Rotation Title: Anesthesia for Cardiothoracic Surgery

I. Definition: The rotation for adult cardiothoracic anesthesiology is part of two one-month rotations in the CA-2 year. The adult cardiac portion is focused on all elements of the perioperative care of patients for all forms of cardiac surgery, including coronary revascularization, valve replacement, valve repair, arrhythmia surgery and ventricular remodeling.

II. Curriculum: The goal is to provide a broad exposure to all elements of anesthesia for adult cardiac surgery. The clinical experience is supplemented by detailed manual and intraoperative discussions

III. Performance Assessments:

A. Self Assessment
You (the resident) are to check off each criterion as the material is mastered. Self reflection on your own competencies is critical.

B. Faculty Assessment
Faculty will periodically review your self assessment and discuss their assessments of your competencies. The overall scores on the six competencies will be reported to you at least weekly.

C. Mentor Assessment
Your mentor should meet with you quarterly and review your entire portfolio. The mentor should report areas in which you have deficiencies (for your level of training). This report may be to you and/or to the program director as determined by your mentor.

IV. Competencies Assessed (Performance Criteria):

A. Patient Care: At the conclusion of this module, the resident should be able to …

1. Discuss a cardiac anesthetic with patient and their family, including alternatives, risks and benefits of the procedure
2. Insert, manage, and interpret the results of arterial catheterization, central venous catheterization, and pulmonary artery catheterization with minimal staff assistance in the majority (>75%) of cases.
3. Perform fiberoptic bronchoscopy with minimal staff assistance in the majority (>75%) of cases.
4. Insert and manage double lumen endotracheal tubes with minimal staff assistance in the majority (>75%) of cases.
5. Place and manage epidural catheters for patients having cardiothoracic surgery.

B. Medical Knowledge: At the conclusion of this rotation, the resident should be able to:

1. Describe the normal anatomy and physiology of the heart.
2. Discuss pharmacology pertinent to the cardiovascular system including arrhythmia therapy, vasodilators, inotropes and modifiers of hemostasis
3. Describe coronary artery and valvular heart disease.
4. Explain anesthesia implications of these diseases.
5. Discuss and explain the rationale of induction and maintenance of anesthesia techniques for cardiothoracic surgery.
6. Discuss the mechanism and anesthesia implications of cardiopulmonary bypass.
7. Describe the pathophysiology and the anesthesia implications of anesthesia for aortic surgery.
8. Explain the sequential steps in cardiopulmonary resuscitation.
9. List the indications, and potential complications of:
   a. arterial catheterization

b. central venous catheterization
c. pulmonary artery catheterization
d. bronchoscopy
e. double lumen tube placement
f. epidural catheters

10. Describe the expected postoperative recovery of the uncomplicated cardiac surgery patient.
11. List common problems and their treatments of this uncomplicated surgery patient
12. Describe the expected postoperative recovery of the uncomplicated thoracic surgery patient.
13. Describe the management of ventilation of the uncomplicated cardiac/thoracic surgery patients.
14. Discuss transesophageal echocardiography
15. Describe the pathophysiology of hypertension
16. Discuss valvular heart disease
18. Discuss artificial circulation and circulatory assist devices

The CA-2 resident on their anesthesia for cardiothoracic surgery rotation shall be responsible for mastering all material listed in Appendix A. These will be assessed by written and oral examinations.

C. Practice Based Learning and Improvement: Throughout this rotation, the resident should be able to …

1. Determine the status and outcome of patients anesthetized by the resident.
2. Review the surgical procedure and anesthetic of completed cases and compare with the anesthetic plan to determine whether the best plan had been formulated
3. Track case counts showing involvement in variety of cases so that comfort level extends to both revascularization and valvular surgeries
4. Attend and/or present at M&M and journal clubs.
5. Follow CV literature for new drugs and techniques
6. Look up and report to attending physicians the scientific evidence for the appropriate surgical care and anesthetic care of both usual and unusual cases. This should be done at least weekly. A copy of this report may be placed in your portfolio.

D. Interpersonal and Communication Skills: At the conclusion of this rotation, the resident will:

1. Be able to identify the relevant preoperative information needed to plan anesthesia for cardiac surgery
2. Know the stage of the surgical procedure quickly by observation and interaction with the surgical team
   a. Recognize when initiation of cardiopulmonary bypass is eminent so the patient can be anticoagulated
   b. Know when weaning from bypass is eminent

E. Professionalism: During this rotation, the resident must:

1. Safely prepare the patient for invasive monitoring
2. Interact with the members of the cardiac team in a professional manner to foster good patient care

F. Systems-Based Practice

1. Resident should understand the role of cardiac catheterization, interventional cardiology and cardiac surgery in the health maintenance of the elderly
2. Resident should review the geriatric module in the context of the cardiac patient-controlled
3. Resident should review international health care models for cardiac care.

Revised: **June 4, 2007**

Appendix A: Medical Knowledge expected to be mastered during CA-2 Anesthesia for Cardiothoracic Surgery Rotation

Lecture 16

Defibrillators

1) Autonomic Internal, External, Implantable; Energy, Cardioversion; Types of Waveforms (Monophasic, Biphasic); Paddle Size and Position; Automated External Defibrillators (AEDs)

Lecture 17

Pacemakers

1) Temporary Transvenous; Permanent (Epicardial, Endocardial), Transcutaneous
2) Types: Fixed Rate, Biventricular Synchronized, Ventricular, Atrial, Atrio-ventricular (A-V) Sequential
3) Standard Nomenclature
4) Reasons for Failure or Malfunction

Lecture 15

Coagulation Monitors and Testing

1) Coagulation Monitors (TEG, ACT, Sonoclot, PFA 400, etc.)

Lecture 58

Biochemistry of Acid Base

1) Normal Acid-Base Regulation: Buffer Systems; Compensatory Mechanisms; Effects of Imbalance on Electrolytes and Organ Perfusion; Strong Ion Difference (SID)
   a) temperature effect on blood gases: alpha-stat vs. pH-stat

Lecture 64

Cardiovascular Physiology – Part 1

1) Cardiac Cycle
   a) control of heart rate
   b) synchronicity of pressure, flow, ECG, sounds, valve action
   c) impulse propagation
   d) normal ECG
   e) electrophysiology, ion channels and currents
2) Ventricular Function
   a) Frank-Starling law; preload and afterload, intracardiac pressures
   b) force, velocity, length, rate of shortening
   c) myocardial contractility, measurement limitations
   d) cardiac output: determinants and regulation
   e) myocardial oxygen utilization
   f) systolic and diastolic function

Lecture 65

Cardiovascular Physiology – Part 2

1) Venous Return
   a) vascular compliance/venous compliance; controlling factors
   b) muscle action; intrathoracic pressure; body position
   c) blood volume and distribution
2) Blood Pressure
   a) systolic, diastolic, mean, and perfusion pressures
   b) intracardiac, pulmonary, venous
   c) systemic and pulmonary vascular resistance, viscosity
   d) baroreceptor function
3) Microcirculation
   a) capillary diffusion; osmotic pressure, Starling's Law
   b) pre-post capillary sphincter control
   c) viscosity; rheology

Lecture 66

Cardiovascular Physiology – Part 3

1) Regional Blood Flow and its Regulation
   a) cerebral and spinal cord
   b) coronary
   c) pulmonary
   d) renal
   e) splanchnic - hepatic
   f) muscle and skin
   g) uterine and placental
2) Regulation of Circulation and Blood Volume
   a) central: vasomotor center, hypothalamic-pituitary-adrenal axis
   b) peripheral: receptors and reflexes
   c) hormonal control
   d) mixed venous oxygen tension and saturation

Lecture 67

Cardiovascular Anatomy

1) Normal Anatomy of Heart and Major Vessels
   a) echocardiographic heart anatomy: chambers, valves, great vessels, pericardium, basic tranesophageal echocardiography (TEE) views, MRI
2) Coronary Circulation
   a) heart conduction system; innervation
   b) blood supply of other major organs

Lecture 68

Inotropes

1) Digitalis; Actions and Toxicity
2) Positive Inotropes
3) Phosphodiesterase III Inhibitors (Inodilators): Milrinone, Others

Lecture 69

Antiarrhythmics

Lecture 70

Antianginal Drugs

Lecture 71

Direct Vasodilators and ACE Inhibitors

1) Nitroprusside, Nitroglycerin, Hydralazine, Nesiratide, etc.
2) Angiotensin Converting Enzyme Inhibitors and Angiotensin Blockers

Lecture 73

Electrolytes and the Heart

1) Electrolytes (Potassium, Magnesium, Phosphorus, Calcium): Cardiovascular Effects

Lecture 74

Ischemic Heart Disease

1) risk factors, predictors of perioperative risk, modification of perioperative risk (e.g., prophylactic beta-blockers)
2) manifestations
3) diagnosis of myocardial infarction; clinical, ECG, enzymes, echocardiography, nuclear techniques
4) pharmacological treatment of angina; thoracic epidural for angina, interventional cardiologic techniques
5) determinants of myocardial oxygen requirements and delivery, silent ischemia, postoperative ischemia
6) perioperative diagnosis and treatment of ischemia; ECG, TEE
7) coronary artery bypass procedures; cardiopulmonary bypass; off-pump and other minimally invasive techniques

Lecture 75

Valvular Heart Disease

1) classification
2) diagnosis, natural history, surgical management
3) anesthetic considerations, minimally invasive techniques
4) subacute bacterial endocarditis prophylaxis

Lecture 76

Rhythm Disorders and Conduction Defects

1) electrophysiology
2) chronic abnormalities: etiology, diagnosis, therapy
   (a) Automated Implantable Cardioverter/Defibrillator (AICD) implantation
   (b) pacemakers: permament, temporary, transvenous, transcutaneous; ventricular synchronization
   (c) ablations, cryotherapy, Maze procedure
3) intraoperative dysrhythmia: etiology, diagnosis, therapy
4) perioperative implications of pacemaker and AICD

Lecture 77

Heart Failure and Cardiomyopathy (Ischemic, Viral, Hypertrophic)

1) definition and functional classification
2) compensatory responses
3) right or left ventricular dysfunction
   (a) etiology
   (b) signs and symptoms
   (c) diagnostic tests
   (d) systolic vs. diastolic dysfunction
4) treatment
   (a) pulmonary edema
   (b) pulmonary hypertension
   (c) cardiogenic shock
5) cardiac transplantation

Lecture 78

Cardiac Tamponade and Constrictive Pericarditis

1) etiology
2) diagnosis; TEE, PA catheter
3) anesthetic management

Lecture 79

Cardiopulmonary Bypass Basics

1) components (pump, oxygenator, heat exchanger, filters)
2) cardiopulmonary bypass techniques
3) mechanisms of gas exchange
4) priming solutions, hemodilution

Lecture 80

Coagulation during Cardiopulmonary Bypass

1) anticoagulation and antagonism; Activated Clotting Time (ACT) and other clotting times, heparin assays, antithrombin III, protamine reactions, heparin and protamine alternatives
2) prophylaxis with aminocaproic acid, tranexamic acid, and aprotinin

Lecture 81

Anesthetic Considerations During Bypass

1) extracorporeal membrane oxygenation (ECMO)
2) cooling and warming, deep hypothermic circulatory arrest
3) monitoring, blood pressure management
4) minimally invasive bypass techniques
5) myocardial preservation: physiology, techniques, complications
6) preconditioning

Lecture 82

Ventricular Assist Devices

1) intraaortic balloon: rationale, indications, limitations
2) artificial heart and ventricular assist devices: internal and external

Lecture 83

Pulmonary Embolism

1) etiology: blood, air, fat, amniotic fluid
2) diagnosis, TEE findings
3) treatment; acute, preventive

Lecture 99

Autonomic Drugs

1) Sympathetic
   a) transmitters and types of receptors
   b) target organ effects; metabolic effects
   c) agonists: peripheral and central actions, direct and indirect actions, alpha vs. beta vs. mixed agonists, alpha and beta-receptor subtype-selective agonists
   d) antagonists: alpha and beta blockers, selective blockers, ganglionic blockers
   e) tocolytic applications
2) Parasympathetic
   a) transmitters
   b) muscarinic effects
   c) nicotinic effects
   d) agonists: cholinergic and anticholinesterases
   e) antagonists

Lecture 161

Anesthesia for Organ Donors

1) Pathophysiology And Clinical Management