Acute Abdominal Pain in Paediatrics

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Overview

Pediatric abdominal pain is a very common complaint for patients presenting to the primary care or the emergency department.[1,2] It often poses a diagnostic dilemma owing to the variety of underlying causes. The vast majority of episodes are benign and self-limiting, but persistent abdominal pain may signify an underlying pathology requiring urgent intervention. Acute abdominal pain is usually a self-limiting, benign condition, such as in gastroenteritis, constipation, or viral illness.[3,4] However, many a times the clinical symptoms may be uncharacteristic. This often poses a challenge for the physician in identifying children who have uncommon and potentially life-threatening conditions that require urgent evaluation and treatment, such as appendicitis, intussusception, volvulus, or adhesion.[4-6]

Etiology of acute abdominal pain

A wide range of surgical and non-surgical conditions can cause acute abdominal pain in children (Table 1).[7,8] Gastrointestinal sources are the most common etiology of abdominal pain in children, encompassing gastroenteritis, constipation, appendicitis, and intussusceptions. Acute appendicitis is the most common surgical cause of acute abdominal pain in children.[3,4] Among the non-surgical conditions, constipation is the most frequently identified cause of acute abdominal pain in children. Estimates of the overall frequency of constipation in childhood are as high as 29%.[2] Other common causes of abdominal pain include systemic viral illness, infections outside of the gastrointestinal tract (streptococcal pharyngitis, lower lobe pneumonia, and urinary tract infection), mesenteric lymphadenitis, and infantile colic.[4]

Evaluation of abdominal pain

In the evaluation of a child with acute abdominal pain, the most important components are careful history taking and repeated physical examinations. Selective use of appropriate laboratory and radiological investigations may be necessary to establish a specific diagnosis. However, the diagnosis may remain uncertain despite a thorough initial evaluation process.[1,4,9] Red flags are critical to investigate in the history and physical exam of abdominal pain (Table 2).[7,10] Assessment of symptoms (duration, intensity), addressing red flags, physical exam findings, and consideration of the incidence of specific etiologies can help narrow the differential diagnosis of acute abdominal pain and facilitate efficient use of diagnostic testing. This approach leverages

Table 1: Causes of acute abdominal pain in children

Age < 2 yrs	Age 2 – 11 yrs	
• Intussusception	• Appendicitis	• Testicular torsion
• Gastroenteritis	• Gastroenteritis	• Incarcerated hernia
• Incarcerated hernia	• Trauma	• Meckel diverticulitis
• Urinary Tract Infection	• Mesenteric adenitis	• Spontaneous Bacterial Peritonitis
• Intestinal Obstruction	• Peptic Ulcer Disease	• DKA
• Malrotation with Volvulus	• Pneumonia (lower lobe)	• Superior mesenteric artery Syndrome
• Trauma	• Hepatitis	• Idiopathic
• Pneumonia(lower lobe)	• Pancreatitis	
• Lactose intolerance	• Henoch- Schonlein Purpura	
• Gastroesophageal reflux	• Haemolytic Uremic Syndrome	
• Hirschsprung disease	• Pyelonephritis /cystitis	

Adapted from: 1. Miranda A. Abdominal Pain. [2018]. Available at: https://www.us.elsevierhealth.com/media/wysiwyg/us/pdf/sample-chapter-9780323399562.pdf. Accessed on 12/05/2021. **2.** Neuman MI. Causes of acute abdominal pain in children and adolescents. [Updated Aug 30, 2019]. Available at: https://www.uptodate.com/contents/causes-of-acute-abdominal-pain-in-children-and-adolescents. Accessed on 12/05/2021.

Table 2: Red flag signs of abdominal pain in children

• Localized pain away from umbilicus • Sudden onset of excruciating pain • Pain awakes child from sleep • Referred pain • Sudden worsening of pain • Vomiting especially bilious • Bloody stools • Fever > 39.4°C • Weight loss • Elevated ESR, high TLC	**Specific physical findings** • Absent bowel sounds • Distension of abdomen • Involuntary Guarding • Focal or diffuse tenderness • Positive rectal examination results • Jaundice • Hepatomegaly • Hemodynamic instability

Adapted from: 1. Miranda A. Abdominal Pain. [2018]. Available at: https://www.us.elsevierhealth.com/media/wysiwyg/us/pdf/sample-chapter-9780323399562.pdf. Accessed on 12/05/2021. **2.** Quak SH. Recurrent abdominal pain in children: A clinical approach. *Singapore Med J.* 2015;56(3):125-128.

pretest probability to increase the diagnostic yield of laboratory tests and imaging studies.[7,11]

A complete description of the patient's pain and associated symptoms makes an integral part of history taking. A classic PQRST mnemonic has been suggested for a complete pain history, as shown in Table 3.[12]

The mnemonic contributes toward obtaining a thorough history. Key questions while evaluating abdominal pain should include- where is the pain felt (location), what kind of pain it is (character), when and how it began (onset), how bad it is (intensity), and where else is the pain felt or where does it radiate (pattern), what makes it worse or better, how it has changed over time, were there any previous episodes, and what are the associated symptoms.[1,12]

Location: Pain from foregut structures, such as the stomach, pancreas, liver, biliary system, and the proximal duodenum usually confines to the epigastric region. The rest of the small bowel and the proximal third of the colon including the appendix are midgut structures; visceral pain associated with these organs is perceived in the periumbilical region.[12]

Character: It is important to distinguish between the dull, poorly localized, aching, or gnawing pain generated by viscerally innervated organs, versus the characteristically "sharp", more defined and localized somatic pain caused by irritation of the parietal peritoneum or other somatically innervated structures.[12]

Onset: Acute-onset pain, especially if severe, should prompt immediate concern about a potential intra-abdominal problem. The prime consideration would be a vascular emergency such as a ruptured abdominal aortic aneurysm or aortic dissection. Other considerations for pain of acute onset include a perforated ulcer, volvulus, mesenteric ischemia, and torsion. Serious vascular issues such as mesenteric ischemia may present with a gradual onset of pain.[12]

Intensity: Severe pain should heighten the concern for a serious underlying cause. On the contrary, milder pain should not necessarily exclude the diagnosis of serious illness.[12]

Pattern: Functional disorders in childhood sometimes occur as a part of normal development process, such as infant regurgitation or toddler's diarrhea.[13] However, a large proportion of children with functional abdominal pain continue to complain of pain.[14] Pain becomes chronic in nature and manifests as an altered sensation due to a complex interaction between emotions, behavior, and gut function. Probably this is why children with chronic abdominal pain more often experience anxiety disorders, depressive episodes, and other somatic symptoms in comparison to those unaffected.[15]

Associated symptoms: It is often helpful to enquire about associated symptoms such as nausea, vomiting, diarrhea, constipation, hematochezia, as a variety of etiologies cause abdominal pain in children and since these are generally documented in most of the patients, these may therefore help in making a diagnosis.[16] In addition, the history should also typically comprise the bowel movement pattern, presence

Table 3: The classic PQRST mnemonic for a complete pain history

P3	Positional, palliating, and provoking factors for pain
Q	Quality of pain
R3	Region, radiation, and referral of pain
S	Severity of pain
T	Temporal factors (such as time and mode of pain onset and progression, and previous episodes

Adapted from: Macaluso CR, McNamara RM. Evaluation and management of acute abdominal pain in the emergency department. *International Journal of General Medicine.* 2012;5:789-797.

of fever, type of stool, amount of vomiting and the timing, the sequence of pain and vomiting, and the presence of a productive cough.[17]

Differential diagnosis of acute abdominal pain in children

Conditions that can be manifested by acute abdominal pain vary in incidence with age and sex. Classification of acute abdominal pain based on age is one adapted approach to narrow the differential diagnosis, which can guide selection of appropriate diagnostic tests, imaging, and definitive treatment.[1,16,17] Acute abdomen in infants younger than 2 years is very difficult to evaluate as the only feature may be inconsolable crying and finally lethargy. In fact, it has also been found that infants with recurrent or chronic abdominal pain in this age group may not present with any typical feature. The differential diagnosis includes recurrent intussusceptions, malrotation with intermittent volvulus, milk allergy syndrome and various malabsorptive diseases, such as lactase deficiency.[17]

Lactose intolerance and functional abdominal pain: A crucial connection

Acute onset severe pain raises concern for alternative etiologies, with primary concerns being underlying lactose intolerance or other carbohydrate malabsorption, celiac disease, or sensitivity to symptoms evoked by digestion of certain foods.[18,19] In infants, acute and unexplained abdominal pain that results in crying or fussing for 3 or more hours per day, during 3 or more days in the preceding week is referred to as 'infantile colic'. Although motility disorders of the gastrointestinal tract can be a predominant cause, in most such cases, pain is assumed to be associated with milk indigestion.[20] Lactose intolerance is mostly attributed to lactase deficiency, which is a widely prevailing condition among all age groups, with a tendency to become significant with age.[21-23] The prevalence of lactase deficiency varies across racial and ethnic groups, with the lowest prevalence in Europeans and European Americans and higher prevalence in Hispanics, Asians, and Asian Americans. The prevalence of lactase deficiency is low in children younger than six years and increases with age.[24] On average, 65% of the world's population is lactose intolerant.[25]

Since the onset of lactose intolerance is insidious and the pain appears only a few hours after milk ingestion, the affected patients/parents are likely to be clueless to lactose being the culprit of the abdominal pain.[19] Even though lactose intolerance itself is not the direct cause of functional abdominal pain in children, the underlying visceral hypersensitivity makes them prone to develop discomfort and pain in the setting of lactose intolerance; presence of lactose intolerance in children with functional abdominal pain disorders is thus likely to worsen the painful symptoms.[26,27] Lactose intolerance is a very important contributory factor to consider in children with recurrent abdominal pain.[28] In a study conducted by Carlo Tolone et al[29] on children with recurrent abdominal pain, lactose intolerance was found to be a cause of abdominal pain in 22.6% of children.

Another common cause of recurrent abdominal pain in children is irritable bowel syndrome (IBS). About 10-15% of older children and adolescents are estimated to suffer from IBS. It is characterized by abdominal pain, which manifests with a change in stool form and/or frequency (not explained by structural, biochemical abnormalities, or any well-recognizable infective cause) and tends to improve with defecation.[30] The diagnosis of abdominal pain in children should be formulated through a complete history, physical examination and even whole abdominal and pelvis ultrasound scan.[17]

Differentiating between clinically stable and critically ill patients: A quick Work up

The clinical approach to a child with acute abdominal pain involves an overall assessment of the child's appearance (lethargy, eye contact, comforted by family member, interactive), food and fluid intake (decreased intake or urine output, normal intake and output), and activity level (lying still, moving about in discomfort, or active).[16] In critically ill appearing patients, an attempt should be made to immediately rule out the surgical causes, particularly those associated with obstruction or ischemia. An urgent need for surgery in acute abdominal pain is likely if the bowel sounds are absent, or if there is bilious vomiting, bloody diarrhea or occult blood in stool, elevated temperature (≥ 100.4°F), rebound tenderness, rigidity (involuntary guarding), or voluntary guarding.[1,16] Therefore, a thorough history along with complete assessment of vital signs and patient's overall appearance can help triage between clinically stable and critically ill patients who may require an urgent surgical procedure (Table 4). In case urgent surgical consultation is needed, delay should not be long while awaiting diagnostic workup.[1] If the diagnosis is undetermined in a child who does not have an acute surgical abdomen, the examination should be repeated in 24 to 48 hours. Up to 30% of children will have a change in their diagnosis.[16,31]

Management considerations for pediatric Acute Abdominal Pain

Management options for children with abdominal pain are diverse and range from pharmacotherapy to dietary interventions, probiotics and psychological and complementary therapies. These interventions help in improving the understanding and maximizing the quality of care for children affected with this condition. Commonly used pharmaceutical agents for treatment of symptoms associated with recurrent abdominal pain are analgesics, proton-pump inhibitors, anticholinergics, antiemetics, antidepressants, antispasmodics, and simethicone.[32-34]

Table 4: Differentiating between clinically stable and critically ill patients

Clinical assessment	Clinically stable patients (non-urgent/nonsurgical diagnosis)	Critically ill patients (may require an urgent surgical intervention)
History	• Midline or generalized pain • Stable pain intensity • Vomiting absent or occurs before onset of pain • Pain of long duration	• Acute, severe, more localized pain • Pain increasing in intensity • Pain preceding vomiting • Bilious vomiting • Hematochezia • Previous abdominal surgery
Physical examination	• Nondistended abdomen with normal bowel sounds • Diffuse tenderness • Rigidity or rebound tenderness absent	• Lethargic and ill appearing • Abdominal distension • Absent or high-pitched bowel sounds • Localized tenderness • Peritoneal signs (rebound tenderness, rigidity, guarding)
Initial evaluation	• Depends on signs and symptoms	• Laboratory tests including complete blood count, electrolytes, liver function tests, amylase, lipase, and urinalysis; pregnancy test in females; Imaging and abdominal ultrasound

Adapted from: Hijaz NM, Friesen CA. Managing acute abdominal pain in pediatric patients: current perspectives. Pediatric Health, *Medicine and Therapeutics.* 2017:8;83-91.

Pharmacotherapy

Analgesics: Choice of analgesics in patients with acute abdominal pain is based on numerous factors, which include severity of the pain, need for diagnostic testing, consultants' availability, and the treating physician's comfort with diagnosis or analgesic use.[35] The conventional approach to treatment of abdominal pain has disapproved of the use of analgesics for the fear of interfering with accurate evaluation and diagnosis. However, it is now believed that analgesics when used judiciously may actually help in enhancing the diagnostic accuracy by permitting detailed examination of a more cooperative patient.[6] However, in pediatric cases, risk of suboptimal analgesia persists, as there is data that shows that analgesia is underutilized, its administration may get delayed, or may be dosed insufficiently in the emergency department.[36]

Antispasmodics: Smooth muscle relaxants, commonly referred to as antispasmodics, have been extensively used for more than two decades in the management of abdominal pain.[37] Antispasmodic medications, which exert anticholinergic effects on smooth muscle, are thought to be helpful for functional abdominal pain, as these reduce the smooth muscle spasms. However, use of anticholinergic drugs is occasional and for short period of time, as their long-term use has been associated with anticholinergic side effects such as dry mouth, urine retention, blurred vision, tachycardia, drowsiness and constipation.[38]

In this context, drotaverine, a tolerable oral spasmolytic agent, offers a great potential in management of abdominal pain.[39] Drotaverine is a synthetic isoquinoline derivative, which exerts a powerful spasmolytic action on smooth muscle cells. It selectively inhibits phosphodiesterase isoenzyme IV, which makes it a potential agent of choice in spastic and motility disorders of the smooth muscle.[40] In contrast to the conventional spasmolytics, which inhibit intestinal passage, preclinical studies have determined that the therapeutic concentrations of drotaverine do not have any inhibitory effect on gastrointestinal motility. It is a highly potent spasmolytic agent that is capable of relieving or preventing smooth muscle spasm of various organs. It offers a favorable tolerability profile and is suitable for oral administration. It does not interfere with the diagnosis of abdominal pain and is devoid of side effects; therefore, it can be used in children for the management of acute and recurrent abdominal pain, particularly in long-term. In practice, drotaverine holds a relevant application as it does not interfere with diagnosis formulation. This is essentially because its anti-spasmodic and pain-killing effect does not mask the symptoms of 'acute abdomen'. Moreover, it is well tolerated, does not exhibit any morphine or dextropropoxyphene like effect (thereby, no addiction), and is free from anticholinergic-associated adverse reactions. Advantages of drotaverine are listed in Box 1.[22,39]

Investigators evaluating its efficacy in different gastrointestinal indications have posited that 72-86% of patients report relief in pain. Drotaverine is even known for prolonged pain relief and maintenance of spasmolysis.[39] A double-blind, randomized placebo-controlled trial[41] evaluated the efficacy and safety of drotaverine hydrochloride in 132 children

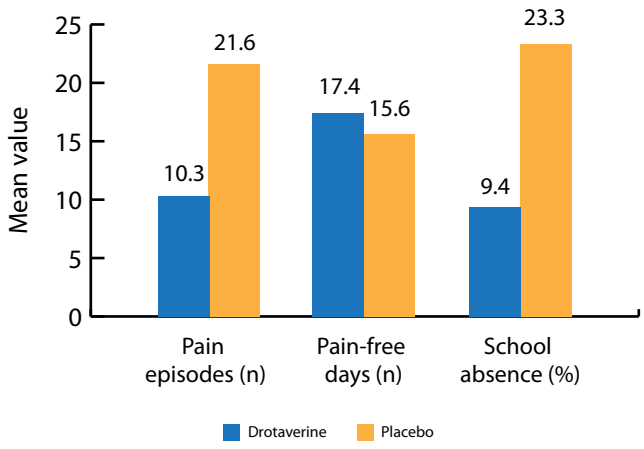
Box 1: Benefits of drotaverine in relieving abdominal pain

- Rapid acting anti-spasmodic agent; provides relief from pain within 5-12 minutes
- Does not mask the symptoms of acute abdomen; therefore, does not interfere with the diagnosis
- Does not interfere with the management of underlying organic disorder or further treatment modalities
- Wide therapeutic applications
- No anticholinergic side effects, unlike dicyclomine/ hyoscine
- Well-tolerated across all age groups
- Negligible drug-drug interactions

Adapted from: Blasko G. Pharmacology, mechanism of action and clinical significance of a convenient antispasmodic agent. *JAMA India.* 2001;4(12):59-66.

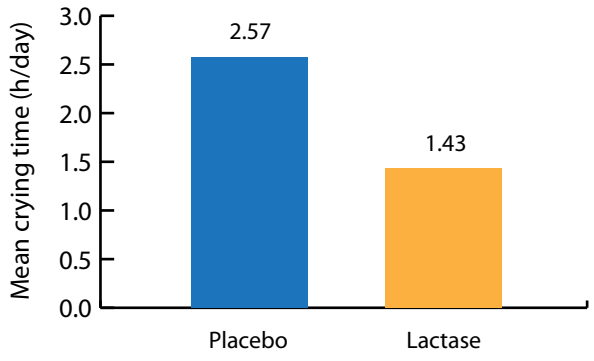
(age 4-12 years) presenting with recurrent abdominal pain. Children between 4-6 years of age received 10 mL syrup orally (20 mg drotaverine hydrochloride or placebo) thrice daily for 4 weeks while children >6 years of age received one tablet orally (40 mg drotaverine hydrochloride or placebo) thrice daily for 4 weeks. There was a considerable reduction in the number of episodes of abdominal pain in the drotaverine group versus placebo group [mean (SD) = 10.3 (14) versus 21.6 (32.4), respectively]. Also, frequency of children missing school days was markedly lesser in drotaverine group versus placebo group (9.4% versus 23.3%, respectively). The number of pain-free days were also slightly higher with drotaverine versus placebo [17.4 (8.2) versus 15.6 (8.7), respectively]; Figure 1. Furthermore, a significant improvement in parental satisfaction score was noticed with drotaverine therapy, with no additional adverse effects as compared to placebo administration. The European report on the survey of all medicinal products for pediatric use stated that drotaverine is used commonly in preschool and school children.[42]

Figure 1: Efficacy of drotaverine in providing symptomatic relief in children with recurrent abdominal pain



Adapted from: Narang M, Shah D, Akhtar H. Efficacy and Safety of Drotaverine Hydrochloride in Children with Recurrent Abdominal Pain: A Randomized Placebo Controlled Trial. *Indian Pediatrics.* 2015;52(10):847-51.

Figure 2: Effect of lactase supplementation on mean crying time of babies



Adapted from: Kearney PJ, Malone AJ, Hayes T, *et al.* A trial of lactase in the management of infant colic. *Journal of Human Nutrition and Dietetics.* 1998;11: 281–285.

Lactase supplementation for pediatric abdominal pain

Dietary interventions, including fiber supplements, lactose free diets or lactobacillus supplementation, have been found effective in the treatment of abdominal pain.[43] Commercially available lactase enzyme preparations are bacterial or yeast beta-galactosidases and are available as preparations that can be taken orally with lactose-containing food. Liquid lactase preparations can be added to milk, which is then refrigerated overnight before use.[24]

A number of studies have validated the efficiency of lactase enzyme supplementation for colicky infants. A randomized, double blind crossover trial[44] of lactase and placebo drops was done in 13 babies who were randomly allocated to add either lactase or placebo drops to their formula feeds for 1 week, followed by 2 days 'wash out'. In the second week, the addition was changed so that subjects served as their own control. The formulas were refrigerated for 24 hours prior to ingestion and the parents were asked to maintain a diary of their crying time. A significant reduction in crying time (1.14 h/day) was seen with lactase as compared to placebo (Figure 2). In another study,[45] a total of 53 infants with colic were either treated with placebo or pre-incubated lactase feed. Study results showed that the total crying time and breath hydrogen levels were at least 45% lower in the treatment group as compared to the placebo group for those babies in whom lactase was indicated, as lactose intolerance was a cause of their colic.

Conclusion

Acute abdominal pain is a very common complaint in the pediatric population and it often poses a diagnostic dilemma owing to the variety of underlying causes. Gastrointestinal sources are the most common etiology of abdominal pain in children, encompassing gastroenteritis, constipation, appendicitis, and intussusceptions. The clinical approach to a child with acute abdominal pain involves an overall assessment including location, onset, character, intensity, and pattern of pain, and associated symptoms, and examination. A quick work up helps in differentiating clinically stable and critically ill patients, who may require immediate surgical consultation. In infants and toddlers of up to 5 years of age, infantile colic is a frequent observation, which occurs due to lactase deficiency. Lactose intolerance secondary to lactase deficiency has been found to be an important cause in recurrent abdominal pain. In addition, for abdominal pain associated with spastic and motility disorders, antispasmodics form the mainstay in management of acute abdominal pain along with NSAIDs. Directly acting smooth muscle antispasmodic, like drotaverine may be a valuable option, both as initial drug used for pain-killing effect and for maintenance of spasmolysis. It does not interfere with the diagnosis of abdominal pain and is devoid of side effects; therefore, it can be used in children for the management of acute and recurrent abdominal pain, particularly in long-term.

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