Sarah Whiteman BSc(Hons) RVN

Sarah graduated from the University of Bristol in 2015 with first class honours in Veterinary Nursing and Bioveterinary Science. After qualifying, Sarah worked at a first opinion practice in Taunton for 4 years before moving to a veterinary hospital in Bath. Sarah particularly enjoys internal medicine and inpatient care. Email: sarah-whiteman@hotmail.com

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Surgical treatment of the hyperthyroid feline patient

Sarah Whiteman BSc(Hons) RVN

Bath Veterinary Group, Rosemary Lodge Hospital, Wellsway, Bath, BA2 5RL, UK

ABSTRACT: Hyperthyroidism occurs due to over production of the thyroid hormones (triiodothyronine—T3 and thyroxine—T4) by the thyroid gland and is a common condition of older cats. Diagnosis is usually suspected on the basis of clinical history and physical examination and can typically be confirmed on assessment of serum basal total thyroxine levels. There are a number of treatment options available, with medical stabilisation followed by surgery chosen in around 27.5% of cases. Post-operative monitoring is important in these patients due to the risk of complications, although this is dependent upon the surgery carried out and surgical technique used. A good success rate and prognosis following surgery is reported.

Keywords: feline; hyperthyroidism; surgery; nursing; endocrine

Hyperthyroidism

Hyperthyroidism is the most common endocrine disease diagnosed in feline patients (Padgett, 2002), with studies showing a prevalence of approximately 9% in cats over the age of ten (Stephens et al., 2014). Over-activity of the thyroid gland, usually due to presence of a mass, results in increased concentrations of either one or both the hormones triiodothyronine and thyroxine (Mooney & Peterson, 2012). In 98% of cases, the cause is functional benign adenomatous hyperplasia, but in around 2% of cats, the condition is a result of thyroid carcinoma (Birchard, 2006; Padgett, 2002; van Hoek & Daminet, 2009).

Diagnosis

Initial diagnosis is suspected on the basis of clinical signs at presentation which might include polyuria, polydipsia, poor coat quality, weight loss despite normal or increased appetite, tachycardia, hyperactivity and difficulty to handle (Figure 1). On examination, an enlarged thyroid gland (goitre) is often palpated, although this is only present in 85–90% of hyperthyroid felines so cannot be relied upon alone (Birchard, 2006). For confirmation of diagnosis, blood testing is required. Measurement of thyroxine (T4) levels provides the most reliable results and is therefore the most common test performed in practice (Peterson, Guterl, Nichols, & Rishniw, 2015). However, in patients where a normal T4 result has been received but the patient is suspected of being hyperthyroid, it is helpful to use a combination of thyroid tests to achieve a diagnosis (Peterson et al., 2015). In general, the T4 levels of hyperthyroid patients fall in the upper reference range or above; if results are in the lower half of the reference range, hyperthyroidism is unlikely. Other blood tests to aid diagnosis include triiodothyronine (T3) and free thyroxine (fT4) levels. However, these have been shown to produce a larger number of false-negative and false-positive results respectively. Although feline-specific tests of TSH levels do not currently exist, some research has looked at use of canine TSH assays to measure levels in feline patients. Results have shown that a normal TSH level is found in only 2% of cats with hyperthyroidism so can be helpful in ruling out hyperthyroidism in patients with equivocal T4 results (Peterson et al., 2015). However, undetectable/low TSH levels are also seen in some cats with normal thyroid function, making this test non-specific, and as such it is rarely used in practice currently.

It is also important to run haematology and biochemistry profiles in these patients to look for clues of hyperthyroidism and for

Figure 1. Hyperthyroid cats often present underweight, with an unkempt coat appearance. This patient is also showing dilated pupils which could suggest ocular damage caused by hypertension, or be as a result of fear and stress in the practice.

evidence of concurrent disease. Common clues of hyperthyroidism include raised liver enzymes, erythrocytosis, leucocytosis and eosinopaenia. Results have shown 90% of patients will have elevated liver enzyme levels and 20% high renal parameters (blood urea nitrogen and creatinine) (Padgett, 2002). However, due to the different interactions between hyperthyroidism and kidney disease, renal status can be difficult to assess in hyperthyroid patients, with some cats developing kidney failure post-stabilisation, despite normal renal parameters on pre-treatment bloods. Research has shown that performing assessment of symmetric dimethylarginine (SDMA) prior to treatment may help to predict cats with occult renal disease—if SDMA is high but creatinine normal, the patient is more likely to develop renal complications once euthyroidism is achieved (Peterson, Varela, Rishniw, & Polzin, 2018). However, a normal SDMA does not rule out post-treatment reduction in renal function. Urinalysis evaluation should also ideally be included as part of the diagnosis to exclude diseases with similar clinical signs such as diabetes mellitus (Donovan, 2014). Assessment of blood pressure in these patients is essential as around 10–23% of cats will have concurrent systemic hypertension (Carney et al., 2016; Taylor et al., 2017). Further tests should also include testing of proBNP levels to identify cardiac remodelling, therefore indicating presence of hypertrophic cardiomyopathy. Cardiac disease is commonly seen in cats with hyperthyroidism (Carney et al., 2016).

Treatment options

The four main treatments for feline hyperthyroidism include:

- Medical treatment with anti-thyroid drugs
- Surgical thyroid gland removal (thyroidectomy)
- Radioactive iodine therapy
- Iodine-restricted diets

Each method has advantages and disadvantages so the option chosen is dependent on patient condition, treatment availability and client preferences (Padgett, 2002). Studies show medical management is the most common treatment option undertaken (65.7%), with thyroidectomy chosen in 27.5% of cases and radioiodine in 5.5% (Higgs, Murray, & Hibbert, 2014).

The main advantage of thyroidectomy over other treatment modalities is the potential for it to be curative, negating the need for long-term medication. It is also relatively straightforward to perform and is less expensive than radioiodine therapy. However, the patient requires a general anaesthetic, the thyroid gland must be accessible surgically (not located intrathoracially), there is a risk of side effects post-operatively and hyperthyroidism may reoccur.

Pre-operative stabilisation

Unless surgery is required immediately or the hyperthyroidism is only mild (slightly elevated thyroxine, no weight loss and mild tachycardia), medical treatment to achieve euthyroidism is recommended initially (Birchard, 2006). Thiamazole (also referred to as methimazole) and carbimazole are commonly used in practice (Figure 2). These agents block production of thyroid hormones, typically resulting in euthyroidism within a couple of weeks. Treatment also aims to control metabolic and cardiac abnormalities, making the patient a better candidate for anaesthesia (Padgett, 2002). The recommended duration of pre-operative treatment varies from seven to ten days (Birchard, 2006) to two to four weeks (Padgett, 2002), but blood tests should be repeated to ensure euthyroidism has been achieved before surgery is performed.

Anaesthesia and analgesia

In general practice, anaesthetic monitoring is usually undertaken by the veterinary nurse. Thyroidectomies can be challenging procedures to monitor with arrhythmias and other cardiac abnormalities often seen (Birchard, 2006).

Premedication using acepromazine is advised as it reduces autonomic tone, decreasing the risk of arrhythmia occurrence (Padgett, 2002). Inclusion of an opioid to provide perioperative analgesia is also recommended (Johnson & Norman, 2007). The patient should then be induced with propofol or alfaxalone. Many papers (Johnson & Norman, 2007; Padgett, 2002) advise to avoid both atropine and ketamine in these patients as oxygen consumption by the myocardium is increased, which can increase arrhythmia occurrence.

An important aspect of monitoring during thyroidectomy is for occurrence of a 'thyroid storm', when a rapid release of thyroid hormone is caused by thyroid gland palpation. Clinical signs include tachycardia, tachydysrhythmia, tachypnoea, hypertension, hyperthermia, hyperglycaemia, neurological abnormalities and signs of shock (Baines & Neiger-Aeschbacher, 2005; Daniels, 2012). Therefore, electrocardiography, blood pressure and temperature monitoring is especially important in these patients, along with close observation of other vital signs, to allow early identification of such complications. Treatment is dependent upon the clinical signs present and involves administration of emergency drugs and intravenous fluid therapy to stabilise the patient.

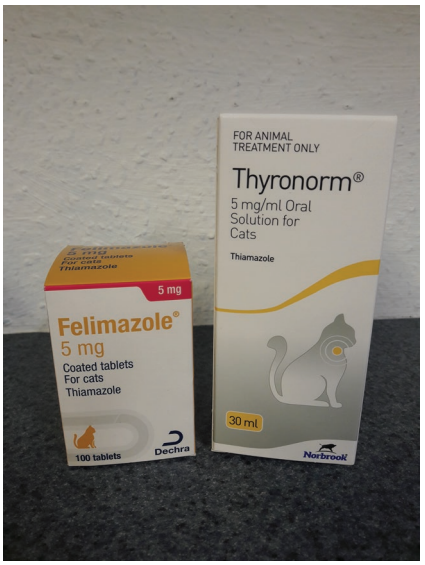

Figure 2. Thiamazole (Felimazole, Dechra, Thyronorm, Norbrook and Thiafeline, Animalcare (not pictured)) and carbimazole (Vidalta, MSD (not pictured)) are most commonly used for pre-operative medical stabilization.

Patient preparation

Positioning for this procedure requires the patient to be in dorsal recumbency with the forelimbs extended caudally to provide extension of the neck. Placement of a rolled up towel or foam wedge under the neck can also help with extension and improvement of the surgical field (Figure 3). An area should be clipped on the ventral neck extending from the mandibular angle cranially to the thoracic inlet caudally and this should undergo an aseptic surgical preparation.

Surgical techniques

There are four techniques used for thyroidectomies:

- Extracapsular—removal of the thyroid gland, its capsule and corresponding parathyroid gland—risk of hypocalcaemia is high with this method, especially during bilateral surgery due to loss of the parathyroid glands
- Modified extracapsular—the thyroid gland is removed along with its capsule, but the parathyroid gland is dissected free and left in situ—damage to the parathyroid glands and hypocalcaemia is still a risk, particularly if surgery is bilateral
- Intracapsular—dissection of the thyroid gland from its capsule to remove the gland only—risk of hyperthyroidism reoccurring is high if not all thyroid tissue is removed
- Modified intracapsular—the thyroid gland is removed followed by the majority of the capsule, leaving a small amount near the parathyroid gland (Anderson, 2005)

It has been suggested previously that should both thyroid glands require removal, the two surgeries were staged and performed at least 3 weeks apart to reduce the risks caused by bilateral thyroid removal (Padgett, 2002). However, many clinicians will now perform a bilateral thyroidectomy in the same surgery. It is important though to ensure thorough post-operative monitoring for the following 72 hours so it may be beneficial to plan these surgeries for earlier in the week where nursing care may be less limited compared to at the weekend.

Figure 3. Patient positioning for thyroidectomy.

Due to the delicate nature of a thyroidectomy, additional procedure-specific equipment may be required by the surgeon. This includes a fine blade, small/iris scissors, magnification, sterile cotton buds and bipolar diathermy for haemostasis.

Post-operative nursing

Initial post-thyroidectomy nursing is similar to most surgical procedures. Immediately post-surgery, monitoring and treatment for hypothermia is important. Hypothermia occurs in up to 70% of patients undergoing surgical procedures (Henderson, 2012) with patients less than 5 kg at greater risk due to a higher surface area to volume ratio (Davies, 2012). Temperature should be monitored peri-operatively and if hypothermia occurs, active warming is recommended until the patient reaches normothermia (37.8–39.2 °C) at which point, a change to passive warming should be made (Davies, 2012). Temperature should then be taken every 10 minutes until the patient is alert and moving, then half hourly ensuring normothermia is maintained.

Following any surgery, it is also best practice to carry out pain assessments using a recognised pain scoring system to determine analgesic requirements. Analgesia is often included in the premedication but additional may be required following surgery. The frequency of pain scoring is the decision of the veterinary surgeon, but ideally should be a minimum of four-hourly, or tailored to the analgesic used with scores recorded 30 minutes following administration, at the midpoint of analgesic duration and at the time it is expected to wear off. These scores will then allow assessment if current analgesia is sufficient and whether it is still required.

Wound management is another important aspect of post-operative nursing. Wounds should be checked at least twice daily for any swelling, erythema, discharge or haemorrhage. However, more frequent checks are ideal, especially if complications are present. The wound should also be gently palpated to assess for any heat or pain. Due to presence of a neck incision, buster collars should be avoided in these patients to prevent pressure on the area and any irritation (Thornley, 2013), so preventing patient interference is also important. Socks or boots may be required on the patient's back feet to prevent scratching of the wound if necessary. Alternatively, a net dressing with padding underneath could be used to cover and protect the wound itself.

It is also important in the post-operative period to monitor patients for signs of hypocalcaemia including twitches, tremors, vocalisation, irritability, hyperaesthesia, loss of appetite, tetany and seizures (Birchard, 2006). If the patient is showing any unusual behaviour, calcium levels should be checked initially to rule out hypoparathyroidism, even if unilateral thyroidectomy only has been performed.

Post-operative complications

Hypocalcaemia is the most serious complication following surgery and occurs due to removal or damage to the parathyroid glands (Donovan, 2014). It is more commonly seen following bilateral thyroidectomy as normal calcium homeostasis can usually be maintained with only one functional parathyroid gland (Padgett, 2002). Hypocalcaemia develops 24–72 hours post-surgery (Padgett, 2002) so blood calcium levels should be measured 24 hours post-procedure, with continued monitoring for 2 days being the gold standard. Although biochemical hypocalcaemia may be seen 24 hours following thyroidectomy, the clinical signs discussed previously may not be seen for a further 24 hours. Therefore, even if calcium levels are only mildly reduced, intervention should be implemented before clinical signs develop.

Renal function should also be monitored post-operatively as azotaemia that was masked pre-operatively may develop (Padgett, 2002). Clinical signs of impaired function include vomiting, diarrhoea, polyuria, and polydipsia (Breton, 2012). Best practice would be to test blood renal parameters (blood urea nitrogen and creatinine) one week post-surgery. It is thought the reduction in thyroxine levels following thyroidectomy causes the increased renal blood flow and glomerular filtration rate (GFR) caused by the hyperthyroid state to decrease. In many cats, this is not associated with kidney problems but in some, this reduction in blood flow may allow kidney disease that was not previously recognised to become apparent. Affected cats become azotaemic and start to develop clinical signs of renal failure (DiBartola, Broome, Stein, & Nixon, 1996; Graves et al., 1994). These changes are usually evident by 4 weeks post-treatment, after which time GFR usually stabilises with little further deterioration.

Hypothyroidism is also now considered a serious complication following thyroidectomy with a recent study (Covey, Chang, Elliot, & Syme, 2019) finding 49% of cats to be hypothyroid in the initial 6 months post-surgery. Hypothyroidism is associated with a higher incidence of post-operative azotaemia and a resultant reduction in survival time (Williams, Elliot, & Syme, 2010).

Other potential post-operative complications include laryngeal nerve damage resulting in laryngeal paralysis and recurrence of hyperthyroidism (Padgett, 2002). Studies have found recurrent hyperthyroidism to occur in 5–27% of patients following thyroidectomy, with surgical technique and experience important factors (Covey et al., 2019).

Prognosis

With correct management and treatment, hyperthyroid cats often live for extended periods following diagnosis, with concurrent disease often contributing to mortality in these patients (Carney et al., 2016).

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Multiple Choice Questions

1. **Hyperthyroidism is caused by overproduction of what hormones?**
   - **(a)** Thyroxine and thyroid stimulating hormone
   - **(b)** Thyroxine and triiodothyronine
   - **(c)** Triiodothyronine and thyroid stimulating hormone
   - **(d)** Oestrogen and progesterone

2. **Studies have shown surgical treatment of hyperthyroidism is chosen in approximately how many cases?**
   - **(a)** 5.5%
   - **(b)** 12.6%
   - **(c)** 27.5%
   - **(d)** 65.7%

3. **What drug should be avoided during anaesthesia of hyperthyroid patients?**
   - **(a)** Ketamine
   - **(b)** Acepromazine
   - **(c)** Methadone
   - **(d)** Alfaxalone

4. **What position should patients be positioned in for a thyroidectomy?**
   - **(a)** Left lateral recumbency with the neck extended
   - **(b)** Dorsal recumbency with the neck extended
   - **(c)** Sternal recumbency with the neck extended
   - **(d)** Right lateral recumbency with the neck extended

5. **What serious complication can be seen following thyroidectomy due to accidental removal or damage to the parathyroid glands?**
   - **(a)** Laryngeal nerve damage/laryngeal paralysis
   - **(b)** Recurrence of hyperthyroidism
   - **(c)** Hypothyroidism
   - **(d)** Hypocalcaemia

For the answers to the MCQs, please go to: **http://www.bvna.org.uk/publications/veterinary-nursing-journal**