Postoperative Delirium in the Elderly

Smita S. Parikh, MD, and Frances Chung, FRCPC

Department of Anesthesia, The Toronto Hospital, Western Division, University of Toronto, Toronto, Ontario

The age-old saying "Granny has never been the same since her operation" does have an element of truth in it. In 1955, Bedford (1) reported on 120 elderly patients who developed postoperative dementia. Acute postoperative psychosis was recognized as early as the 16th century and first documented in 1819. Over the past century, as understanding of the condition evolved, it acquired many synonyms such as acute confusional state, acute brain syndrome, mental dysfunction, and many others (2). Postoperative delirium is a well defined entity today. The high incidence of postoperative delirium in the elderly (i.e., 65 yr or older), ranging from 10%–60% (3–6), has rekindled interest in this disorder. Recent studies have been conducted in ophthalmic (7–9), orthopedic (4,5), and cardiac surgical populations (10–15). Some of these studies have revealed the preventive potential of a geriatric anesthesiologic program (4), the correlation of postoperative delirium with perioperative hypoxemia (16–18), and the predictive value of intraoperative quantitative electroencephalographic monitoring (14) in the occurrence of delirium. Moreover, efforts have been made to devise newer tests (19–23) for an early diagnosis of delirium.

The transient mental dysfunction has an important impact on the patient's health and therefore on health care costs. This condition can result in increased morbidity, delayed functional recovery, and prolonged hospital stay. The adverse effects of postoperative delirium on health and health care costs make early diagnosis and prompt treatment imperative. Since anesthesiologists have an important role in the perioperative management of elderly patients undergoing surgery, it is imperative for them to have a good understanding of postoperative delirium. There has been no definitive analysis of postoperative delirium in the elderly with emphasis on anesthesia care; therefore we undertook to present such an analysis.

Accepted for publication January 6, 1995.

Address correspondence and reprint requests to Frances Chung, FRCPC, Department of Anesthesia, The Toronto Hospital, Western Division, 399 Bathurst St., Toronto, Ontario, Canada M5T 2S8.

Diagnosis and Clinical Features

The distinguishing features of this transient global disorder are impaired cognition, fluctuating levels of consciousness, altered psychomotor activity, and a disturbed sleep-wake cycle (24). It is usually seen on the first or second postoperative day and symptoms are often worse at night. The condition can be silent and go unnoticed, or it may be misdiagnosed as depression (25). Recovery is common (26). In 20%–30%, delirium is followed by death.

The main disorders are cognitive function, thinking, perception, and memory (26). Disturbed perception results in illusions or hallucinations. These are often visual or both visual and auditory. The hallucinations tend to be vivid and frightening. Patients in delirium have disorganized and incoherent thinking and delusions may be present. Short-term memory is impaired. Patients are usually disoriented in regard to time. In more severe delirium, patients are disoriented to place and person. Attention disturbance is always present with the patient easily distracted. Patients are drowsy during the day whereas at night, awake and agitated.

The defining criteria of postoperative delirium are described in the Diagnostic and Statistical Manual of Mental Disorders (DSM (R) III) manual and are shown in Table 1 (27). Bedside tests devised to diagnose this condition include the commonly used Mini Mental State Exam (MMS; Table 2) (28), and other tests, such as The Saskatoon Delirium Checklist (19), Geriatric Mental State Exam (20), Clifton Assessment Procedures for the Elderly (21,22), and Confusion Assessment Method (23). These tests assess speech, consciousness, perception, orientation, coherence, memory, and motor activity. The MMS is easy to conduct, reliable, and can be used for serial testing in fluctuating conditions. Because it is simple, it has a high compliance rate among elderly subjects (29). However, MMS may be less useful for detecting mild or transient impairment in the early phases of drug toxicity and early dementias (19). The Saskatoon Delirium Checklist is more useful for detecting these subtle changes (19).

0003-2999/95/$5.00

Table 1. Diagnosis of Delirium Based on DSM (R) III Criteria[a]

Reduced ability to maintain attention to external stimuli (questions must be repeated as attention wanders) and to appropriately shift attention to new external stimuli.
Disordered thinking as indicated by rambling or incoherent speech.
At least two of the following:
1) Reduced level of consciousness, e.g., difficulty keeping awake during examination.
2) Perceptual disturbance: misinterpretations, illusions or hallucinations.
3) Disturbance of sleep-wake cycle with insomnia or daytime sleepiness.
4) Disorientation to time, place, or person.
5) Increased or decreased psychomotor activity.
6) Memory impairment, e.g., inability to learn new material, past events, or names of unrelated objects.
Clinical features develop over a short period of time (hours to days) and tend to fluctuate over the course of a day.
Either 1) or 2):
1) Evidence from history, physical examination, or laboratory tests of a specific organic factor(s) judged to be etiologically related to the disturbance.
2) In the absence of such evidence, an etiologic factor can be presumed if the disturbance cannot be accounted for by any nonorganic mental disorder.

[a] Diagnostic and statistical manual of mental disorders. 3rd rev. ed. Washington, DC: American Psychiatric Association, 1987:100–4. Reproduced with permission.

Table 2. Mini Mental State Exam[a]

Maximum score	Section
	Orientation
5	What is the year, season, date, day, month?
5	Where are we—state, country, town, hospital, floor?
	Registration
3	Name three objects—1 s to say each. Then ask the patient all three after you have said. Then repeat them until he learns all three. Count trials and record trials.
	Attention and calculation
5	Serial 7s. One point for each correct. Stop after five answers. Alternatively, spell "world" backwards.
	Recall
3	Ask for the three objects repeated above. Give one example of each.
	Language
9	Name a pencil and watch (2 points).
	Repeat the following: "No ifs, ands or buts" (1 point).
	Follow a three-stage command: "Take a paper in your right hand, fold it in half, and put it on the floor" (3 points).
	Read and obey the following:
	Close your eyes (1 point).
	Write a sentence (1 point).
	Copy design (1 point).
30	Total score

[a] From Folstein MF, Folstein SE, McHugh PR. "Mini-Mental State." A practical method for grading the cognitive state of patients for the clinician. J Psychiatry Res 1975;12:189–98. Reproduced with permission.

Incidence

The reported incidence of postoperative delirium varies widely. Incidence in patients in the general surgery group for all age groups ranges from 5% to 10% and, for the elderly, from 10% to 15% (3); for those in the orthopedic surgery group, from 28% to 61.3% (4–6); and for those in the cataract surgery group, from 1% to 3% (30). Knill et al. (31) found a 12% incidence of idiopathic postoperative delirium in 239 patients. In another study of 61 patients, 70 yr and older, they found idiopathic postoperative delirium lasting up to 6 days in 12 days. Noticeable dysfunction persisted for 6 wk in 5% of the elderly patients (32). A 25%–50% incidence of acute delirium in elderly patients hospitalized for medical problems has been reported (33–35). Differences in diagnostic criteria, populations under study, and methods of surveillance used probably account for the wide range of figures. Further studies are needed to determine the risk and the long-term outcome of delirium in the different elderly age groups, the young-old and the old-old.

Pathophysiology

Various hypotheses have been proposed to explain the pathogenesis of postoperative delirium (26). One suggests that when the oxidative metabolism of the brain decreases, the levels of neurotransmitters within the brain, such as acetylcholine, decline and cause mental dysfunction (36,37). Studies have shown that cerebral acetylcholine synthesis is sensitive to hypoxia (38,39). Moreover, an association between postoperative confusion and anticholinergic drug activity has also been observed (19).

The second hypothesis suggests that an increase of serum cortisol from the stress of surgery or anesthesia may be responsible for postoperative confusion (4,40). Reduced availability of tryptophan after cardiopulmonary bypass has also been incriminated in the pathogenesis of postcardiotomy psychosis (41).

Etiologic Factors

Etiology is divided into preoperative, intraoperative, and postoperative factors. These are listed in Table 3.

Preoperative Factors

Aging. A decrease in cerebral neuronal density, blood flow, metabolism (42), and levels of neurotransmitters (43) decreases anesthetic requirement (44).

Table 3. Etiologic Factors

Preoperative
1) Brain affectation due to
a) Physiologic causes—aging
b) Pathologic causes—congenital, traumatic, neoplastic, vascular, idiopathic
2) Drugs
Drug polypharmacy
Drug intoxication or withdrawal
3) Endocrine and metabolic
Hyper/hypothyroidism
Hyponatremia
Hypoglycemia
4) Mental status
Depression
Dementia
Anxiety
5) Sex
Intraoperative
1) Type of surgery
Orthopedic
Ophthalmic
Cardiac
2) Duration of surgery
3) Anesthetic drugs used
4) Type of anesthesia used—general versus regional
5) Complications during surgery
Hypotension
Hyperventilation
Embolism
Hypoxemia
Postoperative
1) Hypoxia
Respiratory causes
Perioperative hypoxia
Residual anesthetics
2) Hypocarbia
3) Pain
4) Sepsis
5) Sensory deprivation or overload
6) Electrolyte or metabolic problem

Table 4. Common Drugs That Affect Cognitive Function[a]

Minor tranquilizers
Diazepam
Flurazepam
Meprobamate
Oxazepam
Chlorazepate
Antihypertensives
Methyldopa
Reserpine
Diuretics
Hydrochlorthiazide
β-Adrenergic blockers
Propranolol
Major tranquilizers
Haloperidol
Thorazine
Thioridazine
Analgesics
Acetyl salicylic acid
Meperidine
Others
Cimetidine
Insulin
Amoxapine
Amantidine

[a] From Larson EB, Kukull WA, Buchner D, Reifler BV. Adverse drug reactions associated with global cognitive impairment in elderly persons. Ann Intern Med 1987;107:169–73. Reproduced with permission.

These biologic changes may also account for the increased predisposition of the elderly to postoperative delirium. There can be a difference between a person's chronologic and biologic age (45). Biologic age, which is determined by the number of diseases a person has had, seems to be the prime determinant of how the person withstands the stress of anesthesia (5,46,47). Although it is not feasible at this stage to quantify a patient's biologic age, it should prove a better predictor of postoperative dysfunction than chronologic age.

Pathologic States in the Brain. Cerebrovascular disease increases a person's vulnerability to hypoxia, which in turn results in reduced acetylcholine synthesis, thus predisposing a person to confusion (37). In patients with organic brain disease or baseline deficits in perception, perioperative stress can induce illusions, hallucinations, and paranoia, thereby setting the stage for delirium (48). In the postoperative period, a patient deprived of antiseizure medication can also develop seizure delirium (49), which may last for several days (25).

Polypharmacy and Drug Interactions. The elderly consume the most drugs of all age groups and are more sensitive to adverse drug reactions (50). Drugs that are likely to affect cognitive function are listed in Table 4 (50). Hurwitz (51) observed that the incidence of adverse drug interactions in patients aged 70–79 yr was three times that in patients aged 40–45 yr (7%). Antihypertensives, antiparkinsonism drugs, psychotropics, and cardiac drugs pose the highest risk of adverse drug reactions (52). Regular use of long-acting benzodiazepines can result in dementia in the elderly, which itself predisposes them to development of postoperative delirium. Chung et al. (53) have also reported the possible interaction of tricyclic antidepressants and general anesthesia as a cause of postoperative delirium.

Alcohol and Sedative-Hypnotic Withdrawal. Surveys of the hospitalized elderly show that the prevalence of alcohol abuse is approximately 18% (54) and that 10%–15% of the elderly are regular users of hypnotic drugs (55). Delirium caused by withdrawal of alcohol or hypnotics may ensue 12–48 h after surgery. Delirium tremens from alcohol withdrawal is dramatic and readily identifiable. However, in an alcoholic with thiamine deficiency, administration of intravenous (IV) glucose can precipitate a possibly fatal delirious state of Wernicke-Korsakoff psychosis (25). This state could go undiagnosed because the associated neurologic signs may be difficult to detect in a delirious patient, especially in the postoperative setting. Chronic subdural hematoma may also cause delirium in an alcoholic.

Endocrine and Metabolic Problems. Intravascular volume depletion has been associated with poor mental function. Although advanced age itself increases the risk of dehydration only slightly, it has been suggested that when a patient's mental score on diagnostic tests is low, the patient should be carefully examined for signs of dehydration (56). Moreover, the use of diuretics in the elderly can often cause hyponatremia, hypokalemia, hypomagnesemia, and metabolic alkalosis (57). When this fluid and electrolyte imbalance is exacerbated perioperatively, it can produce confusion. Endocrinopathies like diabetic ketoacidosis or nonketotic hyperglycemic diabetes (58), hyper- or hypothyroidism (59,60), and hepatic, renal, or pulmonary insufficiency have been shown to predispose a patient to delirium (61).

Depression, Dementia, and Anxiety. Gustafson et al. (4) observed an 88% incidence of acute confusional state after surgery in patients with preoperative depression. Patients with depression are known to have a deficiency of serotonergic and noradrenergic transmitter systems that may predispose them to delirium (62). Some studies (40) have found increased cortisol levels in depressed patients, a finding that has been hypothesized as a possible cause of delirium.

Dementia may be caused by a deficiency in the cholinergic system and in somatostatin (63,64), both of which are essential for normal cognitive functioning, attention, and sleep-wake cycle. A demented patient is, therefore, more vulnerable to delirium. Hypoxia and anticholinergic drugs pose a special threat to these patients.

Psychologic factors, such as anxiety, also play an important role in the incidence of delirium. Some (65–68) strongly believe that adequate psychologic preparation of the patient before surgery is essential and that patients who exhibit normal amounts of preoperative anxiety are least likely to have delirium. It is possible that emergency surgery allows the patient no time for mental preparation and results in subsequent fright-neurosis (69). However, other reports (70) suggest that when the patients' dominant mechanism for coping is denial and their anxiety levels are low, postoperative delirium is less likely to occur.

Gender. In a metaanalytic review of 18 studies, Cryns et al. (71) observed that gender may be predictive of the kind of mental impairment likely to occur after surgery. Women manifest a greater predilection for delirium, and men for cognitive decompensation.

Intraoperative Factors

Type of Surgery. In elderly patients undergoing cardiac surgery, hypoperfusion and microemboli of air or blood cells resulting in brain ischemia are two major factors implicated in the development of postoperative confusion (10–13). Hypoperfusion rather than embolization may play a more significant role in this confusion (14,15). Metabolic demand, ventilation-perfusion mismatch, embolism, vasospasm, or free-radical-induced cerebral microcirculatory impairment may each benefit from increased flow, either through the affected vessels or vital collaterals. Thus neuropsychologic dysfunction after cardiopulmonary bypass could be minimized by maintenance of adequate cerebral perfusion. Hypothermia during cardiopulmonary bypass may offer some cerebroprotection (14).

Among elderly patients undergoing orthopedic surgery, the highest incidence (44%–61%) of postoperative confusion has been observed in patients treated for femoral neck fractures (4,5). Preexisting mental depression, use of anticholinergic drugs, and age were significant predictors for the occurrence of postoperative confusion. Patients who developed delirium required a hospital stay approximately four times longer than those who remained lucid (16). Williams-Russo (5) found that the incidence of postoperative delirium was 41% in patients undergoing bilateral knee replacement compared with 14% in those undergoing unilateral knee replacement. Fat embolism was probably an important contributing factor in the postoperative confusional states in orthopedic patients with fractures or surgery involving reaming of bone marrow (72,73).

Elderly patients undergoing cataract surgery are especially vulnerable because of severe bilateral loss of vision and regular use of anticholinergic drugs or drops (8). Preexisting dementia in this age group compounds the problem (30). When Chung et al. (7) evaluated the mental recovery of patients after cataract surgery with neuroleptanalgesia, they observed that the baseline scores of cognitive function were significant predictors of postoperative cognitive dysfunction. As the acuity of vision deteriorated, psychiatric symptoms increased; with restoration of vision through cataract surgery, the symptoms normalized (9).

Anesthetic Drugs. Various studies (16,19,74) have shown the relation of anticholinergics to postoperative delirium. Acetylcholine acts as a key transmitter in the pathways concerned with arousal and awareness (75). Cholinergic deficiency in the elderly makes them susceptible to even low doses of anticholinergic drugs.

Similarly, drugs that are not anticholinergic, but that block the muscarinic sites, such as phenothiazines, antihistaminics, and some hypnotics, are also implicated in the cause of postoperative psychosis (76). Glycopyrrolate, a quaternary compound, does not cross the blood-brain barrier and does not cause the central nervous system effects that atropine or scopolamine does (77). Glycopyrrolate is the drug of choice in the elderly when an anticholinergic is needed.

As for general anesthetics, barbiturate premedication is implicated in the development of postoperative delirium (26,52). The elimination half-life of benzodiazepines is increased in the elderly. Benzodiazepines also produce greater effects on the central nervous system in the elderly than in all other age groups (78–81). Habitual users of benzodiazepines may have preexisting cognitive impairment (50) that makes them more vulnerable to developing delirium under the stress of anesthesia or surgery. Rogers et al. (6) studied 46 orthopedic patients to determine the risk factors associated with postoperative delirium. Treatment with flurazepam, propranolol, or scopolamine conferred a relative risk for delirium of 11.7 (6). In addition, postoperative delirium could also be a manifestation of benzodiazepine withdrawal (52,82).

Several studies (16,29,83) have found no difference in the effects of general, epidural, or spinal anesthesia on postoperative confusion. Similarly, no differences in the long-term cognitive or psychosocial sequelae have been found with the use of general or regional anesthesia (84). A common cause of delirium is iatrogenic, drug-induced delirium. In the first 48–72 h after surgery, the effects of residual anesthetics have been considered probably causes of impaired cognitive function (85–87). The choice of anesthetic drugs may affect postoperative cognition. Therefore it is important to use newer anesthetics with shorter elimination half-lives.

Postoperative Factors

Hypoxia. Perioperative disturbances of oxygenation and ventilation, underlying pulmonary disease, and anemia can contribute to perioperative hypoxia (88). In patients not monitored with pulse oximetry, hypoxemia is common (89). Oxygen saturation less than 85% may occur for many hours postoperatively at night (90). Nocturnal desaturation was particularly severe in obese patients after major operations (91).

Patients undergoing major surgery have decreased mental function on the third day. There was a significant correlation between mental function on the third day after operation and mean Sa_{O_2} on the second postoperative night after major surgery (18). However, the sample size of this study was small and the measurement of mental function was crude. Moller et al. (92) studied 736 surgical patients, half of whom had been monitored with pulse oximetry during anesthesia and in the postanesthesia care unit. Of the 736 patients, 7.3% suffered a decline of 17% in their postoperative psychologic tests. Three months later, 40% of these patients still had a lower test score than preoperatively. Six weeks postoperatively, 7% of the patients who had been monitored, and treated if hypoxemic, complained of new forgetfulness, while 11% of patients not monitored, and presumably after hypoxemia, voiced the same complaints ($P < 0.06$). Nielson et al. (84) studied 64 elderly patients 3 mo after undergoing arthroplasties. No cognitive changes were detected (84). Therefore, there is no conclusive evidence of association of hypoxia and cognitive dysfunction.

The consequences of hypoxemia on cerebral function in the elderly have not been studied. Hornbein et al. (93) found that normal volunteers exposed to profound hypoxemia (Sa_{O_2} 50%–60%) for several days had shown some mild cognitive deficits. Although the use of supplemental oxygen for postoperative hypoxemia has been recommended (94), there are no well controlled studies to indicate that oxygen therapy was beneficial and improves outcome. An editorial in *Lancet* recommended to characterize the exact risk factors, to identify the deleterious effects of hypoxemia on heart, brain, and other organs, and to clarify the influence of hypoxemia on outcome after surgery (90). Then oxygen can be prescribed in a cost-effective manner.

Hypocarbia. Artificially controlled ventilation can cause hypocarbia. Katzman (63) and Wollman et al. (95) observed a 43% decrease in cerebral blood flow at Pa_{CO_2} of 19 mm Hg. Every millimeter decrease in Pa_{CO_2} decreases the cerebral blood flow by 2%. Such a decrease may prove crucial in the aged.

Sepsis. Postoperative delirium may often be the only manifestation of an underlying septic process such as pneumonia, or may even herald the onset of myocardial infarction. Similarly, inadequate analgesia subjects the patient to undue stress and can precipitate a full-blown confusional state in a marginally compensated patient.

Prevention

Prevention can be applied at preoperative, intraoperative, and postoperative levels. The principles of prevention are mentioned in Table 5.

Preoperative Assessment

Preoperative evaluation gives important clues to the preoperative etiologic factors which increase the

Table 5. Prevention

Preoperative assessment
Detailed history of drugs
Medical problem evaluation
Detection of sensory or perceptual deficits
Mental preparation prior to surgery
Neuropsychologic testing
Use of geriatric-anesthesiologic program
Intraoperative precautions
Adequate oxygenation and perfusion
Correct the electrolyte imbalance
Adjust drug dose
Minimize the variety of drugs
Avoid atropine, flurazepam, scopolamine
Postoperative care
Environmental support
Well-lit cheerful room
Quiet surroundings
Keep patient oriented
Visit by friend or family
Treat pain
Identify risk-associated drugs
Anticholinergics
Depressants
H_2-antagonists
Digoxin, lidocaine
Reassure patient and family

chance of perioperative delirium (Table 3). A thorough assessment of the patient's physical and mental status and medications is very important. Preexisting sensory or perceptual deficits compound a patient's chances of developing confusional states. Any evidence of cognitive impairment should be carefully noted.

The incidence of delirium is significantly lowered when a geriatric-anesthesiologic intervention program is implemented. This intervention program consists of pre- and postoperative geriatric assessment, early surgery, thrombosis prophylaxis, oxygen therapy, prevention and treatment of perioperative decrease in blood pressure, and vigorous treatment of any postoperative complications (4). The outcome of the intervention of 103 patients was compared with a historical control of 111 patients. The incidence of delirium was lower, 47.6% in the intervention study versus 61.3% ($P < 0.05$) in the control study. The incidence of postoperative decubitus ulcers, severe falls, and urinary retention was also lower. The mean duration of hospital stay was lower in the intervention group—11.6 days versus 17.4 days in the control group ($P < 0.001$). Although the design of this study has a methodologic flaw in using a historical control rather than randomization, there is some evidence that the intervention program reduced the incidence, severity, and duration of delirium with a shortened hospital stay (4).

However, a recent study showed that the beneficial effects of systemic detection and intervention in cases of delirium in elderly inpatients were few (96). Medical elderly patients with delirium were randomized to the intervention group or the control group. The treatment group received a geriatric consultation and followup by a liaison nurse. Those in the control group received regular medical care. Further studies in this area are necessary to determine the benefits of the intervention program.

Intraoperative Measures

The mainstay of intraoperative preventive measures is maintaining good oxygenation, normal blood pressure, correct drug dosage, and normal electrolyte levels. The anesthesia regimen should be as simple as possible. The elderly are sensitive to even small doses of drugs. Moreover, altered metabolism or kidney function may result in prolonged action of the drugs. Hence it is essential that anesthetic doses for the elderly be carefully titrated. Drug cocktails should be avoided. Atropine, scopolamine, and flurazepam should be used only if necessary, and the dose should be as low as possible.

Quantitative monitoring of electroencephalographic waves has been used to detect abnormalities during hypotensive episodes during cardiopulmonary bypass. These abnormalities in electroencephalographic waves can predict the occurrence of delirium in the postoperative period, but the role of quantitative electroencephalography monitoring in routine anesthetic practice has yet to be defined (14).

Postoperative Care

Ambulatory surgery may have a role to play in preventing delirium by maintaining a familiar home environment postoperatively. Therefore, more ambulatory surgery for the elderly should be encouraged. The postanesthetic care environment should be conducive to the patient's feeling of well being. Adjusting the light and dark cycles to ensure adequate sleep is very helpful, since sleep deprivation may be an important factor in the genesis of postoperative delirium (97,98). Patients often find intensive care units rather frightening. The various gadgets, each with a different sound, unceasing activity, and constant illumination can cause sensory overload. Delirium developed in this setting often is best treated by transfer of the patient to a regular floor, as soon as medically possible.

Adequate analgesia, especially in patients who cannot communicate easily because of endotracheal tubes or tracheostomy, is crucial. Untreated pain or under treatment of pain can easily tip the balance toward delirium in borderline patients (99).

The importance of nursing care cannot be overstressed. Since they are the main contact with the patient, nurses should be well versed in detecting the earliest signs of delirium. When delirium sets in, the patient and the family need to have constant reassurance from their health care givers.

Drugs associated with the risk of precipitating or worsening delirium should be used with discretion. These include central nervous depressants, H_2-antagonists, anticholinergics, digitalis, phenytoin, lignocaine, and aminophylline.

Management of Postoperative Confusion

Once postoperative confusion has been diagnosed, the patient should be managed with extra vigilance. Although recovery is common, delirium can result in unwarranted complications. Hospitalization may be prolonged; altered cognition may lead to falls and fractures; lines may be pulled out; bandages or wounds may be torn open; prolonged immobilization may lead to decubitus ulcers, pneumonia, or venous thrombosis. Moreover, these patients may have delayed functional recovery and hence may be a burden on relatives and friends.

The first consideration in the management of delirium is to find and treat any underlying organic cause of the confusion. In the elderly, delirium may in fact be the only signal of the onset of conditions such as pneumonia, sepsis, or myocardial infarct (100). An organic cause must be ruled out first with a thorough history, physical examination, laboratory tests, or other diagnostic procedures. If the patient is taking any risk-associated drugs, their doses may be reduced or stopped temporarily.

When confusion is evident, treatment must be instituted promptly. Haloperidol, the drug of choice, does not produce significant hypotension or autonomic effects. It does not aggravate diabetes, hepatic disease, or renal disease. It is compatible with anticholinergic drugs. It does not cause oversedation and, because it is odorless and tasteless, it is palatable (101). Doses of 0.25–2 mg oral haloperidol 1–2 h before bedtime is the preferred treatment. The daily amount may be given as a single dose at bedtime or it may be divided and given two or three times a day. When patients are severely agitated, more rapid control of symptoms can be achieved with intramuscular (IM) haloperidol. A small dose, 0.5 mg IM, is given every hour until symptoms are adequately controlled. IV administration may be preferred to the IM route in the presence of circulatory compromise because the absorption of IM drugs may be erratic (102). Also, the pain of IM injection may add to the patient's confusion and the assessment of enzymes, such as lactate dehydrogenase and creatine kinase, may be complicated (102). Haloperidol also has an advantage of causing less hypotension than chlorpramazine (103).

Droperidol has also been used in rapid tranquilization. Resnick and Burton (104) have observed that droperidol is less anticholinergic and hypotensive and more sedating than other antipsychotic drugs used for rapid tranquilization. Although chlorpromazine is extremely effective, it is a potent α-adrenergic antagonist and can lead to a severe drop in blood pressure. It is not the drug of choice in a critically ill patient who may be dependent on his or her peripheral resistance.

Diazepam can be used alone or in combination with other antipsychotic drugs. It is especially useful in the treatment of delirium tremens. Thiamine is the key drug for the management of Korsakoff's psychosis (103).

Neither muscle relaxants nor physical restraints are particularly effective in the treatment of postoperative confusion. Muscle relaxants are not very practical since their use requires intubation and mechanical ventilation. Physical restraints may aggravate the confusion of an already confused patient because they create the impression of being tied down. Use of restraints should therefore be minimal, and whenever they are used, the reasons for their use should be explained frequently to the patient.

Finally, if delirium progresses to coma, standard treatment for control of airway, breathing, and circulation should be instituted. After recovery from an acute episode, a psychiatric or psychosocial referral may aid early functional rehabilitation. Similarly, nursing assistance at home will help with early discharge from the hospital. Physiotherapy and occupational therapy are also important adjuncts in the management of postoperative delirium.

Summary

Postoperative delirium is common in the elderly in the postoperative period. It can result in increased morbidity, delayed functional recovery, and prolonged hospital stay. In surgical patients, factors such as age, alcohol abuse, low baseline cognition, severe metabolic derangement, hypoxia, hypotension, and type of surgery appear to contribute to postoperative delirium. Anesthetics, notably anticholinergic drugs and benzodiazepines, increase the risk for delirium. Despite the above recommendations, postoperative delirium in the elderly is poorly understood. Clearly, further studies are needed to determine the risk and long-term outcome of delirium in the elderly population. Research is also needed to define the effects of hypoxemia on cerebral function and whether oxygen therapy has any benefits. The geriatric-anesthesiologic intervention program of pre- and postoperative geriatric assessment, early surgery, thrombosis

prophylaxis, oxygen therapy, prevention and treatment of perioperative decrease in blood pressure, and vigorous treatment of any postoperative complications showed some promise, but further definitive studies are needed.

The authors would like to thank Ms. C. Drane for her secretarial assistance in the preparation of this paper.

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