Chapter 29
Common Perioperative Complications in Older Patients

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Introduction

As one of the fastest growing segments of the population, elderly patients account for an increasing percentage of operations in most practices. On the basis of the 2006 National Hospital Discharge Survey, patients aged 65 and older accounted for 35% of all procedures [1]. Elderly patients have a higher rate of postoperative complications. Two large studies found complication rates of 20–50% in patients aged 80 years and older [2, 3]. In contrast, younger patients had complication rates approximately half of that in the elderly patients. Table 29.1 outlines the relative frequency of specific complications in elderly patients undergoing a variety of noncardiac surgical procedures.

Elderly patients are similar to other patients in terms of the "typical" postoperative complications that can occur with an operation such as bleeding, infection, or technical errors. However, elderly patients are at risk for a group of unique complications owing to the physiologic changes of aging and the stress of the perioperative period. The underlying mechanisms for recognition, treatment, and prevention of these complications are the focus of this chapter.

There are some general principles for identifying, preventing, and treating postoperative complications in elderly patients. First and foremost, many postoperative complications in elderly patients have "atypical" presentations, making the recognition of postoperative complications difficult in this age group. For example, infectious complications do not necessarily present with fever and leukocytosis; delirium can be the sole clinical manifestation of an infectious complication.

The second principle is to actively search for and avoid complications. Every surgeon caring for elderly patients has had a case where a single, seemingly minor, postoperative complication spiraled into something more significant. This is because although elderly patients tolerate most elective operations, they have limited physiologic reserves to tolerate the increased physiologic stress of postoperative complications. After emergency operations, much of physiologic reserve is spent maintaining homeostasis, leaving even less reserve for complications. Therefore, it is imperative to avoid preventable complications such as those that result from a poor choice of medications.

The third principle is to perform an adequate preoperative risk assessment including functional status and cognitive assessment. In the elective setting, there is adequate time to fully evaluate the elderly patient for occult comorbidities and determine functional and cognitive status. Unfortunately, the same time is usually not available in the case of urgent or emergency operations. However, this information can often be obtained from caregivers and family. This has a direct impact on expected postoperative course, especially after emergency operations, and can help set expectations and goals of therapy.

Age-Related Complications

Delirium

Delirium is a relatively frequent complication following surgery in elderly patients. Table 29.2 outlines the rates of postoperative delirium for selected common procedures. The reported rates of postoperative delirium range from 15 to >50%. [4] The rate varies from <5% following cataract surgery to as high as 60% after hip replacement [5]. Elderly patients who develop delirium have longer postoperative hospital stays, are more likely to be discharged to a nursing home, less likely to regain full function, and have higher death rates at 30 days, 6 months, and 1 year [5–8].

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Table 29.1 Postoperative complications in elderly patients

	Age	
	<80 ($n=568{,}263$)	≥80 ($n=26{,}648$)
Morbidity	% Complication	
≥1 complication	12.1	20.0
Respiratory complications		
Pneumonia	2.3	5.6
>48 h on ventilator	2.1	3.5
Required reintubation	1.6	2.8
Pulmonary embolism	0.2	0.4
Urinary tract complications		
Urinary tract infection	2.2	5.6
Acute renal failure	0.4	0.6
Progressive renal failure	0.4	1.0
Cardiac complications		
Myocardial infarction	0.4	1.0
Pulmonary edema	0.6	1.0
Cardiac arrest	0.9	2.1
Wound complications		
Deep wound infection	1.4	1.3
Superficial wound infection	1.9	1.7
Wound dehiscence	0.9	0.9
Nervous system complications		
Cerebrovascular accident	0.3	0.7
Coma > 24 h	0.3	0.3
Peripheral nerve injury	0.3	0.3
Other complications		
Systemic sepsis	1.2	2.0
Bleeding requiring >4 units blood	1.0	1.5
Prolonged ileus	1.2	1.7
Deep-vein thrombosis	0.4	0.6
Graft or prosthesis failure	0.5	0.4

Source: Reprinted from Hamel et al. [2], with permission from Wiley Blackwell

Table 29.2 Rates of delirium following selected procedures

Procedure	Rate (%)
Cardiac surgery[a]	48
Aortic surgery[b]	30–50
Vascular bypass[b]	29
Cataract surgery[c]	<5
Hip surgery (elective)[b]	4–15
Hip surgery (emergency)[b]	19–44
Colorectal surgery[d]	38

[a] Data from Rudolph JL et al (2009) Circulation
[b] Data from Dasgupta and Dumbrell [12]
[c] Data from Milstein A et al (2002) Int Psychogeriatr
[d] Data from Beaussier M et al (2006) Reg Anesth Pain Med

Impact on Outcome

The development of postoperative delirium has a deleterious effect on postoperative outcomes. Specifically, postoperative delirium is associated with longer length of stay [6, 9], higher postoperative complication rates [9], higher probability of discharge to nursing home [6], poorer functional outcome [7, 10], and higher death rates at 6 [6] and 12 months [7]. This results in a greater financial burden of care for these patients. Robinson documented an average cost of hospitalization of $50,100 in patients who developed postoperative delirium [6]. In contrast, the average cost of hospitalization in patients who did not develop delirium was $31,600. Two studies of patients undergoing nonorthopedic operations documented a doubling of length of stay in patients with postoperative delirium when compared to patients who do not develop delirium [6, 9].

The development of delirium is also associated with higher rates of overall postoperative complications [9]. This is not unexpected as delirium is often the initial sign of a postoperative complication. However, a large study of patients who developed delirium after surgical treatment of hip fracture did not show an increased length of stay or increased postoperative complication rate when compared to patients who did not develop postoperative delirium [7].

There are also conflicting data on increased rates of discharge to nursing homes in patients who developed postoperative delirium. Robinson et al. [6] showed a significantly higher rate (33%) of postdischarge institutionalization in patients who developed delirium as compared to patients who did not (1%) following nonorthopedic procedures. In contrast, Edelstein et al. [7] did not find a significant increase in the rate of discharge to a skilled nursing facility for patients who developed delirium after hip fracture repair.

There is general agreement, however, that postoperative delirium is associated with worse functional recovery, as demonstrated by decline in basic activities of daily living at 1 [10] and 12 months [7] after treatment of hip fracture, and with a higher risk of death in the 6–12 months following operation [6, 7].

Etiology, Risk Factors, and Precipitating Factors

The underlying mechanisms of delirium are uncertain. However, it appears to represent an imbalance between central nervous system cholinergic and dopaminergic activity. The predominant theory is that underactivity of cholinergic system coupled with excessive dopaminergic activity can lead to delirium. This is supported by precipitation of delirium through use of anticholinergic or dopaminergic medications [11].

Delirium is the end result of a complex interaction between risk factors and precipitating events. Furthermore, in similar situations, similar patients may not necessarily develop delirium. A key component in preventing postoperative delirium is recognition of at-risk patients. The preoperative evaluation should include a detailed cataloging of the common risk factors noted in Table 29.3. The risk factor with the strongest association with development of postoperative delirium is preoperative cognitive impairment [12].

Table 29.3 Risk factors for and precipitating factors of delirium

Risk factors	Precipitating factors
Advanced age	Infection
Underlying cognitive impairment	Medications
Functional impairment	Hypoxemia
Coexisting medical comorbidities	Dehydration
Psychotropic medications	Sensory deprivation
Alcohol abuse	Electrolyte abnormalities
Sensory impairment	Unfamiliar environment
Immobility	Surgery
	Neurologic events
	Sleep deprivation/disruption
	Use of physical restraints
	Malnutrition
	Use of a bladder catheter

Unfortunately, this and many of the other risk factors cannot be modified in the preoperative setting prior to elective operation. However, reduction in the severity of individual risk factors, such as visual and hearing impairment and immobility, has been shown to reduce the incidence of delirium [13]. In addition to risk factors noted in the table, the presence of preoperative pain is a risk factor for postoperative delirium [14]. This is a factor that can be mitigated prior to operation using an appropriate clinical strategy. Specifically, use of oral instead of intravenous analgesia is associated with lower rates of postoperative delirium in elderly patients.

During the perioperative period, the most important strategy to prevent delirium is to actively monitor, treat, and avoid the precipitating factors. Each precipitating factor is a marker for a risk factor, has the potential to increase the severity of risk factors, or can lead to development of complications for which delirium may be a sign. Use of physical restraints and bladder catheters both lead to immobilization. In addition, indwelling bladder catheters predispose to urinary tract infection, which can precipitate delirium. Factors that alter sensorium, such as sleep deprivation or disruption, medications, or neurologic events, can also precipitate delirium. It should be noted that neurologic events are an unusual, but often sought, cause of postoperative delirium.

Diagnosis

Delirium is distinguished from dementia by its acute onset and fluctuating course. Other components include inattention with the inability to focus, disorganized thinking, and altered level of consciousness. Although most clinicians are familiar with the agitated or hyperactive state of delirium, the condition can also present as somnolence. This can lead to misdiagnosis and attribution to other causes. The Confusion Assessment Method as proposed by Inouye [15] is a validated method to diagnose delirium. It requires the presence of acute onset with a fluctuating course and inattention. Either disorganized thinking or altered level of consciousness must also be present to confirm the diagnosis. The presence or absence of each component is obtained by history or testing. Acute onset and fluctuating course are confirmed by direct observation or in the case of patients presenting with delirium through history from family and/or care providers. Inattention can be tested using simple tests such as counting backward (by threes or sevens) or naming months in reverse order. Disorganized thinking is noted on interviewing the patient. The patient will have rambling speech and/or illogical flow of ideas. He or she may switch between subjects of conversation unpredictably. Altered level of consciousness is defined as reduced clarity of surroundings – either lethargy/somnolence or hyperactivity/mania.

Table 29.4 Etiology of acute confusion in surgical patients

I	Infection
M	Metabolic
C	Cognitive, sensory
O	Oxygenation
N	Nutrition, swallowing
F	Function, pharmacy, Foley catheter
U	Unfamiliar environment
S	Stress, pain
E	Electrolytes/fluids
D	Dysfunction lung, liver, kidney, brain

Evaluation and Treatment

Initial evaluation of patients with postoperative delirium is focused on assessing etiology and stabilizing the patient. Review of the preoperative history, including functional assessment and medications, is critical. The presence of risk factors as outlined should be determined. Possible precipitating factors should also be sought. A mnemonic for etiologies of acute confusion in surgical patients is shown in Table 29.4.

In those instances when postoperative delirium occurs, treatment is directed at identifying the underlying cause, providing supportive care and controlling symptoms (Fig. 29.1). Delirium is often a manifestation of other postoperative complications such as occult infection, anastomotic leak, hypoxia, hypovolemia, or electrolyte imbalance. A thorough investigation is indicated to evaluate and treat these possible etiologies. Unfortunately, a single, specific etiology is not identified in a significant number of cases. Supportive care includes many of the strategies used to prevent delirium and also includes measures to ensure airway protection, maintain adequate oxygenation, maintain fluid and electrolyte balance, and provide nutritional support. If possible, physical restraints should be avoided. Control of the patient's symptoms includes the prevention strategies previously discussed. Pharmacologic intervention should be reserved

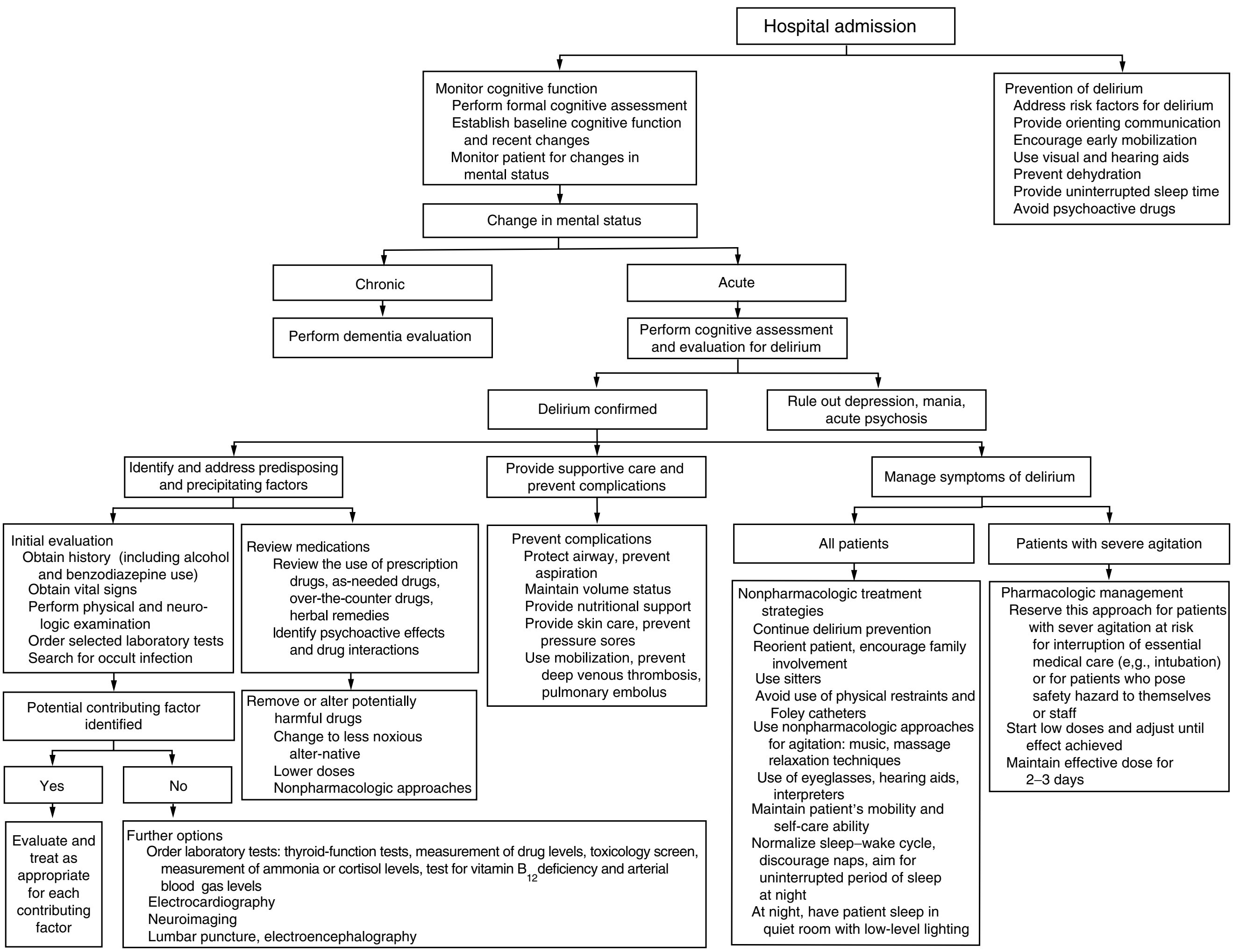

Figure 29.1 Prevention and management of delirium (reprinted from Inouye [11].

for the most severe cases where patients are in danger of injuring themselves. Haloperidol (0.5–1 mg) is the preferred medication for pharmacologic intervention. Benzodiazepines – lorazepam is preferred – should only be used in cases of alcohol or benzodiazepine withdrawal.

Prevention

Strategies to prevent postoperative delirium are outlined in Table 29.5. Effective preventative measures involve multi-component interventions. An early trial demonstrated a reduction in the number and duration of episodes of delirium in medical patients [13]. The interventions to prevent cognitive impairment were orientation and therapeutic activities, prevention of sleep deprivation, early mobilization, communication methods and adaptive devices for hearing and visual impairment, and early intervention to treat dehydration. A subsequent randomized trial in patients with hip fracture found that geriatrics consultation with structured intervention reduced the rate of postoperative delirium when compared with standard care [16].

Table 29.5 Delirium prevention strategies

Orientation	Adequate oxygenation
Avoidance of restraints	Adequate pain management
Hearing aids	Medication review and avoidance
Eyeglasses	Adequate hydration
Family presence	
Bowel and bladder regimen	
Early mobilization	
Adaptive equipment	
Normal sleep/awake cycle	

Studies on pharmacologic prevention of delirium have focused on several different medications. Randomized, placebo-controlled trials in surgical patients have evaluated the antipsychotic drug haloperidol [17], the cholinesterase inhibitor donepezil [18, 19], and the analgesic gabapentin [20]. Haloperidol prophylaxis was associated with reduced severity and duration of delirium in patients at intermediate or high risk for this complication following hip surgery. Hospital length of stay was also reduced; however, the incidence of delirium was unchanged [17]. The trials evaluating prophylactic treatment with donepezil also did not find a reduction in the incidence of delirium or a reduction in hospital length of stay [18, 19]. A single small study of gabapentin found reduced analgesic requirements and a reduced incidence of delirium in patients undergoing spine surgery when compared with placebo [20].

Falls

Greater than one third of persons 65 years of age and older fall each year [21]. Falls are common in the postoperative period although they are likely to be underreported as is the rate of functional disability. Various risk factors for falls have been identified including previous history of falls, dehydration, frequent toileting, cognitive dysfunction, gait disturbances, impaired balance and mobility, and conditions such as Alzheimer's disease. Sleep apnea is known to cause sleep fragmentation and daytime drowsiness, leading to a higher risk of falls [22, 23].

Behavioral disturbances occasionally require the use of restraints in older patients in the postoperative period. Restraints should be used only when clinically justified and with strict adherence to guidelines and required monitoring. Restraints do not reduce the incidence of falls. In a case control study, patients with restraints were more likely to fall than those without restraints [24].

Fall risk should be judged preoperatively by assessing the patient's ability to ambulate and by inquiring about any history of falls in the recent past, both from the patient and family. Those with a history of falls and difficulty ambulating can be referred for perioperative physical therapy. A history of problem alcohol drinking is also associated with increased fall risk [25].

The "Get Up and Go" test is an excellent method to evaluate mobility and balance. It requires a patient to get up from a chair, walk three meters, turn around, and sit down. The test is scored on a five-point scale with 1 = normal, 2 = very slightly abnormal, 3 = mildly abnormal, 4 = moderately abnormal, and 5 = severely abnormal. The patient is rated as a low fall risk (1) or a high fall risk (5) during the maneuver. If an elderly patient is able to accomplish the task in 20 s or less, they are likely to be independent in activities of daily living. Inability to complete the maneuver suggests a high risk of fall [26]. During a 6-month period following hip fracture surgery, 95% of subjects who fell had a test score of >24 s, while 93% of patients who did not fall had scores <24. The limitation of this study is that a moderate functional capacity is needed at the time of discharge to be able to perform in the test [27].

Another useful test for assessment of balance and mobility in frail older adults is the Hierarchical Assessment of Balance and Mobility [28]. The Hierarchical Assessment of Balance and Mobility is designed to be sensitive to changes in mobility of a patient in the postoperative period. A patient's mobility varies from being unable to move off pressure points to being able to grab the bed rail and roll and eventually being able to sit and ambulate. The assessment, therefore, measures mobility (unlimited, limited, limited with aid, one person hands on, one person stand-by, lying or sitting independently, positioning self in bed, in need of positioning), transfers (independent, one person standing by, one person minimal assist, one person assist, two person assist, or total lift), and ambulation (stable ambulation, stable dynamic standing, stable static standing, stable dynamic sitting, stable static sitting, impaired static sitting). Interventions that can prevent falls in the older hospitalized patient include medication review with removal of the offending medication, adequate hydration and monitoring of orthostatic blood pressure, management of postoperative delirium by identifying and treating the cause of delirium, balance and gait training, and adherence to a regular voiding schedule [29]. Problems with vision can lead to a higher incidence of falls in the postoperative period. Vision aids may have been taken away preoperatively, and it is critical that these are returned and made available to the patient in the postoperative period [13].

Functional Decline

Deconditioning is a complex process of physiological change following a period of inactivity, bed rest, or sedentary lifestyle. It results in functional losses in such areas as mental status, degree of continence, and ability to accomplish activities of daily living (Table 29.6). It is frequently associated with hospitalization and the postoperative period in the elderly. The most predictable effects of deconditioning are seen in the musculoskeletal system and include diminished muscle mass and decrease of muscle strength that can seriously limit mobility [30]. Deconditioning following surgery can be debilitating and impede functional recovery. Incontinence and constipation are consequences of deconditioning and can have a significant impact on functional recovery and restoration of Activities of Daily Living (ADL).

Prolonged bed rest following surgery is a risk factor for functional decline [31]. In a study of 223 patients older than 75 years of age who underwent elective surgery for gastric and colorectal cancers, 24% of patients showed a decrease in activities of daily living (ADL) at 1 month following surgery. However, only 3% of patients showed a decline at 6 months. This suggests that older patients are able to attain functional independence and also report better quality of life

Table 29.6 Immobility, deconditioning, and functional decline

Musculoskeletal	***Metabolic***
Atrophy	Negative nitrogen balance
Contractures	Impaired glucose tolerance
Bone loss (osteoporosis)	Altered drug pharmacokinetics
Cardiovascular	***Genitourinary***
Deconditioning	Infection
Decreased plasma volume	Retention
Orthostatic hypotension	Bladder stones
DVT and PE	Incontinence
Pulmonary	***Psychological***
Atrophy	Sensory deprivation
Contracture	Delirium/dementia
Bone loss	Depression
Gastrointestinal	***Skin***
Anorexia	Pressure ulcers
Constipation	
Impaction/incontinence	

after surgery [32]. Patients who show signs of functional decline in the early postoperative period benefit from early physical therapy consultation and discharge to a skilled nursing facility or to a nursing home until satisfactory recovery. A study conducted in patients in intensive care units and ranging from 40 to 70 years have shown that initiation of early physical therapy was safe in older adults, did not increase cost, and decreased length of stay in the intensive care unit as well as hospital length of stay [33]. Another study in patients between 36 and 69 years of age also showed that whole-body rehabilitation – consisting of interruption of sedation – and physical and occupational therapy in the earliest days following a critical illness resulted in better functional outcomes at hospital discharge [34].

Cognitive impairment has been shown to be associated with poor rehabilitation outcomes and increased surgical mortality [35], and dementia is also a predictor of functional disability [36]. Older patients with preexisting chronic renal disease are more likely to be frail and also have a higher risk of developing functional limitation and disability [37, 38]. This may be secondary to a heightened inflammatory state in chronic renal disease [39].

Other General Complications

Infection

Postoperative infections are an important cause of morbidity and mortality in elderly patients. Although little is known about specific decreases in immunologic competence, elderly patients may have diminished immune function, predisposing them to infection [40]. The most common sites of postoperative infection are the urinary tract, lungs, and surgical site [40].

Urinary tract infection (UTI) is typically due to prolonged bladder catheterization. Up to 25% of hospitalized patients have urinary catheters inserted; of these, 10–27% develop UTIs [41]. Eighty percent of nosocomial UTIs are associated with the use of urethral catheters [41] The need for catheterization is increased in elderly patients for several reasons including medication side effects, preexisting incontinence, prostatism, and decreased mobility, all of which hinder urination [40]. Symptoms of UTI in the elderly may be subtle. Postoperative confusion may be the first and only sign of a UTI [40].

As UTIs are associated with significant morbidity and excess hospital cost [42], methods to decrease this complication are warranted. Silver impregnated catheters have been shown to reduce the risk of asymptomatic bacteriuria in short-term catheterization and to provide a cost savings when compared to standard catheters [43]. Urethral catheters impregnated with antibiotics (minocycline, rifampicin, nitrofurazone) have also shown a reduction in asymptomatic bacteriuria for urethral catheterization of less than 1-week duration [43]. However, as the inappropriate use of urinary catheters in the elderly has been documented [44] and the risk of UTI increases with increasing duration of catheterization [45], avoidance of catheterization if possible and early removal of the catheter are important steps in preventing urinary tract infections postoperatively [40].

Nosocomial pneumonia (NP) is the second most frequent hospital-acquired infection and is common in patients undergoing general, noncardiac surgery [46, 47]. Ventilator-associated pneumonia (VAP) is an important subset of NP defined as pneumonia occurring 48–72 h after endotracheal intubation. NP is a leading cause of postoperative mortality in elderly patients [46]. Although NP in older patients does not have distinctive features or a different management approach when this illness arises in younger patients [48], certain risk factors including age and functional status render the elderly vulnerable for developing NP. Underlying comorbid conditions, malnutrition, and impaired immune function may increase the mortality associated with postoperative pneumonia in the elderly [40]. Nasogastric tubes, tracheal intubation, dementia, aspiration (see section "Pulmonary Complications"), recent chest or abdominal surgery, and immobility are additional risk factors [40, 46].

NP is diagnosed using clinical criteria such as fever, purulent sputum, leukocytosis, and the presence of new infiltrates on chest radiography combined with a quantitative lower respiratory tract specimen positive for organisms. The early and appropriate initiation of antibiotic therapy for the treatment of NP has been shown to decrease mortality [47].

Because inappropriate initial antibiotic therapy leads to worsened outcomes, broad-spectrum empiric antibiotics are used at first, and therapy is then tailored based upon final culture results and sensitivities. Strategies to reduce the risk of NP include standard precautions like hand washing and the use of personal protective equipment among health care providers; aspiration prevention methods (see section "Pulmonary Complications") including the use of endotracheal tubes with a dorsal lumen for drainage of tracheal secretions in the subglottic area; and early ambulation, deep breathing, and the use of incentive spirometry [49].

Surgical site infection (SSI) is a significant postoperative complication. SSI is the most common nosocomial infection in surgical patients, accounting for 38% of nosocomial infections in this patient population [50]. Not only is there substantial morbidity and mortality associated with SSI but the economic costs to the patient and health care delivery system are also high [51]. SSI is an infection that occurs somewhere in the operative field after a surgical intervention. Risks of developing SSI include those related to the operative procedure as well as patient-specific risks. Advanced age is considered a host-derived risk factor for surgical site infection [52]. In an analysis of deep incisional and organ/space surgical infections, elderly patients with these infections had longer hospitalizations, more frequent readmissions, and almost double the hospital charges as compared to elderly patients without postoperative infections. Most significantly, the elderly patients with these postoperative infections had a death rate that was more than three times that of the elderly patients without postoperative infections [53].

SSI is caused by organisms introduced into the surgical wound at the time of the operative procedure [51]. Most of these organisms originate from the patient's own flora, but exogenous sources of bacteria may also lead to infection. The implementation of proven surgical infection preventive practices such as appropriate antibiotic selection and administration, intraoperative maintenance of normothermia, the avoidance of shaving the surgical site until just prior to incising the skin, and ensuring perioperative euglycemia has been demonstrated to reduce the incidence of surgical site infection by 27% [52, 54]. Vigilant surveillance of surgical wounds postoperatively is necessary to ensure the early diagnosis and treatment of a wound infection, characterized by erythema at the wound edges and the presence of purulent drainage involving the wound or organ space. Treatment of SSI involves opening the incision and allowing adequate drainage. The use of antibiotics is discouraged unless there are systemic signs of infection. If antibiotics are to be used, the choice should be determined by the most likely pathogens for the operative procedure performed [51].

Complications of Specific Organ Systems

Cardiac Complications

Myocardial Ischemia and Infarction

Major cardiovascular complications following noncardiac surgery occur in over one million patients per year; many of these occur in elderly patients [55]. Cardiac events such as myocardial infarction or cardiac death occur in 1–5% of patients undergoing noncardiac surgery [56, 57]. Postoperative cardiovascular complications substantially increase the risk of other complications and death [58]. In one study, patients with cardiac complications were six times more likely to suffer a noncardiac complication than were those without cardiac complications [59]. At least 10% of all perioperative deaths result from myocardial complications [60].

The most common cardiac complications associated with surgery in elderly patients are myocardial ischemia and myocardial infarction [61]. In a study of 4,315 patients of 50 years of age and older who underwent nonemergent major noncardiac procedures, patients aged 70 years and older had a higher risk for cardiac complications including unstable angina and myocardial infarction, compared to patients younger than 60 years [62]. The elderly are also more likely to have heart failure associated with the myocardial infarction [63]. The mortality associated with perioperative myocardial infarction is approximately 30% [60].

Preexisting hypertension, diabetes mellitus, and history of cardiac or renal failure contribute to a higher incidence of perioperative myocardial infarction (5.1%), cardiac death (5.7%), or ischemia (12–17.7%) in elderly patients [61, 64]. Patients with coronary artery disease have a 4.1% incidence of perioperative myocardial infarction. The perioperative reinfarction rate in patients older than 65 years is 5.5% [61], compared to a 3.5–4.2% perioperative reinfarction rate in the general population. Additional risk factors in the elderly include the need for emergency surgery, major surgical procedures, American Society of Anesthesiologists (ASA) physical status III or IV, and poor nutritional status [61].

A large number of perioperative myocardial infarctions occur during the first 3 days after surgery, particularly on the 1st postoperative day [65, 66]. Although chest pain is the most common presenting symptom of myocardial ischemia in young patients, elderly patients may not experience chest pain. Myocardial ischemic events are silent in over 80% of elderly patients [66, 67]. Detecting episodes of ischemia during the postoperative period is often missed because of incisional pain, residual anesthetic effects, postoperative analgesia, and the lack of typical angina pain by elderly patients [66]. Atypical symptoms such as tachycardia, hypotension, dyspnea, respiratory failure, syncope, confusion, nausea, and excessive hyperglycemia in diabetics are more common presentations of myocardial ischemia in the elderly [60, 64, 66].

Monitoring for specific electrocardiographic changes, such as ST segment elevation and Q waves, accompanied by elevated CK, CK-MB isoenzyme, and troponin T and I levels enables the diagnosis of myocardial infarction [61]. Postoperative ST-segment changes more commonly demonstrate depression than elevation, and most myocardial infarctions are non-Q wave. This differs from what is seen in the nonsurgical setting, suggesting that perioperative myocardial infarctions are more often related to prolonged ischemia rather than acute thrombotic occlusion [66]. As such, EKGs should be obtained in the early postoperative period and between the 3rd and 5th postoperative days in high-risk patients [48].

Noncardiac surgery intensifies myocardial oxygen demand by raising catecholamine concentrations, resulting in an increased heart rate, blood pressure, and free fatty-acid concentrations. β-adrenergic blockers attenuate the effects of increased catecholamine levels and prevent perioperative cardiovascular complications [55]. In a large observational study, the perioperative administration of β-blockers was associated with clinically significant reductions in mortality among surgical patients considered at moderate or high risk for major cardiovascular complications based upon their Revised Cardiac Risk Index score. However, β-blockers were of no significant benefit – and were possibly harmful – in patients at low risk, suggesting that careful patient selection remains necessary [58].

β-blockade may have additional benefits in elderly patients. In one study, patients who received β-blockers were extubated sooner, had lower analgesic requirements, and were more alert sooner after surgery [57]. Prophylactic β-blocker therapy may attenuate the impact of myocardial infarction, resulting in lower in-hospital mortality rates [65].

Potential harmful effects from β-blockers include bradycardia, hypotension, bronchospasm, and congestive heart failure [38, 55, 57]. The use of perioperative β-blockade in patients who had not been receiving β-blockers long-term may also pose an additional risk in that withdrawal of β-blockers may lead to adrenergic hypersensitivity and possibly worsen outcomes [68].

Dysrhythmias

Dysrhythmias have been shown to increase postoperative cardiac morbidity in elderly patients [69]. Postoperative atrial arrhythmias are seen in 6.1% of elderly patients undergoing noncardiac surgery [70]. Electrolyte disturbances and/or increased sympathetic nervous system activity in the perioperative period may lead to cardiac dysrhythmias, although myocardial ischemia or congestive heart failure must be considered [71].

To date, the only consistent preoperative risk factor for an increased incidence of atrial arrhythmias following surgery has been an age of 60 years or older [72]. In patients undergoing elective thoracic surgery, those aged 60 years or older were independently associated with development of atrial fibrillation [70]. Patients who developed postoperative pneumonia or acute respiratory failure were also at risk [70].

The timing of the onset of atrial arrhythmias is similar to that of postoperative myocardial ischemia and likely is related to autonomic nervous system imbalance [72]. These arrhythmias may also be precipitated by pulmonary disease such as pneumonia or pulmonary embolism, volume overload, hyperthyroidism, or sympathomimetic drugs. Atrial arrhythmia-onset peaks 2–3 days following surgery. Although usually well tolerated in younger patients, perioperative atrial arrhythmias can be associated with hemodynamic instability in elderly patients [72]. The complications of atrial fibrillation include stroke and congestive heart failure [73]. Atrial fibrillation is also associated with higher inpatient mortality when accompanied by myocardial infarction (25% vs. 16%) [73].

Management of atrial fibrillation consists of heart rhythm and rate control and prevention of thromboembolism. Although approximately 85% of atrial arrhythmias revert to sinus rhythm with rate-or rhythm-control strategies during hospitalization, recent data suggest that rhythm control by pharmacologic means or direct current electrical cardioversion offers little advantage to a rate-control strategy [72]. Atrial fibrillation responds well to intravenous rate control drugs such as β – and calcium-channel blockers [72]. β-blockers are preferred in patients who have ischemic heart disease but may be relatively contraindicated in patients with severe bronchospastic disease, congestive heart failure, severe sinus bradycardia, or high-degree atrioventricular block [72]. In patients who have Wolff–Parkinson–White syndrome with atrial fibrillation, amiodarone is recommended as first-line therapy [72]. Digoxin should be used as a first-line drug only in patients who have congestive heart failure because of its ineffectiveness in high-adrenergic states such as the perioperative period [72]. As it relates to thromboembolism, oral vitamin K antagonists and aspirin reduce the stroke risk by 68 and 21%, respectively [74]. In the perioperative period, the decision to use bridging anticoagulation with heparin and the timing of resuming anticoagulation postoperatively are dependent on risk of thromboembolism. Clinical prediction rules such as the Congestive Heart Failure-Hypertension-Age > 75-Diabetes-Stroke ($CHADS_2$) assist in risk stratification [75]. $CHADS_2$ estimates the risk of stroke by assigning one point for each of the five included conditions except stroke, which is assigned two points. The total score ranges from zero to six points; aspirin therapy is recommended for thromboembolism prevention for low-risk patients (<5% risk per year; $CHADS_2$ 0–2), whereas oral vitamin K antagonists are prescribed with higher risk patients (>5% risk per year; $CHADS_2$ 3–6) [76, 77].

Significant, sustained ventricular arrhythmias (ventricular tachycardia, ventricular fibrillation, torsade de point) occur less frequently than atrial arrhythmias perioperatively [70, 73]. In a study of patients undergoing major thoracic surgery with continuous postoperative electrocardiographic monitoring for 72 h, nonsustained ventricular tachycardia occurred in 15% of patients [76]. None of the patients required treatment for hemodynamic compromise. Postoperative atrial fibrillation was independently associated with ventricular tachycardia. This association between atrial and ventricular arrhythmias suggests that similar mechanisms may have a role in precipitating postoperative ventricular tachycardia [76].

Congestive Heart Failure

Congestive heart failure is present in 10% of individuals over 65 years of age and is a leading cause of postoperative morbidity and mortality following surgical procedures [69]. Preexisting congestive heart failure is associated with a two- to fourfold increase in postoperative cardiovascular complications, including myocardial infarction, supraventricular and ventricular dysrhythmias, hypotension or hypertension, and cardiac arrest [69, 78]. Heart failure can arise from any condition that compromises the contractility of the heart (systolic heart failure) or that interferes with the heart's ability to relax (diastolic heart failure) [79].

Risk factors for postoperative heart failure included preoperative symptomatic cardiac disease, male sex, and age ≥ 90 in one study of elderly patients with hip fracture undergoing operative repair [80]. Manifestations of postoperative heart failure usually occur within the initial 3 postoperative days [81]. Patients found to be in pulmonary edema postoperatively should be assessed for myocardial ischemia. This includes cardiac monitoring, electrocardiography, and serial cardiac enzyme measurements.

The treatment of postoperative heart failure with pulmonary edema, whether from systolic or diastolic dysfunction, differs little from the general management of heart failure. Angiotensin-converting enzyme inhibitors and diuretics are first-line therapy. In patients with acute decompensated heart failure, angiotensin-converting enzyme inhibitor therapy may need to be held, reduced, or discontinued if hypotension is a concern. In the presence of diuretic usage, electrolyte abnormalities (e.g., potassium, magnesium) should be diagnosed and corrected. β-blocker therapy can be used in heart failure secondary to myocardial ischemia unless hypotension precludes its usage. Digoxin is first-line therapy in heart failure associated with atrial fibrillation [78].

Pulmonary Complications

Pulmonary complications account for up to 40% of postoperative complications and 20% of potentially preventable deaths [82]. Postoperatively, pulmonary complications occur in 2.1–10.2% of elderly patients and include atelectasis, hypoxemia, hypoventilation, acute respiratory distress syndrome, and pneumonia. Development of these complications is associated with prolonged intensive care unit stay and increased mortality [61]. Increased age elevates the odds of developing a postoperative pulmonary complication nearly twofold [83]. Compared with patients younger than 60 years of age, patients of 70 years of age and above had a higher risk of respiratory complications including bacterial pneumonia, noncardiogenic pulmonary edema, and respiratory failure requiring intubation in one study [62].

Age-related alterations in pulmonary function combined with postoperative pulmonary pathophysiologic changes place the elderly patient at greater risk for complications [82]. The physiologic changes of aging lead to decreased lung volumes, expiratory flow rates, and oxygenation. Upper airway reflexes are also reduced, leading to loss of ability to clear secretions [82].

Clinical predictors of adverse pulmonary outcome include the site of surgery (chest, abdomen), duration and type of anesthesia, chronic obstructive pulmonary disease (COPD), asthma, preoperative hypersecretion of mucus, chest deformation, and perioperative nasogastric tube placement [61, 84]. In one multivariate analysis, postoperative nasogastric intubation was the single most important variable associated with postoperative pulmonary complications [85].

Aspiration

The process of deglutition involves a complex coordination of neuromuscular structures during its oral, pharyngeal, and esophageal phases [86]. Age-related changes affect each phase of the swallowing process, increasing the risk of aspiration in the elderly [86]. Aspiration, defined as the inhalation of oropharyngeal or gastric contents into the larynx and lower respiratory tract, is a prerequisite for aspiration pneumonia [86]. Other alterations with aging that contribute to aspiration pneumonia include a change of oropharyngeal colonization to pathogenic organisms, decreased immunity, and impaired pulmonary clearance [86].

The presence of other risk factors in the elderly make them particularly susceptible to oropharyngeal aspiration including dysphagia, poor oral hygiene, altered level of consciousness, and gastroesophageal reflux disease [60, 86] (see Table 29.7). As such, efforts to reduce postoperative aspiration in the elderly are indicated [87]. Elderly patients with signs and symptoms of dysphagia and recurrent pneumonia

Table 29.7 Risk factors for aspiration

Altered consciousness	Advanced age
Alcohol	Dysphagia
Substance abuse	Gastrointestinal motility disorders
Sedatives	Gastroesophageal reflux disease
Anesthesia	Recurrent emesis
Head trauma	Supine position
Seizures	Nasogastric tube
Other neurological disorders	Endotracheal intubation

require an assessment of swallowing function. Patients found on evaluation to be aspirating may require swallow therapy, modification of dietary consistency, upright positioning while feeding, and medications shown to improve dysphagia such as angiotensin-converting enzyme inhibitors, which prevent the breakdown of substance P, a neurotransmitter believed to play a role in the swallowing pathway [86, 88].

Respiratory Failure

Postoperative respiratory failure (PRF), the inability of the patient to be extubated within 48 h after surgery or the need for reintubation after postoperative extubation [89, 90], ranks first among the most serious postoperative pulmonary complications. The incidence of PRF in patients older than 65 years is estimated to be 3.85 per 1,000 elective surgery discharges compared to 1.41 per 1,000 elective surgery discharges in people aged 18–44 [91]. Risk factors for PRF include those that are patient-specific and operation-specific [89]. Age greater than 60 years, functional status, comorbidities, and severity of illness make up patient-specific risk factors. Operation-specific risk factors consist of the location of the incision in relation to the diaphragm, type of anesthesia administered, and the need for an emergent procedure [89]. Pneumonia, pulmonary edema, systemic sepsis, and cardiac arrest are postoperative pulmonary complications associated with PRF [89].

In patients with PRF, mechanical ventilation is used to improve gas exchange, to decrease work of breathing which can utilize as much as 50% of oxygen consumption, and to support fatigued respiratory muscles [91]. Different methods of ventilatory support are available to accomplish these goals. Positive end-expiratory pressure (PEEP) improves oxygenation by recruiting atelectatic areas of the lung. The use of PEEP leads to an increase in oxygenation by reducing intrapulmonary shunting [91].

Ultimately, an assessment has to be made to determine the timing of discontinuing ventilator support. This weaning process may be difficult in patients recovering from severe respiratory failure and prolonged mechanical ventilation. In a study to determine the major cause of planned extubation failure in critically ill elderly patients, inability to handle secretions was the most common airway cause of failure compared to upper airway obstruction in a younger group matched for severity of illness [92]. Traditional weaning parameters such as rapid shallow breathing index, negative inspiratory force, and minute ventilation were not predictive of elderly patients who ultimately failed extubation [92]. The in-hospital mortality for the elderly patients that failed extubation was 47% compared to 20% for the patients successfully extubated [92].

The need for early tracheostomy in elderly patients predicted to require prolonged intubation is controversial. Potential benefits of early (after 3–7 days of continuous ventilatory support) tracheostomy include improved patient comfort, decreased incidence of ventilator associated pneumonia (VAP), and decreased ICU and hospital lengths of stay. A recent retrospective cohort study of ventilated patients of 65 years or older was undertaken to compare outcomes in patients with more (late group) or less (early group) than 7 days of continuous ventilation who underwent tracheostomy [93]. The early tracheostomy group had shorter ICU and hospital admission time, decreased incidence of VAP, and a trend toward decreased mortality [93]. This study also demonstrated the ability to transfer elderly patients with tracheostomy to ventilator step-down units. Given the growing elderly population and need for ICU beds, early tracheostomy may permit more efficient usage of a valuable resource [93].

Prevention of Pulmonary Complications

Prevention of postoperative pulmonary complications in the elderly begins during the preoperative period. Assessing patients for sputum production is important as a productive cough correlates with respiratory failure [90]. Smoking cessation 8 weeks prior to the operation has been shown to improve mucociliary function and promote sputum clearance. The use of bronchodilators can aid expectoration. Providing instruction preoperatively on deep breathing exercises and the use of incentive spirometry facilitate the utilization of these maneuvers postoperatively when anesthesia and sedatives may decrease awareness and hinder education [90].

Postoperatively, an aggressive pulmonary toilet regimen is necessary to reduce pulmonary complications. Of utmost importance is adequate pain control. Splinting from inadequate pain control restricts lung expansion, limits cough to clear secretions, and leads to an increased risk for atelectasis, pneumonia, and hypoxia [69]. However, avoidance of excessive sedatives and narcotics is equally important. Appropriate analgesia will facilitate deep breathing and coughing, incentive spirometry, chest physiotherapy, and early ambulation [69, 82, 85].

Venous Thromboembolism

Venous thromboembolism (VTE) disproportionately affects the elderly [94]. Age is a well-accepted risk factor for VTE, with a mean age of approximately 60 years based on several studies. There is a linear increase in the prevalence of deep venous thrombosis and pulmonary embolism with age [95]. Ninety percent of all pulmonary emboli are estimated to occur in patients over age 50 [82]. The elderly are more likely to have prior recent hospitalization, atherosclerosis, heart failure, frailty, and immobility as factors responsible for their increased prevalence of VTE [94, 96].

For surgical patients, age over 60 years is associated with a high risk for postoperative VTE [94]. In these older patients not receiving prophylaxis, the incidence of proximal deep venous thrombosis is 4–8% and of PE is 2–4% [95]. These numbers are twice as high in high-risk categories that include cancer surgery, joint replacement, previous VTE, and trauma [94]. Because the elderly have a higher bleeding risk when treated with anticoagulants, a balance has to be achieved between optimal VTE prevention and the risk of bleeding complications [94, 97]. Care should be exercised with the use of anticoagulants in patients with creatinine clearance < 30 ml/min and serum creatinine > 2 mg/dl in that the pharmacokinetics of these medications may be affected, thereby increasing the bleeding risk [94].

Early ambulation can decrease the incidence of venous thrombosis with pulmonary embolus. Unfortunately, owing to comorbidity or deconditioning, elderly patients are frequently unable to accomplish this simple exercise [85]. Mechanical prophylactic measures to prevent VTE include graded compression stockings, intermittent pneumatic compression, and venous foot pumps. These devices are attractive in that they are efficacious and are void of bleeding risk. Compliance with these devices may not be optimal, however, because of patient discomfort [94]. Alternatively, the administration of pharmacologic prophylaxis can be verified in the medical record, and its use does not discourage ambulation [94]. Perioperative prophylaxis with unfractionated or low-molecular-weight heparin offers a cost-effective means of reducing the risk of VTE, thereby avoiding a number of postoperative deaths [82]. In high-risk bleeding patients, mechanical prophylactic measures may be all that is available.

Anemia

Preoperative anemia, characterized by less than the normal number of red blood cells (RBC), may be secondary to decreased production, increased destruction, or increased loss [98]. The World Health Organization has defined anemia as a hemoglobin count of less than 13 g/dl in adult men and less than 12 g/dl in nonpregnant women [98]. In elderly patients undergoing surgery, perioperative blood loss leading to or exacerbating anemia leads to increased morbidity and mortality, but the correction of anemia with RBC transfusions is fraught with debate [98–102].

RBC transfusions can be associated with transfusion complications, immunosuppression, and increased bacterial infections in hip fracture patients [98–101]. Conversely, perioperative anemia in the elderly may represent a further physiological insult due to increased cardiac demand and potential tissue hypoxia [100]. As such, the appropriate transfusion threshold in the elderly that would limit risk and optimize benefit would be advantageous.

Restrictive (transfusion for hemoglobin less than 7 g/dl) and liberal (transfusion for hemoglobin less than 10 g/dl) transfusion thresholds have been advocated in an attempt to balance the risks and potential benefits of RBC transfusion. In a randomized clinical trial comparing restrictive and liberal transfusion thresholds, critically ill patients in the restrictive group had similar mortality, and fewer patients developed myocardial infarction and congestive heart failure [98]. Caution should be exercised in extrapolating these results to an elderly population. In the elderly, anemia may impede functional mobility after hip surgery [100]; it may be associated with increased cardiovascular complications [101], mortality [101], and postoperative delirium [100] and may negatively impact quality of life [99]. Additional, well-designed randomized studies are needed to determine the optimal transfusion trigger in the elderly.

Urinary and Renal Dysfunction

Postoperative urinary retention is a frequent complication after surgery especially in elderly males. Although it is not a life-threatening complication, treatment with bladder catheterization puts patients at risk for urinary tract infection and its attendant complications. In one report, 69% of males undergoing hip arthroplasty required postoperative bladder catheterization [103]. Using logistic regression, the predicted probability of catheterization was 85% in males aged 70 years and older. In addition to age and male gender, intraoperative fluid requirement [104], operative duration, operation for rectal tumor, and postoperative pelvic infection [105] are associated with postoperative urinary retention. On the basis of the above noted studies, it would seem reasonable to recognize the risk factors for postoperative urinary retention and working to militate against those factors. Factors associated with postoperative urinary retention in elderly patients are outlined in Table 29.8.

Table 29.8 Factors associated with urinary retention in elderly patients

Age > 55 years
Intraoperative fluids > 750 cc
Operation duration > 4 h
Procedure for middle or lower rectal tumor
Presence of pelvic drain
Postoperative pelvic infection

Aging is associated with decreased renal cortical mass and a 30–50% decrease in the number of functioning glomeruli by the seventh decade [106]. This results in decreased creatinine clearance and decreased maximal urine concentrating capacity. Loss of muscle mass in the elderly patient can result in normal serum creatinine even in patients with decreased renal function. Creatinine clearance is a more accurate measure of renal function and estimated glomerular filtration rate based on the Cockcroft/Gault equation correlates well with creatinine clearance.

Chronic renal disease is prevalent in 11–25% of the elderly population and is an important comorbid condition in the perioperative period. In the general population, patients with chronic kidney disease are at higher risk for adverse outcomes such as death, cardiovascular disease, and hospitalizations [107]. Chronic renal disease is also associated with development of functional impairment [39]. Patients with chronic kidney disease have a higher incidence of hyperkalemia, infections, cardiac arrhythmia, and bleeding in the perioperative period [108].

Postoperative acute renal failure (ARF) is a significant etiology of renal failure, accounting for 25–50% of all cases [109–111]. However, ARF occurs infrequently after operation in elderly patients. In one study of cardiac surgery patients, 2.7% patients aged 70 years and older developed postoperative ARF [112]. In comparison, 1.9% patients younger than 70 years of age developed postoperative ARF. In contrast, another study of patients undergoing coronary artery bypass demonstrated a 3.2% rate of ARF in patients aged 80 and older; only 0.4% of patients younger than 80 years developed ARF. A study of elderly patients undergoing repair of femur fracture found that 24% developed postoperative kidney dysfunction, but none required renal replacement therapy [113].

Recovery of renal function is possible after developing ARF. Data on postoperative ARF are limited. A systematic review and meta-analysis found that approximately 30% of elderly patients do not recover renal function after ARF [114] as compared with 26% of younger patients. Despite failure to recover normal renal function, only 3–6% of elderly patients require long-term dialysis after ARF [115].

Acute renal failure in elderly patients in general and postoperative ARF specifically is associated with a high mortality rate. The mortality rate for patients with ARF (all causes) is 45–75% [115]. The mortality rate for postoperative ARF in elderly patients in one study was 39%. In elderly patients undergoing cardiac surgery, postoperative renal failure was the most significant factor associated with postoperative death with an odds ratio of 4.4 [116]. In one study of patients undergoing cardiac surgery, the death rate in patients developing postoperative ARF was 56.1; however, there was no significant difference in mortality rates in the younger (61.9%) and older (50%) patient groups [112].

Gastrointestinal Complications

Postoperative Nausea and Vomiting

Postoperative nausea and vomiting (PONV) is a major concern in surgical patients, but less so in the elderly. Important risk factors for PONV include female gender, nonsmokers, history of PONV, and the use of postoperative opioids. Each risk factor can be accorded a point of 1. Total scores of 0, 1, 2, 3, or 4 are associated with a risk of PONV of 10, 20, 40, 60, and 80%, respectively [117]. Age is not an independent risk factor for PONV. There is >10% decreased risk of PONV for every decade of age in adults, starting at age 30 [118]. One of the factors that could be responsible for decreased PONV in older adults is the decrease in the doses of anesthetic agents administered. In a study involving 30,842 patients, fentanyl, propofol, midazolam, and isoflurane showed a 10, 8, 6, and 4% reduction in dose per decade of age, respectively [119]. Current consensus guidelines recommend use of regional anesthesia whenever possible as it is associated with a lower incidence of PONV in adults [120]. When general anesthesia is administered, use of propofol for induction and maintenance and avoidance of nitrous oxide can decrease the risk of PONV. Proper preoperative and intraoperative hydration are important in prevention of postoperative nausea and vomiting [121]. Metoclopramide should not be used in the elderly due to significant CNS side effects such as dyskinesia, drowsiness, and agitation. Prophylactic antiemetics should be used based on a risk score and are therefore not recommended in the elderly.

Dysphagia

There is an increased incidence of dysphagia in the elderly. ADL score has been shown to correlate with increased swallowing dysfunction [122]. Knowledge of preoperative nutritional habits is important so that appropriate foods can be offered in the postoperative period. Lack of dentures or offering solid foods in patients who are used to pureed/soft foods can result in inadequate intake and compromise postoperative recovery.

Impairment of swallowing is slow to resolve following extubation [122], especially after prolonged ventilation. This increases the risk of aspiration and subsequent aspiration pneumonia [123]. Aspiration precautions should be rigorously implemented in the postoperative period. These include elevation of the head end of the bed, seated position during meal intake, and specific food consistency.

Although it is not necessary to do a fiberoptic endoscopic evaluation of swallowing in all elderly patients, those with impaired preadmission functional status should be considered at high risk for aspiration and evaluated appropriately [124].

Gastroesophageal reflux disease (GERD) is common in elderly patients and prevalent in greater than 30% of the elderly population [125]. Unlike their younger counterparts, older patients with GERD may not complain of worsening symptoms. It is important to continue antireflux medications in the postoperative period. Proton pump inhibitors are more effective in elderly patients than H_2 blockers. Administration of proton pump inhibitors in the immediate postoperative period helps not only to control GERD but also serves as prophylaxis for bleeding from gastritis or peptic ulcer disease.

Postoperative Ileus

Surgical manipulation of the bowel can cause a prolonged postoperative ileus. Another factor in the development of ileus is the stimulation of opioid receptors. In a prospective study designed to compare surgical outcomes in patients greater or less than 80 years of age, the incidence of postoperative ileus was increased in the older patients [2]. Routine measures such as bowel rest, bowel decompression, and attention to nutrition (TPN) should be addressed.

Enhanced recovery after surgery (ERAS) is used in fast track surgery to reduce surgical stress response and support basic body functions by use of optimized analgesia, early mobilization, and early return to normal diet [126, 127]. This type of multidisciplinary intervention has been used effectively following colon surgery with significant success. It has led to a significant decrease in postoperative ileus and a decrease in hospital stay [128]. Prospective randomized trials are still needed to evaluate the effects of fast track surgery on older patients. While age should not be a contraindication to enroll patients in such a study, it will be critical to determine comorbidities in this group that would limit the benefits of such an intervention [129]. It is possible that while ERAS programs benefit those with significant comorbidities, the benefit may be most evident in vulnerable subgroups such as the elderly [130]. An upload antagonist such as ADL 8-2698 differs from other opioid-receptor antagonists in that it is potent, orally active, and poorly absorbed after oral administration. Once absorbed, the drug has a limited ability to cross the blood–brain barrier. Large doses of ADL 8-2698, thus, have the potential to antagonize gastrointestinal opioid receptors nearly completely without inhibiting the beneficial analgesic action of systemic opioids. These antagonists are able to counteract the effect of morphine on the GI tract [131]. Selective inhibition of GI opioid receptors by a peripherally restricted opioid antagonist can facilitate early recovery of bowel function, decreased hospital stay and still provide adequate pain relief [132].

Summary

As the number of elderly patients increase, they are accounting for a greater proportion of patients in most surgical practices. Therefore, surgeons, and all adult medical practitioners, must be aware of the unique complications associated with the surgical care of elderly patients. Because of their reduced physiologic reserve, elderly patients are less able to respond to and recover from postoperative complications. However, attempts to recognize, treat, and prevent these complications are complicated by atypical presentations.

Optimal care of elderly patients requires significant diligence. The presence of comorbidities and physiology of aging put this population at risk for "typical" complications such as cardiac dysrhythmias, myocardial infarction, pneumonia, and surgical site infection. Equally important, but often less appreciated, are the "atypical" complications that are more prevalent in elderly patients. Delirium is such a complication. It is much less common in younger patients. It is often misdiagnosed in elderly patients. The importance of this lies in the fact that postoperative delirium is often the initial sign of another postoperative complication.

The surgical care of elderly patients can be a gratifying part of surgical practice. By taking appropriate measures to prevent complications and by remaining vigilant, the perioperative experience for patient, surgeon, and the health care team has the opportunity to be rewarding.

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