

- Continued monitoring of uterine activity and fetal HR.
- Pt-controlled epidural analgesia.
- Neonatal surgery:
  - Pt should avoid supine position for 14 d.
  - Carefully titrate opioids with continuous monitoring in intensive care setting.

### Anticipated Problems/Concerns

- Fetal surgery: Delivery for this and future pregnancies requires cesarean section due to high risk of uterine rupture.
- Neonatal surgery: Pt may require concurrent placement of ventriculoperitoneal shunt at time of surgery

or may require shunt placement at a later date if head circumference continues to enlarge.

## Myocardial Contusion (Blunt Cardiac Injury)

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### Risk

- Incidence unknown, in part due to absence of clear diagnostic criteria/test
- 2 million motor vehicle accidents/y, with ~40% involving closed chest injury
- 20–70% incidence by clinical criteria
- 16–20% incidence by autopsy
- Motor vehicle > falls > crush injuries
- Males > females (5:1)
- Commotio cordis a rare form of BCI due to low impact chest injury (sports) causing sudden death

### Perioperative Risks

- Abnormal ECG
- Nonspecific ST-T wave changes (70% of trauma pts)
- Q-wave and ST-segment elevation
- 7–17% false negative
- 60% false positive
- Ventricular arrhythmias, most common in cases of contusion
  - Trifascicular conduction block.
- Other cardiac conditions: Thrombosed or lacerated coronary arteries in spasm, ventricular hypofunction, pericardial effusion/tamponade, pericarditis, valvular

- insufficiency (left-sided > right), ventricular wall rupture (including septum)
- Possible increased risk of cardiac complications (arrhythmias, hypotension) with increased CK-MB troponins and abnormal ECHO
- No evidence of increased mortality assoc with GA

### Worry About

- Malignant ventricular arrhythmia (acute and delayed)
- Cardiac conduction blocks include complete heart block
- Hemopericardium
- Volume status
- Acute hypotension
- Delayed myocardial rupture
- Associated injuries: Pulm contusion, hypoxemia, injuries to the thoracic aorta, flail chest
- Attribution of hemodynamic instability to myocardial contusion versus occult hemorrhage elsewhere

### Overview

- Traumatic injury with hemorrhagic, well-circumscribed lesions of partial or full thickness from myocardial contusion.

- Usually affecting the RV but can be multichambered.
- BCI frequently seen in severe blunt chest trauma and after CPR and precordial thumps, but difficult to definitively diagnose.
- Incorporation of clinical suspicion, anginal chest pain unrelieved by nitrates, ECG—especially ventricular dysrhythmia, CK-MB, troponin I and T levels; 2D ECHO for Dx.
- Amount of malignant arrhythmias may be proportional to the severity of myocardial contusion.

### Etiology

- Mechanical contusion of myocardium from posterior sternum.
- Ram effect from increased transdiaphragmatic pressure or sudden deceleration.
- Automobile accident most common cause, representing ~15% of cases.
- Falls ~10%.
- Crash, sports-related assaults ~15%.

### Usual Treatment

- Supportive
- Adequate volume replacement

### Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	Ventricular contusion	Angina-like chest pain unrelieved by nitrates Dyspnea	Chest wall, sternal tenderness Hypotension with severe dysfunction S <sub>3</sub> Rales	Serial ECG Increased troponin I and T within 6 h ECHO SPECT MRI
	Arrhythmia Valvular disruptions Coronary artery injury: thrombosis, laceration, spasm Effusion/tamponade	Palpitations, dizziness, syncope Dyspnea Chest pain Chest pain	Pulse Auscultatory murmurs  Pericardial friction Diminished heart sounds Distended neck veins	ECG monitoring ECG Angio TTE 2D cardiography PA catheter
RESP	CHF Pulm contusion	Dyspnea Orthopnea Chest tightness	S <sub>3</sub> Rales Wheezing Tachypnea	CXR O <sub>2</sub> saturation

**Key References:** Clancy K, Velopoulos C, Bilaniuk JW, et al.: Screening for blunt cardiac injury: an Eastern Association for the Surgery of Trauma practice management guideline, *J Trauma Acute Care Surg* 73(5 Suppl 4):S301–S306, 2012; Moore EE, Malangoni MA, Cogbil TH, et al.: Organ injury scaling. IV: thoracic vascular, lung, cardiac, and diaphragm, *J Trauma* 36(3):299–300, 1994.

### Perioperative Implications

#### Preoperative Preparation

- FAST is usual first imaging and diagnostic choice to rule in/out pericardial effusion (hemopericardium being the major concern).
- 2D ECHO or abnormal TEE predict periop hypotension and/or valve/septum disruption.
- Assess volume and ensure adequate volume replacement.
- Assess and treat associated concurrent injuries.
- No evidence for benefit of prophylactic antiarrhythmic agents.
- The Cardiac Injury Scale (American Association for Surgery of Trauma) may be useful for quality scoring, research purposes, and objective measures.

#### Monitoring

- Continuous ECG for arrhythmias.
- Consider PA cath for large fluid shift operations or pts with signs of LV dysfunction.
- Increased risk of periop arrhythmias without increased mortality.

#### Airway

- Evaluate for associated airway injury.

#### Preinduction/Induction

- Adequate volume replacement.
- Hypotension more likely with large contusions; avoid cardiodepressant induction agents.

- Extra attention to avoid hypoxia; care required with increased mean airway pressure ventilator strategies (e.g., PEEP).

#### Maintenance

- No one agent or technique shown to be superior.
- Avoid known pulm vasoconstrictors: catecholamine, hypoxia, acidosis, histamine-releasing agents (MgSO<sub>4</sub>, mivacurium).
- Consider high inspired O<sub>2</sub> if there is a contusion.
- NO can aggravate pulm Htn.
- Elevations in PVR may unmask RV failure.
- Increased LV filling pressures and decreased cardiac output often reflect hypovolemia or are secondary to RV failure, not LV failure.

**Extubation**

- May leave pt intubated if concerns for resp failure and hypoxia.

**Adjuvants**

- Combination of appropriate intravascular volume replacement and vasodilators (nitroglycerin) for pulm Htn

**Postoperative Period**

- Delayed hypoxia from pulm injury common and can cause pulm Htn leading to hypotension if RV is severely contused

**Anticipated Problems/Concerns**

- Variable diagnostic criteria, total CK-MB >50 U/L and ≥5% total CK.

- Possible higher risk of cardiac complications with increased CK-MB.
- Almost any arrhythmia may be reported, especially conduction delays; more severe contusion associated with increased malignant ventricular arrhythmia.
- Watch for RV failure leading to increased LV pressure but decreased LV diastolic filling.

## Myocardial Ischemia

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**Risk**

- Incidence in USA: 1.5 million/y develop acute MI; about 50% are silent (without enough symptoms to cause a medical visit); decreased rate of death in the United States balanced by increased population has kept MI numbers constant since 1970 despite increased population; worldwide, the incidence of MI is 9 million/y.
- Some 12 million individuals in USA have narrowing of 70% or more of one or more coronary arteries; among unselected pts over age 40 years, 1.4% have MIs; cardiac death occurs in 1.7%.
- Risk is higher among those of European, Indian, and African American heritage than among Japanese, but the environment of North America equalizes risks.
- Risk is highest in pts with known other atherosclerotic disease (including prior MI): smokers (3.5-fold increase); hypertensives (threefold increase); diabetics (4-fold increase); hypercoagulable or chronic inflammatory diseases (threefold increase); stressed, divorced, or unstable marriage (2.5-fold increase); with wt gain since age 20 years (1.5-fold increase for each 5-kg increase); increased LDL cholesterol in those who do not exercise (0.5% increase for each 1% increase above 100 mg/dL); who do not drink or take vitamin D or aspirin; whose parent died of CAD at <40 y of age (1.4- to 2.5-fold increase); age (threefold increase per decade over 50), family Hx (1.1-fold to 2.4-fold increase)

**Perioperative Risks**

- Periop CV complication (MI, CHF, RHF, arrhythmia requiring Rx) increases the risk ninefold.
- 2-y survival: Rate in high-risk pt with periop MIsch is 25% versus 85% for those without periop MIsch.
- Inadequate coronary perfusion (1–6% reinfarction rate with general surgery; higher with vascular/thoracic/upper abd surgery); lower with cataract/prostate/peripheral surgery with single-limb anesthesia only.
- Can lead to increased left or right ventricular compliance and CHF and dysrhythmias.
- Can lead to inadequate perfusion of other organs and their insufficient function (brain, kidney, liver, gut).

**Worry About**

- Postop period if stressed by perturbations that increase demand (pain, sepsis, fever, hypovolemia and hypovolemia, and tachycardia), or limit supply (thrombosis, hyperviscosity states, diseases limiting pulm function and gas exchange [restrictive, obstructive, parenchymal], Hct <28%)

**Overview**

- Condition of inadequate supply of O<sub>2</sub> and nutrients to myocardial cells relative to need associated with the increased stress of periop period,
- Treatment and prophylaxis of this and related disorders consume 10–20% of total health expenditures. Periop CV complications double with MIsch, with threefold reduction in 2-year survival and threefold increase in periop costs for major surgery.

- Major foci of clinical and basic studies are to decrease incidence and risks from concern over risk-benefit ratio and cost-effectiveness, identifying high-risk pts prior to surgery and segregating them for prior therapy (smoking cessation, control of Htn, hypercholesterol states, hypercoagulable states, PTCA, CABG) or increased periop vigilance and care (PA lines, TEE, ICU care, prophylactic pain therapy).

**Etiology**

- Known atherosclerotic risks (genetic predisposition, smoking, Htn, diabetes, divorced or unstable marriage, inflammation, hypercoagulable states, increase LDL or decrease HDL cholesterol, weight gain)
- Known conditions that increase periop demands on heart (tachycardia; 2-fold greater for HR >90, 11-fold greater for HR >110); or limit supply (vasospastic states; PaCO<sub>2</sub> <25; Hct <28%; hyperviscosity and hypercoagulable states; inadequate O<sub>2</sub> exchange)

**Usual Treatment**

- Decrease atherogenic risk factors.
- Decrease periop demands on the heart.
- Consider preop segregation for statin or aspirin (162.5mg) and nitrate therapies, antispasmodic and sympatholytic therapies, PTCA or CABG considerations, or stepped up postop care of increased monitoring, intensive normalization of hemodynamics, more prophylactic pain therapies. See the algorithm in second Key Reference below the Assessment Points.

**Assessment Points**

System	Effect	Assessment by Hx	PE	Test
HEENT	Plaques in other areas	Risk factor search: Smoking stain, hypercholesterolemic lesions	McArdle earlobe	
CV	Decreased left or right ventricular compliance Decreased pump function arrhythmias Autonomic pain	SOB, DOE, angina, reduced exercise tolerance, palpitations, PND	HR/BP prior to and after two-stair climb; S <sub>3</sub> ; rales; JVD; use character and rhythm	ECG, CXR, stress ECHO or dipyridamole thallium or ambulatory Holter, troponins, and myeloperoxidase tests
RESP		Nocturnal cough, orthopnea		
RENAL	Perfusion insufficiency	Nocturia Erectile dysfunction (male) Loss of ability to achieve orgasm (female)		BUN/Cr
CNS	Autonomic pain syndromes Other atherosclerotic syndromes	Pain in neck or left arm History of stroke or TIA	CNS and cranial nerve exam	Carotid Doppler, testing of ANS

**Key References:** Jeremias A, Kaul S, Rosengart TK, et al.: The impact of revascularization on mortality in patients with nonacute coronary artery disease, *Am J Med* 122(2):152–161, 2009; Fleisher LA, Fleischmann KE, Auerbach AD, et al.: 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines, *Circulation* 130(24):2215–2245, 2014; Practice advisory for the perioperative management of patients with cardiac rhythm management devices: pacemakers and implantable cardioverter–defibrillators, *Anesthesiology* 103(1):186–198, 2005.

**Perioperative Implications****Preoperative Preparation**

- Consider segregation procedures and prophylactic regimens (see [Usual Treatment](#)); continue concurrent aspirin, adrenergic, and antilipidemic therapies; optimize blood sugar control.

**Monitoring**

- ST-T waves of area of myocardium identified as at risk (or II and V<sub>5</sub>) (II especially for CNS surgery); ST-segment trend analysis.
- Consider TEE and arterial line and approaches to intensive normalization of hemodynamics.
- Management of arrhythmia control devices.

**Airway**

- Routine

**Induction**

- Without hemodynamic disturbance and especially with control of HR