The Gamut of Intrinsic and Extrinsic Obstructive lesions of the Descending Duodenum with Pathologic Correlation

Poster No.: C-2507
Congress: ECR 2013
Type: Educational Exhibit
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Keywords: Abdomen, Small bowel, CT, MR, Plain radiographic studies, Diagnostic procedure, Image compression, Drainage, Cancer, Congenital, Diverticula
DOI: 10.1594/ecr2013/C-2507

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Learning objectives

Review the most common and uncommon congenital, inflammatory and tumoral processes that can produce obstruction of the second portion of the duodenum.

Discuss the diagnostic imaging algorithm in the evaluation of the descending duodenal strictures including abdominal plain films and MDCT.

Background

Normal Anatomic Features

The name duodenum, meaning "two plus ten," originated because the length of this part of the small bowel was thought to be equal to 12 fingers' breadth. It is the widest portion of the small bowel, has no mesentery, and is only partially covered by the peritoneum. The duodenum is 25-30 cm long and is divided into four sections.

The duodenum is often overlooked on computed tomographic (CT) scans, and its length belies its importance in the gastrointestinal tract. Its location, with both intraperitoneal and retroperitoneal segments and proximity to the gallbladder, pancreas, stomach, spine, aorta, liver, and other segments of the gastrointestinal tract, results in duodenal involvement by a multitude of primary and secondary processes.

Imaging techniques

When there is suspicion of a duodenal lesion, several techniques can be used to optimize imaging of this commonly overlooked structure. Large amounts of oral contrast material are helpful in opacifying the duodenum. Eventhough upper gastrointestinal series are surpassed by CT scanner (with opacification), they still have some indications.

Imaging findings OR Procedure details

We illustrate the primary duodenal and extraduodenal obstructive processes, with pathologic correlation.

Causes of duodenal obstruction that we have observed may be classified as follows:

- Developmental or congenital factors
- Extrinsic factors (extraduodenal disease)
• Intrinsic factors (intraduodenal disease)

1. Developmental or congenital factors

A. Occlusion by superior mesenteric artery or "duodenal ileus"

Superior mesenteric artery (SMA) syndrome (also known as Wilkie's syndrome) was first described by von Rokitanski in 1861. Wilkie later provided a more detailed anatomical, clinical and patho-physiologic description and named it chronic duodenal ileus. It is a rare vascular compression disorder in which acute angulation of superior mesenteric artery results in compression of the third part of the duodenum leading to obstruction.

The diagnosis of SMAS is based mostly on clinical symptoms and radiologic evidence of obstruction by Barium studies and CT scan

• Clinical presentation:

Weight loss and vomiting depending on the cause and degree of duodenal compression.

The symptoms are relieved by lying prone/ left lateral decubitus.

• Imaging findings:

Upper gastrointestinal barium study: normally the aorto-mesenteric angle and aorto-mesenteric distance is 25° to 60° and 10 to 28 mm respectively. Both parameters are reduced in SMAS, with values of 6° to 15° and 2 to 8 mm respectively.

Contrast enhanced computed tomography (CECT) showed distended stomach with dilatation of second part and constriction/extrinsic compression of the third part of duodenum between aorta and SMA.

B. Congenital band

ACB contained blood vessels and nerve plexi. There are four types of congenital peritoneal band.

- Type 1 band is always associated with intestinal malrotation. The cecum, which is in the upper quadrant of the abdomen, has a band which extends across the second and third parts of the duodenum to the paravertebral gutter (Ladd's band). Duodenal obstruction may result from either compression by Ladd's band and/or from mid-gut volvulus.

- Type 2 band extends from the hepatic flexure of the colon across the second part of the duodenum to the right paravertebral gutter, causing duodenal compression at that site.

- Type 3 band is a hypertrophied hepatoduodenal ligament which obstructs the duodenum at the junction of its first and second parts.
- Type 4 band is a dense fibrous band which binds the distal part of the third part of the duodenum to the prevertebral fascia, causing extrinsic obstruction, and is always associated with an incompletely rotated duodenum.

  • Clinical presentation

  Bilious vomiting in a neonate, although not pathognomonic, warrants investigation for intestinal obstruction, especially if associated with polyhydramnios.

  • Imaging findings

  - Plain abdominal radiograph:

    Normal

    Distension

    Double aeric gastric and duodenal distension «double bubble aspect»

    Distension with gastric air-fluid level.

    Duodenal air-fluid level in pre-spinal.

    Downstream digestive Clarities reflecting incomplete occlusion.

  - upper GI series

    Disproportionate dilatation of the duodenum with distension of its proximal part.

    "Corkscrew appearance" of the duodenum: Duodenojejunal junction is low below the duodenal bulb with swirled proximal jejuna loop.

    Abnormal location of the jejunal loops to the right side of the spine.

C. Other: Volvulus of jejunum, Malrotation of small intestine, Obstruction at ligament of Treitz, Annular pancreas

2. Extrinsic factors (extraduodenal disease)

A. Abdominal aneurysm

   An aortic aneurysm is defined by the permanent localized and irreversible dilatation of the walls of the aorta with loss of parallelism of its edges. The diameter of the expansion must be greater than or equal to 1.5 times the diameter of the aorta interfering. It is fusiform in 95% of cases.
The increase in volume of the aneurysm may cause compression of the duodenum, stomach, urinary tract (ureters), the inferior vena cava and adjacent nerves.

The aneurysm can be revealed by anorexia, occlusive syndromes due to duodenal compression.

It may be complicated by intra-duodenal rupture; an aorto-duodenal fistula develops between the aorta and the third duodenum.

B. Pancreatic lesions

As the duodenum is in close proximity to the pancreatic head, the adjacent phlegmonous exudates in acute pancreatitis may cause oedema and mural thickening of the duodenal loop (duodenitis).

Similar findings may also be seen in acute cholecystitis.

Every pancreatic focal lesion (benign cyst, Islet-cell adenoma, carcinoma) can increase in size and compress the duodenum.

C. Enlarged mesenteric nodes

- Malignant nodes:

Mesenteric lymphadenopathy may result from metastatic malignancy. Almost any malignancy may produce mesenteric lymphadenopathy, although some malignancies are more commonly associated with this finding.

Enlarged mesenteric lymph nodes resulting from malignancy are usually of soft-tissue attenuation and demonstrate homogeneous enhancement following intravenous contrast material administration.

**Lymphoma:** is the most common malignancy resulting in mesenteric lymphadenopathy.

Enlarged nodes may be seen at the mesenteric root, scattered throughout the peripheral mesentery, or in a mixed root-peripheral pattern. Early in the course of the disease, the lymph nodes may be small and discrete. As the disease progresses, the nodes often coalesce, forming a conglomerate soft-tissue mass. Lymphoma is a soft tumor, and extensive mesenteric lymphadenopathy due to lymphoma has a characteristic appearance. They usually have an attenuation value close to that of soft tissue. Following intravenous administration of contrast material, these nodes usually demonstrate homogeneous enhancement. On rare occasions, peripheral enhancement may be seen. The tumor tends to grow around and displace normal anatomic structures that are in the location of the nodal mass, such as vessels or bowel.
Metastasis: Primary malignancies that more commonly result in mesenteric lymphadenopathy include carcinoma of the breast, lung, pancreas, and gastrointestinal tract. Carcinoid tumor may also result in mesenteric lymphadenopathy.

- Inflammatory nodes and infectious origin:

It may be either a localized inflammatory disease process or a systemic inflammatory condition.

The infection may be local or systemic.

The adenitis should be large enough to cause the duodenal obstruction.

Etiologies include: tuberculosis, HIV infection…..

D. Intraperitoneal tumors

Direct extension from close visceral organs may occur in various primary neoplasms; pancreatic carcinoma, right colon cancer, gall bladder and right renal tumours may directly invade the medial or lateral aspect of the duodenal wall, and gastric tumours may spread across the pylorus. Colonic metastases spread across the mesocolon, extending between the hepatic flexure and the descending duodenum or via the lymphatic drainage to the mesenteric nodes surrounding the duodenum.

E. Retroperitoneal tumors

Primary retroperitoneal neoplasms are a rare but diverse group of benign and malignant tumors that arise within the retroperitoneal space but outside the major organs in this space.

They often massive and can involve adjacent organs and/or vital structures, making them difficult to resect.

Among the malignant tumors, retroperitoneal sarcoma is the most common diagnosis and liposarcoma is the most common sarcoma subtype, followed by leiomyosarcoma; nephroblastoma is less common.

Among the benign tumors, schwannomas and paragangliomas are the most frequent.

3. Intrinsic factors (intraduodenal disease)

A. acute and chronic duodenitis;
Infectious processes in the duodenum are rarely diagnosed prospectively from CT scans. Most infectious processes result in inflammation of the duodenum and secondary duodenal wall edema.

The most common infectious cause of duodenitis is Helicobacter pylori. Less common infections include giardiasis and tropical sprue. The findings tend to be nonspecific, such as wall thickening and luminal dilatation. Correlation with clinical history is helpful in diagnosis.

Duodenitis from inflammation without ulcer formation is manifested by thickening of the duodenal bulb wall. Inflammation of the duodenal papillae can occur in patients with acquired immunodeficiency syndrome or who are undergoing radiation therapy.

B. benign and malignant tumors;

Duodenal tumours account for about one-third of small bowel neoplasms, which represent only 5-6% of all GIT neoplasia. Benign tumours include adenoma, adenomatous polyp, lipoma and leiomyoma. The only criterion used to predict a benign lesion is the intraluminal location of a mass. Owing to its characteristic fat density, lipoma is the only intraluminal lesion that can be diagnosed by CT.

Primary malignant tumours include adenocarcinoma, which comprise about 80-90% of all primary duodenal malignant neoplasm, leiomyosarcoma and lymphoma.

Metastases result from direct extension from close visceral organs or from haematogenous spread from various primary tumours may reach the duodenum, especially from malignant melanoma, lung and breast cancer.

A metastasis may be seen as a large soft tissue mass, sometimes with necrosis or cavitation, indistinguishable from lymphoma or leiomyosarcoma.

C. pressure of diverticula;

Duodenal diverticulum, either congenital or acquired, is a frequent incidental finding and is found in 6% of upper GIT barium studies. It is most often located in the mesenteric border of the descending duodenum near the ampulla of Vater and pancreatic head. The diverticulum is seen on CT as an air-filled pocket or as an air-fluid/orally digested contrast material level that may contain debris, medial to the duodenal loop.

At barium examination, such diverticula show the classic "windsock" deformity, with the contrast material-filled diverticulum seen to project into the true lumen. The diagnosis can also be made with CT, at which either a collapsed or contrast material-filled diverticulum can be seen.
Infection, perforation, haemorrhage, pancreatitis or biliary obstruction may rarely complicate duodenal diverticulum and duodenal duplication.

**D. ulcer**

Duodenal ulcers are common pathologic entities that occur most frequently in the duodenal bulb.

Post bulbar ulcers represent 5% of duodenal ulcers.

Their diagnosis is important because they can cause pancreatitis, bleeding, stenosis.

They sit in the duodenum in susvatérien, especially on the inner edge.

Spastic reaction of the opposite wall is almost constant, sometimes more apparent than the ulcer itself.

Endoscopy is difficult given the stenosis.

Barium opacification is of a great help, it shows asymmetric stenosis with an aspect of "pearl threaded" corresponding to the niche profile view, retraction and duodenal edema.

**Images for this section:**
Fig. 1: abdominal CT, axial view constriction/extrinsic compression of the third part of duodenum between aorta and SMA.
Fig. 2: abdominal CT, sagittal view constriction/extrinsic compression of the third part of duodenum between aorta and SMA.
Fig. 3: Plain abdominal radiograph Distension with gastric air-fluid level. Duodenal air-fluid level in pre-spinal. Downstream digestive Clarities reflecting incomplete occlusion.
Fig. 4: upper GI series Disproportionate dilatation of the duodenum with distension of its proximal part. "Corkscrew appearance" of the duodenum Abnormal location of the jejunal loops to the right side of the spine.

Fig. 5: Abdominal CT, axial view aortic aneurysm
Fig. 11: upper GI series duodenal diverticulum
Fig. 10: abdominal CT, axial view large hyper vascular tumor developing in the right kidney, partially necrotic (nephroblastoma) driving inside the duodenum and right colon and strongly adherent to the inferior vena cava.
Fig. 9: abdominal CT, axial view intra-abdominal tumor (small bowel GIST) and duodenal compression

Fig. 8: abdominal CT, axial view enlarged nodes secondary to a Hodgkinian lymphoma
Fig. 7: abdominal CT, axial view acute duodenitis secondary to an acute pancreatitis (E)
Fig. 6: abdominal CT, axial view pancreatic tumor and duodenal compression
Fig. 12: upper GI series duodenal diverticulum
Conclusion

Chronic stenosis of post bulbar duodenal is caused by a number of distinct pathologic processes.

Radiologists should become familiar with the duodenal anatomy, pathology and the imaging patterns of obstructive duodenal lesions in order to help their detection and characterization.

References

CT of duodenal pathology
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