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ANESTHESIOLOGY

Problem-Oriented Patient Management

NINTH EDITION

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*This book is dedicated to the late
Joseph F. Artusio Jr., MD, who taught us not
only to be good anesthesiologists but also to become
better persons.*



Contents

Contributors

Preface

Acknowledgments

SECTION 1 The Respiratory System

1 Asthma and Chronic Obstructive Pulmonary Disease

Jaroslav K. Usenko and Fun-Sun F. Yao

A. Medical Disease and Differential Diagnosis

- A.1. What is the differential diagnosis of dyspnea?*
- A.2. What is the prevalence of asthma and chronic obstructive pulmonary disease (COPD)?*
- A.3. What is the etiology of asthma?*
- A.4. Discuss the pathogenesis of asthma. How is asthma distinguished from COPD?*
- A.5. What are the triggers of bronchospasm?*
- A.6. What is the universal finding in ABGs during asthmatic attacks: hypoxemia or CO₂ retention?*
- A.7. Describe the abnormalities seen in spirometry, lung volumes, and lung capacities during an asthmatic attack.*

B. Preoperative Evaluation and Preparation

- B.1. How would you evaluate the patient preoperatively? What preoperative workup would you order?*
- B.2. How would you distinguish obstructive lung disease from restrictive lung disease by spirometry?*

- B.3. Define normal lung volumes and lung capacities. Give normal values for an average adult male.*
- B.4. What are flow–volume loops? Draw flow–volume loops for a healthy subject and patients with COPD, restrictive lung disease, fixed obstruction of the upper airway, variable extrathoracic obstruction, and variable intrathoracic obstruction.*
- B.5. Define closing volume (CV) and closing capacity (CC). What is the normal value of CV?*
- B.6. Why is the functional residual capacity (FRC) important in oxygenation?*
- B.7. How are FRC and CC affected by age and posture? How are they affected by anesthesia?*
- B.8. Give the equations for shunt (Q_s/Q_t) and dead space/tidal volume (V_d/V_t). What are their normal values?*
- B.9. Interpret the following ABG: pH, 7.36; P_{CO_2} , 60 mmHg; P_{O_2} , 70 mmHg; and CO_2 content, 36 mEq per L.*
- B.10. What are the common physiologic causes of hypoxemia?*
Decreased pulmonary capillary oxygen tension
Increased shunting
Reduced venous oxygen content
- B.11. How would you prepare this asthmatic patient with COPD for surgery?*
- B.12. The patient comes to your perioperative clinic 2 weeks before surgery. He wants to know if his smoking puts him at increased risk during surgery. What do you tell him? Should he quit now?*
- B.13. You discover that the patient had a recent upper respiratory infection (URI), would you postpone surgery? For how long?*
- B.14. What medications would you expect the patient to have taken in the past or be taking at the present time?*

- B.15. The patient was on 20 mg of prednisone per day for 5 days as part of the treatment of an asthma exacerbation 3 months ago. He is currently not on steroids. Should the patient receive stress-dose steroids?*
- B.16. Should patients with reactive airway disease receive preoperative steroids?*
- B.17. What is the onset of action of intravenous steroid therapy in asthma?*

C. Intraoperative Management

- C.1 If the patient had a severe asthmatic attack in the operating room before the induction of anesthesia, would you proceed with the anesthetic or postpone the surgery?*
- C.2. The patient did not have an asthmatic attack in the operating room and you proceed with induction. How would you induce anesthesia? Would you use a supraglottic airway instead of an endotracheal tube?*
- C.3. Would you use propofol for induction of anesthesia?*
- C.4. Would you use thiopental, methohexital, etomidate, or ketamine for induction?*
- C.5. Would you administer lidocaine for intubation?*
- C.6. If this is an emergency surgery and rapid sequence induction is indicated, how would you induce anesthesia in this patient?*
- C.7. Could a regional technique be used for this surgery? Discuss the advantages and disadvantages of neuraxial anesthesia in this patient for this surgery.*
- C.8. Would you choose an inhalational or an intravenous technique for maintenance of anesthesia?*
- C.9. What mechanisms produce bronchodilation from volatile anesthetics?*
- C.10. Which muscle relaxants would you use? Why?*
- C.11. How will you ventilate the patient? Will you use positive end-expiratory pressure (PEEP)? How can you detect the*

presence of auto-PEEP on your ventilator?

- C.12. What is the differential diagnosis of intraoperative bronchospasm?*
- C.13. In the middle of surgery, peak inspiratory pressures (PIPs) suddenly increase. How do you manage this?*
- C.14. How would you give β_2 -agonists? What is their mechanism of action on asthma?*
- C.15. If the patient does not respond to the aforementioned treatment and becomes cyanotic, what would you do?*
- C.16. The asthmatic attack was relieved with your treatment, and the surgery was completed. Following emergence, the patient was found to be hypoventilating. What are the common causes of hypoventilation? What will be your approach to treat hypoventilation?*
- C.17. Would you consider a deep extubation in this patient?*
- C.18. If the patient cannot be extubated, what measures can you take to reduce the likelihood of bronchospasm with an endotracheal tube in place?*

D. Postoperative Management

- D.1. In patients with asthma and COPD, are there special considerations for the use of opioids and nonsteroidal anti-inflammatory drugs (NSAIDs) for postoperative pain control?*
- D.2. Would you consider using a regional technique for analgesia?*
- D.3. The patient was breathing well and was extubated. Would you place this patient on supplemental oxygen in the recovery room? How much?*
- D.4. The patient is hypoventilating in postanesthesia care unit (PACU). Would you initiate noninvasive ventilation (NIV)?*

2 Bronchoscopy, Mediastinoscopy, and Thoracoscopy

Alessia Pedoto, Paul M. Heerdt, and Fun-Sun F. Yao

- A. Medical Disease and Differential Diagnosis
 - A.1. *How is the diagnosis of lung cancer made? What is your prediction for the most likely type of malignancy?*
 - A.2. *What are the less common manifestations of bronchogenic carcinoma?*
 - A.3. *The patient has a long history of cigarette smoking. What is the significance of this finding?*
- B. Preoperative Evaluation and Preparation
 - B.1. *How would you evaluate the patient prior to surgery?*
 - B.2. *What are the pulmonary function guidelines that indicate an increased risk for morbidity and mortality?*
 - B.3. *What are the preoperative concerns of induction immunotherapy?*
- C. Intraoperative Management
 - C.1. *How would you premedicate, monitor, and anesthetize this patient?*
 - C.2. *How many types of bronchoscopes are available and what are the intraoperative considerations of each one?*
 - C.3. *What are the indications for cervical mediastinoscopy? Are there potential complications?*
 - C.4. *The decision was made to proceed with a robotic right middle lobectomy. How would this alter your management?*
 - C.5. *What are the indications for single-lung ventilation and how can it be accomplished?*
 - C.6. *What are the contraindications to the use of double-lumen endotracheal tubes (DLTs)?*
 - C.7. *Would you use a right- or left-sided DLT?*
 - C.8. *How do you know that the tube is in the correct position?*
 - C.9. *How many types of bronchial blockers are available? What are the advantages and disadvantages of bronchial blockers?*
 - C.10. *How will systemic oxygenation be monitored during single-lung ventilation? What is the mechanism of pulse oximetry?*

C.11. The patient was placed in the lateral decubitus position. Describe the effects of lateral positioning on pulmonary blood flow and respiration.

Respiratory Effects

C.12. What is hypoxic pulmonary vasoconstriction (HPV)?

C.13. What are the effects of anesthetic agents on HPV and their clinical implications?

C.14. Discuss pulmonary blood flow distribution, shunt flow, and partial pressure of oxygen in the arterial blood (P_{aO_2}) (fractional inspired O_2 concentration [F_{IO_2}] = 1.0) during single-lung ventilation in the lateral position.

C.15. How could you improve oxygenation during single-lung ventilation?

Ventilated Lung

Collapsed Lung

C.16. A right middle lobectomy was performed. Would you extubate the trachea at the end of the procedure?

D. Postoperative Management

D.1. What are the immediate life-threatening complications that follow lobectomy or pneumonectomy?

D.2. Why is it important to control postoperative pain? How would you achieve this goal?

Epidural, Paravertebral, and Intrathecal Analgesia

Peripheral Nerve Blocks

Systemic Opioids and Adjuvants

Oral and Transdermal Agents

Intrapleural Regional Analgesia

Cryoanalgesia

Transcutaneous Electrical Nerve Stimulation

Shoulder Pain after Lung Resection

3 Aspiration and Postoperative Respiratory Failure

Kapil Rajwani, Edward J. Schenck, and David A. Berlin

A. Aspiration

- A.1. What are the risk factors for perioperative aspiration?*
- A.2. How does large volume aspiration affect the respiratory system?*
- A.3. How should you manage the patient after an aspiration event?*
- A.4. How would you prevent aspiration during emergency surgery?*

B. Postoperative Respiratory Failure

- B.1. How can you predict which patients will develop postoperative respiratory failure?*
- B.2. How can intraoperative anesthesia management prevent respiratory failure?*
- B.3. What is the pathogenesis of postoperative respiratory failure?*
- B.4. What is the diagnostic approach to postoperative respiratory failure?*

C. Indications for Ventilator Support

- C.1. What are the indications for noninvasive positive pressure ventilation (NIPPV)?*
- C.2. What are the indications for emergency endotracheal intubation?*

D. The Acute Respiratory Distress Syndrome

- D.1. What is the definition and etiology of the acute respiratory distress syndrome (ARDS)?*
- D.2. Explain the pathophysiology of ARDS.*
- D.3. What role does ventilator-induced lung injury (VILI) play in ARDS?*

E. Management of Mechanical Ventilation

- E.1. Which mode of mechanical ventilation will you choose? Describe the features of that mode.*
- E.2. How should you set the fraction of inspired oxygen (FIO₂)?*
- E.3. How should you set the positive end-expiratory pressure*

(PEEP)?

E.4. What tidal volume and inspiratory pressure target should you set?

F. Management of Refractory Respiratory Failure

F.1. What else can promote additional lung recruitment?

F.2. What rescue strategies can you use for refractory ARDS?

G. Adjunctive Management of Respiratory Failure

G.1. What is the cause and treatment of the hemodynamic instability associated with mechanical ventilation?

G.2. What is the adjunctive medical therapy for ARDS?

H. Liberation of the Patient from Mechanical Ventilation

H.1. Explain the importance of the decision to extubate the patient or continue mechanical ventilation.

H.2. How will you prepare the patient for liberation from the ventilator?

H.3. How will you recognize when the patient is ready for extubation?

4 Lung Transplantation

Choy Lewis, Ryan Hood, and Charles W. Hogue

A. Medical Disease and Differential Diagnosis

A.1. What are the expected manifestations of severe obstructive pulmonary disease in this patient, and why is she a transplant candidate?

A.2. What other end-stage lung diseases can also be treated with transplantation?

A.3. How many lung transplantations have been performed?

A.4. What are the selection criteria for recipients?

A.5. How is the decision made to transplant one or both lungs, and does this influence preoperative management?

A.6. How does a single-lung transplantation (SLT) differ technically from a bilateral-lung transplantation (BLT)?

B. Preoperative Evaluation and Preparation

B.1. What preoperative evaluation is desirable?

- B.2. Would you premedicate this patient? If so, how?*
- B.3. What vascular access is appropriate?*
- B.4. Is preoperative epidural catheter placement advantageous?*

C. Intraoperative Management

- C.1. What special equipment is necessary?*
- C.2. How would you monitor this patient?*
- C.3. How would you induce anesthesia in this patient?*
- C.4. How would you ventilate this patient? What kind of endotracheal tube would you use?*
- C.5. How does the physiology of single-lung ventilation influence the procedure?*
- C.6. How does single-lung ventilation affect cardiopulmonary function? What are the problems of single-lung ventilation in this patient? How would you treat them?*
- C.7. What problems are associated with the lateral position?*
- C.8. Should volatile anesthetics be avoided during single-lung ventilation?*
- C.9. At what specific points in the procedure are problems anticipated?*
- C.10. How would you deal with problems related to clamping of the pulmonary artery (PA)?*
- C.11. What hemodynamic alterations would you expect during graft implantation and reperfusion? How would you correct them?*
- C.12. When is cardiopulmonary bypass (CPB) necessary for lung transplantation?*
- C.13. Should fluid administration be restricted, and are blood products commonly required?*
- C.14. Would you extubate the patient upon conclusion of the procedure?*

D. Postoperative Management

- D.1. What are the major complications after lung transplantation?*

- D.2. How is postoperative ventilation managed, and for how long is it required?*
- D.3. What special precautions should be taken when a lung transplant recipient requires general anesthesia for subsequent nonpulmonary surgery?*
- D.4. What are the long-term outcomes of lung transplantation?*
- D.5. Are there surgical alternatives to lung transplantation?*

SECTION 2 The Cardiovascular System

5 Ischemic Heart Disease and Coronary Artery Bypass Grafting

Yasdet Maldonado, Nikolaos J. Skubas, and Fun-Sun F. Yao

A. Medical Disease and Differential Diagnosis

- A.1. What is triple-vessel CAD? Name the branches of the coronary arteries.*
- A.2. What are the indications for CABG?*
- A.3. What is percutaneous coronary intervention (PCI)? Discuss its indications, contraindications, and results.*
- A.4. What are the expected results of CABG?*

B. Preoperative Evaluation and Preparation

- B.1. Which preoperative tests would you order?*
- B.2. How would you evaluate the patient's left ventricular function?*
- B.3. Which factors determine myocardial oxygen supply?*
- B.4. What are the three major determinants of myocardial oxygen consumption? How are they measured clinically?*
- B.5. Would you continue the β -blocker (metoprolol) on the day of surgery? Why/why not? What is its half-life? What is the role of β -adrenergic blockers in treating congestive heart failure (CHF)?*
- B.6. Would you continue the angiotensin-converting enzyme (ACE) inhibitor on the day of surgery? Why/why not?*
- B.7. If the patient who is on lisinopril develops hypotension intraoperatively, how would you manage it?*

C. Intraoperative Management

C.I. Before Cardiopulmonary Bypass

C.I-1. What is your plan to monitor the patient?

C.I-2. What is the Allen test?

C.I-3. How would you monitor electrocardiogram (ECG)? Why lead V₅? If you do not have precordial leads in your ECG machine, how can you monitor the left ventricle (LV)?

C.I-4. Should you monitor temperature from multiple sites?

C.I-5. Is it necessary to monitor pulmonary artery (PA) pressure for coronary artery operations?

Diagnostic

C.I-6. What are the possible complications of PA catheterization?

Similar to Central Venous Catheter Insertion

From Pulmonary Artery Catheter

C.I-7. What is normal pulmonary artery occlusion pressure (PAOP)?

C.I-8. What are the hemodynamic consequences of myocardial ischemia? How can you detect myocardial ischemia? Is PAOP a sensitive indicator of myocardial ischemia?

C.I-9. Discuss the principles and clinical applications of intraoperative transesophageal two-dimensional echocardiography.

C.I-10. How would you induce anesthesia? Is there any advantage/disadvantage to using propofol versus etomidate as the main induction agent? What kind of neuromuscular blocker (NMB) would you use? Why?

C.I-11. How would you maintain anesthesia? Volatile anesthetics or total intravenous anesthesia (TIVA)?

C.I-12. What are the cardiovascular effects of volatile anesthetics, morphine, and fentanyl?

C.I-13. What should you do during sternotomy?

C.I-14. Would you use prophylactic nitroglycerin during CABG to

prevent intraoperative myocardial ischemia or perioperative MI?

- C.I-15. If ST-segment depression is seen during surgery, how would you treat it? What is the relation between perioperative myocardial ischemia and postoperative MI?*
- C.I-16. Discuss autologous transfusion and blood conservation for cardiac surgery.*
- C.I-17. What antifibrinolytic will you use to reduce blood transfusions?*
- C.I-18. How do you know that the tip of the PA catheter is in the right ventricle (RV) or the PA?*
Pressure Contour
Ventricular Filling
- C.II. During Cardiopulmonary Bypass*
- C.II-1. What anticoagulant would you give before cardiopulmonary bypass (CPB)? How much would you give? What is its mechanism?*
- C.II-2. What is the half-life of heparin? How is it eliminated?*
- C.II-3. How do you monitor heparin dosage? What is the activated coagulation time (ACT) test?*
- C.II-4. What is total CPB? What is partial bypass?*
- C.II-5. What kinds of pumps are used in CPB? Are they pulsatile or not?*
- C.II-6. What is the purpose of venting the LV? How can it be done?*
- C.II-7. How many types of oxygenators are there? What are the advantages of each type?*
Direct Gas Interface
Without Gas Interface
- C.II-8. What kind of priming solution would you use? How much priming solution would you use? When would you prime with blood? Why?*
- C.II-9. What are the advantages and disadvantages of*

hemodilution?

Advantages of Hemodilution

Disadvantages of Hemodilution

C.II-10. How do you monitor the patient during CPB?

Clinical Monitoring

Laboratory Monitoring at Least Once Every Hour

C.II-11. What should your target BP be during CPB?

C.II-12. How would you treat hypotension during CPB?

C.II-13. How would you treat hypertension (a mean arterial pressure [MAP] of over 100 mmHg)?

C.II-14. How do you prepare an IV infusion of sodium nitroprusside, nicardipine, and nitroglycerin? What are the usual doses? Which do you prefer to use?

C.II-15. How much pump flow would you maintain during CPB? During hemodilution? During hypothermia?

C.II-16. How does blood viscosity change during hemodilution and hypothermia?

C.II-17. How is anesthesia provided during CPB?

C.II-18. Would you give muscle relaxants during CPB? How is the action of muscle relaxants affected during CPB?

C.II-19. How do you know the patient is well perfused during CPB?

C.II-20. How much gas flow would you use for the oxygenator? What kind of gas would you use? Why?

C.II-21. What are the disadvantages of hypocapnia during CPB?

C.II-22. How would you preserve the myocardium during CPB?

C.II-23. What is cardioplegia? How much would you use?

C.II-24. The arterial blood gases and electrolytes during CPB are as follows: pH, 7.36; PaCO₂, 42 mmHg; PaO₂, 449 mmHg; CO₂ content, 24 mEq per L; sodium (Na), 128 mEq per L; potassium (K), 5.8 mEq per L; glucose, 180 mg/dL; and hematocrit, 20%. The patient's temperature is 27°C (80.6°F). At what temperature are blood gases measured?

How would you correct the blood gases according to patient's body temperature? Would you treat the arterial blood gases at 37°C (98.6°F) or at patient's body temperature?

C.II-25. How does the blood sugar level change during CPB? Why? What is optimal glucose control intraoperatively? Does hyperglycemia increase neurologic complications during CPB?

C.II-26. What are the effects of CPB on platelet and coagulation factors?

C.II-27. If the blood level of the venous reservoir is low, what would you replace it with? Blood or balanced salt solution?

C.II-28. How do you estimate the fluid balance during CPB?

C.II-29. For how long a period can the aorta be cross-clamped?

C.II-30. Why does the urine turn pink in some cases of CPB? What is the renal threshold for plasma hemoglobin?

C.II-31. Why does it take longer to rewarm than to cool the patient via the pump oxygenator?

C.II-32. At what temperature can the patient be weaned from CPB?

C.II-33. How would you defibrillate the heart internally during CPB?

C.II-34. If the HR is 40 beats per minute, what should you do?

C.II-35. How would you prepare for termination of CPB?

Laboratory Data

Anesthesia Machine

Monitors

Patient/Pump

Support

C.II-36. How would you decide the need for inotropic support?

C.III. After Cardiopulmonary Bypass

C.III-1. How would you reverse heparin? How much protamine would you use? What are the other drugs used to neutralize

heparin?

C.III-2. What is the action mechanism of protamine?

C.III-3. What are the complications of too much protamine?

C.III-4. What is a protamine reaction? How can you prevent this condition? How do you treat it?

C.III-5. What are the indications for intra-aortic balloon pump (IABP)?

Ischemic Heart Disease

Cardiac Surgery

C.III-6. What are the principles of IABP?

C.III-7. What are the complications of IABP?

D. Postoperative Management

D.1. Would you reverse the muscle relaxants? Why?

D.2. When will you wean the patient from the ventilator?

D.3. What criteria would you use in deciding when to wean the patient from the ventilator?

D.4. What are potential postoperative complications?

Cardiovascular

Pulmonary

Renal

Hemorrhage

6 Mechanical Circulatory Support

Lisa Q. Rong, Mudit Kaushal, and Adam D. Lichtman

A. Medical Disease and Differential Diagnosis

A.1. What is an IABP?

A.2. How is an IABP placed and positioned?

A.3. Describe an IABP inflation and deflation timing.

A.4. How does the IABP help improve hemodynamics?

A.5. What are the indications for IABP placement?

A.6. What are the contraindications and potential complications of IABP placement?

A.7. What are the pitfalls of IABP timing?

A.8. What are the main advantages and disadvantages of IABP

support?

- A.9. What is mechanical circulatory support?*
- A.10. What is a ventricular assist device (VAD)?*
- A.11. What are the types of percutaneous/temporary VADs?*
- A.12. What are the types of permanent VADs?*
- A.13. How does VAD work?*
- A.14. When is circulatory support needed?*
- A.15. What are the physiologic considerations in patients requiring a VAD?*
- A.16. What are the reasons for suboptimal VAD support?*
- A.17. What are common complications from VAD?*
- A.18. How long can VADs remain in the patient?*

B. Preoperative Evaluation and Preparation

- B.1. What is the focus of the preoperative assessment of an LVAD patient?*

C. Intraoperative Management

- C.1. Detail the anesthetic management for a patient undergoing LVAD placement.*
- C.2. How is a VAD patient monitored during a general anesthetic?*
- C.3. Prescribe an anesthetic for a VAD patient.*
- C.4. What is ECMO? What are the indications for ECMO? What are the different types of ECMO?*
- C.5. What are the contraindications of ECMO?*
- C.6. What are the main complications of ECMO?*
- C.7. What are the necessary equipment and teams required to place ECMO? What are the pros and cons of different venoatrial ECMO (VA-ECMO) cannula placement?*
- C.8. How are patients monitored and managed while on ECMO?*
- C.9. What are the complications of ECMO?*
- C.10. How frequently is VA-ECMO being used and how effective is it in cardiogenic shock?*

D. Postoperative Management

- D.1. When and how is a patient weaned off IABP support?*
- D.2. How is weaning from ECMO accomplished?*

7 Valvular Heart Disease

Meghann M. Fitzgerald and Natalia S. Ivascu

A. Medical Disease and Differential Diagnosis

- A.1. What are the major etiologies of AS, AI, mitral stenosis (MS), and MR?*
- A.2. What are the major changes in the loading conditions of the LV that result from the four different lesions? Why do they occur? What changes result from them?*
- A.3. What are pressure–volume (P–V) loops? What do the different inflection points represent?*
- A.4. What are representative P–V loops for the four valvular lesions?*
- A.5. Draw the pressure/time curves for the LV, left atrium, pulmonary artery, and aorta for a normal patient and for patients with each of the four valvular lesions.*
 - Aortic Stenosis*
 - Aortic Insufficiency*
 - Mitral Stenosis*
 - Mitral Regurgitation*
- A.6. What are the basic principles of echocardiography? What are M-mode, B-mode, and Doppler color modalities? How do TTE and transesophageal echocardiography (TEE) differ?*
- A.7. What are the three TEE vantage points for the comprehensive imaging of the LV? How are pressure gradients measured by echocardiography? How do the pressure gradients derived from Doppler echocardiography differ from those obtained in the catheterization laboratory by direct pressure measurement?*
- A.8. What is the role for three-dimensional (3D) echocardiography in the operating room?*

A.9. What are the echocardiographic and cardiac catheterization criteria for the four valvular lesions?

Aortic Stenosis
Aortic Insufficiency
Mitral Stenosis
Mitral Regurgitation

B. Preoperative Evaluation and Preparation

B.1. What are the presenting signs and symptoms of the four valvular lesions listed previously?

Aortic Stenosis
Aortic Insufficiency
Mitral Stenosis
Mitral Regurgitation

B.2. What is the New York Heart Association classification of heart failure?

B.3. Discuss the role of premedication for patients with the four different valvular lesions.

B.4. How would you premedicate the patient with severe AS and MR?

C. Intraoperative Management

C.1. Outline the hemodynamic management goals for each of the four valvular lesions. What are the anesthetic goals with respect to heart rate and rhythm, preload, afterload, and contractility?

Aortic Stenosis
Aortic Insufficiency
Mitral Stenosis
Mitral Regurgitation

C.2. What are the hemodynamic goals for this patient with the combination of severe AS and MR?

C.3. How would you monitor this patient with severe AS and MR?

C.4. Should the patient have a pulmonary artery catheter placed

before induction?

- C.5. Is a pulmonary artery catheter with pacing capabilities indicated?*
- C.6. What anesthetic technique would you employ? Why?*
- C.7. What muscle relaxant would you use for this patient?*
- C.8. What are the usual TEE findings in a patient with AS or MR? How do you grade the severity of AS by TEE? How do you quantify the severity of MR? What is the impact of AS on the severity of MR?*
- C.9. What special considerations particular to cardiopulmonary bypass (CPB) operations do you have for each of the four lesions? Focus on these concerns with respect to the induction and prebypass, bypass, and postbypass periods.*
 - Aortic Stenosis*
 - Aortic Insufficiency*
 - Mitral Stenosis*
 - Mitral Regurgitation*
- C.10. The patient cannot be weaned from CPB following an AV replacement and MV replacement. What are the possible causes?*
- C.11. How would you diagnose right-sided heart failure and pulmonary hypertension? How would you treat it?*
- C.12. How does an intra-aortic balloon pump (IABP) work to benefit the failing heart?*
- C.13. What role does the IABP have in this setting?*
- C.14. What role does TEE play in the placement, timing, and demonstration of efficacy of an IABP?*
- C.15. How would you properly time the IABP cycle?*
- C.16. What are the contraindications to the use of an IABP?*
- C.17. What is the role for ventricular assist devices?*

D. Postoperative Management

- D.1. In the intensive care unit (ICU) 4 hours later, the patient became hypotensive with a low cardiac output. How could*

you distinguish between cardiac tamponade and pump failure? How would the TEE images differ?

D.2. Would you extubate this patient early in the ICU? Why?

D.3. What are the advantages and disadvantages of early extubation?

E. Alternative Treatments

E.1. What are the percutaneous options for MV repair?

E.2. How is percutaneous MV repair performed?

E.3. What are the percutaneous options for AV repair and replacement?

E.4. How is percutaneous AV replacement performed?

E.5. What anesthetic techniques and monitors are used?

E.6. What is minimally invasive cardiac valve surgery?

8 Pacemakers, Implantable Cardioverter-Defibrillators, and Cardiac Resynchronization Therapy Devices

Alan Cheng and Fun-Sun F. Yao

A. Medical Disease and Differential Diagnosis

A.1. What are the indications for PPMs?

A.2. What is sick sinus syndrome? What is chronotropic incompetence?

A.3. How would you diagnose first-, second-, and third-degree AV block; bifascicular block (right bundle branch block [RBBB] with left anterior fascicular hemiblock or left posterior fascicular hemiblock); and trifascicular block?

A.4. Is it necessary to insert a temporary pacemaker before general anesthesia for an asymptomatic patient with bifascicular or trifascicular block?

A.5. What are the three-letter and five-letter identification codes of the North American Society of Pacing and Electrophysiology (NASPE) and British Pacing and Electrophysiology Group (BPEG) generic (NBG) code for pacemaker classification?

A.6. How many modes of pacing are available in modern PPMs?

How do they work? What is the difference between DDD pacing and DDI pacing?

- A.7. The patient was mechanically hyperventilated during surgery, and her pacemaker gradually increased her heart rate. What feature of the PPM is accounting for this?*
- A.8. What are the advantages and disadvantages of atrial pacing only? What are the disadvantages of right ventricular pacing only?*
- A.9. What are the indications for and complications associated with AV sequential PPMs?*
- A.10. How would you know if the patient's PPM was atrially, ventricularly, or atrioventricularly sequentially pacing?*
- A.11. What is a biventricular PPM or CRT device? What are the indications for such a device?*
- A.12. What are the usual lifespans of PPMs and implantable cardioverter-defibrillators (ICDs)?*
- A.13. What is an ICD? How does it work? What is a subcutaneous ICD?*
- A.14. What are the indications for ICDs?*
- A.15. What is the NASPE and BPEG generic defibrillator (NBD) code?*

B. Preoperative Evaluation and Preparation

- B.1. How would you preoperatively evaluate the patient described earlier?*
- B.2. How do you determine whether the patient has a cardiac implantable electronic device (CIED) and define what type of CIED?*
- B.3. How do you determine whether the patient is dependent on the pacing from the CIED?*
- B.4. How do you know if the implanted PPM or ICD is working?*
- B.5. What information would you like to obtain from interrogating this device?*
- B.6. How do you preoperatively prepare the patient for surgery*

and anesthesia?

- B.7. Would you recommend reprogramming this device to asynchronously pace before surgery? What would you recommend regarding the ICD functions of the device?*
- B.8. The patient requires an abdominal magnetic resonance imaging (MRI) prior to the surgery. What considerations should you make regarding her CIED?*

C. Intraoperative Management

- C.1. How would you monitor this patient?*
- C.2. What drugs and equipment would you like to have on hand in the operating room?*
- C.3. How would you set up the transcutaneous external pacer and defibrillator?*
- C.4. Had this patient's ICD been implanted the day before surgery, would you consider avoiding certain inhalational gases for anesthesia?*
- C.5. Electromagnetic interference (EMI) from electrocautery results in significant noise on your cardiac monitor. You recall that EMI also can inhibit pacing function from the PPM. In this pacemaker-dependent patient, how can you determine whether inappropriate inhibition of the PPM is occurring?*
- C.6. What are the potential responses of pacemakers and ICDs to electrocautery?*
- C.7. How would you prevent the effects of EMI on the pacemaker or ICD from the electrocautery?*
- C.8. What are the effects of a magnet on pacemakers and ICDs?*
- C.9. In the middle of surgery, the patient developed ventricular tachycardia. What would you do?*
- C.10. What precautions should be taken when a patient with a CIED is undergoing extracorporeal shock wave lithotripsy (ESWL)?*
- C.11. Is electroconvulsive therapy (ECT) contraindicated in*

patients with pacemakers or ICDs?

C.12. What precautions should be taken during radiofrequency ablation for a patient with a CIED?

C.13. During surgery, the patient developed frequent premature ventricular complexes and some of these resulted in rapid ventricular pacing (see Fig. 8.8). What is accounting for the pacemaker's behavior?

D. Postoperative Management

D.1. How would you monitor this patient in the postanesthesia care unit?

D.2. How would you confirm that the CIED is functioning properly after surgery?

9 Thoracic and Thoracoabdominal Aortic Aneurysms

Yong Zhan, Frederick C. Cobey, Sharon L. McCartney, Madhav Swaminathan, and Jamel Ortoleva

A. Pathophysiology and Differential Diagnosis

A.1. What is a thoracic aortic aneurysm (TAA) and TAAA, and how do they typically present?

A.2. How are TAAs and TAAAs classified?

A.3. What is the pathogenesis of aortic aneurysms and what genetic conditions predispose to their formation?

A.4. What are the risk factors for TAA rupture?

A.5. What is the natural history and medical management of thoracic aneurysms?

A.6. What is a thoracic aortic dissection, and how does it typically present?

A.7. How are thoracic aortic dissections classified?

DeBakey Classification

Stanford Classification

Penn Classification

B. Preoperative Evaluation and Preparation

B.1. What are the indications and timing of surgical intervention for TAAs?

- B.2. *Which patients are candidates for endovascular aortic repair, and what are the advantages to this approach?*
- B.3. *What are the preoperative considerations for the anesthesiologist before TAA repair?*
 - Cardiovascular
 - Respiratory
 - Renal
 - Neurologic
- B.4. *What is the preoperative management of a patient presenting with an acute aortic dissection (AAD)?*
- B.5. *What is the spinal cord blood supply?*
- C. *Intraoperative Management*
 - C.1. *What are the surgical approaches to thoracic aneurysm repair?*
 - Ascending and Arch Aortic Aneurysms
 - Thoracoabdominal Aneurysms
 - C.2. *How is the open repair performed?*
 - Ascending and Arch Aortic Aneurysms
 - Thoracoabdominal Aneurysms
 - C.3. *How are endovascular repairs of TAAAs performed?*
 - C.4. *What are the surgical approaches to aortic dissections?*
 - Type A Aortic Dissection
 - Type B Aortic Dissection
 - C.5. *What are the specific considerations for anesthetic management of the patient presenting for open TAAA repair?*
 - C.6. *What are the specific considerations for anesthetic management of the patient presenting for endovascular TAAA repair?*
 - C.7. *What hemodynamic monitors should be used for the patient undergoing thoracic aneurysm repair?*
 - C.8. *What strategies are used for spinal cord protection during a TAAA repair?*

Left-Heart Bypass
Intraoperative Neuromonitoring
Cerebrospinal Drainage
Hypothermia

C.9. What strategies are used for mesenteric and renal preservation?

C.10. What is the pathophysiology of aortic clamping and unclamping?

Aortic Clamping
Aortic Unclamping

C.11. Why does a coagulopathy ensue and how is it prevented/treated?

D. Postoperative Anesthetic Management

D.1. What are the postoperative complications after open TAAA repair?

Respiratory Failure
Renal Failure
Spinal Cord Injury

D.2. What are the postoperative complications after endovascular TAAA repair?

Left Upper Extremity Ischemia
Stroke
Spinal Cord Ischemia
Renal Failure
Postimplantation Syndrome
Endograft Collapse
Endoleaks

10 Abdominal Aortic Aneurysm Repair

Fun-Sun F. Yao and Anup Pamnani

A. Medical Disease and Differential Diagnosis

A.1. What risk factors are associated with an abdominal aortic aneurysm (AAA)?

A.2. What other diseases are commonly found in patients with

aortic aneurysms?

- A.3. What is the incidence of morbidity and mortality in these patients if they undergo elective open surgical repair? What is the natural history of the disease without surgical repair?*
- A.4. What should be done for smaller aortic aneurysms that are found in patients?*
- A.5. What is the risk of perioperative myocardial infarction (MI) in patients with ischemic heart disease? What can be done to reduce the risk of ischemic events in these patients?*
- A.6. Does the morbidity and mortality of elective repair of an aortic aneurysm differ significantly from that of an emergency repair?*

B. Preoperative Evaluation and Preparation

- B.1. Which preoperative laboratory tests would you require for this patient?*
- B.2. What is the significance of the preoperative ECG? Would you wish to pursue a preoperative cardiac workup? What tests would you request, and what would they tell you?*
- B.3. Is it necessary to evaluate this patient's pulmonary status?*
- B.4. Preoperative arterial blood gas (ABG) measurement shows pH, 7.35; PaCO₂, 47 mmHg; and PaO₂, 68 mmHg on room air. What is the significance of this result?*
- B.5. How would you measure creatinine clearance in this patient, and what is its value in this case?*
- B.6. Describe the blood flow to the spinal cord. What is its relevance to surgery involving the abdominal aorta?*
- B.7. How do you detect spinal cord ischemia?*
- B.8. What are the various surgical approaches to repair an AAA?*
- B.9. How does the choice of surgical technique affect the anesthetic management?*
- B.10. How would you premedicate this patient?*

C. Intraoperative Management

- C.1. Would you use an arterial line? What are the complications of arterial line placement?*
- C.2. What various monitors are available for myocardial ischemia? Is a pulmonary artery catheter (PAC) helpful in determining the occurrence of ischemia?*
- C.3. What additional monitors would you employ?*
- C.4. Is there a role for somatosensory evoked potential (SSEP) monitoring during aortic clamping?*
- C.5. How would you anesthetize this patient for an open repair of the aorta? What techniques could be used for an endovascular aortic aneurysm repair? Discuss the various anesthetic techniques that can be employed for this surgery.*
- C.6. This patient is to be heparinized intraoperatively, and anticoagulation may be continued postoperatively. Is this a contraindication to the preoperative placement of either an epidural or intraspinal catheter? What if the patient is receiving anticoagulants in the preoperative period?*
- C.7. What are your plans for fluid and blood replacement during surgery?*
- C.8. What are the hemodynamic changes of aortic cross-clamp placement? What efforts can be made to minimize these changes both before and during cross-clamping? If the patient develops ST-segment depressions with a rising pulmonary capillary wedge pressure (PCWP) during cross-clamp, what maneuvers should be taken?*
- C.9. Because this case involves an infrarenal aneurysm, is renal blood flow affected with the placement of the cross-clamp? If an endovascular repair is chosen, what are the risks to the kidneys? Are there any treatment maneuvers that can be taken to minimize these risks in either repair?*
- C.10. What are the hemodynamic consequences of aortic cross-clamp removal? What can be done to minimize the effects of removing the aortic cross-clamp? If the systemic blood*

pressure remains depressed after removal of the cross-clamp, what is the differential diagnosis? How would you diagnose and correct the problem?

D. Postoperative Management

- D.1. What are the parameters used to extubate this patient?*
- D.2. What are the anticipated changes in postoperative pulmonary function in these patients? How does the surgical technique affect postoperative pulmonary function? Are there any postoperative maneuvers that can improve respiratory parameters?*
- D.3. How would you control postoperative pain? What are the alternatives in the management of this patient's postoperative pain?*

11 Hypertension

Christopher W. Tam and Fun-Sun F. Yao

A. Medical Disease and Differential Diagnosis

- A.1. Define hypertension and categorize its severity.*
- A.2. What is the prevalence of hypertension?*
- A.3. What is the general classification of hypertension? Enumerate the causes of each type of hypertension.*
 - Etiology of Hypertension
- A.4. What are the clinical patterns of hypertension encountered?*
- A.5. What is the pathophysiology of essential hypertension?*
- A.6. What is the pathophysiology of isolated systolic hypertension (ISH) and of pulse pressure hypertension (PPH)?*
- A.7. What are the end-organ damages caused by long-standing hypertension?*
 - Cardiac Involvement
 - Eye Involvement
 - Renal Involvement
 - Cerebral Involvement
- A.8. Are hypertensive patients at an increased risk for*

perioperative cardiac morbidity?

- A.9. Perioperative cerebral and renal complications are mostly associated with which subtype of hypertension?*
- A.10. Would you employ a controlled hypotensive technique for hypertensive patients? How much would you safely lower the BP?*
- A.11. What are the BP goals for patients with hypertension and when should antihypertensive drugs be initiated?*
- A.12. What is the mechanism of action of antihypertensive drugs?*
 - Diuretics*
 - Antiadrenergic Agents*
 - Direct Vasodilators*
 - Dopaminergic Agonists*
 - Calcium Channel Blockers*
 - Angiotensin-Converting Enzyme Inhibitors*
 - Angiotensin II Receptor Blockers*
 - Other Vasodilators*
- A.13. Does the choice of antihypertensive therapy influence hemodynamic responses to induction, laryngoscopy, and intubation?*
- A.14. Does chronic angiotensin-converting enzyme (ACE) inhibition influence anesthetic induction?*

B. Preoperative Evaluation and Preparation

- B.1. How would you evaluate this patient preoperatively?*
- B.2. Would you postpone the surgery? Why? What BP would you like the patient to achieve before surgery?*
- B.3. Should all or any of the chronic medications be discontinued before the operation?*
- B.4. Should hypokalemia be treated before anesthesia? Why?*
- B.5. Should hypomagnesemia be treated before anesthesia? Why?*
- B.6. Does an asymptomatic carotid bruit increase the risk in these patients?*

- B.7. *The surgery was postponed for 6 weeks. The patient was on metoprolol, aspirin, atorvastatin, captopril, hydrochlorothiazide, and potassium chloride. His BP was 160/60 mmHg and potassium 4.0 mEq per L. How would you premedicate this patient?*
- B.8. *If the patient is an untreated hypertensive patient with BP 170/70 mmHg, would you treat the patient preoperatively with an antihypertensive agent?*

C. **Intraoperative Management**

- C.1. *How would you monitor this patient?*
- C.2. *What are the anesthetic goals for hypertensive patients?*
- C.3. *How would you induce anesthesia for the hypertensive patient?*
- C.4. *How does tracheal intubation produce hypertension?*
- C.5. *What happens to the left ventricular ejection fraction during and immediately following intubation?*
- C.6. *What other measures can prevent hypertension and tachycardia at the time of intubation?*
- C.7. *After induction and intubation, the BP decreased to 70/40 mmHg. What would you do?*
- C.8. *What is your choice of agents for maintenance of anesthesia? Why?*
- C.9. *How would you manage fluid therapy for hypertensive patients?*
- C.10. *During the surgery, BP increased to 220/120 mmHg. How would you treat the hypertension?*
- C.11. *What could you do to prevent hypertension during extubation and emergence?*
- C.12. *Would you consider regional anesthesia for this patient?*

D. **Postoperative Management**

- D.1. *The patient developed hypertension, BP 210/110 mmHg, in the postanesthesia care unit. What would you do?*

12 Cardiac Tamponade

June M. Chan

A. Medical Disease and Differential Diagnosis

- A.1. What is the differential diagnosis of low CO following cardiac surgery?*
- A.2. Describe the pathophysiology of cardiac tamponade.*
- A.3. What are the common etiologies of cardiac tamponade?*
- A.4. What is the difference between acute and delayed cardiac tamponade?*
- A.5. What is regional cardiac tamponade?*
- A.6. Describe the ventricular interaction in cardiac tamponade.*
- A.7. How is coronary blood flow affected in cardiac tamponade?*
- A.8. What is the Beck triad? Describe the typical signs and symptoms of cardiac tamponade.*
- A.9. Define pulsus paradoxus and describe its pathophysiology.*
- A.10. What is Kussmaul sign? Is this finding consistent with tamponade physiology?*
- A.11. Which medical conditions mimic cardiac tamponade?*

B. Preoperative Evaluation and Preparation

- B.1. Interpret and explain the pathophysiologic basis for this patient's hemodynamic findings.*
- B.2. How would you optimize this patient's cardiovascular status prior to definitive diagnosis and treatment?*
- B.3. What are the radiographic findings in tamponade?*
- B.4. A limited bedside transthoracic echocardiogram is performed, demonstrating a layer of clotted blood anterior to the right atrium (RA) and ventricle. What echocardiographic findings support the diagnosis of tamponade?*
- B.5. What additional information should be obtained from a limited echocardiographic study?*
- B.6. Describe the procedures for treating cardiac tamponade. What are the clinical indications for each approach?*

- B.7. Having made the diagnosis of tamponade, what additional investigations are required prior to surgery?*
- B.8. Explain the technical and physiologic principles behind rotational thromboelastometry.*
- B.9. A rotational thromboelastometry was performed, and a 10-minute analysis reveals the following results (see Fig. 12.9 and Table 12.8). How do you interpret this information?*
- B.10. Given the ROTEM[®] findings and high clinical suspicion for occult postsurgical bleeding, what hemostatic products would you arrange to have in the operating room?*
- B.11. How would you organize and conduct the transport of this patient to the operating room?*

C. Intraoperative Management

- C.1. What are the cardiovascular effects of commonly used intravenous anesthetic and coinduction agents?*
 - Propofol
 - Etomidate
 - Ketamine
 - Thiopental
 - Fentanyl
 - Midazolam
- C.2. What is the effect of supine positioning and positive pressure ventilation on the hemodynamics of a patient with tamponade?*
- C.3. Describe the induction process for cardiac tamponade.*
- C.4. Following induction and intubation, the systemic blood pressure decreases to 55/30 mmHg. Describe your management.*
- C.5. What hemodynamic changes are frequently associated with opening the pericardial space?*
- C.6. Following the removal of approximately 500 mL of dark blood and clots from the mediastinum, the patient's CO remains low. What are your differential diagnoses?*

- C.7. *What is pericardial decompression syndrome (PDS)?*
- D. Postoperative Management
 - D.1. *A pericardial drain is placed following mediastinal decompression. How should this drainage tube be managed?*
 - D.2. *How would you manage hypertension in the intensive care unit?*

13 Heart Transplantation and Subsequent Noncardiac Surgery

Jeff T. Granton, Ranjana Bairagi, and Davy Cheng

- A. Medical Disease and Differential Diagnosis
 - A.1. *What are the common diagnoses requiring adult heart transplantation?*
 - A.2. *What are the indications and relative contraindications for recipient selection?*
 - A.3. *What are the criteria for donor heart selection?*
 - A.4. *What is the role of donation after cardiac death (DCD) for heart transplantation?*
 - A.5. *What are the principles of perioperative donor management?*
 - A.6. *What are the risk factors associated with posttransplant mortality?*
 - A.7. *What is the difference between the biatrial and bicaval surgical techniques of heart transplant?*
 - A.8. *When is a combined heart/lung transplant indicated? What are the important differences?*
 - A.9. *What are the medical and surgical alternatives to cardiac transplantation?*
 - A.10. *What is the role of ventricular assist devices (VADs) in this type of patient?*
 - A.11. *What are the considerations in anesthetizing patients for LVAD insertion?*
- B. Preoperative Management
 - B.1. *How would you assess this patient preoperatively?*

- B.2. How would you premedicate this patient? Why?*
- C. Intraoperative Management
- C.1. What anesthetic equipment and monitors would you set up? Why?*
- C.2. What is the role of transesophageal echocardiography (TEE)?*
- C.3. Describe the induction and maintenance of anesthesia.*
- C.4. How would you manage this patient during cardiopulmonary bypass (CPB)?*
- D. Postoperative Management
- D.1. What are the early postoperative complications?*
- D.2. What are the mechanisms of early right ventricular (RV) failure?*
- D.3. How would you treat RV failure following heart transplantation?*
- D.4. How does inhaled nitric oxide (NO) work as a selective pulmonary vasodilator?*
- D.5. What is the pathophysiology of the denervated heart?*
- D.6. What are the common cardiac dysrhythmias following heart transplant?*
- D.7. What are the causes of posttransplant bleeding?*
- D.8. How would you treat posttransplant bleeding?*
- D.9. What are the causes of early graft failure?*
- D.10. How would you manage this patient in the intensive care unit?*
- E. Subsequent Noncardiac Surgery
- E.1. How would you monitor this patient?*
- E.2. What type of anesthetic is best for the heart-transplanted patient?*
- E.3. What anesthetic technique would you choose for this patient?*
- E.4. Do you need to use a muscarinic antagonist with cholinesterase inhibitors to reverse the muscle relaxant in*

- heart-transplanted patients?*
- E.5. What are the anesthetic implications for heart-transplanted patients?*
 - E.6. What is the significant implication of the denervated heart?*
 - E.7. What is the significance of allograft rejection?*
 - E.8. What is the significance of infection in these patients?*
 - E.9. What are the significant implications of drug interactions?*
 - E.10. What is cardiac allograft vasculopathy (CAV)? Why is this important?*
 - E.11. What is the significant implication of posttransplant hypertension?*
 - E.12. What is the significant implication of renal dysfunction?*
 - E.13. What types of malignancy are found in recipients?*
 - E.14. Is ambulatory surgery appropriate for heart transplant recipients?*

14 Ischemic Heart Disease and Noncardiac Surgery

Christopher Szabo and Manuel Fontes

A. Medical Disease and Differential Diagnosis

- A.1. What are the preoperative predictors for major adverse cardiac events (MACE) perioperatively?*
- A.2. What are the determinants of myocardial oxygen demand? How are they measured clinically?*
- A.3. What factors determine myocardial oxygen supply?*
- A.4. What is the mechanism of perioperative myocardial ischemia and MI?*
- A.5. What is the incidence of perioperative reinfarction for noncardiac surgery?*
- A.6. State the perioperative medical therapy you would employ to reduce the incidence of myocardial ischemia.*
 - β -Adrenergic Antagonists (Esmolol, Atenolol, Metoprolol, Bisoprolol)*
 - α_2 -Adrenergic Agonist (Clonidine)*
 - Nitrovasodilators (Nitroglycerin, Isosorbide Dinitrate)*

Calcium Channel Blockers (Verapamil, Diltiazem,
Nifedipine, Nicardipine)

Aspirin

Statins

- A.7. *Based on his MI, would you recommend that the surgery be postponed for a certain period of time? If so, why?*
- A.8. *Would you recommend that this elective colectomy be postponed if the patient underwent placement of a right coronary artery, second-generation DES, and is taking aspirin and clopidogrel (Plavix)?*

B. Preoperative Evaluation and Preparation

- B.1. *How would you evaluate the patient's cardiac condition? What laboratory tests would you like to order?*
- B.2. *Would you recommend further cardiac testing or coronary revascularization before surgery?*
- B.3. *How would you classify the cardiac risk according to the type of surgery?*
- B.4. *What is the role of exercise or pharmacologic stress test for this patient?*
- B.5. *Would you discontinue any medication before surgery?*
- B.6. *How would you premedicate this patient?*
- B.7. *Is there a role for α_2 -agonist in premedication?*

C. Intraoperative Management

- C.1. *What are the intraoperative predictors for perioperative MACE?*

Intraoperative Predictors

- C.2. *How would you monitor the patient in the operating room?*
- C.3. *What electrocardiogram (ECG) leads would you monitor? Why lead V_5 ?*
- C.4. *Would you use a pulmonary artery catheter (PAC)?*
- C.5. *Would you use transesophageal echocardiography (TEE) as a monitor?*
- C.6. *Is regional anesthesia better than general anesthesia for*

patients with cardiac disease?

- C.7. *How will you induce general anesthesia?*
 - C.8. *Would you induce anesthesia with etomidate? Why?*
 - C.9. *What is the best choice of anesthetic agents for maintenance of anesthesia? Why?*
 - C.10. *You notice a new 3-mm ST-segment depression in lead V₅. How would you treat it?*
 - C.11. *Would you give prophylactic intravenous NTG to prevent myocardial ischemia?*
 - C.12. *What is the significance of tight control of the heart rate intraoperatively?*
 - C.13. *When would you extubate the trachea in this patient? What could you do to prevent hypertension and tachycardia during extubation and emergence?*
- D. **Postoperative Management**
- D.1. *What are the postoperative predictors of perioperative MACE?*
 - D.2. *How would you control postoperative pain?*
 - D.3. *Is postoperative anemia associated with adverse cardiac outcome?*
 - D.4. *Is postoperative hypothermia associated with postoperative myocardial ischemia?*
 - D.5. *How would you make a diagnosis of perioperative MI (PMI)?*
 - D.6. *How would you manage the patient with a suspected PMI?*

SECTION 3 The Gastrointestinal System

15 Intestinal Obstruction and Enhanced Recovery after Surgery

Leif Ericksen and Tong J Gan

- A. **Medical Disease and Differential Diagnosis**
 - A.1. *What is the differential diagnosis of the acute abdomen?*
 - A.2. *What are the causes of intestinal obstruction of the small*

bowel and of the large bowel?

- A.3. Differentiate between simple and strangulated bowel obstruction.*
- A.4. Is it important to differentiate whether the bowel obstruction is located in the small bowel or large bowel? Why? How might the distinction be made?*
- A.5. What are the causes and effects of bowel distention?*
- A.6. Describe the fluid shifts during small bowel intestinal obstruction.*
- A.7. Discuss the systemic derangements that occur with intestinal obstruction.*
- A.8. What is an ileus? Discuss its causes and pathophysiology.*

B. Preoperative Evaluation and Preparation

- B.1. What is Enhanced Recovery after Surgery (ERAS)? What are the core tenants of these programs?*
- B.2. Can ERAS be used in this case?*
- B.3. What components of ERAS are applied in the preoperative phase of the care of colorectal surgery (CRS) patients?*
- B.4. Is it important to decompress the abdomen before induction of anesthesia? Why?*
- B.5. Describe the respiratory implications.*
- B.6. What are the implications of the tense abdominal wall?*
- B.7. Outline the methods of abdominal decompression.*
- B.8. Discuss the goals of fluid management.*
- B.9. What would you use as a guide to fluid volume replacement?*

C. Intraoperative Management

- C.1. What dangers are present during induction? How are they planned for?*
- C.2. Does the administration of antacids and/or histamine-2 (H₂) blockers before the induction of anesthesia have a significant value in patients with small bowel obstruction?*
- C.3. In what position would you intubate this patient?*
- C.4. What is the best muscle relaxant to use for the rapid*

sequence induction?

- C.5. *Would you remove or leave the nasogastric tube (NGT) in place before inducing anesthesia?*
- C.6. *Would you use nitrous oxide in this patient?*
- C.7. *Are there any benefits to using a high concentration of inspired oxygen (FIO_2)?*
- C.8. *What components of ERAS are applied in the intraoperative phase of the care of CRS patients?*
- C.9. *What are the strengths, weaknesses, benefits, and challenges of ERAS?*
 - Strengths
 - Weakness
 - Benefits
 - Challenges
- C.10. *What are the indications for ERAS?*

D. Postoperative Management

- D.1. *What are the principles of postoperative care in this patient?*
- D.2. *Are there any postoperative respiratory problems associated with factors other than aspiration?*
- D.3. *If the patient did aspirate gastric contents, what are the possible sequelae of this event? What is the treatment?*
- D.4. *What is gram-negative sepsis? Describe the clinical picture and treatment.*
- D.5. *What components of ERAS are applied in the postoperative phase of the care of CRS patients?*

16 Liver Transplantation

Christopher H. Choi and Vivek K. Moitra

A. Medical Disease and Differential Diagnosis

- A.1. *What are the potential graft options for liver transplantation?*
- A.2. *What are the indications and contraindications for liver transplantation?*

- A.3. *What is acute liver failure (ALF)?*
- A.4. *What is the MELD score, and how is it used in liver transplantation evaluation?*
- A.5. *What is portal hypertension? What are the sequelae of portal hypertension?*
- A.6. *Describe the cardiovascular system of patients with end-stage liver disease (ESLD).*
- A.7. *What causes acute kidney injury (AKI) in patients with cirrhosis?*
- A.8. *What causes hyponatremia in patients with cirrhosis?*
- A.9. *Discuss the neurologic manifestations of acute and chronic liver disease.*
- A.10. *Why do patients with ESLD have abnormalities of hemostasis?*
- A.11. *What is the differential diagnosis for hypoxemia in patients with cirrhosis?*
- A.12. *What are the risk factors and treatment guidelines for spontaneous bacterial peritonitis (SBP)?*
- B. **Preoperative Evaluation and Preparation**
 - B.1. *What preoperative workup is desirable?*
 - B.2. *How is ascites managed preoperatively?*
 - B.3. *How is hyponatremia managed preoperatively?*
 - B.4. *What is a transjugular intrahepatic portosystemic shunt (TIPS) procedure? What is the role of TIPS in the management of patients with ESLD?*
 - B.5. *How are hepatic encephalopathy and elevated intracranial pressure (ICP) treated?*
 - B.6. *Should this patient be transfused with fresh frozen plasma prior to surgery?*
- C. **Intraoperative Management**
 - C.1. *What monitors would you use? Why?*
 - C.2. *What are the considerations for the induction of anesthesia?*
 - C.3. *How does liver disease affect intraoperative medication*

management?

- C.4. What happens during the first stage (preanhepatic phase) of the liver transplant operation?*
- C.5. What happens during the second stage (anhepatic phase) of the liver transplant operation?*
- C.6. What physiologic disturbances should be anticipated during the second stage (anhepatic phase) of the liver transplant operation?*
- C.7. What is venovenous bypass? What are the potential advantages and disadvantages of this procedure?*
- C.8. What surgical techniques anastomose the donor and recipient inferior vena cava (IVC)?*
- C.9. What are the potential advantages of the “piggyback” (vena cava preservation) technique?*
- C.10. What hemodynamic changes are expected after removal of vascular clamps? What is postreperfusion syndrome (PRS)?*
- C.11. How would you treat hyperkalemia?*
- C.12. Why should you anticipate hypocalcemia?*
- C.13. What happens during the third stage of the liver transplant operation?*
- C.14. What causes intraoperative bleeding during each phase of liver transplantation? How is coagulopathy monitored and treated? What are thromboelastography (TEG) and rotational thromboelastography (ROTEM)?*
- C.15. What are the complications of massive transfusion?*
- C.16. How are the complications of massive transfusion prevented?*
- C.17. How is hyperfibrinolysis managed?*
- C.18. When is intraoperative renal replacement therapy indicated?*
- C.19. What intraoperative signs suggest that the hepatic graft is working?*

D. Postoperative Management

- D.1. What are the goals of immediate postoperative care of the liver transplant patient?*
- D.2. What postoperative findings suggest that the hepatic graft is functioning?*
- D.3. What coagulation disturbances should be anticipated in the postoperative period?*
- D.4. Can renal function change after liver transplantation?*
- D.5. What vascular and biliary complications occur after liver transplantation?*
- D.6. What immunosuppressive agents will be given after liver transplantation? What are the major side effects?*

Acknowledgment

SECTION 4 The Nervous System

17 Brain Tumor and Craniotomy

June M. Chan, Elena V. Christ, and Kane O. Pryor

- A. Medical Disease and Differential Diagnosis
 - A.1. What is the pathology of intracranial tumors?*
 - A.2. What is intracranial pressure (ICP), and what are its determinants?*
 - A.3. How does the presence of a mass alter the ICP in this patient, and what are the clinical manifestations of these alterations?*
 - A.4. What is cerebral blood flow (CBF), and what are its determinants?*
 - A.5. What are the cerebral steal syndromes?*
 - A.6. Are there any issues specific to posterior cranial fossa pathology?*
 - A.7. What is the role of preoperative embolization therapy?*
- B. Preoperative Evaluation and Preparation
 - B.1. What are the special considerations in preoperative evaluation of the patient scheduled for posterior fossa*

craniotomy?

- B.2. In a patient who presents with intracranial hypertension, what management might have already been initiated preoperatively, and what are the implications for anesthetic management?*
- B.3. What are the types of intraoperative neurophysiologic monitoring (IOM) that would likely be used for this procedure, and how will they affect the anesthetic management plan?*
- B.4. What are the options for patient positioning during posterior fossa surgery?*
- B.5. What are the principal disadvantages associated with the common posterior fossa craniotomy positions?*
- B.6. How does the sitting position affect your preoperative assessment and planning?*
- B.7. How should the patient position ultimately be determined?*
- B.8. Should this patient receive premedication?*

C. Intraoperative Management

- C.1. What are the anesthetic goals for craniotomy?*
- C.2. What monitors should be used during craniotomy?*
- C.3. Would you monitor for venous air embolism (VAE)? What are the monitoring options?*
- C.4. What specific risks are associated with induction of anesthesia?*
- C.5. How would you induce anesthesia?*
- C.6. What are the effects of anesthetics on cerebral metabolic rate of oxygen (CMRO₂), CBF, and ICP? With this in mind, how would you maintain anesthesia?*
 - Volatile Anesthetics*
 - Nitrous Oxide*
 - Intravenous Anesthetics*
 - Opioids*
- C.7. How would you manage ventilation and maintain arterial*

carbon dioxide (CO₂)?

- C.8. How would you approach diuretic therapy?*
 - C.9. How would you manage serum glucose?*
 - C.10. How would you approach fluid management?*
 - C.11. Once the bone plate is removed and the dura retracted, the surgeon reports that the brain is still “tight.” What would be your response?*
 - C.12. If deliberate hypotension is indicated, how will you achieve it?*
 - C.13. While the surgeon is resecting tumor from near the brainstem, the patient’s heart rate suddenly drops to 20 beats per minute. What is your assessment and management?*
 - C.14. Are there any measures you can take to prevent VAE?*
 - C.15. During the procedure, the precordial Doppler becomes loud and turbulent. The end-tidal CO₂ (EtCO₂) drops from 31 to 13 mmHg, and the systemic pressure from 121/63 to 64/32 mmHg. What is your assessment and management plan?*
 - C.16. What is your approach to emergence? What if the patient does not regain consciousness?*
- D. Postoperative Management**
- D.1. What postoperative complications are of greatest concern? What level of monitoring is required?*
 - D.2. What is your approach to postoperative pain control?*
 - D.3. In the ICU, the patient’s neurologic status deteriorates and ICP monitoring is instituted. What are the different methods of monitoring ICP, and what are their limitations?*

18 Carotid Artery Disease

Priscilla Nelson and Hugh C. Hemmings Jr.

- A. Medical Disease and Differential Diagnosis**
 - A.1. What are the presenting symptoms of carotid stenosis?*
 - A.2. What is the prevalence of carotid artery disease?*

- A.3. *What is the natural course of carotid artery disease as it relates to stroke?*
- A.4. *What in the patient's history puts them at higher risk for having carotid atherosclerosis?*
- A.5. *Do we screen patients for asymptomatic carotid stenosis?*
- A.6. *What is the risk of stroke and cardiovascular events in asymptomatic carotid atherosclerosis?*
- A.7. *What are the current medical options that the patient has for treating carotid atherosclerosis?*
- A.8. *What are the indications for CEA and carotid artery stenting (CAS) in asymptomatic carotid atherosclerotic disease?*
- A.9. *What are the indications for performing a CEA in symptomatic carotid stenosis?*
- A.10. *Is there any role for CAS in symptomatic patients?*
- A.11. *Discuss the anatomy of the cerebral vasculature, including the carotid artery and the circle of Willis.*
- A.12. *Discuss cerebral blood flow (CBF) in the presence of carotid artery disease.*
- A.13. *Discuss the different surgical approaches to carotid revascularization.*
- A.14. *Discuss the endovascular approaches to carotid stenting.*
- A.15. *What is normal CBF?*
- A.16. *What is critically low CBF as measured by the electroencephalogram (EEG)?*
- A.17. *What is cerebral autoregulation?*
- A.18. *How does PaCO₂ affect CBF?*
- A.19. *What are the principal determinants of CBF?*
- A.20. *What is meant by the term luxury perfusion?*
- A.21. *What is meant by the term intracerebral steal?*
- B. **Preoperative Evaluation and Preparation**
 - B.1. *What will you look for in your preoperative evaluation of this patient?*

B.2. Is this patient's blood pressure too high for elective surgery?

B.3. What laboratory data are required preoperatively?

B.4. Will you treat this patient's blood glucose?

B.5. Will you premedicate this patient?

C. Intraoperative Management

C.1. How will you monitor this patient?

C.2. How will you know that the patient's cerebral perfusion is adequate during surgery?

C.3. Discuss the differences and relative advantages and disadvantages of unprocessed EEG and processed EEG monitoring.

C.4. How will you measure CBF intraoperatively? What are the relative advantages and disadvantages of each technique?

C.5. Describe the use of stump pressure and its limitations.

C.6. Describe the use of transcranial Doppler (TCD) and its limitations.

C.7. Describe the use of jugular venous oxygen saturation ($SjvO_2$) and its limitations.

C.8. Describe the use of cerebral oximetry and its limitations.

C.9. Discuss somatosensory evoked potentials (SSEPs) as a monitor of CBF during CEA.

C.10. What type of anesthesia will you choose for this patient if she chose to have an endarterectomy?

C.11. What type of anesthesia will you choose for this patient if she chose to have a carotid stent?

C.12. How will you induce and maintain general anesthesia in this patient for CEA?

C.13. How would you proceed if the patient were to receive regional anesthesia?

C.14. Discuss the effects of anesthetics on CBF.

C.15. Discuss the protective effects of anesthetic agents on cerebral function.

- C.16. *How will you manage this patient's ventilation under general anesthesia?*
- C.17. *How will you manage this patient's blood pressure intraoperatively?*
- C.18. *Discuss reperfusion injury following CEA and CAS.*
- C.19. *What intravenous fluids will you give this patient intraoperatively?*
- D. **Postoperative Management**
 - D.1. *The patient does not "wake up" from general anesthesia. Why?*
 - D.2. *Postoperatively, the patient's blood pressure is 170/96 mmHg. Will you treat this?*
 - D.3. *What immediate postoperative complications might you expect after a CEA?*
 - D.4. *What postoperative complications might you expect after a CAS?*
 - D.5. *Discuss postoperative neurocognitive dysfunction following uncomplicated carotid intervention.*

19 Awake Craniotomy for Mapping and Surgery in the Eloquent Cortex

Thomas A. Moore II and Kenneth G. Smithson

- A. **Medical Disease and Differential Diagnosis**
 - A.1. *What is the eloquent cortex?*
 - A.2. *What is the underlying pathology?*
 - A.3. *What determines intracranial pressure (ICP)?*
 - A.4. *How does a space-occupying mass alter ICP?*
 - A.5. *What is autoregulation, and why is it important?*
 - A.6. *How is cerebral blood flow (CBF) regulated?*
 - A.7. *What drug therapies may be associated with this pathology?*
- B. **Preoperative Evaluation and Preparation**
 - B.1. *Why is the craniotomy performed awake?*
 - B.2. *What neurologic symptoms of the patient are important?*
 - B.3. *What is the status of their other comorbid conditions?*

- B.4. *Are there anesthetic implications from current treatment drugs?*
- B.5. *What laboratory data are required?*
- B.6. *What radiology data should be reviewed?*
- B.7. *How do you prepare the patient for an awake craniotomy?*
- B.8. *Should this patient receive premedications?*
- B.9. *What precautions should be made for airway management?*
- C. **Intraoperative Management**
 - C.1. *How should this patient be monitored?*
 - C.2. *Does this patient require invasive monitoring?*
 - C.3. *Can current drug therapy alter eloquent cortex mapping?*
 - C.4. *Why use hypertonic fluids during a craniotomy?*
 - C.5. *What intravenous fluids (IVFs) are recommended?*
 - C.6. *Would a lumbar drain for cerebrospinal fluid (CSF) removal benefit this patient?*
 - C.7. *Venous air embolism (VAE): Is it a concern in this case?*
 - C.8. *How is the eloquent cortex mapped?*
 - C.9. *How are intraoperative seizures treated?*
 - C.10. *How will you conduct this anesthetic?*
- D. **Postoperative Management**
 - D.1. *What are the major concerns following craniotomy?*

Acknowledgments

20 Head Injury

Chris C. Lee, Susan A. Ironstone, and M. Angele Theard

- A. **Pathophysiology and Differential Diagnosis**
 - A.1. *What types of intracranial injuries are most likely to have occurred in this patient?*
 - A.2. *What is the difference between primary and secondary injury? What factors contribute to secondary injury?*
 - A.3. *What are the benefits and risks of administering mannitol?*
 - Benefits
 - Risks
 - A.4. *What is the effect of hyperglycemia on neurologic outcome?*

following head trauma?

- A.5. What alterations in sodium and potassium balance can occur in patients with head injury?*
 - A.6. In addition to sodium and potassium, what other electrolyte abnormalities can be present after head trauma?*
 - A.7. What are the neuroprotective effects of administering magnesium (Mg)?*
 - A.8. What role do gender and female sex hormones have in the pathophysiology of traumatic brain injury (TBI)?*
 - A.9. What is the role of decompressive craniectomy (DC) as a treatment option for ICP control after head injury?*
 - A.10. Do genetic factors play a role in the outcome after head injury?*
- B. Preoperative Evaluation and Preparation**
- B.1. What is the GCS? What is the significance of a GCS of 7T in this patient?*
 - B.2. In addition to the GCS, what other assessments can be done to evaluate neurologic function?*
 - B.3. What is the role of CT scanning in the initial evaluation of the patient with head injury? What are the management options in patients whose neurologic condition is deteriorating before obtaining a CT scan?*
 - B.4. What is the role of ICP monitoring in the management of head injury?*
 - B.5. How can you clear this patient's cervical spine?*
 - B.6. What are the advantages of early endotracheal intubation in this patient?*
 - B.7. What is your plan for airway management in this patient? How would it change if the patient were combative? How would it change if the patient had facial fractures with significant swelling of the head and neck?*
 - B.8. What are the effects of succinylcholine on ICP? What is the significance of the effect, if any?*

B.9. What coagulation abnormalities are present after TBI? What modalities can be used to provide hemostasis and reduce intracranial hematoma expansion?

C. Intraoperative Management

C.1. What is appropriate hemodynamic monitoring during CT scanning and during craniotomy for evacuation of a subdural hematoma?

C.2. Should hyperventilation be used in this patient?

C.3. What are the implications of arterial hypertension in patients with head injury? How should BP be managed?

C.4. What should be done about intravenous (IV) fluid replacement? Should corticosteroids be given empirically?

C.5. Should hypertonic saline (HTS) be administered to this patient? How is HTS administered?

C.6. The patient underwent a craniectomy for evacuation of a frontal intracerebral hematoma. Should some anesthetic agents be avoided in this situation? Which ones? What agents might be preferred in this situation?

C.7. Should hypothermia be employed in this patient?

D. Postoperative Neurointensive Care Management

D.1. What are the postoperative ventilation concerns in this patient?

D.2. What specific measure should be used to control the patient's ICP? What type of monitoring devices can be used to measure ICP?

D.3. What is neurogenic pulmonary edema? Would you avoid positive end-expiratory pressure (PEEP) in a patient with increased ICP?

D.4. What is the role of antiseizure prophylaxis in the perioperative management of head trauma?

D.5. How can cerebral oxygenation monitoring be used in the clinical management of TBI?

D.6. What methods can be used in the neurointensive care unit to

prevent hyperthermia?

21 Cerebral Aneurysm

Patricia Fogarty Mack

A. Medical Disease and Differential Diagnosis

- A.1. What are the incidence, prevalence, and causes of subarachnoid hemorrhage (SAH), and what are the risk factors associated with rupture of intracranial aneurysms?*
- A.2. What are common sizes and locations of intracranial aneurysms?*
- A.3. What is the pathophysiology of aneurysmal rupture and SAH?*
- A.4. What are symptoms and signs of SAH?*
- A.5. How does one assess the severity of SAH?*
- A.6. What are the cardiovascular effects of SAH?*
- A.7. How is the diagnosis of SAH made?*
- A.8. What is the risk for rebleeding for a patient with SAH?*

B. Preoperative Evaluation and Preparation

- B.1. What are some concerns in going to the interventional neuroradiology suite in the midst of an angiogram to be followed immediately with coiling of an aneurysm?*
- B.2. What type of anesthesia is required for coiling of an aneurysm?*
- B.3. Should one proceed with induction of general anesthesia under these circumstances?*
- B.4. What types of emergencies can occur during coiling of an aneurysm, and how should they be managed?*
- B.5. What other modalities of endovascular therapy are available?*
- B.6. A craniotomy is planned for the following day to clip the middle cerebral artery aneurysm. Should surgery be postponed because of the patient's elevated troponin and CPK-MB fractions?*
- B.7. Would you premedicate this patient before craniotomy?*

C. Intraoperative Management

- C.1. *What are the goals of the induction and maintenance of anesthesia for this patient?*
- C.2. *Is placement of an arterial catheter necessary for induction of anesthesia in this patient in the interventional neuroradiology suite?*
- C.3. *How would you assess fluid status in this patient?*
- C.4. *Would monitoring central venous pressure (CVP) be useful for craniotomy and aneurysm clipping in this patient?*
- C.5. *What other forms of monitoring would you consider?*
- C.6. *What are your specific concerns during induction of anesthesia in this patient?*
- C.7. *How would you accomplish a smooth and safe induction and intubation in this patient?*
- C.8. *Would you perform a rapid sequence induction and tracheal intubation for this patient?*
- C.9. *What are the effects of hypoxemia and hypercapnia, such as would be seen with loss of the airway on induction, on cerebral blood flow (CBF)?*
- C.10. *What is optimal fluid management for aneurysm clipping? Would you use a dextrose-containing solution?*
- C.11. *After the bone plate was removed and as the dura was being opened, the surgeon complained that the brain was "tight." What could you do to achieve better brain relaxation and facilitate surgical exposure?*
- C.12. *How might transmural pressure be decreased to allow for aneurysm clip placement?*
- C.13. *What is the purpose of controlled hypotension, and how is it achieved?*
- C.14. *What are some of the drawbacks of controlled hypotension?*
- C.15. *What methods of cerebral protection might you use during this operation?*
- C.16. *Would you induce mild hypothermia as a means of cerebral*

protection?

C.17. What are the indications for deep hypothermic circulatory arrest?

C.18. What steps should be taken in the case of intraoperative rupture of an intracranial aneurysm?

C.19. How would you plan the emergence from an anesthetic for aneurysm clipping?

D. Postoperative Management

D.1. Would you extubate the patient postoperatively?

D.2. What would be the differential diagnosis if the patient did not return to her preoperative neurologic condition?

D.3. On postoperative day 2, the patient became disoriented and developed hemiplegia. A CT scan was obtained, which shows no new intracranial bleeding. What other diagnostic studies should be performed?

D.4. What is cerebral vasospasm, and what causes it?

D.5. What are pathophysiologic changes seen in cerebral vasospasm?

D.6. How is the diagnosis of cerebral vasospasm made?

D.7. What steps can be taken to prevent cerebral vasospasm?

D.8. What treatments can be undertaken once a diagnosis of cerebral vasospasm is made?

D.9. What are other neurologic complications following SAH and aneurysm clipping?

D.10. What other organ systems may manifest problems postoperatively in aneurysm clipping patients?

SECTION 5 The Endocrine System

22 Pheochromocytoma

Anup Pamnani and Vinod Malhotra

A. Medical Disease and Differential Diagnosis

A.1. What are some common differential diagnoses for arterial

hypertension?

- A.2. What is a pheochromocytoma?*
- A.3. Describe the anatomy of the adrenal gland.*
- A.4. What substances does the adrenal medulla secrete?*
- A.5. What are the mechanisms of action of epinephrine and norepinephrine?*
- A.6. What is the pathway for synthesis and breakdown of catecholamines?*
- A.7. What does the adrenal cortex secrete?*
- A.8. What are the metabolic actions of the glucocorticoids and the mineralocorticoids?*
- A.9. What are the clinical features associated with a pheochromocytoma?*
- A.10. What is the prevalence of pheochromocytomas and paragangliomas?*

B. Preoperative Evaluation and Preparation

- B.1. How can you diagnose and localize the tumor preoperatively?*
- B.2. How do you pharmacologically prepare the patient with a pheochromocytoma for surgery?*
- B.3. What other aspects of preoperative management are important?*

C. Intraoperative Management

- C.1. What drugs should be avoided during the operation?*
- C.2. How would you monitor this patient?*
- C.3. Describe the anesthetic management of the patient with pheochromocytoma.*
- C.4. What drugs are used to control the effects of catecholamine stimulation during surgery?*
- C.5. What are some management concerns after the tumor is removed?*
- C.6. What are some of the concerns with laparoscopic adrenalectomy?*

D. Postoperative Management

D.1. What is the significance of postoperative hypotension? How is it treated?

D.2. What other problems can arise in the postoperative period?

23 Diabetes Mellitus

Mark E. Nunnally and Vinod Malhotra

A. Medical Disease and Differential Diagnosis

A.1. What is the epidemiology of DM in the general population?

A.2. What are the factors in the etiology of the disease?

A.3. How is DM classified?

A.4. What are the complications of DM?

A.5. How are the different forms of this illness treated?

A.6. How is control of the disease adequately monitored?

A.7. What are some of the factors that alter insulin requirements?

A.8. What are the principles of management of diabetic ketoacidosis (DKA)?

A.9. What is a hyperglycemic hyperosmolar state?

B. Preoperative Evaluation and Preparation

B.1. How should this patient be evaluated?

B.2. How would the stiff joint syndrome affect her airway management?

B.3. What are the signs and implications of autonomic neuropathy in the diabetic patient?

B.4. How should this patient be prepared for anesthesia and surgery?

B.5. For elective surgery, how are insulin and glucose requirements managed on the day of surgery?

B.6. How should this patient be premedicated?

C. Intraoperative Management

C.1. What are the effects of anesthesia and surgery on insulin and glucose metabolism?

C.2. What anesthetic techniques should be considered?

- C.3. *How should this patient be monitored?*
- C.4. *How is hyperglycemia treated intraoperatively?*
- C.5. *How is hypoglycemic shock recognized and treated intraoperatively?*
- D. **Postoperative Management**
 - D.1. *How is diabetes controlled in this patient postoperatively?*
 - D.2. *Does diabetes increase perioperative risk?*
 - D.3. *What are the common postoperative complications to be expected in a diabetic patient?*
 - D.4. *Is it necessary to achieve tight perioperative control of glucose?*

SECTION 6 The Genitourinary System

24 Transurethral Resection of the Prostate and Geriatric Anesthesia

Anuj Malhotra, Vinod Malhotra, and Fun-Sun F. Yao

- A. **Medical Disease and Differential Diagnosis**
 - A.1. *What comorbidities are common in patients undergoing TURP?*
 - A.2. *What are the normal physiologic consequences of aging for the various organ systems?*
 - A.3. *How should drug dosages be adjusted for elderly patients? Should any particular medications be avoided?*
 - A.4. *Does a history of prior MI increase the patient's risk of perioperative reinfarction or stent thrombosis?*
 - A.5. *In patients with a history of recent MI, would you recommend that the surgery be postponed for a certain period?*
- B. **Preoperative Evaluation and Preparation**
 - B.1. *How would you evaluate the patient's cardiac condition? Does he need additional testing?*
 - B.2. *Would you discontinue any antihypertensives or any*

medications for angina?

B.3. For a patient with a cardiac implantable electronic device (CIED), what information should you know? What precautions should be taken?

B.4. What types of coronary stents are available? What is their perioperative relevance?

B.5. What is the conventional recommendation for dual antiplatelet therapy (DAPT) in a patient with previous percutaneous coronary intervention (PCI) undergoing elective noncardiac surgery?

B.6. What risk is associated with continuing perioperative antiplatelet therapy? What risk is there with stopping it?

B.7. How should patients with coronary stents undergoing noncardiac surgery be managed?

C. Intraoperative Management

C.1. What monitors would you use for this patient?

C.2. Is there a preferred anesthetic technique for patients undergoing TURP, and why?

C.3. Does regional anesthesia result in a lower incidence of perioperative mortality than general anesthesia?

C.4. What intravenous fluid would you use during TURP?

C.5. Forty minutes after a sensory level of T10 was established with intrathecal anesthesia, and monopolar TURP (M-TURP) resection was initiated with the use of glycine as the bladder irrigating solution, the patient becomes agitated and complains of nausea. Further sedation along with an antiemetic is administered. However, shortly thereafter, the patient becomes very restless, blood pressure rises, and heart rate decreases. The patient becomes cyanotic and obtunded, blood pressure precipitously falls, and pupils are dilated and unresponsive to light. What is the most likely cause of these signs and symptoms, and would these occur during bipolar (B-TURP) or laser TURP (L-TURP)?

resection?

- C.6. What are the important characteristics of irrigation solutions used during TURP?*
- C.7. What is the effect on body temperature of continuous bladder irrigation during TURP?*
- C.8. What is the definition of TURP syndrome? What are the signs and symptoms of the syndrome?*
 - Cardiopulmonary*
 - Hematologic and Renal*
 - Central Nervous System*
- C.9. How does the patient absorb irrigation solution during TURP?*
- C.10. What factors increase the incidence of TURP syndrome?*
- C.11. What is the effect on cardiopulmonary, renal, and central nervous system (CNS) functions of excessive absorption of irrigation solution during TURP?*
- C.12. What causes CNS dysfunction in patients who have undergone M-TURP?*
- C.13. How does acute hyponatremia affect the cardiovascular system?*
- C.14. What prophylactic measures may reduce the incidence of TURP syndrome?*
- C.15. What therapeutic measures are recommended for patients with TURP syndrome?*
- C.16. Is hypertonic saline administration necessary to correct hyponatremia? Explain. What are the risks of rapidly correcting hyponatremia?*
- C.17. What are the toxic effects of glycine? Is there an antidote to glycine toxicity? What are the metabolic by-products of glycine?*
- C.18. What are the symptoms and clinical course of TURP-induced hyperammonemia?*
- C.19. What are the clinical characteristics, causes, and prognosis*

of TURP-related blindness?

C.20. What are the causes of excessive bleeding during TURP?

C.21. What are the causes, signs, symptoms, and treatment of bladder perforation during TURP?

C.22. What are the causes of hypotension during TURP?

D. Postoperative Management

D.1. What is the source of postoperative bacteremia in patients who have undergone TURP? What factors increase the incidence of bacteremia?

D.2. What are the signs of post-TURP septicemia? What preventive measures are generally recommended?

D.3. Is postoperative hypothermia a risk factor for myocardial ischemia?

D.4. What is postoperative cognitive dysfunction (POCD)? How does this differ from delirium, and what is the time course to resolution?

D.5. What are the mechanisms and risk factors for POCD? How would you mitigate the risk of POCD? Does anesthesia type influence development of POCD?

E. Comparing M-TURP, B-TURP, and L-TURP

E.1. What differentiates M-TURP from B-TURP?

E.2. Are decreased morbidity and mortality associated more closely with M-TURP or with B-TURP?

E.3. What differentiates the technologies for L-TURP?

25 Kidney Transplant

Christine Lennon and Fun-Sun F. Yao

A. Medical Disease and Differential Diagnosis

A.1. What are the causes of chronic renal disease that can progress to renal failure?

A.2. How is chronic kidney disease (CKD) diagnosed?

A.3. What are the indications for dialysis?

A.4. What are the common clinical manifestations of ESRD?

A.5. What electrolyte imbalances occur in patients with impaired

renal function, and how are they treated?

- A.6. How is metabolic acidosis managed in chronic renal failure?*
 - A.7. Are patients with renal disease at increased risk of cardiovascular disease?*
 - A.8. When is the best time to receive a kidney transplant?*
 - A.9. How are immunosuppressive drugs managed in kidney transplant recipients?*
 - A.10. How are kidneys allocated to recipients on the waiting list in the United States?*
 - A.11. What is donation after cardiac death (DCD)?*
 - A.12. What is a living donor transplant program?*
 - A.13. What is a paired donor exchange transplant program?*
 - A.14. What are some barriers to receiving a kidney transplant?*
 - A.15. What surgical techniques are available for donor nephrectomy (DN)?*
 - A.16. How is a donor kidney preserved?*
 - A.17. Describe the operative procedure of kidney transplantation.*
- B. Preoperative Evaluation and Preparation**
- B.1. What preoperative workup would you order for a recipient?*
 - B.2. How does the presence of obesity affect the outcome of a transplanted kidney?*
 - B.3. How are routine medications and immunosuppressive medications managed in the perioperative period?*
- C. Intraoperative Management**
- C.1. Are a central venous pressure (CVP) monitoring line, an arterial line, and a pulmonary artery catheter required for the transplant procedure?*
 - C.2. What type of intravenous fluid should be used during surgery?*
 - C.3. How would you conduct the anesthesia induction?*
 - C.4. Is succinylcholine contraindicated in renal failure patients?*
 - C.5. How are the nondepolarizing muscle relaxants affected by*

renal failure?

- C.6. How would you maintain anesthesia during the case?*
- C.7. What are the effects of inhalation anesthetics on renal blood flow (RBF), glomerular filtration (GFR), and urine output?*
- C.8. What are the potential nephrotoxic effects of inhalation anesthetics? What are the nephrotoxic metabolites of inhalation anesthetics?*
- C.9. How does renal failure affect the pharmacology of opioids?*
- D. Postoperative Management**
 - D.1. How is the diagnosis of transplant rejection made?*
 - D.2. What are immunosuppressive agents, and how do they affect anesthetic care?*

26 Robotic-Assisted Laparoscopic Surgery

Judith Weingram

- A. Medical Disease and Differential Diagnosis**
 - A.1. What is the incidence of carcinoma of the prostate?*
 - A.2. How is prostate cancer diagnosed?*
 - A.3. How is prostate cancer treated?*
 - A.4. Define laparoscopy.*
 - A.5. Describe the development of robotic-assisted laparoscopy.*
 - A.6. What are the advantages and disadvantages of minimally invasive surgery over open surgery?*
 - A.7. What are the contraindications to laparoscopic or robotic-assisted laparoscopic surgery? Is pregnancy a contraindication to robotic surgery?*
 - A.8. What other specialties commonly perform robotic surgery?*
 - A.9. Why is carbon dioxide (CO₂) the gas of choice for robotic laparoscopy? What are its disadvantages?*
 - A.10. How much endogenous CO₂ is produced at basal level and at maximal exercise?*
 - A.11. How much CO₂ is stored in the body? Where is it stored? Of what significance is this to laparoscopy?*

A.12. Describe the diffusion and solubility properties of CO₂ and their significance in laparoscopy.

A.13. Is CO₂ soluble in water or plasma? Is it soluble in blood? Why?

B. Preoperative Evaluation and Preparation

B.1. What do you want to know about this patient's history and physical condition that may affect whether or not you clear him for robotic surgery?

B.2. What factors increase this patient's risk of pulmonary complications?

B.3. What laboratory tests should be performed preoperatively?

B.4. What specific information should the patient be given about robotic surgery before obtaining informed consent?

B.5. What additional procedures should be done before surgery?

B.6. What are the three major forces that uniquely alter the patient's physiology during robotic laparoscopy?

C. Intraoperative Management

C.1. What is the anesthetic technique of choice for robotic-assisted laparoscopy? Why?

C.2. Can a laryngeal mask airway (LMA) be used?

C.3. What anesthetic agents or adjuvant drugs are recommended for laparoscopy? Are any anesthetic agents contraindicated?

C.4. Should nitrous oxide (N₂O) be used during laparoscopy? What are the pros and cons? Does N₂O cause bowel distention during laparoscopy? Does N₂O cause nausea and vomiting after laparoscopy?

C.5. Can laparoscopy be performed under local or regional anesthesia?

C.6. What monitors and devices would you apply to the patient? Why?

C.7. How is the patient to be positioned? What special

precautions are required for robotic laparoscopy?

- C.8. *How will you ventilate the patient? What are the respiratory and circulatory effects of the Trendelenburg position during laparoscopy?*
- Respiratory
 - Circulatory
- C.9. *What techniques are available for initial access to the peritoneal cavity? What anesthetic problems can arise during insufflation?*
- C.10. *What intravenous (IV) solution and how much fluid volume do you plan to infuse?*
- C.11. *Under what circumstances should laparoscopy be converted to laparotomy?*
- C.12. *What is the arterial to end-tidal CO₂ gradient (PaCO₂–EtCO₂) in the normal awake patient? What is the cause of the gradient? Does the gradient change during laparoscopy? Why?*
- C.13. *Is an arterial line necessary? Why? Does end-tidal CO₂ tension accurately reflect arterial CO₂ tension? Under what circumstances may the EtCO₂ exceed the PaCO₂? Why?*
- C.14. *What are the possible causes of hypercarbia?*
- C.15. *What factors play a role in the unusually rapid and marked elevation of CO₂ that is sometimes seen in laparoscopy?*
- C.16. *How rapidly does the PaCO₂ rise in the apneic patient (endogenous CO₂)? How rapidly does the PaCO₂ rise if 5% CO₂ gas is inhaled (exogenous)? How rapidly can the CO₂ rise during laparoscopy? What factors explain the differences?*
- C.17. *What is the net effect of pneumoperitoneum, hypercarbia, and steep Trendelenburg on the cardiovascular system?*
- C.18. *What is the net effect of pneumoperitoneum, hypercarbia, and steep Trendelenburg on the respiratory system?*

- C.19. *What is the net effect of pneumoperitoneum, hypercarbia, and steep Trendelenburg on the central nervous system?*
- C.20. *What are the neuroendocrine changes that occur during laparoscopy?*
- C.21. *What is the net effect of pneumoperitoneum, hypercarbia, and steep Trendelenburg on the renal system?*
- C.22. *What is the net effect of pneumoperitoneum, hypercarbia, and steep Trendelenburg on the bowel and gastrointestinal system?*
- C.23. *How would you recognize a CO₂ embolism during laparoscopy? How does this differ from an air embolism? Why should N₂O be discontinued during suspected embolization? Will N₂O increase the size of CO₂ emboli?*
- C.24. *What is the mechanism of increase in shunting resulting from embolization?*
- C.25. *How is a gas embolism (CO₂ or air) treated?*
- C.26. *What are the causes of pneumothorax or pneumomediastinum during laparoscopy? How would you diagnose it? How would you treat it?*
- C.27. *How would you decide when to extubate?*
- D. **Postoperative Management**
- D.1. *What are some of the unique complications of laparoscopy?*
- Injuries from Instruments
 - Complications of Pneumoperitoneum
 - Systemic Effects of CO₂ Absorption
 - Trendelenburg Position
 - Late Complications
- D.2. *In the postanesthesia care unit (PACU), our patient complains of numbness and weakness of the lower extremities after 6 hours of anesthesia for robotic prostatectomy. What tests will you order? When would you remove the Foley catheter and arterial line? Under what*

- circumstances would you order a chest x-ray film?*
- D.3. *What is the incidence of postoperative nausea and vomiting?*

SECTION 7 The Reproductive System

27 Placenta Previa/Placenta Accreta Spectrum

Jill Fong

A. Medical Disease and Differential Diagnosis

- A.1. *What are the leading causes of maternal mortality, and what role does anesthesia play in this mortality?*
- A.2. *What is the differential diagnosis for an antepartum hemorrhage?*
- A.3. *How would you diagnose the etiology of antepartum bleeding after midpregnancy?*
- A.4. *What is the incidence of placenta previa, and what are the associated conditions?*
- A.5. *What are the different types of placenta previa?*
- A.6. *What is the usual obstetric management for placenta previa?*
- A.7. *What is vasa previa? How is it diagnosed and managed?*
- A.8. *What are the risk factors for the development of a placental abruption?*
- A.9. *How is placental abruption diagnosed and managed?*
- A.10. *What complications are associated with placental abruption?*
- A.11. *Who is at risk for uterine rupture, and how is uterine rupture diagnosed?*
- A.12. *What is the treatment for uterine rupture?*
- A.13. *Is this patient at risk for postpartum bleeding?*
- A.14. *What is the placenta accreta spectrum (PAS)?*
- A.15. *How is the PAS diagnosed?*
- A.16. *How is the PAS managed obstetrically?*

A.17. What tests and/or interventions can improve neonatal outcome of a preterm birth?

B. Preoperative Evaluation and Preparation

B.1. How does pregnancy change respiratory function, and what impact does this have on anesthetic care?

B.2. What are the maternal cardiovascular changes of pregnancy?

B.3. What are the maternal gastrointestinal changes of pregnancy?

B.4. What hematologic changes occur during pregnancy?

B.5. What laboratory data do you need before taking this patient to the operating room?

B.6. What preoperative medications would you administer to this patient?

C. Intraoperative Management

C.1. What monitors would you use for this patient?

C.2. What anesthetic could be used in this patient?

C.3. What are the absolute and relative contraindications for neuraxial anesthesia?

C.4. How is postpartum hemorrhage (PPH) defined, and what are the etiologies of this bleeding?

C.5. After delivery of the fetus, the placenta is removed with some difficulty in one small area and generalized oozing from the placental implantation site is noted. What is the most likely cause of this patient's bleeding?

C.6. After delivery of the placenta in a cesarean section, what maneuvers and drugs can enhance myometrial contractility and therefore decrease blood loss?

C.7. When should this patient receive tranexamic acid (TXA)?

C.8. If this patient had ongoing bleeding intraoperatively, what guidelines help determine when red blood cell (RBC) transfusions should be given?

C.9. What laboratory tests should be ordered during the

resuscitation of this patient?

- C.10. If this patient had a massive blood loss, what blood replacement therapy would be indicated?*
 - C.11. What is the role of recombinant activated factor VII (rFVIIa) in the hemorrhaging obstetric patient?*
 - C.12. What is the role of type O Rh-negative (universal donor) uncrossmatched blood in emergency transfusions, and how does this change your future management?*
 - C.13. What complications can occur from the transfusion of blood products?*
 - C.14. What is the role of autologous transfusion in obstetric patients?*
 - C.15. Significant intraoperative blood loss required the transfusion of 8 units of type-specific, crossmatched packed RBCs (pRBCs). This patient had generalized oozing in the surgical field and hematuria. What is your differential diagnosis?*
 - C.16. What is disseminated intravascular coagulation (DIC)?*
 - C.17. Define amniotic fluid embolism (AFE) syndrome and discuss treatment.*
- D. Postoperative Management**
- D.1. If the patient received epidural anesthesia and subsequently developed DIC, when should the epidural catheter be removed?*
 - D.2. You have successfully treated the patient's massive hemorrhage. Her laboratory values have returned to normal. The patient, however, is still hypotensive despite appropriate intravascular volume replacement and support with vasopressors. What is your concern in this case?*

28 Hypertensive Disorders of Pregnancy

Sharon Abramovitz and Jennifer Wagner

A. Medical Disease and Differential Diagnosis

- A.1. What is the classification of hypertension disorders in*

pregnancy as defined by the American College of Obstetricians and Gynecologists?

- A.2. What is preeclampsia?*
- A.3. What is preeclampsia with severe features?*
- A.4. What is eclampsia?*
- A.5. What is HELLP syndrome?*
- A.6. What are the risk factors for developing preeclampsia?*
- A.7. What is the mortality associated with preeclampsia?*
- A.8. Discuss the pathogenesis of preeclampsia.*

Immunologic Factors

Genetic Factors

Endothelial Factors

Platelet Factors

Calcium

Coagulation Factors

Fatty Acid Metabolism

Markers of Angiogenesis

- A.9. Discuss the pathologic alterations of preeclampsia.*

Cardiovascular Changes

Hemodynamic Changes

Hematologic Changes

Renal Changes

Endocrine Changes

Respiratory Changes

Hepatic Changes

Neurologic Changes

Uteroplacental Perfusion

- A.10. What are some of the complications associated with preeclampsia?*

B. Preoperative Evaluation and Preparation

- B.1. What initial laboratory studies are recommended for patients with preeclampsia?*

- B.2. Discuss bleeding time and platelet count evaluation during*

preoperative assessment of a patient with preeclampsia requesting epidural analgesia/anesthesia for labor and delivery.

- B.3. What types of monitoring are important for patients with preeclampsia? When is a central venous pressure (CVP) monitor indicated?*
- B.4. Discuss the obstetric management of preeclampsia with severe features.*
- B.5. What are the antihypertensive agents of choice for preeclampsia?*
- B.6. What drug therapy is the treatment of choice for seizure prophylaxis?*
- B.7. Discuss the mechanism of action of magnesium sulfate.*
- B.8. What are the fetal effects of magnesium sulfate therapy?*
- B.9. Discuss the treatment of magnesium sulfate toxicity.*
- B.10. What conditions mandate immediate delivery, regardless of the gestational age?*
- B.11. Discuss the management of eclampsia.*

C. Intraoperative Management

- C.1. What is your choice of labor analgesia for patients with preeclampsia?*
- C.2. What is the advantage of prehydration prior to initiation of neuraxial analgesia?*
- C.3. What sensory level of analgesia is required for labor and delivery?*
- C.4. Discuss the commonly used local anesthetics for labor analgesia.*
- C.5. Is the addition of epinephrine to local anesthetics advisable in preeclamptic patients?*
- C.6. What is the treatment for the abnormal fetal heart rate pattern seen with maternal hypotension after neuraxial analgesia is instituted?*
- C.7. What would you do after an accidental dural puncture?*