1 Inpatient Care in Internal Medicine

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General Care of the Hospitalized Patient

GENERAL PRINCIPLES

- Although a general approach to common problems can be outlined, **therapy must be individualized**. All diagnostic and therapeutic procedures should be explained carefully to the patient, including the potential risks, benefits, and alternatives.
- The period of hospitalization represents a complex interplay of multiple caregivers that subjects the patient to potential harm by **medical errors and iatrogenic complications**. Every effort must be made to minimize these risks. Basic measures include:
  - Use of standardized abbreviations and dose designations
  - Excellent communication between physicians and other caregivers
  - Institution of appropriate prophylactic precautions
  - Prevention of nosocomial infections, including attention to hygiene and discontinuation of unnecessary catheters
  - Medicine reconciliation at all transfers of care
- **Hospital orders**
  - Computer order entry offers admission order sets that should be entered promptly after evaluation of a patient. A contact number should be made available.
  - Daily rounds should include assessment for ongoing need of IV fluids, telemetry, catheters, and supplemental oxygen, all of which can limit mobility.
  - Routine daily labs, such as CBC and BMP, should be discouraged because significant iatrogenic anemia may develop.
- **Discharge**
  - **Discharge planning** begins at the time of admission. Assessment of the patient's social situation and potential discharge needs should be made at this time.
  - **Early coordination** with nursing, social work, and case coordinators/managers facilitates efficient discharge and a complete postdischarge plan.
  - **Patient education** should occur regarding changes in medications and other new therapies. Compliance with treatment is influenced by the patient's understanding of that treatment.
  - **Prescriptions** should be written for all new medication, and the patient should be provided with a complete medication list including instructions and indications.
  - **Communication** with physicians who will be resuming care of the patient is important for optimal follow-up care and should be a component of the discharge process.

PROPHYLACTIC MEASURES

Venous Thromboembolism Prophylaxis

GENERAL PRINCIPLES

Epidemiology

Venous thromboembolism (VTE) is a preventable cause of death in hospitalized patients. In the largest observational study to date attempting to risk-stratify medical patients, 1.2% of

medical patients developed VTE within 90 days of admission. A total of 10–31% of patients were deemed to be at high risk for VTE, defined as having **2 or more points** by weighted risk factors below (*Chest 2011;140:706*).

Risk Factors

- 3 points: previous VTE, thrombophilia
- 1 point: cancer, age >60

Prevention

- **Ambulation** several times a day should be encouraged.
- **Pharmacologic prophylaxis** results in a 50% decrease in VTE risk, although this includes many asymptomatic calf vein thromboses that do not progress. No overall mortality benefit from prophylaxis has been demonstrated.
- Acutely ill patients at high risk of VTE, without bleeding or high risk of bleeding, should be treated with low-dose unfractionated heparin (UFH), 5000 units SC q12h or q8, or low-molecular-weight heparin (LMWH); enoxaparin, 40 mg SC daily, or dalteparin, 5000 units SC daily; or fondaparinux, 2.5 mg SC daily.
- Aspirin alone is not sufficient for prophylaxis in hospitalized patients (*Chest 2012;141:e195S*).
- At-risk patients with contraindications to anticoagulation prophylaxis may receive mechanical prophylaxis with intermittent pneumatic compression or graded compression stockings, although evidence of benefit is lacking (*Ann Intern Med 2011;155:625*).

Decubitus Ulcers

GENERAL PRINCIPLES

Epidemiology

Decubitus ulcers typically occur within the first 2 weeks of hospitalization and can develop within 2–6 hours. Once they develop, decubitus ulcers are difficult to heal and have been associated with increased mortality (*J Gerontol A Biol Sci Med Sci 1997;52:M106*). Risk factors for the development of decubitus ulcers include, advanced age, paralysis, and severe illness (*Clin Dermatol 2010;28(5):527*).

Prevention

Prevention is the key to management of decubitus ulcers. It is recognized that not all decubitus ulcers are avoidable (*J Wound Ostomy Continence Nurs 2014;41:313*). Preventative measures include:

- **Risk factor assessment**, including immobility, limited activity, incontinence, impaired nutritional status, impaired circulation, and altered level of consciousness.
- **Advanced static mattresses or** overlays should be used in at-risk patients (*Ann Intern Med 2015;162:359*).
- **Skin care**, including daily inspection with particular attention to bony prominences including heels, minimizing exposure to moisture, and applying moisturizers to dry sacral skin.
- **Nutritional supplements** may be provided to patients at risk.
- **Frequent repositioning** (minimum of every 2 hours, or every 1 hour for wheelchair-bound patients) is suggested.

DIAGNOSIS

Clinical Presentation

National Pressure Ulcer Advisory Panel Staging

- **Suspected deep tissue injury:** Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear.

The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer, or cooler as compared to adjacent tissue.

- **Stage I:** Intact skin with nonblanchable redness of a localized area usually over a bony prominence. Darkly pigmented skin may obscure findings.
- **Stage II:** Partial thickness loss of dermis presenting as a shallow open ulcer with a red pink wound bed without slough. May also present as a blister.
- **Stage III:** Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon, or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling.
- **Stage IV:** Full thickness tissue loss with exposed bone, tendon, or muscle. Slough or eschar may be present on some parts of the wound bed. Often includes undermining and tunneling.
- **Unstageable:** Full thickness tissue loss in which the base of the ulcer is covered by slough (yellow, tan, gray, green, or brown) and/or eschar (tan, brown, or black) in the wound bed.

TREATMENT

Optimal treatment of pressure ulcers remains poorly defined. There is evidence to support the following (*Ann Intern Med 2015;162:370*).

- **Hydrocolloid or foam** dressings may reduce wound size.
- **Protein or amino acid supplementation** is recommended, although there are insufficient data to recommend a specific supplement regimen (*Cochrane Database Syst Rev 2014*).
- **Electrical stimulation** may accelerate healing.
- **Other adjunctive therapies** with less supporting evidence include radiant heat, negative pressure, and platelet-derived growth factor. Topical agents (silver sulfadiazine) may optimizing healing or lead to minor slough debridement (Santyl, Xenaderm).
- There is no role for antibiotics to aid healing of a noninfected ulcer.

Other Precautions

GENERAL PRINCIPLES

- **Fall precautions** should be written for patients who have a history of falls or are at high risk of a fall (e.g., dementia, weakness, orthostasis). Falls are the most common accident in hospitalized patients, frequently leading to injury. **Fall risk should not be equated with bedrest**, which may lead to debilitation and higher risk of future falls.
- **Seizure precautions**, which include padded bed rails and an oral airway at the bedside, should be considered for patients with a history of seizures or those at risk of seizing.
- **Restraint orders** are written for patients who are at risk of injuring themselves or interfering with their treatment due to disruptive or dangerous behaviors. Restraint orders must be renewed every 24 hours. Physical restraints may exacerbate agitation. Bed alarms, sitters, and sedatives are alternatives in appropriate settings.

ACUTE INPATIENT CARE

An approach to selected common complaints is presented in this section. An evaluation should generally include a directed history and physical examination, review of the medical problem list (including chronic conditions), review of medications with attention to recent medication changes, and consideration of recent procedures.

Chest Pain

GENERAL PRINCIPLES

Common causes of chest pain range from life-threatening causes such as myocardial infarction (MI) and pulmonary embolism to other causes including esophageal reflux, peptic ulcer disease, pneumonia, costochondritis, shingles, trauma, and anxiety.

DIAGNOSIS

History and Physical Examination

- History should include previous cardiac or vascular disease history, cardiac risk factors, and factors that would predispose the patient to a pulmonary embolus.
- Physical examination is ideally conducted during an episode of pain and includes vital signs (bilateral blood pressure [BP] measurements if considering aortic dissection), cardiopulmonary and abdominal examination, and inspection and palpation of the chest.

Diagnostic Testing

Assessment of oxygenation status, chest radiography, and ECG is appropriate in most patients. Serial cardiac biomarkers should be obtained if there is suspicion of ischemia. Spiral CT and ventilation/perfusion scans are employed to diagnose pulmonary embolus.

TREATMENT

- If cardiac ischemia is a concern, see Chapter 4, Ischemic Heart Disease, for details.
- If a gastrointestinal (GI) source is suspected, Maalox and diphenhydramine (1:1 mix) can be administered.
- Musculoskeletal pain typically responds to acetaminophen or NSAID therapy.
- Prompt empiric anticoagulation if there is high suspicion for MI or pulmonary embolism.

Dyspnea

GENERAL PRINCIPLES

Dyspnea is most commonly caused by a cardiopulmonary abnormality, such as congestive heart failure (CHF), cardiac ischemia, bronchospasm, pulmonary embolus, infection, mucus plugging, and aspiration. Dyspnea must be promptly and carefully evaluated.

DIAGNOSIS

History and Physical Examination

- Initial evaluation should include a review of the medical history for underlying pulmonary or cardiovascular disease and a directed history.
- A detailed cardiopulmonary examination should take place, including vital signs.

Diagnostic Testing

- Oxygen assessment by pulse oximetry or arterial blood gas and chest radiography are useful in most patients.
- Other diagnostic measures should be directed by the findings in the initial evaluation.

Oxygen should be administered promptly if needed. Other therapeutic measures should be directed by the findings in the initial evaluation.

Acute Hypertensive Episodes

GENERAL PRINCIPLES

- Acute hypertensive episodes in the hospital are most often caused by inadequately treated essential hypertension. If there is evidence of end-organ damage, IV medications are indicated. Oral agents are more appropriate for hypertensive urgency without end-organ damage.
- Volume overload and pain may exacerbate hypertension and should be recognized appropriately and treated.
- Hypertension associated with withdrawal syndromes (e.g., alcohol, cocaine) and rebound hypertension associated with sudden withdrawal of antihypertensive medications (i.e., clonidine, α-adrenergic antagonists) should be considered. These entities should be treated as discussed in Chapter 3, Preventive Cardiology.

Fever

GENERAL PRINCIPLES

Fever accompanies many illnesses and is a valuable marker of disease activity. Infection is a primary concern. Drug reaction, malignancy, VTE, vasculitis, central fever, and tissue infarction are other possibilities but are diagnoses of exclusion.

DIAGNOSIS

History and Physical Examination

- History should include chronology of the fever and associated symptoms, medications, potential exposures, and a complete social and travel history.
- Physical examination should include oral or rectal temperature. In the hospitalized patient, special attention should be paid to any IV lines, abnormal fluid accumulation, and indwelling devices such as urinary catheters.
- For management of neutropenic fever, see Chapter 22, Cancer.

Diagnostic Testing

- Testing includes blood and urine cultures, complete blood count (CBC) with differential, serum chemistries with liver function tests, urinalysis, and stool cultures if appropriate.
- Diagnostic evaluation generally includes chest radiography.
- Cultures of abnormal fluid collections, sputum, cerebrospinal fluid, and stool should be sent if clinically indicated. Cultures are ideally obtained prior to initiation of antibiotics; however, antibiotics should not be delayed if serious infection is suspected.

TREATMENT

- Antipyretic drugs may be given to decrease associated discomfort. Aspirin, 325 mg, and acetaminophen, 325–650 mg PO or PR q4h, are the drugs of choice.
- Empiric antibiotics should be considered in hemodynamically unstable patients in whom infection is a primary concern, as well as in neutropenic and asplenic patients.

- Heat stroke and malignant hyperthermia are medical emergencies that require prompt recognition and treatment (see Chapter 26, Medical Emergencies).

Pain

GENERAL PRINCIPLES

Pain is subjective, and therapy must be individualized. Chronic pain may not be associated with any objective physical findings. Pain scales should be employed for quantitation.

TREATMENT

- Acute pain usually requires temporary therapy.
- For chronic pain, use a combination of long-acting medication with bolus as needed.
- If pain is refractory to conventional therapy, then nonpharmacologic modalities, such as nerve blocks, sympathectomy, and cognitive behavioral therapy, may be appropriate.

Medications

- Acetaminophen
  - Effects: Antipyretic and analgesic actions; no anti-inflammatory or antiplatelet properties.
  - Dosage: 325–1000 mg q4–6h (maximum dose, 4 g/d), available in oral, IV, and rectal suppository. Dosage in patients with liver disease should not exceed 2 g/d.
  - Adverse effects: The principal *advantage* of acetaminophen is its lack of gastric toxicity. Hepatic toxicity may be serious, and acute overdose with 10–15 g can cause fatal hepatic necrosis (see Chapter 19, Liver Diseases, and Chapter 26, Medical Emergencies).
- Aspirin
  - Effects: Aspirin has analgesic, antipyretic, anti-inflammatory, and antiplatelet effects. Aspirin should be used with caution in patients with hepatic or renal disease or bleeding disorders, those who are pregnant, and those who are receiving anticoagulation therapy. Antiplatelet effects may last for up to 1 week after a single dose.
  - Dosage: 325–650 mg q4h PRN (maximum dose, 4 g/d), available in oral and rectal suppository. Enteric coated formulation may minimize GI side effects.
  - Adverse effects: Dose-related side effects include tinnitus, dizziness, and hearing loss. Dyspepsia and GI bleeding can develop and may be severe. Hypersensitivity reactions, including bronchospasm, laryngeal edema, and urticaria, are uncommon, but patients with asthma and nasal polyps are more susceptible. Chronic use can result in interstitial nephritis and papillary necrosis.
- NSAIDs

  Effects: NSAIDs have analgesic, antipyretic, and anti-inflammatory properties mediated by inhibition of cyclooxygenase. All NSAIDs have similar efficacy and toxicities, with a side effect profile similar to that of aspirin. Patients with allergic or bronchospastic reactions to aspirin should not be given NSAIDs. See Chapter 25, Arthritis and Rheumatologic Diseases, for further information on NSAIDs.
- Opioid analgesics
  - Effects: Opioid analgesics are pharmacologically similar to opium or morphine and are the drugs of choice when analgesia without antipyretic action is desired.
  - Dosage: Table 1-1 lists equianalgesic dosages.
    - Constant pain requires continuous (basal) analgesia with supplementary, PRN doses for breakthrough pain at doses of roughly 5–15% of the daily basal dose. If frequent PRN doses are required, the maintenance dose should be increased or the dosing interval should be decreased.

TABLE 1-1 Equipotent Doses of Opioid Analgesics

Drug	Onset (min)	Duration (hr)	IM/IV/SC (mg)	PO (mg)
Fentanyl	7–8	1–2	0.1	NA
Levorphanol	30–90	4–6	2	4
Hydromorphone	15–30	2–4	1.5–2.0	7.5
Methadone	30–60	4–12	10	20
Morphine	15–30	2–4	10	30[a]
Oxycodone	15–30	3–4	NA	20
Codeine	15–30	4–6	120	200

NA, not applicable.
Note: Equivalences are based on single-dose studies.
[a]An IM:PO ratio of 1:2 to 1:3 used for repetitive dosing.

- When changing to a new narcotic due to poor response or patient intolerance, the new medication should be started at 50% the equianalgesic dose to account for incomplete cross-tolerance.
- Parenteral and transdermal administration are useful in the setting of dysphagia, emesis, or decreased GI absorption.
- Agents with short half-lives, such as morphine, should be used. Narcotic-naïve patients should be started on the lowest possible doses, whereas patients with demonstrated tolerance will require higher doses.
- Patient-controlled analgesia often is used to control pain in a postoperative or terminally ill patient. Opioid-naïve patients should not have basal rates prescribed due to risk of overdose.
- Selected opiates
  - Codeine is usually given in combination with aspirin or acetaminophen.
  - Oxycodone and hydrocodone are both available orally in combination with acetaminophen; oxycodone is available without acetaminophen in immediate-release and sustained-release formulations. Care should be taken to avoid acetaminophen overdose with these formulations.
  - Morphine sulfate preparations include both immediate release and sustained release. The liquid form can be useful in patients who have difficulty in swallowing pills. Morphine should be used with caution in renal insufficiency.
  - Methadone is very effective when administered orally and suppresses the symptoms of withdrawal from other opioids because of its extended half-life. Despite its long elimination half-life, its analgesic duration of action is much shorter.
  - Hydromorphone is a potent morphine derivative, five to seven times the strength of morphine, and caution should be used when ordering this medication.
  - Fentanyl is available in a transdermal patch with sustained release over 72 hours. Initial onset of action is delayed. Respiratory depression may occur more frequently with fentanyl.

- Precautions
  - Opioids are relatively contraindicated in acute disease states in which the pattern and degree of pain are important diagnostic signs (e.g., head injuries, abdominal pain). They also may increase intracranial pressure.

- Opioids should be used with caution in patients with hypothyroidism, Addison disease, hypopituitarism, anemia, respiratory disease (e.g., chronic obstructive pulmonary disease [COPD], asthma, kyphoscoliosis, severe obesity), severe malnutrition, debilitation, or chronic cor pulmonale.
- Opioid dosage should be adjusted for patients with impaired hepatic or renal function.
- Drugs that potentiate the adverse effects of opioids include phenothiazines, antidepressants, benzodiazepines, and alcohol.
- Tolerance develops with chronic use and coincides with the development of physical dependence, which is characterized by a withdrawal syndrome (anxiety, irritability, diaphoresis, tachycardia, GI distress, and temperature instability) when the drug is stopped abruptly. It may occur after only 2 weeks of therapy.
- Administration of an opioid antagonist may precipitate withdrawal after only 3 days of therapy. Tapering the medication slowly over several days can minimize withdrawal.

• Adverse and toxic effects
- Central nervous system (CNS) effects include sedation, euphoria, and pupillary constriction.
- Respiratory depression is dose related and pronounced after IV administration.
- Cardiovascular effects include peripheral vasodilation and hypotension.
- GI effects include constipation, nausea, and vomiting. Stool softeners and laxatives should be prescribed to prevent constipation. Opioids may precipitate toxic megacolon in patients with inflammatory bowel disease.
- Genitourinary effects include urinary retention.
- Pruritus occurs most commonly with spinal administration.

• Opioid overdose

Naloxone, an opioid antagonist, should be readily available for administration in the case of accidental or intentional overdose. For details of administration, see Chapter 26, Medical Emergencies.

• Alternative medications
- Tramadol is an opioid agonist and a centrally acting non-opioid analgesic that acts on pain processing pathways.
  - Dosage: 50–100 mg PO q4–6h can be used for acute pain. For elderly patients and those with renal or liver dysfunction, dosage reduction is recommended.
  - Adverse effects: Concomitant use of alcohol, sedatives, or narcotics should be avoided. Nausea, dizziness, constipation, and headache may also occur. Respiratory depression has not been described at prescribed dosages but may occur with overdose. Tramadol should not be used in patients who are taking a monoamine oxidase inhibitor, as it can contribute to serotonin syndrome.
- Anticonvulsants (e.g., gabapentin, pregabalin, carbamazepine, oxcarbazepine), tricyclic antidepressants (e.g., amitriptyline), and duloxetine are PO agents that can be used to treat neuropathic pain.
- Topical anesthetics (e.g., lidocaine) may provide analgesia to a localized region (e.g., postherpetic neuralgia).

Altered Mental Status

GENERAL PRINCIPLES

Mental status changes have a broad differential diagnosis that includes neurologic (e.g., stroke, seizure, delirium), metabolic (e.g., hypoxemia, hypoglycemia), toxic (e.g., drug effects, alcohol withdrawal), and other etiologies. Infection (e.g., urinary tract infections, pneumonia) is a common cause of mental status changes in the elderly and in patients with underlying

neurologic disease. Sundown syndrome refers to the appearance of worsening confusion in the evening and is associated with dementia, delirium, and unfamiliar environments.

DIAGNOSIS

History and Physical Examination

- Focus particularly on medications, underlying dementia, cognitive impairment, neurologic or psychiatric disorders, and a history of alcohol and/or drug use.
- Family and nursing personnel may be able to provide additional details.
- Physical examination generally includes vital signs, a search for sites of infection, a complete cardiopulmonary examination, and a detailed neurologic examination including mental status evaluation.

Diagnostic Testing

- Testing includes blood glucose, serum electrolytes, creatinine, CBC, urinalysis, and oxygen assessment.
- Other evaluation, including lumbar puncture, toxicology screen, cultures, thyroid function tests, noncontrast head CT, electroencephalogram, chest radiograph, or ECG should be directed by initial findings.

TREATMENT

Management of specific disorders is discussed in Chapter 27, Neurologic Disorders, available in the online version.

Medications

Agitation and psychosis may be features of a change in mental status. The antipsychotic haloperidol and the benzodiazepine lorazepam are commonly used in the acute management of these symptoms. Second-generation antipsychotics (risperidone, olanzapine, quetiapine, clozapine, ziprasidone, aripiprazole, paliperidone) are alternative agents that may lead to decreased incidence of extrapyramidal symptoms. All of these agents pose risks to elderly patients and those with dementia if given long term.

- Haloperidol is the initial drug of choice for acute management of agitation and psychosis. The initial dose of 0.5–5 mg (0.25 mg in elderly patients) PO and 2–10 mg IM/IV can be repeated every 30–60 minutes. Haloperidol has fewer active metabolites and fewer anticholinergic, sedative, and hypotensive effects than other antipsychotics but may have more extrapyramidal side effects. In low dosages, haloperidol rarely causes hypotension, cardiovascular compromise, or excessive sedation.
- Prolongation of the QT interval. Use should be discontinued with prolongation of QTc >450 msec or 25% above baseline.
- Postural hypotension may occasionally be acute and severe after administration. IV fluids should be given initially for treatment. If vasopressors are required, dopamine should be avoided because it may exacerbate the psychotic state.
- Neuroleptic malignant syndrome (see Chapter 27, Neurologic Disorders).
- Lorazepam is a benzodiazepine that is useful for agitation and psychosis in the setting of hepatic dysfunction and sedative or alcohol withdrawal. The initial dose is 0.5–1 mg IV. Lorazepam has a short duration of action and few active metabolites. Excessive sedation and respiratory depression can occur.

Nonpharmacologic Therapies

Patients with delirium of any etiology often respond to frequent reorientation, observance of the day–night light cycle, and maintenance of a familiar environment.

Insomnia and Anxiety

GENERAL PRINCIPLES

- Insomnia and anxiety may be attributed to a variety of underlying medical or psychiatric disorders, and symptoms may be exacerbated by hospitalization.
- Causes of insomnia include environmental disruptions, mood and anxiety disorders, substance abuse disorders, common medications (i.e., β-blockers, steroids, bronchodilators), sleep apnea, hyperthyroidism, and nocturnal myoclonus.
- Anxiety may be seen in anxiety disorder, depression, substance abuse disorders, hyperthyroidism, and complex partial seizures.

DIAGNOSIS

The diagnosis of insomnia and anxiety is a clinical one. No laboratory or imaging tests help in establishing the diagnosis; however, they can help to rule out other etiologies.

TREATMENT

- Benzodiazepines are frequently used in management of anxiety and insomnia. Table 1-2 provides a list of selected benzodiazepines and their common uses and dosages.
  - Pharmacology: Most benzodiazepines undergo oxidation to active metabolites in the liver. Lorazepam, oxazepam, and temazepam undergo glucuronidation to inactive metabolites; therefore, these agents may be particularly useful in the elderly and in those with liver disease. Benzodiazepines with long half-lives may accumulate substantially in the elderly, in whom the half-life may be increased manyfold.
  - Dosages: Relief of anxiety and insomnia is achieved at the doses outlined in Table 1-2. Therapy should be started at the lowest recommended dosage with intermittent dosing schedules.
  - Side effects include drowsiness, dizziness, fatigue, psychomotor impairment, and anterograde amnesia. Benzodiazepine toxicity is heightened by malnutrition, advanced age, hepatic disease and concomitant use of alcohol, other CNS depressants, and CYP3A4 inhibitors. The elderly may experience falls, paradoxical agitation, and delirium.
    - IV administration of diazepam and midazolam can be associated with hypotension, bradycardia, and respiratory or cardiac arrest.
    - Respiratory depression can occur even with oral administration in patients with respiratory compromise.
    - Tolerance to benzodiazepines can develop and dependence may develop after only 2–4 weeks of therapy.
    - Seizures and delirium may also occur with sudden discontinuation of benzodiazepines. A *withdrawal syndrome* consisting of agitation, irritability, insomnia, tremor, palpitations, headache, GI distress, and perceptual disturbance begins 1–10 days after a rapid decrease in dosage or abrupt cessation of therapy. Short-acting and intermediate-acting drugs should be decreased by 10–20% every 5 days, with a slower taper in the final few weeks. Long-acting preparations can be tapered more quickly.
  - Overdose

    Flumazenil, a benzodiazepine antagonist, should be readily available in case of accidental or intentional overdose. For details of administration, see Chapter 26, Medical Emergencies.
- Trazodone
  - Trazodone is a serotonin receptor antagonist antidepressant that may be useful for the treatment of severe anxiety or insomnia. Common dosing is 50–100 mg at bedtime.

TABLE 1-2 Characteristics of Selected Benzodiazepines

Drug	Route	Common Uses	Usual Dosage	Half-life (hr)[a]
Alprazolam	PO	Anxiety disorders	0.75–4.0 mg/24 h (in three doses)	12–15
Chlordiazepoxide	PO	Anxiety disorders, alcohol withdrawal	15–100 mg/24 h (in divided doses)	5–30
Clonazepam	PO	Anxiety disorders, seizure disorders	0.5–4.0 mg/24 h (in two doses)	18–28
Diazepam	PO	Anxiety disorders, seizure disorders, preanesthesia	6–40 mg/24 h (in one to four doses)	20–50
	IV		2.5–20.0 mg (slow IV push)	20–50
Flurazepam	PO	Insomnia	15–30 mg at bedtime	50–100
Lorazepam[b]	PO	Anxiety disorders	1–10 mg/24 h (in two to three doses)	10–20
	IV or IM	Preanesthetic medication	0.05 mg/kg (4 mg max)	10–20
Midazolam	IV	Preanesthetic and intraoperative medication	0.01–0.05 mg/kg	1–12
	IM		0.08 mg/kg	1–12
Oxazepam[b]	PO	Anxiety disorders	10–30 mg/24 h (in three to four doses)	5–10
Temazepam[b]	PO	Insomnia	15–30 mg at bedtime	8–12
Triazolam	PO	Insomnia	0.125–0.250 mg at bedtime	2–5

[a]Half-life of active metabolites may differ.
[b]Metabolites are inactive.

- It is highly sedating and can cause postural hypotension. It is rarely associated with priapism.
- Levels may be substantially increased when used with CYP3A4 inhibitors.

• Nonbenzodiazepine hypnotics

These agents appear to act on the benzodiazepine receptor and have been shown to be safe and effective for initiating sleep. All should be used with caution in patients with impaired respiratory function.

- Zolpidem is an imidazopyridine hypnotic agent that is useful for the treatment of insomnia. It has no withdrawal syndrome, rebound insomnia, or tolerance. Side effects

include headache, daytime somnolence, and GI upset. The starting dose is 5 mg PO every night at bedtime.
  - Zaleplon has a half-life of approximately 1 hour and no active metabolites. Side effects include dizziness and impaired coordination. The starting dose is 10 mg PO at bedtime (5 mg for the elderly or patients with hepatic dysfunction).
  - Eszopiclone offers a longer half-life compared to the previous agents. Side effects include headache and dizziness. Starting dose is 1 mg PO at bedtime.
  - Ramelteon is a melatonin analog. The usual dose is 8 mg PO at bedtime.
- Antihistamines
  Over-the-counter antihistamines can be used for insomnia and anxiety, particularly in patients with a history of drug dependence. Anticholinergic side effects limit the utility, especially in the elderly.

PERIOPERATIVE MEDICINE

The role of the medical consultant is to estimate the level of risk associated with a given procedure, determine the need for further evaluation based upon this risk estimate, and prescribe interventions to mitigate risk. Although preoperative consultations often focus on cardiac risk, it is essential to remember that poor outcomes can result from significant disease in other organ systems. Evaluation of the entire patient is necessary to provide optimal perioperative care.

Preoperative Cardiac Evaluation

GENERAL PRINCIPLES

Perioperative cardiac complications are generally defined as cardiac death, MIs (both ST and non-ST elevation), CHF, and clinically significant rhythm disturbances.

Epidemiology

- Overall, an estimated 50,000 perioperative infarctions and 1 million other cardiovascular complications occur annually (*N Engl J Med 2001;345:1677*). Of those who have a perioperative MI, the risk of in-hospital mortality is estimated at 10–15% (*Chest 2006;130:584*).
- Perioperative MI (PMI) is believed to occur via two distinct mechanisms. Type I PMI results from erosion or rupture of unstable atherosclerotic plaque, leading to coronary thrombosis and subsequent myocardial injury. Type II PMI occurs when myocardial oxygen demand exceeds supply in the absence of overt thrombosis.
- Although angiographic data suggest that existing stenoses may underpin some perioperative events, a significant number of PMIs are "stress" related (Type II) and not due to plaque rupture (*Am J Cardiol 1996;77:1126*; *J Cardiothorac Vasc Anesth 2003;17:90*).
- Autopsy data indicate that fatal PMIs occur predominantly in patients with multivessel and especially left main coronary artery disease, via the same mechanism as non-PMIs (*Int J Cardiol 1996;57:37*).

DIAGNOSIS

Clinical Presentation

History

The aim is to identify patient factors and comorbid conditions that will affect perioperative risk. Current guidelines focus on identification of active cardiac disease and known risk factors for perioperative events, which include:

- Unstable coronary syndromes including severe angina
- Recent MI (defined as >7 but <30 days)

- Decompensated CHF (New York Heart Association class IV, worsening or new-onset heart failure [HF])
- Significant arrhythmia including non-sinus rhythm (rate controlled and stable)
- Severe valvular disease
- Clinical risk factors for coronary artery disease (CAD)
- Preexisting, stable CAD
- Compensated or prior CHF
- Diabetes mellitus
- Prior cerebrovascular accident (CVA) or transient ischemic attack (TIA)
- Chronic kidney disease
- Poorly controlled hypertension
- Abnormal ECG (e.g., left ventricular hypertrophy, left bundle branch block, ST-T wave abnormalities)
- Age >70 years identified in several studies as a significant risk factor (*JAMA 2001; 285:1865*; *Eur Heart J 2008;29:394*) but not uniformly accepted as independent

Physical Examination

Specific attention should be paid to the following:

- Vital signs, with particular evidence of hypertension. Systolic blood pressure (SBP) <180 and diastolic blood pressure (DBP) <110 are generally considered acceptable. The management of stage III hypertension (SBP >180 or DBP >110) is controversial. However, postponing elective surgery to allow adequate BP control in this setting seems reasonable; how long to wait after treatment is implemented remains unclear.
- Evidence of decompensated CHF (elevated jugular venous pressure, rales, S3, edema).
- Murmurs suggestive of significant valvular lesions. According to the 2014 American Heart Association (AHA)/American College of Cardiology (ACC) Guideline for the Management of Patients with Valvular Heart Disease, the risk of noncardiac surgery is increased in all patients with significant valvular heart disease, although symptomatic aortic stenosis (AS) is thought to carry the greatest risk. The estimated rate of cardiac complications in patients with undiagnosed severe AS undergoing noncardiac surgery is 10–30%. However, aortic valve replacement is also associated with considerable risk. Risk–benefit analysis appears to favor proceeding to intermediate-risk elective noncardiac surgery (see below) with appropriate intra- and postoperative hemodynamic monitoring (including intraoperative right heart catheter or transesophageal echocardiogram) as opposed to prophylactic aortic valve replacement in the context of asymptomatic severe disease. The same recommendations (albeit with less supporting evidence) apply to asymptomatic severe mitral regurgitation, asymptomatic severe AR with normal ejection fraction, and asymptomatic severe mitral stenosis (assuming valve morphology is not amenable to percutaneous balloon mitral commissurotomy, which should otherwise be considered to optimize cardiac status prior to proceeding to surgery). Symptomatic severe valvular disease of any type should prompt preoperative cardiology consultation. See the section on Valvular Heart Disease in Chapter 6.

Diagnostic Criteria

The 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery offers a stepwise approach to preoperative evaluation and risk stratification (Figure 1-1).

- Step 1: Establish the urgency of surgery. Many surgeries are unlikely to allow for a time-consuming evaluation.
- Step 2: Assess for active cardiac conditions (see History, above).
- Step 3: Determine the surgery-specific risk as follows:
  - Low-risk surgeries (<1% expected risk of adverse cardiac events) include superficial procedures, cataract/breast surgery, endoscopic procedures, and most procedures that can be performed in an ambulatory setting.

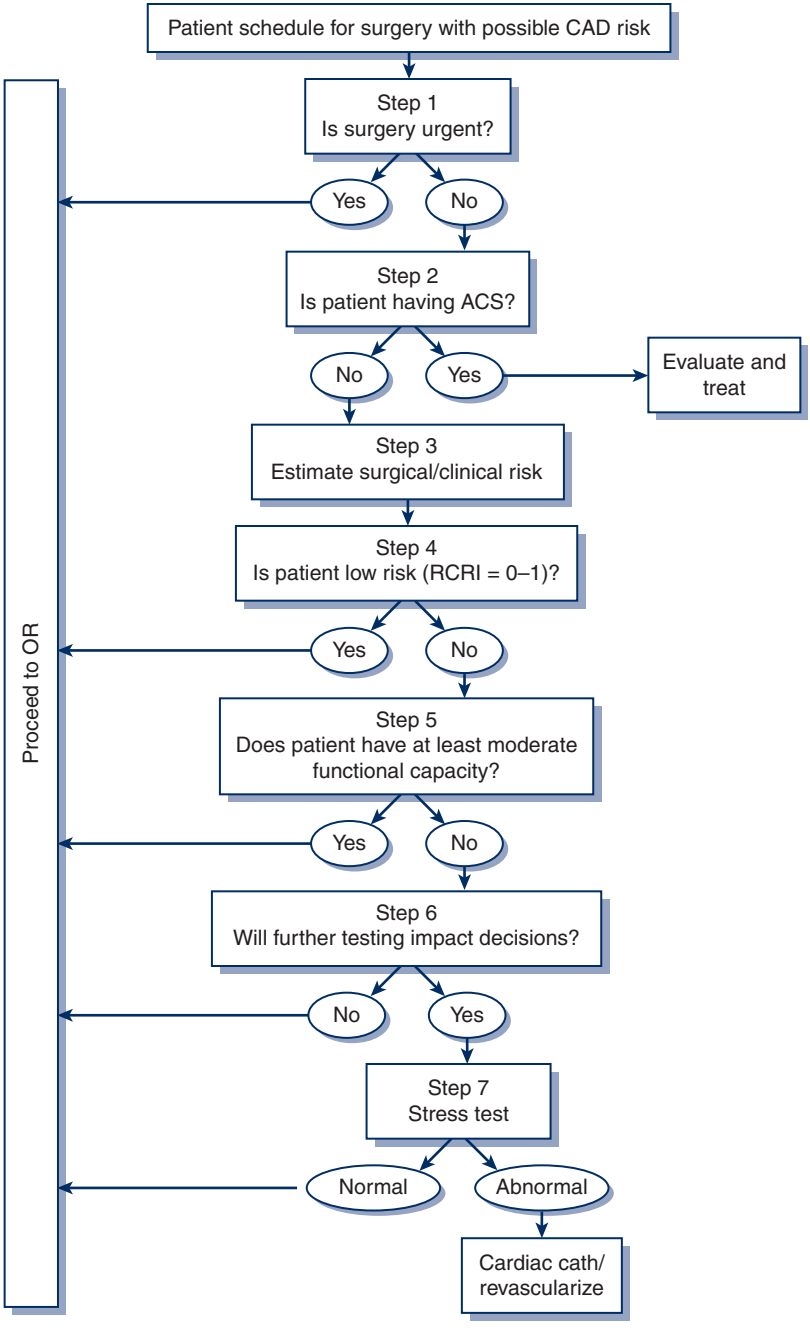

Figure 1-1. Cardiac evaluation algorithm for noncardiac surgery. (Modified from *Circulation 2014;130:e278–e333.*)

- Intermediate risk surgeries (1–5% risk of adverse cardiac events) include carotid endarterectomy, intraperitoneal/intrathoracic surgery, orthopedic surgery, head and neck surgery, and prostate surgery.
- Vascular surgery involving extremity revascularization or aortic repair generally carries the highest risk (>5% risk of adverse cardiac events).

- Step 4: Assess the patient's functional capacity.
  Poor functional capacity (<4 metabolic equivalents [METs]) is associated with an increased risk of perioperative cardiac events (*Arch Intern Med 1999;159:2185*; *Chest 1999;116:355*). Although exercise testing is the gold standard, functional capacity can be reliably estimated by patient self-report (*Am J Cardiol 1989;64:651*). Examples of activities that suggest at least moderate functional capacity (>4 METs) include climbing one to two flights of stairs or walking a block at a brisk pace. Patients with a functional capacity of >4 METs without symptoms can proceed to surgery with relatively low risk.
- Step 5: Assess the patient's clinical risk factors.
  - The number of risk factors combined with the surgery-specific risk (intermediate vs. vascular) determines further management. The following risk factors are adapted from the Revised Cardiac Risk Index (RCRI) (*Circulation 1999;100:1043*):
    - Ischemic heart disease
    - History of TIA or CVA
    - History of CHF
    - Preoperative serum creatinine ≥2 mg/dL
    - Diabetes mellitus requiring insulin
  - Patients with no clinical risk factors are at inherently low risk (<1% risk of cardiac events) and may proceed to surgery without further testing. Patients with one or two clinical risk factors are generally at intermediate risk and may proceed to surgery, although stress testing might help refine risk assessment in selected cases. Patients with three or more clinical risk factors are at high risk of adverse cardiac events, particularly when undergoing vascular surgery. In this population especially, stress testing may provide a better estimate of cardiovascular risk and may be considered if knowledge of this increased risk would change management (*J Am Coll Cardiol 2006;48:964*). A positive stress test in a high-risk patient portends a substantially increased risk of a perioperative cardiac event, whereas a negative study suggests a lower risk than that predicted by clinical factors alone (*JAMA 2001;285:1865*).

Revascularization

- The best available data on preoperative revascularization come from the Coronary Artery Revascularization Prophylaxis (CARP) trial, a prospective study of patients scheduled to undergo vascular surgery (*N Engl J Med 2004;351:2795*). Patients with angiographically proven significant CAD were randomized to revascularization versus no revascularization. There was no difference between the groups in the occurrence of MI or death at 30 days or in mortality with long-term follow-up. Patients with three or more clinical risk factors and extensive ischemia on stress testing were evaluated in a separate small study (*J Am Coll Cardiol 2007;49:1763*). High event rates were seen in both study arms, and no benefit was seen with revascularization. Taken together, these studies suggest that the risk of adverse cardiac events is not altered by attempts at preoperative revascularization, even in high-risk populations. A notable possible exception are patients with left main disease, who appeared to have benefited from preoperative revascularization in a subset analysis of the CARP trial data (*Am J Cardiol 2008;102:809*).
- Based on these cumulative results, a strategy of routinely pursuing coronary revascularization as a method of decreasing perioperative cardiac risk cannot be recommended. However, careful screening of patients is still essential to identify those high-risk subsets who may obtain a survival benefit from revascularization independent of their need for noncardiac surgery.