



Gastrointestinal neoplasia

XX SIVE INTERNATIONAL CONGRESS - Milano, 7th-9th February 2014

Derek Knottenbelt

OBE, BVM&S, DipECEIM, MRCVS, University of Liverpool/University of Glasgow, UK



Philip Leverhulme

Equine Hospital, University of Liverpool

The gastro-intestinal tract and abdominal organs are susceptible to a variety of primary tumours and metastatic tumours. Primary and metastatic neoplasia can affect multiple sites in the oral cavity, pharynx and gastro-intestinal tract. The type of tumour is determined by the cell types present in the tissue and the distribution of blood flow and lymphatic flow to that tissue. With a few notable exceptions, neoplasia of the gastro-intestinal tract is uncommon.

Although there is marked tendency for neoplastic disease to be increasingly prevalent in older aged horses, gastrointestinal tumours are not the preserve of older animals. However, there are also several tumours that occur within the abdomen of young/neonatal horses. For example, the average age of horses with carcinoma is 8-15 years and lymphoma occurs most often in horses under 5 years of age.

Clinical signs associated with alimentary tract neoplastic disease are primarily related to the tumour location. Clinical signs of can be obvious and include enlargement or ulceration of the mandible maxilla. Neoplasia of the tongue results in weight loss failure to chew and swallow correctly halitosis and very frequently a prominent nasal discharge containing the material if the or pharynx is also involved at the centre. Tumours of the oesophagus are singularly rare in horses; however, they can present not only with signs similar to those associated with choke but also with intermittent colic fever and a fetid breath. Gastric neoplasia

(usually gastric carcinoma or leiomyoma) is usually a very occult condition until the signs are advanced but once they do develop there is usually abnormal swallowing behaviour with repeated efforts to swallow, irritation attempts and chronic and progressive weight loss that exonerates towards the termination of the condition

Abdominal neoplasia has been implicated in around 4% of horses presenting with intermittent or chronic colic signs¹.

Changes in faecal consistency, weight loss, ventral oedema associated with either low circulating blood proteins (albumin in particular or circulatory obstructions in major abdominal or thoracic organs) and recurrent fever have been commonly associated with intestinal neoplasia².

Where the tumour results in intestinal obstruction, either complete or partial and incomplete, evidence of abdominal discomfort is common. Benign and malignant forms of intestine or neoplastic disease will have very similar effects on the transit of ingested through the gut.

Probably the most important aspect of cancer diagnosis is in the early detection of paraneoplastic syndromes. These are particularly common in horses with serious internal neoplastic disease and include cancer cachexia, abnormal endocrinologic productions, anaemia, leucocytosis, thrombocytopenia, hypertrophy globulin anaemia and in some circumstances neurologic abnormalities³.



In summary, intestinal neoplasia of either primary or secondary nature has generally been associated with geriatric horses presenting with signs including:

- Weight loss
- Intermittent, progressive or acute onset, non-responsive, colic
- Variable faecal consistency with fecal blood
- Intermittent undulant pyrexia
- Lethargy and anemia
- Anorexia and salivation

Gastric neoplasia is very rare in horses accounting for 1.5% of all equine neoplasms, but it is an important clinical entity in view of its very aggressive pathological behaviour⁴. By far the commonest gastric tumour in horses is gastric squamous cell carcinoma which primarily affects the squamous region of the stomach. This is one of the most aggressive

tumours occurring in the horse. Since the advent of gastroscopy and the routine examination of horses for gastric ulceration syndromes, early diagnosis is now possible. Whether this is in the horse's best interest not is another issue because there is little that can be done about this disease at the present time. In humans, adenocarcinoma accounts for >90% of gastric neoplasms; risk factors associated with the development of human gastric neoplasia include *Helicobacter spp.* infection. *Helicobacter spp.* infection has been reported as a possible cause of equine glandular ulcers in horses, but its relationship to equine gastric neoplasia is unknown. The risk of adenocarcinoma in the horse is relatively low considering the 1:1 ratio of squamous: glandular epithelium¹⁴. Other potential predisposing factors reported in horses include dietary excesses (ni-

TABLE 1 - Table showing the reported gastrointestinal tumours of horses.

Anatomic location	Tumour type	Primary (P)/ Metastatic (M)	Pathologic behaviour (#)	Incidence (##)	Reference
ESOPHAGUS	Squamous cell carcinoma	P	M	+	⁵
STOMACH	Gastric Polyp	P	B	+	⁶
	Leiomyosarcoma	P	M	+	^c
	Lymphoma	P/S	M	++	⁷
	Squamous cell carcinoma	P	M	+++	^{8 d}
SMALL INTESTINE	Adenocarcinoma	P	M	+	^{9 e}
	Leiomyoma / ~sarcoma	P	B/M	+	
	Lipoma	P	B	++++	^{10f}
	Lymphoma	P/M	M	+++	^{11g}
CECUM	Adenocarcinoma	P	M	+++	
	Lymphoma	P/M	M	++	
	Neurofibroma	P	B	+	
LARGE COLON	Adenocarcinoma	P	M	++	^h
	Lymphoma	P/M	M	+++	^{12 i}
SMALL COLON	Lipoma	P	B	++++	
	Leiomyosarcoma	P	M	+	
RECTUM	Lipoma	P	B	++++	
	Polyp	P	B	++	
	Lymphoma	P/M	M	+++	
PERITONEUM	Mesothelioma	P	M	++	^{13 j}
	Fibrosarcoma	P	M	+	

Key: # [pathological behaviour - M = malignant; B = benign; V = variable: # ## + = recorded cases but extremely rare; ++ = rare but regularly reported single cases; +++ = case series of rare cases reported; ++++ = relatively common.



trosamines) or deficiencies (proteins, trace minerals, riboflavin, vitamin A, vitamin E) and chronic irritation^{15,16}.

In horses, squamous cell carcinoma (SCC) is the most common gastric neoplasm and accounts for 3-4% of all SCC cases^{4,17,18}. One report suggests that gastric SCC is the most prevalent primary neoplasm of the gastrointestinal tract¹⁸. Another report suggested an equivalent prevalence of primary intestinal lymphoma¹⁴. Other gastric neoplasms previously reported in the horse include leiomyoma, leiomyosarcoma, gastrointestinal stromal tumour, papilloma, a benign polyp, mesothelioma and lymphoma^{4,6,19,20}. The history and clinical signs associated with gastric neoplasia are frequently vague and seldom localise the disease process to the stomach. The prognosis is grave because surgical resection of equine gastric neoplasms is impossible.

Critically the tumours are frequently advanced by the time a diagnosis is made and widespread transcoelomic and lymphatic / haematologic spread has occurred. Metastasis is common. The condition is best regarded as fatal and most horses die or require early euthanasia. However, with the increasing use of gastroscopy, it is likely that earlier lesions will be detected and then some treatment options may open up.

In 24 gastric neoplasms in one report, 19 were squamous cell carcinoma, 2 were leiomyoma, and one lymphoma, 1 mesothelioma and 1 adenocarcinoma were reported. The mean age for gastric tumours in this study was 18 years, higher than previously reported. There was no sex or breed predilection; this also differs from previous reports¹⁴.

A variety of other neoplastic conditions affects the intestinal tract in addition and some



Figure 1 - Gastric carcinoma. Gastric carcinoma can usually be easily seen endoscopically. It is very often aggressive and highly destructive and rapidly invades the stomach wall to metastasise via the blood and lymphatic routes as well as trans-coelomically so that secondary tumours are liable to be found at any body site. It is possibly the most malignant of all equine neoplasms.

TABLE 2 - Summary of case reports/series of equine gastric neoplasia.

REF	Tumour	N	Age	Sex	Breed	Presenting Sign	Outcome
(14)	SCC leiomyoma lymphoma mesothelioma adenocarcinoma	19 2 1 1 1	Range 9-25 y Median 18 y	58% G 38% F 4% M	38% QH, 21% Arab, 16% QHX, 25% other	Inappetance (71%), Weight loss (58%), Lethargy (29%), Hypersalivation (29%), Colic (21%), Pyrexia (21%), Halitosis (8%), Choke (4%)	22 euthanased 2 died
(21)	SCC		12	M	SB	Anorexia, Cough, colic, 2w	Euthanasia
(8)	SCC		10	F	Walking Horse	Colic, anorexia, 10 d	Died
	SCC		9	G	TB	Anorexia, weight loss 3m	Died
	SCC		15	F	Appaloosa	Anorexia, weight loss 1m	Died
	SCC		10	G	XB	Anorexia, weight loss 3m	Euthanasia
	SCC		14	F	Palamino	Anorexia, weight loss 2w	Euthanasia
	SCC		13	F	TB	Lethargy, fever, anorexia, weight loss 3w	Euthanasia
(22)	SCC		15	G	QH	Chronic intermittent colic	Euthanasia
(6)	Hyperplastic polyp		13	G	Arab	Acute colic	Euthanasia
(19)	Leiomyosarcoma		12	G	TB	Anorexia, weight loss, intermittent fever	Euthanasia
(23)	SCC	5					
(24)	SCC		20	G	XB	Anorexia, cough, colic 2w	Euthanasia
(25)	SCC		17	G	Paint	Respiratory distress, severe weight loss, anorexia, lethargy	Euthanasia
	SCC		9	M	QH	Lethargy, weight loss 2m	Euthanasia
	SCC		17	G	Arab	Weight loss, anorexia, lethargy 2-3w	Euthanasia

SCC = squamous cell carcinoma.

have profound and acute signs while the majority are insidious and very difficult to both investigate and treat.

- Since the early signs of intestinal neoplasia are usually very subtle or subclinical, there is wide variation in duration of clinical signs prior to presentation.
- The most common presenting clinical sign is inappetance (71%)^{2,10-13} which most likely occurs because of one or more of the following

- Space-occupying mass in the lumen of the stomach, abdominal pain (colic) which may be associated with swallowing or after eating, gastric ulceration, oesophagitis, oesophageal obstruction and eructation
 - Eructation is usually accompanied by a necrotic odour
 - Repeated bruxism and gagging and arching of the neck after swallowing, and very slow eating are likely

- Diarrhoea is a feature of infiltrative neoplastic disease
- Other clinical signs reported include:
 - Weight loss is generally associated with inappetance and cachexia and is commonly reported in gastric and intestinal neoplasia
 - Colic may be associated with pain because of impaired gastric outflow and/or abdominal metastases. The pedunculated lipoma is a common cause of strangulating colic in older horses and donkeys
 - Tachycardia is associated with anxiety, abdominal pain and anaemia
 - Hypersalivation is associated with narrowing of distal oesophageal lumen into the cardia because of either distal oesophageal hypertrophy or neoplastic infiltrates
 - Fever is commonly associated with SCC and is likely associated with inflammation secondary to neoplasia, immune response to a necrotic mass or leakage of ingesta into the peritoneum¹⁴
 - Lethargy / anaemia
 - Oesophageal obstruction¹⁴.

Confirmation of the diagnosis of alimentary tract neoplasia can be extremely challenging because the signs are not pathognomonic in anyway. Most of the conventional diagnostic tests including haematology and biochemistry may support the diagnosis of neoplasia but extremely rarely do they confirm that that is the definitive diagnosis. In terms of the haematology associated with intestine neoplasia, the changes are similar to those that would be consistent with diagnosis of neoplastic disease in other sites. A normal city monochromatic anaemia of chronic disease is the most likely evidence of any neoplastic disease but is also associated with chronic inflammatory responses in any site body. They may be evidence blood loss into the gastrointestinal tract and in this event the anaemia may be more profound and there may even be haemolytic anaemia sector as a result of lymphoma.

The diagnostic evaluation of gastric or gastrointestinal neoplasia is appropriate in any horse presenting with any of the clinical symptoms outlined above and should consist of a detailed history, complete physical examination including careful rectal examination,

routine haematology and biochemistry, and peritoneal fluid analysis. Endoscopy, transabdominal ultrasonography, laparoscopy and laparotomy can be used to further evaluate the case²⁶.

1. **Rectal examination** may reveal abnormal findings in up to 67% of abdominal neoplasia cases; findings may include abnormal mass(es), small intestinal distension and caecal impaction¹⁴. Rectal palpation is therefore valuable but negative findings do not exclude metastatic disease because the tumours may be too small or maybe restricted to inaccessible parts of the abdominal cavity. Rectal examination can detect subtle changes in the texture and thickness of the intestinal wall, lymph node enlargement and quite commonly a gritty texture in horses with carcinomatosis (East in all M savage CJ (1998) abdominal neoplasia (excluding urogenital tract). Veterinary clinics of North America equine practice 14:475-493).
2. **Routine haematological analyses** usually show non-specific markers of chronic inflammation, such as hypoalbuminemia, hyperglobulinemia and hyperfibrinogenemia. Anaemia tends to be the most common clinical pathological abnormality^{8,14}. In one case series, 19% of cases showed elevation in liver specific enzymes and all of these had liver metastases. Hypercalcemia of malignancy has been reported in cases of gastric neoplasia¹⁴. Leucocytosis and hyperfibrinogenaemia common findings associated with intestine neoplastic disorders. Quite commonly there is any concurrent hypoalbuminaemia caused by inflammation of the bowel wall with secretion of popular. Infiltrative bowel disease results simultaneously in the failure of absorption of protein and therefore be common protein balance results in a increase in globulin and the decrease in public - this can be detected by using serum electrophoresis tests. However all these non-specific can simply indicate that there is chronic inflammation and some evidence of failure to absorb and excessive secretion or exudation into the bowel lumen.

3. **Faecal analysis** can be performed relatively easily and can sometimes provide very valuable information. This includes the detection of faecal occult blood by the use of a validated commercially available test (Succeed™). The old-fashioned rather crude method of testing for intestinal bleeding is no longer acceptable. The advantage with the commercial test is that it establishes the presence of haemoglobin and also of albumin and so in combination this can provide very useful information in respect of potential gastrointestinal ulceration syndromes. When this test is interpreted alongside the other haematological biochemical and clinical parameters, a diagnosis or a presumed diagnosis of intestinal neoplasia can be supported in many cases.
 4. **Rectal biopsy** has contributed significantly to the diagnosis of some cases of intestinal neoplasia and in particular lymphoma (Lindberg R, Nygren A, Persson SG (1996) rectal biopsy diagnosis in horses with clinical signs of intestinal disorders a retrospective study of 116 cases. *Equine veterinary Journal* 28:275-284). There is considerable controversy over the value of this test but positive results are definitive. The problem is that there are a large number of false negatives. This test is easily performed and where the results are positive it is an extremely easy and safe diagnostic aid.
 5. **Peritoneocentesis** can occasionally identify neoplasia if the tumour is exfoliated and that the cells are shared into the abdominal cavity. The most significant tumour in this respect is gastric squamous cell carcinoma but adenocarcinoma and mesothelioma can also be identified (McKenzie EC, Mills JN, Bolton JR (1997) gastric squamous cell carcinoma in three horses. *Australian veterinary Journal* 75:480 - 483) (Harps O, Brumhard J, Bartmann CP. et al., (1996) Ascites as a result of peritoneal mesothelioma is in a horse. *Tierarztl Pract* 24:270-274). Neoplastic cells from a primary gastric SCC will only rarely be observed in peritoneal fluid. Therefore, the absence of inflammatory or neoplastic cells in peritoneal fluid does not exclude a diagnosis of gastric neoplasia.^{14,26}
 6. **Endoscopic biopsy** is frequently non-diagnostic, but should still be performed. Gastroscopy should be performed if clinical signs and clinical pathological data suggest gastric disease, but failure to identify an abnormality does not rule out gastric neoplasia.
 7. **Ultrasonography** has become a very widely used aspect of the investigation of intestinal disease and with increasing sophisticated equipment the depth and resolution is becoming much more acceptable. In particular the infiltrative bowel diseases and localised masses can be identified relatively easily provided they are within the range of the equipment being used. It has been used for diagnosis of gastritis, impaction, distension and neoplasia. There is the inevitable constraint on the available machine but the large colon and caecum as well as at least part of the small intestine and stomach can be imaged with even relatively ordinary equipment. Ultrasonographic findings may include a heterogenous mass in the left side of the abdomen associated with the greater curvature of the stomach. Metastatic lesions may be identified in the liver, spleen, omentum and peritoneum, and peritoneal effusions may also be identified. In one study, ultrasound findings strongly correlated with post mortem findings, making it a valuable diagnostic tool for investigation of gastrointestinal disease¹⁴. Abdominocentesis will vary from normal, if the mass is confined within the stomach, to an exudate if the mass has spread.
- No successful treatment of any gastric neoplasia has been reported. Treatment of most abdominal neoplasia is restricted in horses because of poor accessibility of much of the abdominal viscera, the financial constraints of extensive surgical procedures and the lack of chemotherapeutic options. However, the most important constraint is a result of the advanced stage of disease by the time diagnosis is reached. Focal lesions and more particularly focal benign lesions can sometimes be surgically corrected. There are reports of suc-

cessful removal of focal tumours of primary or metastatic nature but the outlook following this can be very dependent on the pathologic behaviour of the tumour and its origin. The best example of a “curable” intestinal tumour is the pedunculated lipoma. In this state the effects of the tumour are far worse than the tumour itself - the tumour is extremely benign and the vast majority of older horses have at these some of them. Every now and again however there is one that causes a serious intestine obstruction - usually of a strangulating

nature requiring emergency intervention. Removal of focal haemangiosarcoma, leiomyoma, and even focal intestinal lymphoma tumours can be undertaken with success (see Figure 1).

In the end the prognosis of the condition is the main determinant of the management of any tumour condition - identification of benign and malignant neoplasia is a clinical imperative for both treatment and survival. For almost all forms of genuine primary neoplasia affecting the intestestinal tract the outlook is



Figure 2 - LEFT: A focal lymphoma with spread to the mesenteric lymph nodes. This segmental enterectomy resulted in a prolonged period of remission but ultimately was not curative. RIGHT: This focal hemangioma caused a partial intermittent obstruction with recurrent colic episodes and the se increased in both severity and frequency in spite of dietary management. At laprotomy this focal tumour was identified and removed with a long term cure.



Figure 3 - Caecal adenocarcinoma. This horse was presented with a history of progressively severe weight loss of 2 months duration and recurrent low level colic. He was very positive for fecal occult blood and albumin and this test led to the use of transabdominal ultrasound and peritoneal fluid analysis. A diagnosis can usually be made premortem if enough effort is applied in seeking the diagnosis but some are only confirmed at necropsy. Euthanasia on humane grounds was carried out as soon as the diagnosis of adenocarcinoma was made.

bleak. There is an urgent need for early detection systems that can be applied routinely and economically at an early stage.

Once a diagnosis has been made however, the future of the horse will depend entirely on its condition and the rate of progression of the clinical problem. Where the tumour can be removed surgically - usually only applicable to benign, localised and accessible tumours - the outlook can be better but the long term prognosis remains very guarded. Supportive management including the use of dietary controls and more recently the anecdotal reports of the use of a commercially available supplement (Succeed™, Freedom Health USA) may have a significant benefit. Most of these supplements are however of course only applicable where the diagnosis is made early where pre-cancerous changes are present. There is much to commend approaches which provide horses with a very natural diet because the prevalence of intestine or neoplasia is probably far lower in feral and in well-managed horses as opposed to those which are managed under very artificial conditions.

In the future it may be possible to use various combinations of therapy including surgery and chemotherapeutic drugs; these are mostly applicable to various forms of lymphoma at the moment but even in cases with localised or multiple tumours of a more benign type, the options remain limited. In the infiltrative forms of large and small bowel lymphoma the palliative use of oral prednisolone is possibly a means of prolonging life - however, it is seldom effective; in contrast some cutaneous forms of T-cell rich B-cell lymphoma are improved long term by long term corticosteroid administration. There probably needs to be significant and compelling reasons why animals with these extensive and serious forms of intestine or neoplastic disease should be treated rather than euthanased.

In summary, it is true to say that intestine or neoplasia is rare but early diagnosis is critical if any success is to be achieved in respect of treatment. Currently there are no reports of successful treatment for widely disseminated tumours and those which affect large amounts of the intestinal tract. Some areas of the tract

are inaccessible and then of course even though the tumour may be relatively benign, the outlook is then dependent upon the technical ability to deal with it. Early diagnosis being the most fundamental part means that the clinician needs to adopt a very audit approach to the diagnosis of any intestine or disease because the signs of intestinal neoplasia are easily mistaken for signs of many other conditions. For example diffuse intestine lymphosarcoma (see Figure 2) results in both absorption and secretion abnormalities as well as motility changes and any one of these syndromes can be associated with signs that can easily be treated to parasitism, inflammatory bowel disease of varying types or intestinal infection syndromes such as salmonellosis or clostridiosis.

REFERENCES

1. Mair TS, Hillyer MH. Chronic colic in the mature horse: a retrospective view of 106 cases. *Equine Vet J.* 1997; 29(6):415-420.
2. Carlson G. Lymphoma (lymphosarcoma) in horses. In: Smith BP, ed. *Large Animal Internal Medicine (3rd Edn)*. St. Louis, USA: Mosby Inc; 2002:1072.
3. Ogilvie GK. Paraneoplastic syndromes. *Vet Clin North Am Equine Pract.* 1998; 14:439-449.
4. Sundberg JP, Burnstein T, Page EH, Kirkham WW, Robinson FR. Neoplasms of Equidae. *J Am Vet Med Assoc.* 1977; 170(2):150-152.
5. Campbell-Beggs CL, Kiper ML, MacAllister C, Henry G, Roszel JF. Use of esophagoscopy in the diagnosis of esophageal squamous cell carcinoma in a horse. *J Am Vet Med Assoc.* 1993; 202(4):617-618.
6. Morse CC, Richardson DW. Gastric hyperplastic polyp in a horse. *J Comp Pathol.* 1988; 99(3):337-342.
7. La Perle KMD, Piercy RJ, Long JF, Blomme EAG. Multisystemic, eosinophilic, epitheliotropic disease with intestinal lymphosarcoma in a horse. *Vet Pathol* 1998; 35(2):144-146.
8. Tennant B, Keirn DR, White KK, Bentinck-Smith J, King JM. Six cases of squamous cell carcinoma of the stomach of the horse. *Equine Vet J.* 1982; 14(3):238-243.
9. Honnas CM, Snyder JR, Olander HJ, Wheat JD. Small intestinal adenocarcinoma in a horse. *J Am Vet Med Assoc.* 1987; 191(7):845-846.
10. Blikslager AT, Bowman KF, Haven ML, Tate LP, Bristol DG. Pedunculated lipomas as a cause of intestinal obstruction in horses: 17 cases (1983-1990). *J Am Vet Med Assoc.* 1992; 201(8):1249-1252.
11. Van den Hoven R, Franken P. Clinical aspects of



- lymphosarcoma in the horse: A Clinical report of 16 cases. *Equine Vet J.* 1983; 15(1):49-53.
12. Dabereiner RM, Sullins KE, Goodrich LR. Large colon resection for treatment of lymphosarcoma in two horses. *J Am Vet Med Assoc.* 1996; 208:895 - 897.
 13. Harps O, Brumhard J, Bartmann CP, Hinrichs U. Ascites as a result of peritoneal mesotheliomas in a horse. *Tierarztl Prax.* 1996; 24(3):270-274.
 14. Taylor SD, Halderson GJ, Vaughan B, Pusterla N. Gastric neoplasia in horses. *J Vet Intern Med.* 2009; 23(5):1097-1102.
 15. MacFadden KE, Pace LW. Clinical manifestations of squamous cell carcinoma in horses. *Comp Cont Ed Pract Vet.* 1991; 13(4):669-676.
 16. East LM, Savage CJ. Abdominal neoplasia (excluding urogenital tract). *Vet Clin North Am Equine Pract.* 1998; 14(3):475-493.
 17. Strafuss A. Squamous cell carcinomas in horses. *J Am Vet Med Assoc.* 1976; 168:61-62.
 18. Cotchin E. A general survey of tumours in the horse. *Equine Vet J.* 1977; 9(1):16-21.
 19. Boy MG, Palmer JE, Heyer G, Hamir AN. Gastric leiomyosarcoma in a horse. *J Am Vet Med Assoc.* 1992; 200(9):1363-1364.
 20. Del Piero F, Summers BA, Cummings JF, Mandelli G, Blomme EA. Gastrointestinal stromal tumours in Equids. *Vet Pathol.* 2001; 38(6):689-697.
 21. Wrigley RH, Gay CC, Lording P, Haywood RN. Pleural effusion associated with squamous cell carcinoma of the stomach of a horse. *Equine Vet J.* 1981; 13(2):99-102.
 22. Ford TS, Vaala WE, Sweeney CR, Skand D, Saik JE. Pleuroscopic diagnosis of gastroesophageal squamous cell carcinoma in a horse. *J Am Vet Med Assoc.* 1987; 190(12):1556-1558.
 23. Olsen SN. Squamous cell carcinoma of the equine stomach: a report of five cases. *Vet Rec.* 1992; 131(8):170-173.
 24. Aronoff N, Reed AL, Aronson E. Radiographic diagnosis—gastric tumor in a horse. *Vet Radiol Ultrasound.* 1997; 38(3):185-186.
 25. McKenzie EC, Mills JN, Bolton JR. Gastric squamous cell carcinoma in three horses. *Aust Vet J.* 1997; 75(7):480-483.
 26. Murray MJ. Diseases of the stomach. In: Mair TS, Divers T, Ducharme NWB, Saunders, eds. *Manual of Equine Gastroenterology*: Harcourt Publishers Ltd; 2002:241-248.