

Prevention of Cardiac Ischemia in the Surgical Patient

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***To Anesthesia Providers attending the
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Objectives

- Describe the significance of heart disease in the surgical patient.
- List risk factors for heart disease.
- Discuss the importance of preventing ischemia in the surgical patient.
- Describe the importance of controlling hemodynamics.
- Explain the role of beta blockers in the surgical patient at risk for perioperative cardiac ischemia.
- Give an example of a case where a beta blocker may be beneficial.

Case Study

- 85-year-old, 50-kg female with a history of nausea and vomiting for 24 hours now presents with an acute abdomen. Hx of HTN, PVD, COPD, inferior MI one month ago
- Induction with 100 mcg fentanyl, 50 mg propofol and 50 mg succinylcholine
- After induction, patient's B/P decreased from 120/85 to 60/38; Heart rate increased from 72 to 130's.

Heart Disease

- Sedentary people are almost twice as likely to suffer heart attacks than people who exercise regularly.
- Men suffer heart attacks ~10 years earlier than women do.
- Women tend to be older and sicker when they are treated for a heart attack and have less common symptoms.
- In 2010, heart disease will cost the U.S. over \$300 billion (Includes HC services, medications, and lost productivity)

Heart Disease & Smoking

- Smokers have twice the risk of developing heart disease as nonsmokers.
- Smokers who have a heart attack are more likely to die within an hour of the heart attack than nonsmokers.
- Increases heart muscle oxygen demand by 10%.
- Reduces coronary artery blood flow due to adrenaline release and reduces ability to dilate the arteries
- After five years of giving up smoking, the risk of developing heart disease is the same as for someone who never smoked.

Heart Disease and Surgery

- 400,000 per year will have cardiac surgery
 - * 25% will have perioperative CV morbidity
- 30 million will have noncardiac surgery
 - * 5% (1.5 million) will have perioperative CV morbidity with half of these people suffering an MI
 - * More than half of the deaths after surgery will be caused by cardiac events

Heart Disease and Surgery

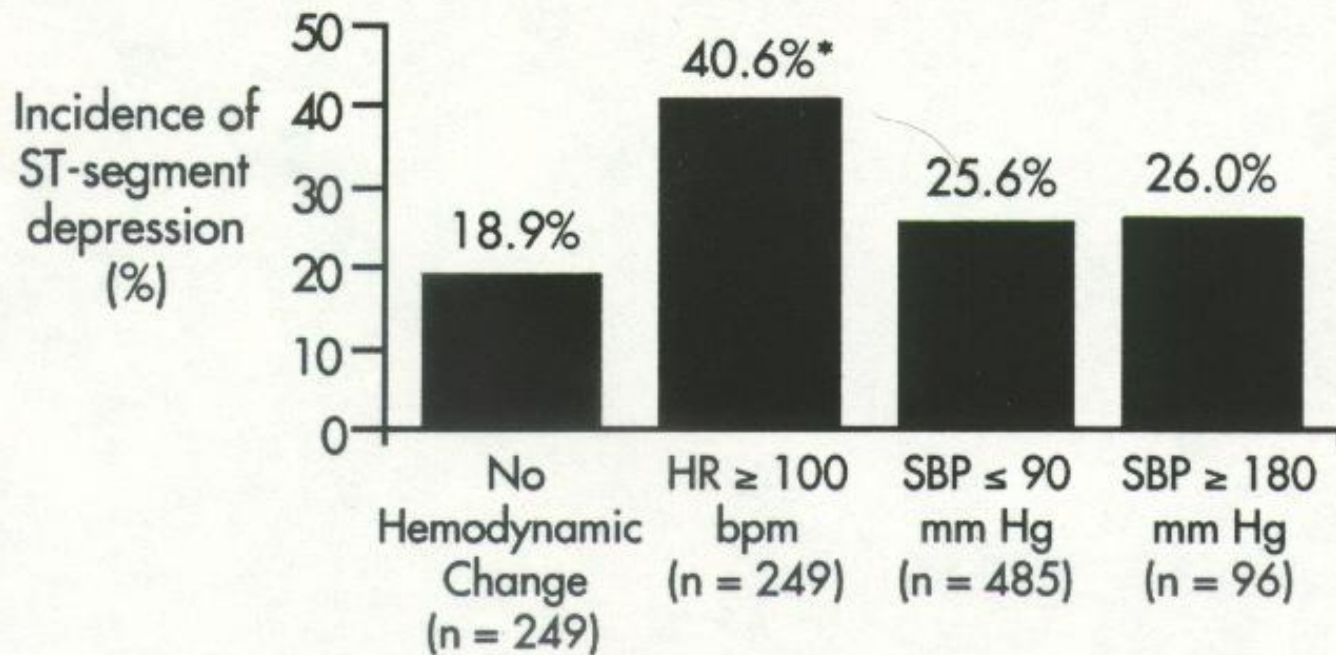
- Of those at risk for perioperative complications, ischemia occurs in 20-40%
- Pts with episodes of ischemia are more likely to die within the next 2 years
- Associated with a 9-fold increase in risk of cardiac death, MI, or unstable angina
- Patient may be asymptomatic until 70% or more occlusion occurs

Heart Disease and Surgery

- More frequent and severe during the postoperative period
- Postop MI is almost 3 X's as frequent in patients with ischemia and is independent of when ischemia occurs
- Ischemia is related significantly to perioperative tachycardia (Wallace)

Anesthesia and Ischemia

Relation between Hemodynamic Abnormalities during Anesthesia and Myocardial Ischemia



* $P < 0.025$ vs others

Slogoff S, Keats AS. *Anesthesiology* 1985;62:107-114.

Detecting Ischemia

- **Lead II:**

- P wave identification
- Ventricular arrhythmias

- **Precordial leads: Ischemia**

- **V5:**

- Most useful to detect ST changes/ischemia of LV

Sensitivity to Detect Ischemia

- V_4 : 61%
- V_5 : 75%
- V_4 & V_5 : 90%
- V_5 , Lead II: 95%
- V_2 , V_3 , V_4 , V_5 , Lead II: 100%

ECG Changes: Pertinent information

- ***ECG changes are a late finding in myocardial ischemia***
- ***Must be aggressively managed***
- ***Postoperatively, greatest incidence of ischemia occurs during first 48 hours***

How healthy is the patient?

Good LV Function

- EF > 55%
- LVEDP (wedge) < 12mmHg
- CI > 2.5 L/min
- No Angina
- No CHF

Functional Capacity

Most likely the best indicator of cardiac risk

- Measured by history or formal exercise testing
- Defined by metabolic equivalents (METs)
- Relates activities to rates of metabolism
- **1-4 METS:**
 - Can eat, dress, walk around house, do dishes
- **4-10 METS:**
 - Can walk on level ground, run a short distance, climb 1 flight of stairs, golf
- **>10 METS:**
 - Can swim, play tennis or football

Impaired LV Function

- EF < 40%
- LVEDP > 18 mmHg
- CI < 2.0 L/min
- Essential HTN
- CHF
- **Triad of Symptoms**
 - **Angina, syncope, dyspnea**

Those at Risk for Perioperative Ischemia

- Age > 40 years

- Obesity
- HTN
- Hypercholesterolemia
- Dysrhythmias
- Smoking history
- PVD
- Diabetes
- Previous MI or angina/Family history

Perioperative Myocardial Ischemia

- If severe or prolonged, may result in:
 - Reversible damage (Stunned myocardium)
 - Irreversible damage (MI, sudden cardiac death)
 - Ventricular arrhythmias
 - Cardiogenic shock, CHF, pulmonary edema
- Even if nonfatal, a poor outcome may occur

Types of MIs

- Two types of heart attacks (First criterion):
 - **Anterior infarct.**
 - Most dangerous type of MI
 - Caused by a blockage in the branch of the LCA
 - Affects LV which pumps blood to all parts of the body and damages the front part of the heart.
 - **Posterior or inferior infarct**
 - Less serious
 - Caused by a blockage in the RCA or one of its branches
 - Affects the back or the base of the heart.

Types of MIs

■ According to the second criterion

■ **ST segment elevation MI (STEMI).**

- Caused by prolonged period of blocked blood supply
- Affects a large portion of the myocardium
- Causes significant changes on EKG & in blood chemical markers

■ **Non-ST segment elevation MI (NSTEMI)**

- Caused by a partial or temporary blockage in blood supply
- Extent of damage is minimal
- No changes on EKG but blood markers indicate MI

Types of MIs

- According to the third criterion:
 - **Transmural myocardial infarction**
 - Results in death of three layers of tissue (epicardium, myocardium, and endocardium) of the myocardial wall.
 - **Nontransmural myocardial infarction**
 - Results in death of limited area of myocardial wall tissue.

Anesthetic Goal

Reduce the incidence and severity of perioperative myocardial ischemia and subsequent myocardial death.

Times of Stress & Catecholamine Release

- Preoperative anxiety
- Induction
- Intubation
- Incision
- Surgical manipulation
- Emergence
- Extubation
- Postoperative Awakening
- Postoperative Pain



Anesthetic Choice

- Each type of (General, regional, MAC) has implications regarding anesthetic and intraoperative monitoring
- It can be beneficial to use volatile agents during noncardiac surgery in hemodynamically stable patients at risk for myocardial ischemia

Anesthetic Choice

- If Regional anesthesia, high dermatomal levels may be associated with significant hemodynamic changes, including hypotension
- MAC with insufficient local anesthetic by surgeon can lead to increased incidence of myocardial ischemia.
- The anesthesia provider must select the best approach for the patient and type of surgery and hypoxemia and hypotension should be avoided

Importance of Prevention

A single episode of postoperative myocardial ischemia is associated with a ninefold increase in the incidence of cardiac complications before hospital discharge and a twofold increase during the next two years.

*What can
we do
to prevent
myocardial ischemia
in
surgical patients?*

Balance Supply & Demand

- **Increase the supply of oxygen**
 - Treat anemia
 - Increase FIO_2
- **Decrease the demand of oxygen**
 - Decrease HR
 - Decrease contractility
 - Decrease preload and/or afterload
 - Prevent sympathetic stimulation

To Prevent Ischemia

- **Suppress the sympathetic stimulation**
 - Narcotics with induction
 - Deep anesthesia
- **Pharmacologic agents**
 - Alpha₂ Adrenergic Agonists
 - Nitrates
 - Calcium channel blockers
 - Beta₁ blockers

Alpha₂ Adrenergic Agonists

- Clonidine, dexmedetomidine
- Prevent tachycardia, provide perioperative control of HTN
- AHA/ACC 2007 Recommendations:
- Alpha₂ agonists may be considered for pts with known CAD or at least one clinical risk factor undergoing surgery

Nitroglycerin

- Reduces myocardial oxygen demand by decreasing preload ; Increases coronary perfusion by dilating coronary arteries and collateral circulation.
- Intraoperative NTG as prevention of ischemia and cardiac morbidity is unclear for high-risk pts having noncardiac surgery, especially those taking NTG for angina.
- The recommendation for prophylactic use of NTG must consider the anesthetic plan and pt hemodynamics and must recognize that vasodilation and hypovolemia can readily occur during anesthesia and surgery.

Calcium Channel Blockers

- Arterial vasodilation and negative inotropic effects
- Meta-analysis in 2003 on perioperative use showed significantly reduced ischemia & SVT along with decreased MI and death
- Post-hoc analysis demonstrated significantly reduced MI and/or death
- More research needed

Beta Blockers

- Protect against ischemia and myocardial reinfarction
- Reduce the incidence of postoperative ischemic events
- Reduce overall mortality caused by cardiac death and CHF in both the immediate and remote perioperative periods

Selective Beta Blockers

- Beta blockers are subdivided by selectivity for cardiac beta₁ receptors
- Implies that action is on specific receptor only
 - Example: beta₁ action is on heart only
- Less likely to cause bronchospasm
- However, as dose is increased, selectivity is diminished!

Contraindications to Beta Blockers

- Few patients have absolute contraindications to perioperative beta blockers
- Our worries:
 - Bronchospasm if reactive airway disease
 - Masked symptoms of low blood sugar if diabetic
 - Increased peripheral vascular resistance due to unopposed α -adrenergic vasoconstriction if PVD

What about the use of beta blockers in the diabetic patient?

- Can mask the symptoms of hypoglycemia and inhibit glycogenolysis, delaying recovery from hypoglycemic events
- New research now shows that selective beta blocker use reduces microvascular and macrovascular complications similar to ACE inhibitor use
- After MI, its use is associated with decreased mortality (50% decrease after one year post hospital discharge)

What about the use of beta blockers in the COPD patient?

- Cardioselective beta blockers do not produce clinically significant adverse respiratory effects in patients with mild to moderate reactive airway disease or with chronic airway obstruction
- Due to their benefits, cardioselective beta blockers should not be withheld from patients with mild to moderate reactive airway disease.

ACC/AHA 2004 Perioperative Guidelines

- Start beta blockers prior to surgery on patients at risk for ischemia; start days to weeks before
- Titrate to a resting HR of 50-60 beats/min; give perioperatively as needed
- Use aggressive therapy during first 48-72 hours postoperatively to provide maximal benefit and continue for 1 week in low-moderate risk and for 2-4 weeks or more in high risk patients.

POISE Study

- **POISE Study (PeriOp ISchemic Evaluation)**
- 8351 pts age 45 and older who were at risk or had ASHD and were having noncardiac surgery
- 23 nations, 190 sites
- Pts not previously on beta blockers received either continued release metoprolol (Toprol) or placebo preop and for 30 days postop

POISE Study

- In the Toprol group, 5.8% experience cardiac arrest, MI or death compared to 6.9% in placebo group
- In the Toprol group, 1% experienced a stroke compared to 0.5% in placebo group. (twice as many)
- In those who had sepsis, twice as many died in the Toprol group

Explanation

- The increased strokes and deaths were most likely due to cardiogenic shock.
- Beta blockers may make the brain particularly vulnerable to strokes in some pts.
- In rats given metoprolol, dramatic reductions in blood flow to the brain and oxygen tension of brain tissue were noted.

Advice on Beta Blockers

- Continue beta blockers in patients presently on them
- Do not give to patients whose risks for hypotension or other complications are too high; document in chart
- Give to patients undergoing vascular surgery who are at high cardiac risk owing to the finding of ischemia on preoperative testing. (level of evidence B)
- Avoid hypoxemia and hypotension perioperatively

2007 STEMI Recommendations

- IV Beta Blockers should not be given to STEMI pts who have any of the following:
 - Signs of heart failure or low output state
 - Increased risk for cardiogenic shock
 - Relative contraindications to beta blockers (PR > 0.24 sec, 2nd or 3rd degree HB, active asthma or reactive airway disease)

2007 STEMI Recommendations

- Risk factors for cardiogenic shock
 - Age > 70
 - Systolic B/P < 120 mmHg
 - HR < 60 or > 110
 - Increased time since onset of symptoms of STEMI

Ischemia in PACU

- Greater incidence in the PACU than during surgery
- Treatment may be more challenging
- Causes:
 - Inflammatory responses continue in the PACU
 - Hypercoagulability and decreased fibrinolytic activity
 - Atherosclerotic plaque instability, HD changes
 - Increased SNS activity associated with pain

Treatment of Ischemia

- **Morphine**
- **Oxygen**
- **Nitroglycerin**
- **Aspirin**
- **Beta blockers**
- **Ace inhibitors**
- **Heparin**

Other Information-Cardiac Stents

*What do you do
if your patient is scheduled
for noncardiac surgery
and has a cardiac stent?*

Patient with a Cardiac Stent

- Significant perioperative morbidity
- Increased morbidity & mortality if surgery occurs shortly after stent placement
 - Due to restenosis and thrombosis of stent
 - Results in life-threatening dysrhythmias, Q-wave MI or death majority of time

When Surgery can be Postponed

- For **elective procedures** with significant risk of bleeding, defer until course of thienopyridine (**Clopidogrel/Plavix**) and **Aspirin** therapy completed
- **2007 Science Advisory**
 - Bare-metal: Wait one month
 - Drug-eluting: Wait 12 months
- **2007 ACC/AHA Guidelines**
 - Bare-metal: Wait 4-6 weeks
 - Drug-eluting: Wait 12 months

When Surgery cannot be Postponed and there is low risk for blood loss:

- Keep patient on ASA and clopidogrel throughout perioperative period
- If on daily ASA monotherapy, ASA should not be discontinued prior to surgery.

When Surgery cannot be Postponed

- If surgery is **urgent or emergent** and clopidogrel must be interrupted, **continue aspirin**.
- Restart Clopidogrel as soon as possible after surgery.
- Consider giving antiplatelet therapy longer (> one month for BM and >12 months for DES).

Case Study #1

- 70 year old male, 84 kg, 70 inches, NKDA scheduled for laparoscopic cholecystectomy
- History: CAD, ischemic cardiomyopathy, bilateral carotid artery stenosis, CHF, HTN, MI in past, hyperlipidemia, CVA, arrhythmias
- Surgical history: CABG X3 10 yrs ago, pacemaker one year ago
- Meds: Coumadin, Isordil, metoprolol, HCTZ, ASA Pravastatin, iron

Case Study #1

- Worked up in Center for Preop Assessment and Planning
- Increasing SOB with activity
- Cardiac workup recently done:
 1. Placed on Lasix which he had previously been on but was discontinued; was placed back on Lasix
 2. DES cardiac stent to be placed in two weeks

Should surgery proceed?

Case Study #2

- 66 year old male, 74 kg, 68 inches, NKDA
- Arrives to holding area without going to Center for Preoperative Assessment and Planning
- Scheduled for craniotomy for malignant tumor
- History: CAD, angina, SOB, CRF, GERD
- Surgical history: CABG12 yrs ago, DES stent placed one mo ago
- Meds: Clopidogrel, ASA, Isordil, metoprolol, epogen, iron
- Cardiologist unaware of patient having surgery

Case Study #2

- Surgery postponed so patient could see cardiologist
- Cardiologist held Clopidogrel but continued ASA
- Patient then had visit with neurosurgeon prior to surgery
- Neurosurgeon gave standing orders to patient, including instructions for patient to refrain from taking any NSAIDs or ASA
- Arrived in holding area six days later for craniotomy

Case Study #2

Should surgery proceed?

Case Study #3

- 52 yr old female having abdominal hysterectomy
- History of HTN and CAD
- DES placed 12 months ago and pt has been free of chest pain
- ASA and clopidogrel stopped prior to surgery

Case Study #4

- 72 yr old female having femoral popliteal bypass graft under general anesthesia for ischemic left leg
- History of hyperlipidemia, HTN, DM Type II and CAD
- BMS placed 2 weeks ago for stenosis of coronary artery; no further chest pain
- ASA and clopidogrel stopped two days prior to surgery

Case Study #5

- 74 year-old, 86 kg female having posterior cervical interbody fusion at C5-C6
- History of ACDF 2 years ago (C3-T1); limited ROM
- History of HTN (B/P 110/70's), increased cholesterol, vertebro-basilar insufficiency, OSA but does not tolerate mask
- Plavix stopped 1 week ago; kept on ASA 325 mg qd

Summary: Drug-eluting Cardiac Stents

- Delay surgery for 12 months
- Antiplatelet therapy for 12 months (ASA, Plavix)
- Premature stoppage of drug is strong predictor of thrombosis (29%)
- High risk of death or MI with thrombosis (88%)
- Small chance of bleeding complications if continued during perioperative period
- Early surgery & stoppage of antiplatelets pose cardiac risk

Summary: Bare Metal Stents

- Delay surgery for 4-6 weeks
- Antiplatelet therapy for 4-6 weeks
- ASA continued indefinitely
- Risk of stopping antiplatelet therapy > the risk of bleeding

The image shows the Gateway Arch in St. Louis, Missouri, a large stainless steel catenary arch. It is captured during the 'golden hour' of sunset or sunrise, with the sun low on the horizon behind the arch, creating a bright glow and long shadows. The sky is a mix of blue and orange. In the foreground, there are dark silhouettes of trees and a building on the left. The text 'Thank you!' is centered over the arch in a bold, italicized, blue font.

Thank you !