ETIOLOGICAL AND CLINICAL-PARACLINICAL IMPLICATIONS OF ACUTE ABDOMINAL PAIN IN CHILDREN

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ETIOLOGICAL AND CLINICAL-PARACLINICAL IMPLICATIONS OF ACUTE ABDOMINAL PAIN IN CHILDREN (Abstract): Abdominal pain is the most important symptom of digestive diseases in children, being one of the most frequent reasons for their coming to the general practitioner, pediatrician or emergency room. The etiological possibilities for abdominal pain are numerous and the condition is difficult to manage even in the best of clinical circumstances, but especially in children who cannot tell a precise history or locate the pain. In such circumstances, the most important role of the doctor is to distinguish between benign self-limiting conditions, and life-threatening diseases, which are true surgical emergencies. Thorough anamnesis and full physical exam of the child guides the diagnosis, and paraclinical tests targeted to the most common group of diseases depending on the child’s age will lead in most cases to setting the positive diagnosis and thus allow the timely initiation of an adequate therapy, either medical, or surgical. This review aims to provide an update on the etiology and the main diagnostic methods of acute abdomen, helping discriminate between those patients who can be managed entirely in primary care, with recommendations based on the most currently accepted concepts in the management of acute abdomen in children. Keywords: ABDOMINAL PAIN, ACUTE ABDOMEN, CHILDREN.

The term “acute abdomen” designates any traumatic or non-traumatic condition with fast onset and digestive pain and symptoms, which requires urgent hospitalization in a surgical ward for monitoring and possibly surgical therapy, if necessary.
Abdominal pain is the third most common chief complaint in emergency departments and is a difficult condition to diagnosis even in the best of clinical circumstances, and especially in children who cannot tell a precise history or locate the pain (1). The etiological possibilities are numerous, but abdominal pain is the most important symptom of digestive diseases and it occurs in most abdominal conditions (involving the guts, the peritoneum, the vessels and nerves, the mesentery, the omentum). When the pain is very sharp, accompanied by other signs and symptoms, and especially when it occurs suddenly, the children are brought by their parents directly to the emergency room of the hospital (2). In this case, the most important role of the doctor is to distinguish between benign self-limiting conditions, such as acute viral
gastroenteritis, constipation or infant’s abdominal colic, and life-threatening diseases, which are true surgical emergencies. This review aims to provide an update on the etiology and the main diagnostic methods of acute abdomen, helping discriminate between those patients who can be managed entirely in primary care, with recommendations based on the most currently accepted concepts in the management of acute abdomen in children.

**Patient assessment and anamnesis**

The process of making a triage decision always begins by reassurance that the child is clinically stable. After this, patient assessment should start with a thorough anamnesis about the child’s age, personal medical history, possible history of physical injury or psychological trauma, presence or absence of appetite (for instance, a child who is hungry is less likely to have appendicitis), pain onset and chronic nature, and associated symptoms, and it should be followed by a detailed physical exam. The child’s anamnesis and physical exam are essential for diagnosis setting and for choosing the right therapeutic approach, and especially for developing a relationship of trust between the doctor and the patient, and the family, considering the usually difficult circumstances of the exam (in the emergency room, while the child is in great pain and the family is deeply distressed). Anxiety increases even more when a possible surgical condition is suspected and it reaches its peak in the family when the surgeon comes. Therefore, it is extremely important for the surgeon performing the anamnesis to be infinitely patient and calm, and to allow the family and then the child (if he/she is older than 2-3 years) to tell what the problem is, while carefully observing the patient’s movements when he/she undresses and is asked to lie on his/her back.

The **child's age** can provide important information. In neonates, congenital malrotation of the small bowel can result in volvulus, causing bowel obstruction with biliary, fecaloid or bloodstained vomiting. Hirschsprung’s disease is also a potential diagnosis in neonates that present with enterocolitis. In children aged between 2 months and 1 year, intussusception is the most common cause of bowel obstruction. Puberty may be the cause of vague abdominal pain in girls with the first menstruation. Just remember that in any girl of child-bearing age pregnancy should always be excluded. Also for adolescents, check for adnexal torsion in girls and testicular torsion in boys.

**Pain onset** may provide useful information. For example, a sharp sudden pain spreading quickly throughout the whole abdomen may be suggestive of gastrointestinal perforation, adnexal torsion or ruptured extra-uterine pregnancy in female adolescents. Extreme agitation of the patient suggests the involvement of an ischemic mechanism, the pain being stabbing, accompanied by paleness, reflex vomiting and perspiration (vagal signs), like in intussusception, volvulus or adnexal torsion. Any pain with insidious onset and increasing intensity may suggest an infectious (acute appendicitis, Meckel diverticulitis), obstructive (bowel obstruction) or neoplastic process. The pain onset seat, when it may be set, namely in children older than 5-6 years, may provide precious information: a pain starting in the epigastrium and then moving towards the right iliac fossa is suggestive of acute appendicitis, a pain in the right hypochondrium irra-
diating in the shoulder is specific to irritation of the diaphragm (sub phrenic abscesses after acute peritonitis for which surgery was recently performed) or to acute cholecystitis, a pain in the left iliac fossa and left hypochondrium is characteristic to enterocolitis, whereas a diffuse periumbilical pain is suggestive of intestinal parasites. When investigating abdominal pain, it is important to ask about pain elsewhere in the body as this can also give clues towards the cause of the disease (referred pain). Common examples are scapular pain due to biliary colic, shoulder pain due to blood or infection irritating the diaphragm (Kehrs sign: left shoulder tip pain is a classical symptom of a ruptured spleen).

The second most common symptom of acute abdomen is vomiting, which may be reflex, in case of ischemia or peritoneal irritation (acute volvulus, strangulated hernia, acute appendicitis), or may be the consequence of an obstruction, which is initially food-related and subsequently becomes bilious and then fecal. Impaired intestinal gas and feces transit, or, on the contrary, diarrhea (especially in small children) may both be signs of acute surgical abdomen.

Finding the cause of acute abdomen in children younger than 5 years is extremely difficult since the child is neither able to express the type or intensity of the pain, nor to locate it, since the ability to locate abdominal pain appears after the age of 4-5 years, with the maturity of the central nervous system. Sometimes, atypical and not very noisy symptoms, or even the absence of physical signs, are another impediment. For instance, a 2-year child with peritonitis may be simply lethargic, complaining of abdominal distention and diarrhea. Therefore, on the first exam, acute appendicitis is mistaken for something else in almost 100% of the patients up to 2 years of age and in 28-57% of the children below the age of 12 (3). The key to early diagnosis is a high level of clinical suspicion, based on the clinical experience of the first doctor examining the child. Given the difficulties encountered when assessing young children with abdominal pain, the ruptured appendix rate is much higher in children than in adults, ranging between 30 and 65% (4).

**Clinical Assessment**

Clinical assessment should be done using the systematic process of inspection, auscultation, palpation and percussion. Therefore, it will start by a general exam of the body, with special focus on the abdomen, to detect any abdomen rigidity or distention, skin rashes (Henoch-Scholein purpura), postoperative scars, possible sings of injury (fig. 1). Palpation is used to detect any areas of guarding, tenderness or any masses and should start away from the area of tenderness. The abdomen should be palpated gently, while observing the patient’s facial expression and respecting the little patient’s hand that will push the doctor’s hand away from the painful spot. Percussion is also a good way of assessing for peritonism and will elicit pain even if the patient has received strong analgesia. Abdomen percussion may reveal hyper sonority in case of pneumoperitoneum or dullness in case of fluid effusions, and auscultation may detect bowel sounds in case of bowel obstruction or abdominal silence in peritonitis or paralytic ileus. One must always ensure that the inguinal and scrotal areas are examined for strangulated hernias, testicular hydrocele in tension or acute scrotum syndrome.
Etiological and clinical-paraclinical implications of acute abdominal pain in children

All physical exams for acute abdomen should end with a **rectal exam**, which may provide extremely important data: pain in the pouch of Douglas in case of appendicitis or peritonitis, palpation of an ovarian tumor or of an extra-uterine pregnancy; also, rectal exam may detect the presence of a fecalith or rectal polyp, may set a diagnosis of infant’s intussusception in the presence of specific “red currant jelly” stool or “meat juice” bleeding (fig. 2).

Paraclinical Assessment

Complete blood count and erythrocyte sedimentation rate, coagulation tests, biochemical exam, urine and stool tests are the routine laboratory tests that should be performed. For adolescent girls, pregnancy testing may also help narrow the differential diagnosis. The **blood count** and coagulation tests may reveal the presence of hemorrhagic anemia (in case of abdominal injury, for instance), abnormally high inflammatory test findings are suggestive of acute appendicitis or another infectious process, high amylase and lipase levels may point to acute pancreatitis. **Hematuria** is specific to a renal condition like lithiasis, but it may also occur in case of irritated ureter by an inflamed retrocecal or mesoceliac appendix. Diarrhea is specific to acute enterocolitis, yet it may also occur in the peritoneal irritation syndrome, whereas blood present in the stool may point, together with perineum and rectal examination, to anal fissures due to constipation, rectal polyp or intussusception (fig. 2).

Among the imaging tests, **ultrasound scanning** is usually the first method that is recommended due to its accessibility and non-invasive nature, as well as to its ability to contribute precious information for diagnosis setting and therapeutic approach. The ultrasound may reveal:

- the presence of free fluid in the peritoneal cavity – blood in case of spleen or liver injuries, gastric or intestinal fluid in

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**Fig. 1.** Sign of injury – bike handlebar blow – in a child with post-injury jejuna perforation

**Fig. 2.** Rectorrhagia after rectal examination – in an infant with intussusception

However, rectal exam may induce severe discomfort, defined as major crying or screaming, in nearly one fourth of children presenting with possible appendicitis, and mild discomfort, defined as facial grimacing, was reported in another 37% (5). That is why the information gained from the rectal examination must be weighed against the potential of induced physical discomfort.
digestive perforations, reaction fluid or puss in acute appendicitis or peritonitis (6);
- the presence of inflamed aperistaltic cecal appendix, possibly with an inner appendicolith, with a diameter exceeding 6 mm in case of acute appendicitis;
- the presence of intraperitoneal abscesses – appendicular, subhepatic, perisplenic and pouch of Douglas abscesses;
- signs of acute cholecystitis – thickened gallbladder wall or small wall abscesses, pericholecystic abscess, gallbladder lithiasis;
- the presence of parenchymatous organ lesions in case of injury - hematoma or ruptured spleen, liver, kidney;
- diminished intestinal peristalsis, thickened-wall fluid-filled intestinal loops – for instance, in peritonitis or acute enterocolitis;
- distended intestinal loops, which are filled with fluid and air – in mechanical obstructions;
- specific “target-like” or “loop-in-loop” signs – in case of intussusception, in which case the ultrasound allows the real-time watching of loop disinvagination when air is blown in or a serum or contrast agent enema is performed (7);
- the presence of abdominal or retroperitoneal tumors;
- the state of the girls’ inner genitalia, the presence of ovary cysts or pathological ovarian torsion – ovarian teratoma, hemorrhagic ovarian cyst (8);
- the state of the urinary system – hydronephrosis, kidney, ureter or gallbladder lithiasis, kidney or gallbladder tumors, full bladder.

If there is any suspicion of occlusive syndrome (hydroaeric levels revealed by abdominal X-ray), gastric or intestinal perforation (pneumoperitoneum) or ingestion of foreign bodies, a thoracic-abdominal X-Ray of the standing patient is recommended (fig. 3 and 4). Thoracic X-ray may reveal the presence of broken ribs, in case of injury, hydro or pneumothorax, or it may reveal basal pneumonia with symptoms such as occasionally sharp abdominal pain, vomiting, poor general condition resembling acute surgical abdomen.

Fig. 3. Occlusive syndrome – hydraeric levels

Fig. 4. Pneumoperitoneum – colic perforation
Due to the high radiation dose involved and to the need of young child sedation, computed tomography (CT) diagnosing acute abdomen in children should be recommended with caution, only when the children are obese, in case of uncertain diagnosis or when the ultrasound scan is inconclusive. However, CT is the preferred diagnosis setting method in case of abdominal injury, as it accurately reveals both solid organ lesions and possible cavity organ perforations. It is also recommended when assessing acute pancreatitis or intestinal inflammatory diseases, whereas in case of abdominal tumors nuclear magnetic resonance (NMR) is preferred, despite it being rarely accessible in the emergency room and despite the drawback of its requiring general anesthesia (9). Tests like angiography, upper or lower digestive endoscopy, paracentesis in case of fluid in the peritoneal cavity (which may reveal the presence of blood, intestinal fluid, pus, ascites fluid, urine) are more rarely used in children in the emergency room.

Laparoscopy has a special place among diagnosis setting exams, being used more and more often lately including in children, due to its many advantages: very small incisions, the possibility of probing the whole abdomen and of flushing it using physiological saline solution, the possibility of peritoneal fluid sampling or biopsy sampling for biological and pathological anatomy tests, and especially the possibility of solving the cause of acute abdomen (ovarian torsion solving and fixation or excision, appendectomy and peritoneal lavage, ileum perforation suture, peritoneal adhesion lysis, hernia reduction and hernia gap closing).

Causes of Acute Abdomen in Children

Here are the most common medical caused of acute abdomen in children: constipation, intestinal parasites, acute gastroenterocolitis, dyspepsia, allergy to cow milk proteins, esophagitis due to gastroesophageal reflux, irritable bowel syndrome, urinary tract infection and ureter colic, virus A hepatitis. Also, consider acute mesenteric lymphadenitis in children presenting after a viral illness or new onset diabetes presenting with abdominal cramps, which are associated with diabetic ketoacidosis. Acute gastroduodenitis, cholecystitis, acute idiopathic or toxic pancreatitis are causes of acute abdomen which usually require drug treatment, although they may sometimes get complicated and require surgery.

Recurrent abdominal pain is a prevalent disorder affecting 10% to 15% of school-age children (10, 11). In many cases, recurrent abdominal pain in children has psychogenic (functional) origins, without having a specific organic cause (infection, inflammation, tumor, obstruction). The big difficulty with recurrent abdominal pain is the fear of missing significant or serious underlying pathology. Table I gives a brief overview of how to differentiate functional from organic abdominal pain (12).

Psychogenic pain may be accompanied by symptoms such as anorexia, nausea, vertigo, cephalalgia, paleness, constipation and, more rarely, vomiting or diarrhea. Psychogenic pain occurs in sensitive over-protected children, with a family history of depression or anxiety, and it is associated with a series of stress factors like a history of frequent diseases, lactose or other hydrocarbon intolerance, drug administration, aerophagia, constipation, and especially with psychosocial factors like the death of
a parent or of another family member, arguments, divorce or separation from the family for other reasons, jealousy after the birth of a sibling, school or financial problems. Psychogenic abdominal pain is sometimes hard to diagnose, it is attributed to various organic conditions and treated with drugs. Drugs should not ordinarily be given because may aggravate the family’s panic and the concept of the pain, creates an unnecessary dependency, and are almost always unrewarding. The treatment is useless unless the psychological cause is found and removed.

**TABLE I.**

<table>
<thead>
<tr>
<th>Clinical feature</th>
<th>Organic</th>
<th>Functional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site of pain</td>
<td>Loin, suprapubic, right upper and lower quadrants</td>
<td>Central</td>
</tr>
<tr>
<td>Family history of abdominal pain, headache and depression</td>
<td>Less likely</td>
<td>More likely</td>
</tr>
<tr>
<td>Anxiety</td>
<td>Less likely</td>
<td>More likely</td>
</tr>
<tr>
<td>Headache</td>
<td>Less likely</td>
<td>More likely</td>
</tr>
<tr>
<td>Alarm symptoms</td>
<td>Persistent or significant vomiting, chronic diarrhea, fever, gastrointestinal blood loss</td>
<td>Less likely</td>
</tr>
<tr>
<td>Poor growth/weight gain</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Abnormal full blood count, erythrocyte sedimentation rate or urinalysis</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

False acute abdomen (extra-abdominal pain causes) may be caused by: basal pneumonia, myocardial infarction, diabetic ketoacidosis, pericarditis, spine conditions, and central nervous system tumors.

The surgical causes may be grouped in four syndromes:
- The peritoneal irritation syndrome and acute peritonitic abdomen, respectively: acute appendicitis and appendicular peritonitis, more rarely primitive acute peritonitis, Meckel diverticulitis, perforated gastric ulcer in adolescents; in the specialty literature, the acute appendicitis is the most common cause of surgical acute abdomen in children, being diagnosed in 1-8% of the children coming to the emergency room complaining of abdominal pain (13, 14);
- Occlusive syndrome: intussusception, malrotation, inner hernia, intestinal obstructions due to adhesions or roundworms, strangulated inguinal hernia; intussusception is the most common cause of acute surgical abdomen in infants under the age of one, its incidence rate peaking between the age of 6 and 11 months (3);
- Hemorrhagic syndrome: intestinal polyposis, ruptured intestinal hemangioma, bleeding ulcer in Meckel’s diverticulum;
- Visceral ischemia syndrome: enteromesenteric infarction (rare in children), normal or pathological ovarian torsion, gastric volvulus and intestinal volvulus, torsion of a pedicle abdominal tumor;
- Acute traumatic abdomen: abdominal injuries with ruptured solid organs or perforated cavity organs; as part of acute surgical abdomen, injuries have had an in-
creasingly higher occurrence rate due to the higher number of causing events, such as road accidents, aggressions, sporting events (fig. 1).

The etiological diagnosis may sometimes not be accurately set before the surgery, doctors only being able to determine the type of acute surgical abdomen that it belongs to. What is important is to decide whether surgery is required, as the procedure should be performed in due time, usually within a few hours, after a short hydro-electrolytic, acidic-basic rebalancing, abdominal decompression if necessary (naso-gastric drainage), antibiotic therapy or blood transfusions (on which the patient’s life is sometimes dependent – for instance, in internal hemorrhage due to ruptured spleen or liver). Older literature recommended, in principal, not to administer analgesics to children with abdominal pain until setting the diagnosis or at least until the surgical examination, since the analgesics may conceal the progress of an acute surgical process. However, once the diagnosis is set and the therapeutic approach is decided on, ruling out any surgical cause, analgesics should be administered immediately. Recent research has proven that the use of analgesic drugs in children with abdominal pain does not increase the risk of diagnosis errors and it should therefore be administered immediately, even before the surgical exam (15).

**DISCUSSION**

Abdominal pain is one of the most common reasons for the children’s coming to the general practitioner or pediatrician. The child’s anamnesis and physical exam usually help set an accurate diagnosis, whereas paraclinical tests targeted to the most common group of diseases depending on the child’s age will lead in most cases to setting the positive diagnosis. When determining the cause of abdominal pain and acute abdomen and subsequent therapeutic approach, communication is in most cases “the key to success”; both the questions asked and the explanations given to the family should be layman versions, spoken in a calm and reassuring voice and even repeated if necessary; direct communication with the patient, even when he/she is only a few years old, decreases the child’s and family’s stress and anxiety levels and strengthens their trust in the healthcare system. For instance, for children who are about to undergo surgery, there are there things which should be emphasized since they are essential: the fact that the child will not feel any pain during the procedure because he/she will be asleep, the fact that when he/she wakes up his/her parents will be there and the fact that he/she will then feel better and be able to go home (16). It is also important for the family to have time to think about and process the information received before giving their informed consent for the surgical procedures. This time will be used by the surgeon to analyze the biologist test results and imaging findings.

Time is of the essence for the doctor as well, since the clinical-paraclinical dynamic reassessment of a child with unclear clinical picture, or the child’s reexamination 1-2 hours later, after his/her hydro-electrolytic and acid-basic rebalancing and after pain therapy administration, may reveal new signs. Biological tests and a few imaging procedures should be performed during this time interval, depending on the age of the child and initially suspected diagnosis. Monitoring the patient closely means that if intervention is required, this
can be done in a timely fashion, reducing post-operative complications.

**CONCLUSIONS**

Thorough anamnesis and full physical exam of the child suffering from acute abdomen who comes to the emergency room, followed by a set of tests and imaging investigations targeted depending on the patient’s age and initial clinical suspicion, will in most cases distinguish medical from surgical etiology of acute abdomen of the child, and thus allow the timely initiation of an adequate therapy.

**REFERENCES**