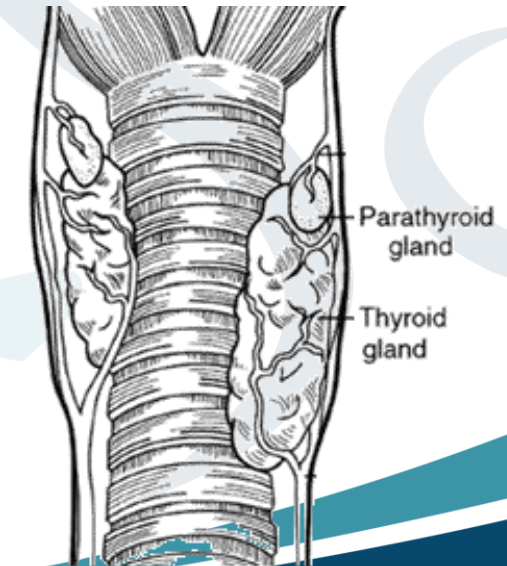
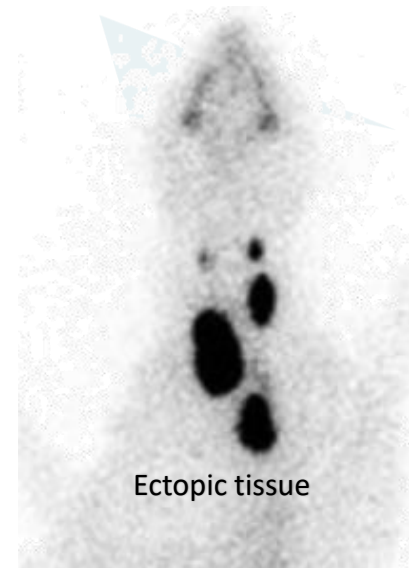
Treatment Options

Advantages

- Potentially curative
- Definitive histopathological diagnosis

Disadvantages

- Expensive in short term
- Requires general anaesthesia
- 70-90% require bilateral thyroidectomy = possible concurrent hypothyroidism and hypoparathyroidism





Radioactive Iodine Therapy (I^{131})

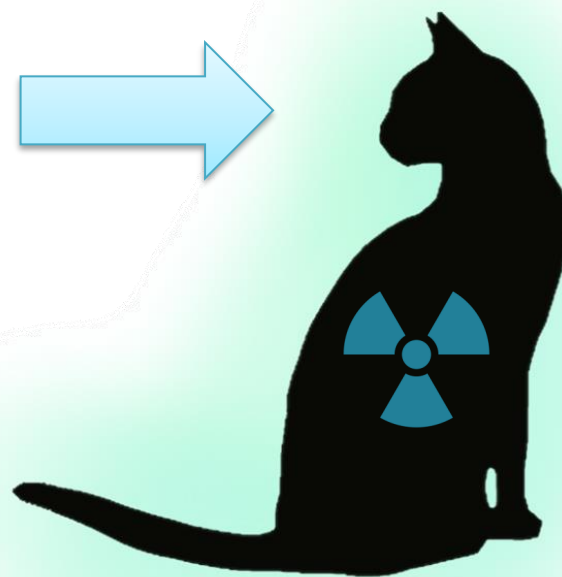
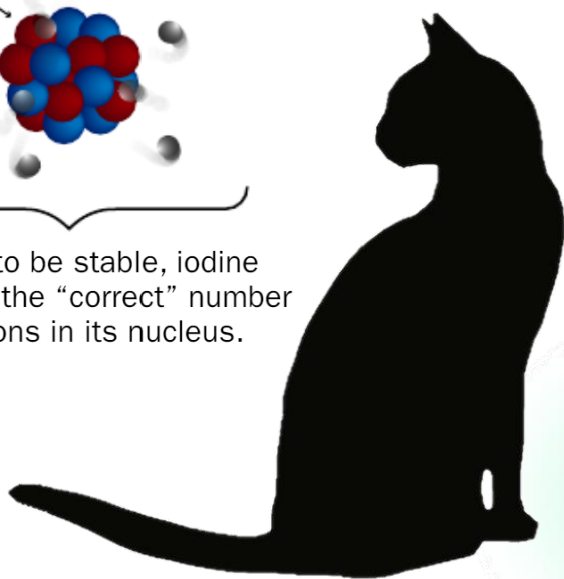
I-127
Stable

Number of protons
and neutrons in
the nucleus

53 protons
74 neutrons

electrons

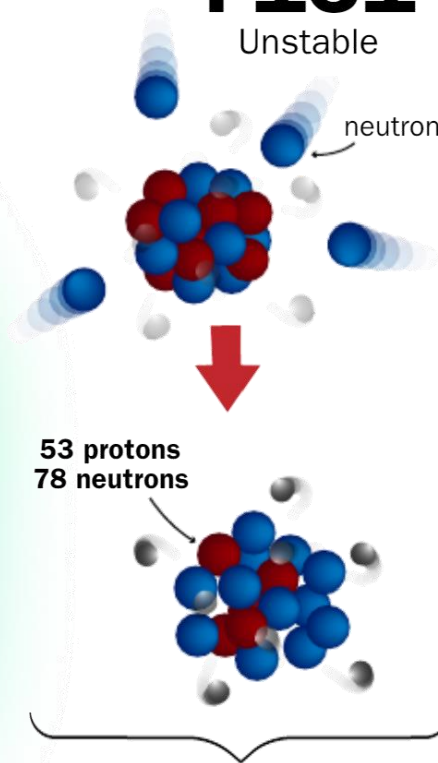
In order to be stable, iodine
must have the "correct" number
of neutrons in its nucleus.



I-131
Unstable

neutrons

53 protons
78 neutrons

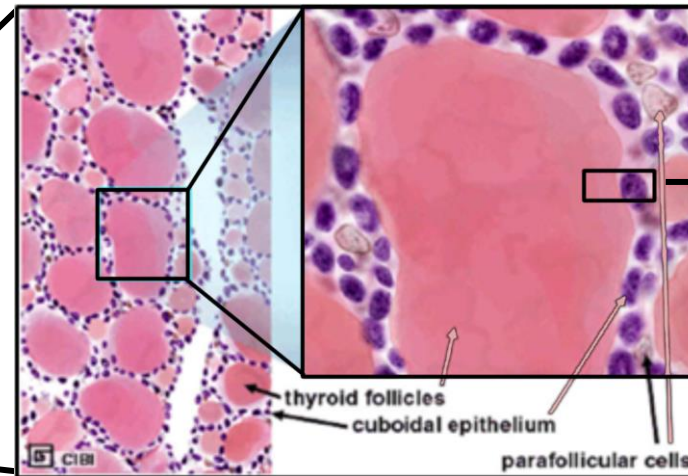
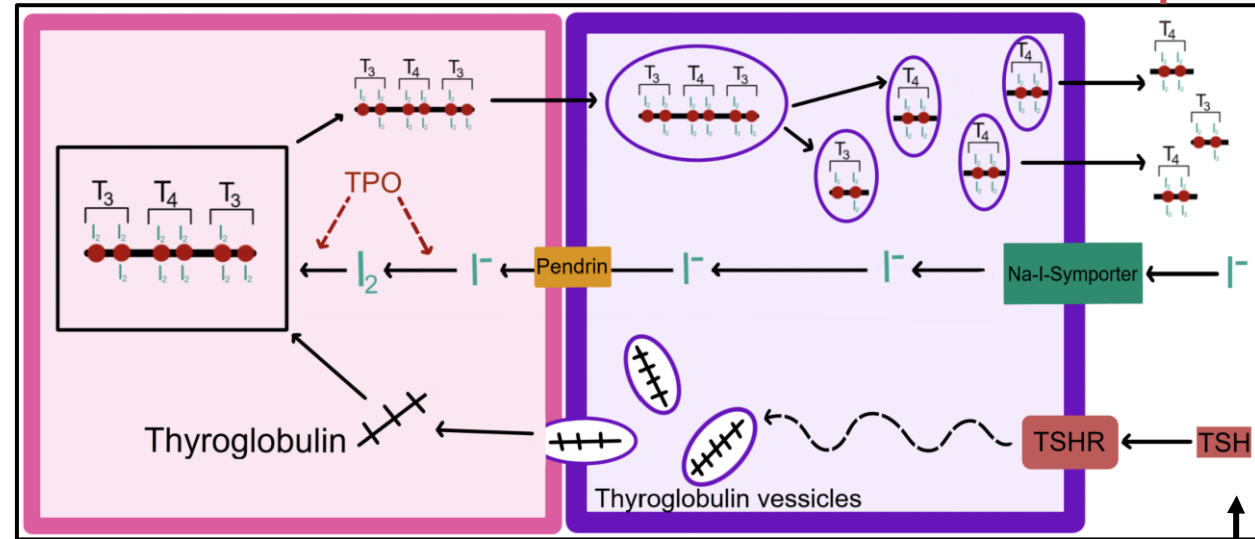
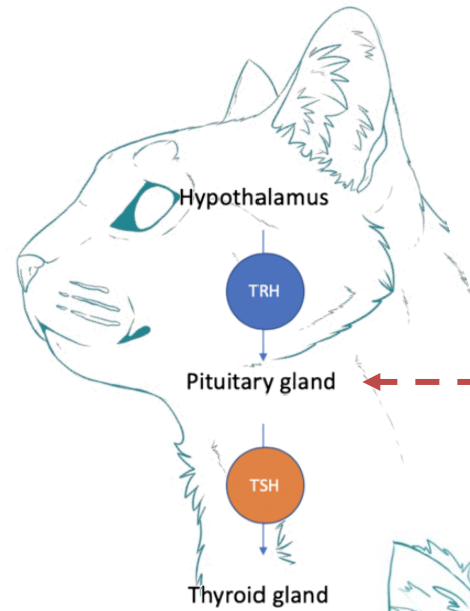


When four more neutrons are added to a stable
nucleus to create another form of iodine, it becomes
unstable and therefore is considered a radioisotope.





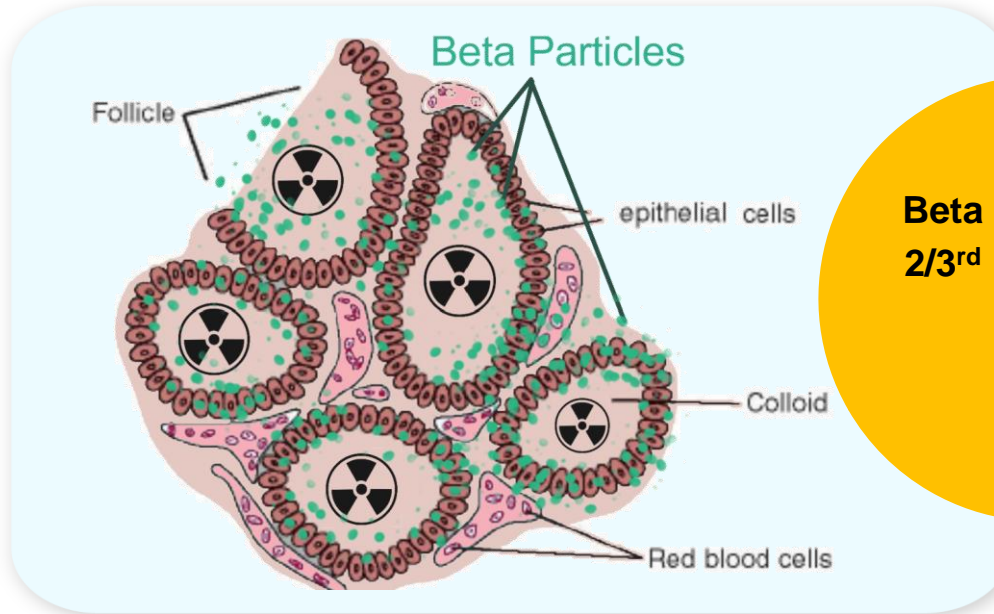
Radioactive Iodine Therapy (I^{131})





Radioactive Iodine Therapy (I^{131})

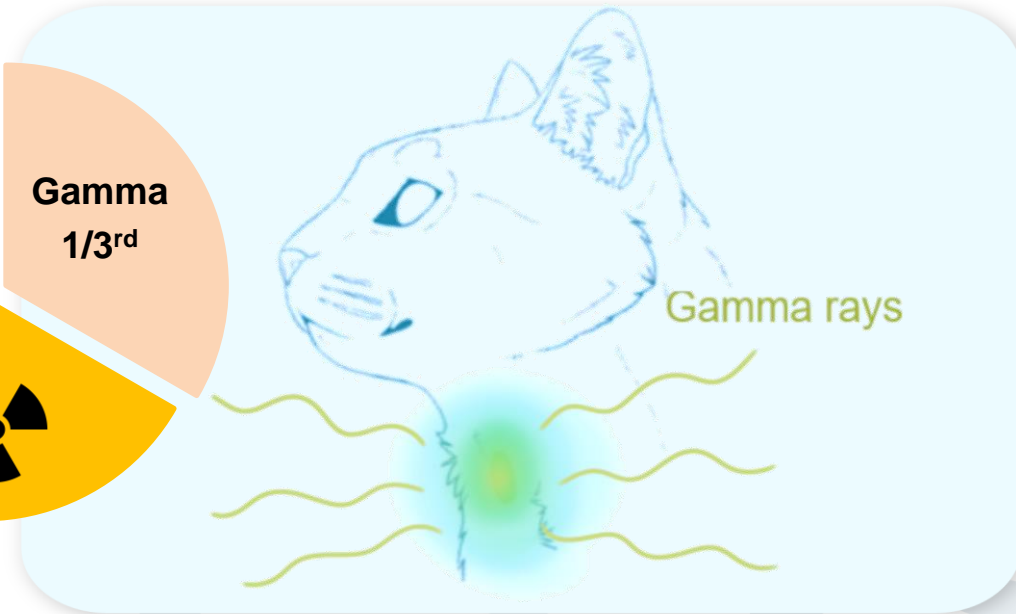
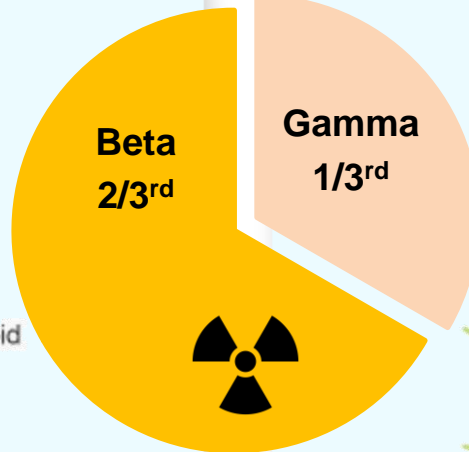
Radioactivity



Beta particles: fast-moving electrons emitted by radioactive decay

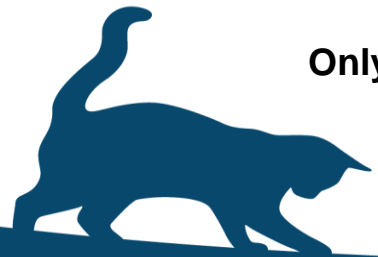
Destroy the cells from the inside

Only penetrate tissue 1-2mm, so surrounding structures preserved



Gamma rays: radiation of the shortest wavelength and highest energy

Requires lead protection and can pass completely through the body





Radioactive Iodine Therapy (I^{131})

Advantages

95% require one treatment for cure of hyperthyroidism

Not invasive

Increased survival times compared to medical management (5 years vs 2 years respectively)

Radioactive
Iodine (I^{131})



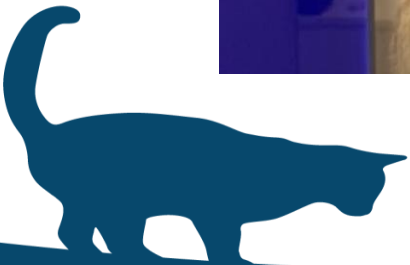
Disadvantages

Expensive in short term

Separation from owner for 5 nights + limited contact for 2 weeks

2% will require thyroid hormone supplementation

Irreversible





Radioactive Iodine Therapy (I^{131})

Radioactive
Iodine (I^{131})



Advantages

95% require one treatment for cure of hyperthyroidism

No invasive procedures or ongoing medications (in >90%)

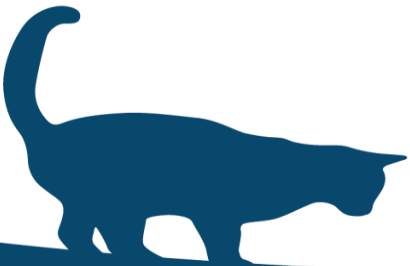
Increased survival times compared to medical management

Median Survival Times

Methimazole only: ~2 years

I^{131} treatment: ~5 years

** Note – possible population bias considering patients with significant comorbidities are less likely to undergo I^{131} treatment





Radioactive Iodine Therapy (I^{131})

Radioactive
Iodine (I^{131})



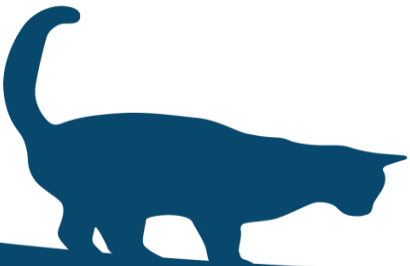
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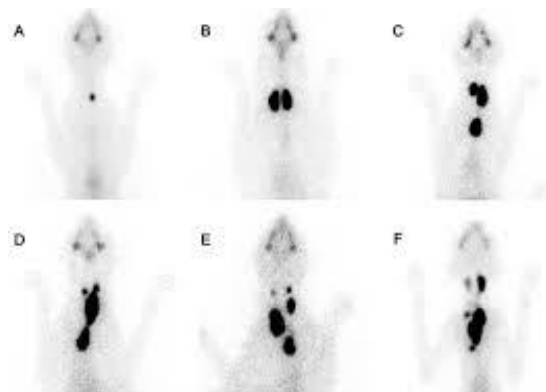
Irreversible





Radioactive Iodine Therapy (I^{131})

Dose Optimisation



Appendix

Scoring system used to select radioiodine dose for treatment of cats with hyperthyroidism

Factor	Classification	Score
Clinical signs*	Mild	1
	Moderate	2
	Severe	3
Serum T_4 concentration	< 125 nmol/L	1
	125 to 250 nmol/L	2
	> 250 nmol/L	3
Thyroid tumor size†	< 1.0 × 0.5 cm	1
	1.0 × 0.5 to 3.0 × 1.0 cm	2
	> 3.0 × 1.0 cm	3

*Severity of clinical signs determined on the basis of number and magnitude of clinical signs and duration of illness. †Thyroid tumor size estimated from digital palpation of the thyroid gland; if both thyroid lobes were enlarged, the sizes of both lobes were added together to determine the score.

Cats with a total score of 3, 4, or 5 were treated with a low dose (2.0 to 3.4 mCi; 74 to 130 megabecquerels (MBq)), cats with a total score of 6 or 7 were treated with a moderate dose (3.5 to 4.4 mCi; 130 to 167 MBq), and cats with a total score of 8 or 9 were treated with a high dose (4.5 to 6.0 mCi; 167 to 222 MBq) of radioiodine.

$$^{131}\text{I administered (cpm)} = \frac{\text{Initial } ^{131}\text{I } (\mu\text{Ci})}{^{131}\text{I ds } (\mu\text{Ci})} \times ^{131}\text{I ds (cpm)}.$$

$$^{131}\text{I uptake (\%)} = \frac{\text{Thyroid counts (cpm)} - \text{Thigh counts (cpm)}}{^{131}\text{I administered (cpm)}} \times 100.$$



Original Investigation

THYROID SCINTIGRAPHY FINDINGS IN 2096 CATS WITH HYPERTHYROIDISM



Radioiodine treatment of 524 cats with hyperthyroidism

Mark E. Peterson, DVM, and David V. Becker, MD



Journal of Veterinary Internal Medicine



STANDARD ARTICLE | [Open Access](#) | [CC](#) | [i](#)

Assessment of serum symmetric dimethylarginine and creatinine concentrations in hyperthyroid cats before and after a fixed dose of orally administered radioiodine

Original Article



Assessment of treatment outcomes in hyperthyroid cats treated with an orally administered fixed dose of radioiodine

Journal of Feline Medicine and Surgery
2020, Vol. 22(8) 744–752
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DOI: 10.5455/OVJ.2022.v12.i2.11

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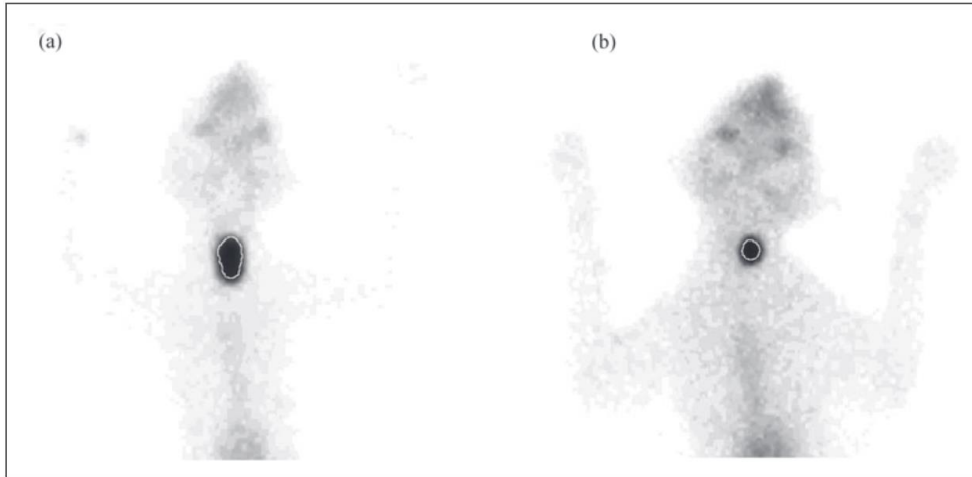
Outcome of radioiodine therapy for feline hyperthyroidism: Fixed dose versus individualized dose based on a clinical scoring system





Radioactive Iodine Therapy (I^{131})

Dose Optimisation – Scintigraphy Based



How does it work?

- Tracer uptake
- Known effective half-life of I^{131}
- Proposed weight of cat's thyroid gland

***Does calculated thyroid volume
= amount of I^{131} required?***

Unfortunately it isn't that easy

Original Article

Scintigraphic thyroid volume calculation in hyperthyroid cats

Veerle Volckaert, Eva Vandermeulen, Jimmy H Saunders,
Anaïs Combes, Luc Duchateau and Kathelijne Peremans



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Radioactive Iodine Therapy (I^{131})

Dose Optimisation – Individualised Scoring System

Appendix

Scoring system used to select radioiodine dose for treatment of cats with hyperthyroidism

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Radioiodine treatment of 524 cats with hyperthyroidism

Mark E. Peterson, DVM, and David V. Becker, MD

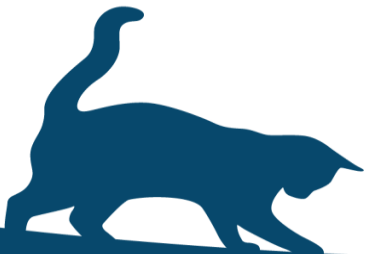
How does it work?

Summation of clinical signs + serum T_4 concentration + thyroid tumour size = a score out of 9

For example:

Clinical signs*	Mild	1
	Moderate	2
	Severe	3
Serum T_4 concentration	< 125 nmol/L	1
	125 to 250 nmol/L	2
	> 250 nmol/L	3
Thyroid tumor size†	< 1.0 × 0.5 cm	1
	1.0 × 0.5 to 3.0 × 1.0 cm	2
	> 3.0 × 1.0 cm	3
		= 6/9

The cat has a score of 6/9, so is treated with a moderate dose of 130-167 MBq





Radioactive Iodine Therapy (I^{131})

Dose Optimisation – Individualised Scoring System

TABLE 1 A scoring system was used to calculate the dose of radioactive iodine administered to each cat

Scoring system before 2015		
Score	Clinical signs	Serum total thyroxine concentration
1	Mild	<125 nmol/L
2	Moderate	125-250 nmol/L
3	Severe	>250 nmol/L
Total score		Dosage
<3		111 MBq
4		148 MBq
5-6		185 MBq

Note: A score was assigned to both TT4 concentration at the time of hospital admission and the clinical signs. These were then added together and on the basis of that figure the dose was given.

TABLE 2 The scoring system used to calculate the dose of radioactive iodine administered to each cat was modified in 2015

Scoring system after 2015		
Score	Clinical signs	Serum total thyroxine concentration
1	Very mild/none	<90 nmol/L
2	Mild	90-125 nmol/L
3	Moderate	125-250 nmol/L
4	Severe	>250 nmol/L
Total score		Dosage
2		74 MBq
3-4		111 MBq
5-6		148 MBq
7-8		185 MBq

DOI: 10.1111/jvim.16161

STANDARD ARTICLE

Journal of Veterinary Internal Medicine **ACVIM**
American College of
Veterinary Internal Medicine

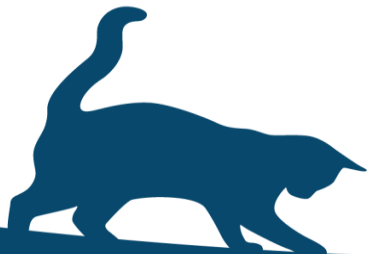
Treatment failure in hyperthyroid cats after radioiodine (I^{131}) injection

Deirdre Mullowney¹ | Yu-Mei Chang² | Barbara Glanemann¹ | Harriet M. Syme¹

Treatment failure defined as persistent hyperthyroidism following I^{131}

Conclusions & Clinical Importance:

Cats with TT4 >150 nmol/L at discharge might be candidates for immediate repeat treatment.



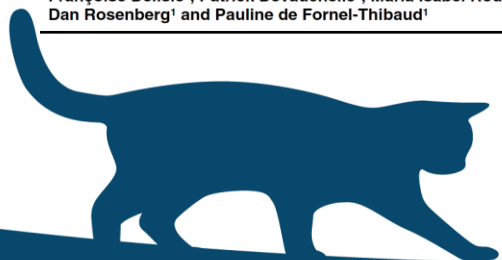


Radioactive Iodine Therapy (I^{131})

Dose Optimisation – Fixed Dose

Many doses have been trialled, ranging from 74 to 185 MBq

Dose: MBq		Dose: MBq		Dose: MBq	
<p>Submitted: 26/11/2021 Accepted: 21/03/2022 Published: 05/04/2022</p> <p>Outcome of radioiodine therapy for feline hyperthyroidism: Fixed dose versus individualized dose based on a clinical scoring system</p> <p>Joana Matos¹*, Bérénice Lutz^{1†}, Lisa-Maria Grandt¹, Felix Meneses², Daniela Schweizer-Gorgas², Thierry Francey¹ and Miguel Campos¹</p> <p>¹Small Animal Internal Medicine Division, Department of Clinical Veterinary Medicine, Vetsuisse Faculty University of Bern, Bern, Switzerland</p> <p>²Clinical Radiology, Department of Clinical Veterinary Medicine, Vetsuisse Faculty University of Bern, Bern, Switzerland</p> <p>[†]These authors contributed equally to this work.</p>		<p>Serum thyroxine concentrations following fixed-dose radioactive iodine treatment in hyperthyroid cats: 62 cases (1986-1989).</p> <p>Meric SM¹, Rubin SI</p> <p>Author information</p> <p>Journal of the American Veterinary Medical Association, 01 Sep 1990, 197(5):621-623</p> <p>PMID: 2211313</p>		<p>Assessment of treatment outcomes in hyperthyroid cats treated with an orally administered fixed dose of radioiodine</p> <p>Lucia Yu¹, Lauren Lacordia¹, Sue Finch² and Thurid Johnstone¹</p>	
<p>Survival times for cats with hyperthyroidism treated with a 3.35 mCi iodine-131 dose: a retrospective study of 96 cases</p> <p>Marie Vagney¹, Loïc Desquilbet², Edouard Reyes-Gomez^{3,4}, Françoise Delisle¹, Patrick Devauchelle¹, Maria Isabel Rodriguez-Piñeiro¹, Dan Rosenberg¹ and Pauline de Fornel-Thibaud¹</p>		<p>Thyroid and renal function in cats following low-dose radioiodine (111MBq) therapy</p> <p>N. C. Finch, J. Stallwood, S. Tasker, A. Hibbert</p> <p>First published: 22 July 2019 https://doi.org/10.1111/jsap.13057 Citations: 13</p>		<p>Ultra-Low Doses of Radioiodine Are Highly Effective in Restoring Euthyroidism without Inducing Hypothyroidism in Most Cats with Milder Forms of Hyperthyroidism: 131 Cases</p> <p>Peterson M.E. and Broome M.R.</p> <p>Conference Proceedings, (2014). American College of Veterinary Internal Medicine, Nashville:</p>	





Radioactive Iodine Therapy (I^{131})

Dose Optimisation

At WAVES, we will use an individualised clinical scoring system





Radioactive Iodine Therapy (I^{131})

Evaluation of Outcomes

**Treatment
SUCCESS**
95%

Cats that are no longer
hyperthyroid
Hypothyroid?



**Treatment
FAILURE**
5%

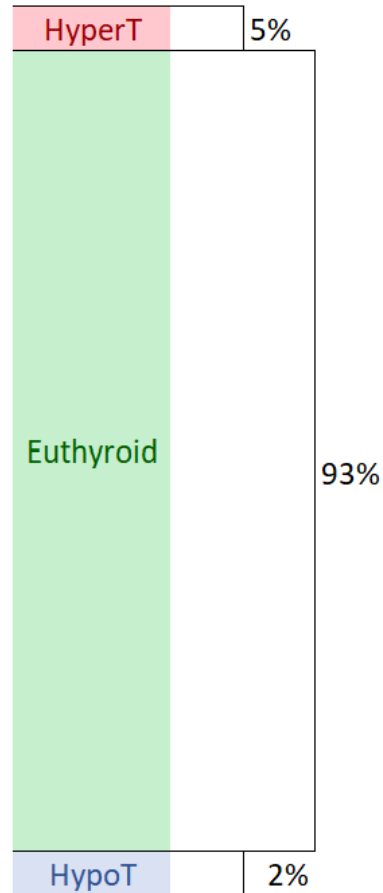
Cats that remain persistently
hyperthyroid





Radioactive Iodine Therapy (I^{131})

Evaluation of Outcomes



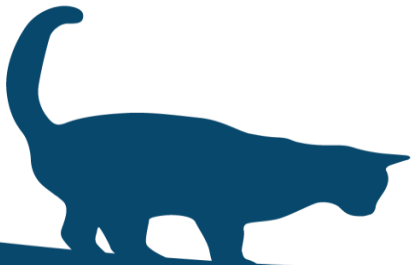
Old Outcomes:

- Hyperthyroid 95%
- Not Hyperthyroid 5%



New Outcomes:

- Persistent Hyperthyroidism 5%
- Euthyroidism 93%
- Overt Hypothyroidism 2%





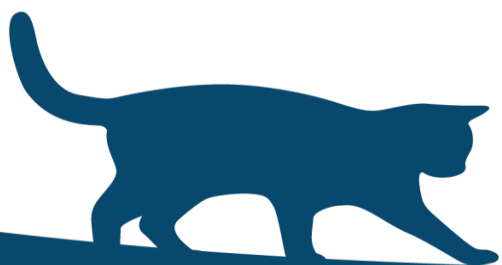
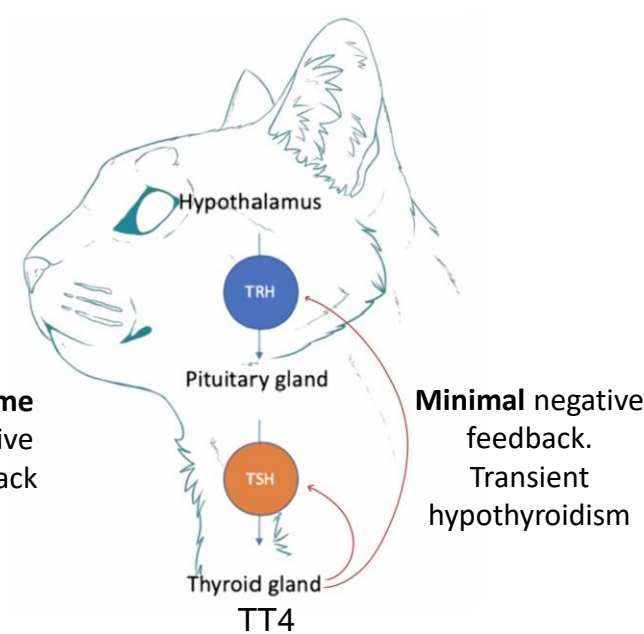
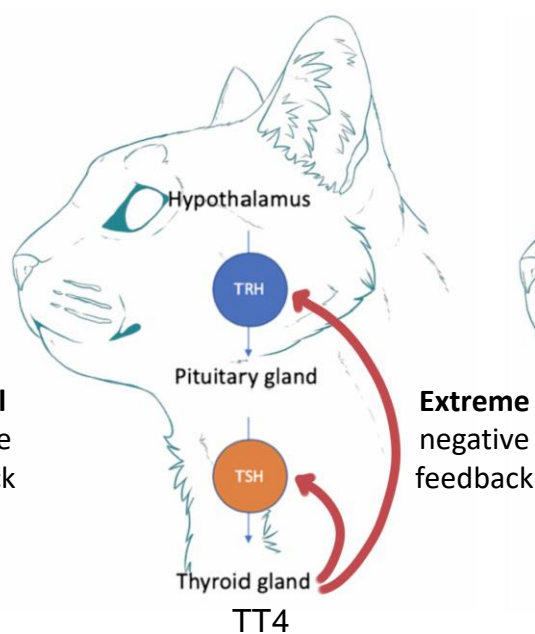
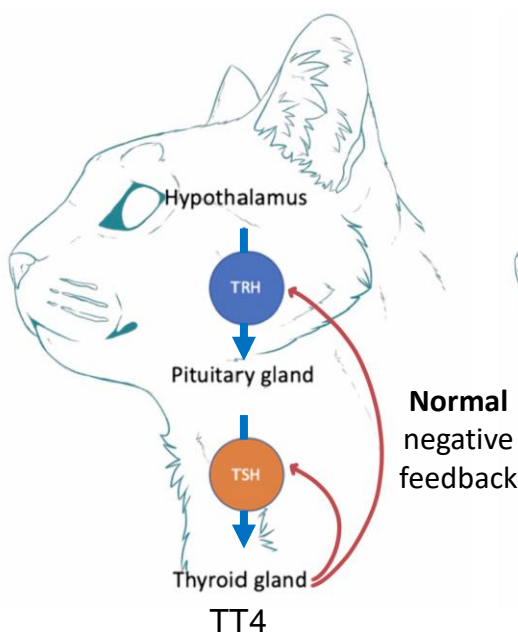
Radioactive Iodine Therapy (I^{131})

Evaluation of Outcomes – Transient Hypothyroidism

Normal Function

Hyperthyroidism

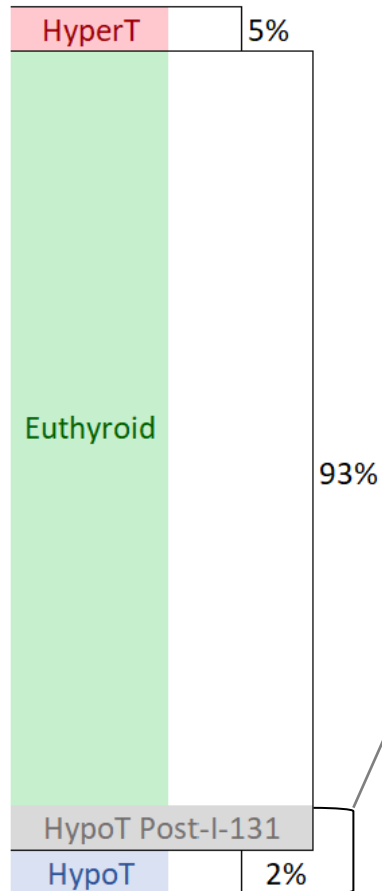
5-7% Post- I^{131}





Radioactive Iodine Therapy (I^{131})

Other causes of Hypothyroidism



	LOW	REFERENCE INTERVAL	HIGH
Non-Thyroidal Illness	TT4		
		fT4	
	TSH		
Subclinical Hypothyroidism?	TT4		
	fT4		
		TSH	
Overt Hypothyroidism	TT4		
	fT4		
			TSH

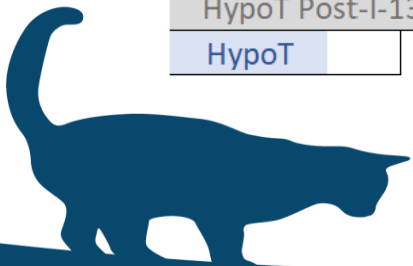
→ 45%

→ 35%

→ 20%



Only 2% of the total population of I^{131} treated cats require thyroxine supplementation



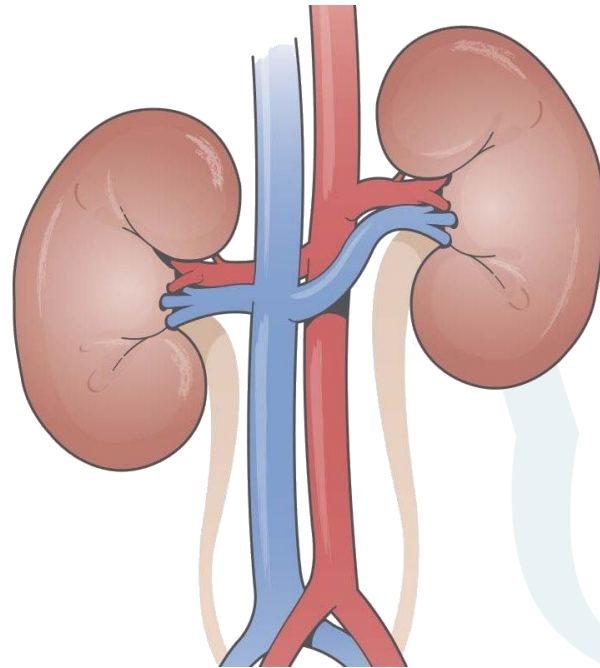


Radioactive Iodine Therapy (I^{131})

Adverse Effects

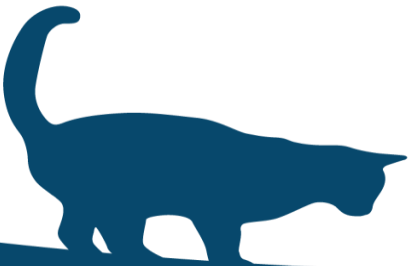
Renal disease

“Unmasking” pre-existing disease



Hypothyroidism

Causes renal impairment





Radioactive Iodine Therapy (I^{131})

Adverse Effects: Renal Disease

Renal Function Markers

Creatinine
Blood Urea Nitrogen (BUN)

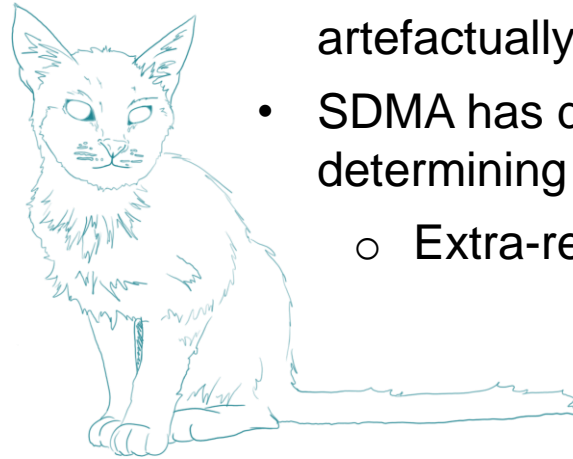
SDMA
Urine Specific Gravity

Hyperthyroidism & renal blood flow

- Raises cardiac output (chronotropic, inotropic)
- Activation of RAAS → increased blood volume
- Renal blood flow increased!

What about SDMA?

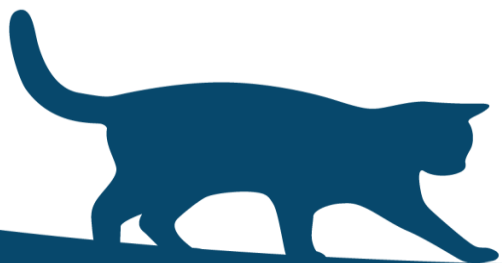
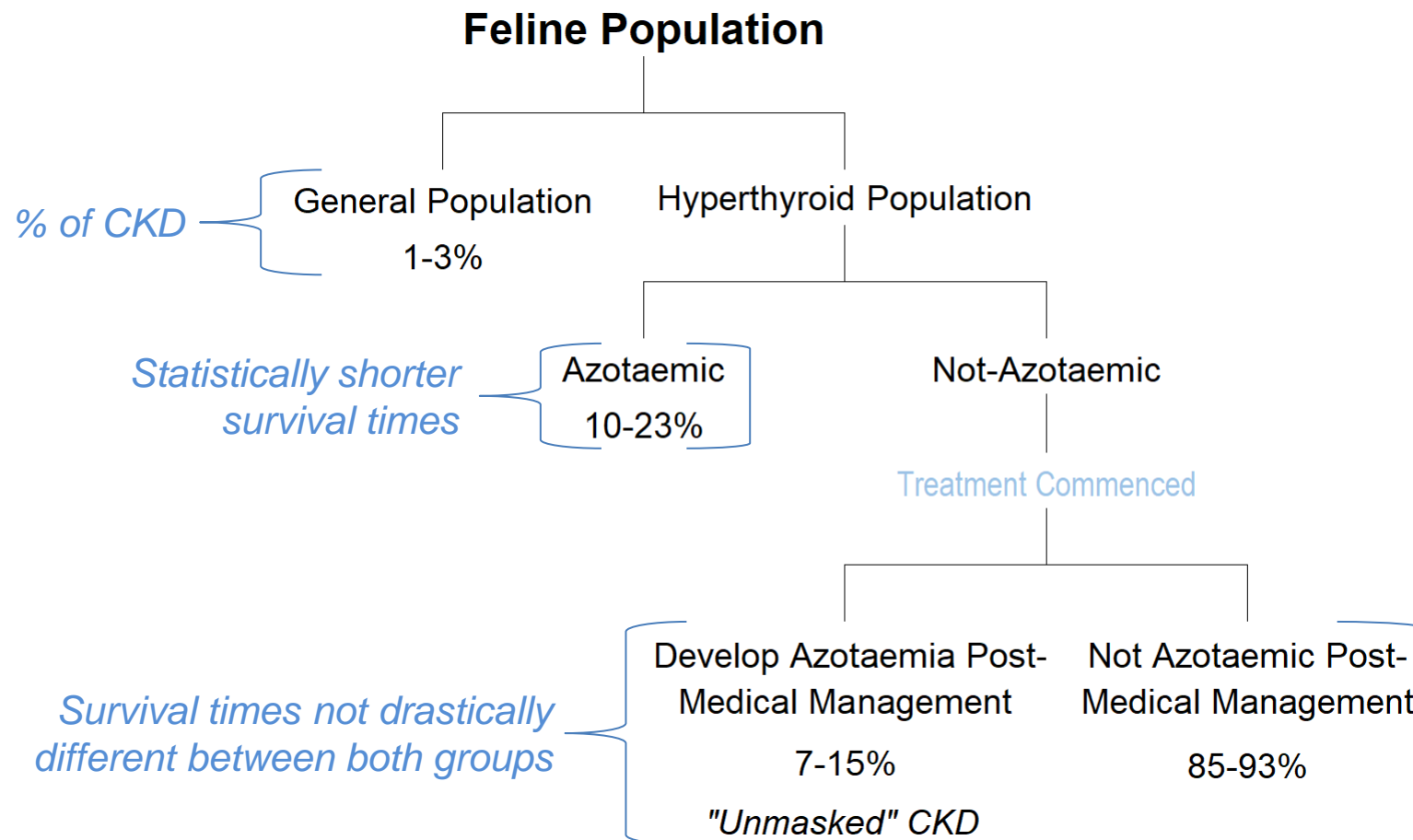
- Also affected by GFR and so can be artefactually lowered (similar to creatinine)
- SDMA has decreased specificity for determining renal function before and after I^{131}
 - Extra-renal factors interfere with SDMA





Radioactive Iodine Therapy (I^{131})

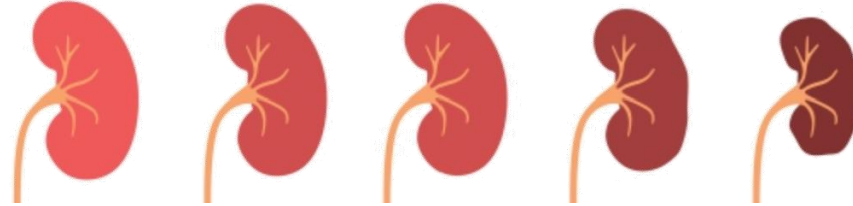
Adverse Effects: Renal Disease





Radioactive Iodine Therapy (I^{131})

Adverse Effects: Renal Disease



You can assess the possibility of CKD before I^{131}

→ Creatinine, BUN, USG

If the cat is already on medical management (such as methimazole), the thyroid status will be known prior to I^{131}

Otherwise, can treat with medical management first if concerned about renal dysfunction





Radioactive Iodine Therapy (I^{131})

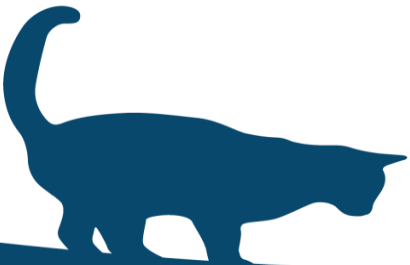
Who is a candidate for I^{131} ?



- IRIS stage I-II when euthyroid
- Not on daily medications



- Overt renal disease when hyperthyroid
- On daily medications
- Serious concurrent medical conditions





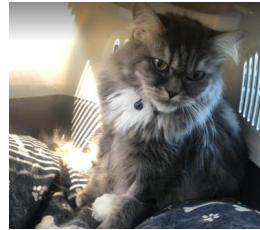
Radioactive Iodine Therapy (I^{131})

The Process

Initial
consultation



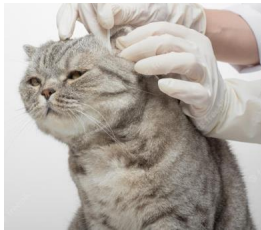
Dose
calculated
and ordered
the week
prior



Dose
administered
12pm
Monday



Discharged
home
Saturday

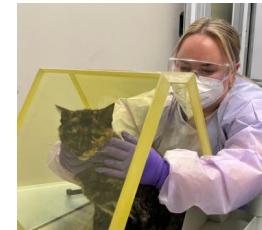


Further
diagnostics if
required

Stop
medications!



Hospitalised
8am Monday



Hospitalised
for 5 nights





Radioactive Iodine Therapy (I^{131})



Initial consultation

Assess suitability of the patient
Discuss process & costs with client



Diagnostics & stop medications

Based on the individual cat and what has already been done with the referring vet, further diagnostics may be required.
Anti-thyroid medications and iodine restricted diets will then be discontinued



Dose calculation

Once the medications/diet have been discontinued for 2 weeks, the TT_4 will be re-measured and the dose calculated the week before I^{131} treatment is scheduled



Before Hospitalisation





Radioactive Iodine Therapy (I^{131})



**Hospitalised 8am
Monday**



**Dose administered
12pm Monday**



**Hospitalised for 5
nights**



**Discharged home
Saturday**



Hospitalisation Period





Radioactive Iodine Therapy (I^{131})

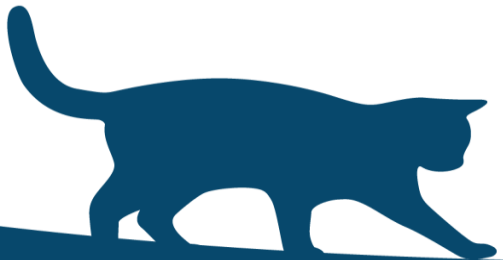


Hospitalised 8am Monday

Admitted to the hospital at 8am

Fasted overnight and receive anti-nausea medication (maropitant) → reduce risk of vomiting the radioactive iodine capsule.

If fractious and pose a risk to themselves and the staff → sedatives (i.e. gabapentin) will be considered





Radioactive Iodine Therapy (I^{131})

PPE is very important!



Dose administered 12pm Monday



Always given at 12pm

Dose calculated to equate for radioactive decay during transit from the laboratory to the clinic





Radioactive Iodine Therapy (I^{131})



Hospitalised for 5 nights

Radiation sensor – assess cat + test the room and staff for contamination

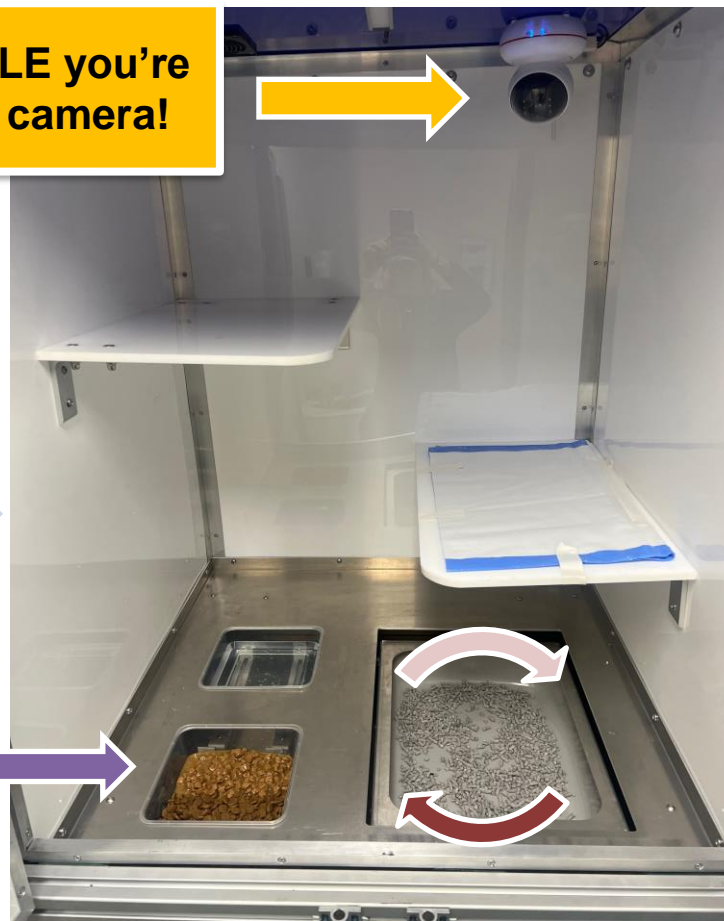
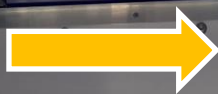




Radioactive Iodine Therapy (I^{131})



SMILE you're
on camera!



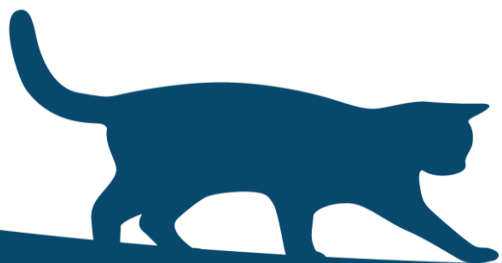
Water
&
Food



Trap door system to rotate out waste without
needing to touch it



Hospitalised for 5 nights





Radioactive Iodine Therapy (I^{131})

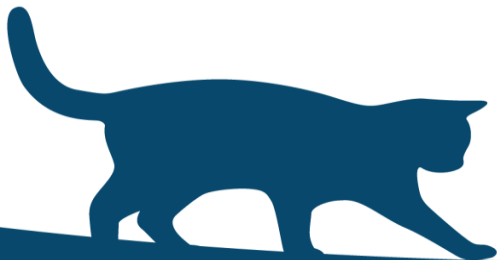


Discharged home Saturday

Acceptable timeframe to reduce radiation exposure risk is 5 days

At Home Care for 2 Weeks

1. Cat **MUST** stay indoors
2. Close contact for <10 minutes per day – NO children or pregnant women should handle the cat during this time
3. Thoroughly wash hands after handling the cat, food/water bowl, & litter tray
4. Litter → Store for 3 months, then normal disposal
5. Wash all bedding separately in a washing machine





Radioactive Iodine Therapy (I^{131})

Monitoring

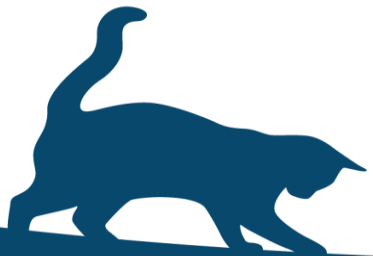


Monitoring Diagnostics

- Blood pressure measurement
- Urinalysis
- Thyroid and renal function tests

Determine Thyroid Status

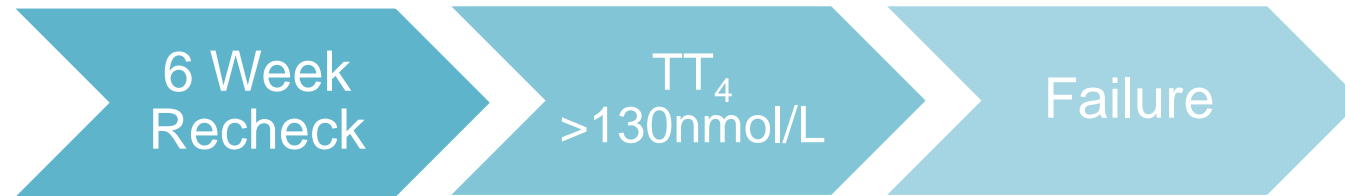
- Euthyroidism
- Hypothyroidism (Transient vs Permanent)
- Persistent Hyperthyroidism



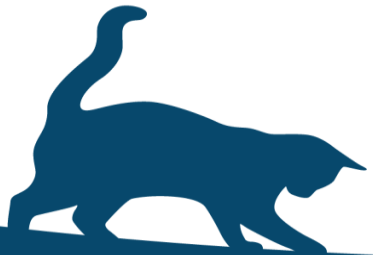


Radioactive Iodine Therapy (I^{131})

High TT_4



Treatment failures usually determined after 6 months
Treatment failures are more likely to be thyroid carcinomas
Scintigraphy or histopathology may be required after 6 months





Radioactive Iodine Therapy (I^{131})

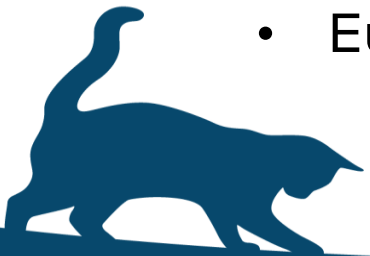
Azotaemia

6 Weeks

Azotaemia

Determine Thyroid Status: Low TT_4 or Euthyroid?

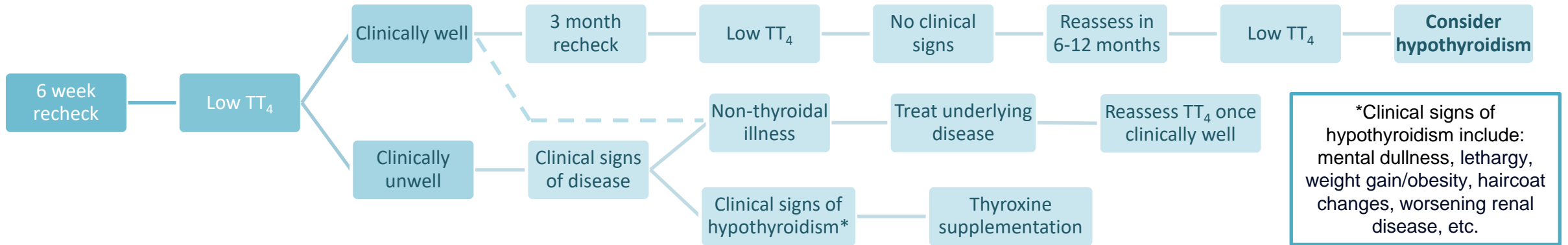
- Low TT_4
 1. May require thyroxine supplementation depending on the degree of hypothyroidism and the degree of azotaemia
 2. The hope would be to wean off thyroxine in case thyroid function has begun to return
- Euthyroid → management for renal disease based on IRIS guidelines





Radioactive Iodine Therapy (I^{131})

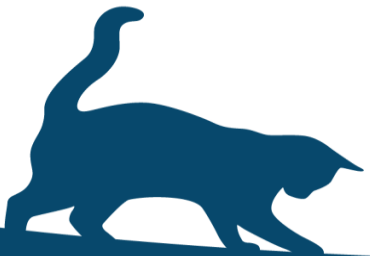
Low TT_4



A low TT_4 measurement after treatment is difficult to interpret and is highly patient dependent.

Transient hypothyroidism is to be expected to a degree.

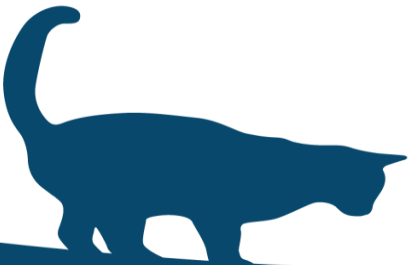
Thyroxine supplementation should not be commenced unless necessary
→ can prolong TRH / TSH suppression via negative feedback.





Conclusion – Radioactive Iodine (I^{131})

1. Safe and effective treatment option
2. Targeted approach (normal thyroid tissue left alone)
3. High success rate
4. Minimal adverse effects
5. Long-term efficacy



Now you know what's HOT about hyperthyroidism!

Thank you for listening

Tiarni Johnston BVSc (Hons) MANZCVS (SAIM)

Internal Medicine Resident

