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Investigation and management of cervical masses

The cervical region is a common site of pathology in dogs and cats, with a range of differential diagnoses possible. It can be a challenging location to investigate and treat due to its complex anatomy. It is important to have a thorough understanding of the regional anatomy in order to tailor appropriate diagnostic tests and treatment (Figure 1). The cervical region can be divided into its separate structures. From rostral to caudal, areas that need consideration are the salivary glands and ducts, the larynx, thyroid and parathyroid glands, trachea and the oesophagus. Other regional structures that should be evaluated when investigating cervical masses include lymph nodes, dermis, subcutis, muscles, and connective tissue.

History

A thorough history taking and physical examination should not be underestimated. Owners should be questioned on when the mass was first noticed, if it has changed in size or shape and if it seems to be painful or bothering the animal. As well as specific questions relating to the mass, other questions to be asked include if any dysphagia, dysphonia or dyspnoea has been observed and general health questions relating to decreased exercise tolerance, inappetence, general well-being and if the dog chews sticks or the owners throw sticks for their dogs. It is also important to ask if any medication has been given as certain medications such as antibiotics or anti-inflammatory drugs can dramatically change the appearance of some masses, for example abscesses.

Physical examination

It is important to perform an overall examination before focusing on the mass. The animal's heart rate, pulse quality, mucous membrane colour and capillary refill time, temperature, respiratory rate, effort, thoracic auscultation, peripheral lymph nodes and abdominal palpation should all be assessed. Some cervical masses will be associated with systemic changes, for example: abscesses which may produce systemic effects due to pyrexia or sepsis; respiratory difficulties due to interference with the recurrent laryngeal nerve or airway compression from a mass effect; or via a paraneoplastic syndrome. Although others may just be causing local disease, concurrent unrelated systemic abnormalities may also be present and the animal should be evaluated for this and stabilised if necessary prior to receiving a sedation or anaesthetic for further investigations.

The consistency of the mass, any pain, ulceration or associated heat should be determined. The mass should also be carefully palpated to determine its relationship and attachment to underlying structures e.g. whether it is fixed or mobile as this can be important to help determine its origin as well as the potential for surgical resection and therefore likely prognosis in some instances, for example in the case of canine thyroid carcinomas: if the tumour is fixed it may be non-resectable. If the patient is cardiovascularly stable, palpation under sedation can be useful to assess mobility of the mass and adherence/involvement with underlying structures and can be performed in conjunction with sedation for diagnostic tests or procedures. Palpation of local lymph nodes and the thyroid tissue to assess for a thyroid goitre are also important. The animal should be examined for any cranial or facial nerve deficits (including the presence of a gag reflex), pain on opening of the mouth, and jugular pulse and filling should be assessed.

Investigations

Initial investigations should include haematology to assess for an inflammatory/infectious leukogram, platelet count and red blood cell count. Serum biochemistry should be performed prior to general anaesthesia. Paraneoplastic syndromes can occur with neoplastic lesions in the cervical region and therefore the biochemistry should be evaluated for evidence of this too. If involvement of the thyroid gland(s) are suspected then a serum total T4, free T4 and thyroid-stimulating hormone concentrations should be evaluated in both cats and dogs. Although most canine thyroid tumours are non-functional, concurrent hyperthyroidism in dogs is almost always associated with malignancy.¹

A thorough oropharyngeal examination is warranted under a light plane of anaesthesia. It is important to assess laryngeal function as any mass in the cervical area could potentially impinge on the recurrent laryngeal nerves. Therefore premedication and anaesthetic drugs should be chosen with this in mind so as not to decrease laryngeal movement. Premedications that have minimal effect on laryngeal function include methadone, buprenorphine, butorphanol and glycopyrolate.² Propofol is typically used as the induction agent although there is varying opinion in the veterinary world as to its effect on laryngeal function. There are publications supporting its use and comparing it to thiopental and ketamine-diazepam³ for laryngeal assessment, however its combined use with ketamine has been advised against due to increased respiratory depression with no concurrent reduction in propofol dose.⁴ The use of doxapram during laryngeal assessment has been advocated to increase respiratory rate and effort, especially if respiration is absent or shallow.^{4,5} Propofol is used at the author's institution as the induction agent of choice for laryngeal assessment but should be carefully given in increments to effect; the animal should still be breathing spontaneously and ideally have a swallow reflex but should be sedated enough to allow insertion of a laryngoscope into the oropharynx. Regardless of the induction agent used, laryngeal movement should be interpreted with the phase of respiration in mind as paradoxical movement can occur with laryngeal paralysis or praxia, with inward motion of the arytenoids during inspiration due to negative intraglottic pressure. During expiration the arytenoids can then return to their normal position, giving a false impression of laryngeal movement.² The oropharynx should also be carefully assessed for evidence of a ranula associated with a salivary gland problem. The tonsils and tonsillar crypts should be examined for tumours such as squamous cell carcinoma, which could have originated here but metastasised to the draining lymph nodes, thereby resulting in a cervical mass. The area under the tongue is often overlooked but should be carefully assessed for evidence of a penetrating injury.

Imaging of the cervical area can be challenging to interpret and often a combination of imaging modalities are helpful. Plain radiographs may not help differentiate the origin of the mass but may show other associated abnormalities which can help to narrow down a differential list. The presence of gas around the larynx, dorsal to the trachea and in the cervical tissue planes, could be associated with a penetrating injury (figure 2) or gas producing bacteria in an abscess (rare). Radiographs should be evaluated for laryngeal and tracheal distortion or compression and signs of trauma e.g. laryngeal fracture. Radiographs should be assessed for mineralisation that depending on its location and distribution could indicate a sialolith, calcinosis circumscripta, foreign body or chronic inflammation or granuloma. If a mandibular or sublingual salivary mucocele or ranula is suspected then contrast sialography (sialogram) can be performed by catheterisation of the salivary duct and injection of a contrast agent (e.g. iohexol) either under fluoroscopy or with a series of radiographs taken at 20-30

second intervals. This can be helpful if the side of origin is in question, but is rarely indicated otherwise as it does not change the clinical decision making.

Computed Tomography can be very useful to image the cervical region, especially with the addition of intravenous contrast agent (Computed Tomography Angiography, CTA), (figure 3). As the area has a complex anatomy, assessment of it using CT slices or 3D reconstruction can be a great advantage, as well as the benefit of allowing 3D evaluation of anatomy with this modality, (figure 4 and 5). Contrast uptake can help to narrow a differential list for example a cyst or abscess would likely have a rim of contrast uptake peripherally with no contrast uptake in the centre of a lesion. Care must be taken when interpreting these images however as necrotic masses can also have a similar appearance. Hounsfield units are a quantitative scale for describing radiodensity, with different substances having different numbers e.g. lung, fat, air, fluid etc. They can be measured on CT scans to help to identify the structure of a mass e.g. fluid versus soft tissue. CT can be especially useful for surgical planning and determination of invasion or involvement with other nearby structures. CT guided aspirates or biopsies can also be performed and other body areas can be quickly screened at the same time.

Magnetic Resonance Imaging (MRI) is another advanced imaging modality that can be useful in this area however the need for general anaesthesia, limited availability and cost in many centres, often results in this being prohibitive in a lot of cases. However MRI is superior to CT for assessing soft tissues and assessing margins of soft tissue lesions. Foreign bodies may not be seen even with advanced imaging due to their small size or degradation within the body, and owners should be warned of the limitations of even advanced imaging techniques. Larger foreign bodies may be seen even with plain radiographs however a wood foreign body has the same radio-opacity as soft tissue and may not be visible.

Ultrasound can be a very useful imaging modality in the cervical region. As well as determining the echogenicity of the structure and potentially the origin it can be useful to assess other structures for involvement e.g. the thyroid glands and local lymph nodes. Colour Doppler flow ultrasonography can be helpful to determine involvement or effect on local vessels e.g. the jugular vein or carotid and for assessment of the vascularity of the mass. A third advantage of ultrasound is its use in guidance for fine needle aspirates or tru-cut biopsies (Figure 6). Ultrasound has been shown in cadaveric studies to be most sensitive for detecting wood foreign bodies and is often the imaging modality of choice for foreign bodies in humans.

Imaging of the thorax is usually indicated when a cervical mass is present to look for concurrent and associated disease processes in particular for metastatic staging, evidence of aspiration pneumonia, pneumomediastinum or mediastinal widening. Abdominal imaging should also be performed e.g. abdominal ultrasound, if a neoplastic process is suspected.

Other imaging modalities such as scintigraphy may also be warranted depending on the differential diagnosis list for the mass. Scintigraphy is most frequently used in cats to assess for the presence and location of ectopic thyroid tissue in hyperthyroid cases, especially for reoccurrence after prior surgical removal or radioactive iodine treatment. However it can also be useful in dogs (although used rarely as most thyroid tumours in dogs are non-functional), to help determine the location of a thyroid related tumour and for metastatic spread. Scintigraphy involves an intravenous injection of a radioactive isotope, usually technetium-99m followed by imaging with a gamma camera (Figure 7). Fine needle aspirates (FNAs), are often warranted with cervical masses and can be performed blindly

or with the aid of ultrasound or CT guidance. Round cells in particular exfoliate well however FNAs can be non-diagnostic or the results can disagree with biopsy sample results. One study excluded 16.8% of cytology slides from FNAs of cutaneous and subcutaneous masses due to poor cellularity.⁶ The same study found a good agreement (90.9%) between cytological and histological diagnosis.

If the mass is fluid filled then FNAs can be particularly helpful to determine the fluid characteristic e.g. transudate versus exudate and to look for signs of sepsis e.g. the presence of bacteria and degenerate neutrophils. If fluid is obtained then this can be collected into a sterile container for bacterial culture and sensitivity testing. If only a small amount of fluid is obtained but bacterial culture is desirable then collection onto a bacteriology swab can be performed. With masses in the cervical region, other tests that can be performed on the fluid include the mucin test (assessing stringiness of the fluid) and staining with periodic acid-Schiff or Alcian blue (mucin specific stains), to assess for saliva (Figure 8). FNAs should also be considered of the local lymph nodes, even if they are of normal size to look for concurrent involvement.

If FNAs are non-diagnostic then incisional or tru-cut biopsies can be considered. Particular care must be taken in the cervical region with this technique however; major vessels and nerves need to be carefully identified and avoided and therefore advanced imaging or ultrasound guidance can play an important role. Thyroid tumours are usually diagnosed on clinical signs and imaging techniques, rather than fine needle aspirates due to the high risk of haemorrhage which can be fatal, and low diagnostic yield.^{7,8}

Biopsies can be performed with use of a tru-cut biopsy needle with or without ultrasound guidance. A small stab incision is first made through the skin and the needle inserted into the lesion. Tissue samples can be submitted for histological analysis and bacterial and fungal culture and sensitivity. Rolled specimens can also be made onto glass slides for cytological analysis as this may yield a diagnosis faster. Biopsies can also be performed surgically via a small incision which can be more accurate in certain situations as the tissue biopsied can be directly visualised i.e. necrotic tissue or surrounding inflammatory reactive tissue can be avoided if directly visualised.

Conclusion

In summary, cervical masses can be challenging to investigate due to the complex anatomy in this area. A thorough and systematic approach is necessary, starting with a detailed history and physical examination. Imaging should be of clinical relevance and tailored to a differential list with assessment of other body organs as indicated.

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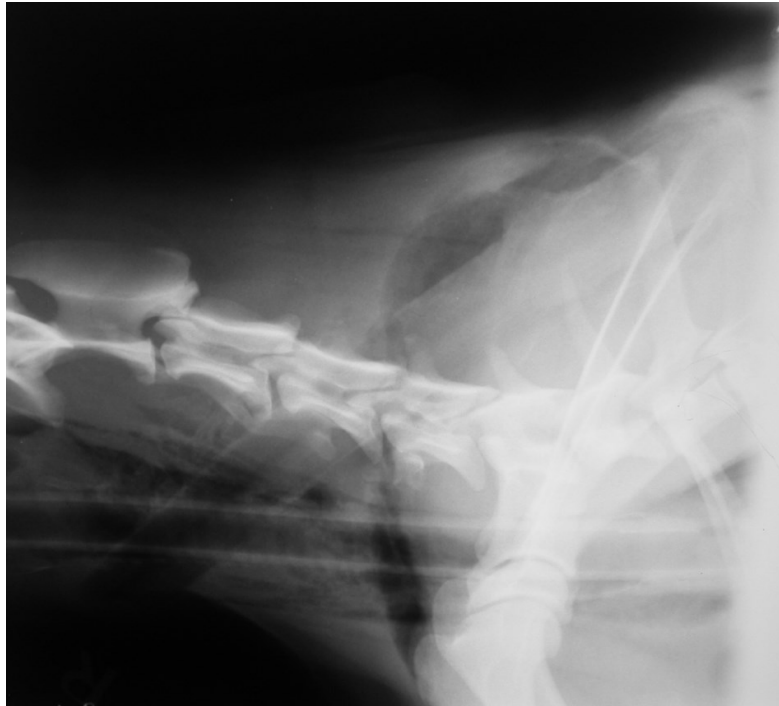


Figure 1. Gas in the fascial planes of the neck, dorsal and ventral to the trachea on a plain radiograph of a dog

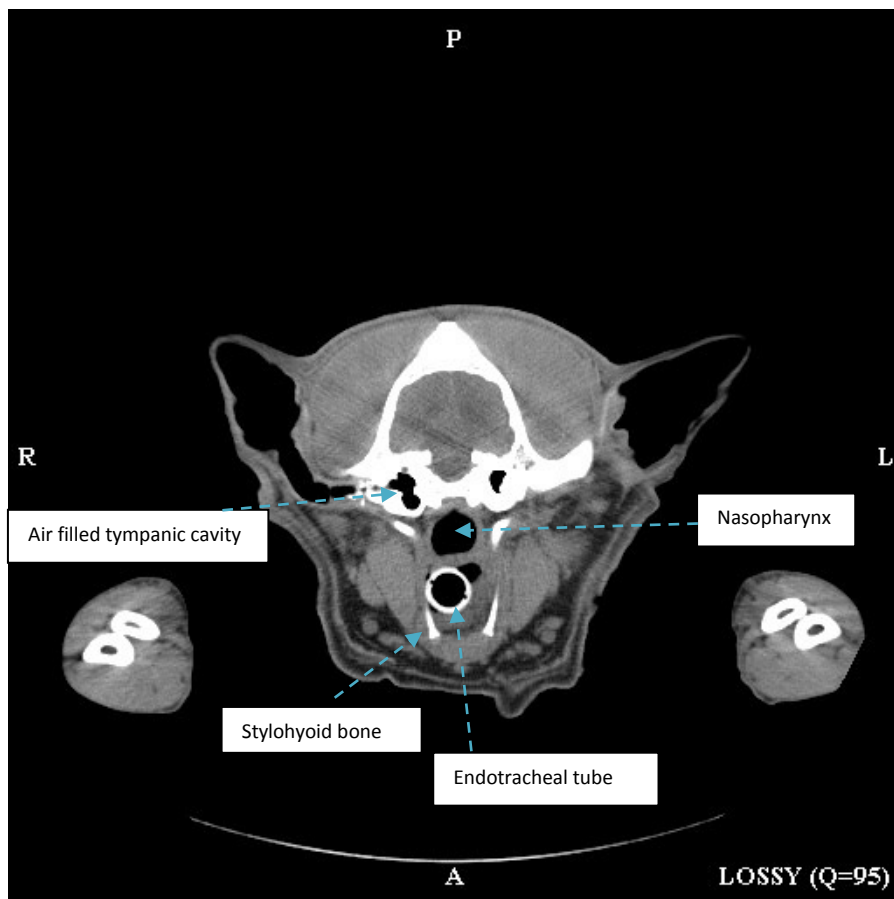


Figure 2. A CT slice of a dog depicting normal anatomy in the laryngeal region

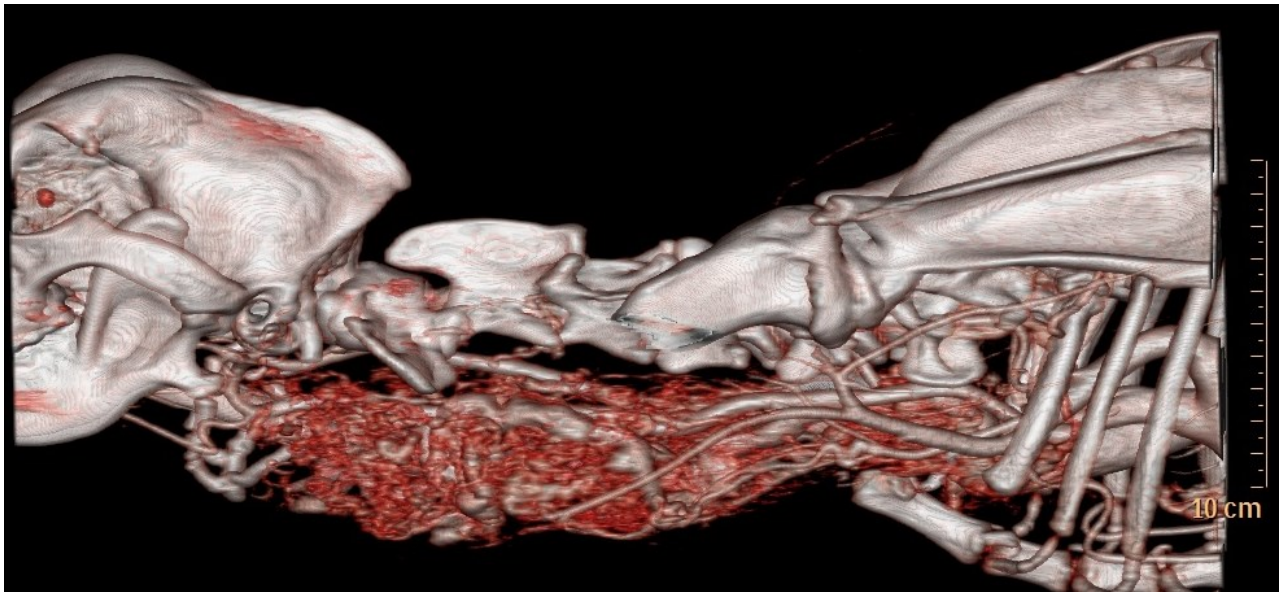


Figure 3. 3D CT angiogram reconstruction of a highly vascular thyroid carcinoma in a dog

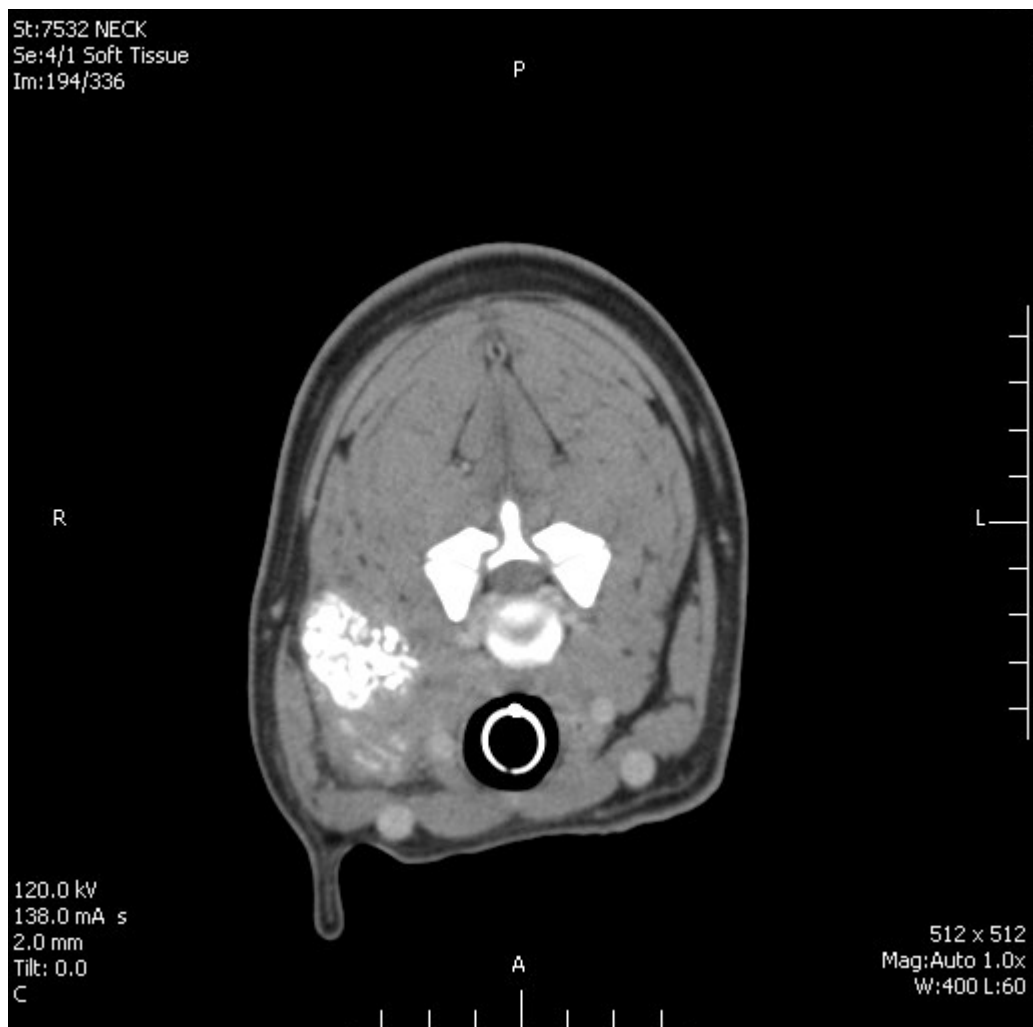


Figure 4. CT slice of a mineralised opacity (calcinosis circumscripta in this dog) in the right cervical region

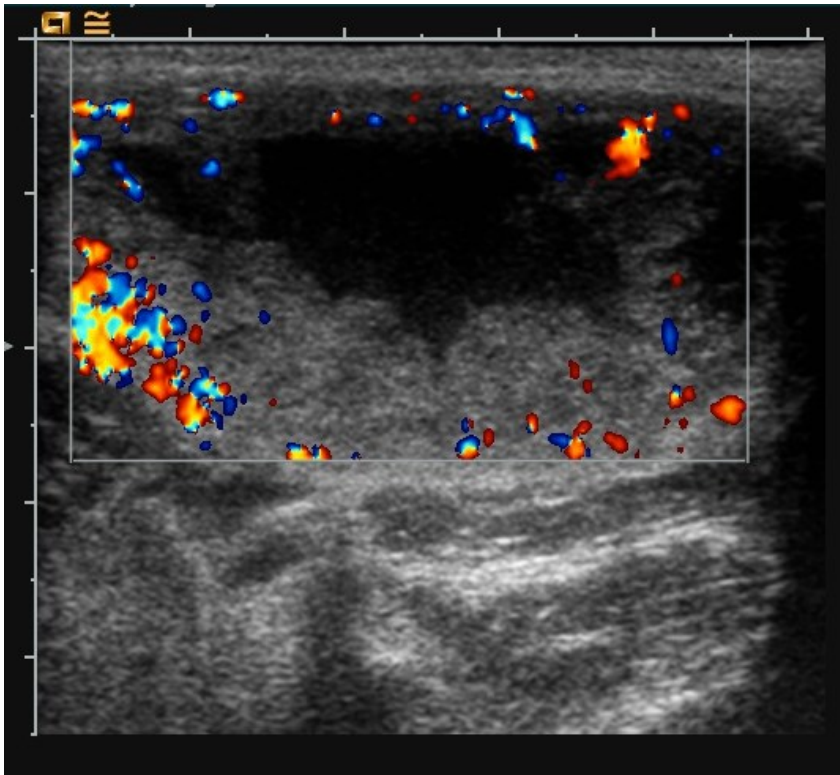


Figure 5. Ultrasound image of a cervical abscess with Doppler showing signal consistent with vessels around the edge of a lucent structure with no vessels, consistent with a fluid-filled cavity in a dog

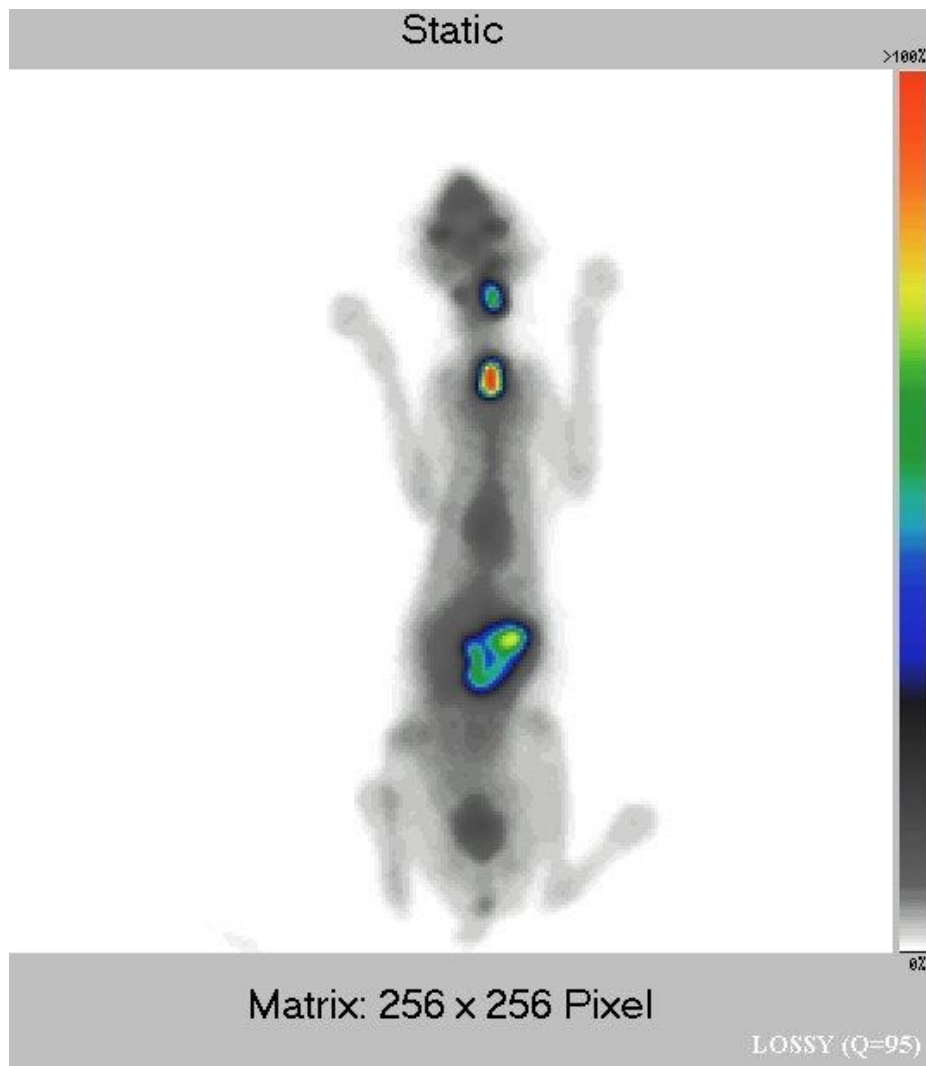


Figure 6. Scintigraphy scan of a cat with reoccurrence of hyperthyroidism following treatment with radioactive iodine. The scan shows uptake from: (top to bottom) a cervical lymph node (metastatic spread), in the thyroid, and normal uptake in the gastric mucosa

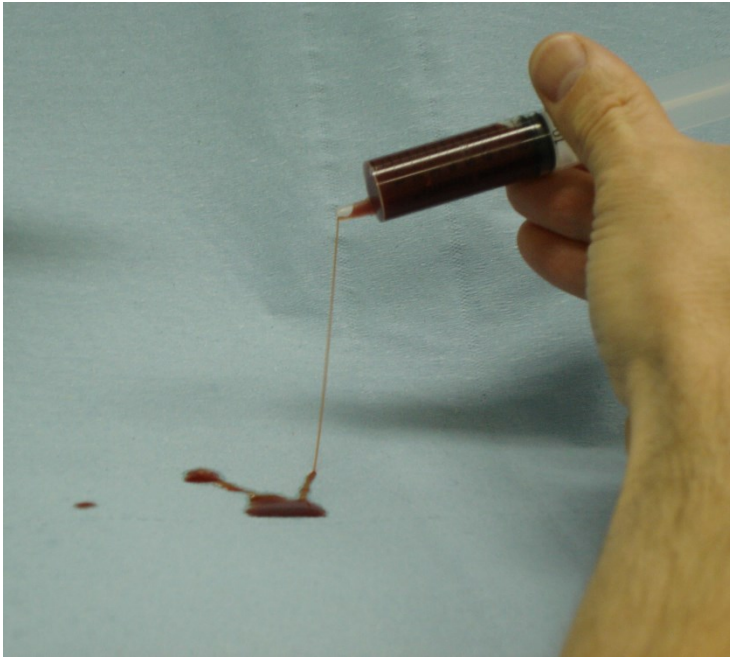


Figure 7. Tests to assess the stringiness of fluid, such as the mucin test for saliva, can be performed on masses of the cervical region. (Picture: Dan Brockman, Royal Veterinary College)



Supplementary Figure 1. Large cervical swelling associated with a salivary mucocele



Supplementary Figure 2. A CT slice of a dog with a thyroid carcinoma, note the mass effect causing displacement of the larynx and vessels to the left