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Introduction

The population of the United States is growing and aging. The U.S. Census Bureau projects the number of Americans age 65 years and older will more than double between 2010 and 2050. The percentage of Americans 65 and older will grow from 13% to more than 20% of the total population by 2030, and the fastest growing segment of this group (individuals 85 years and older) is expected to triple in number over the next four decades. These changes in the age demographics of the U.S. population are largely due to people living longer and the “baby boomer” generation crossing into the 65 and older age bracket in 2011.¹ How will this demographic change impact the health care system?

The National Hospital Discharge Survey has demonstrated increasing hospital utilization by elderly persons. In 1970, individuals 65 and older represented 10% of the population² and accounted for 20% of hospital discharges and 33% of the days of care.³ By 2007, the percentage of persons 65 and older grew modestly to 13%, yet their hospital use increased drastically to 37% of hospital discharges and 43% of the days of care.⁴ The older individuals have significantly higher rates per population of both inpatient and outpatient surgical and nonsurgical procedures compared with other age groups.³⁻⁵ In 2006, elderly patients underwent 35.3% of inpatient procedures and 32.1% of outpatient procedures.^{3,5} As the population of the U.S. continues to age, it will place greater demands on surgical services.⁶ It is imperative that strategies are developed to meet these growing demands and to ensure higher-quality care for geriatric surgical patients.

This American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP)/American Geriatrics Society (AGS) Best Practices Guidelines focus on the optimal preoperative assessment of the geriatric surgical patient. It is a compilation of the most current and evidence-based recommendations for improving the perioperative care of this vulnerable population. While this guide is meant to help surgical teams, other proceduralists, and anesthesiologist in their practice, it is not a substitution for clinical judgment and experience.

Table of Contents

Introduction	i
Preoperative Assessment.....	1
SECTION I. Cognitive and Behavioral Disorders.....	2
A. Cognitive Impairment and Dementia.....	2
B. Decision-Making Capacity.....	4
C. Depression.....	5
D. Risk Factors for Postoperative Delirium.....	6
E. Alcohol and Substance Abuse.....	7
SECTION II. Cardiac Evaluation	8
SECTION III. Pulmonary Evaluation.....	9
SECTION IV. Functional / Performance Status	11
SECTION V. Frailty.....	13
SECTION VI. Nutritional Status.....	14
SECTION VII. Medication Management.....	15
SECTION VIII. Patient Counseling.....	19
SECTION IX. Preoperative Testing	20
Appendices	25
• APPENDIX I. Patient’s Decision Making Capacity	26
• APPENDIX II. Cardiac Evaluation	27
• APPENDIX III. Frailty Score.....	29
• APPENDIX IV. Recommendations for Preoperative Nutritional Support.....	30
• APPENDIX V. Beers Criteria for Potentially Inappropriate Medication Use in Older Adults	31
• APPENDIX VI. Recommendations for Preoperative Discontinuation of Herbal Medicines/Supplements	39
• APPENDIX VII. ACC/AHA Guidelines for Perioperative Beta Blockers.....	40
Expert Panel.....	41
References	44

Preoperative Assessment

In addition to conducting a complete and thorough history and physical examination of the patient, the following assessments are strongly recommended:

- Assess the patient's **cognitive ability** and **capacity** to understand the anticipated surgery (see Section I.A, Section I.B, and Appendix I).
- Screen the patient for **depression** (see Section I.C).
- Identify the patient's risk factors for developing postoperative **delirium** (see Section I.D).
- Screen for **alcohol** and other **substance abuse/dependence** (see Section I.E).
- Perform a preoperative **cardiac** evaluation according to the American College of Cardiology/American Heart Association (ACC/AHA) algorithm for patients undergoing noncardiac surgery (see Section II and Appendix II).
- Identify the patient's risk factors for postoperative **pulmonary** complications and implement appropriate strategies for prevention (see Section III).
- Document **functional status** and history of **falls** (see Section IV).
- Determine baseline **frailty** score (see Section V and Appendix III).
- Assess patient's **nutritional status** and consider preoperative interventions if the patient is at severe nutritional risk (see Section VI and Appendix IV).
- Take an accurate and detailed **medication history** and consider appropriate perioperative adjustments. Monitor for **polypharmacy** (see Section VII, Appendix V, Appendix VI, and Appendix VII).
- Determine the patient's **treatment goals** and **expectations** in the context of the possible treatment outcomes (see Section VIII).
- Determine patient's **family** and **social support system** (see Section VIII).
- Order appropriate preoperative **diagnostic tests** focused on elderly patients (see Section IX).

SECTION I. Cognitive and Behavioral Disorders

A. Cognitive Impairment and Dementia

In 2002, the prevalence of cognitive impairment and dementia among individuals 71 years and older in the U.S. were estimated at 22.2% and 13.9%, respectively.^{7,8} The prevalence of dementia increases exponentially with increasing age older than 65 years.⁹ As the proportion of Americans 85 years and older grows, the number of people living with dementia is projected to rise dramatically.¹⁰

Preexisting cognitive impairment strongly predicts postoperative delirium,¹¹⁻¹⁵ which is associated with worse surgical outcomes, including longer hospital stays, increased risk of perioperative mortality,^{11,13} and postoperative functional decline.¹⁴

ASSESSING COGNITIVE ABILITY

Cognitive Ability:

- For any patient older than age 65 without a known history of cognitive impairment or dementia, a history and cognitive assessment, such as the Mini-Cog (see below), are essential.
- If possible, a knowledgeable informant, such as a spouse or a family member, should be interviewed about the evolution of any cognitive or functional decline in the patient.¹⁶
- If the patient has experienced a decline, they should be referred for further evaluation to a primary care physician, geriatrician, or mental health specialist.
- Postoperative cognitive dysfunction is common but difficult to quantify without documentation of the patient's baseline cognitive status.^{17,18}

The cognitive assessment should be performed early in the patient evaluation because any evidence of cognitive impairment or dementia may indicate that subsequent assessment of functional status and/or medication use may be unreliable.

COGNITIVE ASSESSMENT: MINI-COG

Mini-Cog: 3 Item Recall and Clock Draw¹⁹

1. GET THE PATIENT'S ATTENTION, THEN SAY:

"I am going to say three words that I want you to remember now and later.

The words are **Banana** **Sunrise** **Chair**

Please say them for me now."

Give the patient 3 tries to repeat the words. If unable after 3 tries, go to next item.

2. SAY ALL THE FOLLOWING PHRASES IN THE ORDER INDICATED:

"Please draw a clock in the space below. Start by drawing a large circle. Put all the numbers in the circle and set the hands to show 11:10 (10 past 11)."

If subject has not finished clock drawing in 3 minutes, discontinue and ask for recall items.

3. SAY: "What were the three words I asked you to remember?"

Interpretation of the Mini-Cog

SCORING:

3 item recall (0-3 points): 1 point for each correct word

Clock draw (0 or 2 points): 0 points for abnormal clock
2 points for normal clock

A NORMAL CLOCK HAS ALL OF THE FOLLOWING ELEMENTS:

All numbers 1–12, each only once, are present in the correct order and direction (clockwise) inside the circle.

Two hands are present, one pointing to 11 and one pointing to 2.

ANY CLOCK MISSING ANY OF THESE ELEMENTS IS SCORED ABNORMAL.
REFUSAL TO DRAW A CLOCK IS SCORED ABNORMAL.

Total Score of 0, 1, or 2 suggests possible impairment.

Total Score of 3, 4, or 5 suggests no impairment.

If the patient has evidence of cognitive impairment on the Mini-Cog, consider a referral to a primary care physician, geriatrician, or mental health specialist.^{20,21}

B. Decision-Making Capacity

Assessing the patient's decision-making capacity is critical in determining his or her ability to provide informed surgical consent. The physician should confirm that the patient is able to describe, in his/her own words, the important features of the discussion, including his/her medical condition and the indications, benefits, risks, and alternatives to surgical operations.

ASSESSING DECISION-MAKING CAPACITY

Decision-Making Capacity²²

To determine the patient's decision-making capacity, the physician should confirm that the patient is able to describe (in his or her own words) the important features of the discussion, including his or her medical condition, and the indications/benefits/risks/alternatives to surgical operations.

The four legally-relevant criterion for decision-making capacity:

1. The patient can clearly indicate his or her treatment choice.
2. The patient understands the relevant information communicated by the physician.
3. The patient acknowledges his or her medical condition, treatment options, and the likely outcomes.
4. The patient can engage in a rational discussion about the treatment options.

See **Appendix I** for more details about the assessment of decision-making capacity.

C. Depression

A recent study estimates the prevalence of depression among the U.S. population 71 years and older to be 11%.²³ In the general elderly population, major depression occurs in 1% to 3%, with an additional 8% to 16% exhibiting clinically significant depressive symptoms.

Significant risk factors for depression in the elderly include female gender, disability, bereavement, sleep disturbance, and prior depression. Possible additional risk factors include poor health status, cognitive impairment, living alone, and new medical illness.²⁴

Preoperative depression has been associated with increased mortality after coronary artery bypass graft (CABG)²⁵ and longer postoperative length of stay after CABG and valve operations.^{26,27} Depression has also been associated with higher pain perception and increased postoperative analgesic use.^{28,29}

SCREENING FOR DEPRESSION

Patient Health Questionnaire-2 (PHQ-2)³⁰

1. *In the past 12 months, have you ever had a time when you felt sad, blue, depressed, or down for most of the time for at least two weeks?*
2. *In the past 12 months, have you ever had a time, lasting at least two weeks, when you didn't care about the things that you usually care about or when you didn't enjoy the things that you usually enjoy?*

Interpretation of PHQ-2

If the patient answers YES to either question, then further evaluation by a primary care physician, geriatrician, or mental health specialist is recommended.

NOTE: This screening test has not been validated in extremely frail elderly patients, those with severe concurrent medical illnesses, those who are suffering from medication side effects, or those with impaired communication skills.

D. Risk Factors for Postoperative Delirium

Postoperative delirium is a common complication in elderly patients; in one prospective study of patients undergoing major, elective, noncardiac operations, 9% of patients developed postoperative delirium.¹² In another study, patients undergoing surgical operations requiring postoperative intensive care unit (ICU) stay, 44% of the patients experienced postoperative delirium.¹³ Other studies have described incidence of delirium ranging from 5.1% to 52.2%, with higher rates after hip fracture and aortic surgery.³¹

Risk factors for postoperative delirium are shown below, with the *strongest predisposing factor being preexisting cognitive impairment and dementia*.^{13,32} Postoperative delirium is associated with higher mortality and complications, rates of institutionalization, greater costs and use of hospital resources, longer lengths of stay, and poorer functional recovery.^{11-13,31,32}

RISK FACTORS FOR POSTOPERATIVE DELIRIUM^{12,13,20,21,31-38}

Risk Factors

Cognitive and Behavioral Disorders

- Cognitive impairment and dementia
- Untreated or inadequately controlled pain
- Depression
- Alcohol use
- Sleep deprivation

Disease/Illness Related

- Severe illness/comorbidities
- Renal insufficiency
- Anemia
- Hypoxia

Metabolic

- Poor nutrition
- Dehydration
- Electrolyte abnormalities

Functional Impairments

- Poor functional status
- Immobilization
- Hearing or vision impairment

Other

- Older age ≥ 70 years
- Polypharmacy and use of psychotropic medications (benzodiazepines, anticholinergics, and antihistamines)
- Risk of urinary retention or constipation, presence of urinary catheter

In patients at risk for postoperative delirium, administration of benzodiazepines and antihistamines (for example, diphenhydramine) should be avoided, except in certain circumstances (see **Section VII**).

E. Alcohol and Substance Abuse

A national survey estimated 60% of individuals 50 years and older used alcohol during the 2005–2006 period; fewer people used drugs (2.6% marijuana, and 0.41% cocaine).³⁹ For elderly men (≥65 years), the prevalence of at-risk (2+ drinks/day) and binge-drinking (5+ drinks/day) were 13% and 14.5%, respectively; for elderly women, the prevalence of at-risk and binge drinking were 8.1% and 3.3%.⁴⁰

Preoperative alcohol abuse and dependence are associated with increased rates of postoperative mortality and complications, including pneumonia, sepsis, wound infection and disruption, and prolonged length of stay.^{41,42}

SCREENING FOR ALCOHOL AND SUBSTANCE ABUSE

Modified Version of CAGE⁴³⁻⁴⁶

Ask the patient the following four questions:

1. *Have you ever felt you should **C**ut down on your drinking or drug use?*
2. *Have people **A**nnoyed you by criticizing your drinking or drug use?*
3. *Have you ever felt bad or **G**uilty about your drinking or drug use?*
4. *Have you ever had a drink or drug first thing in the morning (**E**ye-opener) to steady your nerves or to get rid of a hangover?*

Interpretation of Modified CAGE

If YES to any of these questions, consider perioperative prophylaxis for withdrawal syndromes.

If operation can be delayed, consider referring motivated patients to substance abuse specialist for preoperative abstinence or medical detoxification.

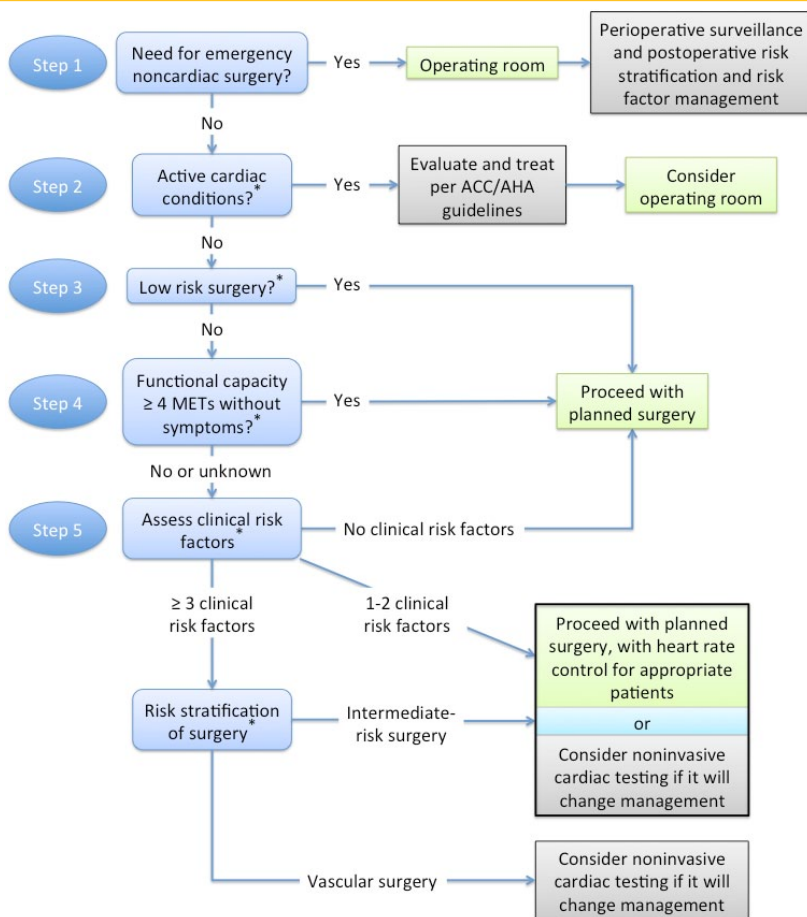
Patients with alcohol use disorder should receive perioperative daily multivitamins (with folic acid) and high-dose oral or parental thiamine (100 mg).

SECTION II. Cardiac Evaluation

For noncardiac surgery, studies describe major perioperative cardiac complications rates at 2% for unselected patients⁴⁷ and 3.9% for patients with or at risk of cardiac disease.⁴⁸ The rates exceed 5% for high-cardiac-risk patients.⁴⁷⁻⁵⁰ Postoperative myocardial infarction (MI) is associated with hospital mortality rates of 15%–25%; patients experiencing nonfatal perioperative MI are at greater risk for cardiovascular death and nonfatal MI during the 6 months after a surgical operation.⁴⁸

Older patients are significantly more vulnerable to perioperative cardiac adverse events.⁵¹ Therefore, it is critical to identify elderly patients with higher risk of cardiac complications to determine appropriate perioperative management and to effectively communicate operative risk.

ACC/AHA ALGORITHM FOR CARDIAC EVALUATION AND CARE FOR NONCARDIAC SURGERY⁵²



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* See **Appendix II** for tables of Active Cardiac Conditions; Cardiac Risk Stratification of Surgery; Metabolic Equivalents (METs); and Clinical Risk Factors.

SECTION III. Pulmonary Evaluation

Postoperative pulmonary complications (PPCs) are common and contribute significantly to overall morbidity and mortality.⁵³ In a systematic review of PPCs in patients undergoing noncardiac surgery, the rate of PPCs across all the studies was 6.8%.⁵⁴ In the same review, study subsets showed median PPCs rates of 14% and 15% in patients ≥ 65 years and ≥ 70 years, respectively.

Although traditionally greater emphasis has been placed on cardiac risk assessment, postoperative pulmonary complications have similar prevalence to cardiac adverse events.⁵⁴⁻⁵⁶ In a study of patients undergoing elective abdominal procedures, pulmonary complications occurred more often than cardiac adverse events and were associated with longer hospital stays.^{57,58} For patients undergoing general and vascular operations at a single NSQIP hospital, PPCs incurred the highest total hospital cost compared with infectious, thromboembolic, and cardiac adverse events, and required the longest median length of stay.⁵⁹ Pulmonary complications also predicted long-term mortality in elderly patients (≥ 70 years) undergoing noncardiac surgery.⁶⁰

The following information is adapted from the *ACS NSQIP Best Practices Guidelines: Prevention of Postoperative Pulmonary Complications*.⁶¹

RISK FACTORS FOR POSTOPERATIVE PULMONARY COMPLICATIONS

Risk Factors

Patient-Related Factors

- Age >60 ^{53-55,62-64}
- Chronic obstructive pulmonary disease (COPD)^{53-55,63,64}
- American Society of Anesthesiologists (ASA) class II or greater⁵³⁻⁵⁵
- Functional dependence^{*54,55,63,64}
- Congestive heart failure⁵³⁻⁵⁵
- Obstructive sleep apnea^{54,55,65}
- Pulmonary hypertension⁶⁶⁻⁶⁸
- Current cigarette use^{54,55,64}
- Impaired sensorium^{†53-55,64}
- Preoperative sepsis⁵³
- Weight loss $>10\%$ in 6 months^{54,55,64}
- Serum albumin <3.5 mg/dL^{53-55,63}
- Blood urea nitrogen (BUN) ≥ 7.5 mmol/L (≥ 21 mg/dL)^{54,55,64}
- Serum creatinine >133 μ mol/L (>1.5 mg/dL)^{54,69}

Surgical Procedure-Related Factors

- Prolonged operation >3 hours^{54,55,62}
- Surgical site^{‡53-55,63,64}
- Emergency operation^{53-55,63,64}
- General anesthesia^{54,55,64}
- Perioperative transfusion^{53-55,64}
- Residual neuromuscular blockade after an operation^{55,70}

Not Risk Factors

- Obesity^{54,55}
- Well-controlled asthma^{54,55}
- Diabetes^{54,55}

* Total dependence was the inability to perform any activities of daily living. Partial dependence was the need for equipment or devices and assistance from another person for some activities of daily living.

† Acutely confused or delirious patient who is able to respond to verbal or mild tactile stimulation, or mental status changes/delirium in the context of current illness.

‡ Highest risk procedures: upper abdominal, thoracic, neurosurgical, head and neck, vascular (for example, aortic aneurysm repair).

PREOPERATIVE STRATEGIES FOR PREVENTING PPCS

Recommendations

- Preoperative optimization of pulmonary function in patients with COPD and asthma that is not well controlled^{71,72}
- Smoking cessation^{*68,73-76}
- Preoperative intensive inspiratory muscle training^{†68,77}
- Selective chest radiograph and pulmonary function tests^{‡55,72}

* Regarding the timing of smoking cessation, one study showed increased rates of PPCs in patients who stop smoking within eight weeks of a surgical operation; another study found that smoking cessation was beneficial as late as four weeks before surgery; a meta-analysis found no increased risk in PPCs with cessation within eight weeks of a surgical operation.

† Based on one single-blinded randomized control trial of patients undergoing elective CABG.

‡ Routine chest radiographs and pulmonary function tests are not recommended.

SECTION IV. Functional / Performance Status

In one prospective study of elderly patients undergoing major surgical operations requiring ICU stay, functional dependence was the strongest predictor of postoperative 6-month mortality.⁷⁸ Another study of Veterans Administration (VA) patients >80 years old showed that 30-day mortality was more strongly predicted by functional status than age.⁷⁹ Impaired mobility in elderly patients has also been linked to increased risk of postoperative delirium^{31,80} and surgical site infections with MRSA.^{81,82} In a study of elderly surgical patients requiring ICU stay, prolonged TUGT (≥ 15 seconds) and any functional dependence were the strongest predictors for requiring postoperative discharge institutionalization.⁸³ In addition, preoperative functional status strongly predicts better recovery and shorter recovery periods for activities of daily living (ADL) and instrumental activities of daily living (IADL) following major abdominal surgery.⁸⁴

1. Assess patient's ability to perform daily activities (functional status).

ASSESSING BASELINE AND CURRENT FUNCTIONAL STATUS IN AMBULATORY PATIENTS

Short Simple Screening Test for Functional Assessment^{21,85}

Ask the patient the following four questions:

1. *Can you get out of bed or chair yourself?*
2. *Can you dress and bathe yourself?*
3. *Can you make your own meals?*
4. *Can you do your own shopping?*

Interpretation of Functional Screening Test

- If NO to any of these questions, more in-depth evaluation should be performed, including full screening of ADLs and IADLs.
- Deficits should be documented and may prompt perioperative interventions (for example, referral to occupational therapy and/or physical therapy) and proactive discharge planning.

NOTE: Patient's responses may not be reliable in the presence of cognitive impairment or dementia.

2. Document deficits in vision, hearing, or swallowing.
3. Inquire about history of falls ("*Have you fallen in the past year?*").
4. Evaluate the patient for limitations in gait and mobility and determine risk for falls.

ASSESSING GAIT AND MOBILITY IMPAIRMENT AND FALL RISK IN AMBULATORY PATIENTS

Timed Up and Go Test (TUGT)⁸⁶⁻⁸⁸

Patients should sit in a standard armchair with a line 10 feet in length in front of the chair. They should use standard footwear and walking aids and should not receive any assistance.

Have the patient perform the following commands:

1. Rise from the chair (if possible, without using the armrests)
2. Walk to the line on the floor (10 feet)
3. Turn
4. Return to the chair
5. Sit down again

Interpretation of TUGT

Any person demonstrating difficulty rising from the chair or requiring more than 15 seconds to complete the test is at high risk for falls. Consider preoperative referral to physical therapy for more detailed gait assessment.

SECTION V. Frailty

Frailty is a syndrome of decreased physiologic reserve and resistance to stressors, which leaves patients more vulnerable to poor health outcomes, including falls, worsening mobility and ADL disability, hospitalizations, and death. It is a clinically distinct entity from comorbidity and disability.^{89,90}

Although a number of alternative measures of frailty exist, Fried et al. proposed a widely-recognized and operational definition⁹¹ (shown below and fully outlined in **Appendix III**), which has been validated for elderly surgical patients.^{89,92} Frailty has been shown to independently predict higher rates of postoperative adverse events (intermediate frail and frail patients had 2.06 times higher odds [95% CI, 1.18–3.60] and 2.54 times higher odds [1.12–5.77] compared with non-frail patients, respectively), increased length of stay (intermediate frail and frail patients had 44% to 53% and 65% to 89% longer hospital stays than non-frail patients), and higher likelihood of discharge to a skilled or assisted-living facility in elderly surgical patients (intermediate frail and frail patients had 3.16 [1.00–9.99] and 20.48 [5.54–75.68] higher odds than non-frail patients).⁹²

Robinson et al. proposed two other definitions of frailty for elderly surgical patients. The first definition measures cognitive impairment (Mini-Cog ≤ 3), poor nutrition (serum albumin ≤ 3.3 g/dL), history of falls (≥ 1 fall in the previous 6 months), and low hematocrit ($< 35\%$).⁷⁸ The second definition includes the factors from the first definition, with the addition of functional impairment (TUGT ≥ 15 seconds and dependence in any ADL), and comorbidity (Charlson index score ≥ 3).⁸³

FRAILTY SCORE: OPERATIONAL DEFINITION⁸⁹

Criteria	Definition
Shrinkage	Unintentional weight loss ≥ 10 pounds in past year
Weakness	Decreased grip strength
Exhaustion	Self-reported poor energy and endurance
Low physical activity	Low weekly energy expenditure
Slowness	Slow walking

Interpretation of the Frailty Score

The patient receives 1 point for each criterion met.

0–1 = Not Frail

2–3 = Intermediate Frail (Pre-frail)

4–5 = Frail

Frail patients are at much higher risk of adverse health outcomes.

Intermediate frail patients are at elevated risk (less than frail ones) but are also at more than double the risk of becoming frail over three years.

See **Appendix III** for a more detailed description of the validated frailty score for surgical patients.

Section VI. Nutritional Status

Rates of malnutrition were found to be 5.8% among elderly individuals in the community, 13.8% in nursing homes, 38.7% in hospitals, and 50.5% in rehabilitation.⁹³

Poor nutritional status is associated with increased risk of postoperative adverse events, mostly infectious complications (for example, surgical site infections, pneumonia, urinary tract infections, and so on) and wound complications (for example, dehiscence and anastomotic leaks), and increased length of stay for patients undergoing elective gastrointestinal surgery.⁹⁴

1. Document height and weight and calculate body mass index (BMI).^{20,21}
2. Measure baseline serum albumin, prealbumin levels.^{20,21}
3. Inquire about unintentional weight loss in the last year.

SCREENING FOR SEVERE NUTRITIONAL RISK⁹⁵

Risk Factors for Severe Nutritional Risk

- BMI <18.5 kg/m²
- Serum albumin <3.0 g/dL (with no evidence of hepatic or renal dysfunction)
- Unintentional weight loss >10%–15% within 6 months

Interpretation of Nutritional Screening

If YES to any above criterion, then the patient is at severe nutritional risk and should, if feasible, undergo a full nutritional assessment by a dietician to design a perioperative nutritional plan to address deficits.

4. Consider preoperative nutritional support for patients at severe nutritional risk (see **Appendix IV**).

Section VII. Medication Management

1. Review and document the patient's **complete medication lists**, including use of nonprescription agents (over-the-counter, non-steroidal anti-inflammatory drugs [NSAIDs], vitamins, eye drops, topical) and herbal products.⁹⁶

NOTE: Patient's responses may not be reliable in the presence of cognitive impairment or dementia.

2. Identify **medications that should be discontinued** prior to a surgical operation and medications that should be avoided. Minimize adverse effects of medications through dose reduction or substitutions.

GUIDELINES FOR MODIFYING PERIOPERATIVE MEDICATIONS

Discontinue before surgery:

- Nonessential medications that increase surgical risk should be discontinued.⁹⁶
- Medications with potential for drug interactions with anesthesia should be discontinued or substituted.⁹⁶
- See Beers Criteria (see **Appendix V**) for additional list of medications that may need to be discontinued perioperatively.⁹⁷
- Herbal medications should be stopped at least 7 days before a surgical operation due to uncertainty of contents.⁹⁶ See **Appendix VI** for more specific recommendations.

Continue perioperatively:

- Medications with withdrawal potential, including selective serotonin reuptake inhibitors (SSRIs), tricyclic antidepressants, benzodiazepines, antipsychotics, monoamine oxidase inhibitors (MAOIs), beta blockers, clonidine, statins, and corticosteroids, should be continued.⁹⁶
- Angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers should be continued *unless* their only indication is for hypertension and the patient's blood pressure is well controlled.⁹⁶

Additional considerations in patients at risk for postoperative delirium:

- Avoid starting new prescriptions for benzodiazepines and consider reducing benzodiazepines when possible.^{33,34}
- **Avoid using meperidine** for treatment of pain.⁹⁸ Ensure that pain is adequately controlled to reduce risk for developing postoperative delirium.³⁵⁻³⁸
- Use caution when prescribing antihistamine H₁ antagonists (**especially diphenhydramine/ Benadryl®**) and other medications with strong anticholinergic effects.^{33,34}
- No increased risk associated with neuroleptics (antipsychotics) and digoxin.³³
- No conclusive evidence for H₂ antagonists, tricyclic antidepressants, anti-Parkinson medications, steroids, NSAIDs, and antimuscarinics.³³

For all other cases: Exercise clinical judgment.

3. Consider which **medications should be started** preoperatively to reduce perioperative risks of adverse events (cardiac, stroke, and so on).

ACC/AHA GUIDELINES FOR PERIOPERATIVE BETA BLOCKERS^{21,52}

Summary of Recommendations on Beta Blockers

Indications: The guidelines support administration of beta blockers to:

- Patients who are already on beta blockers, particularly those with independent cardiac indications for these medications (such as arrhythmia or history of myocardial infarction).
- Patients undergoing intermediate risk or vascular surgery with known coronary artery disease or with multiple clinical risk factors for ischemic heart disease.

Initiation and Titration:

If beta blockers are indicated, when feasible, they should be started at least days to weeks before elective surgery, titrated to a heart rate of 60–80 beats/minute in the absence of hypotension. Titrated rate control with beta blockers should continue during the intraoperative and postoperative periods.

Discontinuation:

Beta blockers should be tapered off slowly to minimize risk of withdrawal.

At the time of this writing, the current ACC/AHA guidelines state that routine administration of high-dose beta-blockers in the absence of dose titration is not useful and may be harmful to patients not currently taking beta-blockers who are undergoing noncardiac surgery.

See **Appendix VII** for full recommendations.

INITIATION OF STATIN THERAPY^{21,52,99}

Recommendation on Statins

Preoperative statins should be started as soon as possible prior to a surgical operation for patients who have known vascular disease, elevated low-density lipoprotein cholesterol, or ischemia on thallium testing.

For patients undergoing noncardiac surgery who are currently taking statins, statin therapy should be continued. Statin use may also be considered for patients undergoing vascular and intermediate-risk surgical operations.

4. Adjust doses of medications for renal function

Older patients are at greater risk for impaired renal function and chronic kidney disease. Since many medications are renally cleared, it is critical to adjust dosages to prevent adverse reactions. Glomerular filtration rate (GFR) is accepted as the best overall measure of kidney function. *Since the ratio of GFR to serum creatinine decreases with increasing age, serum creatinine alone is an inadequate estimate of GFR in older persons.* Several equations that take age into consideration have been developed to estimate GFR, including the following:

Cockcroft-Gault Formula

$$eGFR = \frac{(140 - \text{Age}) \times \text{Body Weight [in kg]} \times [0.85 \text{ if female}]}{72 \times \text{Serum Creatinine [in mg/dl]}}$$

Modification of Diet in Renal Disease (MDRD) Study Equation

$$eGFR = \frac{175 \times \text{Serum Creatinine [in mg/dl]}^{-1.154} \times \text{Age}^{-0.203}}{\times [1.212 \text{ if black}] \times [0.742 \text{ if female}]}$$

These equations have their limitations (for example, in patients with significant muscle wasting and ones with rapidly changing kidney function). In these cases, more accurate measures of GFR can be obtained with exogenous filtration markers.¹⁰⁰

Recommendations for Medications Regarding Renal Function

Medications that are renally cleared should have dosages adjusted based on the patient's estimated GFR.

5. Monitor for **polypharmacy** and potential adverse interactions.

Medication use is common among the elderly; in a survey of nationally sampled community dwelling adults age 57–85 years, 81% were found to be taking one or more prescription medications, which was highest (89.7%) among those 75–85 years old. The use of nonprescription medications was also common; 68% of the older adults were concurrently using over-the-counter medications, dietary supplements, or both with prescription medications. More than half of patients, age 60 years and older, used five or more medications and supplements and 4% were found to be at risk of a major drug-drug interaction.¹⁰¹

Although there is no clear cutoff point for the number of medications that define polypharmacy, the focus should be on the use of suboptimal or inappropriate prescription and nonprescription medications and potential drug-drug interactions. Two studies of ambulatory elderly individuals have found 55%–60% of patients taking either suboptimal medications, or ones without appropriate indications.⁹⁶

Polypharmacy has been associated with increased risk of cognitive impairment, morbidity, and mortality, as well as poorer medication compliance. The risk of adverse drug reactions also increases with greater numbers of medications, leading to more hospital admissions.^{102,103}

Recommendations on Polypharmacy

When possible, nonessential medications should be discontinued perioperatively, and the addition of new medications should be kept to a minimum.

SECTION VIII. Patient Counseling

A study of deceased individuals who were age 60 years and older found that nearly 30% required decision making regarding medical care near the end of life, but lacked decision-making capacity. Approximately two-thirds had advance directives, and these individuals received care strongly associated with their preferences.¹⁰⁴ While the number of elderly individuals with advance directives has increased, one study of older patients undergoing a major operation found that advance directives were rarely present in the medical chart during hospitalization.¹⁰⁵

Although patients often believed that their family, surrogates, and physicians could represent their wishes,¹⁰⁶ the family members, surrogates, and physicians often failed to accurately predict the patients' treatment preferences.¹⁰⁶⁻¹⁰⁸ Few patients had ever discussed their preferences with their family members and their physicians.¹⁰⁶ For incapacitated patients, physicians often rely on health care proxies to make end-of-life decisions for patients, yet a number of studies have discovered negative emotional effects on nearly one-third of surrogates, most commonly guilt and doubt regarding the decisions.¹⁰⁹

Patients' expectations influence their treatment preferences. In a survey of patients 60 years and older with limited life expectancy due to cancer, congestive heart failure, or chronic obstructive pulmonary disease, 98.7% of patients would undergo a low-burden treatment to restore current health (versus no treatment and dying). However, 74.4% would forgo treatment if it resulted in severe functional impairment and 88.8% would reject treatment if it resulted in cognitive impairment.¹¹⁰

These findings stress the importance of having discussions between the physician and the patient to explicitly determine the patient's preferences and expectations from the treatment. In addition, family members and potential decision-making surrogates should be involved in the conversations.

1. Ensure that the patient has an advance directive and has designated health care proxy (or surrogate decision makers). These documents should be placed in the medical chart.

Examples include:

- “Five Wishes” by Aging with Dignity (www.agingwithdignity.org)
- Lifecare Advance Directive (www.lifecaredirectives.com)

2. Discuss with the patient the treatment goals and plans and *be sure that the provider understands the patient's preferences and expectations*. Discussions of the patient's preferences and expectations and ensuing changes should be documented in the medical records.
3. Describe the expected postoperative course and possible complications with the patient. *If relevant, include discussion of possible functional decline and need for rehabilitation or nursing home care during the informed consent process.*
4. Determine patient's family and social support systems, which are of significant importance for discharge disposition. If there is concern of an insufficient family/social support system, consider preoperative referral to a social worker.

Section IX. Preoperative Testing

Over the past few decades, a number of studies have highlighted the relatively low yield of routine preoperative screening and the high aggregate cost from both the direct cost of tests and the subsequent studies for abnormal results. The reports have shown that many of the screening tests produce low rates of abnormal values in asymptomatic patients, are unlikely to change clinical management for the patient with abnormal values, do not strongly predict good or adverse outcomes, or are subject to a combination of these limitations.^{21,111-113 114,115}

The studies have recommended against a routine battery of preoperative screening tests,^{21,111,112,114-116} or ones based on age criteria alone.^{116,117} Instead, they recommend selective diagnostic tests in higher-risk patient populations, which can be identified based on history and physical exam, known comorbidities, and the type of procedure to be performed.^{21,111,112,115-118}

Most hospitals have specific guidelines for when preoperative tests should be performed, such as within 30 days of the operation.²⁰ One study, however, has shown that normal laboratories done up to 4 months prior to a surgical operation could be used safely as preoperative tests as long as no substantial interval change in the patient's clinical status has occurred.^{112,118}

Based on the studies reviewed, the following recommendations are provided for common preoperative tests with indications:

**RECOMMENDED PREOPERATIVE TESTS FOR
ALL GERIATRIC SURGICAL PATIENTS**

Preoperative Tests	Indications
<p>Hemoglobin</p>	<ul style="list-style-type: none"> • Reasonable for all geriatric patients, especially those >80 years.^{20,21} • Recommended for patients undergoing operations in which significant blood loss is anticipated and may require transfusion.^{112,113} • Recommended for patients with history or physical exam suggesting severe anemia:^{112,113} <ul style="list-style-type: none"> • History of profound fatigue, anemia, malignancy, cardiovascular disease, renal disease, or respiratory disease. • On exam, resting tachycardia or conjunctival pallor.
<p>Renal Function Tests (BUN, Cr)</p>	<ul style="list-style-type: none"> • Recommended for all geriatric patients,^{20,21,112,113} especially those who: <ul style="list-style-type: none"> • Are undergoing a major surgical operation (cardiac, vascular, chest, or abdomen).^{112,113} • Have diabetes, hypertension, cardiovascular disease, or use medications that affect renal function (ACE inhibitors, NSAIDs).
<p>Serum Albumin</p>	<ul style="list-style-type: none"> • Reasonable for all geriatric patients,^{20,21,112} especially those who: <ul style="list-style-type: none"> • Have known liver disease, multiple serious chronic illnesses, and recent major illness. • Are undergoing a major surgical operation. • Likely have malnutrition.

**RECOMMENDED PREOPERATIVE TESTS FOR
SELECTED GERIATRIC SURGICAL PATIENTS**

Preoperative Tests	Indications
White Blood Count (WBC)	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening.^{21,111,112} • Recommended for patients with symptoms suggesting infection, known or suspected myeloproliferative disease (splenomegaly or lymphadenopathy), or at high risk for leukopenia from drugs or other known disease.^{21,112} • May be included as part of a complete blood count.²¹
Platelet Count	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening.^{21,111,112} • Recommend for patients with history and physical exam suggesting high likelihood of thrombocytopenia or thrombocytosis.^{21,112} <ul style="list-style-type: none"> • History of bleeding or easy bruising, spontaneous bleeding, or unusual bleeding in previous surgeries. • Known or suspected myeloproliferative disease. • Recent exposure to drugs known to cause thrombocytopenia (chemotherapy agents). • May be included as part of a complete blood count.²¹
Coagulation Tests (Prothrombin Time [PT] and Partial Thromboplastin Time [PTT])	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening.^{21,111,112} • Recommended for patients with history of bleeding disorders, on medications affecting coagulation (for example, chronic antibiotics), on warfarin, or on hemodialysis.^{21,111-113} • Recommended for patients undergoing specific types of operations such as arterial reconstruction, cardiac surgery, cancer operations, and ones in which small amounts of bleeding can cause dramatic complications (neurosurgical or orthopedic spine procedures).^{21,113} • PT should be checked in patients with malnutrition, malabsorption, or liver disease.^{21,111-113}
Electrolytes (Na, K, Cl, CO₂)	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening.^{21,111,112} • Recommended for patients with baseline renal insufficiency, congestive heart failure, those taking diuretics, digoxin, angiotensin-converting enzyme (ACE) inhibitors, or other medications that increase likelihood of abnormal results.^{21,112}
Serum Glucose	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening.¹¹¹⁻¹¹³ • Recommended for patients with known or suspected diabetes, or obesity¹¹²

**RECOMMENDED PREOPERATIVE TESTS FOR
SELECTED GERIATRIC SURGICAL PATIENTS**

Preoperative Tests	Indications
Urinalysis	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening.^{21,112} • Recommended for patients who: <ul style="list-style-type: none"> • Have signs and symptoms consistent with urinary tract infection.^{21,112} • Have known diabetes.¹¹² • Undergoing urogenital surgery.¹¹³ • May be done for surgeries involving prosthesis (heart valves or joint replacement);¹¹³ however, may not be cost effective.²¹
Chest Radiograph (CXR)	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening.^{111,113,119} • Recommended for patients who:^{113,119} <ul style="list-style-type: none"> • Acute cardiopulmonary disease is suspected on the basis of history and physical examination. This includes patients who smoke or have asthma and COPD. • Are older than age 70 with history of stable chronic cardiopulmonary disease and without a recent chest radiograph within the past 6 months. • May require an ICU stay, to establish baseline CXR. • Are undergoing a major surgical operation, including abdominal, thoracic, cardiac, some esophageal, thyroidectomy, other head and neck, neurosurgery, and lymph node procedures.
Electrocardiograms (ECG)	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening, specifically for patients undergoing low-risk procedures if they are asymptomatic.^{52,112} • Recommended for patients who:^{21,52,112,113} <ul style="list-style-type: none"> • Are undergoing intermediate risk or vascular surgery. • Have known ischemic heart disease, previous myocardial infarction, cardiac arrhythmias, peripheral vascular disease, cerebrovascular disease, compensated or prior heart failure, diabetes, renal insufficiency, or respiratory disease. • Evidence for age-based criteria in otherwise healthy individuals is mixed, but likely reasonable if not undergoing low-risk procedure.^{21,52,111-113,120-122}

**RECOMMENDED PREOPERATIVE TESTS FOR
SELECTED GERIATRIC SURGICAL PATIENTS**

Preoperative Tests	Indications
Pulmonary Function Tests (PFT)	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening.^{21,72,113,123} • Recommended for patients undergoing lung resection.^{21,72,124} • For patients not undergoing thoracic surgery, PFTs are recommended for patients who:^{54,123} <ul style="list-style-type: none"> • Have poorly characterized dyspnea or exercise intolerance and diagnostic uncertainty exists between a cardiac or pulmonary limitation and simple deconditioning. • Have obstructive lung disease if it is not clear from the clinical evaluation if patients are at the best possible baseline.
Noninvasive Stress Testing	<ul style="list-style-type: none"> • NOT RECOMMENDED for routine preoperative screening, specifically for patients undergoing intermediate risk surgical operations with no clinical risk factors and for patients undergoing low risk surgical operations.⁵² • Reasonable for patients with three or more clinical risk factors and poor functional capacity (less than 4 METs) undergoing vascular surgery, or for patients with at least one to two clinical risk factors and poor functional capacity (less than 4 METs) who require intermediate risk or vascular surgery, if it will change management.

Appendices

APPENDIX I

- Patient's Decision Making Capacity

APPENDIX II

- Cardiac Evaluation

APPENDIX III

- Frailty Score

APPENDIX IV

- Recommendations for Preoperative Nutritional Support

APPENDIX V

- Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

APPENDIX VI

- Recommendations for Preoperative Discontinuation of Herbal Medicines/Supplements

APPENDIX VII

- ACC/AHA Guidelines for Perioperative Beta Blockers

APPENDIX I. Patient's Decision Making Capacity

LEGALLY RELEVANT CRITERIA FOR DECISION-MAKING CAPACITY AND APPROACHES TO ASSESSMENT OF THE PATIENT²²

Criterion	Patient's Task	Physician's Assessment Approach	Questions for Clinical Assessment*	Comments
Communicate a choice	Clearly indicate preferred treatment option	Ask patient to indicate a treatment choice	Have you decided whether to follow your doctor's [or my] recommendation for treatment? Can you tell me what that decision is? [If no decision] What is making it hard for you to decide?	Frequent reversals of choice because of psychiatric or neurologic conditions may indicate lack of capacity
Understand the relevant information	Grasp the fundamental meaning of information communicated by physician	Encourage patient to paraphrase disclosed information regarding medical condition and treatment	Please tell me in your own words what your doctor [or I] told you about: <ul style="list-style-type: none"> • The problem with your health now • The recommended treatment • The possible benefits and risks (or discomforts) of the treatment • Any alternative treatments and their risks and benefits • The risks and benefits of no treatment 	Information to be understood includes nature of patient's condition, nature and purpose of proposed treatment, possible benefits and risks of that treatment, and alternative approaches (including no treatment) and their benefits and risks
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	What do you believe is wrong with your health now? Do you believe that you need some kind of treatment? What is treatment likely to do for you? What makes you believe it will have that effect? What do you believe will happen if you are not treated? Why do you think your doctor has [or I have] recommended this treatment?	Courts have recognized that patients who do not acknowledge their illnesses (often referred to as "lack of insight") cannot make valid decisions about treatment Delusions or pathologic levels of distortion or denial are the most common causes of impairment
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	How did you decide to accept or reject the recommended treatment? What makes [chosen option] better than [alternative option]?	This criterion focuses on the process by which a decision is reached, not the outcome of the patient's choice, since patients have the right to make "unreasonable" choices

* Patients' responses to these questions need not be verbal.

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APPENDIX II. Cardiac Evaluation

ACTIVE CARDIAC CONDITIONS

Patients require evaluation and treatment before nonurgent, noncardiac surgery (Class I, Level of Evidence B)⁵²

Condition	Examples
Unstable coronary syndromes	<ul style="list-style-type: none"> • Unstable or severe angina (Canadian Cardiovascular Society class III or IV) • Recent MI (≤ 30 days)
Decompensated heart failure	<ul style="list-style-type: none"> • New York Heart Association functional class IV • Worsening or new-onset heart failure
Significant arrhythmias	<ul style="list-style-type: none"> • High-grade A-V block • Mobitz II A-V block • Third-degree A-V heart block • Symptomatic ventricular arrhythmias • Supraventricular arrhythmias (including atrial fibrillation) with uncontrolled ventricular rate (HR >100 bpm at rest) • Symptomatic bradycardia • Newly recognized ventricular tachycardia
Severe valvular disease	<ul style="list-style-type: none"> • Severe aortic stenosis (mean pressure gradient >40 mmHg, aortic valve area <1 cm², or symptomatic) • Symptomatic mitral stenosis (progressive dyspnea on exertion, exertion presyncope, or heart failure)

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CARDIAC RISK STRATIFICATION FOR NONCARDIAC SURGICAL PROCEDURES (BASED ON REVISED CARDIAC RISK INDEX)⁵²

Risk	Examples
Low ($< 1\%$)	Endoscopic procedures, superficial procedures, cataract surgery, breast surgery, ambulatory surgery
Intermediate (1-5%)	Intraperitoneal and intrathoracic surgery, cardiac endarterectomy, head and neck surgery, orthopaedic surgery, prostate surgery
Vascular ($> 5\%$)	Aortic/other major vascular surgery, peripheral vascular surgery

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ESTIMATING ENERGY REQUIREMENTS FOR VARIOUS ACTIVITIES⁵²

Metabolic Equivalents (METs)	
	Can you ...
1 MET	<ul style="list-style-type: none"> • Take care of yourself? • Eat, dress, and use the toilet? • Walk indoors around the house? • Walk a block or two on level ground at 2 to 3 mph (3.2 to 4.8 kph)?
↓	
4 METs	<ul style="list-style-type: none"> • Do light work around the house like dusting or washing dishes? • Climb a flight of stairs or walk up a hill? • Walk on level ground at 4 mph (8.4 kph)? • Run a short distance? • Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture? • Participate in moderate recreational activity like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?
↓	
>10 METs	<ul style="list-style-type: none"> • Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?
<p>Reprinted from <i>Journal of the American College of Cardiology</i>, Vol 54(22), Fleischmann KE, Beckman JA, Buller CE, et al., 2009 ACCF/AHA Focused Update on Perioperative Beta Blockade, p2102-2128, 2009, with permission from Elsevier.</p>	

CLINICAL RISK FACTORS FOR NONCARDIAC SURGICAL PROCEDURES⁵²

Risk Factors
<ul style="list-style-type: none"> • History of ischemic heart disease • History of compensated or prior heart failure • History of cerebrovascular disease • Diabetes mellitus • Renal insufficiency
<p>Reprinted from <i>Journal of the American College of Cardiology</i>, Vol 54(22), Fleischmann KE, Beckman JA, Buller CE, et al., 2009 ACCF/AHA Focused Update on Perioperative Beta Blockade, p2102-2128, 2009, with permission from Elsevier.</p>

APPENDIX III. Frailty Score

FRAILTY SCORE^{89,92}																									
PATIENT RECEIVES ONE POINT FOR EACH CRITERION (0–5)																									
Frailty Criteria	Definition																								
Weight loss	Unintentional weight loss ≥ 10 pounds in the past year.																								
Decreased grip strength (Weakness)	<p>Grip strength in the lowest 20th percentile by gender and BMI. Three trials are performed with a hand-held dynamometer and the average value is used.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">Men</th> <th colspan="2" style="text-align: center;">Women</th> </tr> <tr> <th style="text-align: left;">BMI</th> <th style="text-align: left;">Kg Force</th> <th style="text-align: left;">BMI</th> <th style="text-align: left;">Kg Force</th> </tr> </thead> <tbody> <tr> <td>≤ 24</td> <td>≤ 29</td> <td>≤ 23</td> <td>≤ 17</td> </tr> <tr> <td>24.1–26</td> <td>≤ 30</td> <td>23.1–26</td> <td>≤ 17.3</td> </tr> <tr> <td>26.1–28</td> <td>≤ 30</td> <td>26.1–29</td> <td>≤ 18</td> </tr> <tr> <td>> 28</td> <td>≤ 32</td> <td>> 29</td> <td>≤ 21</td> </tr> </tbody> </table>	Men		Women		BMI	Kg Force	BMI	Kg Force	≤ 24	≤ 29	≤ 23	≤ 17	24.1–26	≤ 30	23.1–26	≤ 17.3	26.1–28	≤ 30	26.1–29	≤ 18	> 28	≤ 32	> 29	≤ 21
Men		Women																							
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26.1–28	≤ 30	26.1–29	≤ 18																						
> 28	≤ 32	> 29	≤ 21																						
Exhaustion	<p>For the following two statements:</p> <ul style="list-style-type: none"> • “I felt that everything I did was an effort.” • “I could not get going.” <p>The patient is asked: “How often in the last week did you feel this way?”</p> <p>0 = rarely or none of the time (<1 day) 1 = some or a little of the time (1–2 days) 2 = a moderate amount of the time (3–4 days) 3 = most of the time</p> <p>The criterion is met if patient answers 2 or 3 to either statement.</p>																								
Low physical activity	<p>Weekly energy expenditure, determined with the short version of the Minnesota Leisure Time Activities Questionnaire (see Taylor et al.¹²⁵) in the lowest 20th percentile by gender:</p> <p>Men: <383 kcal/week. Women: <270 kcal/week.</p>																								
Slowed walking speed	<p>Walking speed in the lowest 20th percentile by gender and height. Time is measured for a distance of 15 feet at normal pace. The average of three trials is used.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">Men</th> <th colspan="2" style="text-align: center;">Women</th> </tr> <tr> <th style="text-align: left;">Height</th> <th style="text-align: left;">Time</th> <th style="text-align: left;">Height</th> <th style="text-align: left;">Time</th> </tr> </thead> <tbody> <tr> <td>≤ 173 cm</td> <td>≥ 7 sec</td> <td>≤ 159 cm</td> <td>≥ 7 sec</td> </tr> <tr> <td>> 173 cm</td> <td>≥ 6 sec</td> <td>> 159 cm</td> <td>≥ 6 sec</td> </tr> </tbody> </table>	Men		Women		Height	Time	Height	Time	≤ 173 cm	≥ 7 sec	≤ 159 cm	≥ 7 sec	> 173 cm	≥ 6 sec	> 159 cm	≥ 6 sec								
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APPENDIX IV. Recommendations for Preoperative Nutritional Support

PREOPERATIVE INTERVENTIONS FOR MALNUTRITION

ESPEN Recommendations^{95,126}

- Use nutritional support in patients with severe nutritional risk for 10–14 days prior to a major surgical operation even if the operation has to be delayed (Grade A).
- Initiate nutritional support (by the enteral route if possible) without delay:
 - Even in patients without obvious under-nutrition, if it is anticipated that the patient will be unable to eat for more than 7 days perioperatively (Grade C).
 - In patients who cannot maintain oral intake above 60% of recommended intake for more than 10 days (Grade C).
- Consider combination with parenteral nutrition in patients in whom there is an indication for nutritional support and in whom energy needs cannot be met (<60% of caloric requirement) via the enteral route (Grade C).
- Encourage patients who do not meet their energy needs from normal food to take oral nutritional supplements during the preoperative period (Grade C).
- Administer preoperative enteral nutrition preferably before admission to the hospital (Grade C).
- Preoperative parenteral nutrition is indicated in severely undernourished patients who cannot be adequately orally or enterally fed for 7–10 days preoperatively (Grade A).
- NOTE: The enteral route is preferred except for the following contraindications: Intestinal obstructions or ileus, severe shock, intestinal ischemia.

Other Recommendations

- Vitamin supplementation for alcohol-related malnourished patient: B12 and folate,²¹ thiamine.

APPENDIX V: 2012 Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

2012 AGS BEERS CRITERIA FOR POTENTIALLY INAPPROPRIATE MEDICATION USE IN OLDER ADULTS⁹⁷

Organ System/ Therapeutic Category/Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Anticholinergics (excludes TCAs)				
First-generation antihistamines (as single agent or as part of combination products) <ul style="list-style-type: none"> • Brompheniramine • Carbinoxamine • Chlorpheniramine • Clemastine • Cyproheptadine • Dexbrompheniramine • Dexchlorpheniramine • Diphenhydramine (oral) • Doxylamine • Hydroxyzine • Promethazine • Triprolidine 	Highly anticholinergic; clearance reduced with advanced age, and tolerance develops when used as hypnotic; increased risk of confusion, dry mouth, constipation, and other anticholinergic effects/toxicity Use of diphenhydramine in special situations such as acute treatment of severe allergic reaction may be appropriate	Avoid	Hydroxyzine and promethazine: High All others: Moderate	Strong
Anti-Parkinson agents <ul style="list-style-type: none"> • Benztropine (oral) • Trihexyphenidyl 	Not recommended for prevention of extrapyramidal symptoms with antipsychotics; more effective agents available for treatment of Parkinson disease	Avoid	Moderate	Strong
Antispasmodics <ul style="list-style-type: none"> • Belladonna alkaloids • Clidinium-chlordiazepoxide • Dicyclomine • Hyoscyamine • Propantheline • Scopolamine 	Highly anticholinergic, uncertain effectiveness	Avoid except in short-term palliative care to decrease oral secretions	Moderate	Strong
Antithrombotics				
Dipyridamole, oral short-acting* (does not apply to the extended-release combination with aspirin)	May cause orthostatic hypotension; more effective alternatives available; IV form acceptable for use in cardiac stress testing	Avoid	Moderate	Strong
Ticlopidine*	Safer, effective alternatives available	Avoid	Moderate	Strong
Anti-Infective				
Nitrofurantoin	Potential for pulmonary toxicity; safer alternatives available; lack of efficacy in patients with CrCl <60 mL/min due to inadequate drug concentration in the urine	Avoid for long-term suppression; avoid in patients with CrCl <60 mL/min	Moderate	Strong

**2012 AGS BEERS CRITERIA FOR POTENTIALLY
INAPPROPRIATE MEDICATION USE IN OLDER ADULTS⁹⁷**

Organ System/ Therapeutic Category/Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Cardiovascular				
Alpha I blockers • Doxazosin • Prazosin • Terazosin	High risk of orthostatic hypotension; not recommended as routine treatment for hypertension; alternative agents have superior risk/benefit profile	Avoid use as an antihypertensive	Moderate	Strong
Alpha blockers, central • Clonidine • Guanabenz* • Guanfacine* • Methyldopa* • Reserpine (>0.1 mg/day)*	High risk of adverse CNS effects; may cause bradycardia and orthostatic hypotension; not recommended as routine treatment for hypertension	Avoid clonidine as a first-line antihypertensive Avoid others as listed	Low	Strong
Antiarrhythmic drugs (Class Ia, Ic, III) • Amiodarone • Dofetilide • Dronedarone • Flecainide • Ibutilide • Procainamide • Propafenone • Quinidine • Sotalol	Data suggest that rate control yields better balance of benefits and harms than rhythm control for most older adults Amiodarone is associated with multiple toxicities, including thyroid disease, pulmonary disorders, and QT interval prolongation	Avoid antiarrhythmic drugs as first-line treatment of atrial fibrillation	High	Strong
Disopyramide*	Disopyramide is a potent negative inotrope and therefore may induce heart failure in older adults; strongly anticholinergic; other antiarrhythmic drugs preferred	Avoid	Low	Strong
Dronedarone	Worse outcomes have been reported in patients taking dronedarone who have permanent atrial fibrillation or heart failure In general, rate control is preferred over rhythm control for atrial fibrillation	Avoid in patients with permanent atrial fibrillation or heart failure	Moderate	Strong
Digoxin >0.125 mg/day	In heart failure, higher dosages associated with no additional benefit and may increase risk of toxicity; decreased renal clearance may lead to increased risk of toxic effects	Avoid	Moderate	Strong
Nifedipine, immediate release*	Potential for hypotension; risk of precipitating myocardial ischemia	Avoid	High	Strong
Spironolactone >25 mg/day	In heart failure, the risk of hyperkalemia is higher in older adults if taking >25 mg/day	Avoid in patients with heart failure or with a CrCl <30 mL/min	Moderate	Strong

**2012 AGS BEERS CRITERIA FOR POTENTIALLY
INAPPROPRIATE MEDICATION USE IN OLDER ADULTS⁹⁷**

Organ System/ Therapeutic Category/Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Central Nervous System				
Tertiary TCAs, alone or in combination: <ul style="list-style-type: none"> • Amitriptyline • Chlordiazepoxide-amitriptyline • Clomipramine • Doxepin >6 mg/day • Imipramine • Perphenazine-amitriptyline • Trimipramine 	Highly anticholinergic, sedating, and causes orthostatic hypotension; the safety profile of low-dose doxepin (≤6 mg/day) is comparable to that of placebo	Avoid	High	Strong
Antipsychotics, first- (conventional) and second- (atypical) generation (see Table First- and Second-Generation Antipsychotics below for full list)	Increased risk of cerebrovascular accident (stroke) and mortality in persons with dementia	Avoid use for behavioral problems of dementia unless nonpharmacologic options have failed and patient is threat to self or others	Moderate	Strong
Thioridazine Mesoridazine	Highly anticholinergic and greater risk of QT-interval prolongation	Avoid	Moderate	Strong
Barbiturates <ul style="list-style-type: none"> • Amobarbital* • Butabarbital* • Butalbital • Mephobarbital* • Pentobarbital* • Phenobarbital • Secobarbital* 	High rate of physical dependence; tolerance to sleep benefits; greater risk of overdose at low dosages	Avoid	High	Strong
Benzodiazepines SHORT- AND INTERMEDIATE-ACTING: <ul style="list-style-type: none"> • Alprazolam • Estazolam • Lorazepam • Oxazepam • Temazepam • Triazolam LONG-ACTING: <ul style="list-style-type: none"> • Chlorazepate • Chlordiazepoxide • Chlordiazepoxide-amitriptyline • Clidinium-chlordiazepoxide • Clonazepam • Diazepam • Flurazepam • Quazepam 	Older adults have increased sensitivity to benzodiazepines and decreased metabolism of long-acting agents; in general, all benzodiazepines increase risk of cognitive impairment, delirium, falls, fractures, and motor vehicle accidents in older adults May be appropriate for seizure disorders, rapid eye movement sleep disorders, benzodiazepine withdrawal, ethanol withdrawal, severe generalized anxiety disorder, periprocedural anesthesia, end-of-life care	Avoid benzodiazepines (any type) for treatment of insomnia, agitation, or delirium	High	Strong

**2012 AGS BEERS CRITERIA FOR POTENTIALLY
INAPPROPRIATE MEDICATION USE IN OLDER ADULTS⁹⁷**

Organ System/ Therapeutic Category/Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Chloral hydrate*	Tolerance occurs within 10 days and risk outweighs the benefits in light of overdose with doses only 3 times the recommended dose	Avoid	Low	Strong
Meprobamate	High rate of physical dependence; very sedating	Avoid	Moderate	Strong
Nonbenzodiazepine hypnotics • Eszopiclone • Zolpidem • Zaleplon	Benzodiazepine-receptor agonists that have adverse events similar to those of benzodiazepines in older adults (for example, delirium, falls, fractures); minimal improvement in sleep latency and duration	Avoid chronic use (>90 days)	Moderate	Strong
Ergot mesylates* Isoxsuprine*	Lack of efficacy	Avoid	High	Strong
Endocrine				
Androgens • Methyltestosterone* • Testosterone	Potential for cardiac problems and contraindicated in men with prostate cancer	Avoid unless indicated for moderate to severe hypogonadism	Moderate	Weak
Desiccated thyroid	Concerns about cardiac effects; safer alternatives available	Avoid	Low	Strong
Estrogens with or without progestins	Evidence of carcinogenic potential (breast and endometrium); lack of cardioprotective effect and cognitive protection in older women Evidence that vaginal estrogens for treatment of vaginal dryness is safe and effective in women with breast cancer, especially at dosages of estradiol <25 mcg twice weekly	Avoid oral and topical patch Topical vaginal cream: Acceptable to use low-dose intravaginal estrogen for the management of dyspareunia, lower urinary tract infections, and other vaginal symptoms	Oral and patch: High Topical: Moderate	Oral and patch: Strong Topical: Weak
Growth hormone	Impact on body composition is small and associated with edema, arthralgia, carpal tunnel syndrome, gynecomastia, impaired fasting glucose	Avoid, except as hormone replacement following pituitary gland removal	High	Strong
Insulin, sliding scale	Higher risk of hypoglycemia without improvement in hyperglycemia management regardless of care setting	Avoid	Moderate	Strong
Megestrol	Minimal effect on weight; increases risk of thrombotic events and possibly death in older adults	Avoid	Moderate	Strong
Sulfonylureas, long-duration • Chlorpropamide • Glyburide	Chlorpropamide: Prolonged half-life in older adults; can cause prolonged hypoglycemia; causes SIADH Glyburide: higher risk of severe prolonged hypoglycemia in older adults	Avoid	High	Strong

**2012 AGS BEERS CRITERIA FOR POTENTIALLY
INAPPROPRIATE MEDICATION USE IN OLDER ADULTS⁹⁷**

Organ System/ Therapeutic Category/Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Gastrointestinal				
Metoclopramide	Can cause extrapyramidal effects including tardive dyskinesia; risk may be further increased in frail older adult.	Avoid, unless for gastroparesis.	Moderate	Strong
Mineral oil, given orally	Potential for aspiration and adverse effects; safer alternatives available	Avoid	Moderate	Strong
Trimethobenzamide	One of the least effective antiemetic drugs; can cause extrapyramidal adverse effects	Avoid	Moderate	Strong
Pain Medications				
Meperidine	Not an effective oral analgesic in dosages commonly used; may cause neurotoxicity; safer alternatives available	Avoid	High	Strong
Non-COX-selective NSAIDs, oral <ul style="list-style-type: none"> • Aspirin >325 mg/day • Diclofenac • Diflunisal • Etodolac • Fenoprofen • Ibuprofen • Ketoprofen • Meclofenamate • Mefenamic acid • Meloxicam • Nabumetone • Naproxen • Oxaprozin • Piroxicam • Sulindac • Tolmetin 	Increases risk of GI bleeding/peptic ulcer disease in high-risk groups, including those >75 years old or taking oral or parenteral corticosteroids, anticoagulants, or antiplatelet agents; use of proton pump inhibitor or misoprostol reduces but does not eliminate risk; upper GI ulcers, gross bleeding, or perforation caused by NSAIDs occur in approximately 1% of patients treated for 3–6 months, and in about 2%–4% of patients treated for 1 year; these trends continue with longer duration of use	Avoid chronic use unless other alternatives are not effective and patient can take gastroprotective agent (proton-pump inhibitor or misoprostol)	All others: Moderate	Strong
Indomethacin Ketorolac, includes parenteral	Increases risk of GI bleeding/peptic ulcer disease in high-risk groups (see above non-COX-selective NSAIDs) Of all the NSAIDs, indomethacin has most adverse effects	Avoid	Indomethacin: Moderate Ketorolac: High	Strong
Pentazocine*	Opioid analgesic that causes CNS adverse effects, including confusion and hallucinations, more commonly than other narcotic drugs; is also a mixed agonist and antagonist; safer alternatives available	Avoid	Low	Strong
Skeletal muscle relaxants <ul style="list-style-type: none"> • Carisoprodol • Chlorzoxazone • Cyclobenzaprine • Metaxalone • Methocarbamol • Orphenadrine 	Most muscle relaxants poorly tolerated by older adults because of anticholinergic adverse effects, sedation, increased risk of fractures; effectiveness at dosages tolerated by older adults is questionable.	Avoid	Moderate	Strong

2012 AGS BEERS CRITERIA FOR POTENTIALLY INAPPROPRIATE MEDICATION USE IN OLDER ADULTS⁹⁷

Organ System/ Therapeutic Category/Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
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*Infrequently used drugs

Abbreviations: ACEI, angiotensin converting-enzyme inhibitors; ARB, angiotensin receptor blockers; CNS, central nervous system; COX, cyclooxygenase; CrCl, creatinine clearance; GI, gastrointestinal; NSAIDs, nonsteroidal anti-inflammatory drugs; SIADH, syndrome of inappropriate antidiuretic hormone secretion; TCAs, tricyclic antidepressants.

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2012 AGS BEERS CRITERIA FOR POTENTIALLY INAPPROPRIATE MEDICATIONS TO BE USED WITH CAUTION IN OLDER ADULTS⁹⁷

Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Aspirin for primary prevention of cardiac events	Lack of evidence of benefit versus risk in individuals ≥ 80 years old	Use with caution in adults ≥ 80 years old	Low	Weak
Dabigatran	Increased risk of bleeding compared with warfarin in adults ≥ 75 years old; lack of evidence for efficacy and safety in patients with CrCl < 30 mL/min	Use with caution in adults ≥ 75 years old or if CrCl < 30 mL/min	Moderate	Weak
Prasugrel	Increased risk of bleeding in older adults; risk may be offset by benefit in highest-risk older patients (for example, those with prior myocardial infarction or diabetes)	Use with caution in adults ≥ 75 years old	Moderate	Weak
Antipsychotics Carbamazepine Carboplatin Cisplatin Mirtazapine SNRIs SSRIs TCAs Vincristine	May exacerbate or cause SIADH or hyponatremia; need to monitor sodium level closely when starting or changing dosages in older adults due to increased risk	Use with caution	Moderate	Strong
Vasodilators	May exacerbate episodes of syncope in individuals with history of syncope	Use with caution	Moderate	Weak

Abbreviations: CrCl, creatinine clearance; SIADH, syndrome of inappropriate antidiuretic hormone secretion; SSRIs, selective serotonin reuptake inhibitors; SNRIs, serotonin–norepinephrine reuptake inhibitors; TCAs, tricyclic antidepressants.

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FIRST- AND SECOND-GENERATION ANTIPSYCHOTICS⁹⁷

First-Generation (Conventional) Agents	Second-Generation (Atypical) Agents
Chlorpromazine Fluphenazine Haloperidol Loxapine Molindone Perphenazine Pimozide Promazine Thioridazine Thiothixene Trifluoperazine Triflupromazine	Aripiprazole Asenapine Clozapine Iloperidone Lurasidone Olanzapine Paliperidone Quetiapine Risperidone Ziprasidone

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DRUGS WITH STRONG ANTICHOLINERGIC PROPERTIES

Antihistamines	Anti-Parkinson Agents
<ul style="list-style-type: none"> • Brompheniramine • Carbinoxamine • Chlorpheniramine • Clemastine • Cyproheptadine • Dimenhydrinate • Diphenhydramine • Hydroxyzine • Loratadine • Meclizine 	<ul style="list-style-type: none"> • Benztropine • Trihexyphenidyl
Antidepressants	Antipsychotics
<ul style="list-style-type: none"> • Amitriptyline • Amoxapine • Clomipramine • Desipramine • Doxepin • Imipramine • Nortriptyline • Paroxetine • Protriptyline • Trimipramine 	<ul style="list-style-type: none"> • Chlorpromazine • Clozapine • Fluphenazine • Loxapine • Olanzapine • Perphenazine • Pimozide • Prochlorperazine • Promethazine • Thioridazine • Thiothixene • Trifluoperazine
Antimuscarinics (Urinary Incontinence)	Antispasmodics
<ul style="list-style-type: none"> • Darifenacin • Fesoterodine • Flavoxate • Oxybutynin • Solifenacin • Tolterodine • Trosipium 	<ul style="list-style-type: none"> • Atropine products • Belladonna alkaloids • Dicyclomine • Homatropine • Hyoscyamine products • Loperamide • Propantheline • Scopolamine
Skeletal Muscle Relaxants	
<ul style="list-style-type: none"> • Carisoprodol • Cyclobenzaprine • Orphenadrine • Tizanidine 	

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APPENDIX VI. Recommendations for Preoperative Discontinuation of Herbal Medicines/Supplements

HERBAL MEDICINES/SUPPLEMENTS: CLINICALLY IMPORTANT EFFECTS AND RECOMMENDATIONS FOR DISCONTINUATION¹²⁷

Herb	Relevant Pharmacological Effect	Perioperative Concerns	Preoperative Discontinuation
Echinacea	Activation of cell-mediated immunity	Allergic reaction; decreased effectiveness of immunosuppressants; potential for immunosuppression with long-term use	No data
Ephedra	Increased heart rate and blood pressure through direct and indirect sympathomimetic effects	Risk of myocardial ischemia and stroke from tachycardia and hypertension; ventricular arrhythmias with halothane; long-term use depletes endogenous catecholamines and may cause intraoperative hemodynamic instability; life-threatening interaction with monoamine oxidase inhibitors	At least 24 hours before a surgical operation
Garlic	Inhibition of platelet aggregation (may be irreversible); increased fibrinolysis; equivocal antihypertensive activity	Potential to increase risk of bleeding, especially when combined with other medications that inhibit platelet aggregation	At least 7 days before a surgical operation
Ginkgo	Inhibition of platelet-activating factor	Potential to increase risk of bleeding, especially when combined with other medications that inhibit platelet aggregation	At least 36 hours before a surgical operation
Ginseng	Lowers blood glucose; inhibition of platelet aggregation (may be irreversible); increased PT-PTT in animals; many other diverse effects	Hypoglycemia; potential to increase risk of bleeding; potential to decrease anticoagulation effect of warfarin	At least 7 days before a surgical operation
Kava	Sedation, anxiolysis	Potential to increase sedative effect of anesthetics; potential for addiction, tolerance, and withdrawal after abstinence unstudied	At least 24 hours before a surgical operation
St. John's wort	Inhibition of neurotransmitter reuptake, monoamine oxidase inhibition is unlikely	Induction of cytochrome P450 enzymes, affecting cyclosporine, warfarin, steroids, protease inhibitors, and possibly benzodiazepines, calcium channel blockers, and many other drugs; decreased serum digoxin levels	At least 5 days before a surgical operation
Valerian	Sedation	Potential to increase sedative effect of anesthetics; benzodiazepine-like acute withdrawal; potential to increase anesthetic requirements with long-term use	No data

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APPENDIX VII. ACC/AHA Guidelines for Perioperative Beta Blockers

ACC/AHA GUIDELINES FOR PERIOPERATIVE BETA BLOCKERS^{21,52}

Full Recommendations⁵²

Class I:

- Beta blockers should be continued in patients undergoing a surgical operation who are receiving beta-blockers to treat angina, symptomatic arrhythmias, hypertension, or other ACC/AHA Class I guideline indications. (Level of evidence C)

Class IIa:

- Beta blockers titrated to heart rate and blood pressure are probably recommended for patients undergoing vascular surgery who are at high cardiac risk owing to coronary artery disease or the finding of cardiac ischemia on preoperative testing. (Level of evidence B)
- Beta blockers titrated to heart rate and blood pressure are reasonable for patients in whom preoperative assessment for vascular surgery identifies high cardiac risk, as defined by the presence of more than one clinical risk factor (history of ischemic heart disease, history of compensated or prior heart failure, history of cerebrovascular disease, diabetes mellitus, renal insufficiency (>2 mg/dL)). (Level of evidence C)
- Beta blockers titrated to heart rate and blood pressure are reasonable for patients in whom preoperative assessment identifies coronary artery disease or high cardiac risk, as defined by the presence of more than one clinical risk factor, who are undergoing an intermediate-risk surgical operation. (Level of evidence B)

Class IIb:

- The usefulness of beta-blockers is uncertain for patients who are undergoing either intermediate-risk procedures or vascular surgery in whom preoperative assessment identifies a single clinical risk factor in the absence of coronary artery disease. (Level of evidence C)
- The usefulness of beta-blockers is uncertain in patients undergoing vascular surgery with no clinical risk factors who are not currently taking beta-blockers. (Level of evidence B)

Class III:

- Beta-blockers should not be given to patients undergoing a surgical operation who have absolute contraindications to beta-blockers. (Level of evidence C)
- Routine administration of high-dose beta-blockers in the absence of dose titration is not useful and may be harmful to patients not currently taking beta-blockers who are undergoing noncardiac surgery. (Level of evidence B)

NOTE: These focused updates in 2009 reflect new evidence that was elucidated after the publication of the "2007 ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery." Most notable was the POISE (PeriOperative ISchemic Evaluation) trial, a large, randomized-controlled trial of fixed higher dose, extended-release metoprolol started the day of noncardiac surgery. This study confirmed reductions in the rates of myocardial infarction, cardiac revascularization, and clinically significant atrial fibrillation; this was offset by increased rates of death, stroke, and clinically significant hypotension and bradycardia.⁵⁰ This prompted the updates, including the recommendation against routine preoperative initiation of high-dose beta blockers in patients not currently taking them, especially in the absence of titration.

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The intent of the ACS NSQIP/AGS Best Practices Guidelines is to provide health care professionals with evidence-based recommendations regarding the prevention, diagnosis, or treatment of common postsurgical complications. The Best Practices Guidelines do not include all potential options for prevention, diagnosis, and treatment. The responsible physician or health care provider must make the final decisions regarding patient care and take into account the patient's individual clinical presentation. The ACS NSQIP/AGS Best Practices Guidelines may be modified without notice.

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