

# The Practice of Emergency Physicians Emergency Medicine Reports

Log on to  
[www.EMRONline.com](http://www.EMRONline.com)

Volume 25, Number 22

October 18, 2004

*Acute abdominal pain, defined in this article as any non-traumatic cause of abdominal pain of less than one week duration, can be one of the most challenging complaints in the emergency department (ED).<sup>1</sup> It is estimated that 5-10% of ED visits are due to abdominal pain.<sup>2,3</sup> The final etiologic diagnoses range from a simple problem to a complicated, life-threatening disease. Even with our current diagnostic abilities, up to 40% of the patients are discharged from the EDs with a diagnosis of "undifferentiated abdominal pain."<sup>4</sup>*

*When evaluating a patient with acute abdominal pain, obtain a pertinent history (duration, character, severity, and radiation of the pain, associated symptoms) and perform a thorough, yet focused, physical examination. Keep in mind the common diagnoses for each patient population and patterns of pain that are typical for some diagnoses. Finally, judiciously use laboratory and radiologic studies to exclude or confirm the presence of life-threatening conditions.*

*While the diagnosis of abdominal pain of uncertain etiology is an acceptable discharge diagnosis, care must be taken to ensure adequate follow up of these patients. Appropriate discharge instructions always must be provided, and follow up should be arranged.<sup>3</sup> All of these precautions will ensure that the patient understands and is satisfied with ED care.*

*A comprehensive review of abdominal pain is beyond the scope of this discussion. Table 1 lists some of the most common causes of acute abdominal pain. This article instead will focus on specific populations presenting with abdominal pain to the ED and their specific or unique diagnoses. The pediatric, elderly, pregnant, and immunocompromised patients are special populations that pose a particular challenge to clinicians. These high-risk groups often present atypically, and serious conditions can be missed or misdiagnosed. Finally, this article will discuss unusual diagnoses that often present with abdominal pain as one of the main symptoms.*

## Acute Abdominal Pain in Special Populations

### Part I: Pediatric Patients

**Authors:** **Larissa I. Velez, MD**, Assistant Professor, Assistant Director of Emergency Medicine Residency Program, University of Texas Southwestern Medical Center, Dallas; **Fernando L. Benitez, MD**, Assistant Professor, Emergency Medicine, University of Texas Southwestern Medical Center, Dallas; and **Salvador E. Villanueva, MD**, Assistant Professor, Emergency Medicine, University of Puerto Rico.

**Peer Reviewers:** **J. Stephan Stapczynski, MD**, Chair, Emergency Medicine Department, Maricopa Medical Center, Phoenix, AZ; and **O. John Ma, MD**, Professor and Vice Chair of Emergency Medicine, Truman Medical Center, University of Missouri—Kansas City School of Medicine.

**EDITOR IN CHIEF**

**Gideon Bosker, MD**  
Special Clinical Projects and Medical Education Resources  
Assistant Clinical Professor  
Section of Emergency Services  
Yale University School of Medicine  
Associate Clinical Professor  
Oregon Health Sciences University

**EDITORIAL BOARD**

**Paul S. Auerbach, MD, MS, FACEP**  
Clinical Professor of Surgery  
Division of Emergency Medicine  
Department of Surgery  
Stanford University School of Medicine  
Stanford, California

**Brooks F. Bock, MD, FACEP**  
Dayanandan Professor and Chairman  
Department of Emergency Medicine  
Detroit Receiving Hospital  
Wayne State University  
Detroit, Michigan

**William J. Brady, MD, FACEP, FAAEM**  
Vice Chairman of Emergency Medicine and Associate Professor,  
Department of Emergency Medicine,  
Associate Professor of Internal Medicine and Program Director of Emergency Medicine Residency,  
Department of Internal Medicine  
University of Virginia School of Medicine  
Charlottesville, Virginia

**Kenneth H. Butler, DO**  
Associate Residency Director  
University of Maryland Emergency Medicine Residency Program  
University of Maryland School of Medicine  
Baltimore, Maryland

**Michael L. Coates, MD, MS**  
Professor and Chair  
Department of Family and Community Medicine  
Wake Forest University School of Medicine  
Winston-Salem, North Carolina

**Alasdair K.T. Conn, MD**  
Chief of Emergency Services  
Massachusetts General Hospital  
Boston, Massachusetts

**Charles L. Emerman, MD, FACEP**  
Chairman  
Department of Emergency Medicine  
MetroHealth Medical Center  
Cleveland Clinic Foundation  
Cleveland, Ohio

**James Hubler, MD, JD, FCLM, FAAEM, FACEP**  
Clinical Assistant Professor of Surgery  
Department of Emergency Medicine  
University of Illinois College of Medicine  
at Peoria;  
OSF Saint Francis Hospital  
Peoria, Illinois

**Kurt Kleinschmidt, MD, FACEP**  
Assistant Professor  
University of Texas Southwestern Medical Center, Dallas  
Associate Director  
Department of Emergency Medicine  
Parkland Memorial Hospital  
Dallas, Texas

**David A. Kramer, MD, FACEP, FAAEM**  
Program Director,  
York Hospital Emergency Medicine Residency  
Clinical Associate Professor  
Department of Emergency Medicine  
Penn State University  
York, Pennsylvania

**Larry B. Mellick, MD, MS, FAAP, FACEP**  
Vice Chairman for Academic Development and Research  
Department of Emergency Medicine  
Medical College of Georgia  
Augusta, Georgia

**Paul E. Pepe, MD, MPH, FACEP, FCCM**  
Professor and Chairman  
Division of Emergency Medicine  
University of Texas Southwestern Medical Center  
Dallas, Texas

**Charles V. Pollack, MA, MD, FACEP**  
Chairman, Department of Emergency Medicine, Pennsylvania Hospital  
Associate Professor of Emergency Medicine  
University of Pennsylvania School of Medicine  
Philadelphia, Pennsylvania

**Robert Powers, MD, MPH, FACP**  
Chief and Professor, Emergency Medicine  
University of Connecticut  
School of Medicine  
Farmington, Connecticut

**David J. Robinson, MD, MS, FACEP**  
Assistant Professor, Vice-Chairman, Research Director  
Department of Emergency Medicine  
The University of Texas – Health Science Center at Houston  
Director, Diagnostic Observation Center  
Memorial Hermann Hospital  
Houston, Texas

**Steven G. Rothrock, MD, FACEP, FAAP**  
Associate Professor of Emergency Medicine  
University of Florida College of Medicine,  
Department of Emergency Medicine  
Orlando Regional Medical Center  
Orlando, Florida

**Barry H. Rumack, MD**  
Director, Emeritus  
Rocky Mountain Poison and Drug Center  
Clinical Professor of Pediatrics  
University of Colorado Health Sciences Center  
Denver, Colorado

**Richard Salluzzo, MD, FACEP**  
Chief Executive Officer and Chief Medical Officer  
Conemaugh Health System  
Johnstown, Pennsylvania

**Sandra M. Schneider, MD**  
Professor and Chair  
Department of Emergency Medicine  
University of Rochester School of Medicine  
Rochester, New York

**John A. Schriver, MD**  
Chief, Section of Emergency Medicine  
Yale University School of Medicine  
New Haven, Connecticut

**David Sklar, MD, FACEP**  
Professor and Chair  
Department of Emergency Medicine  
University of New Mexico School of Medicine  
Albuquerque, New Mexico

**Corey M. Slovis, MD, FACP, FACEP**  
Professor and Chairman  
Department of Emergency Medicine  
Vanderbilt University School of Medicine,  
Medical Director  
Metro Nashville EMS  
Nashville, Tennessee

**J. Stephan Stapczynski, MD**  
Chair  
Emergency Medicine Department  
Maricopa Medical Center  
Phoenix, Arizona

**Charles E. Stewart, MD, FACEP**  
Emergency Physician  
Colorado Springs, Colorado

**Gregory A. Volturo, MD, FACEP**  
Vice Chairman and Associate Professor  
Department of Emergency Medicine  
University of Massachusetts Medical School  
Worcester, Massachusetts

**Albert C. Wehl, MD**  
Assistant Professor of Medicine and Surgery  
Department of Surgery  
Section of Emergency Medicine  
Yale University School of Medicine  
New Haven, Connecticut

**Steven M. Winograd, MD, FACEP**  
Professor and Chair  
Department of Emergency Medicine  
St. Joseph Hospital  
Reading, Pennsylvania

**Allan B. Wolfson, MD, FACEP, FACP**  
Program Director,  
Affiliated Residency in Emergency Medicine  
Professor of Emergency Medicine  
University of Pittsburgh  
Pittsburgh, Pennsylvania

© 2004 Thomson American Health Consultants. All rights reserved.

Part I of this article will discuss pediatric patients, and part II will cover elderly, pregnant and immunocompromised patients.

—The Editor

## Special Populations

This article will discuss abdominal pain in four special populations: pediatric patients, the elderly, the pregnant, and the immunocompromised. Each of these segments of the population has unique problems and very often has atypical and/or delayed presentations. Knowing the particularities helps focus the diagnostic workup and helps establish an accurate diagnosis. This segment will focus on pediatric patients.

**Emergency Medicine Reports™** (ISSN 0746-2506) is published biweekly by Thomson American Health Consultants, 3525 Piedmont Road, N.E., Six Piedmont Center, Suite 400, Atlanta, GA 30305. Telephone: (800) 688-2421 or (404) 262-7436.

**Vice President/Group Publisher:** Brenda Mooney

**Editorial Group Head:** Valerie Loner

**Specialty Editor:** Shelly Morrow Mark

**Marketing Manager:** Schandale Kornegay

**GST Registration No.:** R128870672

Periodicals postage paid at Atlanta, GA. **POSTMASTER:** Send address changes to **Emergency Medicine Reports**, P.O. Box 740059, Atlanta, GA 30374.

Copyright © 2004 by Thomson American Health Consultants, Atlanta, GA. All rights reserved. Reproduction, distribution, or translation without express written permission is strictly prohibited.

**Back issues:** \$31. Missing issues will be fulfilled by customer service free of charge when contacted within one month of the missing issue's date.

**Multiple copy prices:** One to nine additional copies, \$359 each; 10 to 20 additional copies, \$319 each.

## Accreditation

**Emergency Medicine Reports™** continuing education materials are sponsored and supervised by Thomson American Health Consultants. Thomson American Health Consultants designates this continuing education activity for up to 60 hours in Category 1 credit toward the AMA Physician's Recognition Award. Each physician should claim only those hours of credit that he/she actually spent in the educational activity.

This CME activity was planned and produced in accordance with the ACCME Essentials.

**Emergency Medicine Reports™** also is approved by the American College of Emergency Physicians for 60 hours of ACEP Category 1 credit and has been approved for 52 Category 2B credit hours by the American Osteopathic Association. **Emergency Medicine Reports** has been reviewed by the American Academy of Family Physicians as having educational content

**THOMSON**  
★  
**AMERICAN HEALTH  
CONSULTANTS**

## Statement of Financial Disclosure

To reveal any potential bias in this publication, and in accordance with Accreditation Council for Continuing Medical Education guidelines, we disclose that Drs. Velez, Benitez, Villanueva (authors), Stapczynski, and Ma (peer reviewers) report no relationships with companies related to the field of study covered by this CME program. Dr. Bosker (editor) is on the speaker's bureau for Pfizer, Sanofi-Synthelabo, Bristol-Myers Squibb, Roche Pharmaceuticals, and Schering Plough Corp. Dr. Bosker also acknowledges that he receives royalties, commissions, and other compensation relating to the sale of textbooks, reprints of articles, and other written materials to the following pharmaceutical companies: Pfizer, Genentech, Aventis, Pharmacia, and Bayer.

This publication does not receive commercial support.

## Pediatric Patients

It is estimated that 10% of children in the ED have an abdominal complaint.<sup>5</sup> Still, missed diagnoses remain frequent in emergency medicine. Causes for these missed diagnoses include the child's inability to provide a good history, including the characterization of the pain. Pain localization also is poor in children.<sup>6,7</sup> The clinical signs of an abdominal emergency in pediatric patients include vomiting, abdominal pain, and fever.<sup>6</sup> Children may present with systemic and non-specific symptoms such as lethargy, poor feeding, weight loss, irritability, or malaise.<sup>5</sup> Signs and symptoms also are age-dependent, with the younger patients having the more atypical presentations.

The diagnostic etiologies are divided broadly by age (neonate, infant/toddler, and older children). Besides age, an attempt should be made to determine if the abdominal complaint is an acute or chronic problem, as chronic problems rarely are life-threatening.

When evaluating a pediatric patient, perform a systematic physical examination and leave the abdomen for last. This will help with the initial apprehension the patient has and also will allow for a more thorough examination before eliciting pain and possibly losing the patient's cooperation. When examining the abdomen, start with the least tender areas first and finish with the most tender area. Try to engage the child in distracting conversation while performing the examination and move slowly and non-threateningly.

**Necrotizing Enterocolitis (NEC).** NEC is the most common gastrointestinal (GI) emergency in the neonatal period.<sup>8</sup> It is an acute fulminant disease associated with focal and/or diffuse ulceration and necrosis of the distal small intestine and the colon.<sup>9</sup> Prematurity is the most important risk factor. NEC is a disease of neonates, having its usual onset in fewer than five days of life; however, it can present up to four weeks after birth.

Patients present with diffuse abdominal pain, abdominal distention, lethargy, vomiting, and GI bleeding. Peritonitis with acidosis, sepsis, and shock can occur rapidly.<sup>9</sup>

Plain abdominal films initially can show an asymmetric pattern of bowel gas with varying degrees of dilatation.<sup>10</sup> Later, the plain films will demonstrate pneumatosis intestinalis (air in bowel wall) in 70-80% of cases.<sup>9</sup> This is a specific finding in NEC.<sup>7</sup> Air also can be seen in the stomach wall (pneumatosis gastralis) and in the portal system.

The management includes aggressive supportive management, fluid resuscitation, gastric decompression, and emergent surgical consultation. Extensive resection of non-viable bowel may be necessary, resulting in short bowel syndrome in survivors. Antibiotics (ticarcillin [Ticar] and gentamicin [Garamycin], or a third-generation cephalosporin) are used for ill-appearing infants.

A pitfall with this condition is failure to consider NEC as a diagnosis outside the neonatal intensive care unit.

**Volvulus.** In embryonic development, the gut rotates around the superior mesenteric artery and then becomes attached to the retroperitoneum at several points (i.e., duodenum and cecum). If malrotation occurs, the duodenum and cecum remain in close proximity, and the structures can rotate around their vascular

## Subscriber Information

**Customer Service: 1-800-688-2421**

**Customer Service E-Mail:** customerservice@ahcpub.com

**Editorial E-Mail:** shelly.mark@thomson.com

**World Wide Web page:** http://www.ahcpub.com

## Subscription Prices

1 year with 60 ACEP/60 AMA/60 AAFP

Category 1/Prescribed credits

(52 AOA Category 2B credits): \$544

1 year without credit: \$399

Resident's rate \$199

All prices U.S. only.

U.S. possessions and Canada, add \$30 plus applicable GST. Other international orders, add \$30.

acceptable for Prescribed credit hours. This volume has been approved for up to 60 Prescribed credit hours. Term of approval covers issues published within one year from the beginning distribution date of 1/04. Credit may be claimed for one year from the date of this issue. Thomson American Health Consultants (AHC) is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

This is an educational publication designed to present scientific information and opinion to health professionals, to stimulate thought, and further investigation. It does not provide advice regarding medical diagnosis or treatment for any individual case. It is not intended for use by the layman. Opinions expressed are not necessarily those of this publication. Mention of products or services does not constitute endorsement. Clinical, legal, tax, and other comments are offered for general guidance only; professional counsel should be sought for specific situations.

This CME activity is intended for emergency physicians. It is in effect for 36 months from the date of the publication.

## For Customer Service and CME questions,

Please call our customer service department at (800) 688-2421. For editorial questions or comments, please contact **Shelly Morrow Mark**, Specialty Editor, at shelly.mark@thomson.com or (954) 566-9203.

**Table 1. Common Causes of Acute Abdominal Pain**

RIGHT UPPER QUADRANT	LEFT UPPER QUADRANT
<ul style="list-style-type: none"> <li>• Biliary tract disease</li> <li>• Acute hepatitis</li> <li>• Hepatic abscess</li> <li>• Hepatomegaly</li> <li>• Herpes zoster</li> <li>• Right lower lobe pneumonia</li> <li>• Right pyelonephritis</li> <li>• Right renal colic</li> </ul>	<ul style="list-style-type: none"> <li>• Splenic infarction, rupture, aneurysm, enlargement (mononucleosis, leukemia)</li> <li>• Left lower lobe pneumonia</li> <li>• Herpes zoster</li> <li>• Left pyelonephritis</li> <li>• Left renal colic</li> <li>• Peptic ulcer disease</li> <li>• Gastritis</li> </ul>
RIGHT LOWER QUADRANT	LEFT LOWER QUADRANT
<ul style="list-style-type: none"> <li>• Acute appendicitis</li> <li>• Mesenteric adenitis</li> <li>• Ruptured ectopic pregnancy</li> <li>• Meckel's diverticulitis</li> <li>• Ovarian torsion</li> <li>• Ovarian cyst rupture</li> <li>• Pelvic inflammatory disease</li> <li>• Tubo-ovarian abscess</li> <li>• Salpingitis</li> <li>• Mittelschmerz</li> <li>• Psoas abscess</li> <li>• Inguinal hernia</li> </ul>	<ul style="list-style-type: none"> <li>• Diverticulitis</li> <li>• Ruptured ectopic pregnancy</li> <li>• Ovarian torsion</li> <li>• Ovarian cyst rupture</li> <li>• PID</li> <li>• TOA</li> <li>• Salpingitis</li> <li>• Mittelschmerz</li> <li>• Psoas abscess</li> <li>• Inguinal hernia</li> </ul>
FLANK PAIN	EPIGASTRIC
<ul style="list-style-type: none"> <li>• Ureteral Colic</li> <li>• Pyelonephritis</li> </ul>	<ul style="list-style-type: none"> <li>• Abdominal aortic aneurysm</li> <li>• Peptic ulcer disease</li> <li>• Gastroesophageal reflux</li> <li>• Acute angle closure glaucoma</li> <li>• Perforated viscus, early</li> <li>• Acute pancreatitis</li> <li>• Acute appendicitis, early</li> <li>• Myocardial ischemia/infarction</li> </ul>
DIFFUSE PAIN	BACK PAIN
<ul style="list-style-type: none"> <li>• Ascites</li> <li>• Sickle cell crisis</li> <li>• Acute gastroenteritis</li> <li>• Non-specific abdominal pain</li> <li>• Intestinal obstruction</li> <li>• Mesenteric ischemia</li> <li>• Diabetic ketoacidosis</li> <li>• Peritonitis</li> <li>• Spontaneous bacterial peritonitis</li> <li>• Inflammatory bowel disease</li> <li>• Opiate withdrawal</li> </ul>	<ul style="list-style-type: none"> <li>• Abdominal aortic aneurysm</li> <li>• Acute pancreatitis</li> </ul>

supply, resulting in what is called volvulus. Malrotation of the gut thus can predispose patients to volvulus.<sup>7</sup> Volvulus will develop in about 75% of the patients with malrotation. Typically, about 90% of the cases occur in the first year of life, with the

majority of cases presenting in the first month of life. The volvulus can be partial or incomplete, thus giving intermittent symptoms. A complete volvulus can result in bowel necrosis after 1-2 hours. The patients present with bilious vomiting and abdominal distention. They will be acutely ill-appearing and can present in shock. Plain films may suggest diagnosis, showing air-fluid levels and a "double bubble" sign and absence of bowel gas distal to the volvulus. The upper gastrointestinal series (UGIS) is considered the most useful study. It will show the typical corkscrew appearance.<sup>5</sup>

Management includes fluid resuscitation, stomach decompression with a nasogastric tube, and emergent surgical consultation. Antibiotics (ampicillin [Omnipen, Polycillin, Principen], gentamicin, and clindamycin [Cleocin] or metronidazole [Flagyl, Trikacide, Florazole-ER) are used for ill-appearing infants.

Physicians should remember that volvulus is associated with malrotation.

**Hypertrophic Pyloric Stenosis (HPS).** This is the most common cause of infantile GI obstruction. It occurs in about 1 of every 250 live births and is most common in first-born males between 4-8 weeks of age.<sup>7,11</sup> The infants have progressive gastric outlet obstruction from the hypertrophied pyloric muscle. Patients present with non-bilious projectile vomiting and failure to thrive. Despite this, they exhibit hunger and a vigorous sucking reflex. As the vomiting progresses, the patients develop dehydration and a hypochloremic, hypokalemic metabolic alkalosis. In some cases, an "olive," representing the hypertrophied pylorus, can be palpated in the right upper abdomen or epigastrium.<sup>5</sup> The olive is considered a pathognomonic finding in HPS.<sup>7</sup> Peristaltic waves also can be seen in HPS, often preceding the vomiting episodes.

Currently, the diagnosis often is made early by ultrasound (US) before classic physical examination findings or laboratory findings become evident. US has a diagnostic accuracy of about 95%. A pyloric muscle width of 2.5-3 mm is considered normal.<sup>12</sup> The sonographic criteria for HPS are a pyloric muscle thickness greater than 3 mm (the most widely used criterion), a pyloric channel length greater than 17 mm, and a pyloric muscle length greater than 19 mm.<sup>13</sup> A barium (upper GI series) study will show the characteristic string sign.<sup>12</sup>

The management of HPS is aimed at correcting the dehydration, hypokalemia, and acid-base problems, and surgical consultation for pyloromyotomy.

The early diagnosis of HPS can be best confirmed with US showing a pyloric muscle thickness of greater than 3 mm.

**Intussusception.** Intussusception occurs when a segment of bowel invaginates into another segment, causing obstruction. Subsequent bowel edema leads to ischemia. It is the most common cause of intestinal obstruction in those younger than 2 years.<sup>5</sup> The age range of presentation for intussusception is 6-18 months. The condition is more common in males and in the warmer months.<sup>14</sup> Most often, intussusception presumably is due to inflamed Peyer's patches, but in 2-8% a recognizable lead point can be identified, such as a Meckel's diverticulum, duplication cyst, intestinal polyps, or lymphoma.<sup>6</sup> Adenovirus and

rotavirus can be preceding illnesses.<sup>5</sup> In fact, the rotavirus vaccine was withdrawn from the market because of its association with intussusception.

Most commonly, the intussusception is ileocolic; however, ileoileal or other forms are possible. Patients present with episodic crying, irritability, and pulling of the legs up to the abdomen. Patients may appear well between episodes; however, some patients present only with lethargy and prostration.<sup>5</sup> The classic presentation (i.e., abdominal pain, vomiting, and bloody stools) is seen in only 10-33% of cases.<sup>5,6</sup> Currant jelly stools are a late finding and represent bowel ischemia. The classic physical examination finding is called Dance's sign: a sausage-like mass in the right upper quadrant and an empty space in the right lower quadrant representing the displaced cecum.

Plain films are unreliable and are sometimes normal. A soft-tissue mass in the right upper quadrant and an abrupt cut-off of colonic air are suggestive of intussusception. Dilated loops of small bowel with air-fluid levels proximal to the obstruction may be present. US is very accurate and reliable, having a 98-100% sensitivity, 90-100% specificity, and 100% negative predictive value for diagnosing intussusception.<sup>15-17</sup> The US will visualize a target or donut sign in transverse section and sandwich or pseudokidney sign in longitudinal section. The US also can confirm the completeness of the reduction. The US may be helpful in screening for patients who will require a barium enema, but most pediatric centers proceed straight to the barium enema if intussusception is suspected, because it can be both diagnostic and therapeutic in reducing the intussusception.

Non-operative reduction is best. Most cases of intussusception can be reduced using an enema of barium, air, or saline.<sup>14</sup> The barium enema still is the gold standard, and can be both diagnostic and therapeutic in 45-85% of cases. Surgical reduction must be performed if reduction fails or if there is perforation or peritonitis.<sup>14</sup>

Treatment strategies include volume resuscitation, emergent surgical consultation, and gastric decompression. Antibiotics should be used for ill-appearing patients. Ampicillin, gentamicin, and clindamycin or metronidazole are the usual choices. Most centers will admit all patients after a successful reduction and observe those for re-intussusception.

Remember that intussusception is the most common cause of intestinal obstruction in those younger than 2 years. Suspect intussusception instead of colic if the child is older than 4 months and presents with episodic abdominal pain.

**Hernias.** Inguinal hernias occur in about 10-20 per 1000 live births.<sup>5</sup> Prematurity and low birth weight increase the risk.<sup>7</sup> Most hernias are unilateral and are more common on the right side. The male to female ratio is 4:1, but females incarcerate more often.<sup>5</sup> Incarceration is the primary complication of inguinal hernias, and it occurs more commonly in children than in adults. This explains the fact that inguinal hernias are the most common indication for surgery in those younger than 2 years.

Patients with incarceration present with abdominal or inguinal pain, an inguinal or scrotal mass, nausea, vomiting, and occasionally low grade fever.

Attempt reduction if the child appears well. This is accom-

plished by using analgesia, sedation, and placing the patient in a Trendelenburg position.<sup>7</sup> Slow gentle pressure should be applied to the hernia. If the hernia is reduced easily, outpatient surgical referral must be arranged. However, do not reduce if the patient is ill or toxic-appearing. In these cases where incarceration or strangulation is suspected, give fluid resuscitation, antibiotics, and immediately consult the surgeon.

Physicians should not attempt manual reduction in those cases where a strangulated hernia is suspected.

**Appendicitis.** Acute appendicitis is the most common non-traumatic surgical emergency in children, having an estimated incidence of 4 out of every 1000 children.<sup>7</sup> Its occurrence is rare in those younger than 3 years, but it still can occur.<sup>5,6</sup> The peak ages for acute appendicitis are between ages 6 and 14 years. A good rule is that there are more atypical presentations in younger patients.

Abdominal pain, especially in the right lower quadrant, fever, vomiting, and anorexia are good indicators of appendicitis in children. Patients can have diarrhea due to sigmoid colon irritation. If the appendix is retrocecal, they may have only flank pain and dysuria.<sup>5</sup> Probably due to the atypical presentations, appendicitis is still a commonly missed diagnosis for this age group.

Another complication of atypical presentations is the high rate of perforation seen in children. One author reports that 79% of the perforations occur in those younger than 3 years.<sup>18</sup> Pediatric patients also progress to gangrene and perforation faster.<sup>5,19</sup> After perforation, younger patients also do not wall off the perforation as well.<sup>7</sup> This leads to diffuse peritonitis and sepsis.

The complete blood count (CBC) and urinalysis (U/A) rarely help in making the diagnosis. Leukocytosis is common, but not specific, for appendicitis. Pyuria without bacteriuria often is seen as a result of an inflamed appendix in close proximity to the ureters.<sup>7</sup>

Imaging is most useful in those with an uncertain clinical diagnosis. A fecalith can be seen in 10% of the cases, but the plain films often are normal or non-specific. US is an excellent imaging test in children. Benefits of US in pediatric patients include non-invasiveness, avoidance of procedural sedation, and availability.<sup>7</sup> However, US may be technically difficult in obese patients and may require calling in a technician from home at night. Furthermore, the US is both operator- and interpreter-dependent. Criteria used for diagnosing appendicitis with US include a non-compressible appendix greater than 6 mm in diameter.<sup>7</sup> The US also can visualize an appendicolith, peri-appendiceal fluid collections, and abscesses.<sup>20</sup> The US has sensitivity and specificity in the range of 90-95% for the diagnosis of acute appendicitis.

Computerized tomography (CT) scan is at least as useful in children as in adults. An appendiceal CT scan has a sensitivity and specificity in the range of 95-100%.<sup>21,22</sup> The CT scan is best at looking for complications of appendicitis and for ruling out other commonly mistaken diagnoses, such as mesenteric adenitis and inflammatory bowel disease.<sup>6</sup> The CT scan is the imaging modality of choice for diagnosing acute appendicitis in many institutions. Use of intravenous (IV), oral, or rectal contrast is institution-specific.<sup>7</sup>

The management involves keeping the patient on an empty stomach and obtaining a surgical consultation. Antibiotics should be used if there are signs of perforation or abscess formation.

Physicians should remember to appreciate the fast rate of perforation and higher likelihood of peritonitis in this population.

Physicians should take care not to exclude appendicitis because of pyuria, which can be due to an inflamed appendix in close proximity to the ureter.

**Mesenteric Adenitis.** Mesenteric adenitis is a common diagnosis in pediatric patients with acute abdominal pain. It is easily confused with appendicitis. US has become a good diagnostic modality that is helpful in distinguishing between these two diagnoses. The US criteria for mesenteric adenitis include nodes greater than 10 mm in longitudinal diameter and increased in number.<sup>6</sup> The CT scan also is helpful in excluding acute appendicitis as the cause of the right lower quadrant pain.<sup>21</sup> The management is conservative, as it is a self-limited illness.

Physicians should remember to consider mesenteric adenitis in the differential diagnosis of pediatric patients with unclear right lower quadrant pain.

**Acute Gastroenteritis (AGE).** AGE can cause significant, diffuse abdominal pain in children. Usually, the diagnosis can be established by the presence of fever, vomiting, diarrhea, and mild intermittent crampy abdominal pain. However, AGE always should be considered a diagnosis of exclusion. Plain radiographs can show multiple distended loops and air-fluid levels. The US may show free fluid between loops, but radiology mainly is used to exclude other diagnoses.<sup>6</sup>

The treatment of AGE is supportive, with adequate fluid replacement and correction of electrolyte disturbances. Physicians should remember to regard AGE as a diagnosis of exclusion.

**Hemolytic-Uremic Syndrome (HUS).** HUS is one of the most common causes of acute renal failure in children.<sup>23</sup> The condition is rare in those older than 5 years of age. The most common cause of HUS is the verotoxin (also known as shiga-like toxin) produced by *E. coli* 0157:H7. The renal vascular endothelium is damaged, resulting in hemolysis and decreased renal function.

The patients present with abdominal pain, diarrhea, and, occasionally, fever. The stools can be bloody. The condition progresses to hemolytic anemia, renal insufficiency, and thrombocytopenia. Up to 40% of the patients develop seizures, and some develop encephalopathy.

The CBC will demonstrate anemia and thrombocytopenia. Hemolysis also can be demonstrated by an increased indirect bilirubinemia, elevated lactate dehydrogenase (LDH), and hemoglobinuria. Azotemia and hyperkalemia can be seen with renal failure.

The management mainly is supportive, and may include hemodialysis. Plasmapheresis is used in some cases, especially if there is neurologic involvement. Renal transplantation may be required for those who develop permanent renal failure.

The cause for HUS is verotoxin, or shiga-like toxin, produced by *E. coli* 0157:H7.

**Henoch-Schonlein Purpura (HSP).** This is a systemic vasculitis associated with abdominal pain, joint pain, occasional

renal involvement, and a purpuric rash. It is most common between the ages of 4 and 11 years. The diagnosis usually is clinical, made by the presence of a palpable purpuric rash in the buttocks and lower extremities, abdominal pain with nausea, vomiting and diarrhea, microscopic hematuria, and arthralgias. Many patients will have occult heme-positive stools. The abdominal pain typically is diffuse, intermittent, and colicky in nature, caused by edema and vasculitis of the intestines.

Intussusception occurs in HSP and should be sought in patients with severe abdominal pain, distention, or bilious vomiting.

Most patients can be managed as outpatients once life-threatening conditions have been excluded. Steroids are advocated by some for the more severe cases.

Remember that HSP presents with palpable purpura, abdominal pain, joint pain, and renal involvement. There is an association with intussusception.

**Hirschsprung's Disease (Congenital Aganglionic Megacolon).** This is caused by a congenital absence of ganglion cells beginning at the internal anal sphincter and extending proximally to involve a variable length of intestine. The areas affected cannot relax, causing a functional colonic obstruction. Stool accumulates proximally, resulting in massive colonic dilatation.

Patients present with chronic constipation, obstipation, and failure to thrive.<sup>6</sup> Hirschsprung's disease presents most often during infancy. Symptoms usually are present since birth, which helps differentiate this condition from functional constipation. Complications may arise, and patients may be ill appearing due to a toxic megacolon and enterocolitis.

Plain films can show air fluid levels, a dilated colon, and fecal impaction. The barium enema will show a narrow distal colon segment and proximal dilatation. This finding is highly suggestive of Hirschsprung's disease, but the diagnosis must be confirmed by biopsy and rectal manometry.<sup>24</sup>

Management strategies include supportive management, colonic emptying with enemas or polyethylene glycol and aggressive evaluation and surgical consultation for complications. The definitive management is surgical resection of the aganglionic segment.

Remember to consider Hirschsprung's disease in any case of constipation since birth.

**Meckel's Diverticulum.** Meckel's diverticulum is the most common congenital malformation of the small intestine. It follows the rule of twos:

- 2% of the population have them;
- there is a 2:1 male to female ratio;
- there are two types of tissue, gastric and pancreatic;
- they generally are located within two feet of the ileo-cecal junction;
- they are two inches long; and
- they become symptomatic in 2% of those who have it.<sup>5</sup>

Meckel's diverticula can bleed or, less commonly, perforate.<sup>7</sup>

The classic presentation is in a pediatric patient younger than 5 years of age with massive painless rectal bleeding, with 50% of patients with the condition presenting by age 2. The bleeding is described as brick red. Many patients, however, complain of

crampy abdominal pain. Rarely, inflammation and infection of the Meckel's diverticulum (diverticulitis) can occur, mimicking appendicitis, and progressing to perforation and peritonitis.

The imaging modality of choice is a nuclear Technetium-<sup>99m</sup>Tc-pertechnetate scan, also called a Meckel's scan.<sup>5,7</sup> The CT scan is useful for identifying complications from a Meckel's, such as intussusception and diverticulitis.<sup>25,26</sup> Management includes fluid resuscitation, basic laboratories (i.e., CBC, platelets, prothrombin time [PT], partial thromboplastin time [PTT], international normalized ratio [INR]), blood product administration as needed, and evaluation for complications such as obstruction or perforation. Surgical consultation is indicated for resection of the Meckel's diverticulum.

**Other Conditions.** Inflammatory bowel disease (IBD) often does not present until adolescence. Ulcerative colitis (UC) is a chronic mucosal inflammation of the colon. Patients present with bloody diarrhea, fecal urgency, crampy abdominal pain, tenesmus, fever, and a mucoid rectal discharge. Some have constipation. Peritonitis can be seen with toxic megacolon or fulminant colitis.<sup>27</sup> Crohn's disease is a transmural segmental inflammatory process of the GI tract. Since the whole width of the intestine is involved, fistula and abscess formation are common. Patients present with diarrhea, weight loss, and fever. Perforation can complicate Crohn's disease. Patients with IBD often present to the ED with disease flares and complications from them. When IBD is suspected, consultation with a gastroenterologist is indicated. The consultation can occur as inpatient or outpatient, depending on the patient's clinical condition.

Pancreatitis is uncommon in childhood. The most common causes for pediatric pancreatitis are trauma, infection, structural anomalies, systemic diseases, and drugs or toxins.<sup>28</sup> The pediatric presentation of pancreatitis is similar to that of adults. The treatment is the same, with the exception that most children with pancreatitis will require admission.

Biliary tract disease also is uncommon in childhood and has dissimilar precipitating causes in younger children (hemolysis, sepsis, cystic fibrosis, Rocky Mountain Spotted Fever, and Kawasaki disease, among others).<sup>29,30</sup> The clinical presentation of right upper quadrant pain is similar to that of adults, especially with older children and adolescents. Management is similar to that of adults and includes addressing the underlying problem.

Ovarian torsion is more common on the right side and thus can be confused with acute appendicitis. Other ovarian pathology, such as follicular and luteal cysts and ovarian tumors, must be considered in the diagnosis of lower abdominal pain. The US is useful in distinguishing these conditions.<sup>7</sup> Although uncommon, testicular torsion can present with abdominal pain. Testicular necrosis has been reported after 4-6 hours of ischemia, so rapid diagnosis and management is imperative. The US will confirm the diagnosis, but emergent urological consultation must be obtained first if the diagnosis is suspected by physical examination.<sup>7</sup>

In adolescence, gynecological and obstetrical problems must be added to the list of differential diagnoses. Pelvic inflammatory disease, tubo-ovarian abscesses, ectopic pregnancy, and problems such as Fitz-Hugh-Curtis syndrome need to be considered.

Hydrometrocolpos occurs due to an imperforate hymen or cervi-

cal or vaginal atresia. Once menarche starts, the menstrual products accumulate proximally. The patient typically complains of lower abdominal pain that may recur monthly, and a pelvic mass may be palpable, representing the blood-filled uterus. Urinary retention or constipation may be other presenting complaints. The condition generally is suspected when pubertal changes occur without menstrual bleeding. Imperforate hymen is diagnosed on physical examination when a bulging, intact membrane occludes the vaginal introitus. Hydrometrocolpos also can be diagnosed by US.<sup>6</sup>

Caustic ingestions also can present with epigastric or diffuse abdominal pain and can occur in the absence of a history of an ingestion. Children ingest caustic substances due to their exploratory nature. One important concept to remember is that oral burns are not predictive of more distal gastrointestinal burns. All patients with symptoms (i.e., vomiting, drooling, abdominal pain) after a caustic ingestion must undergo an endoscopic evaluation prior to discharge.

Pyelonephritis and renal colic may present with abdominal, not flank, pain in pediatric patients. Diagnostic procedures include plain films, US, or CT scan.<sup>6</sup> The treatment is similar to that for adults, with hydration, analgesia, and antibiotics for those with an infection.

**Non-abdominal Causes of Abdominal Pain.** There are many causes of abdominal pain that are not due to an intra-abdominal pathology or are more systemic in nature. Although the causes are numerous, some of the most important to remember are: black widow spider bite, scorpion bite, lead poisoning, leukemia, sickle cell pain crisis, diabetic ketoacidosis,<sup>31</sup> Streptococcal pharyngitis, lower lobe pneumonia, intestinal parasites, intestinal foreign bodies, cystic fibrosis, and familial Mediterranean fever.<sup>5,9,31</sup>

*Acknowledgements: The authors would like to acknowledge the assistance of Collin Goto, MD, and Patricia Santiago-Muñoz, MD, in the preparation of this manuscript.*

## References

1. Clinical policy: Critical issues for the initial evaluation and management of patients presenting with a chief complaint of nontraumatic acute abdominal pain. *Ann Emerg Med* 2000;36:406-415.
2. Clinical policy for the initial approach to patients presenting with a chief complaint of nontraumatic acute abdominal pain. American College of Emergency Physicians. *Ann Emerg Med* 1994;23:906-922.
3. Kamin RA, Norwicki TA, Courtney DS, et al. Pearls and pitfalls in the emergency department evaluation of abdominal pain. *Emerg Med Clin North Am* 2003;21:61-72, vi.
4. King, KE and Wightman JM. Abdominal pain. In Marx KA, et al, eds. *Rosen's Emergency Medicine: Concepts and Clinical Practice*. St. Louis: Mosby; 2002:185-194.
5. Pollack ES. Pediatric abdominal surgical emergencies. *Pediatr Ann* 1996;25:448-457.
6. Carty HM. Paediatric emergencies: Non-traumatic abdominal emergencies. *Eur Radiol* 2002;12:2835-2848.
7. McCollough M, Sharieff GQ. Abdominal surgical emergencies in infants and young children. *Emerg Med Clin North Am* 2003;21:909-935.

8. Neu J, Weiss MD. Necrotizing enterocolitis: Pathophysiology and prevention. *JPEN J Parenter Enteral Nutr* 1999;23(5 Suppl):S13-7.
9. Roy CC, Morin CL, Weber AM. Gastrointestinal emergency problems in paediatric practice. *Clin Gastroenterol* 1981;10:225-254.
10. Buonomo C. The radiology of necrotizing enterocolitis. *Radiol Clin North Am* 1999;37:1187-1198, vii.
11. Rasmussen LA, Green, Hansen LP. The epidemiology of infantile hypertrophic pyloric stenosis in a Danish population, 1950-84. *Int J Epidemiol* 1989;18:413-417.
12. Kovalivker M, Erez I, Shneider N, et al. The value of ultrasound in the diagnosis of congenital hypertrophic pyloric stenosis. *Clin Pediatr (Phila)* 1993;32:281-283.
13. Teele RL, Smith EH. Ultrasound in the diagnosis of idiopathic hypertrophic pyloric stenosis. *N Engl J Med* 1977;296:1149-1150.
14. Roeyen G, Jansen M, Hubens G, et al. Intussusception in infants: An emergency in diagnosis and treatment. *Eur J Emerg Med* 1999; 6:73-76.
15. Daneman A, Alton DJ. Intussusception. Issues and controversies related to diagnosis and reduction. *Radiol Clin North Am* 1996;34: 743-756.
16. Stanley A, Logan H, Bate TW, et al. Ultrasound in the diagnosis and exclusion of intussusception. *Ir Med J* 1997;90:64-65.
17. Verschelden P, Filiatrault D, Garel L, et al. Intussusception in children: Reliability of US in diagnosis—a prospective study. *Radiology* 1992;184:741-744.
18. Daehlin L. Acute appendicitis during the first three years of life. *Acta Chir Scand* 1982;148:291-294.
19. Brender JD, Marcuse EK, Koepsell TD, et al. Childhood appendicitis: Factors associated with perforation. *Pediatrics* 1985;76:301-306.
20. Kao SC, Smith WL, Abu-Yousef MM, et al. Acute appendicitis in children: Sonographic findings. *AJR Am J Roentgenol* 1989;153: 375-379.
21. Rao PM, Rhea JT, Novelline RA, et al. The computed tomography appearance of recurrent and chronic appendicitis. *Am J Emerg Med* 1998;16:26-33.
22. Garcia Pena BM, Mandl KD, Kraus SJ, et al. Ultrasonography and limited computed tomography in the diagnosis and management of

appendicitis in children. *JAMA* 1999;282:1041-1046.

23. Flynn JT. Causes, management approaches, and outcome of acute renal failure in children. *Curr Opin Pediatr* 1998;10:184-189.
24. Franken EA, Jr., Smith WL, Frey EE, et al. Intestinal motility disorders of infants and children: Classification, clinical manifestations and roentgenology. *Crit Rev Diagn Imaging* 1987;27:203-236.
25. Bennett GL, BA Birnbaum, Balthazar EJ. CT of Meckel's diverticulitis in 11 patients. *AJR Am J Roentgenol* 2004;182:625-629.
26. Rossi P, Gourtsoyiannis N, Bezzi M, et al. Meckel's diverticulum: Imaging diagnosis. *AJR Am J Roentgenol* 1996;166:567-573.
27. Roy MA. Inflammatory bowel disease. *Surg Clin North Am* 1997; 77:1419-1431.
28. Mader TJ, McHugh TP. Acute pancreatitis in children. *Pediatr Emerg Care* 1992;8:157-161.
29. Odom FC, Oliver BB, Kline M, et al. Gallbladder disease in patients 20 years of age and under. *South Med J* 1976;69:1299-1300.
30. Debray D, Pariente D, Gauthier F, et al. Cholelithiasis in infancy: A study of 40 cases. *J Pediatr* 1993;122:385-391.
31. Valerio D. Acute diabetic abdomen in childhood. *Lancet* 1976; 1(7950):66-68.

### Physician CME Questions

81. Which pairing correctly matches the radiological finding with the cause of abdominal pain in infants?
  - A. Volvulus: Double-bubble sign with associated dilatation and increased gas pattern distal to the volvulus
  - B. NEC: Asymmetric pattern of gas with dilatation early in the course of illness and subsequent air in bowel wall (pneumatosis intestinalis)
  - C. HPS: String and pearls sign is seen with a barium upper GI series
  - D. Intussusception: Proximal colonic dilatation and distal narrowing in barium study
82. The most common GI emergency in the neonatal period is necrotizing enterocolitis.
  - A. True
  - B. False
83. Diffuse abdominal pain occurs in all of the following *except*:
  - A. sickle cell crisis.
  - B. inflammatory bowel disease.
  - C. inguinal hernia.
  - D. diabetic ketoacidosis.
84. Sonographic criteria for hypertrophic pyloric stenosis include which of the following?
  - A. Pyloric muscle thickness greater than 3 mm
  - B. Pyloric channel length greater than 17 mm
  - C. Pyloric muscle length greater than 19 mm
  - D. All of the above
85. Which of the following statements is true regarding intussusception?
  - A. The condition is more common in females.
  - B. It is the most common cause of intestinal obstruction in children

### *Emergency Medicine Reports* CME Objectives

*To help physicians:*

- quickly recognize or increase index of suspicion for specific conditions;
- understand the epidemiology, etiology, pathophysiology, and clinical features of the entity discussed;
- apply state-of-the-art diagnostic and therapeutic techniques (including the implications of pharmaceutical therapy discussed) to patients with the particular medical problems discussed;
- understand the differential diagnosis of the entity discussed;
- understand both likely and rare complications that may occur.

- younger than 2 years.
- C. Most commonly, the intussusception is ileoileal.
- D. Plain films are reliable in diagnosis.
86. Which of the following statements is true of appendicitis in children?
- A. CBC and urinalysis rarely help in making the diagnosis.
- B. CT is at least as useful in children as it is in adults.
- C. A high rate of perforation is seen in children.
- D. It is the most common nontraumatic surgical emergency in children.
- E. All of the above
87. Which of the following statements is true of hernias in children?
- A. Prematurity and low birth weight increase the risk.
- B. They are more common on the left side.
- C. They occur more in females.
- D. Males incarcerate more often.
88. Mesenteric adneitis is a common diagnosis in pediatric patients with acute abdominal pain, and it easily can be confused with appendicitis.
- A. True
- B. False
89. The sonographic criteria for acute appendicitis in children are:
- A. non-compressible appendix with a diameter of greater than 7 mm in children.

- B. compressible appendix with a diameter of greater than 6 mm in children.
- C. non-compressible appendix with a diameter of greater than 6 mm in children.
- D. identification of an epiploic appendagitis.
90. Which of the following is/are non-abdominal cause(s) of abdominal pain?
- A. Lead poisoning
- B. Black widow spider bite
- C. Diabetic ketoacidosis
- D. Sickle cell pain crisis
- E. All of the above

### CME Answer Key

81. B; 82. A; 83. C; 84. D; 85. B; 86.E ; 87. A; 88. A; 89. C; 90. E

## In Future Issues:

## Acute Abdominal Pain, Part II

United States Postal Service Statement of Ownership, Management, and Circulation	
1. Publication Title Emergency Medicine Reports	2. Publication No. 0 7 4 6 - 2 5 0 6
3. Filing Date 10/1/04	4. Issue Frequency Bi-weekly
5. Number of Issues Published Annually 26	6. Annual Subscription Price \$399.00
7. Complete Mailing Address of Known Office of Publication (Not Printer) (Street, city, county, state, and ZIP+4) 3525 Piedmont Road, Bldg. 6, Ste. 400, Atlanta, Fulton County, GA 30305	
8. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not Printer) 3525 Piedmont Road, Bldg. 6, Ste. 400, Atlanta, GA 30305	
9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor (Do Not Leave Blank)	
Publisher (Name and Complete Mailing Address) Brenda Mooney, 3525 Piedmont Road, Bldg. 6, Ste. 400, Atlanta, GA 30305	
Editor (Name and Complete Mailing Address) Shelly Morrow, same as above	
Managing Editor (Name and Complete Mailing Address) Valerie Loner, same as above	
10. Owner (Do not leave blank. If the publication is owned by a corporation, give the name and address of the corporation immediately followed by the names and addresses of all stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, give the names and addresses of the individual owners. If owned by a partnership or other unincorporated firm, give its name and address as well as those of each individual. If the publication is published by a nonprofit organization, give its name and address.)	
Full Name	Complete Mailing Address
Thomson American Health Consultants	3525 Piedmont Road, Bldg. 6, Ste 400 Atlanta, GA 30305
Thomson Healthcare, Inc.	Five Paragon Drive Montvale, NJ 07645
11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities. If none, check box <input type="checkbox"/> None	
Full Name	Complete Mailing Address
Thomson Healthcare, Inc.	Five Paragon Drive Montvale, NJ 07645
12. Tax Status (For completion by nonprofit organizations authorized to mail at nonprofit rates.) (Check one) <input type="checkbox"/> Has Not Changed During Preceding 12 Months <input type="checkbox"/> Has Changed During Preceding 12 Months (Publisher must submit explanation of change with this statement)	

13. Publication Name Emergency Medicine Reports	14. Issue Date for Circulation Data Below 8/23/04
15. Extent and Nature of Circulation	
a. Total No. Copies (Net Press Run)	Average No. of Copies Each Issue During Preceding 12 Months
5015	4861
b. Paid and/or Requested Circulation	Actual No. Copies of Single Issue Published Nearest to Filing Date
(1) Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541. (Include advertiser's proof and exchange copies)	3775
(2) Paid In-County Subscriptions (Include advertiser's proof and exchange copies)	16
(3) Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Non-USPS Paid Distribution	82
(4) Other Classes Mailed Through the USPS	184
2. Total Paid and/or Requested Circulation (Sum of 15b(1) and 15b(2))	4057
3. Free Distribution by Mail (Samples, Complimentary and Other Free)	42
(1) Outside-County as Stated on Form 3541	44
(2) In-County as Stated on Form 3541	1
(3) Other Classes Mailed Through the USPS	0
4. Free Distribution Outside the Mail (Carriers or Other Means)	21
f. Total Free Distribution (Sum of 15d and 15e)	64
g. Total Distribution (Sum of 15c and 15f)	4121
h. Copies Not Distributed	894
i. Total (Sum of 15g and h.)	5015
Percent Paid and/or Requested Circulation (15c divided by 15g times 100)	98
16. Publication of Statement of Ownership Publication required. Will be printed in the 10/18/04 issue of this publication. <input type="checkbox"/> Publication not required.	98
17. Signature and Title of Editor, Publisher, Business Manager, or Owner Brenda L. Mooney, Publisher	Date 9/27/04
certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including multiple damages and civil penalties).	
Instructions to Publishers	
1. Complete and file one copy of this form with your postmaster annually on or before October 1. Keep a copy of the completed form for your records.	
2. In cases where the stockholder or security holder is a trustee, include in items 10 and 11 the name of the person or corporation for whom the trustee is acting. Also include the names and addresses of individuals who are stockholders who own or hold 1 percent or more of the total amount of bonds, mortgages, or other securities of the publishing corporation. In item 11, if none, check the box. Use blank sheets if more space is required.	
3. Be sure to furnish all circulation information called for in item 15. Free circulation must be shown in items 15d, e, and f.	
4. Item 15h. Copies Not Distributed, must include (1) newsstand copies originally stated on Form 3541, and returned to the publisher, (2) estimated returns from news agents, and (3), copies for office use, leftovers, spoiled, and all other copies not distributed.	
5. If the publication had Periodicals authorization as a general or requester publication, this Statement of Ownership, Management, and Circulation must be published. It must be printed in any issue in October or if the publication is not published during October, the first issue printed after October.	
5. In item 16, indicate date of the issue in which this Statement of Ownership will be published.	
3. Item 17 must be signed.	
Failure to file or publish a statement of ownership may lead to suspension of second-class authorization.	

### Common Causes of Acute Abdominal Pain

<p><b>RIGHT UPPER QUADRANT</b></p> <ul style="list-style-type: none"> <li>• Biliary tract disease</li> <li>• Acute hepatitis</li> <li>• Hepatic abscess</li> <li>• Hepatomegaly</li> <li>• Herpes zoster</li> <li>• Right lower lobe pneumonia</li> <li>• Right pyelonephritis</li> <li>• Right renal colic</li> </ul>	<p><b>LEFT UPPER QUADRANT</b></p> <ul style="list-style-type: none"> <li>• Splenic infarction, rupture, aneurysm, enlargement (mononucleosis, leukemia)</li> <li>• Left lower lobe pneumonia</li> <li>• Herpes zoster</li> <li>• Left pyelonephritis</li> <li>• Left renal colic</li> <li>• Peptic ulcer disease</li> <li>• Gastritis</li> </ul>
<p><b>RIGHT LOWER QUADRANT</b></p> <ul style="list-style-type: none"> <li>• Acute appendicitis</li> <li>• Mesenteric adenitis</li> <li>• Ruptured ectopic pregnancy</li> <li>• Meckel's diverticulitis</li> <li>• Ovarian torsion</li> <li>• Ovarian cyst rupture</li> <li>• Pelvic inflammatory disease</li> <li>• Tubo-ovarian abscess</li> <li>• Salpingitis</li> <li>• Mittelschmerz</li> <li>• Psoas abscess</li> <li>• Inguinal hernia</li> </ul>	<p><b>LEFT LOWER QUADRANT</b></p> <ul style="list-style-type: none"> <li>• Diverticulitis</li> <li>• Ruptured ectopic pregnancy</li> <li>• Ovarian torsion</li> <li>• Ovarian cyst rupture</li> <li>• PID</li> <li>• TOA</li> <li>• Salpingitis</li> <li>• Mittelschmerz</li> <li>• Psoas abscess</li> <li>• Inguinal hernia</li> </ul>
<p><b>FLANK PAIN</b></p> <ul style="list-style-type: none"> <li>• Ureteral Colic</li> <li>• Pyelonephritis</li> </ul>	<p><b>EPIGASTRIC</b></p> <ul style="list-style-type: none"> <li>• Abdominal aortic aneurysm</li> <li>• Peptic ulcer disease</li> <li>• Gastroesophageal reflux</li> <li>• Acute angle closure glaucoma</li> <li>• Perforated viscus, early</li> <li>• Acute pancreatitis</li> <li>• Acute appendicitis, early</li> <li>• Myocardial ischemia/infarction</li> </ul>
<p><b>DIFFUSE PAIN</b></p> <ul style="list-style-type: none"> <li>• Ascites</li> <li>• Sickle cell crisis</li> <li>• Acute gastroenteritis</li> <li>• Non-specific abdominal pain</li> <li>• Intestinal obstruction</li> <li>• Mesenteric ischemia</li> <li>• Diabetic ketoacidosis</li> <li>• Peritonitis</li> <li>• Spontaneous bacterial peritonitis</li> <li>• Inflammatory bowel disease</li> <li>• Opiate withdrawal</li> </ul>	<p><b>BACK PAIN</b></p> <ul style="list-style-type: none"> <li>• Abdominal aortic aneurysm</li> <li>• Acute pancreatitis</li> </ul>

Supplement to *Emergency Medicine Reports*, October 18, 2004: "Acute Abdominal Pain in Special Populations. Part I: Pediatric Patients."

Authors: **Larissa I. Velez, MD**, Assistant Professor, Assistant Director of Emergency Medicine Residency Program, University of Texas Southwestern Medical Center, Dallas; **Fernando L. Benitez, MD**, Assistant Professor, Emergency Medicine, University of Texas Southwestern Medical Center, Dallas; and **Salvador E. Villanueva, MD**, Assistant Professor, Emergency Medicine, University of Puerto Rico.

*Emergency Medicine Reports*' "Rapid Access Guidelines." Copyright © 2004 Thomson American Health Consultants, Atlanta, GA. **Editor-in-Chief:** Gideon Bosker, MD. **Vice President and Group Publisher:** Brenda Mooney. **Editorial Group Head:** Valerie Loner. **Specialty Editor:** Shelly Morrow Mark. For customer service, call: **1-800-688-2421**. This is an educational publication designed to present scientific information and opinion to health care professionals. It does not provide advice regarding medical diagnosis or treatment for any individual case. Not intended for use by the layman.