Paediatric acute abdomen

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INTRODUCTION

A large proportion of children assessed in hospital with abdominal pain will leave with no definitive diagnosis. The challenge is to treat the majority of children with self-limiting but benign conditions and to swiftly identify and treat the child with an uncommon but potentially life-threatening cause of pain.

CLINICAL APPROACH

Managing acute abdominal pain in children can be a major cause of stress for the child, parent and clinician alike. A calm and child-friendly dedicated paediatric environment supported by specifically trained staff will enhance the clinician's ability to gain the confidence of the parents and child alike.

HISTORY

History taking should be thorough and include specific questions (*Table 1*).

TABLE 1.
The acute abdomen: taking a history

Question	Specific considerations
Characteristics of pain	Type, position, radiation, exacerbating, relieving factors
Gastrointestinal symptoms	Anorexia, nausea, vomiting* (bilious or not), diarrhoea or constipation
Other symptoms	Fever, headache, sore throat, cough, otalgia, dysuria
Other history	Recent food ingestion, foreign travel, history of illness in family members or class mates
Past history	Number of previous episodes and outcome, full medical history including antenatal scans/diagnosis, other conditions, vaccinations
Family	Known illnesses (e.g. sickle cell anaemia), dynamics (e.g. who else is at home, who has attended with child?)
Other	Menarche, dysmenorrhoea, history of unprotected sex
Social	Who is primary carer? (or who has legal guardianship – do not assume it is the parent), if multiple attendances or incompatible history then check if child has social worker or is on the at-risk register

*A history of bilious (green) vomiting in infancy and childhood should always be taken to indicate intestinal obstruction until proven otherwise.

EXAMINATION

General considerations

On entering the consultation room the child's disposition can be revealing. One should have a high index of suspicion for children who do not object to examination or procedures such as venesection. Younger children may feel more at ease if examined on the parent's lap. Gentle distraction and engaging the child in conversation while performing an abdominal examination can be useful in distinguishing a child who is contracting the abdominal muscles voluntarily.

The cardiovascular status of the child should be documented and resuscitation instituted as required (*Table 2*). Pyrexia should be documented as the pattern can have diagnostic significance (see later).

The style and format of an examination will need to vary depending on the age of the child and the prevailing circumstances. Analgesia should be given where appropriate to allow a thorough and proper examination – it will not mask the true signs of peritonitis.

The assessment of deep rebound tenderness is probably an unfair examination for a child and is virtually unnecessary. Rectal examination also has little to offer over a thorough pelvic ultrasound and it is a rare procedure in an awake child over toddler age in the authors' practice. Vaginal examination in the awake, premenarchal girl is never indicated.

Specific areas need always to be examined in the assessment of the acute abdomen (*Table 3*).

INVESTIGATIONS

Few investigations are needed or helpful in the initial assessment. Inflammatory markers are non-specific and equally likely to be raised in an infective but non-surgical cause of abdominal pain. Urea and electrolyte levels should be measured in cases of severe dehydration or prolonged losses from the gastrointestinal tract, e.g. vomiting and diarrhoea. Liver function tests are required in the presence of jaundice and other tests may be required based on the history, e.g. amylase or lipase, in the presence of severe epigastric pain. Urinalysis is mandatory in the initial assessment to rule out urinary tract infection (UTI).

TABLE 2.
The acute abdomen: assessment of level of hydration

Tachycardia
Tone of fontanelle (before 12 months)
Skin turgor
Mucous membranes
Peripheral perfusion
Frequency of micturition (last wet nappy)
Fall in blood pressure is a late sign of shock in children and must be considered as a potential life-threatening emergency

TABLE 3.
Examination of the paediatric acute abdomen

Never forget to examine:
Hernial orifices
Testes (20% of children with testicular torsion will only have abdominal pain)
Hip joints (pathology in the hip joint can present with abdominal pain)
The lung bases thoroughly (Ravichandran and Burge, 1996) (pain is referred to the abdomen)
The back of the patient for bruising or contusions (trauma, non-accidental injury)

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Plain radiology is often unhelpful but should be considered in the presence of vomiting (especially bilious), abdominal distension or previous abdominal surgery. Contrast radiology should be requested after discussion with an appropriate specialist. Ultrasound is of most use in intussusception but is also useful in distinguishing the cause of an abdominal mass and to assess the pelvis in children (Carty, 2002).

DIAGNOSES TO CONSIDER

General considerations

Trauma is a major cause of morbidity and mortality in childhood. Immediate and early mortality usually relates to injury sustained above the neck but poly-trauma should always be suspected. The most common mode is direct blunt injury to the abdomen leading to rupture or contusion of the solid organs, e.g. liver, spleen or pancreas. The gut can be injured at points of peritoneal fixation, e.g. duodenojejunal flexure. Computed tomography scanning with intravenous and if possible enteral contrast leads to the highest diagnostic yield.

Indications for surgery are evidence of hollow visceral perforation or sustained haemodynamic instability (Mackway-Jones et al, 2001).

INFANTS (<2 YEARS)

It is outside the scope of this review to discuss necrotizing enterocolitis (NEC) and congenital causes of gastrointestinal obstruction (mostly encountered on the neonatal intensive care unit). However, a history of prematurity or previous intestinal surgery may indicate a specific diagnosis, e.g. colonic stricture secondary to NEC or Hirschsprung's enterocolitis (fever, abdominal pain, distension, constipation), or raise the possibility of adhesive intestinal obstruction. Previous hepatobiliary disease (biliary atresia or choledochal cyst) may make the child susceptible to ascending cholangitis or pancreatitis (Samuel and Spitz, 1996) (*Table 4*).

Malrotation and midgut volvulus

Abnormal peritoneal fixation leaves the midgut prone to twisting around the axis of the superior mesenteric vessels, resulting in volvulus of the midgut.

Diagnosis is confirmed with an upper gastrointestinal contrast study showing the duodenojejunal junction to the right of the midline. Surgery to correct malrotation should be undertaken as an emergency before the complication of volvulus occurs. Midgut volvulus is a dire emergency and surgery should be undertaken as early as safely possible, often in the absence of any diagnostic radiology. The significance of bilious vomiting in this condition cannot be over-emphasized.

Intussusception

This invagination of one segment of bowel (intussusceptum) into the distal bowel (intussuscipiens) is the most common cause of intestinal obstruction in infants after the neonatal period, usually occurring between 4 and 10 months of age.

Most cases (90%) are idiopathic with the commonest site (>90%) of involvement being the ileocaecal region when the intussusceptum advances into varying lengths of the colon. Lymphoid hyperplasia in the terminal ileum is thought to provide a lead point of the intussusception. A preceding viral illness is implicated in 30–50% of cases.

A pathological lead point occurs with an incidence of between 2 and 12% and should be suspected in older children, and cases of recurrent or ileoileal intussusception. Causes include Meckel's diverticulum, polyp, lymphoma, duplication, appendiceal stump, and intramucosal haematoma, e.g. Henoch–Schönlein purpura.

In the early stages a high index of suspicion is necessary and ultrasound has high sensitivity and specificity, with a 'target sign' evident on transverse section of the intussusception (Macdonald and Beattie, 1995; Carty, 2002).

Early diagnosis, adequate resuscitation and effective reduction of the intussusception are key to prevent mortality. Intravenous fluid therapy is guided by clinical response. Antibiotics are required by all until reduction is complete. Reduction is most commonly effected by pressurized air enema, with laparotomy reserved for failure or pre-existing peritonitis or perforation. Third time recurrences as well as those outside the typical age range should be managed operatively as this implies a pathological lead point.

Inguinal hernia

Inguinal hernias have a high risk of incarceration in infants (10–30%), with the attendant risk of strangulation of the gut and testicular atrophy from pressure on the testicular vessels. The importance of examining the groin in infants is again emphasized. Treatment involves analgesia and attempted reduction by a doctor experienced in the technique. Urgent referral to a paediatric surgery centre is required. Traction, elevation and the application of cold compresses have no place in the management of the incarcerated inguinal hernia.

TABLE 4.
Surgical causes of acute abdomen in children under 2 years of age

Condition	History	Examination
Malrotation: predisposing to volvulus	Intermittent bile vomits (can be single only presenting symptom)	Without volvulus no specific findings
Supervening midgut volvulus: most commonly in first 6 weeks	Acute abdominal pain, persistent bile vomits	Abdominal distension, peritonitis, blood per rectum, shock
Intussusception: usually 4–10 months of age	Intermittent paroxysms of abdominal colic, drawing up knees, vomits (may be bilious), blood per rectum, initially well between episodes	Right upper quadrant mass, empty right iliac fossa, 'redcurrant jelly' stool on per rectum examination, shock in later stages
Incarcerated inguinal hernia	Pain, bilious vomits, majority boys	Distressed, abdominal distension, mass in inguinoscrotal region
Hirschsprung's disease: usually in first few weeks of life	Failure to pass meconium in the first 24–48 hours of life, constipation, abdominal distension (enterocolitis may supervene at any stage)	Abdominal distension, rectal examination may reveal a gush of meconium

Hirschsprung's disease

This disease can rarely be diagnosed beyond the typical neonatal period. A history of delayed passage of meconium (beyond 24 hours) with continuing constipation should be sought. Examination usually reveals a healthy child with abdominal distension. Rectal examination produces an explosive decompression. Clinical suspicion should prompt referral to a paediatric surgeon.

PRE-SCHOOL CHILDREN (2–5 YEARS)

Appendicitis

Acute appendicitis occurs in all ages but pre-schoolers account for just 5% of children with appendicitis. The low incidence in this group means that it is often overlooked (*Table 5*); the lack of an adequate omental barrier can lead to a perforation rate as high as 50%, inversely proportional to the child's age. Atypical presentation with vomiting, diarrhoea and pyrexia is not uncommon. Abdominal pain can be insignificant. A high index of suspicion is vital with a low threshold for ultrasound examination and/or laparoscopy (Williams and Kapila, 1994; Moir, 1996).

SCHOOL-AGE CHILDREN (>5 YEARS)

Appendicitis

Acute appendicitis (*Table 6*) is the single commonest surgically amenable cause of abdominal pain in children, although the cause is still unclear. It is usually a disease of older children and adolescents, with a slightly higher prevalence in boys. Symptoms typically begin with vague central abdominal pain associated with anorexia and a single vomit. Pain shifts to the right iliac fossa and, as the overlying peritoneum becomes inflamed, becomes more acute and localized. The child is reluctant to move, cough, or in any way aggravate the pain. Localized tenderness and involuntary guarding in an ill child, usually with mild pyrexia and tachycardia, are the commonest signs although only a third of children have such a classic presentation.

TABLE 5.
Surgical causes of acute abdomen in the pre-school age

Condition	History	Examination
Incarcerated inguinal hernia	As in *Table 4*	
Acute appendicitis	Symptoms may be vague including lethargy or poor feeding, nausea/vomiting, anorexia, diarrhoea or constipation may occur. Central abdominal pain, localizing to right iliac fossa is uncommon in this age group	Often systemically unwell, flushed, pyrexia (38–38.5°C) not invariable, dehydrated, tender in right iliac fossa, may progress to peritonitis quickly

TABLE 6.
Surgical causes of acute abdomen in school-age children (>5 years)

Condition	History	Examination
Acute appendicitis	Symptoms may be vague including lethargy or poor feeding, central abdominal pain, localizing to RIF, nausea/vomiting, anorexia, diarrhoea or constipation may occur	Often systemically unwell, flushed, pyrexia not invariable, dehydrated, tender in RIF, may progress to peritonitis quickly
Meckel's diverticulum	Varies according to mode of pathology: rectal bleeding with peptic ulceration, intussusception in older children, and mimics appendicitis, and volvulus	
Pancreatitis	Epigastric pain often following trauma or viral illness	Shock in severe cases, tachypnoea, epigastric tenderness
Inflammatory bowel disease	Chronic abdominal pain, diarrhoea (mucous and blood), weight loss, lethargy	Cachectic, abdominal mass especially in RIF, perianal disease, extraintestinal manifestations (joints, eyes, skin)
Testicular pathology	History of trauma	Pyrexia, unilaterally tender scrotum
Tubo-ovarian pathology	Peri/post-menarchal, cyclical, history of unprotected sex	Suprapubic tenderness

RIF = right iliac fossa

Untreated appendicitis may progress to perforation and peritonitis within 24 hours (less in young children). A retrocaecal appendix may have a longer history with no localized rigidity or rebound tenderness and with pelvic appendicitis the signs are often misdiagnosed as UTI, gynaecological problems or gastroenteritis (Davenport, 1996; D'Agostino, 2002).

Meckel's diverticulum

This ileal remnant of the vitellointestinal duct, present in 2% of the population, may contain ectopic gastric mucosa. Presentation is usually with painless rectal bleeding that leads to a significant drop in the haemoglobin. It cause an acute abdomen as intussusception, volvulus or diverticulitis that mimics appendicitis can occur (D'Agostino, 2002). A technetium scan shows increased uptake by ectopic gastric mucosa in up to 70% of cases but diagnostic laparoscopy is increasingly used.

Pancreatitis

Upper abdominal pain is much less common in children than in adults. If it recurs, particularly in older children, the cause may relate to gall stones (especially in children with chronic haemolysis, e.g. sickle cell anaemia), peptic ulcers or pancreatitis. In childhood, pancreatitis is often associated with a choledochal cyst or may be caused by mumps or trauma. The Imrie prognostic and Ranson severity scores are of doubtful significance in children (Haddock et al, 1994; Samuel and Spitz, 1996).

Primary acute peritonitis

This used to be common in young girls following ascent of pneumococcal or streptococcal infection from the genital tract. Examination of a peritoneal fluid sample and antibiotic therapy are the main treatments but laparoscopy may be required to exclude a surgical cause.

Inflammatory bowel disease

Initial presentation of inflammatory bowel disease (IBD) may be with an exacerbation of diarrhoea, abdominal pain and fever, or may be with a complication such as toxic dilatation. Consideration of IBD in the differen-

tial diagnosis of acute abdomen may influence the threshold and procedure of any surgical intervention.

Testicular pathology

Testicular torsion causes acute scrotal pain, usually in adolescence, which may be associated with lower abdominal pain, nausea and vomiting. The main differential diagnoses are infection (epididymo-orchitis) or torsion of one of the vestigial testicular appendages.

Ovarian pathology

In teenage girls various specific conditions can mimic appendicitis: ovarian cysts, corpus luteal cysts, mittelschmerz, tubal pregnancy and salpingitis. These children have traditionally had the highest incidence of unnecessary appendicectomies. Pelvic ultrasound and, in selected cases, diagnostic laparoscopy will improve accuracy in diagnosis.

COMMON NON-SURGICAL CAUSES OF ABDOMINAL PAIN

Constipation

Children with acute or chronic constipation can undoubtedly experience abdominal pain. The physician should be wary of returning a child home with this diagnosis as the parents may tolerate a worsening of the symptoms based on the supposition of benign cause. It is sensible to treat with mild laxatives but keep an open mind for the possibility of another developing condition.

Urinary tract

UTIs occur mostly in pre-school children although they may present at any age. The classical symptoms of dysuria, frequency and loin pain are rarely seen in young children but microscopy and culture of an uncontaminated urine sample, obtained by 'clean catch' or suprapubic aspirate, will help clarify the diagnosis. Antibiotics should be followed by an investigation of the urogenital tract, perhaps with a renal ultrasound and radioisotope scan. The commonest anomalies identified are vesicoureteric reflux, duplex collecting systems, hydronephrosis and ureterocoeles. Only about 8% of children with a UTI have a surgically correctable condition, but these are important diagnoses to reach.

Obstruction at the level of the pelviureteric junction can produce acute pain. Suspicion should prompt an ultrasound scan.

Viral-associated abdominal pain

Other causes of acute abdominal pain are best differentiated from appendicitis by active observation with repeat abdominal examination after a few hours. Viral-associated abdominal pain (VAAP) is a poorly defined label for a symptom complex of abdominal pain, pronounced fever (39–40°C), and often a prodromal upper respiratory tract infection. Abdominal examination shows tenderness, often moving in location, usually without signs of peritonism. It is thought that inflammation of mesenteric lymph nodes leads to a peritoneal reaction; although the condition is self-limiting differentiation from acute appendicitis requires active observation over several hours. VAAP can only be diagnosed after active observation with repeated reassessments, preferably by the same surgeon, to exclude a known surgical cause of abdominal pain (Davenport, 1996; Simpson and Smith, 1996; Barker et al, 2002).

Infective gastroenteritis can cause significant abdominal pain, usually without signs on abdominal examination.

Rarer causes

Other causes of abdominal pain may need to be considered. These include pneumonia, sickle cell disease, ketoacidosis, hepatitis, poisoning (e.g. lead), Henoch–Schönlein purpura, acute porphyria, migraine or psychological causes. The history often gives significant clues when considering these diagnoses.

CONCLUSIONS

Despite the myriad potential causes of acute abdomen in childhood a systematic approach will help to minimize missed diagnoses and resultant complications. Children often have atypical presentations of common entities. Even when a firm diagnosis cannot be made early in its course certain symptoms and signs are associated with surgically correctable causes of acute abdominal pain: vomiting of bile, asymmetric pain, localized tenderness and peritonism. Muscle guarding and rigidity as signs of peritoneal inflammation cannot be ignored, but they can easily be mimicked by a quick, clumsy palpation by an inexperienced clinician. The early involvement of a paediatrician or paediatric surgeon in the care of children with significant abdominal symptoms or findings is always appropriate. HM

KEY POINTS

- No specific diagnosis will be found in up to half of children who attend hospital with abdominal pain.
- Specific history and clinical examination by an experienced paediatrician or paediatric surgeon can help to distinguish those with a surgical diagnosis
- Always beware of the infant or toddler with bilious vomiting. Discussion of the child with a paediatric surgeon is mandatory.
- Never forget to examin the hernial orifices, testes, hips and lung bases of a child who presents with abdominal pain.

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