In This Issue

Lesson 17  Pearls and Pitfalls in the Evaluation of Nonspecific Abdominal Pain ........................ Page 2

The differential diagnosis for nonspecific abdominal pain is broad, and many of the diagnoses require timely identification and treatment to prevent significant morbidity or death. However, even a thorough investigation often fails to reveal a specific diagnosis. This lesson reviews the evidence for using several common studies in evaluating these patients.

Lesson 18  Delirium in Elderly Patients .................................... Page 11

Delirium in elderly patients can signal loss of independence and a decline in health. It can also be the first—maybe the only—sign of serious medical illness. Emergency physicians must assess elderly patients for delirium and actively seek reversible causes while minimizing interventions that can worsen a patient’s confusion.

Contributors

Jack Perkins, MD, FACEP, and Karen Perkins, MD, wrote “Pearls and Pitfalls in the Evaluation of Nonspecific Abdominal Pain.” Dr. Perkins is an attending physician in the emergency department at Franklin Square Hospital Center, associate program director of the Internal Medicine Residency at Franklin Square Hospital, and clinical assistant professor in the Department of Medicine at the University of Maryland School of Medicine in Baltimore, Maryland. Dr. Karen Perkins is faculty in the Family Medicine Residency at Franklin Square Hospital Center in Baltimore.

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Sharon E. Mace, MD, FACEP, reviewed “Delirium in Elderly Patients.” Dr. Mace is professor of medicine at the Cleveland Clinic Lerner College of Medicine, Case Western Reserve University, director of the Observation Unit and director of Pediatric Education and Quality Improvement at the Cleveland Clinic Foundation, and faculty for the MetroHealth Medical Center Emergency Medicine Residency Program in Cleveland, Ohio.

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Target Audience. This educational activity has been developed for emergency physicians.
Pearls and Pitfalls in the Evaluation of Nonspecific Abdominal Pain

Jack Perkins, MD, FACEP, and Karen Perkins, MD

Objectives

On completion of this lesson, you should be able to:

1. Explain why a WBC count should be interpreted cautiously in patients with abdominal pain.
2. Explain why a normal serum lactate does not exclude mesenteric ischemia in patients with abdominal pain.
3. Discuss the appropriate use of a serum lipase in patients with abdominal pain.
4. Recognize that an elderly patient with abdominal pain is at high risk for morbidity and mortality and likely will present with atypical signs and symptoms.
5. Discuss why it is inappropriate to withhold opiate pain medications from a patient with abdominal pain awaiting a surgical evaluation.
6. Describe when an “observation” strategy is appropriate for patients with undifferentiated abdominal pain.

From the EM Model

1.0 Signs, Symptoms, and Presentations

1.2 Abdominal

Abdominal pain is frequently cited as the most common presenting complaint in US emergency departments. Roughly 5% to 8% of all chief complaints are centered on abdominal pain.1 Some patients will present with a history and physical examination that are suggestive of a particular disease entity. For example, patients presenting with fever, anorexia, vomiting, and right-lower quadrant abdominal pain are likely to be evaluated for acute appendicitis. However, a large majority of abdominal pain patients will provide a vague history, and their physical examination will not localize to any specific quadrant. These patients are often described as having “nonspecific” abdominal pain. In fact, approximately 20% to 40% of all patients complaining of abdominal pain will not receive a specific diagnosis for their complaint, and they will be discharged or admitted with a diagnosis of “undifferentiated” abdominal pain.1 Consequently, emergency physicians may order laboratory tests without a specific diagnosis in mind. This practice is nearly universal but is not evidence-based and serves only to increase cost and length of stay in the emergency department. Emergency physicians can improve outcomes for patients with nonspecific abdominal pain by understanding that certain common laboratory tests such as amylase, lipase, lactate, and the WBC count are not sensitive and specific enough to be useful in this patient population.

Case Presentations

Case One

A 30-year-old woman complaining of abdominal pain is brought to the hospital by her family. She reports diffuse pain for 2 days that has gradually increased and is not responding to over-the-counter analgesics. She reports subjective fevers at home but denies dysuria, vaginal discharge, anorexia, or change in bowel habits. She says she has been nauseated and had one episode of nonbloody emesis the previous day. She takes no medications regularly and denies any previous medical history. She is sexually active with one male partner and uses barrier protection each time. Her last menstrual period was 1 week ago and was normal for her.

Her vital signs are blood pressure 118/72, pulse rate 98, respiratory rate 14, and temperature 37.2°C (99°F). She is young and healthy appearing but is in moderate discomfort and seems to have a tough time finding a comfortable position in bed. Her cardiac and pulmonary examinations are within normal limits. Her abdominal examination reveals tenderness to moderate palpation in all quadrants without guarding or rebound. There is no organomegaly noted. Her pelvic and rectal examinations are normal. The emergency physician orders a urinalysis, urine pregnancy, and a CBC. She is given 4 mg of morphine intravenously for pain and a 1-liter bolus of normal saline.
Critical Decisions

- How should the WBC count be used in evaluating abdominal pain?
- Is a lactate level an appropriate screening test in patients with suspected mesenteric ischemia?
- Are amylase and lipase levels useful as screening tests for pancreatitis in nonspecific abdominal pain?
- How should the evaluation of elderly patients with nonspecific abdominal pain differ from that for younger adults?
- Does opiate administration alter the examination findings or outcome of patients with abdominal pain?
- What can be done to improve outcomes for patients with undifferentiated abdominal pain?

Case Two

A 75-year-old man with severe abdominal pain is brought in by paramedics. He lives at home and noted sudden onset of peri-umbilical abdominal pain 2 hours ago; he reports that the pain has become progressively worse. He has had one episode of nonbloody emesis and denies diarrhea. He denies any fevers, chills, urinary symptoms, back pain, or recent similar symptoms. He has a history of well-controlled atrial fibrillation for which he takes metoprolol, 50 mg twice daily, and also warfarin, 5 mg at night. He denies any history of abdominal surgery. His vital signs are blood pressure 168/92, pulse rate 112, respiratory rate 18, temperature 37.9°C (100.2°F), and pulse oximetry 99% on 2 liters of oxygen via nasal cannula. Physical examination reveals an elderly man in severe discomfort who answers questions appropriately. His cardiac examination reveals an irregularly irregular heart rhythm with no appreciable murmurs. The pulmonary examination is unremarkable. His abdominal examination is remarkable for decreased bowel sounds, mild tenderness to palpation in all quadrants, and no ascertainable involuntary guarding or rebound tenderness. There is no pulsatile mass appreciated. His stool guaiac is negative for blood.

The patient has an 18-gauge intravenous line placed and is started on a 1-liter bolus of normal saline. The physician orders a CBC, complete metabolic panel, coagulation studies, venous lactate, lipase, urinalysis, cardiac enzymes, ECG, and a portable chest radiograph. A bedside ultrasound examination by the emergency physician reveals a normal-caliber aorta and no free fluid on focused assessment with sonography for trauma (FAST) examination. The patient is administered 6 mg of morphine intravenously and is given an antiemetic.

The Evolution of the Abdominal Pain Patient Evaluation

In present-day emergency departments ordering a computed tomography (CT) scan or a sonogram is easy, and these and other technologies are often readily available. However, 40 years ago, emergency physicians had fewer resources and had to rely on plain films and the WBC count for help in the diagnostic process. A three-part longitudinal study at the University of Virginia followed this process over three decades. In 1972, 1993, and 2007, investigators studied 1,000 consecutive patients presenting with abdominal pain. In 1972, more than 41% of patients received a diagnosis of undifferentiated abdominal pain, and although this number fell to 21% in 2007, it is still remarkable that more than one in five patients with abdominal pain will not receive a specific diagnosis. The average time spent evaluating these patients went from 2.9 hours in 1993 to 4.3 hours in 2007. Most of this increased time can be explained by the significant jump in use of CT and ultrasound imaging (Table 1). Perhaps the most concerning finding from their study was the average cost of a single patient evaluation. Using 2007 hospital and provider costs, the average work-up in 1972 cost $473 (CBC, urinalysis, plain films, and basic chemistry panel). In 1993 the cost increased to $795 for a CBC, basic chemistry panel, liver function tests, amylase, urinalysis, urine pregnancy test, and an ultrasound. Simply doing a CT of the abdomen and pelvis instead of the ultrasound study done in the 1993 workup increased the total charge to $3,932. The increased time and money expenditure also do not definitively produce better patient outcomes. In 1972, there were 11 cases (1.1%) that ultimately required surgical intervention that were not appropriately diagnosed on initial presentation. None of these patients died, and only one patient had significant morbidity (prolonged hospital course). A 1993 study by Lukens et al supports this finding in their study of the natural history of undifferentiated abdominal pain. They followed 307 patients (average age 30) who were evaluated and given the diagnosis of undifferentiated abdominal pain. No patients died, and 90% were pain free by 14 days. The conclusion is that most young patients who present with nonspecific abdominal pain will do well. The cost to the health care system and radiation exposure should be weighed heavily when considering CT imaging of these patients.
CRITICAL DECISION
How should the WBC count be used when evaluating abdominal pain?

The WBC count is readily available in most hospital emergency departments, with a result time of less than 1 hour and a hospital charge of approximately $25. A normal WBC count range is considered to be 4,500 to 10,000 cells/mm$^3$, with some variability among laboratories. Physicians often associate an elevated WBC with infection or inflammation and are likely to suspect that a patient with a normal WBC with the complaint of abdominal pain is less likely to have a condition requiring urgent intervention than a patient with an elevated WBC. However, in healthy adults the WBC count can be elevated in smokers and as a result of pregnancy, exercise, and stress. Common drugs, including aspirin, corticosteroids, and triamterene, among others, can also elevate the WBC count. The WBC can be lowered by the use of medications such as antibiotics, antihistamines, and diuretics.

A frequent question facing the emergency physician when presented with a patient with nonspecific abdominal pain is whether or not the WBC will determine the need for further observation, surgical consultation, emergent imaging, or discharge home. A 2005 prospective observational study attempted to generate a model to predict diagnoses requiring urgent medical or surgical intervention. This study analyzed 165 nonpregnant patients older than 17 years, with no evidence of abdominal trauma, acute abdomen, or shock on presentation. The WBC count was minimally helpful in these patients, with the nonintervention group (n = 108) having an average WBC count of 9 cells/mm$^3$ versus the intervention group (n = 57) with an average WBC of 12.3 cells/mm$^3$. The WBC was ultimately not used in the decision tree generated by this study, despite this modest difference.

The specific subpopulation of reproductive-age women (n = 100, 15 to 45 years old) with the presenting complaint of nontraumatic abdominal pain was examined in a prospective 1995 study examining the effect of the WBC on emergency department clinical decision-making. The initial diagnosis was altered in two patients after the WBC was known to the clinician; one diagnosis was erroneously changed to appendicitis with the report of an elevated WBC, and another was correctly changed to undifferentiated abdominal pain from acute appendicitis after a normal WBC was resulted. Although 4 patients requiring urgent intervention (3 for appendicitis, 1 for ectopic pregnancy) had an abnormal WBC, 17 of 73 (23%) patients not admitted to the hospital and with no evidence of infectious disease also had an elevated WBC. None of these patients had a change in diagnosis or disposition based on the WBC.

One of the most common surgical diagnoses presenting to the emergency department is appendicitis, with approximately 15% of people in the Western world requiring appendectomy during their lifetime. Appendectomy is now the most common emergency abdominal procedure performed in the United States, with a negative appendectomy rate of approximately 15%. Multiple studies have examined the utility of the WBC in suspected cases of appendicitis.

A 2004 prospective study of 274 nonpregnant patients examined the WBC after the attending emergency physician had presumptively diagnosed appendicitis. Of the patients with appendicitis, 24% had a WBC less than 10,000, while of the patients without appendicitis 48% had a WBC greater than 10,000. The WBC was determined not to be clinically useful in this study.

In summary, the WBC is too variable to be used as an accurate predictor of causes of abdominal pain requiring urgent intervention. In practice, the emergency physician will frequently use the WBC to determine the need for further diagnostic testing, imaging, or surgical consultation. However, the literature reveals that an elevated WBC is a poor predictor of surgically correctable disease and that many patients with appendicitis have no elevation of their WBC. History and physical examination should guide the clinician’s interpretation of the WBC.

CRITICAL DECISION
Is a lactate level an appropriate screening test in patients with suspected mesenteric ischemia?

Mesenteric ischemia is a rare but catastrophic condition with an estimated mortality rate of 50% to 80% depending on the anatomy involved (highest for superior mesenteric artery ischemia). It remains a difficult diagnosis to make, especially because the presenting complaint and physical examination are nonspecific. Plasma lactate levels have become a popular laboratory test in the evaluation of abdominal pain.

### Table 1.
Change over 35 years in rate of diagnostic testing per 1,000 abdominal pain patients$^2$-$^4$

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<tr>
<td>Plain film</td>
<td>427</td>
<td>302</td>
<td>210</td>
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<tr>
<td>CBC</td>
<td>950</td>
<td>569</td>
<td>645</td>
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<td>Liver function tests</td>
<td>0</td>
<td>372</td>
<td>544</td>
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<tr>
<td>Amylase/lipase</td>
<td>0</td>
<td>386</td>
<td>440</td>
<td>+14%</td>
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<tr>
<td>Ultrasound</td>
<td>0</td>
<td>60</td>
<td>209</td>
<td>+348%</td>
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<tr>
<td>CT of abdomen/pelvis</td>
<td>0</td>
<td>8</td>
<td>256</td>
<td>+3,200%</td>
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pain (especially in the elderly), mainly in hopes that a normal lactate level excludes the diagnosis of mesenteric ischemia. Lactic acid is produced through anaerobic metabolism, and lactate is the end product when lactic acid is buffered by bicarbonate. Using a lactate level to screen for mesenteric ischemia assumes that the localized intraabdominal tissue ischemia will result in an elevated venous lactate when a sample is drawn from a peripheral vein. However, bench research using pig models would suggest that this is incorrect.

Two separate investigators used pig models to examine the effect of ligation of the superior mesenteric artery (SMA) on plasma lactate concentration. The studies examined plasma lactate concentrations up to 4 and 6 hours respectively after ligation of the SMA. They found that the plasma lactate level was not significantly elevated even after 4 and 6 hours of continuous ligation of the SMA. However, they did discover that intraperitoneal lactate was significantly elevated within hours of SMA ligation. The authors’ conclusion is that a venous plasma lactate is not a useful marker early in the disease course of SMA ischemia.\textsuperscript{15,16}

Although there is a paucity of clinical research involving the use of plasma lactate levels and suspected mesenteric ischemia; a study by Lange and Jackel\textsuperscript{14} emphasizes the nonspecific nature of an elevated lactate in patients with abdominal pain. They prospectively evaluated 85 patients with acute abdominal pain. Twenty patients (mean age 74 years of age) were diagnosed with mesenteric ischemia on hospital discharge. The mean delay from symptom onset to presentation in the emergency department was 22 hours, with a mean time of 30 hours between symptom onset and initiation of laparotomy. Only 5 of 20 patients were alive at 4 days, and all but 2 of 20 had died by 3 weeks. The average plasma lactate concentration was 5.4 mmol/L on initial presentation to the emergency department. The authors also noted that the plasma lactate was elevated in those patients who had bacterial peritonitis and in half of the cases of complete small bowel obstruction. Overall, 46 out of 48 patients who required urgent operative intervention had an elevated lactate level. The authors concluded that an increased lactate level in a patient presenting with abdominal pain should raise concern that emergent surgery will be required. However, they note that the lactate level can be elevated in numerous other disease processes such as shock, sepsis, hepatic coma, renal failure, and diabetic ketoacidosis. Thus, the increased lactate level must be recognized as nonspecific for an abdominal catastrophe. The authors do not comment on the utility of a normal lactate level in excluding mesenteric ischemia.

The conclusions to be drawn from the above literature are that an elevated plasma lactate level in mesenteric ischemia is likely a relatively late finding, and a normal laboratory value should not exclude the diagnosis. Emergency physicians must use clinical acumen in suspecting this diagnosis and consult a surgeon early to provide the best chance for a positive outcome. While waiting for a surgical consultation, emergency physicians should strongly consider ordering CT angiography to facilitate a diagnosis; however, this does not substitute for a surgical evaluation at the bedside.

**CRITICAL DECISION**

Are amylase and lipase levels useful as screening tests for pancreatitis in nonspecific abdominal pain?

Acute pancreatitis is a common etiology of abdominal pain, resulting in more than 200,000 hospital admissions yearly in the United States; it has an overall mortality rate of approximately 5%. The American College of Gastroenterology guidelines for the diagnosis of pancreatitis require that two of the following three criteria be met: 1) abdominal pain consistent with pancreatitis, 2) an increase in serum lipase and/or amylase levels to at least three times the upper limit of normal, and 3) CT scan images consistent with pancreatitis.\textsuperscript{17} It is common practice in many emergency departments to use the readily available serum amylase and lipase assays as “routine” tests in nonspecific abdominal pain; however, there is not any good evidence supporting this practice.

Amylase is a digestive enzyme produced predominantly by the exocrine pancreas and the salivary glands and is responsible for the digestion of starches into smaller carbohydrates.\textsuperscript{18} In acute pancreatitis the increased conversion of trypsinogen to trypsin leads to pancreatic injury and inflammation.\textsuperscript{17} The resultant obstruction of venous and lymphatic drainage from pancreatic and peripancreatic tissues often causes the serum amylase to rise. In acute pancreatitis it usually rises within 6 to 24 hours and returns to normal in 5 to 7 days.\textsuperscript{18} Unfortunately, it is well recognized that amylase levels are normal in approximately 20% to 30% of patients with acute pancreatitis. This is likely due to late presentation to medical care after amylase levels have returned to normal or in alcoholic pancreatitis and recurrent pancreatitis when the exocrine pancreas is no longer able to produce sufficient amylase. Finally, hyperlipidemia interferes with the serum amylase assay and can produce falsely low results.\textsuperscript{19,20}

Amylase is produced in small amounts by multiple organs and can be elevated in a wide range of gastrointestinal and nongastrointestinal conditions (Table 2). The magnitude of the serum amylase level does not correlate with disease severity in acute pancreatitis, and the return of the serum amylase level to normal does not guarantee clinical improvement.\textsuperscript{18}

Lipase is a pancreatic enzyme responsible for hydrolyzing triglycerides into monoglycerides and...
free fatty acids. It is mainly produced by the pancreas and has much less systemic distribution than amylase. However, certain nonpancreatic conditions are associated with elevated lipase levels (Table 3).

Because of the above considerations, when acute pancreatitis is suspected, the initial serum screening test should be lipase, not amylase. Sensitivity and specificity are not improved when ordering both tests.

Given these limitations, the role of “routine screening” with amylase and lipase levels in patients with nonspecific abdominal pain should be questioned. In a 2009 United Kingdom study, 1,540 patients presented to a large teaching hospital with abdominal pain and subsequently had amylase and lipase levels drawn despite a documented clinical suspicion of acute pancreatitis in only 7% of these patients. Of these 1,540 patients, 44 had acute pancreatitis (3%), but only two-thirds of these 44 had either amylase or lipase levels equal to or greater than three times the upper limit of normal. The remaining 16 patients had a radiographic diagnosis of pancreatitis. In addition, 41 of the 1,540 patients had significant amylase or lipase elevations and no pancreatitis. The best test was a lipase level equal to or greater than three times normal; this had a sensitivity of 64% and a specificity of 97% with a positive predictive value of 41% and a negative predictive value of 99% for acute pancreatitis. With the routine screening method employed for all complaints of abdominal pain, 115 patients needed to be screened to make each diagnosis of acute pancreatitis by serum amylase or lipase at a cost of $825.21

The emergency physician should order a lipase level to diagnose acute pancreatitis only when history and physical examination are compatible with this diagnosis. There is no utility in ordering an amylase level in addition to lipase. Neither lipase nor amylase should be used as screening tests in nonspecific abdominal pain. Acute pancreatitis is possible when both amylase and lipase levels are normal, thus a negative test does not definitively rule out disease, and further investigation is warranted if there is a strong clinical suspicion of pancreatitis.

CRITICAL DECISION
How should the evaluation of elderly patients with nonspecific abdominal pain differ from that for younger adults?

The elderly population (defined here as patients older than 65 years) is expanding rapidly, and emergency medicine is going to see a large shift in demographics as the elderly live longer and more baby boomers reach their eighth and ninth decades. The estimated mortality rate for an elderly patient presenting with abdominal pain is 10% to 14% (mortality from appendicitis alone is 4% to 8% in the elderly), and close to 33% of elderly patients will require surgery after presentation with abdominal pain.22 The elderly are more likely to present in atypical fashion, which explains why close to one-quarter of elderly patients requiring appendectomy are discharged home after their initial physician encounter.22 The elderly also may not seek care in a timely fashion, and they often have significant comorbid disease that affects morbidity and mortality.

The elderly are more likely than younger patients to have a nonspecific physical examination, normal laboratory markers, and unremarkable or atypical vital signs, despite the presence of acute abdominal pathology. Parker et al reviewed 231 elderly patients who presented with acute abdominal pain (1 week or less in duration) for differences in temperature or WBC count that might predict the need for surgical intervention.23 They found that 37% of the patients required surgical intervention and there was no significant difference in temperature curve or leukocytosis among patients who did or did not require surgery. Another study highlighting the difficulty of making an accurate diagnosis in the elderly focused specifically on appendicitis. Storm-Dickerson et al reviewed the presentation and evaluation of appendicitis in patients older than 60 years, contrasting the 10-year span from 1978 to 1988 with the period from 1988 to 1998.24 They discovered that the perforation rate was 72% from 1978 to 1988 and 51% from 1988 to 1998, despite a marked increase in the use of CT imaging for diagnosis. The rate of misdiagnosis was 54% from 1988 to 1998, which is staggering considering that 44% of patients received CT imaging.

The bottom line is that patients in this age group must be viewed as being at high risk for poor outcome and missed diagnoses every time they

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<th>Table 2. Nonpancreatic causes of elevated amylase</th>
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<td>Appendicitis</td>
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<td>Aspirin</td>
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<td>Azathioprine</td>
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<td>Burns</td>
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<td>Calcium</td>
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<td>Cholecystitis</td>
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<td>Diabetic ketoacidosis</td>
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<td>Ectopic pregnancy</td>
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<td>Estrogens</td>
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<td>Macroamylasemia</td>
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Critical Decisions in Emergency Medicine

6
present with abdominal pain. The history and physical examination must be meticulous, taking special note of comorbid disease that could cause or mimic abdominal pathology (eg, atrial fibrillation, heart failure, coronary artery disease). Emergency physicians should liberally order laboratory testing and ancillary imaging on these patients, and even if laboratory studies and imaging do not yield a diagnosis, admission for observation should be considered. It is within the national standard of care to admit more than 50% of elderly patients with abdominal pain. Those patients who are discharged should be reevaluated in 12 hours and given explicit discharge instructions outlining criteria that require immediate return.

CRITICAL DECISION

Does opiate administration alter the examination findings or outcome of patients with abdominal pain?

The appropriate timing of opiate pain medication administration in patients who have abdominal pain is controversial. When patients are scheduled to be evaluated by a surgeon, emergency physicians are ethically compelled to ease patients’ suffering while they await this consultation. The surgical concern is that opiates could alter the physical examination findings and mask indications of acute pathology requiring surgical intervention.

One of the most comprehensive explorations of this question was completed by Ranji et al who performed a metaanalysis of 12 studies evaluating the effect of opiates on the abdominal examination.25 Nine of the twelve studies enrolled patients with nonspecific abdominal pain while the other three studies included patients with right lower quadrant pain. Interestingly, the authors concluded that opiates likely did alter the abdominal examination findings, although the methodological differences between the studies made it difficult to assess whether this alteration affected patient care. Further calculations led them to estimate that 909 patients would have to be treated with opiates for one patient to potentially suffer from a management error directly related to the administration of opiates prior to the surgical examination. The authors concluded that there was insufficient evidence to show that opiate administration prior to a surgeon’s examination was more likely to result in adverse outcomes. Consequently, they recommend erring on the side of ethical treatment of the patient and providing analgesia to the patient with abdominal pain.

Any studies investigating this issue are inherently limited by the difficulty in randomizing and blinding the examining physicians. Furthermore, it is nearly impossible to eliminate the subjective variability that will be encountered by having multiple providers examine the patient and render their opinion on physical examination findings. Unfortunately, studies assessing the effect of opiate administration in abdominal pain are likely to dwindle in volume as the use of diagnostic imaging has risen sharply in recent decades. The surgeon and emergency physician may elect to use diagnostic imaging to answer questions not answered by the initial history and physical examination. Much of the initial debate surrounding this issue arose before the widespread use and availability of imaging as an adjunctive investigative tool. We conclude that at the present time there is no compelling literature to demonstrate that patients will be harmed by the early and judicious administration of opiate medications for their abdominal pain, and physicians should be ready to ease their patients’ suffering.

CRITICAL DECISION

What can be done to improve outcomes for patients with undifferentiated abdominal pain?

Emergency physicians can improve the care of patients with undifferentiated abdominal pain simply by using the tincture of time. The strategy of observation and repeat serial abdominal examinations is significantly underused by physicians intent on making a diagnosis and disposition expeditiously. However, sometimes the early use of imaging and laboratory testing may not be advantageous, especially in younger patients. Not only can CT imaging fail to yield a diagnosis, but younger patients could be harmed by the significant radiation exposure during their reproductive years.

Abdominal pain from possible appendicitis is an ideal example of a disease process that is quite amendable to an observation strategy. Abdominal pain patients with high probability of appendicitis need immediate surgery. Abdominal pain patients with very low probability of appendicitis may be released home with appropriate discharge instructions. But abdominal pain patients with low to moderate probability of appendicitis are appropriate candidates for evaluation with a short period of observation. Appendicitis evolves over hours and days, and it is generally thought that perforation requires at least 24 to 48 hours. In 1975, White et al used intensive observation in an attempt to decrease the rate of unnecessary laparotomies for appendicitis.26 They had surgeons perform physical examinations every

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<th>Table 3. Nonpancreatic causes of elevated lipase</th>
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<td>Azathioprine</td>
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Pearls

- In patients with suspected mesenteric ischemia, early surgical consultation is their best chance for survival.
- Become comfortable evaluating young patients with nonspecific abdominal pain by the selective use of laboratory testing instead of an “abdominal panel.”
- Order a lipase only if the history and physical examination are suggestive of pancreatitis.
- The elderly patient with abdominal pain is likely to have atypical signs, symptoms, and vital signs.

Pitfalls

- Ordering a CT scan to evaluate for appendicitis solely because of leukocytosis.
- Dismissing the possibility of mesenteric ischemia based on a normal lactate level.
- Not recognizing the myriad of intraabdominal processes that can cause an elevated lipase.
- Failing to administer pain medications to patients with severe abdominal pain while they wait for a surgical evaluation.
- Failing to continue evaluation and treatment of an elderly patient with abdominal pain by placing them in outpatient observation if the emergency department laboratory tests and imaging studies fail to reveal a diagnosis.

8 hours and were able to decrease the rate of unnecessary laparotomy from 15% to 1.9%. Researchers in Pennsylvania confirmed these findings by reviewing hospitals with and without strict observation programs for patients suspected of having appendicitis. Those hospitals with observation programs had significantly lower rates of finding a normal appendix in surgery.

Possible appendicitis is just one of the abdominal disease processes that could benefit from the use of observation. Other patients who may have a serious disease but most likely have a benign etiology such as gastroenteritis, gastritis, or gastroesophageal reflux can also benefit from observation. Although there are certain possible diagnoses such as mesenteric ischemia that need immediate intervention, most serious dangerous diseases such as appendicitis can be safely evaluated over the 8- to 24-hour time period available with outpatient observation.

To provide patients with observation services beyond the usual 3 to 4 hours that are usually provided to an emergency department patient, additional personnel and service area are required—additional physician and nurse services as well as additional space. Preferably an area of the emergency department can be designated for observation patients (an emergency department observation unit). If the department is overcrowded and there is no space for providing these additional services, these patients must be transferred to other parts of the hospital.

Those patients who are suitable for discharge need detailed instructions if they are diagnosed with “undifferentiated” abdominal pain. Do not falsely reassure the patient by providing a benign diagnosis (eg, reflux, gastroenteritis) if that diagnosis has not been confirmed in the emergency department; the patient may subsequently dismiss any change in their pain or symptoms as a consequence of the benign diagnosis and fail to return for reevaluation.

Simply by having a vague discharge diagnosis (eg, abdominal pain of uncertain etiology), the patient will be more likely to notice subsequent changes in pain or symptoms and return for reevaluation. It is also prudent to have a specific followup day and time for the patient with undifferentiated abdominal pain. The standard is to have these patients reevaluated within 12 hours. If they cannot be seen by their primary provider in that time frame, have them return to the emergency department for a reevaluation.

Case Resolutions

- **Case One**
  In the case of the 30-year-old woman with diffuse abdominal pain and tenderness to moderate palpation in all quadrants, her urinalysis and urine pregnancy were both negative, and her WBC was 14,000 cell/mm³ without a left shift. The emergency physician opted to use an observation strategy in her management, and within 6 hours all of her symptoms had resolved and she was tolerating clear liquids. She was discharged with instructions to return in 12 hours for reevaluation in the emergency department or with her primary doctor.

- **Case Two**
  In the case of the 75-year-old man with severe abdominal pain, the emergency physician suspected acute SMA occlusion based on the patient’s presentation and his history of atrial fibrillation. The lactate was not elevated, but the emergency physician strongly suspected mesenteric ischemia and called a surgeon to evaluate the patient immediately while simultaneously ordering a CT angiogram. The CT angiogram confirmed the diagnosis of acute SMA occlusion, and the patient went to the operating room for embolectomy.

Summary

Abdominal pain is a common presentation in the emergency department, the workup is costly and
time consuming, and despite this there remains a 20% to 40% chance of not arriving at a specific diagnosis. It is imperative to use resources wisely and resist the temptation to order laboratory testing in young patients with nonspecific abdominal pain. The elderly patient must be considered separately, and it is prudent to order laboratory testing and diagnostic imaging in liberal fashion in search of a diagnosis in this population. They have a higher likelihood of surgical disease and have a significant risk of mortality from abdominal pain complaints. If the evaluation does not yield a diagnosis, then a strategy of observation and repeat examinations may be warranted. Finally, remember to provide pain relief to your abdominal pain patients as there is no evidence to suggest they will be harmed and it is your ethical duty to relieve suffering.

References

The LLSA Literature Review

“Infection in solid-organ transplant recipients” reviewed by Jennifer Martindale, MD, and J. Stephen Bohan, MD, MS, FACEP; Harvard Affiliated Emergency Medicine Residency, Brigham and Women’s Hospital


A fundamental challenge in transplant medicine is balancing the risks of transplant recipient infection and allograft rejection. Infection is an inherent part of a patient’s post-transplant course. Early diagnosis is essential, despite a broader differential for and more subtle manifestations of infection in this group of patients.

Several sources of infection must be considered. The transplant donor is an important source of both latent infection and active infection undetected by routine screening assays. Pathogens that may be transmitted with the allograft include cytomegalovirus, tuberculosis, Trypanosoma cruzi, herpes simplex virus, human immunodeficiency virus, West Nile virus, hepatitis virus, and Epstein-Barr virus. Altered mental status and hepatitis may be signs of donor-derived infection.

Distant exposures to pathogens associated with hobbies (Cryptococcus neoformans) and travel (Histoplasma capsulatum, Coccidioides immitis, tuberculosis) in the transplant recipient can develop into active and fulminant infection if not eradicated prior to transplant. Transplant patients can also become ill from common community-acquired and hospital-acquired infections.

The differential diagnosis of infection in the solid-organ transplant recipient is based on a timeline that starts with the date of transplantation. Within the first month post-transplant, patients are more susceptible to donor- and recipient-derived infections than to opportunistic infections. Between 1 and 6 months after transplant, patients are at increased risk for viral (polyomavirus BK, adenovirus) and fungal infections. Immunosuppressive therapy is typically tapered 6 months after transplant, decreasing the risk of opportunistic infections. However, transplant patients continue to be at increased risk for community-acquired infections. This timeline may be restarted when allograft rejection calls for intensification in immunosuppressive therapy.

Infection in the transplant patient has been greatly reduced by prevention strategies. Prior to transplant, candidate recipients will be immunized against measles, mumps, rubella, diphtheria, pertussis, tetanus, hepatitis B, poliovirus, varicella, influenza, and pneumococcal pneumonia. After transplantation, patients universally take prophylaxis: trimethoprim-sulfamethoxazole (to prevent pneumocystis pneumonia, Toxoplasma gondii, Isospora, Cyclospora, Nocardia, and Listeria) and oral antiviral agents (to prevent cytomegalovirus and other herpes viruses). Transplant patients may also undergo routine surveillance of subclinical infection with sensitive quantitative assays. Preemptive treatment with antimicrobials begins if an assay is positive.

**Highlights**

- Sources of infection to consider in the transplant patient include donor-derived pathogens, recipient-derived pathogens, and nosocomial and community-acquired pathogens.
- Patterns of infection depend on time from transplant date, current immunosuppressive regimen, and antimicrobial prophylaxis.
- Effective prophylaxis against opportunistic infections and the development of new diagnostic assays has altered the epidemiology of post-transplant infection.
Delirium in Elderly Patients

Jonathan M. Glauser, MD, FACEP

■ Objectives
On completion of this lesson, you should be able to:

1. Describe characteristics of delirium that distinguish it from dementia.
2. Define delirium in clinically relevant terms.
3. Explain the evaluation needed to discover reversible causes of alterations in mental status.
4. Compare and contrast medical emergencies that affect mentation.
5. Discuss treatment modalities that minimize risk for development of delirium.
6. Describe the role of emergency medicine in diagnosing and treating entities that immediately affect the independent functioning of patients.

■ From the EM Model
14.0 Psychobehavioral Disorders
14.5 Organic Psychoses

Delirium is a condition characterized by loss of reasoning and recent onset of confusion. With the aging of the general population, this becomes an important problem for providers caring for elderly patients. Recognition of delirium, correction of underlying factors, and prevention and treatment of its causes become paramount, as delirium has been demonstrated to be related to poor outcomes, including nursing home placement, functional decline, and death. Since delirium is associated with longer hospital stays, it is an expensive problem as well. Delirium resulted in $6.9 billion in extra hospital costs in 2004 dollars.1

The role of emergency medicine in the detection, diagnosis, and prevention of delirium, with attendant investigation of medication use, investigation of infection, and provision of appropriate stimuli, is evolving and may be critical. Rates of delirium are highest among hospitalized older patients. One study of 297 elderly emergency department patients indicated that 26% had mental status impairment. Of these 78 patients, only 22 had any documentation of mental status impairment by an emergency physician, and 37% of those with delirium were discharged home.2 Older patients may not appear sick apart from their behavioral change, making it particularly important to take seriously complaints by family members or caregivers that a patient has not been acting right.

Management of this common problem entails identification and treatment of the underlying illness, as well as avoiding factors known to cause or aggravate delirium. Although restraints can exacerbate the delirium, dangerous and disruptive behaviors must be controlled. Patients could sustain injuries from falling, combative ness, or pulling out catheters or intravenous lines.

■ Case Presentations

■ Case One
A 78-year-old woman presents after a home health care provider found her lying on the floor of her home. It is unknown how long she had been lying there. On arrival, the patient is talking loudly and incoherently. She is argumentative and demands to know where she is. She is combative when nurses attempt to undress her and refuses blood draws. Her vital signs are blood pressure 154/96, pulse rate 88 and regular, respiratory rate 18, and pulse oximetry 94% on room air. A few minutes later she is found wandering down the hallway; it takes several staff members to get her into a treatment room. Her neurologic examination is nonfocal, and her lungs are clear to auscultation. The abdomen shows poorly localized lower abdominal discomfort and slightly diminished bowel sounds. There is no rash.

■ Case Two
An 85-year-old man presents with his daughter, who reports that he has
Critical Decisions

- How can delirium be differentiated from dementia?
- What are the underlying chemical imbalances that cause delirium?
- What information is most important to obtain from a patient’s history to elucidate the cause of delirium?
- What assessment tools are available for the evaluation of mental status?
- What laboratory tests are indicated in the evaluation of patients with delirium?
- What environmental factors place patients at risk for delirium?
- What are the “can’t miss” diagnoses causing delirium?
- What is the pharmacologic management of delirium in the elderly?
- What are the roles of encephalography, lumbar puncture, and neuroimaging in the evaluation of delirium?

seemed to lack energy for the past day or two and did not want anything to eat or drink for the past day. He is sleepy but is pleasant when engaged by the physician in conversation. He does not have any complaint of pain, although he seems to be a bit short of breath. It is difficult to elicit any specific history from the patient. His daughter gives nearly the entire history and says that he “hasn’t been himself” for the past 2 days. On examination, the patient’s vital signs are blood pressure 105/70, pulse rate 52, respiratory rate 22, and pulse oximetry 92% on room air. An ECG reveals T-wave inversions and Q waves in the inferior leads, and his troponin level is 0.36. He is oriented to name only, although he knows he is in a hospital. Motor function is grossly normal; lungs show bibasilar crackles, and the abdomen is nontender. A chest radiograph shows cardiomegaly and pulmonary venous congestion.

**Case Three**

A 66-year-old man is brought in by ambulance. His daughter had called him at home and, when he did not answer, she went to check on him and found him lethargic and confused. He has a history of diabetes but no prior heart disease or stroke. In the emergency department, he answers questions related to his name but falls asleep easily. Vital signs are blood pressure 145/97, pulse rate 77 and regular, respiratory rate 20, and temperature 37.8°C (100°F). He falls asleep intermittently during the interview and arouses to shout that there is a large rat in the room and yells that the staff is trying to poison him with tainted food. His ECG shows left ventricular hypertrophy and a sinus rhythm. His neurologic examination is nonfocal.

**Delirium**

The percentage of elderly emergency department patients with delirium at the time of hospital admission may be as high as 25% and may approach 50% among the hospitalized elderly.\(^1,3,4\) Up to one quarter of all emergency department patients over age 70 have impaired mental status or delirium. Up to 30% of older medical patients experience delirium at some time during their hospitalization.\(^1,5\)

Although vital signs are obtained for every patient who is evaluated in the emergency department, acute mental confusion in an elderly patient may be a more accurate herald of physical illness than fever, pain, or tachycardia. In the aged, delirium can result from nearly any physical illness or intoxication with even therapeutic doses of commonly used drugs.\(^6\)

After correcting for baseline covariates such as age, gender, baseline dementia, functional status, and illness severity/APACHE II score, delirium present on admission has been demonstrated to be a powerful predictor of death, new nursing home placement, and functional decline.\(^7\)

The incidence of delirium is high in hospice units, emergency departments, postacute settings, and, especially, in ICUs, where it may be as high as 70%.\(^8\) Because there are so many etiologies, it seems unlikely that there is a single underlying mechanism for delirium. Because these patients have underlying medical illness, are often in postoperative or intensive care settings, and may be on multiple medications, these and other confounding factors make isolated study of delirium difficult.

Delirium involves an acute confusional state. There is alteration in mental status, with symptoms referable to impairment of attention and cognition. It is characterized by alteration of consciousness, with reduced ability to focus. The disturbance is typically caused by a medical condition, including substance intoxication, medication side effect, and medicine withdrawal. Fluctuating awareness, impairment of memory and attention, and disorganized thinking characterize delirium.\(^9\)

Loss of mental clarity may be subtle; family members and caregivers may report that the patient had not been “acting right.” It is important to learn from them what the patient’s prior level of functioning was, since dementia frequently is an underlying factor. The patient may alternately appear agitated, excessively drowsy, or hypervigilant.\(^3\)
CRITICAL DECISION
How can delirium be differentiated from dementia?

Delirium generally develops over hours to days. Symptoms can be intermittent, with the result that different observers note different behaviors over a given time period. The acuteness of the symptoms is particularly helpful in differentiating delirium from dementia. Because either state can be described as a “confusion,” the diagnosis can be missed both in the emergency department and in inpatient wards. Eliciting a history of mental status change from family members or caregivers should trigger an investigation as to the cause for acute mental status change. Hallucinations associated with delirium tend to be visual, while those associated with acute psychosis are more likely to be auditory.

Dementia increases the risk of developing delirium, and delirium is associated with increased risk of developing dementia. Whether delirium initiates the process of cognitive decline or simply unmasks subclinical dementia is unclear.

The American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders, 4th edition, lists four features that characterize delirium, as follows: 1) disturbance of consciousness, with reduced ability to focus, sustain, or shift attention; 2) a change in cognition or development of a perceptual disturbance not accounted for by an established or evolving dementia; 3) development of symptoms over the course of hours to days, fluctuating during the course of the day; and 4) evidence that the disturbance is caused by a medical condition, substance intoxication, or medication side effect.

Confusion, a characteristic of delirium, entails a reduced attention span and a problem with coherent thinking. Cognitive abnormalities typically worsen at night. Disturbances in attention often increase in the evening, a concept called “sundowning,” and staff who work evening or night shifts may be more apt to detect behavior change.

Dementia entails a loss of mental capacity. This develops chronically, rather than over the course of hours to days. Most cases in the United States are due to Alzheimer disease. Cognitive change in Alzheimer disease is progressive and occurs over months to years. Remote memory and attention remain intact during the early stages.

The differences between delirium and dementia have been emphasized more in older literature. Patients diagnosed with delirium and treated appropriately often do not return to their baseline functional status, so with cases of persistent delirium and reversible dementia, the differences between dementia and delirium can become quite blurred. From the perspective of emergency patients, the correct approach is to assume delirium and rule out reversible causes for altered mentation.

As noted above, even if there is a reversible cause of delirium, the symptoms may persist. Only approximately 20% of elderly patients had resolution of all new symptoms of delirium at 3 to 6 months after hospital discharge, indicating that delirium often is not completely reversible.

CRITICAL DECISION
What are the underlying chemical imbalances that cause delirium?

Because delirium can be caused by a variety of medications, withdrawal states, and infectious and metabolic processes, it has been postulated that neurotransmitter disturbances may be a common underlying factor. Acetylcholine deficiency and dopamine excess have been cited, making it critically important to investigate patients’ use of medications with anticholinergic effects. Drugs such as narcotics, benzodiazepines, and medications with anticholinergic effects, might be the sole cause for delirium in about one-quarter of cases.

Anticholinergic activity of medications has been linked to cognitive impairment, delirium, and dementia. One review of clinical databases analyzed the impact of anticholinergics and noted that medications with anticholinergic activity often negatively affect the cognitive performance of older adults. This study was undertaken with the knowledge that, of the 36 million Americans aged 65 and older in 2005, an estimated 20% to 50% of them took medications with some anticholinergic activities. The routine treatment of asthma, urinary incontinence, and certain psychiatric conditions may include anticholinergic medications. However, several other medications have anticholinergic effects and can contribute to attention deficits and hallucinations (Table 1). Many drugs used by older adults can lead to anticholinergic activity when measured by radioreceptor binding. Given that elderly patients may have age-related impairment in hepatic metabolism and in renal excretion of medications, as well as a significant decrease in cholinergic neurons, the central nervous system of older patients may be particularly susceptible to the effects of anticholinergic medications. A reduction in the anticholinergic drug burden to the patient may improve cognitive impairment, although the extent and duration of reduced exposure required to achieve a clinically significant improvement remains to be determined.

Dopamine agonists have also been implicated as causing delirium or confusional states. These include amantadine, bromocriptine, levodopa, pergolide, ropinirole, and pramipexole. A relative excess of dopamine has been cited as a cause of delirium and may explain why dopamine blockers such as haloperidol provide relief of symptoms. Dopaminergic excess contributing to delirium may be related to its regulatory influence on the release of acetylcholine.
Neurotransmitters such as serotonin, norepinephrine, γ-aminobutyric acid (GABA), and melatonin, among others, may have a role as yet undefined.\(^3\)

Elderly people do not metabolize medications as well as younger patients do, making drugs common precipitants of delirium. There may be several factors working in concert to cause delirium: infection or change in medication superimposed on a person with multiple chronic diseases.\(^9\)

There are undoubtedly other less well-defined chemicals that might have a role in delirium. Cerebrospinal fluid studies of patients with delirium have shown abnormalities in endorphins, serotonin, norepinephrine, and GABA.\(^18\)

**CRITICAL DECISION**

**What information is most important to obtain from a patient’s history to elucidate the cause of delirium?**

A broad range of clinical abnormalities can precipitate delirium. A history of any recent febrile illness could indicate systemic infection. A history of organ failure should be applied broadly to include liver, kidney, pancreas, heart, endocrine, and neurologic disease.

Obtaining a medication list may be both paramount and difficult. Over-the-counter agents can be responsible for mental status changes and are not always listed by the family or by the patient. Drugs prescribed by other physicians may not appear on the medical record. Drugs prescribed to other household members may be available to the patient.

A history of alcohol or drug abuse may provide insight into alterations in behavior or mentation. Any history of recent depression should be elicited.

**CRITICAL DECISION**

**What assessment tools are available for the evaluation of mental status?**

There are a number of tests for mental status in the literature. Some of the better known ones are presented here.

The Confusion Assessment Method (CAM) uses four criteria to differentiate delirium from dementia:\(^19,20\)

1. Acute onset and fluctuating course: Is there evidence of an acute change from the patient’s baseline behavior? Does it come and go? Does it increase or decrease in severity during the course of the day?
2. Inattention: Does the patient have difficulty focusing? Does he/she have trouble keeping track of what is said? Can they recite the days of the week backwards?
3. Disorganized thinking: Is the patient’s speech rambling, disorganized, or incoherent? Is there illogical flow of ideas? Is there unpredictable switching from subject to subject?
4. Altered level of consciousness: Is the patient hyperalert, drowsy, difficult to arouse, or in a coma? Anything except “alert” is considered abnormal.\(^21\)

The Orientation-Memory-Concentration Test (OMC) examination for cognitive impairment is another series of brief questions to evaluate cognitive impairment.

1. What year is it now?
2. What month is it now?
3. Repeat this phrase after me: “John Brown, 42 Market Street, Chicago.”
4. About what time is it?
5. Count backwards from 20 to 1
6. Say the months in reverse order
7. Repeat the memory phrase Each question is weighted, and a score above 20 represents severe impairment.\(^22\)

The Mini Mental Status Examination has been employed for more than three decades. It includes the following tasks, with a point scale attached:

1. What is the date? (year)(season) (date)(day)(month) – 5 points
2. Where are we right now? (state) (county)(town)(hospital)(floor) – 5 points
3. Name three objects: Give one point for each correct answer – maximum score 3 points
4. Serial 7’s: subtract 7’s from 100 consecutively; one point for each correct answer up to 5 answers – maximum score 5 points. Alternatively, spell

<table>
<thead>
<tr>
<th>Table 1. Medications with anticholinergic activity commonly used in older people(^5)</th>
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<tr>
<td><strong>Antihistamines</strong></td>
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<td>Chlorpheniramine</td>
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<td>Meclizine</td>
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<td>Promethazine</td>
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<td><strong>Antispasmodics</strong></td>
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<td>Dicyclomine</td>
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<td>Hyoscyamine</td>
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<td><strong>Tricyclic antidepressants</strong></td>
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<td>Doxepin</td>
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<td>Imipramine</td>
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<td><strong>Benzodiazepines</strong></td>
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<td>Alprazolam</td>
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<td><strong>Analgesics</strong></td>
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<td>Codeine</td>
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<td><strong>Antiarhythmics</strong></td>
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<td>Digoxin</td>
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<td>Furosemide</td>
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<td><strong>Antiparkinsonism drugs</strong></td>
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<td>Orphenadrine</td>
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<td>Trihexyphenidyl</td>
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<td><strong>Bronchodilators</strong></td>
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<td>Theophylline</td>
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<td><strong>Bladder antispasmodic</strong></td>
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<td>Oxybutynin</td>
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<td><strong>Antiparkinsonism (sialorrhea)</strong></td>
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<td>Glycopyrrolate</td>
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<td><strong>Antacid/GERD</strong></td>
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<td>Cimetidine</td>
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<td>Ranitidine</td>
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<td><strong>Plants</strong></td>
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<td>Deadly nightshade</td>
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<td>Henbane</td>
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<td>Jimsonweed</td>
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<td>Mandrake</td>
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<td><strong>Ophthalmic drugs</strong></td>
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<td>Atropine</td>
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<td><strong>Cyclopentolate</strong></td>
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14
Table 2.
Laboratory and radiologic testing that could reveal causes for delirium

| Arterial blood gases                     |
| CBC                                      |
| Cerebrospinal fluid testing for infection (lumbar puncture) |
| Chest radiograph                        |
| Cortisol levels, test for B12 deficiency |
| Drug levels                              |
| ECG                                      |
| EEG                                      |
| Electrolytes, including magnesium and calcium |
| Hepatic function tests, ammonia levels  |
| Neuroimaging: Head CT scan, MRI         |
| Pulse oximetry                           |
| Renal function tests                    |
| Serologic tests for syphilis, HIV       |
| Thyroid function                         |
| Toxicologic screening                    |
| Urinalysis                               |

“world” backwards – 1 point for each correct letter
5. Repeat the three objects listed above – 1 point for each object
6. Show the patient a pencil and a watch and ask the patient to name them – 2-point maximum
7. Repeat the phrase: “No ifs, ands, or buts”. No repeats allowed – 1 point maximum
8. Follow a three-stage command: “Take a paper in your right hand, fold it in half, and put it on the floor” – score 1 point for each correct action
9. On a blank piece of paper, write “close your eyes” and ask the patient to read and do what it says – 1 point
10. Give the patient a blank piece of paper and ask him/her to write a sentence. The sentence must contain a noun and verb and be sensible – 1 point
11. Ask the patient to copy a design. All angles must be present and two must intersect – 1 point
The maximal score on the MMSE is 30 points. A score of less than 24 points is suggestive of dementia or delirium. The test does not reliably distinguish between the two.

There are other behavior evaluation scales. The Delirium Rating Scale was developed to measure the severity of delirium. It assesses temporal onset, behavior, severity of illness, cognition, mood, sleep, and perceptual disturbances. The Confusion Rating Scale was developed for simple and rapid nursing assessment, and measures disorientation, inappropriate behavior, inappropriate speech, and hallucinations.

**CRITICAL DECISION**
What laboratory tests are indicated in the evaluation of patients with delirium?

The list of diseases that can induce delirium is very long. Clearly, not all patients should undergo the same complete diagnostic workup with its attendant costs and delay in therapy. Targeted testing may include serum electrolytes, including calcium, creatinine, CBC, urinalysis, and urine culture. Blood gas testing may reveal respiratory alkalosis associated with liver failure, sepsis, or salicylate intoxication or it can reveal respiratory acidosis caused by carbon dioxide retention from pulmonary abnormalities such as exacerbations of chronic obstructive pulmonary disease or pneumonia or congestive heart failure. Liver function testing, thyroid function, vitamin B12 levels, and chest radiograph can reveal underlying pathology. Testing should be based on clinical findings specific to each patient (Table 2).

**CRITICAL DECISION**
What environmental factors place patients at risk for delirium?

Anything that affects a person’s orientation can place that person at risk for delirium. Frequent room changes within the hospital, absence of a clock or watch, or absence of reading glasses are examples. Physical or chemical restraints and absence of familiar faces such as family members can exacerbate the process. Early mobilization, walking, management of sleep and anxiety without the use of drugs, and addressing hearing impairment to keep the patient aware of his or her surroundings all may help.

The risk for delirium and confusional states is increased with brain disorders such as dementia, stroke, and parkinsonism. Dementia may have been unrecognized prior to the development of delirium. Advanced age and hearing and visual impairment increase vulnerability to delirium. Potential precipitating factors are numerous and include infection, psychoactive drugs, dehydration, malnutrition, and immobility, including use of restraints. Use of bladder catheters has been associated with delirium as have polypharmacy and a wide variety of metabolic disorders. Table 3 enumerates some risk factors and Table 4 enumerates precipitating factors for delirium.

There is evidence that removal of disorienting factors may prevent delirium. Environmental modification and nonpharmacologic sleep aids can diminish insomnia. Early mobilization and minimizing restraints for patients with limited mobility have shown efficacy. Providing patients with access to clocks, calendars, and windows with outside views, as well as eyeglasses and assistive hearing devices has been demonstrated to decrease the duration and number of delirium episodes.

**CRITICAL DECISION**
What are the “can’t miss” diagnoses causing delirium?

A wide variety of medical conditions can precipitate delirium in susceptible persons. Patients with alteration in mental status have generally been admitted to the hospital. However, with increasing pressure to decrease in-hospital stays and in the interest of diagnosing life-threatening illness rapidly, ruling
out certain underlying precipitants becomes of paramount importance in the emergency department. Some causes are enumerated in Table 5.

Pharmacologic causes, including alcohol/sedative-drug withdrawal (SSRI, barbiturates, benzodiazepines), as well as drug/alcohol toxicity, should be investigated. Anticholinergic toxicity must be recognized, although absence of tachycardia, fever, or mydriasis may make it more difficult.

Sepsis, whether from pneumonia, urinary tract infection, skin and soft-tissue infections, or meningitis, must be identified. Myocardial infarction may present with confusion without chest pain. Fluid and electrolyte disturbances (hypernatremia, hyponatremia, uremia, liver failure, hypoglycemia, hypercalcemia, thyrotoxicosis) may present with altered mentation and are reversible. Hypoxemia from any cause must be addressed.

Low perfusion states include shock from any cause and heart failure.

Adrenal failure and other endocrinopathies should be investigated when other causes are not found. The possibility of ongoing seizures or post-ictal state should be considered.

CRITICAL DECISION
What is the pharmacologic management of delirium in the elderly?

Firstly, physical restraints should be avoided if at all possible, as there is risk of pressure ulcers, prolonged delirium, aspiration, and loss of mobility.

Clearly, pharmacologic causes for the delirium should be addressed, and any offending medications discontinued. This especially applies to minimization of the use of sedative-hypnotics, narcotics, and anticholinergics. That said, intermediate-acting benzodiazepines are preferable in elderly patients. Lorazepam can be administered orally or parenterally and has no known active metabolites.3 Lorazepam administered intravenously is effective within 5 minutes but can worsen confusion and sedation.

Haloperidol has a longer history of use and is less costly than newer atypical antipsychotic agents such as olanzapine, quetiapine, ziprasidone, and risperidone. Risperidone, 0.5 mg twice daily; olanzapine, 2.5 to 5 mg daily; or quetiapine, 25 mg twice daily, may be acceptable alternatives but do not have the track record of haloperidol in the pharmacologic treatment of delirium.28

High-dose haloperidol has a higher rate of extrapyramidal side effects than does low-dose haloperidol (0.5 to 1 mg orally or intramuscularly) or the other atypical antipsychotic agents. Haloperidol is associated with a low risk of hypotension and sedation. It is preferable as well because it has few anticholinergic side effects.3 Atypical antipsychotics are preferable to use of haloperidol in patients with parkinsonism.29

CRITICAL DECISION
What are the roles of electroencephalography, lumbar puncture, and neuroimaging in the evaluation of delirium?

Electroencephalography is useful in patients with an altered level of consciousness in order to exclude subclinical or nonconvulsive seizures. Nonconvulsive seizures lack any motor findings but can cause impaired or fluctuating consciousness. The electroencephalogram (EEG) can also confirm the diagnosis of some metabolic or infectious encephalopathies that have characteristic EEG patterns.

Work in the 1940s indicated that delirium was a disturbance of global cortical function, with the appearance of abnormal, slow-wave activity and slowing of the dominant posterior alpha rhythm. These findings correlated with level of consciousness and other behaviors regardless of the underlying cause.30 Fast-wave, low-voltage activity may predominate in alcohol or drug withdrawal. Findings on EEG were so consistent that an EEG can be used to establish the diagnosis of delirium when the diagnosis is in doubt.

Nonconvulsive status epilepticus can present with aphasia, facial twitching, and unexplained nystagmus. This requires an EEG for diagnosis and management.32 In one study evaluating 198 EEGs for the indication of altered consciousness, definite or probable nonconvulsive status epilepticus was reported in 37%.32 Although not necessarily an emergency test, an EEG should be considered in the evaluation of any patient with altered consciousness not otherwise explainable. Some consider the EEG to be the method of choice in confirming the clinical diagnosis of delirium and in providing a measure of its severity.31

The role of lumbar puncture (LP) is not well defined. Certainly, older patients with meningitis are unlikely...
to present with the classic triad of fever, headache, and meningismus. Bacterial meningitis is an unusual disorder. In a retrospective study of 81 elderly patients admitted to the hospital for evaluation of fever and mental status changes, cerebrospinal fluid cultures were negative for bacteria in 80 cases. LP is still considered mandatory when the cause of delirium is not obvious. The threshold for performing an LP should be lower in a febrile patient.

Computed tomography (CT) should be used selectively, although neuroimaging is mandatory if patient history and laboratory findings do not give a cause. The emergency physician need not employ CT universally if there is an identifiable underlying medical condition, no history of trauma, no focal neurologic signs, and the patient is arousable and able to follow simple commands. That said, one series of CT scans performed in 123 medical ICU patients indicated new CT findings present in 26, leading to a change in diagnosis in 11 and a change in treatment in 6. There were 13 cases of cerebral infarction, intracranial hemorrhage in 2, and tumor in 3.

MRI is more sensitive than CT for acute stroke, posterior fossa lesions, some white matter lesions, and inflammatory lesions such as reversible posterior leukoencephalopathy and acute disseminated encephalomyelitis. Whether these findings on MRI will influence the immediate treatment course in critically ill patients remains to be established.

**Case Resolutions**

**Case One**

The agitated woman who had been found on the floor of her home required sedation with haloperidol before she would cooperate for testing. A niece was contacted and brought her medications, which included amitriptyline for sleep, furosemide and digoxin for chronic congestive heart failure, ranitidine for presumed gastritis, and diphenhydramine for skin pruritus. This was treated successfully, and her anticholinergic medications were discontinued. Unfortunately, she did not regain enough cognitive function to live independently and was discharged after an 8-day hospital stay to an extended nursing care facility.

**Case Two**

The 85-year-old man was found to have had an inferior myocardial infarction, although its age could not be determined. The patient required placement of a temporary pacemaker for bradycardia as low as 38 beats per minute. The family declined cardiac catheterization after his ejection fraction was noted on echocardiography to be 10%. A permanent pacemaker was placed, and he was discharged to the care of his family. He remained awake, although he never regained orientation to date or location. He entered a hospice program and died 2 months later.

**Case Three**

The laboratory work-up of the somnolent 66-year-old man revealed a blood glucose of 253 and a serum creatinine of 3.45, increased from a baseline of 0.94 checked 3 weeks earlier. His urinalysis had to be obtained via catheter and revealed an output of over 1,200 mL. He was hydrated, his urinary catheter remained in, and his creatinine fell to 1.2 after 1 week. A urology consultation was obtained, and the patient ultimately underwent a transurethral resection of his prostate. After a 2-week hospital stay, he was discharged to home with assisted care for meals. He was able to urinate and function otherwise independently on discharge.

**Summary**

Delirium is a clinical syndrome characterized by a disturbance in level of consciousness with reduced ability to focus, sustain, or shift attention. It may have protean medical and surgical causes including medication side effects and substance intoxication or withdrawal. It is very common among older medical patients during hospitalization and in the emergency department. Altered cognition may be characterized by agitation or by

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**Table 5.**

<table>
<thead>
<tr>
<th>“Can’t miss” (ie, potentially reversible) causes for delirium</th>
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<tbody>
<tr>
<td>Alcohol/sedative-drug withdrawal (SSRI, barbiturates, ethanol, benzodiazepines)</td>
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<tr>
<td>Anticholinergic toxicity, perhaps without tachycardia, fever, or mydriasis</td>
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<tr>
<td>Drug/alcohol toxicity</td>
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<tr>
<td>Endocrine: thyroid, parathyroid, adrenal failure</td>
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<tr>
<td>Fluid and electrolyte disturbances (hypernatremia, hyponatremia, uremia, liver failure, hypoglycemia, hypercalcemia, thyrotoxicosis, magnesium)</td>
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<tr>
<td>Head injury</td>
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<tr>
<td>Hepatic encephalopathy</td>
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<tr>
<td>Hypertensive encephalopathy</td>
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<tr>
<td>Hypoxemia</td>
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<tr>
<td>Low perfusion states: shock, heart failure</td>
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<tr>
<td>Myocardial infarction may present with confusion without chest pain</td>
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<tr>
<td>Other medication side effects: serotonin syndrome, inhaled toxins (cyanide, carbon monoxide)</td>
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<td>Seizures, nonconvulsive status epilepticus</td>
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<tr>
<td>Sepsis: pneumonia; urinary, skin, and soft-tissue infections; meningitis; encephalitis; brain abscess</td>
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<tr>
<td>Uremia</td>
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lethargy. Focal neurologic findings are not characteristic.

The differential diagnosis is broad, mandating careful investigation of past medical history, review of medications and substance abuse, and possible extensive laboratory and neuroimaging workup. This is a potentially reversible state, and emergency physicians should be aggressive in diagnostic and therapeutic management. Cognitive assessment in infirm older patients may improve detection rates and prevent delirium in a significant number of patients, with attendant improved outcomes. Signs of delirium may persist for many months and may indicate future health problems and loss of independence. Management entails identification of underlying causes, nonpharmacologic interventions, and pharmacologic therapy to manage the acute effects of delirium.

### Pearls
- Delirium is associated with poor outcomes, including nursing home placement, functional decline, longer hospital stays, and death.
- Older patients with an acute illness may not appear sick apart from their behavioral change.
- Acute mental confusion in an elderly patient may be a more accurate herald of physical illness than fever, pain, or tachycardia.
- Delirium implies an acute confusional state that generally develops over hours to days.
- A history of mental status change from family members or caregivers should prompt an investigation for reversible causes.
- Dementia increases the risk of developing delirium, and delirium is associated with increased risk of developing dementia.
- From the perspective of emergency patients, it is safer to assume delirium and to look for reversible causes for altered mentation.
- An estimated 20% to 50% of the elderly may be taking medications with some anticholinergic activities.

### Pitfalls
- Failure to recognize an acute decline in mental status and vigorously pursue medical workup.
- Failure to investigate patients’ use of medications with anticholinergic effects; acetylcholine deficiency and dopamine excess have been associated with delirium.
- Failure to recognize that elderly persons may not metabolize medications well, making drugs common precipitants of delirium.
- Failure to recognize occult infection as a precipitant of acute mental status change.
- Failure to assess for and document cognitive impairment in a patient with altered mentation.
- Use of iatrogenic therapies that can exacerbate delirium: restraints, urinary catheters, rooms without windows or clock, absence of hearing aids and eyeglasses, and multiple room changes.

### References


Sinus rhythm with intermittent runs of nonsustained ventricular tachycardia (VT), VT rate 150. The first QRS complex is narrow and preceded by upright P waves in leads I, II, and III indicating underlying sinus rhythm. The rhythm then becomes VT (P waves are found within some of the T waves, indicating atrioventricular dissociation); after an 8-beat run of VT, sinus rhythm recurs for 2 beats, then another run of VT begins. VT is defined as a ventricular rhythm of 3 or more beats at a rate faster than 110-120/minute. If the rhythm lasts 30 seconds or less, it generally is referred to as nonsustained VT; if longer than 30 seconds, it is referred to as sustained VT.

Feature Editor: Amal Mattu, MD, FACEP
**The Critical Image**

**A middle-aged, unidentified man found by a roadside by police, minimally responsive.** EMS reported the patient was febrile to 39.4°C (103°F). In the emergency department, vital signs are blood pressure 128/80, heart rate 100, respiratory rate 14, and oral temperature 36.9°C (98.4°F). Oxygen saturation is 100% on room air, and glucose is 90. The examination showed no evidence of trauma and was normal except for a disheveled appearance, an odor of alcohol, and a Glasgow Coma Scale score of 10. A head CT was rapidly performed.

A: Noncontrast CT demonstrated a hypodense mass in the region of the patient’s left thalamus, internal capsule, and basal ganglia. The mass is exerting mass-effect, partially effacing the anterior horn of the left lateral ventricle and creating some midline shift.

B: Intravenous contrast was then administered and revealed ring-enhancement.

Noncontrast CT is sufficient for many immediate management decisions. In this case, CT ruled out a traumatic injury and revealed a mass and the presence of mass-effect, a contraindication to lumbar puncture, which had been anticipated in this patient to evaluate for meningitis, given the presence of fever and altered mental status.

Hypodensity on noncontrast CT can suggest regional cerebral edema such as vasogenic edema from a neoplasm or cytotoxic edema from ischemic infarction. Intravenous contrast can reveal subtle lesions on brain CT or provide additional information about more obvious lesions. Vascular abnormalities, infections, and neoplasms often demonstrate characteristic patterns of contrast enhancement. Ring-enhancement suggests toxoplasmosis, lymphoma, cerebral abscess, metastatic disease, or glioma.

Following CT, the patient was treated for toxoplasmosis and was found to have a CD4 count of 49. He was started on highly active antiretroviral therapy for HIV/AIDS.

**Feature Editor:** Joshua S. Broder, MD, FACEP. See also *Diagnostic Imaging for the Emergency Physician* (winner of the 2011 Prose Award in Clinical Medicine, the American Publishers Award for Professional and Scholarly Excellence) by Dr. Broder, available from the ACEP Bookstore, www.acep.org/bookstore.
CME Questions

Qualified, paid subscribers to Critical Decisions in Emergency Medicine may receive CME certificates for up to 5 ACEP Category 1 credits, 5 AMA PRA Category 1 Credits™, and 5 AOA Category 2-B credits for answering the following questions. To receive your certificate, go to www.acep.org/newcriticaldecisionstesting and submit your answers online. On achieving a score of 70% or better, you will receive a printable CME certificate. You may submit the answers to these questions at any time within 3 years of the publication date. You will be given appropriate credit for all tests you complete and submit within this time. Answers to this month’s questions will be published in next month’s issue.

1. The most common emergency abdominal surgical procedure performed in the United States is:
   A. aortic aneurysm repair
   B. appendectomy
   C. bowel resection for small bowel obstruction
   D. cholecystectomy

2. A falsely low serum amylase level in a patient with a high likelihood of pancreatitis can be caused by which of the following?
   A. HIV
   B. hyperlipidemia
   C. mumps
   D. small bowel perforation

3. In a patient with a clinical picture consistent with pancreatitis, which serum diagnostic test is indicated?
   A. amylase
   B. amylase and lipase
   C. C-reactive protein
   D. lipase

4. A 28-year-old woman presents with nonspecific abdominal pain. Her CBC reveals a WBC of 13,800 without a left shift. Which of the following is the correct course of action in response to the leukocytosis?
   A. call a surgeon to evaluate for appendicitis
   B. initiate antibiotics
   C. interpret the finding as nonspecific for any abdominal pathology
   D. repeat the CBC in 6 hours to evaluate for a trend

5. What is the utility of a serum lactate level in evaluating a 70-year-old man with abdominal pain with suspected mesenteric ischemia?
   A. an elevated lactate combined with a leukocytosis warrants a laparotomy in this patient
   B. an elevated serum lactate is diagnostic of mesenteric ischemia
   C. a normal serum lactate excludes mesenteric ischemia
   D. a serum lactate level neither confirms nor excludes mesenteric ischemia by itself

6. An 85-year-old woman with atrial fibrillation presents with severe abdominal pain of 2 hours’ duration. She is not on warfarin because she is prone to frequent falls. Her abdominal examination is nonspecific, but mesenteric ischemia is suspected. What is the next step in management?
   A. call a surgeon immediately and arrange for CT angiography
   B. order a CT without contrast
   C. order a lactate and, if it is elevated, then order a CT angiogram
   D. provide opiate analgesics and reassess when pain is improved

7. Patient in which age group are most likely to present with perforated appendicitis?
   A. adolescents
   B. adults younger than 55 years
   C. adults older than 65 years
   D. children between 8-15 years old

8. A 19-year-old woman has right lower quadrant pain, fever, vomiting, and anorexia. She has never been sexually active. She is in significant pain, and the surgeon wants to examine her and get an ultrasound before any surgical exploration. How should you treat the patient’s pain?
   A. administer acetaminophen rectally
   B. administer intravenous morphine
   C. administer oral NSAIDs
   D. no pain medication should be given to avoid altering the examination

9. An 89-year-old man presents with severe abdominal pain and nausea. A thorough evaluation, including laboratory studies, ECG, plain films, and a CT scan, does not reveal a diagnosis. The patient still has pain despite multiple rounds of opiates. What is the next step in this patient’s management?
   A. administer broad-spectrum antibiotics
   B. discharge home with oral analgesics
   C. place in observation on the surgical service
   D. try oral liquid challenge after another round of pain medications

10. A 40-year-old man has been evaluated for abdominal pain and is ready for discharge with a diagnosis of “undifferentiated” abdominal pain. How should he be advised regarding followup?
    A. follow up as needed with his primary provider
    B. follow up if his symptoms worsen
    C. follow up in 12 hours for reevaluation in the emergency department or with his primary provider
    D. follow up in 2 to 3 days with primary provider

11. Which of the following is characteristic of delirium?
    A. it entails progressive mental decline over several months to years
    B. patients always appear acutely ill
    C. patients present with recent or acute onset of confusion
    D. underlying factors are almost never found
12. What is true historically of the role of emergency medicine in diagnosing delirium?
A. approximately 5% of patients with delirium are discharged home from the emergency department
B. injuries from falls and combativeness are rare
C. mental status impairment is present in approximately 25% of elderly patients
D. mental status impairment is consistently well documented in the medical record

13. Which of the following is most likely to indicate significant physical illness in the elderly?
A. acute mental confusion
B. complaint of extremity pain
C. normal gait
D. tachycardia

14. Which of the following is a reason that an atypical antipsychotic (eg, olanzapine, etc.) would be used instead of haloperidol to control acute delirium in an elderly patient?
A. atypical antipsychotics cost less
B. atypical antipsychotics efficacy data in this group are overwhelmingly convincing
C. atypical antipsychotics have fewer anticholinergic effects
D. atypical antipsychotics should be used if the patient has parkinsonism

15. What is most characteristic of dementia?
A. develops over hours to days
B. has a gradual onset
C. medically reversible cause is generally found
D. there is no risk for later development of delirium

16. An 85-year-old man presents with progressive loss of cognitive skills over the past 2 months, with worsening in the past 24 hours. His family reports that he has been falling more often. His medications include hydroxyzine for allergic symptoms. His heart rate is 122, and temperature is 38.2°C; other vital signs are normal. He appears dehydrated, with pupils that are reactive and 5 mm. His speech is mumbled, and his gait is unsteady. Which of the following is the best plan of action?
A. administer haloperidol, and if a favorable response is noted admit to hospital for further workup
B. discontinue hydroxyzine, and have the patient reevaluated by primary care in 24 hours
C. discontinue patient’s medications, obtain laboratory data, head CT, chest radiograph, and urinalysis, and admit to hospital
D. obtain a head CT, and if negative transfer to skilled nursing facility

17. The EEG findings of a patient with delirium most commonly reveal which of the following?
A. fast-wave activity and rapid movement in the occipital lobe
B. fast-wave activity of the dominant posterior alpha rhythm
C. slow-wave activity and slowing of the dominant posterior alpha rhythm
D. temporal lobe epilepsy

18. Which drugs are commonly associated with delirium in the elderly?
A. acetaminophen
B. anticholinergic medications
C. nonsteroidal anti-inflammatory drugs
D. selective serotonin reuptake inhibitors

19. Which score on the Mini Mental Status Examination is suggestive of dementia or delirium?
A. 27
B. over 30
C. under 24
D. under 50

20. Which of the following may reduce the risk of delirium in hospitalized patients?
A. bladder catheterization
B. polypharmacy
C. provision of clocks, windows with views, and hearing aids
D. sleep deprivation
The Drug Box

Dicryclove

By Michael Marquard, DO; Summa Health System Emergency Medicine Residency

Patients with chronic conditions such as inflammatory bowel disease are often seen in emergency departments with exacerbations of their disease. In some instances instead of using opioids for symptom control, an antispasmodic could benefit the patient. Dicylolvemone can be especially useful for patients presenting with abdominal cramping and spasms. It is also useful to control chronic noninfectious diarrhea by slowing peristalsis. Dicyclomine is an anticholinergic medication, and patients should be warned of the common side effects. Use of this medication is discouraged in the elderly because of its anticholinergic properties; it is considered high risk on the Beers' list.

Mechanism of Action
Anticholinergic, competitive antagonist of the M3 receptor reduces smooth muscle and secretory activity of the gastrointestinal tract.

Indications
Irritable bowel syndrome, abdominal cramping or spasm, noninfective diarrhea, and urinary urge incontinence (off label)

Dosing – Adult
PO: initial dose 20 mg four times daily, maximum dose 160 mg/day
IM: 10-20 mg four times daily, maximum 1 to 2 days
IV: do not give intravenously, can cause thrombosis/plebitis
Start with 10 mg PO, caution with long-term use.

Dosing – Elderly
Contraindicated in infants younger than 6 months of age
Dosing – Pediatrics
Infants older than 6 months, 5 mg three or four times daily
Children, 10 mg three or four times daily

Side Effects
Headache, palpitations, dry mouth, constipation, urinary retention, fever, blurred vision, and dizziness

Estimated Cost to Hospital and Patient
$12 for ten 10-mg tablets
$13 for a 10-mg dose IM (hospital cost)

Contraindication/Precautions
Caution with toxicity/overdose leading to anticholinergic toxicity
Serious respiratory reactions, central nervous symptoms, and deaths have been reported following administration to infants; contraindicated for use in infants younger than 6 months
Caution with use in elderly due to sedation and possible worsening of psychosis or dementia. This medication is considered high risk per Beers criteria.

Pregnancy Class: B; not to be used while breast feeding because of passage into breast milk

Feature Editors: Michael S. Beeson, MD, MBA, FACEP; Amy Niertit, MD