CT evaluation of benign gastric lesions

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SUMMARY
This pictorial review demonstrates CT features of benign gastric lesions. CT features are non-specific and frequently overlap. Familiarity with the most specific findings on CT may be useful for diagnosis.

Key words: Computed tomography, benign gastric lesions.

INTRODUCTION
Barium contrast studies and endoscopy have been used for detection of gastric abnormalities. Computed tomography (CT) is also a valuable adjunct to these modalities. It allows evaluation of the lumen and the stomach wall and adjacent structures.¹² Frequently CT is requested to further evaluate a gastric lesion suggested by barium studies or endoscopy, in order to demonstrate its extent.¹

A prerequisite for technically good studies is optimal distension and contrast opacification of the gastric lumen with positive or negative contrast medium.

Recently the use of water as an oral contrast medium has been recommended, particularly together with intravenous contrast enhancement. The enhancing gastric wall and adjacent low-attenuation water emphasize any abnormality.³⁴ The use of air as a contrast medium is necessary for evaluation of gastric tumours using 3 D reconstruction.⁵

Three-dimensional CT and virtual endoscopy are helpful imaging tools in identifying the intraluminal component of the gastric lesion, although accurate evaluation requires conventional endoscopy.⁶ The radiology images of many gastric tumours overlap and their differentiation is difficult; some of them have characteristic CT features that may suggest the diagnosis, but generally, most have no specific CT features.⁷⁸

In this article we discuss and illustrate the CT appearance of benign gastric lesions and demonstrate signs that could help to distinguish between some of them.

CT TECHNIQUE
To obtain two-dimensional images of the stomach, oral ingestion of 500-800 ml of pure tap water is sufficient to optimally distend the stomach.³⁴ Intravenous administration of 1 mg glucagon or 5 mg butyl scopolamine before scanning induces gastric wall hypotonia. A total of 100-150 ml contrast agent intravenously administered at a rate 2.5 - 3 ml/sec and scanning 35 sec after the start of infusion optimally enhances the gastric wall and any lesion.³⁴

Scanning is usually performed with 120 KV p, 230 m A, 5 mm collimation , and 7 mm / sec table feed from the diaphragmatic dome to the lower abdomen with a single breath-hold of 25-30 sec. The patient is usually prone.

Additional images can be obtained in specific positions if required.

GASTRIC STROMAL TUMOURS
Gastrointestinal stromal tumours are a group of tumours of mesenchymal origin, characterized by various biological patterns. They are most common in the stomach (60-70%) and have a wide clinical spectrum, from benign to malignant.⁹

This group include tumours with differentiation toward
smooth muscle cells (eg, leiomyoma, leiomyosarcoma),
tumours with differentiation toward neural elements (eg,
 schwannoma, neurofibroma), lipocytic tumours (eg, lipoma,
 liposarcoma), tumours originating from vascular tissue (eg,
 glomus tumour, hemangioma, lymphangioma), and others.10
 Tumours of low mitotic rate and small size (smaller than 5 
 cm) usually have a benign behavior.9

 Imaging these tumours is important since their 
 biologic behavior is more critical to determine the 
 prognosis than their histopathologic criteria.11 CT 
 patterns of gastric stroma tumours are nonspecific. 
 Benign tumours are usually intramural, have a regular 
 shape, homogeneous structure, and homogeneous 
 contrast enhancement. Malignant tumours are usually 
 have exophytic, diffuse involvement and heterogeneous 
 morphology and enhancement. Enlarged lymph nodes 
 and metastases may be present.11,12

 LEIOMYOMA

 Gastric leiomyoma is the most common benign 
 tumour of the stomach, accounting for 2,5% of all gastric 
 tumours.1 The lesion most frequently develops in the 
 antrum and body but may also be found in the fundus. 
 Leiomyomas are usually submucosal lesions originating 
 from the muscularis propria or muscularis mucosa and 
 presenting as endogastric lesions; exogastric leiomyomas 
 originate from the serosa. The size of the tumour is 
 usually smaller than 5 cm and is asymptomatic, but 
 ulceration may cause bleeding.1,5,8

 On CT, leiomyomas appear as solid round or ovoid 
 mass lesions of uniform density, well-delineated with 
 smooth borders, producing a focal thickening of the 
 gastric wall.13 When they are exogastric, the fat plan 
 between the tumour and the adjacent organs is preserved. 
 The inner margin may be irregular because of its 
 ulceration. Calcification may also be detected and the 
 tumour occasionally enhances after IV contrast admi-
 nistration8 (Fig. 1,2,3). Moreover, on 3D CT and virtual

 Figure 1. Benign leiomyoma of the stomach in a 73 - year old 
 man with symptoms of bleeding. CT scan obtained with water 
 as contrast agent shows a soft-tissue mass in the wall of the 
 antrum with endogastric growth (arrow). This is smoothly 
 marginated with slightly inhomogeneous enhancement due to 
 hemorrhage. A central ulceration was found in gastroscopy.

 Figure 2. Benign leiomyoma of the stomach in a 55 year old 
 woman with symptoms of bleeding. CT scan obtained with 
 water as contrast agent shows a soft-tissue mass arising from 
 the fundus (arrow). It’s margins are smooth and it has a slightly 
 inhomogeneous enhancement.

 Figure 3. Benign leiomyoma of the stomach in a 52 year old 
 woman with a recent history of vomiting. CT scan obtained 
 with water as contrast agent shows a small soft-tissue mass in 
 the wall of the fundus that is partially calcified and enhanced, 
 (arrow).
gastroscopy, bridging folds over the tumour may be detected, surrounding the endoluminal mass.\textsuperscript{14}

A large exogastric leiomyoma could be difficult to distinguish from a leiomyosarcoma.\textsuperscript{15} CT features of size, contour enhancing pattern, mesenteric fat infiltration, and regional lymphadenopathy are significantly reliable in differential diagnosis\textsuperscript{11} (Fig. 4).

**Figure 4.** Leiomyosarcoma of the stomach in a 74-year old man with clinical findings of pain and fever. CT scan obtained with air as contrast agent (severely ill patient) shows a large soft-tissue mass in the wall of the fundus, having endogastric and exogastric growth (arrow). The lesion is heterogeneous in enhancement and it has a low density area, due to central necrosis.

**LEIOMYOBlastoma**

Leiomyoblastoma is a rare benign neoplasm variant of leiomyoma, arising from muscle cells and predominantly composed of round or polygonal cells.\textsuperscript{13} Leiomyoblastomas are more common in men than in women and tend to occur more often in the antrum. They are considered to have a malignant potential and metastasis occurs in 10\% of cases.\textsuperscript{13} The common symptoms are epigastric pain and upper Gl bleeding.

CT features are not different from leiomyoma and a definitive diagnosis is made only with histology after laparotomy (Fig. 5).

**Lipoma**

Lipomas are benign tumours composed of adipose tissue and represent about 2-3 \% of all benign gastric tumours.\textsuperscript{16} The lesions are usually small in size, solitary and sessile, and the antrum is the commonest site of their location. When small, lipomas are usually asymptomatic and detected incidentally. When larger, the main clinical manifestation is bleeding due to ulceration of the tumour.\textsuperscript{16,17} Gastric lipomas are localized, encapsulated tumours and have a submucosal or, less frequently, subserosal origin.\textsuperscript{18}

At CT lipoma appears as a well-circumscribed tumour with homogeneous negative attenuation values and no infiltrative growth\textsuperscript{1,7,16} (Fig. 6,7). Therefore, the CT pattern of lipoma is specific, based on the fat density of the tumour and unnecessary endoscopy or surgery can

**Figure 5.** Benign leiomyoblastoma of the stomach in a 80- year old woman with symptoms of bleeding. CT scan obtained with air as contrast agent (because of her age) shows a soft-tissue mass in the wall of the antrum with endogastric growth (arrow). The tumour is smoothly margined and has homogeneous enhancement.

**Figure 6.** Lipoma of the stomach in a 53-year old man with epigastric pain due to gastritis. CT scan obtained with water as contrast agent shows a small well-circumscribed, submucosal fatty mass in the pre-pyloric wall (arrow). The overlying mucosa is clearly visible (open arrow).
Figure 7. Lipoma of the stomach in a 54-year old man with clinical symptoms of intermittent gastric obstruction. CT scan obtained with water as contrast agent shows a small, fatty mass in the wall pylorus (arrow). The mass in the duodenum (open arrow) represents a small component of a 4 cm Brunner gland hamartoma causing the obstruction.

be avoided. 7

INFLAMMATORY LESIONS

Gastritis

Gastritis is an inflammatory process of the gastric mucosa and has many causes, including infection, inflammatory conditions, irradiation, ingestion of alcohol and medications. On CT it appears, in most cases, as thickening of gastric folds and the gastric wall (Fig. 8). The thickened wall attenuation is similar to that of soft tissue and it could have a bright enhancement in the arterial phase. 1,3,8

Low density areas in the thickened wall due to edema have been described. 7 Gastritis is considered a pathological rather than radiological diagnosis; CT findings of the wall are similar to those of tumour infiltration (Fig 9,10). But unlike carcinoma there are no adenopathy or extension to adjacent structures.

Gastric ulcer disease

Benign peptic ulcer can appear on CT in sizable or subtle areas of thickening of the gastric wall. Local findings as contrast enhancement of the lesion, focal wall thickening > 5 mm, and perigastric tissue abnormalities could assist in distinguishing the malignancy. 19 The ulcer crater can be identified when its base is perpendicular to the plane of the CT section (Fig. 11,12). Computed tomography is sensitive in demonstrating gastric or duodenal ulcer perforation as extraluminal air or contrast medium. 20

VASCULAR PATHOLOGY

Varices

Gastric varices are usually the result of portal hypertension, secondary to cirrhosis. They are dilated venous collaterals of the short gastric and left gastric veins, usually seen in the fundus of the stomach. On unenhanced CT, a multilobulated mass can easily be mistaken for a neoplasm. On enhanced CT, rounded or tubular structures can be seen within the gastric wall, enhancing
to the same degree as vessels. They have distinctive appearance that confirms the diagnosis\textsuperscript{21,22} (Fig. 13). Dilated venous collaterals are usually seen in the region of gastrohepatic ligament and near the lesser omentum. 3D CT has similar results to that of a conventional barium study or endoscopy,\textsuperscript{6} and 3D CT portography seems to be useful for the treatment of patients with gastric fundic varices.\textsuperscript{23}

**CONCLUSION**

CT remains a complementary tool to gastroscopy, despite the development of 3D CT and virtual reality
technology. It allows the view and measurement of
the exact size of the abnormality. Among the described
benign gastric lesions, lipoma and varices have typical
CT features.

REFERENCES

1. Fishman EK, Urban BA, Hruban RM. CT of the stomach:
2. Meyers MA Gastric carcinoma: imaging, staging,
management. In: Meyers MA, ed. Neoplasm of the
digestive tract: imaging, staging and management.
3. Horton KM, Fishman EK. Helical CT of the stomach:
evaluation with water as an oral contrast agent. *AJR*
1998; 171: 1373-1376
of gastric cancer: CT findings and pathologic correlation
using 5 mm incremental scanning , hypotonia, and water
5. Lee DH Two - dimensional and three - dimensional
imaging of gastric tumours using spiral CT. *Abdom
Imaging* 2000 ; 25: 1 - 6
6. Ogata I, Komohara Y, Yamashita Y, et al. CT evaluation of
gastric lesions with three-dimensional display and interactive
virtual endoscopy: comparison with conventional barium
study and endoscopy. *AJR* 1999 ; 172: 1263-1279
7. Park SO, Han JK, Kirn TK et al. Unusual gastric tumours: 
1435 -1446
8. Merino S, Saiz A, Moreno MJ et al. CT evaluation of
gastric wall pathology. *BJR* 1999; 72: 1124-1131
9. Miettinen M, Lasota J. Gastrointestinal stroma tumours
-definition, clinical histological, immunohistochemical,
and molecular genetic features and differential diagnosis.
*Virchows Arch* 2001; 438: 1-12
10. Appelman HD Mesenchymal tumours of the gastrentestinal
tract. In: Ming SC, Goldman H, eds. Pathology of the
gastrentestinal tract. Baltimore, Williams and Wilkins, 1998:
361 -368.
leiomyoma and leiomyosarcoma: CT differentiation. *J.
sarcomas: correlation of MR imaging and histopathologic
findings in nine patients. *Radiology* 1998; 208: 591 - 595
13. White EM Benign tumours of the stomach. In: Margulis
AR ed. Modem imaging of the alimentary tube. Berlin
14. Lee DH Three - dimensional imaging of the stomach by
15. Pannu HK, Hruban RH, Fishman EK. CT of gastric
leiomyosarcoma:patterns of involvement *AJR* 1999; 173:
369 -371
of the stomach: CT findings and differential diagnosis. *J
Comput Assist Tomogr* 2000 ; 24: 854 -858
gastric lipoma: US,CT and MR findings *Eur. Radiol*
1999:9:256-258
and malignant gastric ulcer: CT findings. *Radiol Med
(Torino)* 2001; 102:32-36
20. Ranschaert E, Rigauts H Conflined gastric perforation:
ultrasoudand computed tomographic diagnosis. *Abdom
Imaging* 1993; 18: 318-319
tomographic recognition of gastric varices. *AJR* 1984; 142:
1121 -1125
22. Carucci LR, Levine MS, Rubesin SE, Laufer l. Tumourous
gastric varices: radiographie findings in 10 patients.
*Radiology* 1999; 212:861 -865
dimensional portography using multislice helical CT is
clinically useful for management of gastric fundic varices.
*AJR* 2001; 176: 899-905