SESSION K1

Abdominal Imaging in the Older Adult
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Session Description:

This presentation addresses basic, important, fundamental concepts and principle of abdominal imaging and discusses how these concepts and principles can be used in understanding illnesses. The information is presented from a radiologist's point of view, in a manner that can be understood by a non-radiologist, and gives the participants insight into the thinking process involved in interpreting abdominal x-ray examinations. Common radiographic findings will be presented and discussed, along with their interpretation and correlation with the patient's clinical findings and disease process. The importance of good radiographic technique will be stressed, as will the importance of thinking through the diagnosis.

Learning Objectives:

Following my presentation, participants will be able to:

1. Discuss radiographic findings of normal anatomy on plain abdominal films, upper GI's, and lower GI's.
2. Discuss the findings that distinguish small bowel from large bowel.
3. Describe the radiographic findings of small bowel obstruction and large bowel obstruction and be able to state common causes of each.
How can you distinguish small bowel from large bowel?

STOMACH AND SMALL BOWEL

- Swallowed air is a major source of gas in stomach
- Very common to see small amounts of gas in nondistended loops of small bowel
- Small bowel is a winding tube which is of variable lengths and position within the abdomen
- In general, the small bowel loops lie within the CENTRAL portion of the abdomen
- Small bowel loops vary in size
- In general, small bowel loops normally range between 2cm to 4cm in transverse diameter
- Small bowel loops which are greater than 4 to 5cm should be considered to be dilated
THE SMALL BOWEL

- Small bowel folds
  - Generally are circumferential vs haustra of colon
  - Typically NOT obliterated when small bowel is distended
  - Slow passage of food along the intestine and allow increased surface for absorption
- Names
  • Circular folds
  • Plicae circulares
  • Valvulae conniventes
  • Valves of Kerckring

THE LARGE BOWEL

- Located along the LATERAL PERIPHERY of the abdomen, and along the upper portion of the abdomen, below the stomach
- Portions of the large bowel are the Cecum, Ascending Colon, Transverse Colon, Descending Colon, Sigmoid Colon, and Rectum
- Size of large bowel loops vary, but in general range between 3cm to 6cm
- Haustral markings
  - Folds of large bowel are not circumferential
  - Folds of large bowel are wider spaced than small bowel

FREE AIR

Pneumoperitoneum

Air or gas in the abdominal cavity
Small amounts of free air can be missed on plain films
CT regarded as the standard and should be done if there is any question of free air
CT can detect quantities as small as 5 cc

Pneumoperitoneum

RADIOGRAPHIC FINDINGS
Thin, smoothly curved shadow
Superior surface of shadow curved where gas is bounded by the diaphragm
Gas may be found under one or both diaphragms
Gas easier to recognize on right because of the homogeneous density of the liver
Pnuemoperitoneum

RADIOGRAPHIC FINDINGS
On the left normal gas shadow in the stomach may cause confusion
On left, close observation will sometimes show the presence of two shadows
Left lateral decubitus view of abdomen may be helpful

Pnuemoperitoneum

RADIOGRAPHIC FINDINGS
On left lat decubitus view, gas will rise to highest point in the flank and be visible as a horizontal translucent area between the lateral surface of the liver and the abdominal wall, with the background of the homogenous density of the liver making the gas more apparent

Pnuemoperitoneum

Perforated gas containing abdominal viscus most common cause
Usually a perforated peptic ulcer
Perforated tumor
Abdominal trauma
Laparoscopic surgery – insufflating the abdomen with carbon dioxide

Pnuemoperitoneum

Perforated duodenal ulcer
Bowel obstruction with perforation
Ruptured diverticulum
Penetrating trauma
Ruptured inflammatory bowel disease (megacolon)
Necrotizing enterocolitis

Pnuemoperitoneum

Bowel cancer
Ischemic bowel
After laparotomy
After laparoscopy
Breakdown of surgical anastomosis
Bowel injury after endoscopy
Colonic or peritoneal infection
SMALL BOWEL OBSTRUCTION

- Symptoms
  - Abdominal pain
  - Abdominal distention
  - Vomiting
- Often history of prior surgery
  - After surgery adhesions may form
    - Common cause of obstruction
- Other causes
  - Hernia
  - Malignancy
  - Inflammatory bowel disease
  - Volvulus
  - Appendiceal abscess
  - Gallstone ileus

SMALL BOWEL OBSTRUCTION

ETIOLOGY
Postoperative adhesions most common cause of SBO
- incarcerated groin hernia
- Malignant tumor (20%)
- Inflammatory bowel disease (5%)
- Volvulus (3%)
- Miscellaneous causes (2%)

SMALL BOWEL OBSTRUCTION

COMPLICATIONS
- Sepsis
- Intra-abdominal abscess
- Wound dehiscence
- Aspiration
- Short bowel syndrome (as a result of multiple surgeries)
- Death (secondary to delayed treatment)

LARGE BOWEL OBSTRUCTION

- Obstruction of colon usually caused by cancer or diverticulitis
- Other causes
  - Volvulus, hernia, fecal impaction
- Symptoms
  - Constipation
  - Abdominal distention
  - Abdominal pain
- Dilated loops of bowel PROXIMAL to the obstructing point
- Diagnosis can be confirmed by endoscopy or barium enema

ILEUS

- When intestinal motility is impaired, ileus may occur
- On radiographs enlarged, distended loops of large and small bowel are seen
- If ileus is localized to one part of abdomen, distended loops of bowel are present in that specific region
COLORECTAL CANCER

RISK FACTORS

- Age - most common over 50
- Diet - diets high in fats and low in fiber
- Polyps
- Medical History - Ovarian cancer, uterine cancer, breast cancer, prior colorectal cancer
- Family History
- Ulcerative Colitis

SYMPTOMS

- Change in bowel habits
- Blood in stool
- Diarrhea
- Constipation
- Bloating
- Stools that are narrower than usual
- Weight loss
- Abdominal cramping

DETECTION

- Fecal occult blood test
- Sigmoidoscopy
- Colonoscopy
- Barium enema
- Digital rectal examination
- Virtual colonoscopy

UNDERSTANDING X-RAYS:
Abdominal Imaging

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THE ABDOMEN

PLAIN FILM DIAGNOSIS

NORMAL ANATOMY:

A. INTRAABDOMINAL ORGANS:

The right and left hemidiaphragms define the superior extent of the abdomen. The liver is located in the right upper quadrant, just below the leaf of the right diaphragm, and forms a homogeneous density, representing the largest intra-abdominal organ, weighing between 1000 to 2000 grams in normal adults. It functionally is composed of three lobes, a right-lobe, a left lobe and a caudate lobe. The liver varies considerably in size and shape in different individuals. The right border of the liver can usually be distinguished by a thin layer of fat, and the lower border of the right lobe of the liver is often identifiable because of the radiolucent fat within the omentum and around the colon, located just beneath the right lobe of the liver. Usually, the inferior margin of the left lobe of the liver is not visible. The liver functions to regulate many blood constituents, including blood glucose, and is important in protein metabolism.

The spleen is located in the left upper quadrant, and normally measures between 10 to 14 cm in length. The upper border of the spleen is convex and its lower border concave, with its upper border usually situated between the ninth to eleventh ribs. The spleen can be mobile at times and may sometimes be found medial to the splenic flexure of the colon, below the stomach, or even above the gastric fundus. The average adult spleen weighs between 80 to 300 grams, with the spleen typically decreasing in size and weight with age. Its functions include erythrocyte storage, phagocytosis, adult lymphopoiesis, immune response, and fetal hematopoiesis.

The kidneys lie posteriorly in the upper abdomen, and their outlines are usually visible if adequate perirenal fat is present. In patients who are thin or asthenic, with decreased body fat, the kidney outlines may not be visible. The pancreas usually cannot be seen on plain films. The outer margins of the psoas muscles are usually identifiable because of the fatty tissues surrounding them. If filled with urine, the urinary bladder can be visualized, and in women, surrounding pelvic fat may allow visualization of the uterus.

B. STOMACH AND SMALL BOWEL:

On supine films, a "mass" may be seen in the left upper quadrant which represents fluid, secretions, and food within the stomach, located in the gastric fundus (pseudotumor of gastric fundus). When the patient is placed upright, the fluid then shifts to the antrum and gas goes into the fundus, helping to make the diagnosis.

Swallowed air is the major source of gas which is seen in the stomach. Some of that gas passes through the small bowel to the colon. It is very common to see small amounts of gas within nondistended small bowel loops. Small bowel loops vary in size, but normally range between 2 cm to 4 cm in transverse diameter. Small bowel loops which are greater than 4 to 5 cm should be considered dilated. The small bowel is a winding tube which is of variable lengths and variable position within the abdomen, but in general lies within the central portion of the abdomen as opposed to the large bowel which is located along the lateral periphery of the abdomen and the upper portion of the abdomen, below the stomach.
The small bowel loops are therefore distinguished from gas in the colon by their central location in the abdomen, and can also be distinguished by the mucosal folds which they contain. The small bowel folds run throughout the entire circumference of the small bowel (valvulae conniventes or plicae circulares), as opposed to the large bowel, where the folds are not circumferential and are spaced wider than the small bowel folds (Haustral markings). The small bowel is composed of the duodenum, jejunum, and ileum.

C. **THE LARGE BOWEL:**

As indicated above, the large bowel occupies the upper portion of the abdomen, below the stomach, and the right and left lateral peripheries of the abdomen, with the small bowel located in the middle. The portions of the large bowel are the cecum, ascending colon, transverse colon, descending colon, sigmoid colon, and rectum. The normal size of large bowel loops is variable, but in general ranges between 3 cm to 6 cm. The folds of the large bowel are not circumferential and are wider spaced than the small bowel folds, and are called Haustral markings.

D. **ABDOMINAL CALCIFICATIONS:**

Many different types of calcifications occur within the abdomen, and can be seen on plain films. These calcifications include mesenteric lymph nodes, usually secondary to granulomatous disease, aortic calcifications, arterial calcifications, hepatic and splenic calcifications, often secondary to histoplasmosis, pancreatic calcifications, gallstones (about 10 to 15% of gallstones contain enough calcium to be visible on plain film), urinary tract stones, fecaliths, enteroliths, calcified intraabdominal cysts which can be found in the spleen, liver, adrenal gland, kidney, and mesentery; echinococcal cysts of the liver, ovarian teratomas, benign and malignant tumors, and phleboliths, to name some.

**SMALL BOWEL OBSTRUCTION:**

**SYMPTOMS:**

Patients typically present with abdominal pain, abdominal distention, and vomiting. Very often the patients have a history of previous abdominal surgery, but not always. After surgery, adhesions commonly form and are a common cause of obstruction. Other causes include hernia, malignancy, inflammatory bowel disease, and miscellaneous conditions such as volvulus, appendiceal abscess, and gallstone ileus.

**RADIOGRAPHIC FINDINGS:**

When obtaining radiographs on patients suspected of small bowel obstruction, it is good protocol to obtain an upright chest film, combined with the films of the abdomen. The upright chest film can help to find free air if a perforated viscus is the cause of the pain, and can also be helpful in identifying a pneumonia which may be causing referred pain to the abdomen.

In simple obstruction, the small bowel is blocked at a single point, without any significant interference with its blood supply. This is the usual case if an adhesive band is the cause of the obstruction. In approximately three to five hours after onset of an obstruction, gas and fluid will accumulate proximal to the obstruction, and can be seen on the abdominal film. The small bowel loops become distended proximal to the obstruction, and air fluid levels are often present.
In the early stages of small bowel obstruction, or if the obstruction is partial, only a few distended loops of small bowel may be present, but with the passage of time, more of the small bowel loops will become involved, and their size will increase. In addition, with complete small bowel obstruction that is early, or with small bowel obstruction that is incomplete, gas can often be seen in bowel loops distal to the site of the obstruction, including colon, which will be of normal size and caliber. If the small bowel obstruction is complete, and enough time has elapsed for the colon to be evacuated, little or no gas will be seen in the colon. On occasion, the obstructed bowel may be entirely filled with fluid, a situation that is more likely to occur in proximal jejunal obstruction.

**LARGE BOWEL OBSTRUCTION:**

Obstruction of the colon is usually caused by cancer or diverticulitis. Volvulus, hernia, and fecal impaction are other causes. The symptoms include constipation, abdominal distention, and abdominal pain.

Colon obstruction is identified by dilated loops of large bowel proximal to the obstructing point, and if the ileoceleval valve is incompetent, gas can flow from the colon into the small bowel, causing these loops to be distended also. This helps to partially decompress the colonic obstruction.

In sigmoid volvulus, two parallel distended loops of bowel can be seen rising out of the pelvis, representing the distended, twisted loops of sigmoid colon, which often fills most of the abdomen giving an inverted "U" shape to the sigmoid colon. When barium is given, the characteristic "bird's beak" may be seen at the site of the volvulus.

If colonic obstruction is suspected, the diagnosis should be confirmed by either endoscopy or barium enema. If the cecum reaches 12 cm in diameter, impending perforation should be suspected, and prompt decompression should be performed.

**ILEUS:**

When intestinal motility is impaired, either due to laparotomy or other types of trauma, ileus may occur. Hypothyroidism, hypokalemia, and medications which inhibit intestinal mobility may also cause ileus. On plain film radiographs, enlarged, distended loops of large and small bowel are seen. If the ileus is localized to one part of the abdomen, distended loops of bowel are present in that specific region. Early in the process, upright films show little fluid in the bowel.