

Diagnosing and managing acute abdominal pain in children

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ABSTRACT

Acute abdominal pain is a common complaint in children. The care of these patients is challenging for clinicians because presentation, diagnosis, and treatment are different in children than adults. This article describes the presentation, physical examination, diagnosis, and treatment of common causes of acute abdominal pain in children and discusses emerging trends in diagnosis and treatment.

Keywords: pediatric, acute abdominal, abdominal pain, appendicitis, intussusception, gastroenteritis

Learning objectives

- Recognize common causes of acute abdominal pain in children.
- Describe diagnostic approaches to acute abdominal pain in children.
- Identify the components of care for children with acute abdominal pain.

Acute abdominal pain in children can present as a challenging complaint for primary care providers (PCPs).¹ It is defined as nontraumatic pain that requires rapid treatment, diagnosis, and in some cases surgery. Special considerations should be made in children who present with acute abdominal pain. Care must be guided by cause, patient age, presentation, and thoughtful selection of diagnostic imaging. This article reviews several of the common causes of acute abdominal pain in children and discusses emerging topics including nonoperative

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treatment of appendicitis, the use of clinical decision rules combined with imaging, and the possibility of a norovirus vaccine. **Table 1** presents details of patient presentation, physical examination, red flags, diagnosis, and treatment of sections below.

APPENDICITIS

Appendicitis is the most common surgical cause of abdominal pain in children, and most commonly occurs during adolescence when the lymphoid hyperplasia of the tissue is at the highest rate.^{2,3} When the lumen becomes obstructed and inflamed, younger children may have atypical symptoms that delay the diagnosis.³ Furthermore, the omentum is underdeveloped in children, allowing for diffuse peritonitis if the appendix perforates.³ The nonspecific presentation and delay of diagnosis increase the risk of complications in children under age 5 years.³

Presentation and physical examination The most predictable examination findings for appendicitis in adults are right lower quadrant (RLQ) pain, abdominal rigidity, and periumbilical pain.² This is not the case in children. A review by the American Academy of Family Physicians found that RLQ pain was seven times more likely to present in adults with appendicitis than in children.² When RLQ pain is found in children, it is more often reproduced with a hopping movement, with coughing, or with rebound pain on physical examination.² Findings that more likely

Key points

- Children with acute abdominal pain may present with nonspecific symptoms.
- Diagnosis of abdominal pain should include non-radiation-based imaging.
- Common medications used in adults for abdominal pain may be contraindicated in children.
- Clinicians must be aware of potential long-term psychosocial effects of abdominal pain in children.

indicate appendicitis in children are obturator sign and Rovsing sign.² Children under age 3 years may present with intermittent nonspecific symptoms such as vomiting, fever, abdominal distension, diarrhea, and lethargy.³

Diagnostic methods To reduce the risk of radiation, the American Academy of Pediatrics, National Cancer Institute, and the American Pediatric Surgical Association have recommended using ultrasound and other non-radiation-based imaging when evaluating children with abdominal pain.^{2,4}

Other findings that may help confirm the diagnosis are elevated white blood cell (WBC) count; C-reactive protein (CRP) level; and APPY1 biomarker panel, which consists of WBC, CRP, and myeloid reactive protein levels.² The APPY1 was found to have a 98% sensitivity when used alone and 99% sensitivity when combined with ultrasound.²

In addition to diagnostic imaging, clinical decision rules (CDRs) can be used to help make a diagnosis of appendicitis. A frequently used CDR is the Pediatric Appendicitis Score (PAS), which takes into account children's symptoms presenting more frequently, such as the RLQ pain with hopping or coughing and rebound tenderness seen above.² The use of CDRs with ultrasound may increase diagnostic reliability and reduce the need for CT.⁴ Ultrasound combined with the PAS has a 98.6% accuracy in ruling out appendicitis, compared with ultrasound alone at 69.2% and the PAS alone at 57%.⁴ CT should not be used as a first-line diagnostic tool in children; however, when there is a high clinical suspicion and negative ultrasound, CT can be used to ensure the diagnosis is not missed.^{2,4}

Treatment Appendectomy is the treatment of choice for appendicitis.⁵ Recently, however, nonoperative management has been discussed as an emerging option.⁵ A retrospective study examined 65,712 children from 45 hospitals in the United States from 2010 to 2016 who were diagnosed with appendicitis without perforation; 6% were treated nonoperatively.⁵ The outcomes after 1 year for the nonoperative group included an increase in ED visits and hospitalizations; additionally, 46% of the children initially managed nonoperatively subsequently required an appendectomy within 1 year.⁵ This study also examined recent prospective trials

that found a 58% to 79% 1-year appendectomy rate for children treated nonoperatively.⁵ Although medical management of appendicitis is an emerging topic, it is not yet the standard of care and more research is needed before it becomes a mainstay in the treatment of appendicitis.

INTUSSUSCEPTION

Intussusception is the most common cause of bowel obstruction in children under age 2 years.⁶ Peak incidence is between age 4 and 9 months.⁶ In this condition, a segment of the intestine invaginates into the adjoining intestine, most commonly near the ileocolic junction.⁶ Intussusception should be high in the differential in younger children who present with severe abdominal pain or a palpable mass in the right upper or lower quadrant.⁶ The cause in children under age 2 years usually is idiopathic; however, in older children it may be caused by a pathological lead point as a result of other causes such as Meckel diverticulum, tumors, or polyps.^{1,6} Although pathologic causes are less likely in young children, they should be ruled out. Intussusception is an emergency because complications can lead to bowel infarction, perforation, and death.⁶

Presentation and physical examination The classic triad for intussusception consists of colicky abdominal pain, vomiting, and bloody stool.⁶ However, less than one-third of children present with these symptoms.⁶ More commonly, children present with nonspecific symptoms such as vomiting, intermittent abdominal pain, irritability, decreased appetite, and lethargy.⁶

Diagnostic methods Ultrasound is the initial diagnostic method of choice in children, with a sensitivity of 98% to 100% and specificity of 88% to 100%.⁶ Although CT is the most sensitive modality for diagnosis in adults, it is not routinely used to diagnose intussusception in children.⁶

Treatment The management for uncomplicated intussusception is hydrostatic or pneumatic enema under ultrasound guidance.⁶ Surgical reduction may be indicated in patients with complicated intussusception: those who show signs of peritonitis or perforation, or those for whom reduction with enema is not possible.⁶

CONSTIPATION

Functional constipation in children is defined as constipation that occurs without an organic cause.⁷⁻⁹ The Rome IV guidelines establish diagnostic criteria based on age.⁹ Diagnosis of most children who have an organic cause will be done in the neonatal period.⁷ Constipation accounts for 3% of pediatric visits, and 25% of all pediatric gastroenterologist visits.^{7,8} Complications from constipation include stool impaction and encopresis.⁷ In addition, 25% of children will go on to have chronic constipation as adults.⁷

Children may present with constipation for various reasons, including diet changes, psychosocial issues, medications, and underlying medical causes such as cystic fibrosis,

hypercalcemia, and lactose allergies.⁷ A thorough history is especially important in these cases, as any stress or change in lifestyle may trigger an episode.

Presentation and physical examination For details of the physical examination, see Table 1. Guidelines do not recommend a digital rectal examination for children who present with functional constipation.^{7,9} An abdominal examination, inspection of the perianal and lumbosacral region, and a neurologic examination may be indicated.⁷⁻⁹

Diagnostic methods In most cases, the diagnosis of constipation is clinical, with no indication for imaging or laboratory tests.⁸ The Rome IV guidelines frequently are used to aid in diagnosis.⁹ Patients diagnosed with functional constipation using the Rome IV guidelines should not meet criteria for irritable bowel syndrome or other medical conditions that could explain their symptoms.⁹

Treatment A multifaceted approach to the treatment of functional constipation includes education, disimpaction, maintenance, and long-term follow-up.⁷⁻⁹ Education includes teaching the family about the pathophysiology of constipation and fecal incontinence, the concept of overflow incontinence, the use of laxatives, a high-fiber diet with adequate water intake, and the importance of physical activity.^{7,8} In addition, explaining that the child cannot control these symptoms is important to prevent embarrassment and frustration.^{7,8}

When a palpable fecal mass is present on the abdominal examination, perform disimpaction.^{7,8} An osmotic laxative such as polyethylene glycol is recommended as the first choice for chemical disimpaction, as well as for maintenance therapy.⁷⁻⁹ If osmotic laxatives are ineffective, stimulant laxatives such as bisacodyl or senna can be added to the

TABLE 1. Diagnosis and treatment of selected causes of acute pediatric abdominal pain^{2,6-13}

	Acute appendicitis	Intussusception	Constipation	Acute gastroenteritis	IBD
History	Periumbilical pain migrating to RLQ, fever, anorexia	Vomiting, abdominal pain, irritability, hematochezia, currant jelly stool, lethargy	Decreased bowel movements, hard lumpy stool, abdominal pain, stool-retentive behavior, fecal incontinence	Dehydration, cramping, malaise, diarrhea, fever, vomiting	Abdominal pain
Physical examination	Absent or decreased bowel sounds, positive psoas sign, positive obturator sign, and positive Rovig sign	Palpable mass in RLQ	Abdominal examination: gas or stool examination	Look signs of dehydration or uncontrolled vomiting	<ul style="list-style-type: none"> • Perianal/rectal: fistulas, skin tags, fissures • Musculoskeletal: arthritis • Skin: pyoderma gangreosum or erythema gangreosum • Mouth: aphthous ulcers
Red flags	High fever, symptoms for a long period of time, altered mental status	Signs of peritonitis or bowel perforation	<ul style="list-style-type: none"> • Delayed meconium after birth (more than 48 h), failure to thrive • Perianal: fistulas, fissures, or signs of abuse 	<ul style="list-style-type: none"> • Altered mental status • Bilious or bloody vomiting • Inconsolable • Petechial rash • High fever • Age less than 6 months • Immunosuppressed • Recent antibiotic use • Diarrhea for more than 2 weeks 	Anemia, growth failure, signs of toxic megacolon, signs of colon cancer
Diagnosis	Ultrasound	Ultrasound: target sign	Rome IV guidelines	Stool cultures, if necessary	Colonoscopy with biopsy and esophagogastroduodenoscopy
Treatment	Appendectomy plus antibiotics and pain management	<ul style="list-style-type: none"> • Hydrostatic or pneumatic enema under ultrasound guidance • Surgery if reduction under enema is not possible 	<ul style="list-style-type: none"> • Patient and parent education • Polyethylene glycol 	<ul style="list-style-type: none"> • Fluid and electrolytes • Probiotics 	Exclusive enteric nutrition, thiopurines, anti-TNFs, methotrexate

regimen as second-line therapy.⁸ Laxatives should be used for at least 2 months and normal bowel movements should occur for 1 month before the medications are discontinued.^{7,8} Long-term care of functional constipation also should include education, diet, and lifestyle modifications to prevent relapse.⁷

ACUTE GASTROENTERITIS

Acute gastroenteritis is a diarrheal disease with rapid onset that may be accompanied by fever or vomiting.^{10,11} Two of the most common viral causes are rotavirus and norovirus.¹¹ The annual incidence of positive cases has decreased significantly each year due to the introduction of the rotavirus vaccine in 2006.¹¹ Norovirus has now become the most common cause of acute gastroenteritis outbreaks worldwide and is responsible for 50% of all viral gastroenteritis cases.¹¹ Norovirus is highly infectious. Its prevalence is likely due to its resistance to heat, freezing, and most disinfectants, including alcohol and chlorine.¹¹ Although acute gastroenteritis is commonly thought of as a mild self-limiting disease, it accounts for 1.5 million office visits, 200,000 hospitalizations, and 300 deaths each year in the United States.¹⁰

Presentation and physical examination Take a history of the child's recent fluid intake and urine output, as well as examining the patient's general appearance, eyes, mucous membranes, and tear output for signs and symptoms of dehydration.¹⁰

Diagnostic methods Acute gastroenteritis is generally a clinical diagnosis.¹¹ Although stool cultures may determine the cause, this should only be obtained in patients with the red flags listed in Table 1.¹⁰

Treatment Rehydration and reducing severity of symptoms are the mainstays of treatment. Oral rehydration is first line; however, severely dehydrated patients may need hospital admission.^{10,11} In addition, children with emesis and moderate to severe dehydration may need an antiemetic such as ondansetron to help with rehydration.^{10,11} For children who are nursing, encourage breastfeeding, which has been shown to reduce the incidence and severity of acute gastroenteritis.¹⁰ Educate parents and caregivers on proper hand hygiene and safe water and food preparation.^{10,11}

Multiple studies have examined the use of probiotics in the treatment of gastroenteritis and have found a reduction in both the duration of diarrhea and relapse of the disease with use of *Lactobacillus rhamnosus* GG and *Saccharomyces boulardii*-I745.¹²

Lastly, although a vaccine exists for rotavirus, none exists for norovirus. As of 2019, a potential vaccine was undergoing clinical trials and had shown beneficial immune response in adults and children.¹⁰

INFLAMMATORY BOWEL DISEASE

Inflammatory bowel disease (IBD), which comprises Crohn disease and ulcerative colitis, is a chronic condition increasing in incidence worldwide.¹³ The cause is unknown but is thought to be a combination of genetics, dysfunction of the gut microbiome, and environmental factors leading to a

TABLE 2. Differences in physical examination findings for ulcerative colitis and Crohn disease¹³

Ulcerative colitis

- Bloody diarrhea
- Abdominal pain specifically with defecation
- Involves colon, and only mucosa layer
- Endoscopy shows diffuse continuous mucosal inflammation involving the rectum, diffuse erythema, friability and granular. Loss of vascular pattern in colon.

Crohn disease

- Abdominal pain
- Diarrhea with or without blood
- Weight loss
- Involves mouth to anus, with all layers of gut affected
- Endoscopy shows deep fissures, cobblestoning of intestinal mucosa
- More common to have extraintestinal symptoms

dysregulated immune system.^{13,14} Although IBD is considered to be a disease that affects older adolescents (ages 11 to 16 years), diagnoses have been increasing in younger children.^{13,14}

Presentation and physical examination The physical examination is listed in Table 1. IBD typically presents more aggressively in children, especially those under age 5 years.^{13,14} Children present with more extensive disease, and nonspecific symptoms such as unexplained fevers, anemia, and poor growth.^{13,14} In children under age 5 years, the initial presentation of ulcerative colitis is bloody diarrhea and abdominal pain.¹³ Crohn disease may present with rectal bleeding, as well, and often is initially misdiagnosed as ulcerative colitis in children under age 5 years.¹³

Diagnostic methods Guidelines recommend a total colonoscopy with ileal intubation, an upper endoscopy, multiple biopsies, and complete small bowel exploration as diagnostic tools for IBD in children.¹³ The findings distinguishing Crohn disease and ulcerative colitis are compared in Table 2.

Treatment Although IBD medications such as thiopurines, corticosteroids, and anti-TNF therapies used for adults may be used for children, clinical trials are lacking for newer therapies and their efficacy in children.¹⁴ Adverse reactions to common IBD medications can be more severe in children and the effects can be long-term, such as stunted growth from corticosteroid use.¹⁴ Furthermore, children under age 6 years are not likely to respond to traditional IBD treatments.¹³

Of the IBD medications that have demonstrated efficacy, 5-aminosalicylates may be used in patients with mild disease; however, they have been shown to be less effective in children than other treatments, with more exacerbations and shorter remission periods.¹³ Anti-TNF agents are considered first-line for children with severe disease who present with growth delay due to disease or medication use from IBD.¹⁴ The use

of anti-TNF medications in children has higher rates of remission than when used in adults and a safer adverse reaction profile than thiopurines.¹⁴ Anti-inflammatory medications have been to be effective because children are more likely to have inflammatory rather than the stricturing disease seen in adults.^{13,14} Corticosteroid adverse reactions are common, however. Exclusive enteric nutrition (EEN) may be an alternative to corticosteroids in children. Like corticosteroids, EEN has been shown to reduce inflammation without the adverse reactions, although its use is limited to 6 to 12 weeks and often a nasogastric tube must be used.^{13,14} Given the effectiveness of EEN, more research has been focusing on the microbiome and how diet can affect the course of IBD.¹³ Although evidence is insufficient to support the use of diets such as the FODMAP, research is ongoing.¹³

Children and adolescents with IBD face challenges including delayed growth, depression, and the effect of the disease on their families.^{13,14} Increased parental stress has been shown to have a negative effect on IBD disease severity.¹³ Depression is more prevalent in adolescents with IBD than in those with other chronic diseases, and should thus be screened for regularly.¹³

CONCLUSION

The approach to acute abdominal pain in children can be daunting, as neither the presentation nor the response to standard adult treatments is common. Obtaining a thorough history is one of the most important aspects of accurate diagnosis. A combination of thorough physical examination and the use of non-radiation-based imaging will confirm many of the common diagnoses. Providing parent and patient education on chronic diseases, such as constipation and IBD, may be as significant as the medical management. Further research is still developing on the nonoperative treatment of appendicitis, management of childhood IBD, and potential for a norovirus vaccine. Clinicians must be aware of emerging trends and be prepared to use evidence-based treatments in the care of children who present with acute abdominal pain. **JAAPA**

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