IMAGING APPROACH IN CHILDREN WITH ACUTE ABOMINAL PAIN

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Acute abdominal pain is one of the most common causes to visit a medical doctor regardless of the child's age. The child's history and a clinical examination are the clue factors in decision, whether laboratory examinations or imaging procedures are necessary. In child with acute abdominal pain the main role of imaging is to differentiate between acute abdomen which requires surgical management and acute abdominal pain which needs conservative treatment. In children a differential diagnosis of acute abdominal pain is age related. Ultrasound (US) examination of abdomen is the first line imaging modality in children with acute abdominal pain. US can visualize the direct cause of abdominal pain, and diagnose the exact nature of the pathology in many emergency situations. US findings often have an impact on a treatment and on a decision about the best modality for further imaging. Plain abdominal radiography is a method of choice only when the bowel perforation, ileus or bowel obstruction (particularly in neonatal period), as well as foreign body ingestion are suspected. Contrast examinations of gastrointestinal tract have a significant role in small children with suspected congenital anomalies, most commonly to rule out malrotation. Magnetic resonance imaging is rarely an option in children with acute abdominal pain.

Descriptors: ACUTE ABDOMINAL PAIN, CHILDREN, IMAGING, ULTRASOUND, DIFFERENTIAL DIAGNOSIS

INTRODUCTION

Acute abdominal pain is a common complaint in childhood. It varies with age, associated symptoms, and pain location (1-3). Differential diagnosis is wide, and it poses a diagnostic challenge due to wide variety of underlying causes. Usually the abdominal pain is benign and self-limiting. Common causes of abdominal pain include gastroenteritis, constipation, systemic viral illness, mesenteric lymphadenitis, infantile colic, and infections outside of the gastrointestinal tract (e.g. streptococcal pharyngitis, lower lobe pneumonia, and urinary tract infection) (3, 4). The most important is to differentiate between surgical and non-surgical conditions. About 1% of children with acute abdominal pain need surgical intervention, most frequently due to appendicitis, intussusception, incarcerated hernia, volvulus, or adhesions (1). Child's history and clinical examinations help to guide the next steps; laboratory

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and imaging procedures. Ultrasound (US) is the first line imaging modality in acute abdominal pain evaluation (5, 6).

The purpose of this paper is to point out the role of imaging in children with acute abdominal pain: when and which imaging modality is indicated in various clinical scenarios and in different children ages.

CLINICAL EVALUATION

Child's history should be taken in details: symptom onset pattern, progression, location, intensity, characters, precipitating and relieving factors of abdominal pain, and associated symptoms, such as fever. Information about vomiting, stool (consistency, hematochezia or melena, diarrhoea, constipation), recent abdominal trauma and previous abdominal surgery has to be obtained. The possible extra-abdominal causes of abdominal pain, most common being basal pneumonia, have to be ruled out. Age of the child is a key factor in the evaluation of acute abdominal pain, because the differential diagnosis of acute abdominal pain is age dependent (Table 1) (1-3).

Physical examination includes evaluation of general appearance, vital signs (hydration status, fever, tachypnea, tachycardia, blood pressure), and abdominal status. Abdomen should be palpated and the area of maximal tenderness should be determined. An examiner needs to find

Table 1.
The most common causes of abdominal pain during childhood by age and by management (conservative or surgical treatment)

	<2 years	2 to 5 years	5 to 12 years	>12 years
CONSERVATIVE TREATMENT	Infantile colic	Functional pain	Functional pain	Functional pain
	Gastroenteritis	Gastroenteritis	Gastroenteritis	Gastroenteritis
	Constipation	Constipation	Constipation	Constipation
		Mesenteric lymphadenitis	Mesenteric lymphadentis	Cholecystitis
		HSP	HSP	PID
	UTI	UTI	Renal stones	Renal stones
		Pneumonia, pharyngitis	Pneumonia, pharyngitis	Dysmenorrhea
SURGICAL TREATMENT	Intestinal obstruction	Appendicitis	Appendicitis	Appendicitis
	Intussusception	Intussusception		Ovarian torsion
	Volvulus	Volvulus		Testicular torsion
	HPS	Trauma	Trauma	Ectopic pregnancy
	Hirschsprung			
	Incarcerated hernia	Incarcerated hernia	Incarcerated hernia	Incarcerated hernia

Legend: HPS - hypertrophic pyloric stenosis, HSP - Henoch-Schonlein purpura, PID - pelvic inflammatory disease, UTI - urinary tract infection

out the degree of abdominal tenderness, location, rebound tenderness, rigidity, distension, masses or organomegaly (liver, spleen). The examination of recto-anal area, pelvis, external genitalia, and thorax is also obligatory.

Selective use of appropriate laboratory tests (complete blood cell count, urinalysis, serum glucose and electrolytes) is followed by imaging, when it is necessary to make a diagnosis. When a diagnosis remains uncertain, the child with acute abdominal pain should be kept at the hospital under supervision and repeated physical examinations, laboratory tests and imaging are required.

IMAGING IN ACUTE ABDOMINAL PAIN

Various algorithmic approaches to the children with acute abdominal pain requiring urgent management have been proposed (1, 5, 7, 8). Imaging is indicated on the bases of previous obtained patient's history, clinical condition and laboratory tests.

Abdominal US, including Doppler techniques, is the method of choice in children with acute abdominal pain in most cases. The frequency of probe depends on the size and age of the child. General abdominal US with scanning of the liver, biliary tree, pancreas, both kidneys, and spleen is performed with a 3.5-6MHz convex probe prior to US examination with high resolution linear probe (8-11). In addition, free fluid, large mass or collection, pleural effusions at the lung bases have to be excluded as a potential cause of abdominal pain. Also, urinary bladder and available parts of intrapelvic reproductive system need to be examined with a convex probe. Bowel has to be systematically evaluated with linear probes. In graded-compression US a pressure through the transducer is applied in order to displace and compress the underlying bowel loops to see appendix. US examination is able to detect the cause of abdominal pain and visualize the exact nature of the pathology in many emergency situations. It helps to differentiate between surgical and non-surgical conditions, and helps to delineate the management plan for the patients (7, 10).

Plain abdominal radiograph is reserved for cases in which bowel obstruction, perforation, or radiopaque foreign body ingestion is suspected (8). Maxfield et al. described eight radiographic patterns on the frontal supine abdominal radiography which help narrow the differential diagnosis and triage the neonate with suspected bowel obstruction (12). When the perforation is suspected, abdominal plain radiography should be performed in left-side down decubitus and upright views to detect free intraperitoneal air and air-fluid levels. The abdominal plain radiography can also assess calcifications, which could be expected in cases of meconium peritonitis and can be present in various abdominal masses.

Chest radiography is indicated to rule out a basal pneumonia which can present with abdominal pain. It is often combined by US examination. Trans-hepatic and trans-splenic approach during abdominal US can be extremely useful in detecting basal pneumonia. Therefore, paying attention at the lung bases during abdominal US can easily point to a cause of abdominal pain, and enable an immediate and proper treatment (13).

Fluoroscopic contrast studies of gastrointestinal tract, upper gastrointestinal series or enema, are used for further assessment of suspected pathology of the hollow viscera and they help to determine the level of obstruction (high or low). Pulse fluoroscopic technique has to be used to limit the radiation dose (8). Fluoro grab images are used to document the findings.

In fluoroscopic procedures barium contrast media is the most often used contrast agent in fluoroscopic procedures whether administered orally or rectally. Barium is contraindicated when the viscus perforation is suspected. In such cases, low-osmolality, non-ionic, water soluble iodinated contrast media is indicated. Iodinated contrast is also a contrast of choice in neonatal period.

Computer tomography (CT) and magnetic resonance imaging (MRI) are not routinely used in emergency non-traumatic radiology, but can be of great help when a diagnosis is uncertain, such as suspected retrocecal appendicitis and intraabdominal abscess not seen by US. CT is the method of choice in polytrauma patients.

COMMON CAUSES OF ACUTE ABDOMINAL PAIN WITH CHARACTERISTIC IMAGING APPEARANCES - DEFINITIVE DIAGNOSIS

Intestinal obstruction is a life-threatening condition which requires urgent diagnosis and treatment. It usually presents with cramping abdominal pain. Causes of intestinal obstruction include congenital atresia and stenosis in neonatal period, malrotation and volvulus, intussusception, incarcerated inguinal hernia and postoperative adhesions (14).

The main cause of intestinal obstruction in neonatal period is congenital (sometimes transitory) stenosis or atresia along the gastrointestinal tract (intestinal atresia, meconium ileus, meconium plug syndrome, Hirschsprung's disease) and malrotation with or without volvulus (15). For further management it is important to differentiate between high or low gastrointestinal obstruction (6). Maxfield's radiographic patterns on the frontal supine abdominal radiography help narrow the differential diagnosis and triage the neonatal with bowel obstruction to the next phase of management, either addition imaging (fluoroscopic contrast gastrointestinal imaging) or admission to the medical or surgical team for treatment (12). Double or triple bubble with or without some distal gas indicate high bowel obstruction. Diffusely dilated loops is suggestive of a low obstruction, while dilated scattered bowel loops are sign of a "sick belly" and could be associated with high or low obstruction. He also described five patterns on upper gastrointestinal series (normal duodenum position, malposition of duodeno-jejunal junction, corckscrew duodenum, complete and partial duodenum obstruction) and four patterns on contrast enema (normal colon, microcolon, short colon, colonic calibre change) which give the definitive diagnosis (12).

Abdominal US plays an important role in suspected intestinal obstruction, from neonatal to teenage group (5, 7, 16). Malrotation can be clinically suspected in children with recurrent vomiting. During the US examination malrotation is suspected when the third part of duodenum lies intraperitoneal and not in its normal retroperitoneal position between arteria mesenterica superior (AMS) and aorta (17). The inverse orientation of the AMS and the superior mesenteric vein (VMS) is also highly suspected for malrotation. Volvulus is a life-threatening condition. Approximately 80% of volvulus cases are diagnosed during the first month of life, and up to 90% of symptomatic cases occur within the first year of life (5, 16). The specific US sign for volvulus is a so called "whirlpool sign" which corresponds to a clockwise wrapping of the SMV around the SMA and has a high predicting value for volvulus (Figure 1) (16, 17). Doppler helps to determine the vessels and the perfusion of bowel wall. In inconclusive US examination upper gastrointestinal series is performed with typical corkscrew appearance of duodenum and jejunum (18).

Hypertrophic pyloric stenosis (HPS) is presented usually by non-bilious projectile vomiting and dehydration (with

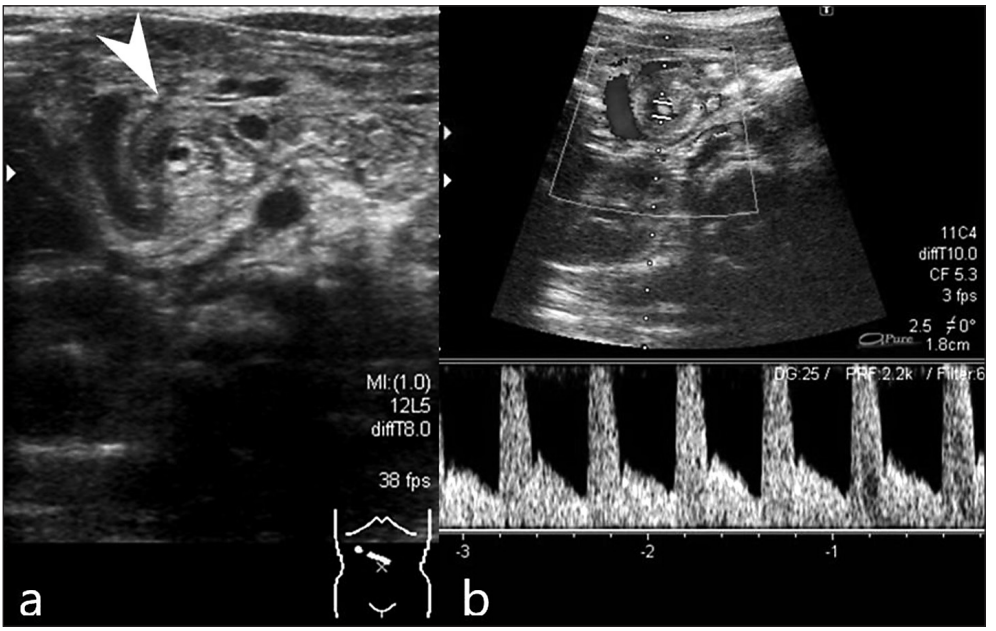

Figure 1.
Abdominal ultrasound (US) in a 3-week-old girl with intense crying and abdominal distension.
a) grey-scale US in mid abdomen shows a "whirl-like" pattern of small bowel loops (arrowhead),
b) Colour Doppler ultrasound showing "whirlpool sign," clockwise rotation of superior mesenteric vein, and small bowel around centrally placed superior mesenteric artery.

or without hyperchloremic metabolic alkalosis) in a full-term newborn between 2 and 8 weeks. Abdominal US is a golden standard technique for diagnosing HPS. Specific signs are elongation of the pylorical channel (>17 mm, range 15-20 mm), anteroposterior diameter of the pylorus >12 mm, and thickness of the pyloric muscle >3 mm (range 2.5-4 mm) (5, 7, 16). However, HPS in smaller and younger infants can be a disease in evolution, and repeating an ultrasound is necessary (19).

Intestinal intussusception is the most common in the first and second year of life (peak between 3 and 9 months) and it is the most common cause of bowel obstruction in children younger than 5 years. The classic clinical triad is intermittent abdominal pain, a palpable mass, and bloody stools, but it is present in less than 40% of children. Therefore, US imaging is an essential part of diagnostic algorithm (20). US has a sensitivity and specificity of about 98%. The typical US sign specific for intussusception is a so called "the target sign" (in transverse view) composed of a peripheral hypoechoic ring with central echogenicity and pseudo-kidney sign (longitudinal view), correspond to the bowel wall surrounding hyperechoic mesenteric fat contained within the intussusception (Figure 2) (20). A highly specific US finding of intussusception is the presence of mesenteric lymph nodes within the lumen of the intussuscipiens.

Doppler US helps to determine the absence of blood flow within the intussusception (correlates well with the bowel ischemia and necrosis at surgery) and is a predictor of unsuccessful enema reduction. Conjoined US signs could be enlarged nodes, free fluid and bowel distension (20). Ileocolic intussusception requires emergent reduction, whereas small-bowel short

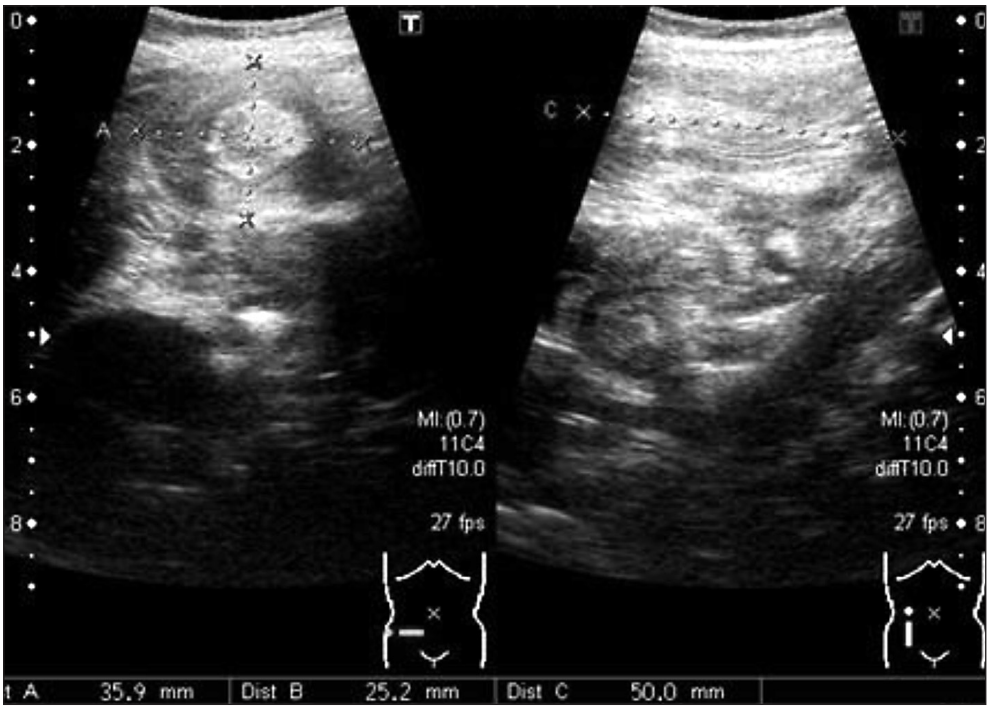

Figure 2.
Abdominal ultrasound (US) in a 8-month-old boy with intermittent crampy pain and crying. Grey-scale US showed a typical "target sign" on transversal view (right) representing layers of the intestine within the intestine, and "pseudo-kidney or sandwich sign" on longitudinal view (left) - the fat-containing mesentery which is dragged into the intussusception, containing vessels, is reminiscent of the renal hilum, with the renal parenchyma formed by the edematous bowel.

intussusceptions resolve spontaneously without intervention. Clinically insignificant small bowel intussusception is the one with preserved peristalsis. US guided intussusception hydrostatic reduction by saline enema is an easy, safe (complication rate is 3‰) and effective method for the treatment of intussusception in the absence of acute abdominal findings or suspected leading points (21-23). In these cases surgery is the treatment method of choice. Xiaolong X et al. found in their study that an age of under 1-year-old, a duration of symptoms of more than or equal to 48h, rectal bleeding, constipation, palpable abdominal mass and location of mass (left over right side) were risk factors for the failure of hydrostatic reduction of intussusception (24). It is very important to know that ileo-colic intussusception in children older than 5 years is highly suspected to have a pathological leading point, such as Meckel's diverticulum, polyp or lymphoma.

Inguinal hernia

Incarcerated inguinal hernia should be excluded in children with groin or scrotal mass or pain. Usually the diagnosis is made after clinical and physical examination. US has a diagnostic accuracy of 97% in surgically confirmed cases, sensitivity of 92.7%, and specificity of 81.5% (11). US shows the presence of herniated bowel loops into the inguinal canal and scrotum and thickening of the bowel wall. The Valsalva maneuver is useful in diagnosis of inguinal hernia - during this maneuver

the herniated sack enlarges and protrudes through the defect in the inguinal canal with increased abdominal pressure. Colour Doppler can be used to evaluate the vascularity of the bowel wall.

The graded-compression US has become the initial imaging study of choice in the assessment of children with right lower quadrant abdominal pain. The cecum serves as a helpful anatomic landmark for localization of the appendix providing a sonographic starting point in the search for the appendix. First, the acute appendicitis should be ruled out. The differential list can be long and should be age and gender specific like primary mesenteric lymphadenitis, inflammation (including acute exacerbation of inflammatory bowel disease) and infection, intussusception, and also non-gastrointestinal related causes, such as pyelonephritis or urolithiasis. Less common typhlitis, fat necrosis (epiploic appendagitis, omental infarction), Meckel diverticulum are on the list. In teenage girls we have to think about pelvic inflammatory disease, rupture of the ovarian cyst and ovarial torsion (25, 26).

Acute appendicitis is the most common pediatric surgical emergency. An 85-100% sensitivity and 89-98% specificity for US accuracy in appendicitis diagnosis have been documented when US is performed by skilled radiologist. The lower rates in some studies are due to the user-dependence nature of US (9, 27). The real clinical value of different scores (Alvarado and Pediatric Appendicitis Scores) for predicting acute appendicitis are still in question (28, 29). At US, a thickened non-compressible appendix with maximum outer wall dia-

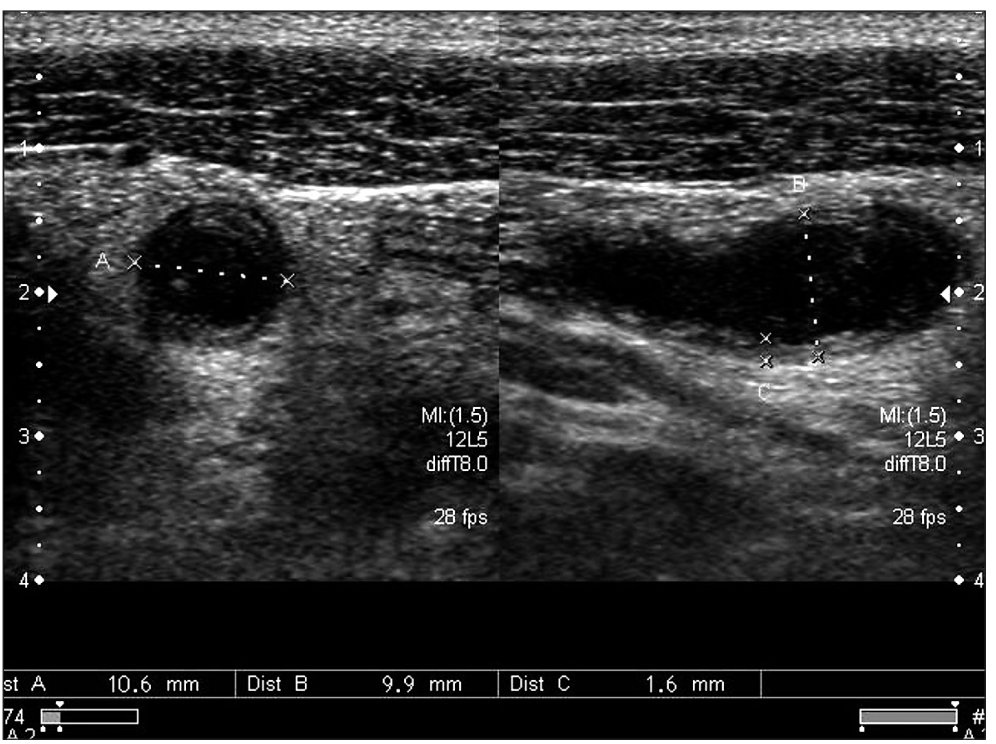

Figure 3.
Abdominal ultrasound in a 12-year-old boy with right abdominal pain shows aperistaltic, non-compressible, dilated (>6 mm outer diameter), fluid filled appendix and prominent echogenic periappendiceal fat.

meter greater than 6 mm has 98% sensitivity and specificity of being positive for acute appendicitis (Figure 3). It is important to trace the entire appendix, because inflammatory changes may be limited to the tip of the appendix - "tip appendicitis". The appendix is usually hypervascular at colour Doppler in acute non-perforating setting. Appendicoliths can be identified as echogenic foci with posterior acoustic shadowing in up to 30% of cases. Increased thickening and hyperechogenicity of periappendiceal mesenteric fat is an additional sign (Figure 3).

It is important to be familiar with several conditions or findings that can alter the appearance of the appendix at US (30). When the examiner fails to find appendix, clinical suspicion for acute appendicitis based on history and physical examination is more important than negative US examination. Appendiceal perforation and abscess formation are important to recognize and diagnose early. Rates of perforation tend to be significantly higher in children younger than 8 years (62.5%) than in older children (29.5%) (31). Diagnosing perforated appendicitis can be particularly challenging when the appendix decompresses as it perforates before a well-defined abscess collection is formed (5, 27). Periapendiceal fluid and loss of echogenic submucosal layer is an ancillary sign that can suggest perforation. A walled-off fluid collection with mobile internal echoes, with or without foci of gas, is consistent with abscess (5). Absence of flow on colour Doppler indicate the gangrenous appendicitis. Sometimes perforated appendicitis can be diagnosed based only on a specific indirect signs, such as free appendicolith (32).

Mesenteric lymphadenitis and infectious ileocolitis are the most common alternative diagnosis in children with symptoms similar to acute appendicitis (30). Mesenteric lymphadenitis is diagnosed when enlarged mesenteric lymph nodes in clusters of at least three are seen, mostly at the root of the mesentery and in the right lower quadrant, and without any identifiable underlying inflammatory process (25, 33). The definition of pathologic lymphadenopathy varies: most authors suggest using a longest diameter greater than 10 mm as pathologic, whereas others suggest using short-axis diameter greater than 10 mm (25). However, even small lymph nodes less than 5 mm in short-axis diameter may be symptomatic (25). Enlarged lymph nodes can be associated with other causes of abdominal pain (secondary mesenteric lymphadenitis). Infectious ileocolitis, particularly by Yersinia enterocolitica, Camplobacter jejuni or Salmonella enteritidis, presents by enlarge ileocecal lymph nodes and thickened bowel wall. In addition, acute flare of Crohn's disease can lead to secondary appendiceal enlargement and inflammation.

Acute gastroenteritis is the most common gastrointestinal inflammatory process in children and is present in all age groups. Viral etiology is the most common cause of gastrointestinal tract infections. In clinical history vomiting usually precedes the diarrhea by 12 to 24 hours. A low-grade fever may be present and mild to moderate abdominal cramping. Clinical examination of the abdomen usually reveals a non-distended soft abdomen with no localized tenderness. In most cases imaging is not necessary, except in non-typical cases to rule out other possible causes of abdominal pain. US may show fluid-filled hyperperistaltic loops of bowel with little or no wall thickening in children with gastroenteritis.3 In the study by Kim et al. where all children with abdominal pain were included, the most common cause was bacterial and viral gastroenteritis which was much greater than acute appendicitis and mesenteric adenitis put together (12.7%) (4).

Typhlitis, also known as neutropenic colitis, is a rare inflammatory condition in immunocompromised children and in children with acute leukemia that typically

involves the cecum. A characteristic echogenic thickening of the mucosa is seen on US (34, 35).

Henoch-Schonlein purpura is an autoimmune vasculitis that variably affects the bowel, skin, joints, and the kidney (36). Most often occurs in children between 3 and 5 years of age. Children with Hench-Schonlein purpura with bowel involvement may show bowel dilatation, hypomotility, bowel wall thickening, and transient small bowel intussusception.

Epiploic appendagitis and omental infarction are two specific types of fat necrosis that commonly manifest with abdominal pain that mimics acute abdomen. Each has a characteristic appearance and correct identification of these conditions is crucial to avoid unnecessary surgical intervention (37). At US, epiploic appendagitis appears as an echogenic, non-compressible mass with a hypoechoic ring at the point of maximal tenderness. Omental infarction is a rare condition and usually present with subacute onset of pain in the right lower quadrant, often with a slightly elevated white blood cell count. Other gastrointestinal symptoms such as vomiting, nausea, and fever are absent. Omental infarction is typically triangular and involves the inferior aspect of the right side of the omentum. It is characteristically situated between the anterior abdominal wall and the transverse or ascending colon, corresponding in location to the greater omentum (Figure 4) (36). US shows an ovoid or cake-like hyperechoic soft-tissue mass, avascular on colour Doppler. The location of fat usually corresponds to the area of pain. McCusker et al. demonstrate the efficiency of US in the diagnosis and management of omental infarction in children (38). The US imaging findings for this entity can be subtle on sonography, and recognition of the abnormality is operator-dependent. CT is performed in cases of uncertain diagnosis to identify a characteristic fat lesion located between the anterior abdominal wall and the colon. The infarcted omental fat

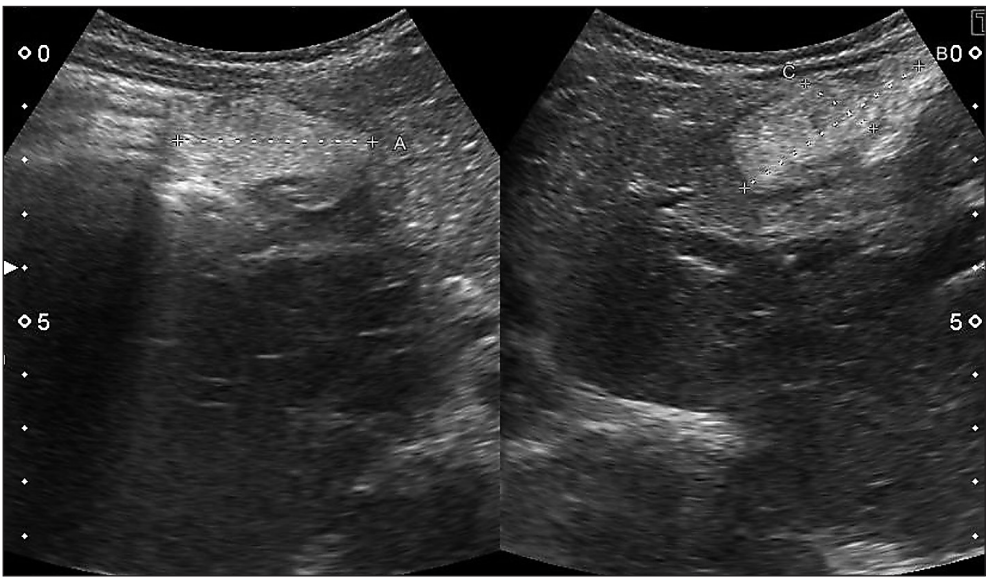

Figure 4.
Abdominal ultrasound in a 5.5-year-old girl with pain in upper abdomen, fever up to 38°C and increased inflammatory parameters (CRP 120) showed a hyperechoic mass situated between the anterior abdominal wall and the transverse colon. Omental infarction is diagnosed and was treated conservatively.

shows mixed attenuation on CT (36). The patient is usually treated conservatively.

Acute pelvic pain in teenage girls is also in indication for urgent US examination (7, 39). The knowledge of the normal growth and development of the uterus and ovaries is necessary in order to recognize abnormalities. Well filled, but not over-distended urinary bladder as a good sonographic window is recommended (Figure 5). The main concern is to differentiate between adnexal torsion from massive ovarian edema, hemorrhagic ovarian cyst. We should also think about obstructive outflow tract disorders of the vagina presented after menarche (hematometrocolpos, hematocolpos) with enlarged and distended uterus and vagina on US, and the possibility of ectopic pregnancy in teenage girls. Complications of pelvic inflammatory disease (ascending infection of the female genital tract caused by various sexually transmitted microorganisms) can also be presented by acute pelvic pain.

Abdominal pain not related to gastrointestinal tract

US can easily detect and determine other causes of abdominal pain like cholecystolithiasis, cholecystits, acute pyelonephritis (distension of the renal capsule), acute dilation of the renal pelvis due to urolithyasis or obstruction at the ureteropelvic junction, various abdominal tumors (solid and cystic lesions), etc. (4). Some extra-abdominal pathology (diseases of spine and chest) and metabolic disorders may appear as an acute abdomen, but in these conditions abdominal findings are negative (7). Basal pneumonia is frequent cause of abdominal pain. Therefore, do not forget to visualize both lung bases (transhepatically and transsplenically), as well as pathological changes within them, while performing an abdominal US (13).

INDETERMINATE CHALLENGING CASES

If the diagnosis remains unclear, there are many further options (9). Repeating clinical examination, laboratory and imaging, usually US, increase the diagnostic accuracy. CT is the next choice in the difficult patient in many centres worldwide. Indications for CT have to be justified due to high ionising radiation burden in children. MRI is beginning to be used in the evaluation of the paediatric patient with acute abdomen, particularly in suspected appendicitis. The main problem is a long

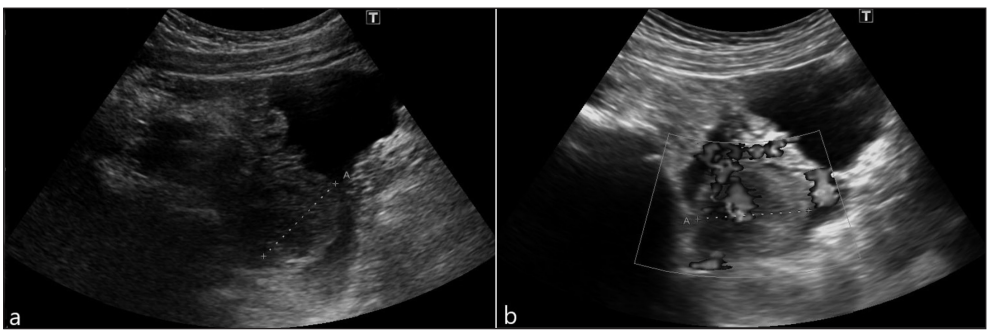

Figure 5.
Abdominal ultrasound (US) in a 12-year-old girl who woke up during the night because of the sharp pain. Due to the persistent pain in the right lower part of the abdomen US was performed 2 days later to rule out acute appendicitis.
a) Free fluid in pelvis and morphological changed right ovarium is seen,
b) Colour Doppler US showed the vascularization of ovarium and a torsion-detorsion ovarium scenario is suspected. The rupture of hemorrhagic ovarian cyst was diagnosed during laparoscopy.

duration of examination. A child with acute abdominal pain is not able to lie still in the gantry and sedation or anesthesia is necessary. In some indeterminate cases with clinical deterioration the surgery, mostly laparoscopic, has to be performed without final diagnosis.

CONCLUSION

The causes of acute abdominal pain in children vary with the patient's age. A complete history and detailed physical examination is mandatory Abdominal imaging examinations, with US and plain abdominal radiograph being the first line imaging, could deliver useful information in order to narrow the differential diagnosis of abdominal emergencies and provide a timely treatment.

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Sažetak

PRISTUP RADIOLOŠKOJ DIJAGNOSTICI U DJECE S AKUTNIM BOLOVIMA U TRBUHU

Damjana Ključevšek

Akutni bolovi u trbuhu kod djeteta su jedan od najčešćih razloga posjeta liječniku bez obzira na godine djeteta. Anamneza i klinički pregled djeteta su ključni čimbenici u odluci da li su potrebne laboratorijske pretrage ili slikovna dijagnostika. Kod djeteta s akutnim bolovima u trbuhu je glavna uloga slikovne dijagnostike razlikovati akutni abdomen koji treba hitno kirurško liječenje i akutni bol u trbuhu koji zahtjeva konzervativno liječenje. Diferencijalna dijagnoza akutnih bolova u trbuhu kod djece je povezana sa starošću djece. Ultrazvučni (UZ) pregled trbuha je prvi izbor slikovne dijagnostike. Sa UZ možemo vizualizirati izravni uzrok bolova u trbuhu i dijagnosticirati točnu prirodu patologije u mnogim hitnim situacijama. UZ nalaz često utječe na odluku o liječenju i na odluku o izboru slijedećih, za dijete najboljih pretraga. Nativno rendgensko slikanje trbuha je metoda izbora kod sumnje na perforaciju crijeva, ileus, opstrukciju crijeva (osobito u neonatalnom razdoblju) ili kod ingestije stranog tijela. Rendgenske kontrastne pretrage gastrointestinalnog trakta imaju značajnu ulogu kod male djece sa sumnjom na urođene anomalije, najčešće za isključenje malrotacije. Snimanje magnetskom rezonancom kod djece s akutnim bolovima u trbuhu se rijetko izvodi.

Deskriptori: AKUTNI BOLOVI, TRBUH, DJECA, SLIKOVNE PRETRAGE, ULTRAZVUK, DIFERENCIJALNA DIJAGNOZA