

Essentials of Trauma Anesthesia

Second Edition

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Edited by

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To my grandchildren, Lisa and Jack, for coming into our lives and giving us so much joy.
AJV

To the victims of blunt and penetrating trauma, and to all those who work long and hard to transport, stabilize, diagnose, treat, and rehabilitate them. To my children Adrienne, Emily, and Rebecca, grandchildren Jane and Lucy, and parents, Thelma and David for their love.

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Preface

Traumatic injuries kill more than five million people annually. Millions more suffer the physical and psychologic consequences of injury, which have an enormous impact on patients, their families, and society. In the United States, trauma is the third leading cause of death in people of all ages, and the leading cause of death in individuals 46 years and younger. Trauma is also the single largest cause for years of life lost.

Although few anesthesiologists care exclusively for trauma patients, most will treat trauma patients at one time or another in their clinical practice. These encounters can occur at the end of the day or in the middle of the night and challenge clinicians to expeditiously manage multisystem derangements despite incomplete patient information.

Active participation of anesthesiologists in the care of severely injured patients provides the best opportunity for improved outcome. We believe participation should not only include involvement in anesthetic management, but also the initial evaluation, resuscitation, and perioperative care of these patients. Unfortunately, current training does not expose trainees to the entire spectrum of trauma care. Although there are a few textbooks that deal with trauma anesthesia, these books are quite extensive, serve mostly as reference books, and are not meant to be read cover-to-cover.

Our intention in creating the first edition of *Essentials of Trauma Anesthesia* was to provide anesthesiology trainees and practitioners with a concise review of the essential elements in the care of the severely injured patient and to emphasize the role of anesthesiologists in all aspects of trauma care: from time of injury until the patient leaves the critical care areas of the facility. This second edition of *Essentials of Trauma Anesthesia* continues to pursue that goal while identifying many recent advances in trauma care including paradigm shifts in the management of bleeding and coagulopathy, new neuromuscular blockade and anticoagulant reversal drugs, and updated clinical practice guidelines.

As in the first edition, we present, in three parts, the essential elements of trauma anesthesia care. The first section deals with the core principles of trauma anesthesia including epidemiology, mechanisms of injury and prehospital care, initial evaluation and management, airway management, shock, resuscitation and fluid therapy, vascular cannulation, blood component therapy, general and regional anesthesia for trauma, monitoring, echocardiography, and postoperative care of the trauma patient. A new chapter dealing with coagulation monitoring of the bleeding trauma patient has been added to the first section. The second section reviews the anesthetic considerations for traumatic injuries by anatomical area, and includes chapters on traumatic brain injury, spinal cord injury, ocular and maxillofacial trauma, and chest, abdominal and musculoskeletal trauma. The last section discusses anesthetic management of specific trauma populations including burn, pediatric, geriatric, and pregnant patients. Although we have maintained the structure, style, and format of the previous edition, all chapters have undergone extensive revisions to ensure content is current.

The editors of this book are academic trauma anesthesiologists, each with 30 years of experience caring for trauma patients. We were fortunate to recruit expert contributors who are actively engaged in clinical care at leading United States and Canadian trauma centers. The chapter contributors were given the task of creating an easily readable and clinically

relevant review of current trauma management. As editors, we have worked closely with the contributors to attain a consistent style, cover the subject matter in a coherent and logical manner, prevent unnecessary duplication, and provide cross-referencing between chapters. The liberal use of bullet-points and tables facilitated the creation of a portable text that is conducive to the rapid appreciation of the essential elements in trauma care.

We hope the second edition of this textbook will serve as a useful, practical guide to anesthesiology trainees and practitioners who currently manage or will manage trauma patients. We hope that all anesthesia providers, from the novice to advanced practitioners, will benefit from this book and, more importantly, that this will improve their care of trauma patients.

The editors thank the members of the American Society of Anesthesiologists' Committee of Trauma and Emergency Preparedness (COTEP) and our trauma anesthesiology colleagues at MetroHealth Medical Center and the Ryder Trauma Center for helping us select the topics for this book. The editors are also grateful to the chapter authors for contributing to this effort despite their already heavy clinical workload. Most of the contributors of this book are members of the Trauma Anesthesiology Society (TAS), which has enthusiastically supported and endorsed this project. Finally, we wish to acknowledge the support of Sarah Payne, Jade Scard, and all the staff at Cambridge University Press in the preparation and timely publication of *Essentials of Trauma Anesthesia*.

Albert J. Varon, MD, MHPE, FCCM
Charles E. Smith, MD

Abbreviations

AANS	American Association of Neurological Surgeons
ABA	American Burn Association
ABG	Arterial blood gas
ABSI	Abbreviated burn severity index
ACE	Angiotensin-converting enzyme
ACES	Abdominal cardiac evaluation with sonography in shock
ACL	Anterior cruciate ligament
ACLS	Advanced cardiac life support
ACS	American College of Surgeons
ACT	Activated clotting time
ADH	Antidiuretic hormone
AEC	Airway exchange catheter
AI	Aortic insufficiency
AIS	American Spinal Injury Association impairment scale
AKI	Acute kidney injury
aPTT	Activated partial thromboplastin time
ARBs	Angiotensin-receptor blockers
ARDS	Acute respiratory distress syndrome
ASA	American Society of Anesthesiologists
ASD	Atrial septal defect
ASE	American Society of Echocardiography
ASIA	American Spinal Injury Association
ASRA	American Society of Regional Anesthesia and Pain Medicine
ATC	Acute traumatic coagulopathy
ATLS	Advanced trauma life support
AVDO₂	Arteriovenous oxygen content difference
AVN	Avascular necrosis
AX	Axillary
BAI	Blunt aortic injury
BIS	Bispectral index
BP	Blood pressure
bpm	Beats per minute
BSA	Body surface area
BtpO₂	Brain tissue O ₂ partial pressure
BVM	Bag-valve-mask
CBC	Complete blood count
CBF	Cerebral blood flow
CDC	Centers for Disease Control and Prevention
CFD	Color flow Doppler
CMAP	Compound muscle action potential
CMRO₂	Cerebral metabolic rate of oxygen
CNS	Central nervous system
CO	Cardiac output
COHb	Carboxyhemoglobin
COPD	Chronic obstructive pulmonary disease
COT	Committee on Trauma
CP	Cricoid pressure
CPB	Cardiopulmonary bypass
CPDA	Citrate-phosphate-dextrose with adenine
CPP	Cerebral perfusion pressure
CPR	Cardiopulmonary resuscitation