International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.
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https://ijpsat.org/
Vol. 47 No. 2 November 2024, pp. 190-204

Severe Abdominal Pain In Pediatrics Review

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Abstract – Severe abdominal pain is a common cause of pediatric emergency consultation. Although a small percentage is due to a strict process, the difference in time from the normal to the frequent causes can be a challenge. Childhood age greatly affects the likelihood of diagnosis. Taking a detailed history and careful physical examination remains the cornerstone of diagnostic guidance. In cases of doubt, it may be necessary to judiciously use some complementary tests, in which ultrasound appears for its benefit, since it is less invasive and provides useful information in many cases. In this review, we will discuss some of the most common causes of pediatric age, as well as an analysis of syndromic groups. We emphasize the importance of adequate analgesia that is given even before the physical examination, which, without hiding the main signs, comforts the child and allows to do a physical examination and tranquility is important.

Keywords – Acute abdomen; Appendicitis; Intussusception.

Objectives

- Know the main factors that lead to acute abdomen in different age groups.
- Understand the pathogenesis of various clinical disorders, such as acute abdominal pain and differential diagnosis.
- Recognize the importance of providing pain relief.
- Find out about the medical history and the most important diagnostic signs that indicate acute abdomen.
- Use embedded analytics appropriately and know their limitations.
- Know the guidelines for hospital referrals.

I. Introduction

Acute abdominal pain is a common cause of pediatric emergency diagnosis, but most are due to mild and self-limiting processes. Early detection of severe, time-sensitive forms is important, but unnecessary diagnosis or aggressive treatment must be avoided. The number of children examined in the emergency department who have abdominal pain as the main reason for the examination is estimated at 5%, but only between 1% and 8% of them will require hospitalization or surgical evaluation (1,2). Therefore, many cases are associated with medical procedures, generally of low severity. However, it is often difficult to distinguish severe abdominal pain that will require urgent surgical intervention from those that will not; and among these, those that are due to mild and more or less self-limiting processes, those that are due to less frequent or that require specific treatment. Understanding the different types and causes of abdominal pain helps identify patients whose condition will not improve without medical or surgical intervention. In

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ISSN: 2509-0119.
© 2024 Scholar AI LLC.
https://ijpsat.org/
Vol. 47 No. 2 November 2024, pp. 190-204

general, careful history and careful and repeated physical examination, combined with the correct judgment and selection of other tests, allows the doctor to differentiate the child who needs help quickly by the person who will benefit from the treatment (2 -4). Sometimes, this decision cannot be made after the initial examination and a follow-up period will be necessary. Most of the time severe abdominal pain stops immediately. It is important to identify the processes that wait in time, i.e. those who diagnose the disease/treatment late may cause a high risk of complications or an increased disease, as it may happen in appendicitis or intussusception. On the other hand, it is also desirable not to fall into the diagnosis of disease and to carry out harmful tests or treatments on patients who do not need them. Physiopathology and syndromes Pain is manifested by a series of different symptoms, which help in diagnosis. Four main diseases are defined: inflammatory, recurrent, traumatic and adnexal. The abdominal pain sensation is transmitted to the central nervous system by somatic and visceral afferent fibers. The visceral afferent system enters the visceral peritoneum and its lining. Visceral pain is not good, but, in general: the pain comes from parts of the foregut (stomach, duodenum, pancreas) located in the epigastrium; pain from the midgut (small intestine and colon to the splenic flexure) in the periumbilical region; and the pain from the hindgut part is felt in the hypogastrium. In contrast, pain from the parietal peritoneum (for example, inflammation) and the abdominal wall (for example, muscle trauma) is detected by the somatic afferent fibers that detect it well (4,5). Referred pain results from a combination of visceral and somatic pain pathways in the spinal cord or central nervous system. Pain originating from the abdominal viscera can be perceived as originating from a distant somatic site (4,5).

For example, diaphragmatic irritation secondary to pancreatitis, cholecystitis, liver injury, or bleeding may be classified as pain originating from the neck and lower shoulders because the pain pathways of the diaphragm and shoulders are gathered at the level of the spinothalamic bundles at level of C4. Similarly, inflammation of the gallbladder can be in the right infrascapular region, pancreatic pain in the back, migrating urethral stones can be felt as it progresses to the ipsilateral groin, and rectal and gynecologic pain in the sacral region. In contrast, pain from somatic conditions, such as pleural effusion and pneumonia, can be perceived as originating from the lower abdomen, because afferents from 2 areas converge at the level of D10-11. Therefore, it must be taken into account that the location of the pain does not always correspond to the problem in the anatomical position (2-5). Diseases associated with severe abdominal pain (3-5) Inflammatory diseases cause pain from irritation or inflammation of the peritoneum, usually due to bacterial processes. In general, it is a strong but local pain, and it is possible to find an analgesic condition, in which the patient remains immobile. The patient should avoid walking or walking slowly. There may be signs of guarding and decreased peristaltic sounds. In the case of perforation of the abdominal cavity, the symptoms worsen, abdominal distention and rigidity of the abdominal muscles are often seen.

1. **Occlusive syndrome**

Occurs when there is difficulty in passing the bowel normally, either mechanically or rigidly (paralytic ileus). It is associated with the expansion of the intestine to the level of the obstruction, which can cause a pronounced clinical abdominal distention. It is accompanied by vomiting, which can be severe, and other clinical symptoms, such as pallor and sweating. The pain is often seen as unpleasant and the patient cannot find a position that relieves the pain, so it gives some irritation. A similar condition can occur due to the obstruction of other digestive organs or ducts, such as bile and pancreatic ducts or ureter. Trauma syndrome occurs as a result of abdominal trauma that causes peritoneal irritation, generally due to the presence of blood or digestive content in the peritoneal cavity. The history of the trauma is not always obvious, and may not be understood or hidden by the adult (a case of abuse). Most of the cases are closed trauma and the most commonly affected viscera are the spleen and liver.

2. **Adnexal syndrome**

This is the result of the disorder of the genital system. In men, the most common causes are testicular torsion, epididymitis and testicular trauma. In women, it is the physiological process of puberty that usually causes: ovulation or dysmenorrhea, but it is important to take into account pathologies such as: torsion of ovarian cysts, ectopic pregnancy and pelvic inflammatory disease.

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ISSN: 2509-0119.
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https://ijpsat.org/
Vol. 47 No. 2 November 2024, pp. 190-204

Table I. Causes of acute abdominal pain in relation to age

Neonatal period	Sepsis
	Urine infection
	Colic Gastroenteritis
	Alimentary intolerance
	Necrotizing enterocolitis*
	Intestinal perforation
	Meconium ileus
	Hirschsprung's disease
	Volvulus intestinal malformation
Infants	Gastroenteritis
	Trauma
	Colic
	Alimentary intolerance
	Urine infection
	Intestinal intussusception
	Strangulated inguinal hernia
	Appendicitis
	Testicular/ovarian torsion
	Hirschsprung's disease
	Volvulus
Preschoolers	Gastroenteritis
(2-4 years)	
	Urine infection
	Food transgressions
	ENT focus
	Appendicitis
	Pneumonia
	Tumors
	Urinary lithiasis
	Testicular/ovarian torsion
	Multiple inflammatory syndrome
	Post COVID-19
	Hemolytic uremic syndrome
Schoolchildren	Gastroenteritis
(4-11 years)	Appendicitis
	Urine infection
	ENT focus
	Trauma
	Pneumonia
	Schönlein-Henoch purple
	Cholecystitis/Cholelithiasis

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https://ijpsat.org/
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	Diabetic ketoacidosis
	Testicular/ovarian torsion
	Inflammatory bowel disease
	Multiple inflammatory syndrome
	Post COVID-19
Teenager	Appendicitis
	Ovulatory pain/Menstruation
	Inflammatory bowel disease
	Pelvic inflammatory disease
	Cholecystitis
	Pancreatitis
	Diabetic ketoacidosis
	Schönlein-Henoch purple
	Multiple inflammatory syndrome
	Post COVID-19
	Ectopic pregnancy
	Peptic ulcer
	Psychosomatic

***Necrotizing enterocolitis is almost exclusive to preterm newborns and usually manifests itself during hospital admission**

Acute abdomen regarding strength, type and duration, these are personal data that are not always easy to determine. A scale appropriate for the child's age can be used to determine strength. Abdominal pain that is severe and continues for more than six hours indicates surgical pathology, since it occurs more in relation to a large inflammatory process; while colic-like pain indicates obstruction of the bowel or genital tract. Severe pain may occur in conditions that originate from previous ones (2-5).

2.1 Associated symptoms

Fever, fatigue, malaise, anorexia, or pallor may be present. It is unusual for a person with appendicitis to be hungry. The child had persistent and persistent intussusception. The presence of symptoms of an upper respiratory tract infection or viral infection may indicate mesenteric lymphadenitis. Dysuria causes urinary tract infections. In Schönlein-Henoch vasculitis, there is usually a characteristic purpuric rash and periarticular edema, but abdominal pain sometimes appears before these symptoms. The presence of other digestive symptoms is common and must be noted. The presence of vomit, indicating its appearance, for example whether it is thick or red, is important. You should ask about the frequency and consistency of stools, as well as the presence of blood or mucus. The presence of fever, large soft stools and vomiting indicate the diagnosis of gastroenteritis. However, especially in children, other possibilities can be considered that can mimic or worsen this condition significantly.

2.2 Examination

In time, when the administration of analgesia is appropriate (8) ,which can be difficult if the first examination is painful or stressful, which is why we emphasize the importance of careful observation and before analgesia. Other tests, the most effective test is abdominal ultrasound. The quality of other tests does not exclude the diagnosis of major abdominal surgery. In most of our patients, the diagnosis can be established based on data obtained only from history and physical examination (2-5). Other tests should be reserved for cases where the diagnosis is unclear or when the test can confirm or refute an important disease. It should be noted that it is important to take care of a significant pathology in time, which may require help depending on the time, but it is also important to avoid unnecessary examinations, especially if it is troublesome or attacking him. There are many diagnostic possibilities, as we have already mentioned, according to the test in each case. It is a specific medical condition that must guide the doctor in the choice of one or more tests. Imaging It is important to examine, auscultate and palpate the abdomen. This should be done slowly and after the administration of appropriate analgesia. Complementary tests are more important for research guidance than any other research.

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https://ijpsat.org/
Vol. 47 No. 2 November 2024, pp. 190-204

It is important to examine, auscultate and palpate the abdomen. And for this to be reliable, it is desirable to do it slowly and without haste, after dispensing the appropriate analgesic (6)

An examination of the stomach will be done after removing the clothes or diaper, checking the presence of distension, old scars, lumps or skin lesions of any kind. In addition, the abdomen is auscultated to assess abdominal sounds and, finally, palpation is performed. It is not always easy to calm the child during the examination, so proceed carefully and thoughtfully, leaving the most painful area for the last. The presence of pain or its intensity may be important to guide the diagnosis. Palpation also makes it possible to find out involuntary guarding or rebound pain when there is a sound or pain that indicates peritoneal irritation. However, as the child is young, the signs of peritoneal irritation are unreliable (7). It is also important to look for hepatomegaly or splenomegaly and look for other possible abnormalities. To examine the size of the liver or the lower spleen, one should start from the inguinal area and work up to the subcostal area, because significant organomegaly may not be found if the examination begins in the middle part of abdomen. Next, we examine the inguinal region, looking for hernias, and organs. Care should be taken to examine the testicles in children with abdominal pain, because testicular trauma, testicular torsion, and epididymitis can be accompanied by widespread abdominal discomfort. A swollen and tender testicle without cremastric reflex on the affected side suggests testicular torsion and therefore requires an urgent ultrasound. Rectal examination can be uncomfortable and should not be done routinely. When it is considered necessary, a medical doctor will do it well to get the information (e.g. a surgeon, if there is a suspicion of a surgical infection, or a specialist in women's diseases, in the case of a young person showing inflammation of the organs).

3. Bowel problems

3.1 Pyloric stenosis

Pyloric stenosis (PS) is an obstruction of the intestine caused by idiopathic circular muscular hypertrophy and non-rest of the pyloric antrum. PS usually appears between 3 and 12 weeks and is four times more common in boys than in girls [8]. Affected infants experience violent, "projectile" vomiting. On ultrasound, using the liver as a viewing window, the Antro pyloric band is seen near the gallbladder. Pedialyte should be given if the stomach is not distended. In terms of length, the criteria for PS are a tissue layer greater than 3 mm and a canal length greater than 15 mm [9,10,11]. Other findings include lack of duct opening, poor gastric emptying, and thickening of the mucosa. The stability of the results must be confirmed during the follow-up period [12]. In inconsistent cases, short-term ultrasound monitoring can determine whether pyloric stenosis has finally started, or can show that the diagnosis has disappeared, indicating pylorospasm [9,13]. In rare cases where ultrasound is not available, UGIS can show abnormal gastric emptying, a well-differentiated "cord" sign in the compressed pyloric lumen, and an "apple head" caused by the pyloric artery that enters. in the stomach and duodenum. Treatment of PS includes rehydration and electrolyte replacement, followed by pyloromyotomy.

3.2 Midgut malrotation and volvulus

Malrotation is an abnormal position of the intestine resulting from a disruption of the fetal midgut's counterclockwise rotation around the axis of the superior mesenteric artery (SMA). This results in narrowing of the small bowel mesentery and results in midgut volvulus, in which the small bowel twists clockwise around the SMA, resulting in duodenal obstruction and small, life-threatening ischemia. Obstructions can also result from mesenteric appendages called Ladd's bands. 90 % of cases occur in the first year of life, and 60-80% in the first month of life, often with sudden vomiting [14]. Older children present with unusual symptoms, such as irritability, constipation, occasional vomiting, and inability to function properly [14,15].

UGIS is a comprehensive reference and must be implemented quickly [16,17]. In normal patients, when passing the first contrast bolus, the duodenojejunal junction (DJJ) is located in the upper quadrant on a frontal view, and the duodenal sweep is retroperitoneal and posterior . In malrotation, the DJJ is located to the right of the spine and under the duodenal bulb in front, and the duodenum protrudes from the front to the side . After passing through the midgut volvulus, the twisted intestine forms a "cover" or circle, or it can end in a "bird's beak" if there is a strong obstruction [18,19]. Contrast-enhanced plain radiographs and normal intestinal gas patterns cannot exclude the lesion [20]. Although ultrasound for malrotation is not widely used, midgut volvulus provides a "wind

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ISSN: 2509-0119.
© 2024 Scholar AI LLC.
https://ijpsat.org/
Vol. 47 No. 2 November 2024, pp. 190-204

sign", with clockwise rotation of the intestine and mesenteric vein (VMS) around the axis of the AMS [21,22].Treatment is the Ladd procedure, which includes evacuation of the volvulus (if present), lysis of the bands, and expansion of the mesenteric base by inserting a small intestine into the right-abdomen section and the colon and the left side of the years, like. and appendectomy.

3.3 Acute appendicitis

Acute appendicitis is a transmural inflammation of the appendix, resulting from ischemic mucosal damage and viral load after luminal obstruction. Causes include fecal impaction and lymphoid hyperplasia, and foreign bodies and tumors are rare. Complications include perforation that leads to phlegmon or abscess, peritonitis, and small bowel obstruction. Appendicitis is a common surgical emergency that occurs in children of any age, and is more common in teenagers. However, appendiceal perforation is more common in young people [23]. The most common presentation is migration of periumbilical pain to the right side, along with fever and nausea, although up to one-third of children have non-classical presentation [23]. This challenge is compounded by the great variability in the location, orientation, and length of the appendages. Ultrasound is the first imaging test, sometimes followed by CT or MRI in case studies [24]. Ultrasound signs of appendicitis include appendix diameter > 6 mm, wall thickness > 3 mm, increased color Doppler (hyperemia of the appendiceal wall), accumulation of fluid in the lumen of the appendix and peri appendicular inflammation and hyper echogenicity of the surrounding fat [24,25,26].Ultrasound signs of perforation include the loss of echogenic submucosal layer, phlegmon, liquid area or true abscess, extraluminal appendicitis, complex ascites, and dilated bowel [27,28].

Table 3 Risk Assessment Scale - Pediatric Appendicitis Score (PAS)

Symptoms	Pain migration	1
	Anorexia	1
	Nausea or vomiting	1
Signs	Tenderness in right iliac fossa	2
	“Rebound” signs	2
	Fever >38ºC	1
Analysis	Leukocytosis >10,000/mm3	1
	Neutrophilia >75%	1

Score ≥ 7 would recommend surgical treatment. (Source: Samuel M. Pediatric appendicitis score. J Pediatr Surg.2002; 37: 877-81.)

CT findings include rapid diffusion and wall thickening, fluid retention, peri appendicular fat accumulation, appendicolith, adjacent bowel obstruction, mesenteric lymphadenopathy, and abscess if ruptured. MRI findings include rapid T2 hyperintensity in the peri appendicular tissue, wall thickness, and fluid and/or free fluid collection [29]. An appendicolith can be seen as a focal cyst. Laparoscopic appendectomy is the main treatment, although individual control depends on the surgeon and the institution. In the case of uncomplicated appendicitis, another option is the administration of antibiotics alone [30]. Treatment of ruptured and inflamed appendicitis includes antibiotics, percutaneous drainage and interval appendectomy after the inflammation subsides [31].

3.4 Intussusception

Intussusception is the insertion of the intestinal loop (intussusceptum) into the distal intestinal cavity (intussuscipiens). Untreated intussusception can lead to bowel obstruction and ischemic stroke. Intussusception in children is usually ileocolic and idiopathic,

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ISSN: 2509-0119.
© 2024 Scholar AI LLC.
https://ijpsat.org/
Vol. 47 No. 2 November 2024, pp. 190-204

possibly due to lymphoid proliferation from a viral infection, and rarely due to complications such as Meckel's diverticulum, enteric duplication cyst, polyp or lymphoma. The age of onset of the disease is usually 3 months to 3 years, with a peak between 5 and 9 months [32]. Patients have one or more symptoms of the triad: abdominal colic pain, vomiting and bloody diarrhea. A plain radiograph is not the first diagnosis, but it can show a small distention of the intestine and sometimes a "crescent" or "meniscus" sign and intussusception is seen as a large soft tissue that is associated with gas [33,34]. . On a left lateral decubitus image, intussusception is ruled out if air is seen in the cecum and ascending colon. Ultrasound is highly sensitive and accurate for the diagnosis of ileocecal intussusception. Diagnostics include the "target" or "doughnut" sign, in which the cross section of the intussusception appears as a concentric kidney ring, and the "pseudo kidney" sign, in which the sagittal view shows the central echogenic mesentery mimicking the renal sinus fat . Unlike temporary intussusceptions from the small intestine to the colon, ileocolic intussusceptions usually occur on the right and are large (>2-2.5 cm), with large adipose core and lymph nodes central lymphatics [35,36]. Intussusception is reduced by air enema or liquid enema, under fluoroscopic or ultrasound control [33, 37]. Predictors of decreased success on imaging include fluid retention, ascites, and intestinal obstruction [34,35]. If the first attempt fails, a delayed appeal attempt may be considered [2]. The recurrence rate can reach 9 to 19% [37]. Surgery is reserved for patients whose enemas fail or who have complete contraindications to enemas, including open airways and peritonitis.

3.5 Small bowel obstructions/adhesions

Small Bowel Obstruction (SBO) is a blockage of the small intestine that prevents the progress of digested food. Unexpected bowel obstructions can be partial, complete, or "hand closed." in which there are both proximal and distal barriers. The most common causes of intestinal obstruction in children are adhesions and hernias, although congenital causes are more common in infants [38]. Other less common etiologies include tumors, inflammatory bowel disease, midgut volvulus, intussusception, Meckel's diverticulum, and foreign bodies. Adhesive SBO esophagus manifests as abdominal pain, bloating, vomiting, and constipation in children after surgery [39]. Adhesions usually appear in the first three months and can be seen after any operation, usually ileostomy and Ladd's procedure, but rarely after appendectomy [39,40]. An abdominal x-ray usually shows the presence of an obstruction. The second view (left lateral or horizontal decubitus) is not necessary unless the diagnosis is certain, but it is useful in determining the level of air and water and exclude free air [41,42]. Findings include distension of the small bowel that does not fit into the bowel, air and fluid levels, and distention of the distal bowel. Absence of intestinal gas does not exclude spontaneous bowel obstruction, because the loops can be filled with fluid and associated with high-level obstruction in closed loops [42,43].

CT scan describes the condition and cause of spontaneous bowel obstruction, as well as complications such as strangulation and perforation [44]. Findings include a dilated small bowel >2.5 cm, focal caliber changes and changes to collapsed distal loops, and a "small bowel" sign of debris leaking into the bowel. If nothing else is evident in a child who has had previous surgery, it is assumed to be the cause [44]. Obstructions that are compressed show signs of ischemia, including intestinal wall thickness, pneumatosis, ascites, and mesenteric edema [45,46]. Initial management includes nasogastric tube interruption, abdominal rest and fluid replacement, if there are no signs of ischemia that would require emergency surgery [40]. Some surgeons recommend the gastrografin test, using hyperosmolar as a diagnostic and treatment agent. Candidates for non-surgical management are identified by differential progress in the cecum within 6 to 24 hours [47].

3.6 Meckel's diverticulum

Meckel's diverticulum (MD) is a blind pouch found at the antimesenteric end of the ileum, representing incomplete resorption of the omphalomesenteric canal, which connects the embryonic intestine to the yolk sac. Different types of remnants of the omphalo-mesenteric canal include fistula, sinus, cyst, polyp and fibrous tissue. Complications of bone marrow dysplasia usually occur before the age of 10 [48,49]. The most common presentation is painless lower gastrointestinal bleeding, caused by ulceration of the ectopic gastric mucosa overlying the DM. Bowel obstruction due to DM can result from intussusception, volvulus, fibrous bands, or an incarcerated hernia known as a Littré hernia [49]. Meckel's diverticulitis is an inflammatory process that presents similarly to appendicitis [48]. Technetium-99m perdechnetate scintigraphy is the best tool to diagnose MD with gastric mucosa, which appears as an increase in the lower right side that appears at the same time in the stomach [50,51]. In addition to gastrointestinal bleeding, the diagnosis of MD is difficult to establish early due to nonspecific findings [51]. On ultrasound, the diagnosis area due to MD is

seen as a large circular or elongated mass at the distal end of the intussusception [48]. In any transverse imaging, Meckel's diverticulitis mimics appendicitis, however, the warm tubular system connected to the ileum and the normal appendix can be seen differently [48,49,52]. Surgical resection is performed in all cases of complicated DM. In the case of intussusception, reduction by enema can be attempted, which will lead to subsequent surgery [48].

3.7 Foreign Body Ingestion

Foreign body nutrition is the oral consumption of non-food items from outside the body. Most cases occurring between 6 months and 5 years of age involve benign conditions that can be treated safely, but some require special attention [53,54]. Coins stuck in the esophagus can cause dysphagia and narrowing of the trachea due to local inflammation. A button battery can inject a corrosive solution into the esophagus, quickly causing mucosal damage, perforation, fistula of the trachea or aorta, which can be fatal [55]. Multiple magnets, or magnets combined with ferromagnetic material, can attract each other across the bowel, causing perforation, fistula or obstruction [55]. Obstruction can also result from an impact on a pre-existing stenosis or at a stop point such as the upper and lower sphincter, crossing the aortic valve, pylorus, and ileovalve [55].Bezoars are formed by hair-like implants, which clump together and cause obstruction of the intestines. X-rays help determine the identity, location, and complexity of a foreign body. Images are obtained from the nose to the abdomen, including the front and back of the neck, thorax, and abdomen [53]. Most foreign bodies are radiopaque, but plastic, plant material (e.g., wood), aluminum, and bone are radiolucent. Disc batteries (buttons) can be recognized immediately by their two rings seen from the front and the front face seen from the side [53]. CT allows accurate and reveals problems if the radiograph is not limited. Oral contrast may be left to avoid obscuring the object or disrupting subsequent endoscopy [55]. Fluoroscopy using contrast-enhanced fluid can show radiolucent foreign bodies and detect perforations. Foreign bodies are usually removed at the same time and can be monitored until they are expelled in the stool [55]. Risk factors or complications require endoscopic or surgical removal [56].

3.8 Incarcerated Hernia

A hernia is the protrusion of an organ outside of its original location, and an inguinal hernia is the most common type. In children, most of them are indirect hernias that appear in the viscera from the inguinal ring deep in the scrotum or labia, secondary to the process patent vaginalis in men, or nuck's canal in girls [57, 58, 59]. Hernias usually involve the bowel or omentum, but may also involve appendages, Meckel's diverticulum, ovary, fallopian tube, uterus, or bladder. It is defined in the hospital as the irreducibility of the hernia and can lead to bowel obstruction and strangulation [60,61]. Inguinal hernias are 5 to 10 times more common in boys than in girls, but the number of incarceration is equal [58]. Premature infants are at higher risk [58,59]. Hernias appear as a bulge in the groin, scrotum or labia. Incarcerated hernias are usually mild and irregular, with associated symptoms of abdominal obstruction [58].

Although the diagnosis is clinical, ultrasound can distinguish the hernia from similar symptoms such as hydrocele, lymphadenopathy or tumor [58]. Ultrasound shows the peristaltic loops of the intestines, maneuvered using the Valsalva maneuver or moving to a standing position [57,62]. Ultrasound diagnosis of strangulation is narrowing of the abdominal wall, loss of Doppler, and fluid in the hernia sac [57,62]. In girls, the incarcerated ovary shows signs of ischemia such as enlargement, stroma growth, peripheral cavities and lack of Doppler fluid [57]. Treatment consisted of attempted manual reduction followed by immediate surgical repair [63,64]. If the ovary is incarcerated, patients can proceed with surgery immediately to avoid the risk of torsion [57].

4. Genitourinary diseases

4.1 Ovarian Torsion

Ovarian torsion is a reversal of the vascular pedicle of the ovary, which destroys lymphatic and venous drainage and can lead to vascular damage and hemorrhagic termination of the ovary. Most cases occur in girls between the ages of 9 and 14, with or without underlying cause, but trauma can occur in younger girls due to ligamentous laxity [65.66]. The most common causes are mature cystic teratoma and follicular cysts larger than 4 to 5 cm [66]. Torsion can also occur in inguinally herniated ovaries, including paraovarian cysts, or separated from the fallopian tube [65]. Symptoms include sudden onset of lower abdominal pain, nausea and fever [67]. The most reliable ultrasound diagnosis is the enlargement of the ovary on one side, with a ratio > 2.5 (median ratio 12)

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ISSN: 2509-0119.
© 2024 Scholar AI LLC.
https://ijpsat.org/
Vol. 47 No. 2 November 2024, pp. 190-204

compared to a normal ovary [68,69]. Other findings include absent follicles, central echogenic stroma, medial or contralateral position, tubular structure on the side representing the pedicle and ligaments of the fallopian tube, or a twisted pedicle and "swirl" " the principle of which the vessel is turned . [66,70,71]. However, Doppler flow may be absent, however, preserved arterial flow does not exclude torsion, because the venous flow is first empty and has secondarily from the ovarian and uterine arteries [65,70]. It is characterized by a large cystic mass with large fluid and sometimes a calcified rim [56]. CT and MRI are not the first line, but they can detect abnormalities when it is not expected or when ultrasound is inconclusive. Findings include an adnexal mass, a long fallopian tube, a "swirl" sign of a twisted vascular pedicle, hemorrhagic content, poor enhancement, a different appearance of surrounding fat, and removal of the uterus from the affected side. [56,67,59]. Treatment includes laparoscopic surgical excision and removal of cysts or any underlying cysts. Salpingo-oophorectomy is reserved for necrotic ovaries or benign tumors [56]. Ovaripexy is controversial and not always performed [56].

4.2 Testicular torsion

Testicular torsion is the movement of the spermatic cord that causes blood to flow to the testicle. The most common type, intravaginal torsion, occurs in teenage girls and is caused by a " bell clapper deformity," in which the upper repair of the tunica vaginalis leaves the testicle and spermatic cord mobile in the scrotal sac. The smallest type, which disappears, appears at birth, and it is caused by the rupture of the scrotal wall causing the spermatic cord, testis, and tunica vaginalis to twist as a unit. Signs and symptoms include severe scrotal pain, which may wake the child, referring to abdominal or inguinal pain, nausea and vomiting, scrotal induration and erythema, and lack of ipsilateral cremastric reflex [61]. The most reliable ultrasound diagnosis is the abnormal appearance of the spermatic cord, including the "swirl" sign that is seen as a complex, or solid, irregular, or irregular cord. inactive, also known as "swampy pseudo mass" or "knot." torsion" [61,62]. Other findings include testicular globular enlargement, non-horizontal position, epididymal protrusion, and reactive hydrocele. Different echotexture with lines and hypoechoic plaques correspond to the risk of non-viability [61,63]. Doppler flow is absent or reduced compared to the normal segment, except in the case of segmental or non-transitory segments where fluid flow can be preserved [61,62, 64]. In cases of fetal malformation, ultrasound shows a small infarcted testicle with a calcified rim [65]. Treatment includes immediate surgical repair and orchidopexy, which in some areas can be induced using a manual for appropriate individuals [66]. Since the bell deformity is usually bilateral, a contralateral orchidopexy is performed [66]. Orchiectomy is reserved for unresectable necrotic vessels.

4.3 Urolithiasis and Obstruction

Urolithiasis is an intraluminal accumulation of stones composed of minerals and salts that form in the urinary system. In children, this phenomenon is often observed in conditions that cause diseases such as metabolic diseases (e.g., hypercalciuria, hyperoxaluria), urinary tract infections, drugs, and urinary stasis [68,69]. Urolithiasis can appear at any age with abdominal or abdominal pain, hematuria, dysuria, fever and vomiting [70]. Complications include renal failure, pyelonephritis and sepsis [71]. Ultrasound is the first image and shows hyperechoic foci with acoustic shadowing and twinkle artifact [67,69,70]. Signs of obstruction include hydronephrosis, parenchymal hyper- or hypo echogenicity, perinephric fluid, high resistance indices, and weakened ureteric jet [67,69] Signs of infection include debris or gas in the collection system, urothelial thickening, focal hypoechoic hypo vascular area in the parenchyma, or true abscess [69]. CT is highly sensitive for ureteral stones and stones <3 mm, but is reserved for accuracy [69]. Low-dose and ultralow-dose protocols are used to reduce radiation]. [67,69] The stones are hyperdense and are clearly visible in the non-contrast exams using the windowing algorithm [67,69,70,71]. Signs of obstruction include hydroureteronephrosis, nephromegaly, a delayed nephrogram, perinephric or periureteral stranding, and wall segments that accumulate around the ureteral stone [67]. Treatment includes hydration , pain management and medical expulsive therapy [67,69] .Treatments are used for prevention and other complications, including extracorporeal shock wave lithotripsy, ureteroscopy, percutaneous nephrostomy and ureteral stenting, and percutaneous nephrolithotomy [69].

5. Acute cholecystitis

Acute cholecystitis (AC) is an inflammation of the gallbladder wall due to bile stasis and bacterial overload, resulting from obstruction of the cystic intestine by gallstones (calculous cholecystitis) or hypokinesia of the gallbladder without stones (acalculous cholecystitis) . Cholecystitis stones cause more than half of the cases in children and are seen in patients with severe disease, various

International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.
© 2024 Scholar AI LLC.
https://ijpsat.org/
Vol. 47 No. 2 November 2024, pp. 190-204

diseases, systemic vasculitis and trauma [72, 73, 74]. AC occurs throughout the abdomen and presents with pain, nausea, fever, and jaundice [74]. Calculous cholecystitis and acalculous cholecystitis appear in the same way on ultrasound, except for the absence of gallstones in the latter. Findings include gallbladder distention, wall thickness > 3.5 mm, wall edema with a dramatic appearance, pericholecystic fluid, hyperemia of the adjacent liver, and Murphy's sign and tenderness when examining the gallbladder [72,75]]. If ultrasound is the same, magnetic resonance cholangiopancreatography (MRCP) can detect stones in the gallbladder neck and cystic duct [76,77]. During hepatobiliary scintigraphy using iminodiacetic radiopharmaceuticals (IDA), CA is detected by non-visualization of the gallbladder within the first 60 minutes [78,79].The “rim” sign corresponds to an increase in liver function around the gallbladder fossa. It is thought that increasing the amount of morphine decreases the accuracy rate and the test time. Treatment for acalculic cholecystitis is cholecystectomy, but patients with severe disease can receive drainage through percutaneous cholecystostomy [80]. Management of acalculic cholecystitis is usually conservative [72,81].

6. Pancreatic disease

6.1 Pancreatitis and complications

Pancreatitis is an inflammation of the pancreas characterized by edema and destruction of the parenchyma and pancreatic tissue, resulting from inappropriate activation of pancreatic enzymes. Pancreatitis can be idiopathic, but risk factors in children include cholelithiasis, drugs, congenital anomalies of the pancreatic duct or bile duct, trauma, systemic diseases, metabolic diseases, and autoimmune diseases [82]. All age groups can be affected, but the disease usually occurs after the age of 5 [83]. It is manifested by abdominal or epigastric pain, nausea, vomiting and increased blood levels of amylase and lipase. The 2 phenotypes described in the Atlanta classification are interstitial edematous pancreatitis, characterized by pancreatic edema, and necrotizing pancreatitis, characterized by no enhancing areas of necrosis [84]. Complications include hemorrhage, fluid collection, infection, pseudoaneurysm of the proximal artery, and splenic artery thrombosis. Ultrasound is performed first, mainly to determine the presence of gallstones, while CT or MRI are reserved for diagnosis [97]. Ultrasound can show hypertrophy and hypo echogenicity of the pancreas, ill-defined borders and dilation of the pancreatic duct, and can help define the contents of the fluid collection [82,83,85]. CT findings include partial or diffuse pancreatic thickening, irregular segmentation, peripancreatic stranding, and retroperitoneal fascial thickening [82,83]. MRI findings include pancreatic edema and peripancreatic edema on T2 images, loss of normal pancreatic signal and brightness on T1, hyperintensity on T1 due to hemorrhage, and non-enhancing areas due to necrosis [82,83]. CPRM is used to diagnose cholelithiasis and pancreatic lesions. Pancreatitis-related fluid accumulation was defined in the Revised Atlanta classification based on duration and degree of formation [84]. In interstitial edematous pancreatitis, a "large collection of peripancreatic fluid" is seen < 4 weeks after the onset, and a "pseudocyst" is seen > 4 weeks later and is covered . In necrotizing pancreatitis, a "massive necrotic mass" is observed > 4 weeks after the onset, and " walled-off necrosis" is observed > 4 weeks and is covered with solid internal material [82,86]. Treatment of pancreatitis begins with abdominal rest, rehydration, and pain medication. Antibiotics are given in cases of infected pancreatic necrosis, and drainage or cyst gastrostomy may be performed in cases of accumulation of mature peripancreatic fluid.

II. Conclusion

Abdominal pain is one of the most common complaints of children presenting in the emergency room. Radiology plays an important role in the diagnosis of the colon in children and can quickly diagnose many new pathologies. The age of the patient is very useful in clarifying the differential diagnosis and in guiding the selection of imaging tests. Ultrasonography is used as radiation-free first-line imaging for many of the diagnoses discussed in this article, including pyloric stenosis, appendicitis, intussusception, strangulated hernia, ovarian and testicular torsion, urolithiasis, acute cholecystitis, and pancreatitis. Other techniques used in acute abdominal evaluation include abdominal x-ray and abdominal x-ray for foreign body ingestion, UGIS for midgut rotation and filling, and rapid non-contrast MRI for appendicitis. The use of CT is limited by concerns about exposure to ionizing radiation, but is useful for some specific indications, such as the detection of SBO transition points. , to detect obstructive ureteral stones and to detect complications of appendicitis and pancreatitis when MRI is not readily available. The basic diagnoses described in this article are the cornerstone of pediatric emergency abdominal radiology, and knowledge of the main clinical and imaging findings allows rapid recognition. and treatment of these potentially devastating conditions.

Conflict of Interest

All authors declare no conflicts of interest.

Author Contribution

Authors have equally participated and shared every item of the work.

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