

Perioperative Assessment of and Care for the Elderly and Frail



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KEYWORDS

- Geriatric • Elderly • Frailty • Perioperative • Postoperative delirium
- Perioperative complications • Medical consultation • Geriatric consultation

HOSPITAL MEDICINE CLINICS CHECKLIST

1. More than one-third of surgical procedures involve patients 65 years of age or older.
2. Morbidity and mortality of major surgeries increase with older age, but the effect of age is significantly influenced by severity of illness, comorbidities, and functional status, making age an insensitive and nonspecific measure for use in individual decision making.
3. Preoperative evaluation should be considered an opportunity for a detailed assessment addressing the special needs of the geriatric patient and discussing treatment goals.
4. Frailty is characterized by decreased resilience to stressors and increased physiologic vulnerability, and is associated with an increased risk of postoperative complications.
5. A multidisciplinary approach considering the special needs of the elderly is effective in improving outcomes of frail older adults.

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BACKGROUND AND SIGNIFICANCE

The Aging of the Population and Surgery

The profile of aging in the United States has changed dramatically over the last 10 years; in 2013 there were 44.7 million adults greater than or equal to 65 years of age. By 2030, individuals 65 years of age or older will exceed 70 million and it is expected that individuals 85 years of age or older will triple in the next 4 decades.^{1,2} The same pattern of changing demographics is seen in individuals undergoing surgeries; in 2008 one-third of the 44 million surgical procedures involved patients greater than or equal to 65 years old.¹ In 2010, more than 300,000 total hip replacements were performed and more than half of these patients were 65 years of age or older. The number of total hip replacements increased by 92% from 2000 to 2010 in patients greater than or equal to 75 years old, from 41,600 to 80,000 procedures.³

Current Challenges in Perioperative Management of Elderly and Frail Patients

The changes in physiology and anatomy caused by aging, the presence of chronic comorbidities, and the progression of disease states have profound impacts on elderly patients' responses to injury and stress. Geriatric patients have higher risk of complications, higher morbidity and mortality, longer lengths of stay, and higher readmission rates compared with younger patients undergoing the same procedures.

In 2012 the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) and the American Geriatric Society (AGS) jointly published a comprehensive guideline on the optimal preoperative assessment of geriatric patients.² The evidence-based recommendations include specific evaluations for geriatric patients, such as cognition, depression, risk of delirium, functional status, baseline frailty score, nutritional status, treatment goals, and expectations. Although justified, it may be unlikely for surgeons to complete all the elements of the evaluation because of either lack of time and/or skills in geriatric assessment, thereby requiring the involvement of primary care physicians, hospitalists, or geriatric care providers.

Is age an independent factor for perioperative complications?

Among patients greater than or equal to 65 years old, the rate of complications and death after surgery increases with age; for example, postsurgical in-hospital mortality is significantly lower in patients less than 80 years old than in those greater than 80 years old (0.7% vs 2.6%, respectively) and 1 in 4 patients older than 75 years develop postoperative complications.^{4,5}

Although, in general, older age is associated with an increase in morbidity and mortality after major surgeries, age alone should not be used to determine the individual patient's eligibility for surgery. Elderly individuals are a heterogeneous group; some are highly functional in their 90s, whereas others are frail, disabled, or with multiple comorbidities. Several studies have shown that factors such as emergency surgery (rather than elective surgery), presence of comorbidities, frailty status, severity of illness, and a high American Society of Anesthesia (ASA) score have stronger impacts on mortality and postoperative complications than patient age.⁵⁻⁷

Perioperative Assessment of the Elderly

At present, the preoperative assessment focuses on individual system assessment; multimorbidity and frailty are often overlooked and providers do not devote sufficient attention to the specific needs of the elderly. In addition to a complete history and physical, the following elements should be assessed in older adults: baseline

cognition, risk for delirium, functionality, nutritional status, frailty, decision-making capacity, and the patient's treatment goals and expectations (**Box 1**).

Calculating the surgical risk for elderly patients

Several tools exist to assess the perioperative cardiac or pulmonary risk of postoperative complications but there are no specific geriatric assessment tools. The ACS NSQIP developed a surgical risk calculator using the data collected from 400 hospitals and greater than 1.4 million surgeries across 1500 surgical procedures from 2009 to 2012.⁸ The universal surgical risk calculator model predicts 30-day outcomes, including mortality, complications, length of stay, and discharge to a facility, based on 21 patient risk factors, including age and functional health status. It represents a useful on-line decision-support tool that allows clinicians and patients to make decisions and understand the patient-specific postoperative risks.⁹

Cardiac and pulmonary risk assessment in the elderly

Aging is associated with several changes in the cardiovascular and pulmonary systems that increase vulnerability to postoperative complications. The compliance of the vascular system is decreased and elderly patients are more likely to have cardiac diastolic dysfunction. Small changes in intravascular volume may induce cardiovascular instability and elderly patients are at a higher risk to develop acute pulmonary edema with small amount of bolus fluids as well as developing postoperative atrial fibrillation. Of note, age is not included in the Revised Cardiac Risk Index (RCRI) and several studies found that the addition of age or frailty index improves the prediction power for adverse events of the ASA score and the RCRI.^{10,11}

Age more than 60 years is a risk factor for postoperative pulmonary complications including aspiration, atelectasis, and pneumonia, especially in patients with impaired

Box 1

Perioperative geriatric-focused complete history and physical

- Functional status: assisted activities of daily living (ADLs) and instrumental ADLs (IADLs) (see **Table 3**)
- Ask about devices and any history of falls
- Detailed medication history, including over-the-counter and herbal medications
 - How much the patient is really taking of as-needed medications such as benzodiazepines to avoid postoperative withdrawal and delirium
 - Medications used for sleep, such as diphenhydramine and acetaminophen
- Screen for alcohol and substance abuse/dependence
- Assess family and social support systems
- Identify risk factors for pulmonary complications
- Perform a preoperative cardiac evaluation according to ACC/AHA algorithm
- Assess cognition
- Assess nutritional status
- Assess risk for postoperative delirium
- Determine frailty score using tools such as Fried evaluation, REFS (see **Tables 4 and 6**)
- Assess decision-making capacity (see **Table 8**)

Abbreviations: ACC, American College of Cardiology; AHA, American Heart Association; REFS, Reported Edmonton Frailty Scale.

cognitive status, tobacco use, history of chronic obstructive pulmonary disease, or stroke.¹² Elderly patients have twice the risk of pulmonary complications compared with younger patients after controlling for comorbidities. The evidence-based interventions that reduce postoperative pulmonary risk include incentive spirometry and early ambulation and both may be more challenging to be implemented in the elderly.

What preoperative diagnostic tests are useful in this population?

As with any other age group, preoperative tests in elderly patients should not be ordered routinely but performed on a selective basis, to guide and optimize perioperative management.

There is no specific battery of tests for the elderly and testing should be guided by the recommendations of the professional societies such as ASA, American College of Cardiology/American Heart Association.^{13,14} A detailed history and physical examination combined with the risk of surgery for blood loss and perioperative fluid shifts are most useful in deciding which tests should be ordered. Because elderly patients have multiple coexisting conditions, physicians frequently order routine preoperative tests out of concerns for patient safety.¹⁵ One study of patients with hip fracture found that 15% of the patients had a stress test or echocardiogram but the results did not lead to changes in management; however, testing resulted in a significant delay to surgery.¹⁶

For low-risk surgery such as cataract removal, the ASA guidelines specify that no tests are recommended because testing neither decreases adverse events nor improves outcomes.^{13,17} However, a recent study that included more than 500,000 Medicare patients undergoing cataract surgery found that 53% of these patients had at least 1 test in the month before the surgery, resulting in a \$4.8 million additional cost.¹⁸

Elderly-specific assessment

Cognitive function Cognitive function should be assessed in adults older than the age of 65 years to establish a baseline level, help determine capacity, and better evaluate the risk of delirium. As part of the physical examination, cognition should first be assessed informally; simple interviews about orientation to self, place, and time, along with asking a patient to remember/discuss a recent event (eg, upcoming surgery) can be used to assess short-term memory.

There are several cognitive assessment tools but the most practical one for nongeriatricians is the Mini-Cog, which is easy to use and is not influenced by language or education (**Table 1**).

Decision-making capacity Medical decision-making capacity is the ability to consent to or refuse care. It has been shown that up to 48% of hospitalized elders have impaired decision-making capacity.¹⁹ Capacity should be assessed before making the decision for a surgical procedure; this ensures that the patient understands the proposed treatment, its risks and benefits, as well as any alternatives. Although it is the responsibility of the surgeon to consent the patient for a surgical procedure, the medical consultant has the obligation to discuss with the patient/family the risk for medical complications; if the consultant identifies issues regarding capacity of understanding, the surgical team should be notified.

Lack of decision-making capacity may be reversible and every effort should be made to treat the underlying disorder. If the primary team has difficulty determining whether a patient has capacity, then a psychiatrist, geriatrician, or medical professional skilled in this area should be asked to assess the patient (**Box 2, Table 2**).

Assessment Tool	Administration	Scoring	Advantages
Mini-Cog	Three-item Recall: ask the patient to repeat 3 words and remember them for a few minutes Clock Drawing Test: ask the patient to draw a large circle on paper and put in all of the numbers as if looking at a watch or a clock. Then ask the patient to put in the hands as if it were 11:10 or 8:20. Ask the patient to remember the 3 previously stated words.	If trouble remembering 1–2 words and an abnormal clock draw, there is suspicion for dementia Next steps: can proceed with MOCA, inform patient's PCP, or refer for further cognitive testing (geriatrics, neurology)	Easy, rapid, <3 min Not influenced by language or education
MOCA (http://www.mocatest.org)	One-page questions and tasks that assess multiple cognitive domains, including executive function and short-term recall	Score ≤ 26 considered abnormal and is suspicious for dementia Add 1 point for education ≤ 12 th grade Add 1 point for education \leq ninth grade	<10 min to finish Available and validated multiple languages and also for low vision

Abbreviations: MOCA, Montreal Cognitive Assessment; MMSE, Mini Mental Status Examination; PCP, primary care provider.

Functional status

Functional status reflects the interaction of physiologic aging, nutritional status, frailty, and acute and chronic medical conditions.²⁰ It is essential in the geriatric assessment and provides key information on the degree of frailty, resilience, and the ability to tolerate and recover from surgical procedures. Several studies have shown that

Substance abuse
Depression or other untreated mental illness
Thyroid disorders
Delirium
Acute illness (urinary tract infection, pneumonia)
Metabolic derangements
Hypoxia/hypercarbia
Recent head injury

Table 2 Components of decision-making capacity			
Criterion	Patient's Task	Assessment Approach	Comments
Communicate a choice	Clearly indicate preferred treatment option	Ask patient to indicate a treatment choice	Frequent reversals of choice may indicate a lack of capacity
Understand the relevant information	Grasp the fundamental meaning of information communicated by the treatment team	Encourage patient to paraphrase information regarding the medical condition and treatment	Include the nature of patient's condition, nature and purpose of proposed treatment, benefits and risks, and alternative approaches (including no treatment)
Appreciate the situation and its consequences	Acknowledge medical condition and likely consequences of treatment options	Ask patient to describe views of medical condition, proposed treatment, and likely outcomes	Patients who do not acknowledge their illness (lack of insight) cannot make valid decisions about treatment
Reason about treatment options	Engage in a rational process of manipulating the relevant information	Ask patient to compare treatment options and consequences and to offer reasons for selection of option	This criterion focuses on the process by which a decision is reached, not the outcome of the patient's choice, because patients have the right to make unreasonable choices

Adapted from Appelbaum PS. Clinical practice. Assessment of patients' competence to consent to treatment. *N Engl J Med* 2007;357(18):1834–40; and Grisso T, Appelbaum PS. *Assessing competence to consent to treatment: a guide for physicians and other health professionals*. New York: Oxford University Press; 1998.

patients with poor baseline functional status are at high risk for delirium, prolonged hospitalization, postoperative complications, institutionalization, readmission, and death.^{21–23} In addition, older adults are at risk for functional decline when hospitalized. It is estimated that previously ambulatory older adults walk less than 20% of what they do at home, which rapidly leads to muscle wasting; bedbound elders can lose up to 5% of muscle mass per day, which increases the need for short-term rehabilitation and long-term placement.

Functional status can be assessed by interviewing the patient (self-reported) and/or family caregivers as well as with standardized performance-based testing. The choice of the assessment tool depends on the surgical population and setting.

Self-reported Measures

Basic activities of daily living (BADLs) evaluate the ability to complete essential elements of self-care, and instrumental activities of daily living (IADLs) describe more complex activities that an individual needs to live independently. The questions

used in assessing the BADLs and IADLs can be included in the preoperative admission questionnaire (**Table 3**).

Performance-based Assessments

If the patient ambulates, the Timed Up and Go test (TUG) test is a validated, objective measure that can be done in just few minutes. It is one of the components of the frailty assessment and it may be used as a baseline performance to evaluate when a patient will return to prior function after a surgical procedure (**Fig. 1**).

If functional limitations are identified, patients undergoing major elective surgeries should be referred to physical therapy for prerehabilitations and the discharge planning should be developed considering these limitations.

Nutritional status

The risk of malnutrition increases with age and the reported prevalence of malnutrition is 38.7% in hospitalized elderly. Although there is no uniformly accepted definition of malnutrition in the elderly, common indicators include decreased food intake, involuntary weight loss, abnormal Body Mass Index, decreased albumin, and vitamin deficiencies. Poor nutrition in older adults is a key factor related to perioperative complications, including increased risk of infections, delirium, poor wound healing, muscle weakness leading to falls and fractures, and extended intubation. It is also associated with increased length of stay, readmission rates, and mortality. Weight loss is also one of the characteristics of the frailty syndrome (**Box 3**).

For patients undergoing major surgical procedures, a more thorough evaluation can be considered and the short-form version of the Mini Nutritional assessment (MNA) can be used. It can be found at www.mna-elderly.com.²⁴ Patients at severe nutritional risk should undergo a nutritional assessment by a dietician to design a perioperative nutritional plan to address deficits, and at minimum should receive multivitamins and nutritional supplements.²

Table 3	
Basic and instrumental activities of daily living	
Basic Activities of Daily Living (BADL)	
Bathing	Score (0–6), 6 being the highest level of function ^a
Dressing	
Toileting	
Transferring	
Continence	
Feeding	
Instrumental Activities of Daily Living (IADL)	
Ability to use the telephone	Score (0–8), 8 being the highest level of function ^a
Shopping	
Food preparation	
Housekeeping	
Laundry	
Transportation (driving or arranging transportation)	
Medications	
Finances	

^a For each category a score of zero is given if a person needs assistance or is dependent; a score of 1 is given if the person is independent.

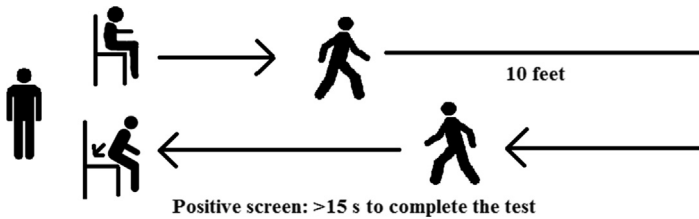


Fig. 1. Timed Up and Go Test (TUG). Ask the patient to (1) sit down on a chair, (2) to stand up and walk 3 m (10 feet), and (3) to sit back down on chair. If this takes the patient longer than 15 seconds, it is considered to be a positive screen.

Frailty and its impact on postoperative outcomes

What is frailty and how is it measured?

Frailty is a common geriatric syndrome defined as a progressive decrease in physiologic reserve, which results in an increased vulnerability to stressors and adverse outcomes such as falls, hospitalizations, institutionalization, and death.^{25,26} Although the prevalence of frailty increases with age, people can age without frailty or can be frail without being old. It is estimated that approximately 7% of adults greater than or equal to 65 years old and 20% to 40% of those older than 80 years are frail,²⁵ and that the reported prevalence of frailty in elderly patients undergoing surgery is between 4.1% and 50.3%.²⁷⁻²⁹

Although a consensus on how best to define and assess for frailty has not yet been reached, it is clear that frailty affects outcomes. Multiple definitions have been proposed but 2 primary approaches are used to define frailty:

1. Frailty phenotype: performance-based criteria
 In 2001, Fried and colleagues²⁵ published a landmark study that defined frailty using 5 criteria and showed that frailty is associated with several outcomes, including disability, institutionalization, and death (Table 4).
2. Frailty indexes: accumulation of deficits models
 This alternative approach measures frailty as a multifactorial and dynamic index that is based on the idea that the more deficits a person has, the greater the chance that they will be frail. Several indexes exist and the most common used are:
 - a. Clinical Frailty Scale (CFS)
 Different from other approaches, the CFS incorporates the provider’s judgment, which makes it easily accessible in the office setting, especially if the provider has an established relationship with the patient³⁰ (Table 5).
 - b. The Reported Edmonton Frailty Scale (REFS) has been validated for use by non-geriatricians³¹ and assesses multiple domains (Table 6).

<p>Box 3 Risk factors for malnutrition</p> <p>BMI less than 18.5 kg/m²</p> <p>Albumin level less than 3.0 g/dL</p> <p>Unintentional weight loss of greater than 10% to 15% within the past 6 months</p> <p><i>Abbreviation:</i> BMI, Body Mass Index.</p>

Table 4	
Fried criteria for frailty assessment	
Fried Criteria Parameters	Description
Weakness	Decreased grip strength in the lowest 20% at baseline
Exhaustion	Self-reported poor energy and endurance
Shrinkage	Unintentional weight loss (≥ 4.5 kg [10 lb] in the prior year)
Slowness	Poor mobility (slow gait speed) (refer to Table 1/Fig. 1)
Low level of physical activity	Based on weighted score of kilocalories expended per week
Frailty Status	Number of Criteria Parameters
Robust/nonfrail	0
Intermediate/prefrail	1–2
Frail	≥ 3

From Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56(3):M148; with permission.

What are the consequences of frailty on postoperative outcomes?

Several studies have shown that frailty independently predicts higher rates of postoperative complications, longer hospital stays, institutionalization, and death after cardiac and noncardiac, elective, or urgent surgeries.^{10,27–29} In a study of patients 65 years or older undergoing elective surgeries, preoperative frailty was associated with 2 times higher odds of postoperative complications and 3 times higher odds of discharge to a skilled facility after previously living at home.^{10,32}

Which screening tool is better and how to use the results in clinical practice?

There is no consensus on which scale or scoring system should be used. The REFS, which is the system with which the authors have the most experience, includes several

Table 5		
Clinical Frailty Scale (CFS)		
Score	Frailty Category	Description
1	Very fit	Robust, active individuals
2	Well	No active diseases but less fit than category 1
3	Well, with treated comorbidities	No or minimal disease symptoms
4	Apparently vulnerable	Individuals complain of being slow or having disease symptoms
5	Mildly frail	Limited dependence on others for IADL
6	Moderately frail	Need help with both ADLs and IADLs
7	Severely frail	Completely dependent on others for ADLs or terminally ill

From Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005;173:489–95; with permission.

Table 6 Reported Edmonton Frailty Scale (REFS)					
Frailty Domain	Item	0 Point	1 Point	2 Points	Points
Cognition	Please imagine that this predrawn circle is a clock. I would like you to place the numbers in the correct positions then place the hands to indicate a time of 10 after 11	No errors	Minor spacing errors	Other errors	
General health status	In the past year, how many times have you been admitted to a hospital?	0	1–2	>2	
	In general, how would you describe your health?	Excellent Very good Good	Fair	Poor	
Functional independence	With how many of the following activities do you require help? (meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medications)	0–1	2–4	5–8	
Social support	When you need help, can you count on someone who is willing and able to meet your needs?	Always	Sometimes	Never	
Medication use	Do you use 5 or more different prescription medications on a regular basis?	No	Yes	—	
	At times, do you forget to take your prescription medications?	No	Yes		
Nutrition	Have you recently lost weight such that your clothing has become looser?	No	Yes	—	
Mood	Do you often feel sad or depressed?	No	Yes	—	

(continued on next page)

Frailty Domain	Item	0 Point	1 Point	2 Points	Points
Continence	Do you have a problem with losing control of urine when you do not want to?	No	Yes	—	
Functional Performance	I would like you to sit in this chair with your back and arms resting. Then, when I say "GO," please stand up and walk at a safe and comfortable pace to the mark on the floor (approximately 3 m away), return to the chair, and sit down	0–10 s	11–20 s	>20 s indicates that patient is unwilling, or requires assistance	
Totals	Final score is the sum of column totals				___/17

The maximum score is 17, representing the highest level of frailty.

Frailty scores are: 0 to 4, no frailty; 5 to 6, apparently vulnerable; 7 to 8, mild frailty; 9 to 10, moderate frailty; greater than or equal to 11, severe frailty.

From Rolfson DB, Majumdar SR, Tsuyuki RT, et al. Validity and reliability of the Edmonton Frail Scale. *Age Ageing* 2006;35(5):527; with permission.

domains that are important for perioperative evaluation, such as cognition, nutrition, functional performance, and social support.

Although clinicians may question the necessity of a screening tool for frailty, viewing it as an unnecessary addition to their experience and common sense, the ACS NSQIP guidelines recommend evaluation and documentation of frailty. With the availability of more standardized definitions and valid instruments, it is reasonable to include screening for frailty in the preoperative evaluation of the elderly.

Frailty assessment help surgeons' preoperative decision making and can be used to provide more accurate prognostic information for patients and families. In addition, it may be used as a clinical risk tool for stratification to standardize geriatric management and facilitate targeting health care resources more effectively for this vulnerable population.

What are the risk factors for delirium and how can the postoperative development of delirium be minimized?

Delirium is an acute confusional state characterized by inattention and a fluctuating course, preventable in at least one-third of cases, and often reversible. It is common and can occur in 13% to 50% of older adults undergoing surgery, carrying a significant degree of morbidity and mortality, ranging from 22% to 76%.³³ Postoperative delirium is linked to a higher risk of falls, aspiration, pneumonia, pressure ulcers, and urinary

retention. It is associated with longer lengths of stay and readmission rates, as well as decreased function and discharge to a nursing facility instead of home.

Medication-related side effects are a frequent cause of postoperative delirium. The most well-known and useful tool to guide the evaluation of medications that can precipitate delirium is the Beers list.³⁴ In the postoperative setting, several medications with anticholinergic properties are still used, including diphenhydramine as an adjunctive for sleep, prochlorperazine for nausea and vomiting, benzodiazepines to decrease anxiety around the surgery, and zolpidem as a sleep aid. These medications can all cause delirium, and alternatives should be used instead (**Box 4, Table 7**).

There are 3 types of delirium: hyperactive, hypoactive, and mixed. Hypoactive delirium is frequently missed postoperatively because it is thought that the patient is sleepy as a consequence of the narcotics or a late effect of anesthesia. Hyperactive delirium presents as restlessness or agitation and, in surgical patients, there is high risk for removing drains, opening wounds, and dislocating devices. A frequently used bedside tool to assess for delirium is the confusion assessment method³⁵; it takes less than 5 minutes and consists of 4 criteria (**Table 8**).

THE ROLE OF MEDICAL PERIOPERATIVE CLINICS, AND GERIATRIC AND MEDICAL COMANAGEMENT PROGRAMS

Hospitalists are increasingly involved in the care of surgical patients and most hospitalist programs have developed partnerships with surgeons to provide perioperative care. The collaboration ranges from the traditional consult or comanagement programs to hospitalists serving as the primary attendings for surgical patients. In 2008, at least 85% of hospital medicine groups provided comanagement services.³⁶

Box 4

Predisposing risk factors for delirium

Patient-related risk factors

- Nonmodifiable
- Age greater than 70 years
- Male sex
- Medical comorbidities: dementia, history of stroke, depression
- History of delirium
- Functional impairment
- Sensory impairment: visual and hearing
- Surgical intervention

Extrinsic factors

- Usually amendable to change
- Drugs: anticholinergics, sedative-hypnotics, benzodiazepine, opioid analgesics, diphenhydramine
- Inappropriate pain control
- Use of physical restraints, multiple tethers (eg, intravenous lines, Foley catheters)
- Environmental: intensive care unit, windowless room, immobility, sleep deprivation
- Urinary retention and constipation
- Neurologic: stroke, subdural hematoma, seizure
- Metabolic abnormalities: dehydration, hypoxia, electrolyte abnormalities
- Infections: urinary tract infection, pneumonia
- Cardiac: myocardial infarction, arrhythmia, congestive heart failure
- Endocrine: hypothyroidism or hyperthyroidism, hypoglycemia or hyperglycemia

Medication	Examples	Better Alternatives/Guidance
Antiemetics	Metoclopramide, Prochlorperazine	Ondansetron
Antihistamines (first generation)	Diphenhydramine, hydroxyzine	Cetirizine
Antipsychotic medications	Haloperidol IV, doses >1 mg	Nonpharmacologic approach if possible Quetiapine (12.5–25 mg) or Haloperidol (0.5 mg IM) only if patient or others are at risk of harm
Antidepressants	Amitriptyline (TCA)	Sertraline, citalopram
Benzodiazepines	Alprazolam, lorazepam, clonazepam	Do not use for first-line treatment of anxiety, sleep, or delirium
Insulin	Sliding scale (cause of hypoglycemia)	Increase threshold or discontinue if patient is NPO
Muscle relaxers	Cyclobenzaprine	Warm or cold compress, massage, topical agent
Opioid analgesics	Meperidine, codeine	Acetaminophen, topical agents, low-dose morphine or oxycodone, titrated to effect
Sedative-hypnotic sleeping aids	Zolpidem (10 > 5)	Trazodone (25 mg)
Medications for urinary incontinence	Oxybutynin	Mirabegron Solifenacin

Medication classes increasing risk of delirium (see AGS Revised Beer's Criteria for potentially inappropriate medication use in older adults for more details).

Abbreviations: IM, intramuscular; IV, intravenous; NPO, nil by mouth; TCA, tricyclic antidepressant.

A partnership between surgical and medical services to evaluate and optimize patients more than 65 years of age preoperatively may improve patients' outcomes. The proactive care for the older people undergoing surgery (POPS) pathway³⁷ and the preoperative assessment of cancer in the elderly (PACE)³⁸ program are example of successful programs specifically designed for the elderly. These programs included multidisciplinary preoperative comprehensive assessment at an early stage in order to assess patient's fitness for the procedure and allow time for optimization.

Once frailty is identified in a patient undergoing a major surgery, there should be a multidisciplinary evaluation and collaboration between surgeons, anesthesiologists, nurses, and rehabilitation, and early involvement of medicine or geriatrics.

Patients with hip fractures represent a special group that poses several challenges to the institutions. Most elderly patients hospitalized with a fragility fracture are frail and have multiple comorbidities. After surgical repair, both short-term and long-term outcomes are poor; 20% of patients enter a long-term care facility within 1 year of surgery, and the 1-year mortality may be as high as 33% to 40%.³⁹ Guidelines and recommendations have addressed the importance of combined geriatric and

Table 8		
Confusion assessment method		
<i>Major Criteria (Both Features Must Be Present)</i>		
1. Acute change in mental status and/or Fluctuating course	Is there evidence of an acute change in mental status from the patient's baseline behavior fluctuate during the day; that is, tend to come and go or increase and decrease in severity?	Yes/no
2. Inattention	Did the patient have difficulty focusing attention; for example, being easily distractible or having difficulty keeping track of what was being said?	Yes/no
<i>Minor Criteria (1 of 2 Features Must Be Present)</i>		
3. Altered level of consciousness	Vigilant (hyperalert) Lethargic (drowsy, easily aroused) Stupor (difficult to arouse) Coma (unarousable)	Yes/no
4. Disorganized thinking	Was the patient's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas, or unpredictable switching from subject to subject	Yes/no

Adapted from Inouye SK, van Dyck CH, Alessi CA, et al. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med* 1990;113(12):947; with permission.

orthopedic care as an alternative to traditional treatment, although the optimum treatment model is unknown. Several models have been developed, including geriatric consultation teams which are comanaged care between hospitalists or geriatricians and orthopedic surgeons. These models have shown improvement on the rate of complications, delirium, mortality, and time to surgery. However, the availability of geriatricians is limited and these types of programs cannot be replicated in most hospitals. Training hospitalists in the principles of geriatric management of surgical patients and implementing comanagement programs that use hospitalists instead of geriatricians may be an alternate way to optimize care for older adults.⁴⁰

Fig. 2 presents a preoperative standardized multiprofessional pathway for a patient scheduled for an elective major surgery.

SUMMARY AND FUTURE DIRECTIONS

Older adults should undergo the standard risk stratification based on the history, physical examination, and diagnostic tests but the assessment should be supplemented with geriatric-specific evaluation, including frailty, cognitive status, nutrition, functional status, and risk of delirium. Management of frail older adults provides many challenges to surgical teams. A multidisciplinary patient-centered approach implementing evidence-based interventions and hands-on, rather than consultative care, with follow-up may improve postoperative outcomes. To be effective, these pathways need to include geriatric assessment early in the course of the surgery planning to ensure sufficient time for optimization.

Preoperative of elderly patients should identify patients who are at high risk for adverse outcomes, balanced between function and futility. This type of assessment enables patients and their families to have informed discussions about the risks and develop treatment plans that meet their goals.

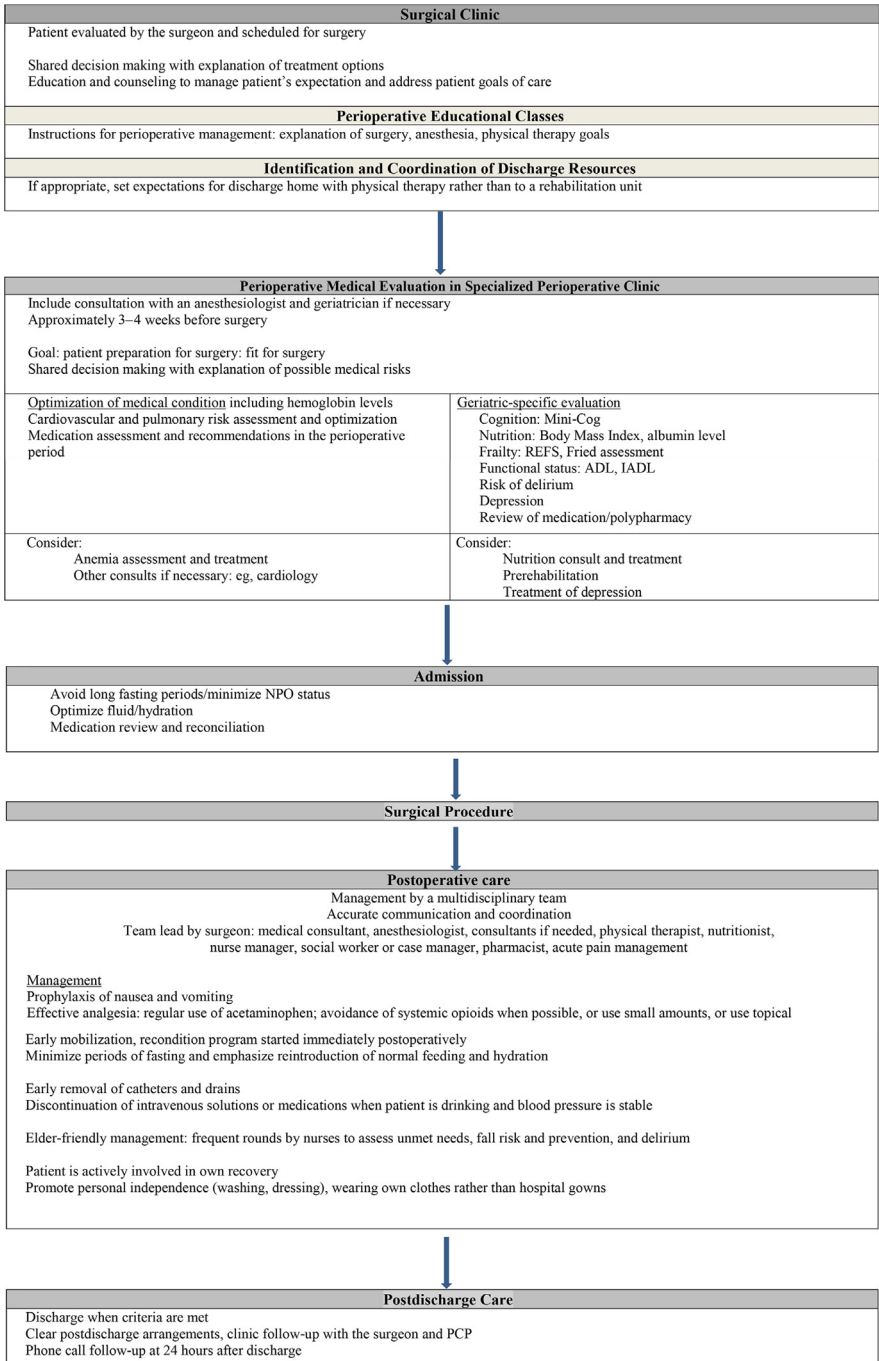


Fig. 2. Preoperative pathway for an elderly patient scheduled for an elective major surgery. Standardized multiprofessional pathway. Goal: improve patient outcomes and speed up recovery after surgery. NPO, nil by mouth; PCP, primary care provider.

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REFERENCES

1. CDC Fast Stats. Available at: <http://www.cdc.gov/nchs/fastats/older-american-health.htm>. Accessed August 17, 2015.
2. Chow WB, Rosenthal RA, Merkow RP, et al. Optimal preoperative assessment of the geriatric surgical patient: a best practices guideline from the American College of Surgeons National Surgical Quality Improvement Program and the American Geriatrics Society. *J Am Coll Surg* 2012;215(4):453–66.
3. CDC Data Briefs. Available at: <http://www.cdc.gov/nchs/data/databriefs/db186.htm>. Accessed August 16, 2015.
4. Liu LL, Leung JM. Predicting adverse postoperative outcomes in patients aged 80 years or older. *J Am Geriatr Soc* 2000;48(4):405–12.
5. Polanczyk CA, Marcantonio E, Goldman L, et al. Impact of age on perioperative complications and length of stay in patients undergoing noncardiac surgery. *Ann Intern Med* 2001;134(8):637–43.
6. Berry AJ, Smith RB 3rd, Weintraub WS, et al. Age versus comorbidities as risk factors for complications after elective abdominal aortic reconstructive surgery. *J Vasc Surg* 2001;33(2):345–52.
7. Hamel MB, Henderson WG, Khuri SF, et al. Surgical outcomes for patients aged 80 and older: morbidity and mortality from major noncardiac surgery. *J Am Geriatr Soc* 2005;53(3):424–9.
8. Bilimoria KY, Liu Y, Paruch JL, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. *J Am Coll Surg* 2013;217(5):833–42.e1–3.
9. ACS surgical calculator. Available at: <http://riskcalculator.facs.org/>. Accessed August 16, 2015.
10. Makary MA, Segev DL, Pronovost PJ, et al. Frailty as a predictor of surgical outcomes in older patients. *J Am Coll Surg* 2010;210(6):901–8.
11. Welten GM, Schouten O, van Domburg RT, et al. The influence of aging on the prognostic value of the Revised Cardiac Risk Index for postoperative cardiac complications in vascular surgery patients. *Eur J Vasc Endovasc Surg* 2007;34(6):632–8.
12. Arozullah AM, Khuri SF, Henderson WG, et al. Development and validation of a multifactorial risk index for predicting postoperative pneumonia after major noncardiac surgery. *Ann Intern Med* 2001;135(10):847–57.
13. Committee on Standards and Practice Parameters, Apfelbaum JL, Connis RT, et al. Practice advisory for preanesthesia evaluation: an updated report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation. *Anesthesiology* 2012;116(3):522–38.
14. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Developed in collaboration with the American College of Surgeons, American Society of Anesthesiologists, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and

- Society of Vascular Medicine Endorsed by the Society of Hospital Medicine. *J Nucl Cardiol* 2015;22(1):162–215.
15. Brown SR, Brown J. Why do physicians order unnecessary preoperative tests? A qualitative study. *Fam Med* 2011;43(5):338–43.
 16. Ricci WM, Della Rocca GJ, Combs C, et al. The medical and economic impact of preoperative cardiac testing in elderly patients with hip fractures. *Injury* 2007;38(Suppl 3):S49–52.
 17. Routine preoperative laboratory testing for patients scheduled for cataract surgery. American Academy of Ophthalmology. Available at: <http://one.aao.org/clinical-statement/routine-preoperative-laboratory-testing-patients-s>. Accessed August 20, 2015.
 18. Chen CL, Lin GA, Bardach NS, et al. Preoperative medical testing in Medicare patients undergoing cataract surgery. *N Engl J Med* 2015;372(16):1530–8.
 19. Appelbaum PS. Clinical practice. Assessment of patients' competence to consent to treatment. *N Engl J Med* 2007;357(18):1834–40.
 20. Guralnik JM, Ferrucci L. Assessing the building blocks of function: utilizing measures of functional limitation. *Am J Prev Med* 2003;25(3 Suppl 2):112–21.
 21. Covinsky KE, Fortinsky RH, Palmer RM, et al. Relation between symptoms of depression and health status outcomes in acutely ill hospitalized older persons. *Ann Intern Med* 1997;126(6):417–25.
 22. Inouye SK, Peduzzi PN, Robison JT, et al. Importance of functional measures in predicting mortality among older hospitalized patients. *JAMA* 1998;279(15):1187–93.
 23. Robinson TN, Raeburn CD, Tran ZV, et al. Postoperative delirium in the elderly: risk factors and outcomes. *Ann Surg* 2009;249(1):173–8.
 24. Mini Nutritional Assessment. Available at: www.mna-elderly.com. Accessed August 14, 2015.
 25. Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56(3):M146–56.
 26. Pel-Littel RE, Schuurmans MJ, Emmelot-Vonk MH, et al. Frailty: defining and measuring a concept. *J Nutr Health Aging* 2009;13(4):390–4.
 27. Krishnan M, Beck S, Havelock W, et al. Predicting outcome after hip fracture: using a frailty index to integrate comprehensive geriatric assessment results. *Age Ageing* 2014;43(1):122–6.
 28. Dasgupta M, Rolfson DB, Stolee P, et al. Frailty is associated with postoperative complications in older adults with medical problems. *Arch Gerontol Geriatr* 2009;48(1):78–83.
 29. Lee DH, Buth KJ, Martin BJ, et al. Frail patients are at increased risk for mortality and prolonged institutional care after cardiac surgery. *Circulation* 2010;121(8):973–8.
 30. Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005;173:489–95.
 31. Rolfson DB, Majumdar SR, Tsuyuki RT, et al. Validity and reliability of the Edmonton Frail Scale. *Age Ageing* 2006;35(5):526–9.
 32. Robinson TN, Wu DS, Pointer L, et al. Simple frailty score predicts postoperative complications across surgical specialties. *Am J Surg* 2013;206(4):544–50.
 33. Inouye SK, Westendorp RG, Saczynski JS. Delirium in elderly people. *Lancet* 2014;383(9920):911–22.
 34. Fick DM, Cooper JW, Wade WE, et al. Updating the Beers Criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. *Arch Intern Med* 2003;163(22):2716–24.

35. Inouye SK, van Dyck CH, Alessi CA, et al. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med* 1990;113(12):941–8.
36. Siegel EM. Just because you can, doesn't mean that you should: a call for the rational application of hospitalist comanagement. *J Hosp Med* 2008;3(5): 398–402.
37. Harari D, Hopper A, Dhese J, et al. Proactive care of older people undergoing surgery ('POPS'): designing, embedding, evaluating and funding a comprehensive geriatric assessment service for older elective surgical patients. *Age Ageing* 2007;36(2):190–6.
38. Pope D, Ramesh H, Gennari R, et al. Pre-operative assessment of cancer in the elderly (PACE): a comprehensive assessment of underlying characteristics of elderly cancer patients prior to elective surgery. *Surg Oncol* 2006;15(4):189–97.
39. Bentler SE, Liu L, Obrizan M, et al. The aftermath of hip fracture: discharge placement, functional status change, and mortality. *Am J Epidemiol* 2009;170(10): 1290–9.
40. Mangram AJ, Shifflette VK, Mitchell CD, et al. The creation of a geriatric trauma unit "G-60". *Am Surg* 2011;77(9):1144–6.