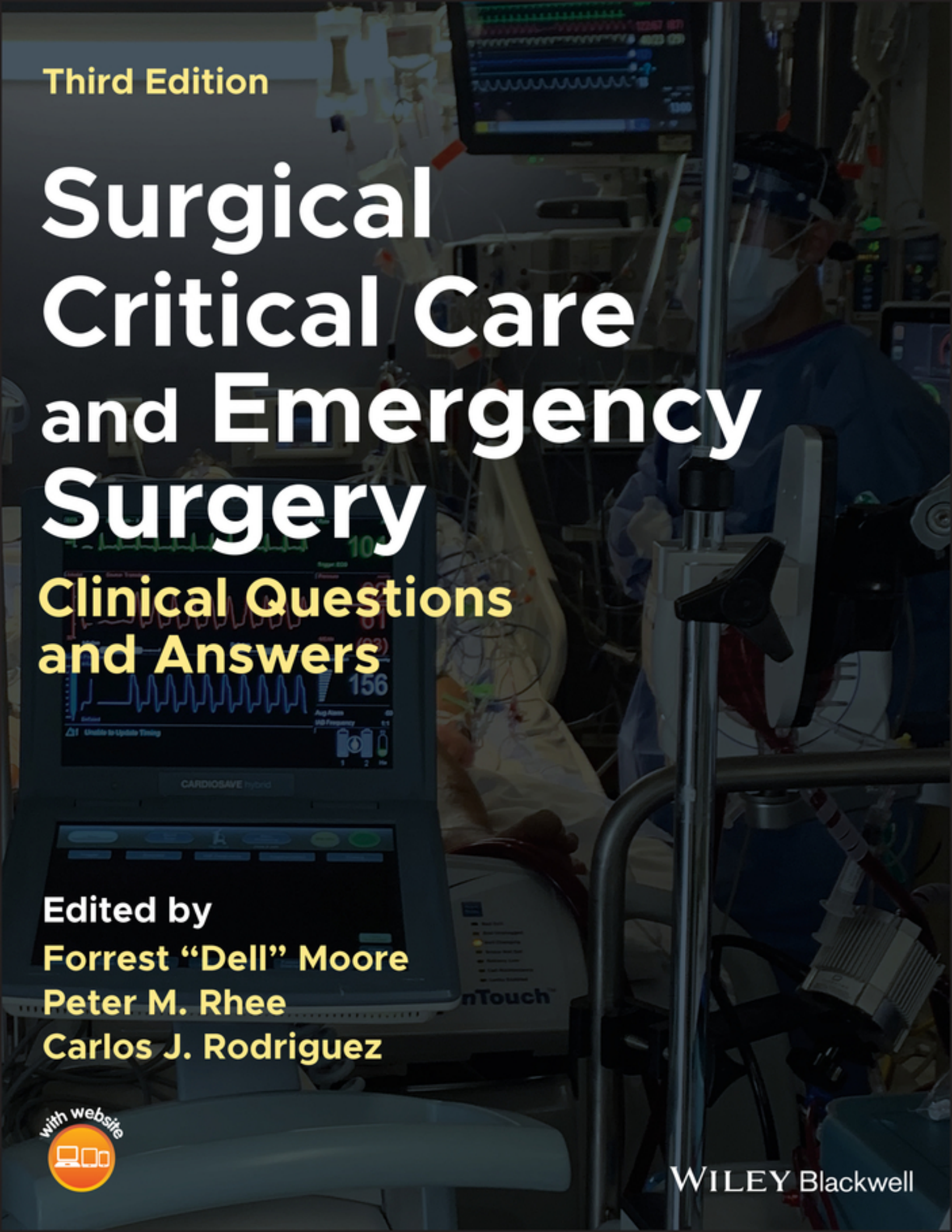

Third Edition

Surgical Critical Care and Emergency Surgery

Clinical Questions and Answers

Edited by
Forrest "Dell" Moore
Peter M. Rhee
Carlos J. Rodriguez

with website

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Edited by

Forrest "Dell" Moore, MD, FACS
Associate Professor of Surgery
TCU & UNTHSC School of Medicine
Vice Chief of Surgery
Associate Trauma Medical Director
John Peter Smith Health
Forth Worth, TX, USA

Peter M. Rhee, MD, MPH, FACS, FCCM, DMCC
Professor of Surgery at New York Medical College
USUHS, and Morehouse College of Medicine
Chief of Acute Care Surgery and Trauma
Vice Chair of Surgery

Carlos J. Rodriguez, DO
Associate Professor of Surgery
TCU & UNTHSC School of Medicine

Director, Emergency General Surgery
Director, Surgical Research
John Peter Smith Health
Fort Worth, TX, USA

WILEY Blackwell

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List of Contributors

Yousef Abuhakmeh, DO
MAJ, MC US Army
Banner University Medical Center
University of Arizona College of Medicine
Tucson, AZ, USA

Vishal Bansal, MD
Scripps Mercy Hospital
San Diego, CA, USA

Stephen L. Barnes, MD
Division of Acute Care Surgery, Department of Surgery
University of Missouri
Columbia, MO, USA

Elise Becker, MD
Naval Medical Center
San Diego, CA, USA

Christopher Bell, MD
William Beaumont Army Medical Center
El Paso, TX, USA

Patrick Benoit, DO
Walter Reed National Military Medical Center
Bethesda, MD, USA

Mauer Biscotti III, MD
Division of General Surgery, Department of Surgery
San Antonio Military Medical Center
San Antonio, TX, USA

Matthew J. Bradley, MD
Uniformed Services University of the Health Sciences
Program Director General Surgery Residency

Walter Reed National Military Medical Center
Bethesda, MD, USA

Matthew Bronstein, MD
Division of Trauma and Acute Care Surgery
New York Medical College
Westchester Medical Center
Valhalla, NY, USA

Kevin W. Cahill, MD
Christiana Care Health Care System
Newark, DE, USA

Catherine Cameron, MD
Landstuhl Regional Medical Center
Landstuhl, Germany

Jeremy W. Cannon, MD, SM
Division of Traumatology, Surgical Critical Care & Emergency Surgery, Perelman School of Medicine at the University of Pennsylvania
Philadelphia, PA, USA

Department of Surgery, F. Edward Hébert School of Medicine, Uniformed Services University of the Health Sciences
Bethesda, MD, USA

Luis Cardenas, DO, PhD
Department of Surgery Christiana Care Health Care System
Newark, DE, USA

Brett M. Chapman, MD
LSUHSC-New Orleans
New Orleans, LA, USA

Elaine Cleveland, MD
William Beaumont Army Medical Center
El Paso, TX, USA

Jorge Con, MD
Division of Trauma and Acute Care Surgery
New York Medical College
Westchester Medical Center
Valhalla, NY, USA

Alan Cook, MD, MS
University of Texas at Tyler
Tyler, TX, USA

J. Craig Egan, MD
Phoenix Children's Hospital
Phoenix, AZ, USA

Brett D. Crist, MD
Department of Orthopaedic Surgery
University of Missouri
Columbia, MO, USA

Jeffrey P. Coughenour, MD
Division of Acute Care Surgery
Department of Surgery
University of Missouri
Columbia, MO, USA

Gregory J. Della Rocca, MD, PhD
Department of Orthopaedic Surgery
University of Missouri
Columbia, MO, USA

Harsh K. Desai, MD
Department of Surgery Christiana Care Health Care System
Newark, DE, USA

Joshua Dilday, DO
Division of Acute Care Surgery
University of Southern California
LAC + USC Medical Center
Los Angeles, CA, USA

Jay J. Doucet, MD, MSc
Department of Surgery
University of California San Diego
San Diego, CA, USA

Therese M. Duane, MD
TCU & UNTHSC School of Medicine
Department of Surgery
Texas Health Resources
Fort Worth, TX, USA

Joseph DuBose, MD
Department of Surgery
Dell School of Medicine
University of Texas Austin
Austin, TX, USA

Drew Farmer, MD
Trauma Surgery, Surgical Critical Care & Emergency Surgery
Perelman School of Medicine
University of Pennsylvania
Philadelphia, PA, USA

Adam D. Fox, DO
Division of Trauma and Critical Care Surgery Rutgers New Jersey Medical School
University Hospital
Newark, NJ, USA

Charles J. Fox, MD
R Adams Cowley Shock Trauma Center Division of Vascular Surgery
University of Maryland School of Medicine
Baltimore, MD, USA

Rondi Gelbard, MD
Division of Trauma and Acute Care Surgery
Department of Surgery

University of Alabama at Birmingham
Birmingham, AL, USA

Frederick Giberson, MD
Department of Surgery Christiana Care Health Care System Newark
DE, USA

Matthew A. Goldshore, MD, PhD, MPH
Department of Surgery
Perelman School of Medicine at the University of Pennsylvania
Philadelphia, PA, USA

Rathnayaka M. K. Gunasingha, MD
Walter Reed National Military Medical Center
Bethesda, MD, USA

Juan P. Gurria, MD
Phoenix Children's Hospital
Phoenix, AZ, USA

Melike Harfouche MD
Division of Trauma and Acute Care Surgery
University of Maryland – Shock Trauma Center
Baltimore, MD, USA

Hang Ho, MD
Augusta University Medical Center
Augusta, GA, USA

Luke Hofmann, DO
Brooke Army Medical Center
San Antonio, TX, USA
F. Edward Hebert School of Medicine Uniformed Services University
Bethesda, MD, USA

Romeo Ignacio, MD
Division of Pediatric Surgery

Rady Children’s Hospital
San Diego, CA, USA

MAJ Jacob Swann, MD
Regions Hospital
Saint Paul, MN, USA

Douglas James, MD
Section of Trauma and Acute Care Surgery
Westchester Medical Center
Valhalla, NY, USA

Kirstie Jarrett, MD
Banner University Medical Center
Tucson, AZ, USA

Bellal Joseph, MD
Division of Trauma, Surgical Critical Care, Burns and Acute Care Surgery
University of Arizona College of Medicine
Banner University Medical Center
Tucson, AZ, USA

Lewis J. Kaplan, MD, FCCM, FCCP
Division of Trauma, Surgical Critical Care and Emergency Surgery, Department of Surgery, Perelman School of Medicine, University of Pennsylvania
Philadelphia, PA, USA

Corporal Michael J. Crescenz VA Medical Center
Philadelphia, PA, USA

Lindsey Karavites, MD
Division of Acute Care Surgery
University of Southern California
LAC+USC Medical Center
Los Angeles, CA, USA

Joshua Klein, DO
Department of Surgery, Trauma & Acute Care Surgeon

Westchester Medical Center, Division of Trauma & Acute Care Surgery
New York Medical College, Valhalla, NY, USA

Leslie Kobayashi, MD
Division of Trauma, Acute Care Surgery
Surgical Critical Care and Burns
University of California San Diego
San Diego, CA, USA

Narong Kulvatunyou, MD
Department of Surgery University of Arizona School of Medicine
Banner University Medical Center
Tucson, AZ, USA

Raul Reina Limon, MD
Division of Trauma, Critical Care, Burns, and Emergency Surgery
Department of Surgery
University of Arizona
Tucson, AZ, USA

Gary Lombardo, MD
Division of Trauma and Acute Care Surgery
New York Medical College
Westchester Medical Center
Valhalla, NY, USA

Ryan Malcom, MD
Division of Trauma and Acute Care Surgery
New York Medical College
Westchester Medical Center
Valhalla, NY, USA

Toni Manougian MD, MBA
Department of Critical Care Anesthesiology
New York Medical College

Westchester Medical Center
Valhalla, NY, USA

Matthew J. Martin, MD
Trauma and Acute Care Surgery Service
Scripps Mercy Hospital
San Diego, CA, USA

Kazuhide Matsushima, MD
Division of Acute Care Surgery
University of Southern California
LAC+USC Medical Center
Los Angeles, CA, USA

Adrian A. Maung, MD, FCCM
Yale School of Medicine
New Haven, CT, USA

Richard S. Miller, MD
Department of Surgery
TCU & UNTHSC School of Medicine
John Peter Smith Health
Fort Worth, TX, USA

William Mohr III, MD
Regions Hospital
Saint Paul, MN, USA

Ida Molavi, MD
Department of Trauma and Acute Care Surgery Louisiana State University Health
Shreveport, LA, USA

Thomas Muse, MD
Department of Trauma and Acute Care Surgery
Department of Surgery
University of Alabama at Birmingham
Birmingham, AL, USA

Christopher S. Nelson, MD
Division of Acute Care Surgery
Department of Surgery
University of Missouri
Columbia, MO, USA

Omar Obaid, MD
Division of Trauma, Critical Care
Burns, and Emergency Surgery
Department of Surgery
University of Arizona
Tucson, AZ, USA

Thomas A. O'Hara, DO
Dwight D. Eisenhower Army Medical Center
Fort Gordon, GA, USA

Terence O'Keeffe, MB ChB
Augusta University Medical Center
Augusta, GA, USA

Kristine Tolentino Parra, MD
Naval Medical Center
San Diego, CA, USA

Gregory S. Peirce, MD
Womack Army Medical Center
Fort Bragg, NC, USA

Annalise Penikis, MD
University of Maryland Medical Center
Baltimore, MD, USA

Herb A. Phelan, MD, MSCS
Department of Surgery, LSU School of Medicine
New Orleans, LA, USA

Kartik Prabhakaran, MD
New York Medical College

Westchester Medical Center
Valhalla, NY, USA

Theodore Pratt, MD
Naval Medical Center
San Diego, CA, USA

Eric Raschke, DO
Madigan Army Medical Center
Tacoma, WA, USA

Shariq Raza, MD
Trauma Surgery, Surgical Critical Care & Emergency Surgery
Perelman School of Medicine
University of Pennsylvania
Philadelphia, PA, USA

Peter M. Rhee, MD
Division of Trauma and Acute Care Surgery
New York Medical College
Westchester Medical Center
Valhalla, NY, USA

Daniel Roubik, MD
Brooke Army Medical Center
San Antonio, TX, USA

Navdeep Samra, MD
LSU Health
Shreveport, LA, USA

Jaideep Sandhu, MBBS, MPH
City of Hope National Medical Center
Duarte, CA, USA

Jarrett Santorelli, MD
Division of Trauma, Acute Care Surgery, Surgical Critical Care and Burns

University of California San Diego
San Diego, CA, USA

Fariha Sheikh, MD
Division of Trauma and Critical Care Surgery
Rutgers New Jersey Medical School
University Hospital
Newark, NJ, USA

Jared Sheppard, MD
Division of Acute Care Surgery, Department of Surgery
University of Missouri
Columbia, MO, USA

Ilya Shnaydman, MD
Division of Trauma and Acute Care Surgery
New York Medical College
Westchester Medical Center
Valhalla, NY, USA

Elise Sienicki, MD
Naval Medical Center, San Diego, CA, USA

Brandt Sisson, MD
Naval Medical Center
San Diego, CA, USA

Michael C. Smith, MD
Division of Trauma and Surgical Critical Care
Vanderbilt University Medical Center
Nashville, TN, USA

Collin Stewart, MD
Banner University Medical Center
University of Arizona College of Medicine
Tucson, AZ, USA

Michelle Strong, MD, PhD
Trauma and Acute Care Surgeon
Austin, TX, USA

Jonathan Swisher, MD
LTC, MC US Army William Beaumont Army Medical Center
El Paso, TX, USA

Andrew Tang, MD
University of Arizona College of Medicine
Banner University Medical Center
Tucson, AZ, USA

Anne Warner, MD
Department of Surgery
Christiana Care Health Care System
Newark, DE, USA

Cassandra Q. White, MD
Department of Surgery
Augusta University
Augusta, GA, USA

Andrew J. Young, MD
Division of Trauma, Critical Care and Burn
The Ohio State University
Columbus, OH, USA

Bardiya Zangbar, MD
Division of Trauma and Acute Care Surgery
New York Medical College
Westchester Medical Center
Valhalla, NY, USA

About the Companion Website

This book is accompanied by a companion website

www.wiley.com/go/surgicalcriticalcare3e

The website features:

- Interactive multiple choice questions

Part One
Surgical Critical Care

1
Respiratory and Cardiovascular Physiology

Anne Warner, MD, Harsh Desai, MD, and Frederick Giberson, MD
Department of Surgery, Christiana Care Health Care System, Newark, DE, USA

1. *In a patient who develops ARDS, the addition of PEEP in optimizing ventilatory support has which of the following effects?*

   A. *Maximal alveolar recruitment with inspiration.*

   B. *Decreasing mean airway pressure.*

   C. *Decreased right ventricular afterload.*

   D. *Improvement of functional residual capacity (FRC).*

   E. *Increasing left ventricular afterload.*

   The use of positive end-expiratory pressure (PEEP) as part of the ARDS ventilatory strategy has been shown to improve the functional residual capacity (FRC) above the closing pressure of alveoli, thereby preventing alveolar collapse. PEEP maximizes alveolar recruitment at end expiration, not inspiration. The addition of PEEP increases inflation pressure, thereby increasing peak alveolar pressure and ultimately mean airway pressure. Increased PEEP increases pulmonary vascular resistance impeding right vascular stroke volume and thereby left ventricular filling. It also decreases the transmural pressure – the pressure needed to be overcome in order to eject stroke volume – thereby decreasing left ventricular afterload.

Answer: D

Briel M, Meade M, Mercat A, et al. Higher vs lower positive end-expiratory pressure in patients with acute lung injury and acute respiratory distress syndrome. *JAMA.* 2010; 303 (9): 865–873.

Schmitt JM, Viellard-Baron A, Augarde R, et al. Positive end-expiratory pressure titration in acute respiratory distress syndrome patients: impact on right ventricular outflow impedance evaluated by pulmonary artery Doppler flow velocity measurements. *Crit Care Med.* 2001; 29: 1154–1158.

2. *Which of the following is NOT a component of the inflammatory cascade leading to lung injury in ARDS?*

   A. *Injury to type I and type II epithelial cells within the alveoli.*

   B. *Capillary endothelial dysregulation resulting in recruitment of neutrophils.*

   C. *Sequestration of predominantly lymphocytes within the pulmonary microcirculation.*

   D. *Release of cytoplasmic granules from neutrophil degranulation.*

   E. *Exudation of protein-rich fluid into the distal airspaces.*

   The inflammatory cascade in ARDS is thought to be initiated by activation of circulating neutrophils by the release of IL-1 and TNF by macrophages and monocytes. Endothelial dysregulation attracts and retains neutrophils with subsequent sequestration within the pulmonary microcirculation. This occurs through adhesion of neutrophils to endothelial cells and neutrophil stiffening. Neutrophils then move into lung parenchyma and degranulate propagating injury to the

type I and II epithelial cells within the alveoli allowing for exudation of protein-rich fluid, erythrocytes, and platelets into the distal airspaces.

Answer: C

Abraham E. Neutrophils and acute lung injury. *Crit Care Med.* 2003; 31(supp): S195–S199.

3. *A 27-year-old man is undergoing exploratory laparotomy after presenting with a gunshot wound to the left flank. He is currently hemodynamically stable. The operative team has concern for possible ureteral injury and asks that methylene blue be administered for identification of possible urine leak. Shortly after administration, the patient desaturates to SpO_2 of 82% with remaining hemodynamics remaining appropriate. What is the management for the etiology of this patient's desaturation event?*

   A. *Perform a left tube thoracostomy.*

   B. *Immediate bronchoscopy.*

   C. *Abort the procedure.*

   D. *Manual bag mask ventilation.*

   E. *Watch and wait without immediate intervention.*

   The multiple uses of methylene blue have been established including use in methemoglobinemia treatment as well as potential use in vasoplegic syndrome. In the operating room, methylene blue is often used to evaluate renal function and for potential leak in urologic procedures. However, one of the adverse effects of methylene blue is to decrease pulse oximetry readings.

   Pulse oximeters are made up of a side containing two light emitting diodes that emit at 660nm and 940nm

detecting deoxygenated and oxygenated hemoglobin, respectively. The light is captured after passing through the arteries in the finger by a probe on the other side of the oximeter. This is then passed through and alternating current amplifier to block nonpulsatile wave forms from veins. The ratio of oxygenated to total hemoglobin is used to calculate SpO_2. When administered, methylene blue transiently decreases the detected oxygenated hemoglobin as the methemoglobin fraction, usually a small percentage of total circulating hemoglobin, increases until processed out through the renal system. Therefore, for this patient, aborting the procedure is not necessary. The desaturation is transient and not caused by mucus plugging, which may require bronchoscopy, pneumothorax, which would require tube thoracostomy, or significant atelectasis, which may require bag mask ventilation.

Answer: E

Clifton J and Leikin JB . Methylene blue. *Am J Ther.* 2003; 10(4): 289–291.

Rong LQ, Mauer E, Mustapich TL, et al. Characterization of the rapid drop in pulse oximetry reading after intraoperative administration of methylene blue in open thoracoabdominal aortic repairs. *Anesth Analg.* 2019; 129(5): 142–145.

4. *A 65-year-old woman is in the post-anesthesia care unit following elective inguinal hernia surgery. Shortly after arriving, she is noted to have increasing shortness of breath and wheezing requiring administration of a nebulized beta agonist. The patient has a known history of COPD. Which of the following pulmonary function test patterns would be expected in a patient with COPD?*

A. *FEV1 decreased; FVC decreased/normal; FEV1/FVC ratio decreased.*

B. *FEV1 increased; FVC decreased; FEV1/FVC ratio increased.*

C. *FEV1 decreased/normal; FVC decreased; FEV1/FVC ratio normal.*

D. *FEV1 increased; FVC increased; FEV1/FVC ratio increased.*

E. *FEV1 decreased; FVC decreased; FEV1/FVC ratio decreased.*

Pulmonary function testing is often used in preoperative evaluation, particularly prior to thoracic procedures. These can be used, in addition to history and exam, to identify obstructive versus restrictive lung processes. Three of the important measures are the forced vital capacity (FVC) – the total volume forcefully expired after maximal inspiratory effort; forced expiratory volume in 1 second (FEV1) – the volume of air forcefully expired after maximal inspiratory effort in 1 second; the FEV1/FVC ratio. In evaluating spirometry results, first step is to interpret the FEV1/FVC ratio. If less than the lower limit of normal, an obstructive pattern is suspected. If greater than lower limit of normal, the FVC is evaluated and if less than lower limit of normal, a restrictive process is considered. Obstructive diseases include COPD, asthma, and emphysema while restrictive lung diseases include neuromuscular disorders and interstitial lung diseases.

Answer: A

Barreiro TJ and Perillo I . An approach to interpreting spirometry. *Am Fam Physician.* 2004; 69(5): 1107–1115.