Effective Perianesthesia Care

Kim Litwack PhD, RN, APNP, CPAN, CAPA, FAAN

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Objectives
- Discuss the potential risks for the presurgical patient
- Identify appropriate data required for the presurgical patient

The Patient with Pre-Existing Cardiac Disease

For non-cardiac surgery

Evaluation, Screening and Patient Preparation Part I

The Patient History
- Chief complaint
- History of Present Illness
- Need for Surgery
- Past Medical History
- Review of Systems
Specific Cardiac Risks
- Coronary Artery Disease
- Hypertension
- Congestive Heart Failure
- Mitral Valve Prolapse

Coronary Artery Disease
- Chronic disease of the arterial system characterized by abnormal thickening and hardening of vessel walls

Pathophysiology
- Vessel injury
- Fatty streak
- Fibrous plaque
- Complicated lesion

Note: Because lesion development is progressive, there are multiple opportunities for intervention

Vessel Injury
- Smoking
- Diabetes
- Hypertension
- Homocysteine levels
- Alcohol
- Stress

Fatty Streak
- Smooth muscle cell proliferation
- Deposition of lipoproteins
- Deposition of platelets

Fibrous Plaque
- Continued deposition of platelets
- Deposition of elastic fibers and collagen
- Deposition of lipids
- Initial tissue necrosis
Complicated Lesion

- Microhemorrhages
- Deposition of platelets and fibrin
- Thrombus formation
- Lipid deposition
- Calcification of vessel

Proposed Causes
Modifiable vs Non-Modifiable

- Diet
- Exercise
- Glucose control
- Stress management
- Smoking
- Hypertension
- Age
- Sex
- Race
- Genetic history

Risks of Coronary Artery Disease

- Dysrhythmias
- Hypertension
- Renal Disease
- Myocardial Infarction

Risks of Myocardial Infarction

- Sudden death
- Cardiogenic shock/Heart Failure
- Pericarditis
- Dysrhythmias
- Thromboemboli
- Rupture of the heart
- Aneurysm formation

Treatment of CAD

- Nitrates
- Lifestyle Modifications
- Management of co-morbidities

Perioperative Implications

- Scheduling of Surgery r/t MI
- Assessment of Chest Pain
- Preoperative EKG
- Continuation of medications on DOS
- Management of Dysrhythmias
- Management of Hypertension in OR/PACU
Hypertension

- Consistent elevation of systemic arterial pressure
- **Optimal:** < than 120/80
  - Prehypertension: 120-139/80-89
  - Stage I: <140-159/90-99
  - Stage II: >160/>100
  - Diabetics: <130/85

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Pathophysiology

- HTN causes initial vessel injury--CAD
- CAD--vessel narrowing--**Increased pressure**
- HTN causes release of biochemical mediators of inflammation
- Inflammation further narrows vessel--**Increased pressure**

Causes of HTN

- **Primary Hypertension:** No known cause
  - Proposed to be genetic and environmental
- **Secondary Hypertension:** Identifiable cause
  - Renal disorders
  - Endocrine disorders
  - Vascular disorders
  - Pregnancy-induced
  - Neurologic disorders
  - Acute stress
  - Drugs and other substances

Risk Factors for HTN

- Family History
- Aging
- Smoking
- Obesity
- ETOH
- Male gender
- African-Americans
- High sodium
- Low K+, Mg++, Ca++
- Diabetes Mellitus

Risks of Hypertension

End-organ damage

- CAD
- MI
- CHF
- Renal Failure
- Peripheral Vascular disease
- Retinopathy

Treatment of HTN

- **Lifestyle Modification**
- **Pharmacology**
  - Diuretics
  - Beta blockers
  - ACE inhibitors
  - Calcium channel blockers
  - Alpha blockers
  - Alpha-beta blockers
  - Angiotensin II blockers

It is acknowledged that most patients will need two or more agents to control BP.

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Perioperative Implications

- Clearance: 2 months..2 weeks..Don’t clear
- Be prepared to cancel surgery
- Labs
- Continue meds on day of surgery
- Management of hypertension in PACU

Congestive Heart Failure

- A condition in which the myocardium is unable to produce a cardiac output adequate to meet the metabolic demands of tissues, especially for oxygen

Pathophysiology

- Myocardial Injury causing ↓ CO
- Myocardium will attempt compensation
- Able to handle physiologic loads only
- Over time, decompensation occurs

Compensating for Decompensation

- Increased sympathetic tone in response to decreased CO and BP
- Activation of the RAAS in response to decreased renal perfusion
- Outcome: Compensation worsens decompensation into heart failure

Proposed Causes/Risk Factors

- MI
- Cardiomyopathy
- Dysrhythmias
- Hypertension
- Aortic regurgitation/stenosis
- Anemia

Risks of CHF

- Myocardial Infarction
- Hypertension
- Cardiomyopathy
- Aortic regurgitation/stenosis
- Dysrhythmias
- Increased perioperative morbidity and mortality
Treatment of CHF
- Oxygen Therapy
- Diuretics
- Beta Blockers
- Afterload Reduction

Perioperative Implications
- Evaluate for acute signs and symptoms
- Ambulatory facility: arrange transfer
- Cancel surgery unless true emergency
- Monitoring
- Pharmacologic intervention
  - Oxygen
  - Diuretics
  - Afterload reduction

Mitral Valve Prolapse
- Bulging of mitral cusps upwards into LA during systole due to weakened valve
- Potential exists for regurgitant flow
- Regurgitant flow increases risk for thrombus formation and SBE

Proposed Causes
- Familial-congenital
- Aging
- Marfan’s syndrome and scoliosis

Risks of MVP
- Mitral regurgitation
- Infective endocarditis
- TIAs
- Dysrhythmias
- Sudden death

Treatment of MVP
- None, unless symptoms interfere with ADL
- None, unless regurgitant flow present
Perioperative Implications
- Most asymptomatic and require no intervention
- Antibiotic prophylaxis with regurgitant flow
- Anticipate dysrhythmias

Pre-existing Pulmonary Disease

Specific Pulmonary Risks
- Asthma
- Emphysema
- Chronic Bronchitis
- Smoker

Asthma
- Chronic airway disease characterized by airflow obstruction, airway hyper-responsiveness, and airway inflammation
- Critical role of inflammation

Pathophysiology
- Mast cell activation
- Inflammatory cell infiltration
- Collagen deposition in basement membrane
- Edema
- Denudation of airway epithelium

Effects of Airway Inflammation
- Airway hyper-responsiveness
- Airflow limitation
- Respiratory symptoms
- Disease chronicity
Pre-disposing Factors

- The single best predictor of asthma potential is ATOPY: a genetic predisposition for IgE mediated response to common allergens (triggers)

Epidemiology

- Most common chronic lung disorder
- Over 14 million asthmatics in US
  - Almost 5 million children
- 470,000 hospitalizations/year
- 5000 deaths/year

Diagnosis of Asthma

- Episodic symptoms of airflow obstruction
  - Wheezing, cough, SOB, triggers
- Airflow obstruction is at least partially reversible
  - Using short-acting B2 agonist-Albuterol
- Alternative diagnoses excluded

Alternative Diagnoses excluded

- Infants and Children
  - 1. Upper airway disease
  - 2. Obstruction of large airways
  - 3. Obstruction of small airways
  - 4. Other

- Adults
  - 1. COPD
  - 2. CHF
  - 3. Pulmonary embolism
  - 4. Laryngeal dysfunction
  - 5. Mechanical obstruction-tumor
  - 6. Pulmonary infiltrates
  - 7. Cough secondary to drugs
  - 8. Vocal cord dysfunction

Physical Examination

- Hyper-expansion of thorax
- Wheezing
- Increased work of breathing
- Increased nasal secretions
- Mucosal swelling
- Atopic dermatitis, eczema
- Peak flow monitoring
Classification of Severity

- Mild intermittent
- Mild persistent
- Moderate persistent
- Severe persistent

Classification based on symptom frequency and limitations, night symptoms and lung function

Mild Intermittent

- Symptoms <2x/week
- Brief exacerbations
- Intensity may vary
- Night symptoms < 2x/month
- PEF >80% predicted with <20% variability

Mild Persistent

- Symptoms >2x/week but <1x/day
- Exacerbations may affect activity
- Night symptoms >2x/month
- PEF >80% predicted with 20%-30% variability

Moderate Persistent

- Daily symptoms
- Daily use of short acting B<sub>2</sub> agonist
- Exacerbations affect activity >2x/week
- Night symptoms >1x/week
- PEF >60% to <80% predicted with >30% variability

Severe Persistent

- Continual symptoms
- Limited physical activity
- Frequent exacerbations
- Frequent night symptoms
- OEF <60% predicted with >30% variability

Goals of Treatment

- Maintain “normal” pulmonary function
- Optimal pharmacotherapy
- Prevent chronic symptoms
- Maintain activity levels
- Prevent exacerbations/hospitalizations
- Meet expectations
### Controlling Asthma Severity
- Identify triggers
- Environmental control
- Health promotion
- Pharmacotherapy

### Step-Wise Pharmacotherapy
- Amount and frequency of medications dependent on symptoms and directed towards suppression of airway inflammation
- Rescue medications
  - Anticholinergics
  - Systemic corticosteroids
- Control medications
  - Corticosteroids
  - Cromolyn sodium/nedocromil
  - Long-acting B2 agonists
  - Methylxanthines
  - Leukotriene modifiers

### Rescue Medications
- Short-acting B2 agonists
- Anticholinergics
- Systemic corticosteroids

### Control Medications
- Corticosteroids
- Cromolyn sodium/nedocromil
- Long-acting B2 agonists
- Methylxanthines
- Leukotriene modifiers

### Perioperative Implications
- Preoperatively
- Intraoperatively
- Postoperatively

### Pre-operative Management
- Signs and symptoms of asthma
- Pulmonary function
- Quality of life status
- History of exacerbations
- Pharmacotherapy
- Ability to intervene as necessary
Intraoperative Management
- Ongoing assessment of airflow
- Ongoing assessment of oxygenation
- Ability to intervene as necessary

Postoperative Management
- Ongoing assessment of airflow adequacy
- Ongoing assessment of oxygenation
- Ability to intervene as necessary

Chronic Bronchitis/Emphysema
- Airway obstruction
- Resistance to airflow
- Chronic hypoxemia

- Smoking
- Pollution
- Alpha-1 antitrypsin deficiency

Chronic Bronchitis
- Inflammation of the airways
- Edema and hyperplasia
- Hyper-secretion of mucus
- Increased risk of infection

Emphysema
- Abnormal enlargement of the airways
- Destruction of the alveolar wall
- Hyper-inflation of the lungs
- Loss of elastic recoil

Diagnosis and Treatment
- History, PE, CXR, PFT, ABG

- Treatment
  - bronchodilators
  - anticholinergics
  - expectorants
  - steroids
  - antibiotics
Perioperative Implications
- Smoking Cessation
- Inhalers to the OR
- Evaluate for acute symptoms on DOS
- Pre-op pulse ox determination
- Anesthetic choice
- Post-op pulmonary care

Smoking
- Wouldn’t it be nice…
- They would if they could, but they can’t… so we…
  - Oxygenate
  - Humidify
  - Pulse oximetry monitoring
  - Encourage coughing

Having a Plan

Evaluation, Screening and Patient Preparation Part II

Specific GI Risks
- Reflux/GERD
- Hepatitis
- Alcoholism

PUD/Reflux
- Disruption in cytoprotective gastric and duodenal mucosa resulting in symptoms of reflux and epigastric tenderness
Pathophysiology

- Imbalance between normal protective factors and injurious factors
- Disruption of mucus layer, pH, blood flow, epithelial renewal
- Invasion by H. pylori, additive effects of smoking, NSAIDs, ETOH, stress, steroids

Risks of Reflux

- Aspiration
- Nausea
- Asthma exacerbation
- Esophageal dysplasia

Treatment of PUD/Reflux

- H2 antagonists
- Proton pump inhibitors
- H. pylori eradication

Perioperative Implications

- Consider use of H2 antagonists pre-op
- Elevate HOB
- Protect against aspiration
- Evaluate for wheeze. Treat as necessary.
- Consider antiemetic
- Advance diet as tolerated

Hepatitis

- Viral infection of hepatocytes
  - Hepatitis A, B, C, D, E, ...

- Inflammation of hepatocytes may also be drug-induced or ETOH induced

Pathophysiology

- One of 5 viral types that cause progressive injury to hepatocytes with potential for hepatic destruction and failure, increased risk of hepatic cancer and development of carrier state.

A B C D E
Proposed Causes and Risk Factors
- Hepatitis A and E are transmitted fecal- or orally
- Hepatitis B, C, and D are transmitted via body fluids, contaminated needles
- Vaccine protection exists against A and B (and by default D)

Risks of Hepatitis
- Transmission to health care workers
- Declining liver function
- Delayed and unpredictable drug metabolism

Treatment
- Primarily supportive
- Universal precautions

Perioperative Implications
- Acute hepatitis: inappropriate for ASU
- Chronic and stable
  - MANDATORY
  - UNIVERSAL
  - PRECAUTIONS

Alcoholism/Acute Intoxication
- Significant impairment associated with persistent and excessive use of ETOH

Pathophysiology
- Poorly understood
Proposed Causes
- Genetic
- Ethnicity and culture
- Occupation
- Sex

Risks of Alcoholism
- Co-morbidities
- Risk of fall/injury
- High perioperative morbidity and mortality
- Discharge risk

Treatment
- Now is not the time

Perioperative implications
- Aspiration risk
- Delirium tremens risk
- Pharmacodynamics and pharmacokinetic alterations
- Safety of personnel

Specific Neurologic Risks
- Parkinson’s disease
- Alzheimer’s disease

Parkinson’s Disease
- Idiopathic condition resulting from neuronal degeneration and a loss of brain stem nuclei
### Pathophysiology
- Loss of dopaminergic input (hyperkinetic symptoms)
- Presence of Lewy bodies in cytoplasm
- Recent evidence supports an oxidant theory

### Proposed Causes/Risk Factors
- Advancing age 4-70 (peak mid 50's)
- ? Autosomal dominant transmission
- No gender, ethnic, geographic, socioeconomic factors known

### Risks of Parkinson’s Disease
- Falls
- Depression
- Other: orthostatic hypotension, slurred speech, dementia

### Treatment
- Palliative
- Dopaminergic agents (Levodopa, Parlodel, Eldepryl)
- Anticholinergic agents to treat tremor (Cogentin, Artane)

### Perioperative Implications
- Allow time
- Fall precautions
- Prompt restarting of medications
- Patient safety if dementia is present
- Consent issues if dementia is present

### Alzheimer’s Disease
- Progressive, irreversible memory loss with impairment of cognitive and social functioning
Pathophysiology
- Development of intracellular neurofibrillary tangles
- Cause of these tangles is unknown
  - Histopathological changes
  - Cholinergic hypothesis
  - Genetic hypothesis
  - Aluminum: Associated with plaques but relevance unknown
  - Viral: little evidence to support

Risks of Alzheimer’s Disease
- Memory loss with cognitive impairment
- Falls
- Agitation, anxiety and depression
- Disruption of surgical site/monitors/IV’s

Treatment
- Supportive
- Controlling behavioral syndromes

Perioperative Implications
- Consent issues
- Anesthetic management
- Nursing care
- Involve familiar supports
  - Recognize that this may be as good as it gets

The Obese Patient
- Obesity: Definition
  - BSA 27-30 Mild
  - BSA 30.1-35 Moderate
  - BSA >35 Severe
Pathophysiology

- **Idiopathic**: Energy intake greater than energy expenditure
- **Secondary** causes rare
  - Endocrine: hypothyroidism
  - Genetic: Prader-Willi
  - Pharmacologic: Steroid induced

Proposed Causes/Risk Factors

- Genetic
- Cultural
- Metabolic
- Social
- Psychologic

Risks of Obesity

- **Co-Morbidities**
  - CV: HTN, cardiomyopathy
  - Pulmonary: SOB
  - Endocrine: Diabetes
  - Vascular: Clots/emboli
  - GI: Reflux
  - Orthopedic: Arthritis

Treatment

- Multi-dimensional

Perioperative Implications

- Airway is a primary concern
- Positioning is equally important
- Patient comfort: Pain and privacy
- Fluid replacement
- Pharmacokinetics and pharmacodynamics
- DVT/emboli prevention

Having a Plan
Perioperative Management of the Diabetic Patient

Epidemiology
- Affects 6% of all Americans <50 years
- Affects 10-15% of Americans >50
- Equal number not diagnosed
- High impact on surgery due to:
  1. Sheer number of patients with diabetes
  2. Complications of disease requiring surgery
  3. 50% of all diabetics will have surgery

Surgery r/t Disease (examples)
- Eye: Retinopathy, cataract
- Vascular: Bypass graft
- Heart: CABG
- Orthopedic: Amputation
- Renal: Transplant
- GI: Bariatric

Goal of Periop Management of the Patient with Diabetes
- To achieve an outcome in patients with diabetes equal to that of patients without diabetes.

Diabetes, per se, does not increase the risks of surgery. The secondary end organ consequences increase the risk.

PeriOp Risks d/t Organ Dysfunction
- Increased postop MI: May be silent
- Cardiac arrest d/t autonomic neuropathy
- CRF d/t diabetic nephropathy
- CVA and limb ischemia d/t PVD
- Postop wound infection
- Dehydration d/t hyperglycemia
- Diabetic control disrupted by stress response
- Airway compromise and altered drug metabolism d/t obesity
So…..

- IF end organ compromise is the biggest predictor of risk, and given that end organ compromise is the result of poor glycemic control….then….

- Maintenance of good (tight) control would become the goal of diabetic management

But….there are many patients with poor control….Why?

1. Health care providers assume patients are doing what they are told, so they don’t reteach, explore, explain.
2. Patients don’t like tight control, even though tight control makes them feel better.

Role of Insulin

Definition: Type I

- Chronic systemic disease of altered glucose metabolism and hyperglycemia due to absolute lack of insulin

The Diabetic Patient

- Type I (JODM, IDDM, Ketosis Prone)
  - Absolute deficiency of insulin production
  - Insulin required to sustain life
  - Ketosis prone
What happens in Diabetes Type II?

- Type II (AODM, NIDDM, Ketosis Resistant)
- Relative deficiency of insulin production, secretion, and/or uptake
- In type II diabetes, there is the added component of hyperinsulinemia
- Ketosis resistant

Proposed Causes/Risk Factors

- Genetic
- Lifestyle

Treatment of Diabetes

- Insulin or oral hypoglycemics
- Diet
- Exercise
- Glucose monitoring
- Regular medical assessment and care

Med Management of Type II

Perioperative Priorities

- Major goal is to mimic normal metabolism
  - Avoid hypoglycemia
  - Avoid excessive hyperglycemia
  - Avoid electrolyte alterations
  - Avoid protein catabolism (ketosis)
- Be aware of/manage co-morbidities

Metabolic response to anesthesia and surgery

1. Surgery elicits a stress response, proportional to amount of tissue trauma.
2. Result is an increase in cortisol and catecholamines.
3. Effect is insulin hyposecretion, insulin resistance and increased protein catabolism.
4. Anesthesia suppresses insulin secretion and alters glucose metabolism.
5. Result is increased risk of hyperglycemia and ketogenesis.
Having a Management Plan

Preoperative Assessment: History
- Important, even in undiagnosed
- Type of DM and treatment
- Complications
- Previous hospitalizations/surgeries
- Symptoms of ischemic cardiac, renal and/or PVD

Preop Management of Poorly Controlled Diabetic Patient
- Evidence of poor control is evidence of increased risk potential.
- Research supports switching type II patient to, and controlling patient, on insulin therapy in advance of surgery.
- Elective surgical clearance should be seriously evaluated.

Preop Assessment: Physical Exam
- Complete cardiac evaluation
- Sensory and peripheral circulation assessment
- Assessment for autonomic neuropathy via assessment of orthostatic hypotension

PreOp Assessment: Labs/testing
- Fasting serum glucose
- HgB A1c
- BUN and creatinine
- Screen for microalbuminemia/proteinuria
- ECG

HgBA1c
Preop Management of Well-Controlled Type II Patient

- IV with D5.45
- This solution provides glucose, thereby preventing hypoglycemia and protein catabolism.
- Lactate solutions avoided as lactate converts to glucose in fasting state, leading to hyperglycemia.

Preop Management of Well-controlled type II Patient

- 12 hour preop fast (gastroparesis)
- Stopping of oral agents is dependent upon class of agents used
  - Long-acting agents (Diabenese) stopped 3 days before surgery
  - Diabeta (Glyburide) and Glucotrol (Glipizide) can be stopped on DOS
  - Thiazolidinediones/Metformin stopped night before DOS
- Preop glucose monitoring
- Sliding scale insulin prn

Intraop Management of Patient with Well-Controlled Type II Diabetes

- Frequency of glucose monitoring dependent upon:
  1. Type of anesthetic
  2. Stress of the procedure
  3. Patient’s response to the process
- Usually every 1-2 hours
- Cover with sliding scale prn

PostOp Management of Patient with Well Controlled Type II Diabetes

- If oral intake can be rapidly re-established, oral meds can be restarted as well at half dose for first day and then full dose next day.
- If hospitalized, patient may require use of insulin as opposed to oral agent until diet resumed and surgical stress minimized.
- If postop renal failure develops, Metformin should NOT be restarted.
- If postop CHF develops, thiazolidinediones should NOT be restarted.

Periop Management of Patient with Type I Diabetes

- Key is to balance energy intake (calories) with insulin requirements, pre-intra and postop.
- Patients on split mixed therapy, research supports HOLDING regular insulin on DOS and taking HALF of the Hagedorn or Lente dose.
- Ideal would be first case of the day
- IV started preop with D5 solution.
- Glucose management with sliding scale.
- Minor surgery q2 monitoring. Major, q1 hour.
**Periop Insulin Regimens**

- Sliding scale SQ
- Continuous IV regimen
- IV bolus at regular intervals
- Sliding scale continuous IV

**Sliding scale SQ**

- Common, familiar
- 2-4 hour peak effect of regular insulin
- Unpredictable absorption of SQ
- Up/down effects on glucose control

**Continuous IV Regimen**

- D_{10}+ Insulin (regular) +Potassium (GIK) solution
- Closely mimics steady state physiology with administration of 5-10 G glucose, 1-2 units of insulin and 100-125 cc/fluid per hour to match glucose production, insulin secretion and replacement of loss.
- Infusion mix may have to be recalculated and changed with each glucose measurement.

**IV Bolus of insulin**

- Regular injections of insulin at set intervals
- Example: 10 units every two hours
- Additional insulin via sliding scale
- 20 minute peak of IV regular insulin does not mimic normal physiology causing extremes in measurements

**Sliding Scale Continuous IV**

- Most elemental and physiologic of all regimens
- Dextrose IV with insulin IV via separate line titrated to serum glucose levels
- Care must be taken to avoid accidental over-infusion.
- Meds maybe precipitate if mixed in insulin line.

**PostOp Management of Patient with Type I**

- Continue to use insulin as before surgery given diet and “sick day” plan
Complications in the PACU

- Hypoglycemia
- Hyperglycemia

Hypoglycemia

Hyperglycemia

Management

- Insulin
- Hydration
- Continued glucose monitoring

Take Home Message

- Major goal is to mimic normal metabolism
  - Avoid hypoglycemia
  - Avoid excessive hyperglycemia
  - Avoid electrolyte alterations
  - Avoid protein catabolism (ketosis)

- Be aware of/manage co-morbidities
Questions?

References