Postoperative Delirium: Overview and Opportunities to Optimize Outcomes

Case Study and Commentary, *James L. Rudolph, MD, SM, Kimberly Schreiber, BS, and Mary Beth Harrington, RN, PhD, ACNS-BC, ANP-BC*

JCOM CME

CME jointly sponsored by Wayne State University School of Medicine and JCOM

This article has a companion CME exam that follows the article. To earn credit, read the article and complete the CME evaluation on pages 510 and 511. Estimated time to complete this activity is 1 hour. Faculty disclosure information appears on page 507. Release date: 15 October 2008; valid for credit through 30 October 2009.

Program Audience

Primary care physicians.

Educational Needs Addressed

Delirium is a common, morbid, and costly condition in older patients. Delirium places patients at risk for complications of hospitalization. Patients with delirium are more likely to have iatrogenic infection, pressure ulcers, deconditioning, falls, incontinence, polypharmacy, and malnutrition. Ultimately, these conditions further limit independent functioning leading to potential nursing home placement, frailty, and death. The past 10 years have brought important developments in the identification, treatment, and prevention of delirium. It is essential that clinicians understand the principles of delirium prevention and management and apply these principles to all patients at risk for delirium.

Educational Objectives

After participating in this CME activity, primary care physicians should be able to

1. Know how to diagnose and perform a workup for delirium
2. Describe the treatment of delirium
3. Understand medical system barriers to care of patients with delirium
4. Describe strategies to prevent delirium

CASE STUDY
Initial Presentation

A 68-year-old man is admitted to the hospital for elective peripheral artery bypass to improve his ability to walk without pain. Underlying medical conditions include coronary artery disease, type 2 diabetes, hypertension, hyperlipidemia, osteoarthritis, and obesity. He had 4-vessel coronary artery bypass graft surgery 3 years ago. Recalling the experience, the patient reports "seeing bugs" and "being out of it" for several days after his cardiac surgery and asks if similar effects are possible after this surgery.

- **How common is delirium in the operative patient?**

Delirium, an acute change in mental status characterized by a disturbance of attention and consciousness, is a frequent complication after surgery. It occurs in 32% to 50% of cardiac surgery patients, 21% to 48% of peripheral vascular surgery patients, and 13% to 17% of head and neck surgery patients [1]. The in-hospital mortality of postoperative delirium is between 4% and 13% [2], which is equivalent to that for in-hospital myocardial infarction [3]. Patients with delirium after surgery are at risk for complications, longer length of stay, increased likelihood of being discharged to a nursing home, dementia, and loss of independence [4–7].

Delirium is common in older patients presenting to the hospital, with 14% to 24% having delirium upon admission [3]. Because of the high prevalence and poor outcomes associated with delirium, all older patients should be screened on admission for existing (prevalent) delirium regardless of the setting. Older patients without prevalent delirium should be evaluated for delirium risk.

From the Brigham and Women's Hospital, Boston, MA (Dr. Rudolph); Loyola University Chicago, Stritch School of Medicine, Chicago, IL (Ms. Schreiber); and Geriatric Research Education and Clinical Center, VA Boston Healthcare System, Boston, MA (Drs. Rudolph and Harrington).

Table 1. Delirium Risk Prediction for Hospitalized Patients

Risk Factor*	Defined As
Cognitive impairment	MMSE score < 24
Acute illness	APACHE score > 16
Vision impairment	Corrected > 20/70
Dehydration	Urea nitrogen/creatinine ratio ≥ 18

MMSE = Mini-Mental State Examination. (Adapted with permission from Inouye SK, Viscoli CM, Horwitz RI, et al. A predictive model for delirium in hospitalized elderly medical patients based on admission characteristics. Ann Intern Med 1993;119:474–81.)

*To predict delirium, assign 1 point for each risk factor present: 0 points = 3%–9% incidence, 1–2 points = 16%–23% incidence, and 3–4 points = 32%–83% incidence.

There are validated methods to identify patients at risk for delirium in the medical and surgical populations [2,8]. Four major factors predict delirium risk in hospitalized patients: cognitive impairment, severity of illness, visual impairment, and dehydration [8]. **Table 1** describes the risk factors for delirium and the incidence of delirium with increasing risk factors. Across studies, preexisting cognitive impairment is consistently the strongest risk factor for delirium [2,3,9,10]. It is important to note that age alone is not a risk factor. Although delirium is more prevalent in the older population, delirium can occur in all ages. Generally, delirium is considered in the inpatient setting, but patients in postacute, long-term, or palliative care have chronic diseases that increase susceptibility to acute illness [8,11,12]. In this case, the patient's prior delirium may also be a risk factor for future delirium [13].

Operation and Postoperative Course

The patient undergoes an uncomplicated peripheral vascular bypass and is conversant with staff and family on the operative day. His pain is controlled with an epidural catheter, and there are no bleeding or infectious concerns. In the evening of postoperative day 1, he gets progressively more confused with paranoid thoughts and hallucinations. On the morning of postoperative day 2, he arouses to tactile stimulation but falls quickly asleep. When questioned, he can respond to yes/no questions (eg, "Are you in pain?") but cannot answer open-ended questions (eg, "Tell me about your pain").

- **Does this patient have delirium?**

The diagnosis of delirium is generally made with the criteria established by the *Diagnostic and Statistical Manual of Mental Disorders* (DSM). An algorithm based on DSM criteria, called the confusion assessment method (CAM), has been validated and used in over 200 studies [14]. A variant of the CAM called the CAM-ICU has been validated for use in intensive care unit (ICU) patients [15]. The features of the CAM are displayed in the **Figure**. For diagnosis of delirium, the CAM requires an acute change in mental status, fluctuations throughout the course of the day, inattention, and either disturbance of thought or alteration in consciousness. When accompanied with training and standard mental status testing, the CAM has a sensitivity of 94% to 100% and a specificity of 90% to 95% [16,17].

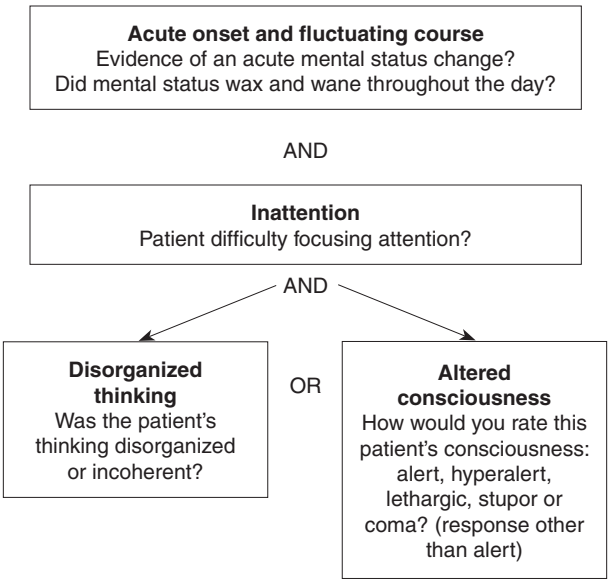

Figure. The confusion assessment method. Delirium requires an acute onset, fluctuating course, inattention, and either disorganized thinking or altered consciousness. (Adapted with permission from Inouye SK, van Dyck CH, Alessi CA, et al. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. Ann Intern Med 1990;113:941–8.)

The primary cognitive deficit in delirium is inattention. The traditional cognitive assessment in the hospital, orientation, has poor sensitivity (23%–26%) but good specificity (95%–96%) for inattention. Cognitive assessments that have improved sensitivity and specificity for inattention include registration and recall of 3 words (sensitivity, 85%; specificity, 96%), days of week and months of the year backwards (sensitivity, 66%; specificity, 99%), and digit span forward and backward (sensitivity, 84%; specificity, 92%) [18]. The CAM-ICU adaptation includes the Attention Screening Exam, a nonverbal attention assessment that has been independently validated [19,20].

There are 3 psychomotor variants to delirium: hyperactive, hypoactive, and mixed [21]. The hyperactive variant

Table 2. Medications That May Precipitate Delirium*

Antidepressants	Benzodiazepines
Amitriptyline	Diazepam
Imipramine	Chlordiazepoxide
Paroxetine	Flurazepam
Antihistamines	Cardiac drugs
Diphenhydramine	Digoxin
Hydroxazine	Amiodarone
Chlorpheniramine	Methyldopa
Cimetidine	Procainamide
Famotidine	CNS drugs
Antipsychotics	Levodopa
Thioridazine	Lithium
Chlorpromazine	Phenytoin
Olanzapine	Divalproex
Antispasmodics	Gastrointestinal agents
Cyclobenzaprine	Prochlorperazine
Baclofen	Loperamide
Oxybutynin	Metoclopromide
Atropine	Pain medications
Hyoscyamine	Meperidine
Antivertigo	Indomethacin
Meclizine	Opioids

CNS = central nervous system.

*The list is not comprehensive but highlights medications felt to be inappropriate for use in older patients due to evidence that they may cause acute cognitive change.

accounts for 15% to 30% of delirium cases [22]. This variant is rarely missed by clinicians and nurses because patients are acting aggressively, pulling tubes and wires, and frequently experiencing psychotic symptoms (delusions, paranoia, hallucinations). The hypoactive variant is much more subtle and occurs in 19% to 73% of patients [22]. Patients with hypoactive delirium are sleepy and lethargic, do not participate in care activities (eg, physical therapy, additional studies), and are much more likely to have the diagnosis of delirium delayed [23]. Recent research has found that these hypoactive patients are at substantially higher risk of mortality, presumably related to the delay in diagnosis [24]. The final variant is the mixed disorder with features of both hyperactive and hypoactive (42%–52%) [22]. These patients frequently have altered sleep-wake cycles and do not act as aggressively as hyperactive patients, but are often dismissed as having "sundowning" or dementia.

Diagnosis

The morning of postoperative day 2, the patient's primary care physician visits the patient and makes the diagnosis of delirium. The physician performs a physical examination and reviews the medical and nursing records with a focus on medication administration.

- **What is the appropriate workup of a patient with delirium?**

Delirium is a multifactorial syndrome resulting from the additive combination of small insults (eg, environmental change, sleep deprivation, psychoactive medications, acute illness) that may not have caused delirium independently. However, the combined effect of these small insults may cause delirium in a patient with strong predisposing factors to develop delirium [25]. For example, a low-risk patient may not develop delirium from surgery, but the combination of surgery, sleep deprivation, pain, psychoactive medications, and fluid shifts may precipitate delirium. On the converse, patients at high risk of developing delirium will require fewer insults; sometimes the transition between the home environment and hospital environment is enough to precipitate delirium. The goal of the physician is to identify and treat as many insults as possible.

Patients with delirium may not provide accurate history. Thus, the physician unfamiliar with the patient's history may need to contact family, caregivers, and/or nursing staff to identify the previous level of mental status functioning and when the mental status changed. Other important historical elements include accurate outpatient medication profile, alcohol use, prehospital function, sleep habits, and nutritional status.

The focus on physical examination is crucial to the workup of delirium. This should be individualized for each patient based on risk factors. In this case, a careful physical examination to assess for cardiac complications of surgery (eg, postoperative myocardial infarction, congestive heart failure, pulmonary embolism) would be warranted because of the high preoperative cardiac risk. On the other hand, stroke and seizure would be lower on the differential diagnosis as a cause of delirium. Thus, a thorough neurologic examination can save the patient, physician, and care team from unnecessary workup. Specifically, if there are no new focal neurologic findings, then the value of brain imaging is limited [26]. Similarly, if seizure activity is not witnessed, an electroencephalogram has a very low pretest probability [3]. Further areas for examination would include assessment of infectious complications, constipation, and urinary retention.

All patients with delirium should undergo a thorough review of recent changes in medications with a focus on medications associated with cognitive adverse effects. **Table 2** lists some medications that can precipitate delirium

[27–29]. Medications for sleep, pruritis, nausea, cardiac protection, and muscle relaxation can precipitate delirium [30]. While all opioid pain medications can cause delirium, meperidine has been shown to cause delirium at 3 times the rate of others [28]. Epidural analgesia may also be a risk factor. Unnecessary or offending medications should be re-evaluated and discontinued if possible or at least a reduction of dose should be considered.

Workup

The physician considers a broad differential diagnosis in the management and treatment of the patient's delirium. Electrolytes, complete blood count, and urinalysis are ordered. An electrocardiogram is ordered because the patient was at high risk of cardiac event. She also follows up on a low oxygen saturation reading by ordering arterial blood gas and chest radiograph. She considers her past interactions with the patient to address the possibility that the current mental status could be related to a longer-term mental disorder.

- **How may delirium be distinguished from other mental disorders?**

Care should be taken to avoid labeling the patient with delirium as having dementia or depression. While these conditions often coexist [31], there are important differences between these states. First, delirium is an acute change in cognitive function occurring over hours to days [32]. Both dementia and depression will develop over a longer time course. Second, mental status will fluctuate throughout the course of a day in delirium. Additionally, the cardinal cognitive deficit of delirium is inattention, whereas memory is impaired in dementia and cognitive function is relatively preserved in mild and moderate depression. Finally, the disturbance of consciousness with some delirium patients should not be present in mild to moderate dementia and depression.

Initial Treatment

The physician asks the nurse to begin a series of nonpharmacologic strategies to improve patient comfort and safety. Citing concern for the patient's safety, the patient's nurse asks the physician to order restraints.

- **What is first-line treatment of delirium?**

While nonpharmacologic methods of behavioral management have limited evidence to support their use, these methods are potentially able to spare patients from pharmacologic and physical restraints. Restraints, both formal (eg, wrist, vest, ankle) and informal (eg, urinary catheters, oxygen tubing, continuous intravenous lines) are associated with morbidity. The use of psychoactive medications on a malfunctioning brain can produce unpredictable results and should be undertaken after carefully weighing the risks and benefits. Because nonpharmacologic methods have little potential toxicity, these should be the first line in the behavioral management of a patient with delirium [3]. Nonpharmacologic measures include creating a calm environment, preserving the sleep-wake cycle, frequent reorientation, including family members in the patient's care, increasing mobility, and coordinating care delivery [3].

- **What is the role of medications in delirium?**

Medications to manage agitation in the delirious patient do not treat the underlying delirium and may have deleterious effects [3]. The risks and benefits must be carefully considered in each patient prior to prescribing. Benzodiazepines may disinhibit the older patient, cause a paradoxical reaction, or may induce delirium [28]. Use should be limited to those with Parkinson's disease, diffuse Lewy body dementia, or adverse drug reactions to antipsychotics [33]. Anticholinergic medications may precipitate or worsen the complications of delirium [34].

Antipsychotics are the primary medications to manage agitation associated with delirium [35]. Theoretically, the atypical antipsychotics have fewer extrapyramidal adverse effects, although a recent systematic review found no difference between atypical and typical antipsychotics [36]. Further, some antipsychotics may be anticholinergic [37]. Thus, the medication of choice for management of agitation associated with delirium remains haloperidol at lower doses (0.5–1.0 mg) [38]. As always, the geriatricians' motto "start low and go slow" applies to the use of any medication to manage agitation associated with delirium.

If antipsychotics are prescribed, the patients should be monitored for adverse effects. In older cognitively impaired patients, antipsychotics may carry an increased risk of mortality [39,40]. Electrocardiogram should be monitored for prolongation of the QTc interval. Antipsychotic medications have been associated with aspiration pneumonia [41], presumably from oropharyngeal dysphagia [42], which may be an extrapyramidal side effect [43].

Treatment Plan

The physician explains to the nurse why she does not wish to order restraints. Together they formulate

a treatment plan that addresses both the physician's concern that medications and restraints can be harmful and the nurse's concern regarding patient safety. They agree to use nonpharmacologic, environmental, and stimulating strategies prior to giving medications for agitation. The physician prescribes a low dose of haloperidol to be used in the event that the other strategies do not successfully manage the patient's agitation.

On the drive to her office, the physician reflects on her interaction with the nurse. Although she feels the best patient care would be achieved with nonpharmacologic therapies, she understands the pressures of the nursing workload. In this case, the physician felt that a collaborative treatment plan had been achieved. However, she wonders if this plan will be carried through into other shifts when she will not be present to educate the nursing staff.

- **What medical system barriers hinder care for patients with delirium?**

Astute physicians and nurses are crucial to the identification, management, and treatment of delirium [3]. In the course of a given day, nurses spend more time with patients than physicians. This increased contact presents important opportunities to assess mental status and identify associated fluctuations, disorganized thinking, and altered levels of consciousness. Because nursing effort and time increase with the delirious patient, nurses may feel increased pressure to complete their required duties for other patients. Educating and empowering nurses to improve care of patients with delirium could lead to innovative solutions in workload parity and health care team development.

Because of the rapid changes in the understanding of delirium over the past 10 years, medical and nursing practice has not yet fully incorporated these changes. Proactive models of nursing education can improve the assessment for mental status and delirium [44,45]. A short, standardized assessment for delirium is important to nursing practice, because it provides an understanding of mental status that can be used to work with the patient for the remainder of the stay [45,46]. For example, if a patient is delirious, repeated efforts at orientation by physicians, nurses, and other staff may help the patient recognize the hospital setting and act accordingly. On the converse, the interactions with the nondelirious patient can focus on management of disease, rehabilitation, and discharge planning. Substantial educational effort is needed to fully incorporate such advances into the nurse and physician care of the patient with delirium.

While medicine has traditionally utilized a hierarchal structure with respect to the nurse-physician relationship, the care of the patient with delirium should be more collegial because of the crucial role of the nurse [47–49]. Much literature and effort has focused on team training in the surgical setting, and the same principles apply to the care of the patient with delirium. Principles such as "the patient as the focus of care," "each team member shall be heard," and "individualized planning and testing to meet the patient's needs" are important in delirium as well [50,51]. Developing the nurse-physician relationship improves patient outcomes, reduces liability award outcomes, and improves the job satisfaction of both [52].

Nurse Follow-up

At lunchtime, the physician receives a call from the nurse manager. In the staff meeting, the nurse was discussing the time commitment for her patient. The nurse manager wants to discuss strategies to prevent delirium that could be integrated into the unit routines.

- **What strategies can prevent delirium?**

A key feature in management of the patient at intermediate to high risk for delirium is to institute a surveillance program or prevention program. In prior work, physicians miss 33% to 66% of delirium in older inpatients [53–55] and nurses identify less than 20% of patients with delirium [23]. Delay in identification and treatment of the underlying causative factors results in increased morbidity and mortality [3]. Programs to prevent delirium are cost-effective strategies that have been proven in randomized trials [4,56,57]. Thus, early recognition, surveillance, and prevention strategies are warranted.

While moderate- and high-risk patients should be screened daily with a validated instrument for the diagnosis and severity of delirium, recent work has called attention to the need for a mental status vital sign to survey for delirium [58]. A mental status vital sign would be much simpler and much less specific than a delirium instrument. For example, the causes of increased temperature are numerous, but the presence of increased temperature results in an assessment and workup. A mental status vital sign would not identify causes for delirium, but instead only alert the nurse and physician to complete a more thorough assessment of mental status and potential causes for delirium.

There are strategies that have been shown in randomized controlled trials to prevent delirium. **Table 3** outlines the structure modules used in medical and surgical patients to prevent delirium. The most comprehensive was the initiation of the Hospital Elder Life Program (HELP), which includes 6 modules to prevent delirium [57]. Overall, the program was able to reduce the incidence of delirium from

15% to 10%. In subsequent analyses, the HELP program was found to be cost-neutral [56]. In surgical patients, structured consultation by a geriatric physician within 24 hours of surgery was shown to reduce delirium after hip fracture from 50% at control to 32% with intervention [4].

A recent randomized placebo-controlled study examined haloperidol prophylaxis for the prevention of delirium after hip fracture [59]. In the single-site study, low-dose haloperidol (1.5 mg/day) did not reduce the incidence of delirium (relative risk, 0.9 [95% confidence interval, 0.6–1.3]). However, haloperidol significantly reduced the severity and duration of delirium as well as mean length of stay [59]. The results should be interpreted with caution, because the functional impact of haloperidol on older patients at risk for delirium is not fully understood.

Acute Care for the Elderly (ACE) units, which are designed to meet the care needs of older patients, frequently aim to specifically prevent delirium [60]. ACE units and smaller-scale models, such as the delirium room, utilize multidisciplinary care teams to minimize pain, disorientation, sleep disturbances, and immobilization and to prevent hospital complications that may precipitate delirium [61]. The design of such units incorporate lighting strategies to reduce nighttime stimulation, nonskid floors that decrease risk of falls, and staff trained to identify and manage hyperactive behaviors using nonpharmacologic protocols [49].

Case Resolution

The patient improved over several days and was discharged to a postacute facility. After 3 weeks, his delirium cleared and he resumed his activities of daily living but did not fully resume his preoperative level of function. On the ward, the primary care physician began a series of early-morning nursing education sessions to improve care for delirious patients. The nurse manager is considering implementing a delirium surveillance program.

Table 3. Care Strategies and Protocols to Prevent Delirium

Medical patients
Cognitive stimulation and reorientation
Clock, orientation board, staff introduction
Nonpharmacologic sleep protocol
Lights out, warm milk, relaxation tape, back rub
Sleep enhancement
Unit-wide noise reduction and sleep promotion
Mobilization protocol
Ambulation or range of motion 3 times a day
Vision protocol
Replace glasses, large-print reading material
Hearing protocol
Cerumen disimpaction, portable amplifiers
Dehydration
Early recognition, oral repletion, IV if needed
Surgical patients
Appropriate environmental stimuli
Clock, calendar, glasses, hearing aids, etc
Elimination of unnecessary medications
Discontinue benzodiazepines, anticholinergic, etc
Adequate CNS oxygen delivery
Supplement oxygen, transfusion if needed
Early mobilization and rehabilitation
Out of bed on postoperative day 1, daily physical therapy
Regulation of bowel/bladder function
Discontinue urinary catheter; bowel movement every 48 hours
Treatment of severe pain
RTC acetaminophen; scheduled opioids
Fluid/electrolyte balance
Identify and treat fluid and electrolyte abnormalities
Prevention, identification, and treatment of postoperative complications
Myocardial infarction, arrhythmia, pneumonia, UTI
Adequate nutritional intake
Dentures, positioning, oral supplementation
Treatment of agitated delirium
Identification, nonpharmacologic management

CNS = central nervous system; IV = intravenous; RTC = around the clock; UTI = urinary tract infection. (Adapted from Inouye SK, Bogardus ST Jr, Charpentier PA, et al. A multicomponent intervention to prevent delirium in hospitalized older patients. N Engl J Med 1999;340:669–76; and Marcantonio ER, Flacker JM, Wright RJ, Resnick NM. Reducing delirium after hip fracture: a randomized trial. J Am Geriatr Soc 2001;49:516–22.)

Funding/support: This work was supported in part by NIA T35 AG026781 and the American Federation for Aging Research Medical Student Training in Aging Research. Dr Rudolph receives support through a VA Rehabilitation Research and Development Career Development Award.

Corresponding author: James L. Rudolph, MD, SM, BWH Division of Aging, 1620 Tremont St, 3rd Fl., Boston, MA 02120, jrudolph@partners.org.

Financial disclosures: None.

References

1. Rudolph JL, Marcantonio ER. Caring for the patient with postoperative pelirium. Hospitalist 2004;8:20–5.
2. Marcantonio ER, Goldman L, Mangione CM, et al. A clinical prediction rule for delirium after elective noncardiac surgery. JAMA 1994;271:134–9.
3. Inouye SK. Delirium in older persons. N Engl J Med 2006;354:1157–65.
4. Marcantonio ER, Flacker JM, Wright RJ, Resnick NM. Reducing delirium after hip fracture: a randomized trial. J Am Geriatr Soc 2001;49:516–22.

5. Marcantonio ER, Flacker JM, Michaels M, Resnick NM. Delirium is independently associated with poor functional recovery after hip fracture. J Am Geriatr Soc 2000;48:618–24.
6. Franco K, Litaker D, Locala J, Bronson D. The cost of delirium in the surgical patient. Psychosomatics 2001;42:68–73.
7. Lundstrom M, Edlund A, Bucht G, et al. Dementia after delirium in patients with femoral neck fractures. J Am Geriatr Soc 2003;51:1002–6.
8. Inouye SK, Viscoli CM, Horwitz RI, et al. A predictive model for delirium in hospitalized elderly medical patients based on admission characteristics. Ann Intern Med 1993;119:474–81.
9. Rudolph JL, Jones RN, Grande LJ, et al. Impaired executive function is associated with delirium after coronary artery bypass graft surgery. J Am Geriatr Soc 2006;54:937–41.
10. Robertsson B, Blennow K, Gottfries CG, Wallin A. Delirium in dementia. Int J Geriatr Psychiatry 1998;13:49–56.
11. Kiely DK, Bergmann MA, Murphy KM, et al. Delirium among newly admitted postacute facility patients: prevalence, symptoms, and severity. J Gerontol A Biol Sci Med Sci 2003;58: M441–5.
12. Holroyd S, Laurie S. Correlates of psychotic symptoms among elderly outpatients. Int J Geriatr Psychiatry 1999;14:379–84.
13. Litaker D, Locala J, Franco K, et al. Preoperative risk factors for postoperative delirium. Gen Hosp Psychiatry 2001;23:84–9.
14. Wei LA, Fearing MA, Sternberg EJ, Inouye SK. The Confusion Assessment Method: a systematic review of current usage. J Am Geriatr Soc 2008;56:823–30.
15. Ely EW, Truman B, May L, et al. Validation of the CAM-ICU for delirium assessment in mechanically ventilated patients. J Am Geriatr Soc 2001;49:S2.
16. Inouye SK, van Dyck CH, Alessi CA, et al. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. Ann Intern Med 1990;113:941–8.
17. Inouye SK. Delirium in hospitalized older patients: recognition and risk factors. J Geriatr Psychiatry Neurol 1998;11:118–25.
18. Stavros KA, Rudolph JL, Jones RN, Marcantonio ER. Delirium and the clinical assessment of attention in older adults. J Am Geriatr Soc 2008;56:S199–S200.
19. Ely EW, Inouye SK, Bernard GR, et al. Delirium in mechanically ventilated patients: validity and reliability of the confusion assessment method for the intensive care unit (CAM-ICU). JAMA 2001;286:2703–10.
20. O'Keeffe ST, Gosney MA. Assessing attentiveness in older hospital patients: global assessment versus tests of attention. J Am Geriatr Soc 1997;45:470–3.
21. Liptzin B, Levkoff SE. An empirical study of delirium subtypes. Br J Psychiatry 1992;161:843–5.
22. de Rooij SE, Schuurmans MJ, van der Mast RC, Levi M. Clinical subtypes of delirium and their relevance for daily clinical practice: a systematic review. Int J Geriatr Psychiatry 2005;20: 609–15.
23. Inouye SK, Foreman MD, Mion LC, et al. Nurses' recognition of delirium and its symptoms: comparison of nurse and researcher ratings. Arch Intern Med 2001;161:2467–73.
24. Kiely DK, Jones RN, Bergmann MA, Marcantonio ER. Association between psychomotor activity delirium subtypes and mortality among newly admitted post-acute facility patients. J Gerontol A Biol Sci Med Sci 2007;62:174–9.
25. Inouye SK, Charpentier PA. Precipitating factors for delirium in hospitalized elderly persons. Predictive model and interrelationship with baseline vulnerability. JAMA 1996;275:852–7.
26. Hirano LA, Bogardus ST Jr, Saluja S, et al. Clinical yield of computed tomography brain scans in older general medical patients. J Am Geriatr Soc 2006;54:587–92.
27. Fick DM, Cooper JW, Wade WE, et al. Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. Arch Intern Med 2003;163:2716–24.
28. Marcantonio ER, Juarez G, Goldman L, et al. The relationship of postoperative delirium with psychoactive medications. JAMA 1994;272:1518–22.
29. Agostini JV, Leo-Summers LS, Inouye SK. Cognitive and other adverse effects of diphenhydramine use in hospitalized older patients. Arch Intern Med 2001;161:2091–7.
30. Flacker JM, Cummings V, Mach JR Jr, et al. The association of serum anticholinergic activity with delirium in elderly medical patients. Am J Geriatr Psychiatry 1998;6:31–41.
31. Fick DM, Agostini JV, Inouye SK. Delirium superimposed on dementia: a systematic review. J Am Geriatr Soc 2002;50: 1723–32.
32. American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-IV-TR. 4th ed., text revision. Washington (DC): The Association; 2000.
33. Flacker JM, Marcantonio ER. Delirium in the elderly. Optimal management. Drugs Aging 1998;13:119–30.
34. Han L, McCusker J, Cole M, et al. Use of medications with anticholinergic effect predicts clinical severity of delirium symptoms in older medical inpatients. Arch Intern Med 2001; 161:1099–105.
35. Breitbart W, Marotta R, Platt MM, et al. A double-blind trial of haloperidol, chlorpromazine, and lorazepam in the treatment of delirium in hospitalized AIDS patients. Am J Psychiatry 1996;153:231–7.
36. Lonergan E, Britton AM, Luxenberg J, Wyller T. Antipsychotics for delirium. Cochrane Database Syst Rev 2007;(2):CD005594.
37. Chew ML, Mulsant BH, Pollock BG, et al. Anticholinergic activity of 107 medications commonly used by older adults. J Am Geriatr Soc 2008;56:1333–41.
38. Seitz DP, Gill SS, van Zyl LT. Antipsychotics in the treatment of delirium: a systematic review. J Clin Psychiatry 2007;68: 11–21.
39. Schneider LS, Dagerman KS, Insel P. Risk of death with atypical antipsychotic drug treatment for dementia: meta-analysis of randomized placebo-controlled trials. JAMA 2005;294: 1934–43.
40. Wang PS, Schneeweiss S, Avorn J, et al. Risk of death in elderly users of conventional vs. atypical antipsychotic medications. N Engl J Med 2005;353:2335–41.
41. Wada H, Nakajoh K, Satoh-Nakagawa T, et al. Risk factors of aspiration pneumonia in Alzheimer's disease patients. Gerontology 2001;47:271–6.
42. Rudolph JL, Gardner KF, Gramigna GD, McGlinchey RE. Antipsychotics and oropharyngeal dysphagia in hospitalized older patients. J Clin Psychopharm. In press 2008.

43. Gareri P, De Fazio P, De Fazio S, et al. Adverse effects of atypical antipsychotics in the elderly: a review. Drugs Aging 2006;23: 937–56.
44. Bergmann MA, Murphy KM, Kiely DK, et al. A model for management of delirious postacute care patients. J Am Geriatr Soc 2005;53:1817–25.
45. Soja SL, Pandharipande PP, Fleming SB, et al. Implementation, reliability testing, and compliance monitoring of the Confusion Assessment Method for the Intensive Care Unit in trauma patients. Intensive Care Med 2008;34:1263–8.
46. de Jonghe JF, Kalisvaart KJ, Timmers JF, et al. Delirium-O-Meter: a nurses' rating scale for monitoring delirium severity in geriatric patients. Int J Geriatr Psychiatry 2005;20:1158–66.
47. Callahan CM, Boustani MA, Unverzagt FW, et al. Effectiveness of collaborative care for older adults with Alzheimer disease in primary care: a randomized controlled trial. JAMA 2006; 295:2148–57.
48. Melis RJ, van Eijken MI, Teerenstra S, et al. A randomized study of a multidisciplinary program to intervene on geriatric syndromes in vulnerable older people who live at home (Dutch EASYcare Study). J Gerontol A Biol Sci Med Sci 2008;63:283–90.
49. Landefeld CS, Palmer RM, Kresevic DM, et al. A randomized trial of care in a hospital medical unit especially designed to improve the functional outcomes of acutely ill older patients. N Engl J Med 1995;332:1338–44.
50. Schmalenberg C, Kramer M, King CR, et al. Excellence through evidence: securing collegial/collaborative nurse-physician relationships, part 2. J Nurs Adm 2005;35:507–14.
51. Strasser DC, Falconer JA, Stevens AB, et al. Team training and stroke rehabilitation outcomes: a cluster randomized trial. Arch Phys Med Rehabil 2008;89:10–5.
52. Erickson JI, Clifford JC. Building a foundation for nurse-physician collaboration. CRICO Forum 2008;26:6–7.
53. Levkoff SE, Besdine RW, Wetle T. Acute confusional states (delirium) in the hospitalized elderly. Annu Rev Gerontol Geriatr 1986;6:1–26.
54. Levkoff SE, Evans DA, Liptzin B, et al. Delirium. The occurrence and persistence of symptoms among elderly hospitalized patients. Arch Intern Med 1992;152:334–40.
55. Gustafson Y, Brannstrom B, Norberg A, et al. Underdiagnosis and poor documentation of acute confusional states in elderly hip fracture patients. J Am Geriatr Soc 1991;39:760–5.
56. Rizzo JA, Bogardus ST Jr, Leo-Summers L, et al. Multicomponent targeted intervention to prevent delirium in hospitalized older patients: what is the economic value? Med Care 2001; 39:740–52.
57. Inouye SK, Bogardus ST Jr, Charpentier PA, et al. A multicomponent intervention to prevent delirium in hospitalized older patients. N Engl J Med 1999;340:669–76.
58. Flaherty JH, Rudolph J, Shay K, et al. Delirium is a serious and under-recognized problem: why assessment of mental status should be the sixth vital sign. J Am Med Dir Assoc 2007;8: 273–5.
59. Kalisvaart KJ, de Jonghe JF, Bogaards MJ, et al. Haloperidol prophylaxis for elderly hip-surgery patients at risk for delirium: a randomized placebo-controlled study. J Am Geriatr Soc 2005;53:1658–66.
60. Simon L, Jewell N, Brokel J. Management of acute delirium in hospitalized elderly: a process improvement project. Geriatr Nurs 1997;18:150–4.
61. Flaherty JH, Tariq SH, Raghavan S, et al. A model for managing delirious older inpatients. J Am Geriatr Soc 2003;51:1031–5.

JCOM CME

WAYNE STATE UNIVERSITY

CME EVALUATION: Postoperative Delirium: Overview and Opportunities to Optimize Outcomes

DIRECTIONS: Each of the questions below is followed by several possible answers. Select the ONE lettered answer that is BEST in each case and circle the corresponding letter on the answer sheet.

1. Complications associated with delirium include
   A. Discharge to nursing home
   B. Falls
   C. Malnutrition
   D. All of the above

2. The diagnosis of delirium is often missed because
   A. The patient is combative to nursing staff
   B. The patient is hallucinating
   C. The patient responds to closed-ended questions appropriately
   D. The patient's mood is labile

3. Should a patient require pharmacologic intervention as a last resort, the drug with the least associated adverse effects is
   A. Meperidine
   B. Haloperidol
   C. Clonazepam
   D. Clozapine

4. Which of the following tests must be performed prior to the diagnosis of delirium?
   A. Electroencephalogram
   B. Mental status assessment
   C. Brain imaging
   D. Lumbar puncture

5. Which of the following mental status assessments is critical to the diagnosis of delirium?
   A. Aphasia (name common objects)
   B. Orientation (name person, place, and time)
   C. Memory (recall objects after several minutes)
   D. Attention (name the months of the year backward)

6. Nonpharmacologic methods for behavioral management of patients with delirium is desirable because
   A. Medications and restraints have complications
   B. Medications are too expensive
   C. Nurses have too much free time
   D. Nonpharmacologic measures are a quick cure for delirium

EVALUATION FORM: Postoperative Delirium: Overview and Opportunities to Optimize Outcomes

Participants may earn 1 credit by reading the article named above and correctly answering at least 70% of the accompanying test questions. A certificate of credit and the correct answers will be mailed within 6 weeks of receipt of this page to those who successfully complete the test.

Circle your answer to the CME questions below:

1.	A	B	C	D
2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
6.	A	B	C	D

Please answer the following questions:

1. How would you rate this educational activity overall?
   __ Excellent __ Good __ Fair __ Poor

2. This article was fair, balanced, free of commercial bias, and fully supported by scientific evidence.
   __ Yes __ No

3. Please rate the clarity of the material presented in the article.
   __ Very clear __ Somewhat clear __ Not at all clear

4. How helpful to your clinical practice was this article?
   __ Very helpful __ Somewhat helpful __ Not at all helpful

5. What changes will you make in your practice as a result of reading this article?
   _____
   _____
   _____
   _____
   _____
   _____

6. What topics would you like to see presented in the future?
   _____
   _____
   _____
   _____
   _____

Release date: 15 October 2008
Expiration date: 30 October 2009

Please print clearly:

Name:_____

MD/DO/Other: _____

Address: _____

_____

City: _____

State:_____ Zip:_____

Phone: _____

Fax: _____

E-mail: _____

Are you a health care professional licensed to practice in the US/Canada who can use Category 1 AMA PRA CME credit to fulfill educational requirements? ____ Yes ____ No

Physicians are required to report the actual amount of time spent on the activity, up to the maximum designated 1 hour. The actual time spent reading this article and completing the test was _____.

Please mail or fax this sheet to:

Wayne State University, Division of CME
101 E. Alexandrine, Lower Level
Detroit, MI 48201
FAX: 313-577-7554

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of Wayne State University School of Medicine and the *Journal of Clinical Outcomes Management*. Wayne State University School of Medicine is accredited by the ACCME to provide continuing medical education for physicians.

Wayne State University School of Medicine designates this educational activity for a maximum of 1 AMA PRA Category 1 credits. Physicians should only claim credit commensurate with the extent of their participation in the activity.