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An Approach to Various Gastric Pathologies Using an "Image Appearance – Based Classification" on Computed Tomography

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Although pathologies affecting stomach are commonly encountered in computed tomography imaging of the abdomen, they are frequently overlooked. Their etiologies are often diverse; however, most of them have certain well-documented imaging characteristics. Conventionally the stomach abnormalities were classified according to their etiopathogenesis. This article aims at providing the readers with an easy approach by categorizing abnormalities of stomach using a novel image appearance – based classification. An attempt to illustrate various gastric pathologies using this new classification by means of pictorial examples is made. Basic computed tomography imaging anatomy of the stomach and imaging techniques that need to be adapted are also emphasized in the outset of the discussion.

Background

Though, like any other organ system in the body, stomach can be affected by various spectrum of diseases,[1] it remains one of the commonly overlooked organs in the computed tomography (CT) examination. Moreover, until recently the role of CT was limited to a very few gastric pathologies such as staging of stomach cancer and CT was considered less optimal for evaluating most of the other conditions. For diagnosing pathologies like small polyps and ulcers, endoscopy was used primarily, whereas conditions like diverticulae required barium studies.[2] Nevertheless, with the advent of recent improvements in software and hardware in the field of CT imaging and many cutting edge reconstruction algorithms, more and more exquisite details of this hollow viscus are being increasingly visualized. This has paved the way to newer scopes of looking at this organ in CT imaging and resulted in increase in number and variety of pathologies that can be identified.

In this context, it appears imperative to recognize distinct radiological patterns that this wide variety of gastric pathologies can produce. By sorting the particular gastric pathology that is encountered in one of the morphologic forms of radiological presentation, one can narrow down possible differentials, have a reasonable approach, and reach a logical conclusion.

CT Anatomy of Stomach

Stomach is a hollow visceral organ that connects esophagus proximally and duodenum distally. Anatomically, it is divisible into fundus, cardia, body or corpus, and pylorus (Fig 1).

The gastroesophageal junction is usually seen at the level where one can see the ligamentum venosum, an anatomical landmark for identification of gastroesophageal junction in the axial sections (Fig 2). However, with the multiplanar reconstruction it can effortlessly be localized in coronal and sagittal views.

When adequately distended, normal wall thickness of the stomach on multidetector CT measures 3-5 mm.[3] Many times the distal antral wall thickness measures more than 5 mm.[4] This smooth and uniform wall thickening of antrum relative to the rest of the stomach is due to the presence of pyloric sphincter and is considered normal. Adequate caution should be taken in evaluating the gastroesophageal junction, as this region is notorious for spuriously increased wall thickness due to its oblique course in relation to the axial scan plane. Gastroesophageal junction is considered abnormal when stomach wall thickness is more than 10 mm.[3] Any dilatation of esophagus on CT scan without apparent cause should raise suspicion of structural or functional pathologies of gastroesophageal junction. The gastric rugal folds should appear smooth and regular with thickness of up to 4-5 mm (Fig 3).[5]

Perigastric fat planes are well demonstrated on CT (Fig 4). Unlike upper gastrointestinal tract series and endoscopy, CT is not only useful for identifying luminal pathologies but also helps in evaluating mural and extramural diseases of the stomach.[6] The arterial supply of the stomach is primarily derived from the branches of the celiac artery. The gastric and gastroepiploic vessels supply the lesser and greater curvatures of the stomach,

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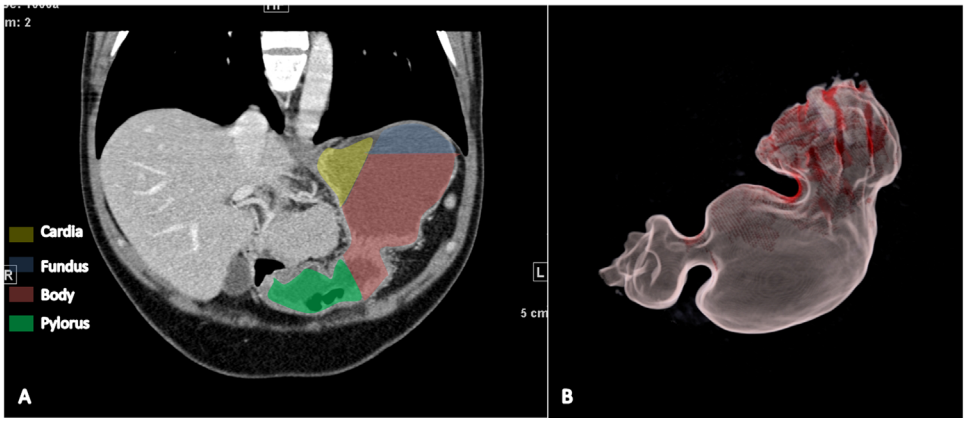

Fig. 1. (A) Oblique coronal reconstructed CT image showing various parts of the stomach identified by different color shades. (B) Volume-rendered CT image of the stomach showing the parts. (Color version of figure is available online.)

respectively (Fig 5). Lymphatics of the stomach usually drain into gastric, hepatic, and pancreatico-splenic nodes (Fig 6). Evaluation of the lymph nodes is of importance in staging of gastric carcinoma. In the context of staging, the regional lymph nodes of the stomach are divided into 23 stations (among which 6 are perigastric and 17 are extraperigastric), which are classified broadly into 3 major groups, according to Japanese Gastric Cancer Association (Table 1, Fig 7).[7,8] They are considered abnormal when they measure more than 10 mm in short axis in the CT examination.[9]

CT Imaging Techniques

Approximately 6 hours of fasting before the procedure is preferred. For better evaluation, optimal and adequate distension of the stomach is recommended.[10] Whereas an undistended stomach may result in identifying spurious abnormalities, excessive distension may result in missing some subtle findings.[11] We prefer plain water over iodinated contrast material as orally administered substance for luminal distension of stomach. Plain water is readily available, easily tolerated, and serves as a neutral contrast medium. Water is superior to positive iodine-based oral contrast agents in finding out small enhancing mural lesions. Water, unlike iodinated contrast media, does not interfere with postprocessing when a concurrent CT angiography is being contemplated. In our institution when CT is targeted to evaluate gastric pathologies, approximately 500-800 mL of plain water is administered, with or without an on-table dose of 250 mL just before scanning. Effervescent agents may be used in some situations, as air distension is useful when a 3D rendering and virtual endoscopic examinations are planned. After intravenous contrast injection the gastric wall enhancement is the most optimal at the portal venous phase, after approximately 70 seconds from the time of injection. Various postprocessing methods can be employed to assess the stomach and its pathologies according to the nature of the disease.

Fig. 2. Axial CT image at the level of upper abdomen showing fissure for ligamentum venosum (arrow), the section where gastroesophageal junction is normally identified.

Classification of Gastric Pathologies Based on Imaging Appearances

The abnormalities that can occur in the stomach are usually grouped and viewed according to the underlying pathology like inflammatory, neoplastic, developmental, etc., in a general outlook. But practically, from the radiologists' perspective, it looks imperative to approach various gastric abnormalities according to certain imaging patterns and thereby reason out probable underlying causes (Fig 8). Hence, we propose a novel image appearance – based classification of gastric pathologies (Table 2). Various pictorial examples are provided in each category, underlining the pathologies that can conform to the specific image pattern. The authors believe that such a structured approach can make the task of imaging and working out the seemingly vast variety of gastric pathologies into a simpler and reasonable one. Some of the imaging examples presented later were taken in the circumstances when abnormality of the stomach was rather incidentally picked up. Thus appropriate distension and ideal phase of imaging may not be found in such cases.

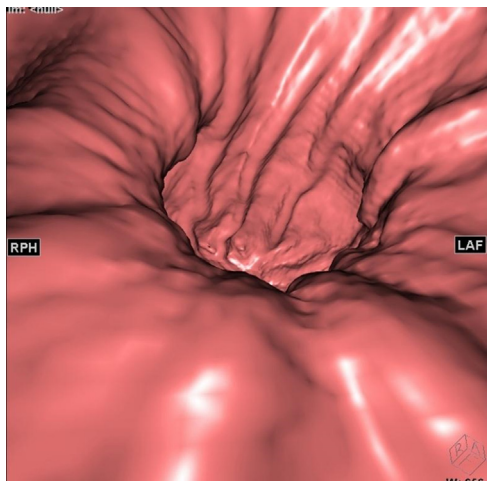

Fig. 3. Virtual endoscopic view of the stomach showing the normal rugal folds. RPH and LAF representing the orientation of the view. RPH, Right-Posterior-Head; LAF, Left-Anterior-Foot. (Color version of figure is available online.)