

Referred Abdominal Pain

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Abdominal pain is one of the most common and distressing presentations that pediatricians encounter. Up to 25% of school-age children report pain severe enough to interfere with their daily activity, requiring many to seek the assistance of their pediatrician. In approaching pain, the location, duration, onset, radiation, alleviating/exacerbating factors, and associated symptoms should all be considered. Abdominal pain is generally classified as visceral, somatoparietal, or referred. Pain may originate from intra-abdominal organs, surrounding structures, or areas outside the abdomen. Visceral pain receptors are located in the muscles and mucosa of organs and, therefore, sense an acute stretching of the structure's wall experienced as a diffuse aching or cramping. Somatoparietal pain receptors are located in the peritoneum, muscle, and skin of the parietal region and are experienced as a sharp well-localized pain that may be alleviated in a position that relaxes the peritoneum or muscle. Referred abdominal pain occurs when the brain is unable to localize the source of discomfort due to nociceptive dorsal horn neurons receiving convergent inputs from different tissues. It is usually located in the cutaneous dermatome, sharing the same spinal cord level as the visceral inputs. This poses a diagnostic challenge because pain due to a gastrointestinal etiology may be experienced at a distant location; conversely, pain originating from a location outside the abdominal viscera may be experienced as abdominal pain. This *In Brief* reviews important concepts and etiologies of referred abdominal pain.

Four common diagnoses that each highlight a type of referred abdominal pain are explored further: abdominal migraine, pelvic inflammatory disease (PID), peptic ulcer disease (PUD), and diabetic ketoacidosis (DKA). The Table provides a summary of other diagnoses that are relevant to referred abdominal pain.

ABDOMINAL MIGRAINE

Abdominal migraine demonstrates referred pain to the abdomen from a distal site due to convergent inputs from the nervous system. Affecting 2% to 4% of children, abdominal migraine is defined as paroxysmal episodes of intense acute abdominal pain lasting at least 1 hour. Pain may be diffuse or localized to the periumbilical or midline abdomen. Each episode is separated by weeks to months and can be debilitating. At least 2 episodes over a 6-month period and 2 or more of the following must be present to meet the diagnostic criteria: anorexia, nausea, vomiting, headache, photophobia, or pallor. Children often report the same triggers, associated symptoms, and relieving factors as those who have classic migraines. Abdominal migraine is a diagnosis of

exclusion; however, a cyclic pattern of symptoms, age at onset (3–10 years of age), a family history of migraines, and symptom relief with antimigraine therapy support the diagnosis.

The pathophysiology of abdominal migraines remains unclear, although there is evidence that the abdominal pain is related to visceral hypersensitivity of the digestive tract, referred from the central nervous system. Treatment relies on good sleep hygiene, hydration, and stress reduction, along with avoiding dietary triggers. Analgesics (ibuprofen, acetaminophen) can be effective as abortive therapy and should be taken early with the onset of symptoms. Options for prophylaxis for severe cases include cyproheptadine, amitriptyline, topiramate, or propranolol.

PELVIC INFLAMMATORY DISEASE

PID is an example of referred abdominal pain from a structure adjacent to the abdomen. PID comprises a range of female upper genital tract inflammatory disorders, including endometritis, salpingitis, tubo-ovarian abscess, and pelvic peritonitis. According to the Centers for Disease Control and Prevention (CDC) diagnostic criteria, lower abdominal or pelvic pain must be present along with at least 1 of the following: adnexal tenderness, cervical motion tenderness, or uterine tenderness. The pain is generally insidious, bilateral, and dull. Within 3 days of initiation of antibiotic drug therapy, patients should have a marked decrease in pain. If not, the clinician must consider poor adherence to the antibiotic drug regimen, presence of a tubo-ovarian abscess with the need to broaden antibiotic drug coverage, or an incorrect diagnosis. Pelvic ultrasonography and hospital admission are recommended for teenagers with PID who fail outpatient therapy. PID is a clinical diagnosis and is not based on microbial testing. The most common sexually transmitted organisms associated are *Chlamydia trachomatis* and *Neisseria gonorrhoeae*. However, PID is often polymicrobial and can be caused by other organisms, particularly anaerobes, gram-negative rods, *Mycoplasma genitalis*, and *Haemophilus influenzae*. Thus, treatment with broad spectrum antibiotic agents effective against anaerobes and gram-negative bacteria is recommended. Due to the challenges of diagnosing PID and the potential risk of infertility, maintaining a low threshold for diagnosis is advised. Presumptive treatment would not impair the clinical course of other common causes of lower

abdominal pain, such as appendicitis, ovarian cyst, or ectopic pregnancy, and it would help confirm the diagnosis if symptoms improve within 72 hours of antibiotic drug treatment.

PEPTIC ULCER DISEASE

PUD illustrates a cause of referred pain from the abdomen to a distal site. The most common symptoms of PUD are epigastric pain and dyspepsia; however, back pain may be a referred presentation via visceral afferent pathways. Nociceptive impulses from the duodenum are transmitted to the spinal cord through thoracic segments, leading to localized pain in the dermatome superficial to the site of the painful stimulus. Albeit rare in pediatrics, gastric and duodenal ulcers can also be complicated by perforation and bleeding, irritating the peritoneal cavity and causing acute shoulder pain from irritation of the phrenic nerve.

The most common causes of PUD are *Helicobacter pylori* infection and medications (eg, nonsteroidal anti-inflammatory drugs). If suspected, a trial of acid suppression by an H₂ receptor antagonist or proton pump inhibitor (PPI) may be offered. The North American Society of Pediatric Gastroenterology, Hepatology, and Nutrition guidelines recommend testing for *H pylori* in children with suspected gastric or duodenal ulcers. Biopsy remains the gold standard in diagnostic evaluation, although noninvasive testing (stool antigen or urea breath test) may still be used to confirm for test of cure. If detected, *H pylori* treatment regimens must consider clarithromycin resistance. Therefore, 4 to 6 weeks after stopping antibiotic drug therapy and at least 2 weeks after stopping PPIs (because these medications may yield false-negative test results), repeated testing should be considered. However, treatment to eradicate *H pylori* infection is not expected to improve symptoms in children who do not have PUD. Therefore, children with functional abdominal pain should not be tested for *H pylori*.

DIABETIC KETOACIDOSIS

DKA exemplifies a metabolic cause of referred abdominal pain. DKA commonly develops acutely over a 24-hour period. Symptoms of weight loss, polydipsia, and polyuria may exist several days before DKA, but the presenting symptoms are frequently abdominal pain, nausea, and vomiting. Abdominal pain, found in 40% to 75% of patients with DKA, may

TABLE. Etiologies of Referred Pain from the Abdomen versus Referred Pain to the Abdomen

REFERRED PAIN FROM THE ABDOMEN	
Location of Pain	Site of Origin
Right shoulder	Perforated duodenal ulcer
Midback	Biliary colic
Lower back	Pancreatitis
Costovertebral angle	Renal or urethral stones
Sacrum	Uterine or rectal pain
Superficial pain	Gastric ulcers
REFERRED PAIN TO THE ABDOMEN	
Origin of Pain	Etiology
Cardiac	Myocardial infarction, myocarditis pericarditis
Pulmonary	Pleural effusion, pneumonia, pulmonary embolism
Musculoskeletal	Costochondritis, rib fracture, herniated thoracic disk, muscle spasm
Genitourinary	Testicular torsion, ovarian torsion, pelvic inflammatory disease, UTI, ectopic pregnancy, ovarian cyst, hematocolpus
Systemic	Diabetic ketoacidosis, hyperthyroidism, systemic lupus erythematosus, uremia, vasculitis, sickle cell disease, porphyria
Central nervous system	Abdominal migraine, depression, functional abdominal pain
Infectious	Streptococcal pharyngitis, EBV mononucleosis, Rocky Mountain spotted fever, herpes zoster, Lyme disease

mimic an acute abdomen. This presentation creates a challenge for physicians to decipher whether an underlying intra-abdominal process coexists based on clinical symptoms alone. For one-third of patients, the etiology of abdominal pain is what precipitated DKA (ie, pyelonephritis, pancreatitis, hepatitis, gastritis). For most patients, where abdominal pain is due to DKA alone, there are several mechanisms postulated, including hyperglycemia-mediated impaired gastrointestinal motility, rapid expansion of the hepatic capsule, and volume depletion causing mesenteric ischemia. However, the strongest correlation has been found between the severity of metabolic acidosis and the presence of abdominal pain. Correction of hyperglycemia, metabolic acidosis, and electrolyte abnormalities often leads to resolution of the patient's abdominal pain. Therefore, we suggest that in the absence of a clear cause for abdominal pain, one should treat the underlying metabolic acidosis while considering other possible causes of the abdominal pain.

These cases illustrate how referred abdominal pain requires pediatricians to think outside the box and outside the abdomen. Broadening the differential diagnosis to include sources of referred abdominal pain is vital to a proper diagnosis; however, we lay caution to unnecessary extensive evaluations that may be costly both economically and psychologically. Using an integrative approach to consider psychosocial aspects of care is essential and will often assist regardless of the underlying diagnosis.

COMMENTS: How many times have we encountered a pediatric patient and needed to review the differential diagnosis for abdominal pain? Many, many times if your experience has been similar to mine. Although I strove to be empathetic that the patient was suffering, reviewing the differential diagnosis of abdominal pain and considering referred abdominal pain was one of my more favorite cognitive exercises. It required knowledge of

anatomy but also thinking outside the box, as these authors mentioned, and sharpening one's clinical reasoning skills. I find it fascinating that not only the abdominal anatomical structures must be considered, but considering outside the abdomen to the thorax, chest, pelvis, musculoskeletal, cardiac, and genitourinary regions and beyond for possible etiologies. Yet, the challenge to the pediatric diagnostician is to think carefully, rely on the history and repeated examination of the

patient, and target evaluation to make sure it is cost-effective.

– Janet R. Serwint, MD
Associate Editor, *In Brief*

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