

# Diagnostic imaging of gastrointestinal tract

## Radiodiagnostic examination of the esophagus and stomach

### Skiagraphy

The esophagus can only be displayed on a plain image if it is pathologically altered.

- With large hiatal hernia, an oval formation with a surface may appear in the heart shadow,
- You can also see a significantly enlarged esophagus with food residues in achalasia.
- If perforation of the esophagus occurs, a pneumomediastinum can be formed, which creates a double contour on its edge or pneumocolum.
- A large gastric bubble with a surface is displayed during gastric distension.

### Skiascopy

Although sciascopy is partly replaced by endoscopic examination, it still has a range of indications.

- Swallowing and esophageal X-ray: X-ray examination of the esophagus with a barium contrast agent under sciascopic control. It is possible to prove, for example, diverticulum, hiatal hernia, esophageal varices and reflux esophagitis also have a characteristic picture. Oesophageal X-ray is a key examination for tumorous stenoses when planning interventional treatment - the insertion of an oesophageal stent.
- Oesophageal X-ray with aqueous contrast agent: indicated e.g. in post-operative conditions for elimination of anastomosis leakage and assessment of its throughput, but evaluation is indicative. This examination is also indicated if a bite is suspected to be stuck in the oesophagus (e.g. fish bone), in addition a cotton ball soaked in a contrasting agent is administered. So it can be caught at the site of the bite.
- Gastric X-ray: examination is almost completely replaced by endoscopy. For example the extent of tumor infiltration and ulcers can be evaluated.
- Videofluoroscopy: a special examination for swallowing disorders, where the swallowing act is recorded with a high time resolution (20 fps) for the functional evaluation of the individual phases of the swallowing act.

### Ultrasonography

Ultrasonographically, you can see the part of the esophagus to the left behind the thyroid gland. The stomach can also be displayed, but there is a very limited evaluation: the back wall may not be fully visible because of the filling. Gastroesophageal reflux in neonates and infants can also be seen on USG, but the use of this method is not currently recommended due to its low specificity.

### Endoscopic ultrasonography

Endoscopic ultrasonography has a very good resolution for pathologies on the mucous membranes of the esophagus, stomach, duodenum and the surrounding area (pancreas, nodes).

### Computed tomography (CT)

Esophageal CT is most often performed during tumor staging. Just before starting the examination, the patient swallows a sip of contrast medium to visualize the lumen. CT of the stomach is performed after an oral intake of 500-1000 ml of water, which ensures its good distension.

### Angiography

Angiographic examination is usually indicated with a view to interventional performance in bleeding, where endoscopy has failed, and a high risk of surgery.

## Radiodiagnostic examination of the small intestine

### Small bowel anatomy

It attaches to the stomach as a tube around 3-4 cm in diameter, long on the living and just after death 3-5 m. The actual length of the intestine cannot be established because it depends on the degree of contraction or relaxation of the wall muscles, in connection with this as well as the time since death and the measurement technique. On the dead (after relaxing muscle tension), the small intestine can extend up to 7 m, while stretching the intestine during removal during the autopsy also plays a role. The course here is the main and last stage of enzyme fission of food in absorbable components and absorption of the resulting components.

The small intestine consists of 3 parts: duodenum, jejunum and ileum.

### X-ray native abdominal image

Native abdominal imaging is the basic examination method for acute conditions to exclude ileosis or pneumoperitoneum. It is also suitable for controlling the development of the ileosal state. Radiation load approx. 1 mSv.

## Ultrasound

Ultrasound is also the basic examination method, but the small intestine usually cannot be imaged in its entirety - part is covered with gas, and in obese patients it is not possible to use linear probes with a higher frequency (better resolution for shallower structures). Detects wall enlargement, hypervascularization in inflammation (color mapping), surrounding fluid (ascites), distension of loops by fluid (but not air - this limits investigability). No radiation exposure.

## GIT passage

Dynamic examination, in which the patient drinks a contrast agent, the passage of which through the digestive tract is monitored under sciascopic control and documented by sciagraphy. Indicated in patients with passage disorder (subileotic conditions). Radiation load estimated at 2-3 mSv.

## Enteroclysis

After insertion of the nasojejunal probe into the duodenojejunal bend under sciascopic control, a bar contrast agent is administered to the probe, followed by methylcellulose solution. The contrast agent gradually fills the small intestine and displays its relief. Indicated for suspected small bowel disease (typically Crohn's disease). It is not indicated as an acute examination. The radiation exposure is estimated at 2-3 mSv, however, the ICRP in its 2008 report states 7.8 mSv.

## CT of the small intestine

- CT enteroclysis : As with conventional enteroclysis, a nasojejunal tube is inserted to administer methylcellulose solution (2000 mL). An antispasmodic ( *Buscopan* ) is given intravenously to slow the intestinal passage and affect the spasms, and CT of the abdomen and small pelvis with contrast agent is performed iv
- CT enterography : Mannitol solution (usually) in an amount of 1500–1700 ml the patient drinks for 45–55 minutes, then an antispasmodic ( *Buscopan* ) is administered intravenously and a CT of the abdomen and small pelvis with contrast agent is performed iv
- CT of the abdomen (routine) : classic CT of the abdomen and small pelvis with an effect is usually indicated in acute cases.

The disadvantage of CT is the higher radiation exposure (approx. 7 mSv), but this can be reduced to 3 mSv in lean patients using a low-dose technique. During the examination, both the intestinal wall and extraintestinal structures (abscess, ascites, skeletal involvement, parenchymal organ involvement) are displayed. CT enterography is more pleasant for the patient than CT enteroclysis, but he must drink the required amount of mannitol solution (it is slightly sweet). Because mannitol and methylcellulose are not absorbed, most patients develop diarrhea after examination. In non-acute cases, CT or MR enterography is the method of choice.

## MR of the small intestine

The distension of the small intestine is also used e.g. mannitol solution per os, spasmolytic. Rapid sequences are ideal, there is no radiation exposure. MR enterography is the method of choice for imaging the small intestine in the diagnosis of IBD (inflammatory bowel disease).

## Radiodiagnostic examination of the large intestine

### Large intestine anatomy

The large intestine ( *intestinum crassum* ) is the last part of the digestive tract that receives a mushy to fluid content from the small intestine - chymus . Water and electrolytes are absorbed from chyme in the large intestine. The contents of the large intestine are formed in the stool. The length of the large intestine is 1.2–1.5 m and the width of the large intestine is approximately 4–7.5 cm .

It consists of 6 parts: caecum (with appendix vermiformis), colon ascendens, colon transversum, colon descendens, colon sigmoideum, rectum.

### Native imaging of the abdomen

Native abdominal imaging is the basic examination method for acute conditions - to exclude ileosis , pneumoperitoneum (eg diverticulum perforation), colon distension in pneumosis, toxic megacolon. The image of edematous hauster (so-called "*thumbprinting*") can be found in inflammatory or ischemic changes. A serious symptom is the finding of gas in the intestinal wall, which, however, is usually more visible on CT. The amount of stool formed is found in constipation.

## Ultrasound

Ultrasound is a first-line method for acute conditions, but its informative value is often limited by the patient's investigability (obese patients with pneumatosis almost always can not be examined). Ultrasound can detect:

- Inflammation of the colon wall ( colitis ): widening of the intestinal wall over 3-4 mm, infiltration of the submucosa (hyperechogenic layer), increased vascularization in the color record.
- Diverticulitis: segmental edematous changes usually in the sigmoid or aboral descendant region. The inflammatory altered diverticulum with the reaction of the surrounding fat can be shown.
- Epiploic appendicitis: a district of hyperdense leaked fat on the antimesenteric side of the large intestine (usually the sigmoid) at the site of maximal pain.
- Appendicitis: seepage of the appendix wall with its thickening (diameter over 6 mm), seepage of surrounding fat, soreness under the tube.
- Ileus: only sometimes can fluid distension of the colon be seen - usually more gas is present and the large intestine cannot be examined well.
- Tumors: only rarely manage to show ev. colon tumor , most colorectal cancers are located aborally (rectum, sigma) and out of reach. However, ultrasound shows, for example, liver metastases.

## Irigography

Irigography is a two-stage examination of the large intestine . The patient must be emptied before the examination - preparation with Fortrans or MgSO 4 solution (as before colonoscopy).

After insertion of the rectal tube, a barium suspension is applied and then air is insufflated . The patient must be positioned during the examination - the BaSO<sub>4</sub> solution is liquid and "water flows downhill" - so that there is an even two-contrast filling of the entire large intestine. A sign of filling the entire colon is the reflux of the contrast agent into the terminal ileum or filling the appendix (if any).

The examination is suitable for imaging tumorous changes , polyps , it can also be used to visualize post-inflammatory changes and the extent of disability in diverticulosis. The superior method is, of course, classical (fibro-optical) colonoscopy and the examination is therefore performed on patients who do not agree with classical colonoscopy, or this cannot be performed completely due to unfavorable anatomical conditions (sharp bending, adhesion). In workplaces where CT colonography is available, CT colonography should be preferred because it has a higher yield.

## Defecography

Defecography is a skiascopic examination of the defecation mechanism. The rectal tube is filled with the rectal ampoule and part of the aboral sigma with a contrast agent which is thickened.

The examination monitors:

- pelvic floor movements: decline in the pelvic floor,
- arching of the rectal wall during defecation: ventral and dorsal rectocele,
- rectal mucosal prolapse,
- anorectal angle: insufficient development in pubastectal spasticity,
- residue after defecation: significant above 1/3 of the initial load.

## CT colonography

This is a CT examination of the abdomen and small pelvis with a special preparation of the large intestine . The patient must be emptied again (preparation with Fortrans, MgSO 4 solution or other laxatives). In some workplaces, so-called "fecal tagging" is added, where an orally administered contrast agent increases the density of the residual colon content, which can thus be better distinguished from polyps. Prior to the examination itself, the colon is insufflated with air or CO<sub>2</sub> by rectifying the tube. The examination can be performed either natively (as a screening with the question of the presence of polyps) or with the administration of an iodine contrast agent also for other indications. A total of two scans are performed, first on the back, then on the abdomen - there is usually some fluid left in the large intestine, which in one position could cover the ev. pathology. The evaluation is performed by an experienced radiologist (at least 50 examinations performed under the supervision of another radiologist).

The basic method of CT colonography evaluation is the method of virtual endoscopy (as if "colon flight"), the found lesions are further evaluated in 2D (multiplanar reconstruction, thin sections). The disadvantage of CT colonography is the radiation exposure (however, the second scan is usually performed in low-dose mode, in the case of a screening indication both scans) and the inability to perform a biopsy . The advantage is the display of extraintestinal structures (mesentery, nodes, liver - staging ), the display of a slightly larger area of the intestinal wall than allowed by optical colonoscopy and greater comfort during examination (than during optical colonoscopy).

CT colonography is not an acute examination. If Crohn's disease and incomplete colonoscopy are suspected, it is more appropriate to indicate CT enterography, which shows both the small intestine and, in many cases, the large intestine - but it is not possible to evaluate polyps.

CT colonography should be performed no earlier than one and a half months after the end of acute diverticulitis due to the increased risk of perforation in insufflation.

## CT of the abdomen, pelvis (routine)

Routine CT of the abdomen and pelvis works well in acute conditions. Prior to the examination, an iodine contrast agent solution (10–20 ml in 500–1000 ml) is administered orally; During the examination it is possible to display:

- Even a minimal amount of free air (pneumoperitoneum).
- Distension of the large (but also small) intestine by fluid and gas in ileosal conditions.
- Zone of transition between distended and undistended intestine: site of obstruction.
- Infiltration of the colon wall: colitis, ischemia.
- Larger colon tumors (but not smaller polyps, difficult even flat lesions).
- Gas in the intestinal wall, absence of saturation of the intestinal wall, occlusion of arteries and veins (according to the examination phase) in intestinal ischemia.
- Diverticula: if more frequent or in an inflammatory infiltrate in diverticulitis .
- Appendicitis in otherwise healthy individuals.

## **MRI of the large intestine**

MRI is indicated in the staging of rectal and rectosigma tumors. There is also an examination similar to CT colonography - MR colonography, which is not routinely performed.

## **Links in czech**

Tenké střevo

Tlusté střevo

Radiodiagnostické vyšetření jícnu a žaludku