GI Tract
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July 6, 2006

GI TRACT

1) Other Names:

- Gastrointestinal tract
- Digestive tract
- Alimentary tract

2) Definition/Location:

- Digestion and absorption are the primary functions of the GI tract. Food is mechanically and chemically broken down with the help of specific enzymes and accessory glands until nutrients are absorbed through the wall of the intestine into the blood or lymph system. The undigested and unabsorbed food is eliminated from the digestive tract by the process of defecation (Hagen-Ansert, p. 276, 1/2/1).
- The GI tract is a long tube extending from the mouth to the anus (Hagen-Ansert, p. 272, 1/2/1).
- The GI tract includes the mouth, pharynx, esophagus, stomach, small intestines (duodenum, jejunum, and ileum) and large intestines (cecum, ascending colon, transverse colon, descending colon, and rectum), also known as the alimentary canal (Curry-Tempkin, p. 214, 1/1/1).
- There are three types of accessory digestive glands—the salivary glands, liver, and pancreas— that secrete digestive juices into the digestive system (Hagen-Ansert, p. 272, 2/1/2).
- The stomach (located in the left upper quadrant, within the left hypochondrium and epigastric regions) is a large, smooth, muscular organ that has two surfaces and is divided into three parts: the lesser curvature and the greater curvature; and the fundus, body, and pylorus, respectively (Hagen-Ansert, p. 272, 2/3/1)
- Vascular supply to the stomach is supplied by the right gastric arterial branch, pyloric and right gastroepiploic branches of the hepatic artery, left gastroepiploic branch and vasa brevia of the splenic artery, and left gastric artery (Hagen-Ansert, p. 27, 2/2/1).
- The mesentery outlines the small intestine and contains the superior mesenteric vessels, nerves, lymphatic glands, and fat between its two layers. The celiac axis supplies the duodenum through its right gastric, gastroduodenal, and superior pancreaticoduodenal branches (Hagen-Ansert, p. 274, 2/3/1), (p. 275, Figure 9-5).
- The celiac, superior mesenteric, and inferior mesenteric arteries supply both the small and large intestine. The superior mesenteric arterial branches include the ileocolic, the right colic, and the middle colic ateries. Branches of the inferior mesenteric artery include the left colic, sigmoid, and superior rectal arteries (Hagen-Ansert, p. 274, 2/4/1), (p. 275, Figure 9-5).

- The venous system of the stomach, small intestine, and large intestine are all parallel to the arterial vessels, which drain into the portal venous system (Hagen-Ansert, p. 274, 2/2/2).
- The appendix is located on the abdominal wall under McBurney's point. McBurney's point is located by drawing a line from the right anteroposterior iliac spine to the umbilicus. At approximately the midpoint of this line lies the root of the appendix (Hagen-Ansert, p. 279, 2/3/3).

3) Ultrasound Appearance: (Curry-Tempkin, p.222, "Sonographic Appearance")

- The sonographic appearance of bowel depends on the presence or absence of air, gas, feces, or fluid within the lumen, and on the recognition of anatomic landmarks (p. 223 Figure 14-11).
- The layers of the bowel wall create a characteristic appearance on ultrasound called a gut signature, wherein up to five layers can be visualized: 1) the mucosa layer directly contacts the intraluminal contents and is lined with epithelium having many folds, which increase the absorptive surface and give the mucosal layer its high echogenicity, 2) the submucosa beneath it contains blood vessels and lymph channels in connective tissue appearing hypoechoic, 3) the muscularis contains the circular and longitudinal bands of fiber which appear echogenic, 4) the serosa is a thin, loose layer of hypoechoic connective tissue, 5) the mesothelium covers the intraperitoneal bowel loops with an echogenic appearance.
- The esophagus is normally recognized at the esophagastric (EG) junction on a longitudinal scan of the aorta, just to the left of the midline (p. 223 Figure 14-12). In the neck, it may be seen posterior to the thyroid gland on the left and is usually recognized by its bull's-eye appearance (p. 223, Figure 14-13).
- Empty loops of bowel also demonstrate the target (bull's eye) pattern: a thin, hypoechoic sonolucent periphery with an echogenic center of varying size.

4) Normal Size Range(s):

The esophagus is approximately 23 cm in length. It is the narrowest part of the alimentary canal, and is most contracted at the origin and at the point where it passes through the diaphragm (Curry-Tempkin, p. 219, 2/6/1).

- The size of the stomach varies considerably. The greatest length of the stomach is from 25 to 30 cm, from the top of the fundus to the bottom of the greater curvature; its widest diameter is 10 to 12 cm. The distance between the two openings ranges from 7 to 15 cm (Curry-Tempkin, p. 219, 2/7/1).
- The pyloric canal is 2 to 3 cm in length (Curry-Tempkin, p. 220, 1/1/1).
- The small intestine is approximately 5 to 6 m in length and 4 cm in diameter. The duodenum measures approximately 22 to 25 cm in length. The jejunum measures about 2 to 2.3 m in length comprising the upper two fifths of the remaining small intestine. The ileum contains the lower three fifths of the small bowel and is some 3.5 m in length and 3 cm in diameter (Curry-Tempkin, p. 220, 1/3/1), (Hagen-Ansert, p. 272, 2/5/1).

- The appendix varies from 1 to 9 inches in length, averaging 3 inches (Hagen-Ansert, p. 279, 2/4/1).

5) Pertinent Lab Data: (Curry-Tempkin, p. 229, "Laboratory Values")

- Plasma Test:
  - Carcinoembryonic antigen (CEA): 0-25 mg/ml; an increase in this count indicates inflammatory bowel disease.
- Serum Test:
  - Total cholesterol: 150-250 mg/dl; a decrease in this count indicates cancer, or fat malabsorption.
  - Total lipids: 400-800 mg/dl; a decrease in this count indicates fat malabsorption.
- Urine Test:
  - Chloride (CL-): 110-254 mEq/24 hr; a decrease in this count indicates pyloric obstruction, and/or diarrhea.
  - Potassium (K+): 25-100 mEq/l; a decrease in this count indicates diarrhea, and/or malabsorption.
  - Sodium (NA+): 75-200 mg/24 hr; a decrease in this count indicates diarrhea.
- The most common laboratory data the sonographer may come across in a patient with gastrointestinal disease relate to the presence of blood in the stool. Anemia may be present as a result of chronic blood loss. Blood in the stool indicates the presence of a bleed somewhere in the gastrointestinal system. Infection would show elevation of the white blood count (Hagen-Ansert, p. 277, 1/4/1).
- Cholecystokinin is released by the presence of fat in the intestine and regulates gallbladder contractions and gastric emptying. Secretin is released from the small bowel to stimulate the secretion of bicarbonate to decrease the acid content of the intestine (Hagen-Ansert, p. 277, 1/2/2).

5) Common Pathologies

- Upper Gastrointestinal Tract
  - **Polyp**- A small, tumorlike growth that projects from a mucous membrane surface; sonographic findings include fluid distention of the stomach and appearance of solid masses that adhere to the gastric wall; the polyp has various echogenicity; a large polyp may be heterogeneous; its contours may be sharply defined, depending on the nature of the surface; the detection of a pedicle maybe possible (Hagen-Ansert, p. 281, 2/1/1).
  - **Gastric carcinoma**- At least 90% to 95% of malignant tumors of the stomach are carcinomas; on ultrasound examination, the sonographer should look for the target or pseudokidney sign; the patient may have gastric wall thickening (Hagen-Ansert, p. 281, 2/5/1), (p. 283, Figures 9-15, 9-16).
  - **Lymphoma**- Characteristics include enlargement of the stomach and thickened mucosal folds, multiple submucosal nodules, ulcerations, and a large extraluminal mass; the sonographer will

see a large and poorly echogenic (hypoechoic) mass, thickening of gastric walls, and a spoke-wheel pattern within the mass (Hagen-Ansert, p. 281, 2/7/1).

- **Gastric Bezoar**- Movable intraluminal masses of congealed ingested materials that are seen on upper GI radiographs; complex mass is seen with internal mobile echogenic components; in the fasting patient a broad band of high-amplitude echoes or a hyperechoic curvilinear dense strip at the anterior margin is seen (Hagen-Ansert, p. 281, 1/5/1).
- **Metastatic disease**- Found in the submucosal layer, forming circumscribed nodules or plaques; on ultrasound, a target pattern, circumscribed thickening, or uniform widening of the stomach wall without layering is visible (Hagen-Ansert, p. 282, 2/3/1).

- Lower Gastrointestinal Tract
  - **Acute appendicitis:** The wall of the inflamed appendix is greater than 2 mm thick, and perforation may be present when asymmetric wall thickening is seen; the distinction of layers is impaired, and each layer is sonographically heterogeneous; the typical target-shaped lesion consists of a hypoechoic, fluid-distended lumen, a hyperechoic inner ring representing mainly the mucosa and submucosa, and an outer hypoechoic ring representing the muscularis externa (Hagen-Ansert, p. 285, 1/5/3; p. 286, Fig. 9-18).
  - **Crohn's disease**- A recurrent granulomatous inflammatory disease that affects the terminal ileum, colon, or both at any level; the reaction involves the entire thickness of the bowel wall; on ultrasound, a symmetrically swollen bowel target pattern with preserved parietal layers around the stenotic and echogenic lumen is seen; patients show rigidity to pressure exerted with transducer, and peristalsis is absent or sluggish (Hagen-Ansert, p. 289, 1/1/1; p. 288, Fig. 9-20 through 9-22).

7) Patient Prep

- The technique used to observe the upper gastrointestinal tract is for the patient to drink 10 to 40 oz of water through a straw after a baseline ultrasound study of the upper abdomen. The straw helps prevent ingestion of excess air when the water is consumed (Hagen-Ansert, p. 277, 1/8/1).
- The patient should be in an upright position for the examination; this causes air in the stomach to rise to the fundus of the stomach and not interfere with the ultrasound beam (Hagen-Ansert, p. 277, 1/8/3).
- The lower gastrointestinal tract requires no preparation. To image the lower colon, it may be useful to give the patient a water enema in order to help better delineate the colon (Hagen-Ansert, p. 277, 1/8/5).

8) Transducer (Probe) Frequency: (Curry-Tempkin, p. 89, "Transducer")

- 3.0 MHz – 3.5 MHz
- 5.0 MHz for thinner patient

9) Protocol:

- The gastroesophageal junction is seen on the sagittal scan to the left of the midline as a bulls-eye or target-shaped structure anterior to the aorta, posterior to the left lobe of the liver, and inferior to the hemidiaphragm (The left lobe of the patient's liver must be large enough to be able to image the gastroesophageal junction) (Hagen-Ansert, p. 277, 2/1/1; p. 278, Fig. 9-8).
- Usually only the gas-filled duodenal cap is seen to the right of the pancreas (Hagen-Ansert, p. 277, 2/5/1). The duodenum can be outlined easily with water ingestion or a change in position. Generally the right lateral decubitus position allows the fluid to drain from the antrum of the stomach into the duodenum. Observation of peristalsis is useful to delineate the duodenum (Hagen-Ansert, p. 279, 1/2/1).
- The small bowel is more difficult to image with ultrasound unless contrast or fluid is present. When there is fluid in the bowel, the sonographer may be able to look for peristalsis, air movement, or movement of intraluminal fluid contents to rule out obstruction (Hagen-Ansert, p. 279, 2/2/1; p. 280, Fig. 9-12).
- A fluid-filled colon may present as a mass. The water-enema technique should be used to help delineate if the mass is within the colon, separate from the colon, or just the colon itself. The patient should have a full bladder when scanned to help push the small bowel out of the pelvis. Only a small amount of lukewarm water needs to be given as the sonographer follows the rectum and rectosigmoid colon (Hagen-Ansert, p. 279, 2/7/1).

10) Image References:

- Hagen-Ansert, p. 273, Fig. 9-1
- Curry-Tempkin, p. 223, Fig. 14-11, 14-12, and 14-13
- Hagen-Ansert, p. 283, Fig. 9-15
- Hagen-Ansert, p. 285, Fig. 9-17
- Hagen-Ansert, p. 286, Fig. 9-18
- Hagen-Ansert, p. 278, Fig. 9-8
- Hagen-Ansert, p. 280, Fig. 9-12
- Hagen-Ansert, p. 281, Fig. 9-14

11) References

- Curry, R.A. and Tempkin, B.B. (2006). Sonography: Introduction to Normal Structures and Function (2nd ed.). St. Louis, MO: Saunders.
- Hagen-Ansert, S.L. (2006). Textbook for Diagnostic Ultrasonography (6th ed.)(Vol. 1). St. Louis, MO: Mosby.