The role of imaging in complications of inflammatory bowel diseases in pediatric patients

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Learning objectives

• to enlist the most common complications of inflammatory bowel diseases (Crohn disease and ulcerative colitis) in pediatric patients

• to depict their imaging aspects

• to underline the role of imaging studies in the future management of the pediatric patient

Background

Crohn's disease and ulcerative colitis account for the disorders that represent the IBD.

Crohn’s disease stands up for a chronic inflammatory bowel disease, which was once considered rare in the pediatric population, but is now recognized with increasing frequency among children of all ages. It has become one of the most important chronic diseases that affect children and adolescents, 20-30% of the patients being diagnosed under the age of 20 [2].

Ulcerative colitis (UC) is a diffuse mucosal inflammation which affects the rectum and may also extend proximally to the colon. Many patterns of presentation are possible within the pediatric age group and 20-25% of all cases of UC occur in patients aged 20 years or younger [3].

Children and adolescents with severe Crohn's disease or UC may experience life-threatening complications but also long-term consequences, such as growth failure, malnutrition, puberty delay and bone demineralization [2,3].

The most common complications of IBD include abscesses, fistulae, sinus tracts, strictures, adhesions and perforation, all affecting the quality of life of the pediatric patient [4].

Fistulae and abscesses are more common in Crohn disease but occur also in patients with ulcerative colitis and their formation is due to transmural bowel perforation. Perianal and perirectal fistulae are the most common types and cause a secondary obstructive hydronephrosis. These complications may be refractory to intensive medical treatment,
surgical intervention is often required and the risk of recurrence is high. Other fistula types include enterovesical (resulting in recurrent urinary tract infections and pneumaturia), enteroenteric, enteromesenteric, enterocutaneous and rectovaginal[2,4].

**Sinus tracts** represent incomplete fistulae ending in a "cul-de-sac"[2].

**Strictures** in patient with Crohn's disease are usually benign but they can cause obstruction. Usually the strictures are inflamed and can be resolved with medical treatment, but in some cases, endoscopic or surgical intervention is required. In patients with ulcerative colitis, colonic strictures are more significant and should be resected due to their possible malignant transformation [4].

**Adhesions** may also contribute to intestinal obstruction [2].

**Perforation** is one of the most dangerous complications of Crohn disease, with a mortality rate of 50%. It can occur in the presence of fulminating disease and has the features of classic peritonitis, although symptoms can be masked by corticoid therapy. If perforation occurs into other segments of bowel it can lead to fistulae or to abscess formation into areas such as the retroperitoneum [2,3].

Another severe complication of IBD is **massive intestinal hemorrhage**, which can occur in some cases, especially in patients with UC [5].

**Toxic megacolon** may also occur in patients with fulminant ulcerative colitis and is a life-threatening complication which requires urgent surgical intervention[4].

**Malignancy** represents the most feared long-term intestinal complication of IBD. Patients with UC carry a 10- to 30-fold risk of colon cancer, which increases with the extent and duration of the disease. Surveillance colonoscopy with biopsies is recommended every 2 years after 8 years of disease. The risk of malignancy in Crohn's disease is not as high, but it exist however, especially in patients with pancolitis. There is also a risk of small intestinal carcinoma development in patients with Crohn's disease. Carcinoma is generally preceded by epithelial dysplasia, therefore, colonoscopy surveillance is also recommended for patients with Crohn's disease [2,4].

Consequences of long-term IBDs are secondary **anemia and growth delay**, more frequently observed in patients with Crohn's disease than in UC [5].
Findings and procedure details

Ultrasound (US) is currently the first examination requested to evaluate patients with IBD. It has the advantage of being noninvasive, does not use ionizing radiation, patient preparation is not required, but has the disadvantage of interoperator variability.

Fig. 1: US image - enteromesenteric fistula with abscess in the proximity of the right iliac vessels

References: Dr. Otilia Fufezan, 3rd Pediatric Clinic, Cluj - Napoca
Fig. 5: US image - stricture in a patient with active Crohn's disease (bowel wall thickening, satellite adenopathies)

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It is usually performed with a high-frequency linear-array probe and manages to assess the morphological and functional aspects of the bowel wall, the vascularisation and perivisceral spaces in real time. US can detect the wall thickness, loop stiffness, bowel dilatation and it is very valuable for the detection of fistulae or abscesses, abnormal peristaltis of the bowel loops and mesenteric inflammatory changes.
Fig. 2: US image - perianal abscess

References: Dr. Otilia Fufezan, 3rd Pediatric Clinic, Cluj - Napoca
Fig. 3: US image of perianal abscess

References: Dr. Otilia Fufezan, 3rd Pediatric Clinic - Cluj - Napoca

Use of contrast material has been found to increase accuracy, while Doppler evaluation can determine the presence of active disease.
**Fig. 4:** US image and Doppler interrogation - enteromesenteric fistula in a patient with active Crohn’s disease (bowel wall thickening and mesenteric stranding fat)

**References:** Dr. Otilia Fufezan, 3rd Pediatric Clinic, Cluj - Napoca

US is less suitable for the assessment of UC, due to the poor visualisation of the rectum and sigmoid colon [7,8].

**CT enterography** is used primarily for the diagnosis and evaluation of IBD and their complications, and depicts more aspects of the disease in comparison with US. It has the advantage of being noninvasive and rapid, but has the great disadvantage of the use of ionizing radiation.

Indications for CT enterography include identifying and staging IBD and assessing potential complications, such as obstruction, fistula or abscesses. It is also preferred for acute presentation that may have complications such as perforation, abscess, severe stricture and fistula that require surgical intervention.

The inability to obtain intravenous access, allergy to intravenous contrast material, the impossibility to tolerate oral or nasogastric tube administration of oral contrast material, the need of anesthesia and pregnancy are contraindications for CT enterography.

The patient will not eat or drink anything 4 hours prior to the study, an intravenous access is obtained and then the patient is given oral contrast material to drink. Before performing the CT scan, the patient is injected with intravenous contrast and then a late arterial phase is performed. No other substances are required; during one breath take the whole abdomen can be examined.
A better detection of the complications of IBD is possible and also a more accurate appreciation of the length of the affected segments.

Strictures are differentiated from other causes of luminal narrowing on the basis of dilatation of the proximal bowel, proximal stasis or fecal material (small bowel feces sign).
Fig. 6: CECT (contrast enhanced CT) image, coronal section, venous phase - ileal stricture with consequent dilation of small bowel loops in a patient with Crohn's disease

References: Dr. Cosmin Caraiani, Cluj - Napoca
An other imaging method useful for detection of strictures is CT enteroclysis, in which the contrast material is administrated via a nasoduodenal or nasojejunal tube.

Fistulas which can be detected at CT enterography are enterocutaneous, enteroenteric and perianal. An aspect of bowel matted together and tethered to a common point, similar to a cloverleaf or asterisk suggests a enteroenteric fistula, while a perianal or other enterocutaneous fistula appears as an enhancing soft-tissue-attenuation lesion extending to the skin surface.
Fig. 7: CECT image, coronal section, venous phase - enteroenteric fistula in a patient with Crohn's disease

References: Dr. Cosmin Caraiani, Cluj - Napoca
Fig. 8: CECT image, coronal section, venous phase - enterocecal fistula with secondary traction of the cecum and right psoas muscle abscess (patient from Figure 7).

References: Dr. Cosmin Caraiani, Cluj - Napoca
Abscesses represent a complication of penetrating Crohn disease and appear as a loculated fluid collection with a thick, enhancing rim and sometimes with small locules of air within the abscess cavity. Common locations are intraabdominal abscesses (adjacent to bowel loops) and perirectal abscesses.
**Fig. 9**: CECT image, coronal section, venous phase - right psoas abscess in the same patient in Figure 7 and Figure 8

**References**: Dr. Cosmin Caraiani, Cluj - Napoca

Pneumatosis, when present, is easily detected with CT enterography in cases in which megatoxic colon is present [6,8].

**MR enterography or MR enteroclysis** also have been developed for small-bowel evaluation. Luminal distention of the bowel is achieved with negative or biphasic agents, ideal for visualization of the bowel wall.

In MR enterography, the patient ingests large volumes of oral contrast material, while in MR enteroclysis, methylcellulose suspension is administrated through a nasojejunal tube.

The preparation of the patient is the same as for the CT procedures.

Antiperistaltics can be used to reduced peristaltic artifacts.

Most protocols for MR enterography include fast T2-weighted sequences in the coronal and axial planes, steady-state free precession sequences in the coronal plane and unenhanced and contrast-enhanced T1-weighted fat-suppressed images in various planes.

MRI has the advantage of no radiation use, it can provide dynamic information about the bowel distension and motility and offers a good soft-tissue contrast.

A high cost, limited accessibility, variable protocols and lower spatial and temporal resolution represents its major disadvantages.

Both MRI techniques compare successfully with CT enteroclysis in terms of diagnostic sensitivity and accuracy.

MR enterography, which has the ability to evaluate bowel peristaltis and permits the examination of the same segment of bowel over multiple time points in the same study seems to be more usefully in the detection of strictures than CT enterography.

Also, for the assessment of fistulas, post contrast fat-saturated T1-weighted imaging represents the modality of choice. [6,8]

**Pelvic MRI** is the imaging modality of choice for assessing perianal and perirectal complications. Up to 25% of the pediatric patients will present with perineal disease at diagnosis while 45% will have perineal complications at some stage of the disease.
Technical aspects, such as peristalsis and respiratory movement are reduced in the perineal area and longer, high-resolution imaging sequences can be applied to provide excellent anatomical information.

MRI provides accurate delineation of fistula tracts and exact abscess location. It depicts the complex sphincteric and muscle anatomy of the anal canal and perineum, which is extremely important for the operative planning. Operative planning based on MRI imaging has been reported to reduce fistula recurrence.

Fig. 10: MR enterography, axial images, T2 Fat Sat sequence - horseshoe abscess in a patient with active Crohn's disease

References: Dr. Cosmin Caraiani, Cluj - Napoca

Protocols include high-resolution, spin echo T2 sequences in the axial, coronal and sagittal planes and also precontrast and contrast enhanced fat-saturated spin echo T1 sequences in the axial, coronal and sagittal planes.

The classification of fistulas is made accordingly to their anatomical course, starting with its origin in the bowel lumen and describing their course to skin exit. Very important aspects which will help in treatment and surgical planning are the site of origin, length, anatomical planes through which the fistula courses and its site of exit.

Intersphincteric fistulas appear between the cylinders of the internal and external muscular sphincters and exit at the anal verge.
Trans-sphincteric fistulase course through the internal and external sphincteric cylinders and exit at a certain distance from the anal margin.

Internal fistula include tracks between the intestine and the internal structures, such as the vagina, vulva and urethra.

Fistulas can be multiple and complex and an accurate delineation of each is essential in surgical planning.

MRI imaging also depicts sinus tracks from the bowel which lead to an abscess cavity. The levator ani represents the anatomical separation of the perineal abscess collections. If the abscess is located below the levator ani it is known as an ischioanal abscess, while a collection above this muscle is considered to be an ischiorectal abscess. In some cases, abscesses can traverse the levator ani muscle and involve both compartments. Also, sinus tracks to the space of Courtney can result in "horseshoe" abscesses in this compartment.

An exact delineation of abscesses and sinuses is important for deciding between drainage or seton placement. [6, 9]

**Images for this section:**
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Conclusion

The presence of intestinal complications in children and adolescents with IBD should be considered, mainly because of the high impact on the quality of life.

Imaging studies remain the mainstays of investigation in case of complications and are crucial for the further therapeutical management.

Personal information

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