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# Diagnostic imaging and endoscopic finding in dogs and cats with gastric tumors: A review

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## Summary

Medical imaging is an essential part of the diagnostic workup of many gastrointestinal disorders. This paper reviews imaging and endoscopy of gastric tumors in dogs and cats and the techniques used. The appearance of the normal as well as the various aspects of gastric tumors are described for these different modalities. Plain radiography is widely available but has limited diagnostic value. Contrast radiography has higher sensitivity but is laborious and time-consuming. Ultrasonography (if an adequate acoustic window is available), endosonography and endoscopy are the most appropriate modalities for diagnosing gastric tumors. They are especially useful when obtaining samples for cytologic or histopathologic examination, because the imaging modalities do not always differentiate between inflammatory or infectious conditions and neoplastic disorders. Hydro-helical CT was found helpful for evaluating the location and local invasiveness of the lesion. Ultrasonography and endoscopy are useful modalities for taking adequate biopsies.

Keywords: cat, dog, endoscopy, gastric, neoplasia, imaging

## Diagnostische Bildgebung und endoskopische Befunde von Magentumoren bei Hunden und Katzen: Eine Übersicht

Die bildgebende Diagnostik ist ein wichtiger Teil zur Diagnosestellung von vielen gastrointestinalen Erkrankungen. Dieser Artikel gibt einen Überblick über die verschiedenen bildgebenden Verfahren, die zur Identifizierung von Magentumoren bei Hunden und Katzen angewendet werden. Sowohl physiologische Erscheinungsbilder als auch pathologische Veränderungen werden beschrieben. Röntgenaufnahmen sind im allgemeinen leicht verfügbar, haben allerdings nur geringe diagnostische Aussagekraft. Kontraststudien haben einen höheren diagnostischen Wert, sind aber zeitaufwändig und arbeitsintensiv. Ultraschall (falls ein adäquates akustisches Fenster verfügbar ist), Endosonographie und Endoskopie sind die zuverlässigsten diagnostischen Untersuchungsverfahren zur Identifikation von Magentumoren. Da die bildgebende Diagnostik nicht immer zwischen Entzündung oder Neoplasie unterscheiden kann, sind sie besonders nützlich zur Entnahme von cytologischen oder histopathologischen Proben. Hydro-helical CT ist hilfreich zur Feststellung der Lokalisation und Invasivitaet der Läsionen. Ultraschall und Endoskopie dienen vor allem zur adäquaten Biopsieentnahme.

Schlüsselwörter: Katze, Hund, Endoskopie, Magen, Neoplasma, Bildgebung

## Gastric tumors in dogs and cats

Gastric tumors are rare in dogs and cats representing less than 1 % of all malignancies (Gualtieri et al., 1999). The mean age of affected animals is 8 years (15 years for leiomyomas), with a 2:1 male-to-female ratio (Kerpsack and Birchard, 1994). A higher incidence of gastric carcinoma (CA) has been reported in Belgian shepherd dogs, Collies, Staffordshire bull terriers and Siamese cats, implying a genetic component (Scanziani et al., 1991; Lubbes et al., 2009). A strong environmental component has been suggested in dogs as experimental long-term administration of nitrosamines may induce CA (Sasajima et al., 1977). While in humans *Helicobacter pylori* may be associated with the development of gastric tumors, it is not confirmed in dogs and cats (Withrow, 2007). Patients with gastric tumors usually present with a history of progressive vomiting, hematemesis, melena, anorexia and weight loss. Chronic vomiting is caused by neoplastic stenosis, gastric ulceration and/or gastric motility disorders. Weight loss may be a result of anorexia, malabsorption and maldigestion, loss of protein and blood from an ulcer, and/or generalized tumor cachexia. Occult blood in the feces may be detected. The clinical signs can last from weeks to months (Withrow, 2007). Laboratory abnormalities may include panhypoproteinemia, microcytic hypochromic anemia related to chronic gastro-intestinal blood loss and malabsorption. Both leiomyoma and leiomyosarcoma may present with paraneoplastic hypoglycemia (Bagley et al., 1996), and elevated liver enzymes due to hepatic metastasis or obstruction of the common bile duct (Withrow, 2007). The majority of gastric tumors are malignant and epithelial in origin and affect the distal two-thirds of the stomach. Adenocarcinoma (AC) accounts for 70–80 % of canine stomach tumors (Swann and Holt, 2002). They often appear scirrhous (firm, white serosa) and have been termed linitis plastica (leather bottle) because of their firm, nondistensible texture. In AC, lesions can be diffusely infiltrative and expansile, often with a central crater and ulceration, or may look more polypoid (Murray et al., 1972). Leiomyosarcoma is often bulky, tends to affect the entire thickness of the gastric wall and most commonly occurs at the pyloric antrum. Lymphoma is the most common gastric tumor in the cat and may be solitary in the stomach or one component of a systemic involvement. Other malignancies include mast cell tumor (mastocytoma), extramedullary plasmacytoma, fibrosarcoma (Withrow, 2007) and, very rarely, gastric carcinoid. Metastases may reach the stomach by lymphatic or blood vessels. Benign stomach tumors are much less common. Typically, gastric adenomas and leiomyomas are solitary incidental findings located near the cardia (Swann and Holt, 2002). A diffuse extension and/or malignant transformation is rare, but possible. Final diagnosis has to be made with histopathology. The aim of this study is to review the imaging and endoscopic features of gastric tumors in dogs and cats.

## Imaging modalities for diagnosis of gastric tumors

### Radiography

A native radiographic examination of the stomach includes four projections: ventrodorsal (VD), dorsoventral (DV), left lateral (LL) and right lateral (RL). Using these projections, air within the stomach can be manipulated to visualize all its regions. Additional oblique projections may be used to isolate or project specific areas of the stomach. On the lateral view, the axis of the stomach from the fundus throughout the body and pylorus is parallel to the ribs. On the VD view of the dog, the cardia, fundus and body of the stomach are located to the left of the midline, and the pyloric portion is located in the right hemiabdomen. The pyloric sphincter is usually located in the right cranial abdominal quadrant around the level of the 10th or 11th rib, usually cranial to the pyloric canal. On the VD view of the cat, the stomach is more acutely angled with the pylorus located at or near the midline. The normal gastric wall appears smooth and uniform and is a few mm thick when fully distended. Rugal folds are more tortuous in the non-distended stomach and become more uniform and parallel to the gastric curvature as distension increases. In the pyloric antrum, they are small and spiral (Frank, 2013).

Contrast radiographic studies should always be preceeded by survey radiographs. Various radiographic techniques have been described such as positive-contrast gastrography (CG), using barium or iodinated contrast medium, pneumogastrography (PG), using air or another gas, double-contrast gastrography (DCG), using a positive contrast followed by gas and low-volume gastrography. Low volume barium or iodine contrast medium can be used to show stomach location (Dennis et al., 2010). Additionally, (dynamic) gastric emptying studies may be performed with barium/food or radiopaque marker/food mixtures (Miyabayashi and Morgan, 1984). A CG allows evaluation of the stomach wall and gastric emptying. After the patient has been fasted for 12 hours, a survey radiographic study is performed without sedation. Then, a barium sulfate suspension (30 % weight/volume) is administered through an orogastric tube or a syringe. The recommended volume of barium is 8–12 mL/kg for small and medium dogs, 5–7 mL/kg for large dogs and 12–20 mL/kg for cats (Root and Morgan, 1969, Morgan, 1977). The VD, DV, RL and LL radiographic projections are performed after 0, 15 and 30 minutes and 1, 2 and 3 hours after barium administration (Wallack, 2003). Normal gastric emptying time for contrast medium is 30–120 minutes (Miyabayashi and Morgan, 1986) in a dog and 15–60 minutes in a cat (Morgan, 1981). For a DCG, patient preparation is the same as for a CG. The barium dose for DCG is 3 mL/kg for dogs $< 8$ kg, 2 mL/kg for dogs 8–40 kg, 1.5 mL/kg for dogs $> 40$ kg, 6 mL for cats followed by 20 mL/kg of air through an orogastric tube (Evans and Laufer, 1981, Evans and Biery, 1983). Then, the tube is withdrawn into the caudal esophagus and the patient is rotated 360° along the long axis multiple times to distribute the barium as uniformly as possible. Between each of the four projections, the patient is rotated to maintain adequate coating. If the animal expels any air, more can be administered to keep the stomach distended. If gastric perforation is suspected, water-soluble iodinated contrast medium should be used instead of barium. Iodinated contrast (240–300 mg/mL) should be diluted 50:50 with water and the same dose as the barium administered. Iodine gives a poor contrast and mucosal detail compared with barium. The PG is performed using air only at a dose of 5 mL/kg. Negative contrast alone is not a satisfactory method of studying the stomach and may be useful only for assessing the thickness of the stomach wall. The DCG was found to be more sensitive and specific than CG in detection of gastric disease (Evans, 1983).

Gastric lesions may be recognizable on survey radiographs if the stomach is filled with air and does not contain a large amount of food. Masses that protrude into the lumen may be apparent on radiography (Burk and Ackermann, 1996). However, radiology of the stomach for intramural lesions is usually not helpful. A gastric AC usually presents as a diffuse thickening of the gastric wall or, less frequently, shows a focal wall thickening at the level of lesser curvature and pylorus. Gastric leiomyoma and leiomyosarcoma share similar features. Both tumors tend to present as a mass lesion that extends asymmetrically from the gastric wall and does not affect the lumen or, less frequently, they appear as a distinct mass within the stomach lumen (Burk and Ackermann, 1996). Lymphoma and carcinoid are associated with a diffuse, minimally or moderately thickened stomach wall (Dennis et al., 2010). Lymphoma may also present as a focal mass that extends out from the gastric wall and does not affect the lumen (Burk and Ackermann, 1996).

On CG or DCG, the intraluminal masses appear as filling defects that are better visible when the contrast leaves the stomach (Fig. 1A, B). Secondary signs of a gastric tumor include the presence of a gastric ulcer, an abnormal pattern of rugal folds, poor local or diffuse gastric distension, lack of peristaltism and delayed gastric emptying. Gastric ulcers are difficult to identify on conventional radiographs. They are more conspicuous in barium studies because they produce craters in the wall of the stomach that look like outpouchings from the lumen (Frank, 2013). A stomach shape that fails to change may indicate infiltration of the gastric wall, which will not usually have marked gastric distension.

## Ultrasonography

Transabdominal ultrasonography (US) is the imaging modality of choice for examination of the abdomen in veterinary medicine. Endoscopic ultrasonography or endosonography (EUS) is useful for studying the stomach wall, but the instruments are very expensive. For US in dogs and cats, two or three transducers should be used. A microconvex transducer with a frequency range between 5–10 MHz can be used in all animals and may allow visualization of all parts of the stomach. For large- and giant-breed dogs, a transducer with a lower frequency (3.5–5 MHz) may be useful to evaluate the deepest part of the stomach. A linear high frequency transducer (7–15 MHz) may be useful to scan the complete stomach in cats and small dogs and to evaluate the superficial ventral aspect and left lateral aspect of the stomach in all animals. The animal should be fasted for 12 hours before the examination so that the stomach is empty or contains gas or fluid but no food. Water administration at 10–15 mL/kg will enhance visibility of mural pathology and may help overcome air-induced artifacts (Penninck, 2002). The abdomen is usually examined in dorsal decubitus. However, for the stomach, because of the presence

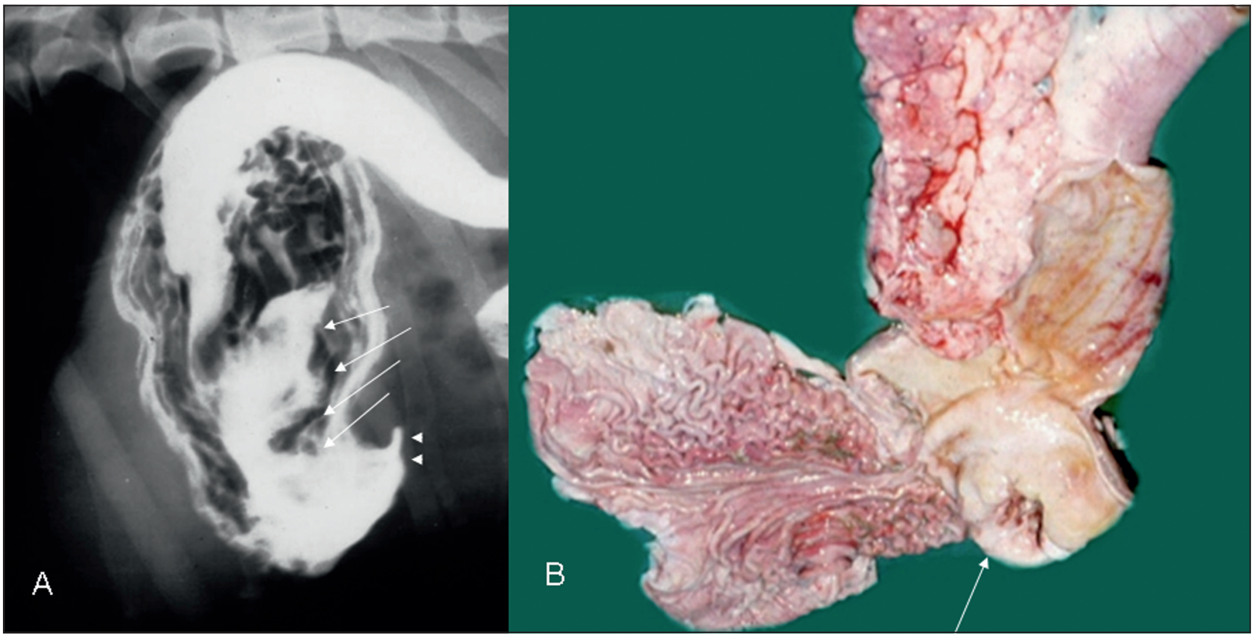


*Figure 1*: A RL view of a dog with gastric CA. (A) Thickening of the gastric wall appears at the gastric body and antrum. The stomach wall shows an irregular filling defect in this positive gastrogram (arrows). A small amount of barium fills up a crater of the tumor in the antrum (arrowheads). (B) Gross anatomy of the same dog, with loss of mucosa architecture and a crater (arrow) at the pyloric antrum.

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of gas and fluid, a combination of positions (dorsal, right lateral, left lateral recumbency and standing position) may be required to completely visualize the stomach wall. Right lateral recumbency is useful for pyloric examination and left lateral for the fundus. The echoendoscope (radial and linear multifrequency scanners) is similar to a conventional endoscope except that it has an ultrasound transducer at its tip; EUS allows visualization of both the inner and outer parts of the gastric wall, using high-frequency transducers that can be taken close to the target regions. Transducer coupling is either by direct mucosal contact or inflation of a water-filled balloon surrounding the transducer (Fig. 2) (Gaschen et al., 2007). However, up to now, no study has assessed the usefulness of EUS in diagnosing gastric disease in dogs and cats.

On US, different tumor types can show a similar appearance. Loss of layering and a focal thickening are strongly suggestive of a gastric tumor, with a higher sensitivity than radiography (Seiler and Mai, 2009). The thickening of the gastric wall can be generalized or localized, symmetrical or asymmetrical, and associated or not with significant loss of motility. A focal thickening with normal layered architecture may suggest leiomyoma, malignant histiocytosis or a polyp. The CA shows a typically asymmetrical, moderate to severe, heterogeneous gastric wall thickening. The normal layers are obliterated but may be replaced by three alternating bands referred to as pseudolayering. Pseudolayering is visible as a poorly defined, echogenic lining on the innermost and/or outermost portions of the gastric wall, separated by a more echoic central zone. It most likely correlates with the unevenly layered tumor distribution noted histopatologically (Penninck et al., 1998). Myogenic tumors (leiomyoma and leiomyosarcoma) are often located in the pyloric region and appear as hypoechoic submucosal masses arising from the muscular layer. Leiomyoma usually appear as a homogeneous, small, sessile, echoic mass in dogs (Myers and Penninck, 1994). A large, complex mass with an irregular central cavity (representing hemorrhage, necrosis or cystic degeneration) most likely represents a leiomyosarcoma (Seiler and Mai, 2009). It can ulcerate and lead to wall perforation (Myers and Penninck, 1994). Canine and feline gastric lymphoma usually show circumferential, transmural thickening associated with diffuse loss of normal wall layering and reduced wall echogenicity, localized decreased motility and moderate regional lymphadenopathy (Penninck et al., 1994; Penninck, 2002). Lymphoma can also show a focal hypoechoic eccentric mass (Seiler and Mai, 2009). The CA and lymphosarcoma are often associated with regional lymphadenopathy. In gastric CA, lymph nodes have a target appearance, with a poorly defined echoic rim and a highly defined echoic center (Penninck et al., 1998).

The US features of malignant histiocytosis, malignant fibrous histiocytoma and histiocytic sarcoma have been reported sporadically (Kaser-Hotz et al., 1996; Cruz-Arámbulo et al., 2004). Other tumors, like carcinoid,

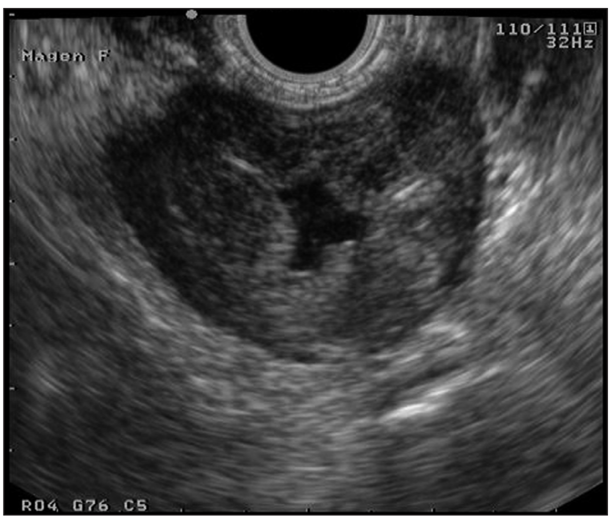


*Figure 2:* EUS image of the stomach in a dog with gastric CA. The stomach shows complete loss of stomach wall layering.

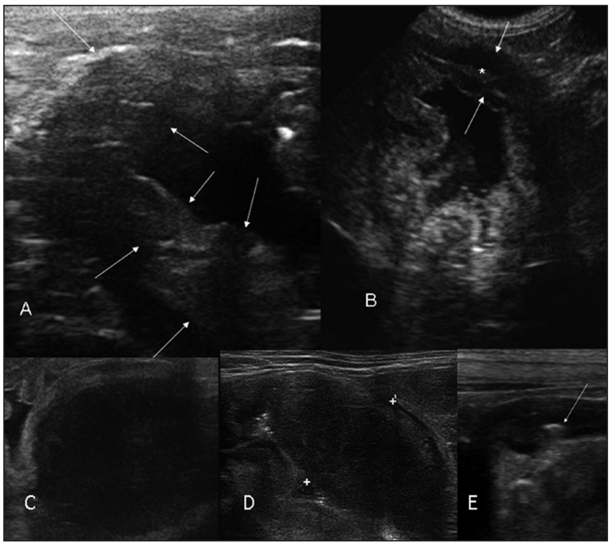


*Figure 3*: (A) US of the gastric antrum of a dog with AC. There is irregular heterogeneous gastric wall thickening (among arrows) with loss of layering. (B) US of a dog with an AC of the lesser curvature and antrum. In the ventral portion of the stomach wall there is a pseudolayering pattern, with hypoechogenic innermost and outermost parts (arrows), separated by a more echoic central zone (asterisk). (C) Longitudinal US view of dog with leiomyosarcoma of the gastric antrum. A homogenous, round, hypoechoic mass lesion involving the muscular layer of the stomach wall is visible. The mucosa and submucosa are normal. (D) US longitudinal image of the gastric fundus and body of a cat with lymphoma of the stomach. There is a severe circumferential thickening and complete loss of layering of the stomach wall, which is mostly hypoechoic. The wall between the callipers measures approximately 2.5 cm. (E) US image at the level of the gastric body of a dog. Gastric ulceration is visible as a focal wall thickening with loss of layering and disruption of the normal mucosal surface. The ulcer crater is filled with gas (arrow).

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neurilennoma, nerve-sheath tumor, mast cell tumor and hemangiosarcoma, tend to appear as poorly defined echoic masses or as a focal thickening with loss of layering. There are no specific US features for these tumors (Penninck, 2008).

Benign gastric polyps (hyperplastic and adenomatous) are sessile or pedunculated nodules that arise from the mucosa and protrude into the gastric lumen. In dogs and cats, they may occur as solitary or multiple cauliflower lesions. Occasionally, large polyps in the pyloric antrum can cause gastric outflow obstruction. On US, canine gastric polyps appear as heterogeneous lesions confined to the mucosa without involvement of the submucosal layer. Gastric wall thickening corresponding to wall edema and luminal fluid accumulation associated with reduced gastric motility may be observed in animals with large lesions. Gastric polyps can rarely present with poorly visualized gastric wall layers (Diana et al., 2009).

Stomach ulcers are a possible complication of gastric tumors. The US findings associated with gastric ulceration are focal wall thickening with indistinct wall layers, or loss of layering and disruption of the normal mucosal surface in a large ulcer with an ulcer crater. It can be a focal accumulation of hyperechoic material on the mucosal surface (gas bubbles or blood clots) and decreased motility of the affected wall segment (Fig. 3A–E) (Seiler and Mai, 2009).

US-guided fine needle aspiration of the gastrointestinal tract has been described (Vignoli and Saunders, 2011).

## Endoscopy

Gastroscopy is a minimally invasive, minimally traumatic procedure that allows direct visualization of the gastric wall and is associated with low morbidity and mortality (Guillfort, 2005). A flexible endoscope with an insertion tube with 1 m of working length and a tip with a diameter between 7–9 mm (< 9.5 mm) is recommended. The accessory/biopsy channel should have a minimum diameter of 2.2 mm and the tip should be capable of four-way deflection. The tip must be able to retroflex more than 180° in one plane with a small radius of curvature. The endoscope must have an inflation system (essential for stomach visualization) and a washing lens system. A xenon light source is preferred for greater illumination. Suction is necessary to remove secretions and air biopsy forceps should be available for tissue collection. The patient should be fasted at least 12 hours. Water is allowed. If a barium contrast radiographic study has been performed, gastroscopy should be delayed for 24 hours because barium can cause serious blockage of the instrument (Hall, 2008). General anesthesia with intubation is required for gastroscopy. The patient is positioned in left lateral re-

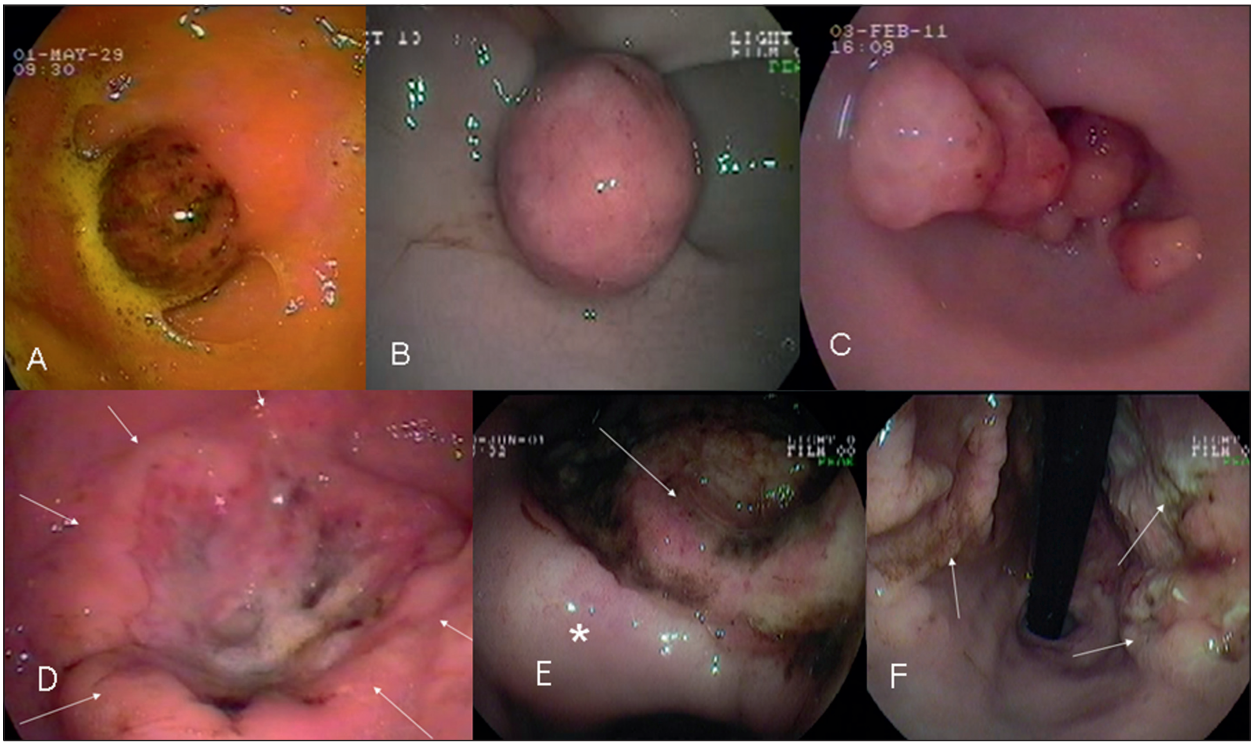


*Figure 4:* (A) Adenomatous polyp in a dog is visible at the gastric antrum. (B) Large gastric polyp of the antrum (CA in situ) in a dog with chronic vomiting. (C) Gastric antrum grape-like polyps (AC) in a cat with chronic vomiting. (D) Gastric ulcer (AC) in a dog with anorexia and weight loss. Arrows indicate the neoplastic ulcer's borders that surround the necrotic centre. The tumor is located in the gastric body. (E) Gastric CA in a dog. The small curvature (asterisk) is extremely thickened and the fundus folds (arrow) are replaced by proliferative ulcerated neoplastic tissue. (F) Gastric fundus lymphoma in a cat. Arrows indicate fundus rugal folds infiltrated by neoplastic tissue.

cumbency because this position facilitates the evaluation of the pylorus. Lubrication of the endoscope is preferred before it is introduced. A mouth gag must be inserted (Hall, 2008). Gastroscopy is contraindicated when gastrointestinal perforation is suspected, the patient is inadequately prepared, the patient cannot be anesthetized or the patient has coagulation disorders. Complications of gastroscopy (overdistension of the stomach, perforation due to poor technique, mass rupture and transmission of enteropathogenic organisms) are rare (Guillfort, 2005).

Gastric polyps are sessile or pedunculated protuberances of the gastric mucosa that do not disappear with maximal inflation. They can be benign (adenomatous polyp), malignant (CA) or inflammatory/hyperplastic. Polyps are most commonly found in the pyloric region, more often in the antrum than the canal and pylorus. At gastroscopy, polyps are generally single, multilobated or grape-like masses that may bleed from an eroded surface and may or may not occlude the pyloric orifice (Gualtieri et al., 1999). Endoscopic surgery can be performed to remove polypoid lesions (Foy and Bach, 2010). Gastric neoplasms can present with a variety of appearances, from raised plaques or masses projecting from the lumen to firm, diffusely infiltrating masses invading the stomach wall. They may ulcerate and alter the gastric lumen and shape. Ulcers occur more frequently with AC and leiomyoma/leiomyosarcoma than lymphoma. Typically, gastric ulcers have raised and thickened margins. The bed of the ulcer blood can be present in the gastric fundus and may indicate the ulcer's presence. Ulcers resulting from gastric AC are usually associated with broad areas of induration, while ulcers due to leiomyoma are usually crater-like with raised margins. Gastric AC is most commonly seen on the lesser curvature of the stomach. It may appear as an obvious mucosal mass or with mucosal change of color (from pink to purple) with deep pigmentation of the mucosa, ulceration, loss of normal landmarks and rigidity of the gastric mucosa (Simpson, 2005). Sometimes an AC shows marked proliferative changes with a rigid, very dense wall that has completely lost the normal rugal fold architecture. Infiltrative neoplasms, such as lymphoma, usually show a diffusely thickened mucosa with a markedly increased wall consistency (Fig. 4A–F). However, they can also appear as a mass lesion. Gastric lymphoma can affect either the entire stomach or only part of it, and show a mucosa that is often lumpy and friable or, less commonly, thick and irregular (Hall, 2008). The indurated mucosa often feels heavy and yields little as the endoscope or biopsy forceps contacts it (Guillfort, 2005). If the mass is in the pylorus, it may occlude the pyloric orifice. Leiomyoma usually appear as expansile submucosal masses often located in the cardia or in the lesser curvature (Gualtieri et al., 1999). All gastric lesions should be biopsied by endoscopic forceps or cytology brushes and multiple samples should be taken for cytology or histopathology.

### Computed Tomography (CT) and Magnetic Resonance Imaging (MRI)

CT and MRI are used for diagnosis and staging of gastric tumors in human, however so far they are no studies in the veterinary literature. The accuracy of CT in the diagnosis and staging of gastric cancer improves when helical CT of the stomach is performed after the oral administration of water. This procedure, which is termed helical-hydro CT (HHCT), is followed by the intravenous injection of contrast medium to enhance the image of the gastric wall (Wei et al., 2005). The feasibility of HHCT in 11 healthy animals (9 dogs and 2 cats) and 18 clinical cases (14 dogs and 4 cats) was recently evaluated in veterinary medicine (Terragni et al., 2012). Adequate uniform gastric distension was obtained with administration via oral tube of 30 mL water/kg body weight; the patients were then imaged before and after the administration of intravenous iodinated contrast medium. (Fig. 5) This is the only study on HHCT in veterinary medicine, and it concluded that HHCT is easy to perform and is a useful technique for the diagnosis of gastric tumors in dogs and cats (Terragni et al., 2012).

## Conclusion

US and endoscopy are useful modalities for studying stomach tumors and are helpful for taking biopsies. Radiology has limited use due to low sensitivity, and contrast radiology is unpractical, while EUS has limited use in veterinary medicine due to its expense and fewer indications. CT and MRI have the potential to be useful in the future.

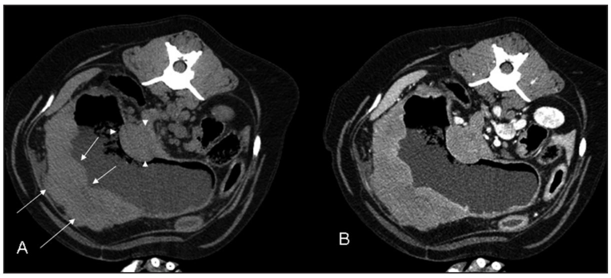


*Figure 5:* CT image of a dog with lymphoma. (A) The slice at the level of the fundus body shows an irregular, severe wall thickening of the greater curvature (arrows) and a focal thickening of the smaller curvature (arrow heads). (B) The same image after contrast medium administration shows a moderate homogenous contrast enhancement of the lesion. The CT study of the same dog showed a generalized lymphadenopathy in the abdomen.

## Imagerie diagnostique et découvertes endoscopiques lors de tumeurs gastriques chez le chien et le chat: un aperçu

L'imagerie diagnostique est un élément important du diagnostic de nombreuses affections gastro-intestinales. Cet article donne un aperçu des diverses techniques d'imagerie qui peuvent être utilisées pour identifier des tumeurs gastriques chez le chien et le chat. On décrit aussi bien les aspects physiologiques que les altérations pathologiques. Des clichés radiographiques sont en général facilement disponibles, ils n'ont toutefois qu'une valeur diagnostique limitée. Les études utilisant des moyens de contraste ont une meilleure valeur diagnostique mais nécessitent du temps et de travail. L'échographie (pour autant qu'on dispose d'une fenêtre acoustique adéquate), l'endosonographie et l'endoscopie sont les techniques diagnostiques les plus sûres pour identifier les tumeurs gastriques. Comme les techniques d'imagerie ne permettent pas toujours de différencier entre inflammation et tumeur, elles sont particulièrement utiles pour prélever des échantillons pour la cytologie ou l'histopathologie. Le scanner hydro-hélical est utile pour définir la localisation et l'extension d'une lésion, alors que l'échographie et l'endoscopie servent avant tout à effectuer des biopsies adéquates.

## Diagnostica per immagini e reperti endoscopici di tumori gastrici in cani e gatti: visione d'insieme

La diagnostica per immagini è una parte importante della diagnosi di molte malattie gastrointestinali. Questo articolo fornisce una panoramica delle varie tecniche di imaging utilizzate per l'identificazione di tumori gastrici in cani e gatti. Vengono descritti sia le manifestazioni fisiologiche che i cambiamenti patologici. I raggi X sono in genere facilmente disponibili, ma hanno poco valore diagnostico. Studi di contrasto hanno un valore diagnostico superiore, ma necessitano tempi lunghi e elaborazioni intense. Ultrasuoni (se un'adeguata area acustica disponibile), ecografia endoscopica e endoscopia sono i metodi di esame diagnostico più affidabili per l'identificazione di tumori gastrici. Poiché la diagnostica per immagini non sempre può distinguere tra infiammazione e neooplasia, sono particolarmente utili per la rimozione di campioni citologici o istopatologici. Hydro-TC spirale è di aiuto per determinare la localizzazione e l'invasività delle lesioni. L'ecografia e l'endoscopia sono usate principalmente con un'adeguata biopsia.


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