Perioperative Management
- Ensure adequate premedication and consider benzodiazepines.
- Airway instrumentation: Important trigger for bronchospasm; avoid unnecessary airway instrumentation (e.g., consider supralaryngeal airway and deep extubation).
- Consider IV medication (e.g., IV lidocaine) to depress airway reflexes.
- Avoid histamine-releasing medications (e.g., atracurium, mivacurium, morphine), and when possible consider avoiding muscle relaxant reversal agents that cause increased airway hyperreactivity (e.g., neostigmine, physostigmine).

Intraoperative Signs/Symptoms of Airway Hyperreactivity
- Wheezing: Auscultation of lungs can provide qualitative information regarding amount of airflow.
- Air trapping/Auto-PEEP: Secondary to decreased expiratory airflow → dynamic hyperinflation, reduced dynamic compliance of lungs → hypotension by decreased venous return, pneumothorax, subcutaneous emphysema, and cardiac arrest secondary to right ventricular failure; consider a 30- to 60-sec apnea trial.
- Hyperinflation: Signified by increased plateau pressure (goal: P_{plat} <30 cm H_2O), can be reduced by decreasing minute ventilation and shortening inspiratory time/lengthening expiratory time.
- Hypercapnia: Secondary to increased dead-space ventilation, made worse by hyperventilation.
  - Acute rise in Pco_2: Increases cerebral blood flow, increases intracranial pressure, decreases intracellular pH, and decreases cardiac contractility.

Differential Diagnosis
- Ventilator malfunction
- Endotracheal tube obstruction
- Endobronchial intubation
- Pneumothorax
- Pulmonary embolus

Treatment
- Switch to manual bag ventilation; allows direct qualitative assessment of pulmonary compliance and release of trapped gas.
- Remove trigger.
- Bronchodilators (e.g., β_2-agonist), consider combining with anticholinergic (e.g., ipratropium).
- Anti-inflammatories (e.g., corticosteroids, cromolyn, leukotriene inhibitors).
- Deepen anesthetic to depress airway reflexes, reduce bronchospasm, and resultant bronchodilation: inhalational anesthetic, intravenous anesthetic (e.g., propofol, ketamine), and neuromuscular blocker (e.g., rocuronium).
- Consider epinephrine, magnesium sulfate, heliox, bronchoscopy to remove mucus plug, noninvasive positive pressure ventilation to decreased work of breathing (if not intubated), and extracorporeal life support.

Postoperative Period
- Pain may trigger bronchospasm/laryngospasm: Prevent pain and treat promptly; consider regional anesthesia when possible.
  - Neuraxial blockade improves postop lung function due to improved pain therapy and diaphragmatic function.
- Close observation for postop bronchospasm/laryngospasm.

Atherosclerotic Disease

Marc B. Royo

Risk
- Over 100 million USA adults age 20 y or older have a total cholesterol >200 mg/dL.
- Cardiovascular disease accounts for approximately 1 of every 3 deaths in USA (31.3%).

Perioperative Risks
- Cardiovascular disease increases risk of periop major adverse cardiac events (cardiac death, nonfatal myocardial infarction, and nonfatal cardiac arrest).
- Approximately 3% of pts undergoing noncardiac surgery will experience a periop cardiac complication.

Worry About
- Increased risk of end-organ hypoperfusion (e.g., myocardial, cerebral, renal)
- Increased risk of embolic events from unstable plaque rupture
- Association with aneurysm formation and increased risk of dissection
- Coexisting diseases and behaviors such as Htn, DM, and tobacco smoking
- Possible link with increased risk of postop delirium

Overview
- Lipid deposition and eventual calcification of coronary, cerebral, and peripheral arteries
- Integral in the pathogenesis of coronary artery disease, carotid artery disease, peripheral arterial disease, and some forms of chronic kidney disease

Etiology
- Multifactorial
- Risk factors: dyslipidemia, Htn, DM, endothelial dysfunction, smoking, and male sex

Usual Treatment
- Primary prevention include modification of risk factors (diet, physical activity, and smoking)
- Pharmacologic options for prevention includes antithrombotics (e.g., aspirin) and lipid-lowering agents
- Coronary artery disease: Antianginal treatment (nitrates, β-blockers, and calcium channel blockers), angioplasty, stenting, and CABG surgery
- Carotid artery disease: carotid endarterectomy or stenting
- Cerebrovascular insufficiency: extracranial-intracranial bypass is sometimes performed
- Peripheral vascular insufficiency: angioplasty, stenting, or revascularization

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	Htn, ventricular dysfunction (systolic and/or diastolic), coronary artery stenosis, myocardial ischemia	Angina, exercise intolerance, dyspnea, usually asymptomatic	Split S_2, S_3 and/or S_4; murmur; cardiomegaly	Vital signs, ECG, treadmill exercise testing, pharmacologic stress test, coronary angiography, and ECHO; may consider perioperative troponin screening in high-risk individuals
RESP	COPD (many are smokers)	Smoking history, dyspnea on exertion, sputum production	Decreased breath sounds, prolonged expiration, wheezing, signs of right heart failure	ABG, PFTs, CXR
CNS	Cerebrovascular insufficiency/infarction	History of syncope, TIA, CVA	Carotid bruit; focal neurologic deficits	Carotid US ultrasound or angiogram
PERIPH ARTERIES	Limb blood flow supply/demand imbalance, aneurysm formation	Claudication; may be asymptomatic; rest pain	Decreased pulses, pulsatile abdominal mass, nonhealing peripheral wounds	Ankle-brachial systolic pressure index, angiogram, and MRI
GI	Intestinal ischemia	Abdominal pain; occult blood in stool/gastric contents	Abdominal exam may be paradoxically normal	CBC, amylase, and mesenteric angiography

Key References: Hansson GK, Libby P, Tabas I: Inflammation and plaque vulnerability, *J Intern Med* 278(5):483–493, 2015; Halub ME, Sidwell RA: Cardiac risk stratification and protection, *Surg Clin North Am* 95(2):217–235, 2015.

Perioperative Implications

Preoperative Preparation
- Consider risk stratification tool (RCRI) and AHA/ACC clinical practice guideline to direct preop evaluation.
- Optimize cardiac symptomatology.
- Continue antianginal Rx (nitrates, β-blockers, calcium channel blockers, aspirin, and statins).
- Attention to and stabilization of coexistent diseases (HTN, DM, and COPD).

Monitoring
- Cardiovascular
  - ECG with appropriate lead placement; ST trending.
  - Consider intra-arterial catheter.
  - Consider CVP catheterization to monitor volume status.
  - Consider TEE in high-risk pts (cardiac surgery, recent MI, CHF, and unstable angina).

- Cerebrovascular
  - Stump pressure, EEG, and SEPs have been used in carotid endarterectomy.
  - CSF pressure and drainage in thoracoabdominal aneurysm repair.

Airway
- None

Preinduction/Induction
- Avoid extreme or prolonged changes in heart rate or blood pressure.
- Treat HR and BP changes aggressively.

Maintenance
- No one anesthetic agent or technique is superior; maintaining HR at a low level and hemodynamic stability are more important.
- For peripheral vascular surgery, regional anesthesia in combination with postop epidural analgesia may decrease the incidence of graft thrombosis (see also Peripheral Vascular Disease).
- For carotid endarterectomy, maintaining cerebral perfusion pressure is an important goal.
- For abdominal aortic surgery, optimizing loading conditions, and detecting and treating myocardial ischemia and ventricular dysfunction are important, particularly around aortic clamping/unclamping.

Extubation
- Same concerns as during induction
- Rapid emergence to allow neurologic assessment after carotid endarterectomy

Adjuvants
- β-blocking agents and other antihypertensives are useful in hyperdynamic situations.
- Prophylactic nitroglycerin and Ca^{2+}-channel blockers used to treat myocardial ischemia have not been conclusively proven effective.
- Use vasoconstrictors, such as α-adrenergic agonists, with caution, to increase BP in cases of heart failure.

Anticipated Problems/Concerns
- High risk of periop myocardial ischemia (often silent).
- Avoid postop hypothermia (increases oxygen demand).
- Periop volume status important for pts with history of heart failure.
- Concern for reocclusion with peripheral revascularization procedures.
- Risk of renal dysfunction and neurologic injury in cases of aortic surgery.

Atrial Fibrillation

Sheela Pai Cole

Risk
- Isolated atrial fibrillation affects >1% of those >60 y of age.
- Overall incidence is 0.4% of adult population.
- In the postcardiac surgical population, the incidence can be as high as 27-40%.
- No racial predominance.
- Prevalence increases with older age.
- Independent risk factor for stroke.
- In pts presenting for cardiac surgery, the incidence of postop atrial fibrillation increases with increasing left atrial size, as well as in the presence of valvular abnormalities.

Perioperative Risks
- Rapid ventricular response in CHF
- May be a sign of impending or ongoing myocardial ischemia
- Embolization if persisting beyond 48 h without anticoagulation

Worry About
- Decreased cardiac output due to loss of atrial kick, especially in the presence of left ventricular hypertrophy, aortic stenosis, or diastolic dysfunction
- Myocardial ischemia secondary to increased myocardial O_2 demand
- Increasing embolization risk with increased duration

Overview
- Develops over 2 decades in 2% of pts >30 y of age.
- Related to left atrial size, underlying heart disease, and abnormal electrophysiology.
- Incidence increases with age.
- Most affected persons have underlying cardiac disease.
- Common after cardiac surgery, particularly valve surgery.

Etiology
- CAD
- RHD
- Cardiomyopathy; heart failure
- Mitral stenosis; mitral regurgitation especially with left atrial enlargement
- Htn and associated left ventricular hypertrophy
- Pericarditis
- Resp insufficiency including hypoxia and hypercarbia
- Hypercatecholamine states such as hyperthyroidism
- Subarachnoid hemorrhage
- Sarcoidosis/amyloidosis
- Idiopathic

Usual Treatment
- Cardioversion for hemodynamic instability in the first 48 h
- Amiodarone increases the chances of spontaneous conversion to sinus rhythm, especially if cardioversion is required
- Digitalis
- β-blockers
- Calcium antagonists
- Quinidine (with digitalis)

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	CHF Angina Stroke	Palpitations Chest pain Dyspnea Orthopnea	Variation in intensity of first heart sound; absence of A waves in jugular venous pulse; irregularly irregular ventricular rhythm	ECHO (if indicated)
RESP	CHF Pulm embolism	Dyspnea Orthopnea Chest pain Tachypnea	S_3 Rales Wheezing	CXR, V/Q scan (if suspicion of pulm embolism)
GI	Ischemic bowel from low flow or embolization	Abdominal pain	Acute abdomen	ABGs/lytes
RENAL	Decreased renal perfusion	Decreased urine output		BUN/Cr
CNS	Syncope, fatigue	Stroke	Neurologic deficit	Head CT

Key References: Mitchell LB, Crystal E, Heilbron B, et al: Atrial fibrillation following cardiac surgery, *Can J Cardiol*, 21(Suppl B):45B–50B, 2005; Prystowsky EN, Padanilam BJ, Fogel RI: Treatment of atrial fibrillation, *JAMA*, 314(3):278–288, 2015.

Perioperative Implications

Preoperative Preparation
- Search for precipitating causes: new onset may signify acute disease process, which may delay surgery
- Control ventricular response or perform synchronized cardioversion to normal sinus rhythm if unstable
- If AFIB has been present for longer than 48 h, presence of clot in left atrium needs to be ruled out before cardioversion

Monitoring
- ECG with ST-segment analysis
- Additional monitoring such as use of arterial line or pulm artery catheter should be predicated on type of surgery, additional comorbidities, or hemodynamic instability

Airway
- None; consider intubation if shock present

Preinduction/Induction
- Avoid excessive sympathetic stimulation.
- Maintain oxygenation/ventilation.

Maintenance
- Monitor oxygenation, maintain normocarbia, and correct electrolyte imbalances.
- Control ventricular response.