Emergency War Surgery

Previous page:
Hero's Highway shuts down. Airmen from the 332nd Expeditionary Medical Group carry a stretcher under the Hero's Highway flag during an aeromedical evacuation training exercise. The historical flag was recently cased in a ceremony on September 1, 2011.
Photograph: US Air Force photo no. 110707-F-GU448-007.
Photographer: Senior Airman Jeffrey Schultze.

Emergency War Surgery

Fifth United States Revision

2018

Borden Institute
US Army Medical Department Center and School
Health Readiness Center of Excellence
Fort Sam Houston, Texas

Office of The Surgeon General
United States Army
Falls Church, Virginia

"All the circumstances of war surgery thus do violence to civilian concepts of traumatic surgery. The equality of organizational and professional management is the first basic difference. The second is the time lag introduced by the military necessity of evacuation. The third is the necessity for constant movement of the wounded man, and the fourth—treatment by a number of different surgeons at different places instead of by a single surgeon in one place—is inherent in the third. These are all undesirable factors, and on the surface they seem to militate against good surgical care. Indeed, when the overall circumstances of warfare are added to them, they appear to make more ideal surgical treatment impossible. Yet this was not true in the war we have just finished fighting, nor need it ever be true. Short cuts and measures of expediency are frequently necessary in military surgery, but compromises with surgical adequacy are not."

—Michael E. DeBakey, MD
Presented at Massachusetts General Hospital
Boston, October 1946

THE FIFTH UNITED STATES REVISION

of

EMERGENCY WAR SURGERY

IS DEDICATED TO THE

COMBAT PHYSICIAN

Dosage Selection:

The authors and publisher have made every effort to ensure the accuracy of dosages cited herein. However, it is the responsibility of every practitioner to consult appropriate information sources to ascertain correct dosages for each clinical situation, especially for new or unfamiliar drugs and procedures. The authors, editors, publisher, and the Department of Defense cannot be held responsible for any errors found in this book.

Use of Trade or Brand Names:

Use of trade or brand names in this publication is for illustrative purposes only and does not imply endorsement by the Department of Defense.

Neutral Language:

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

The opinions or assertions contained herein are the personal views of the authors and are not to be construed as doctrine of the Department of the Army or the Department of Defense. For comments or suggestions on additional contents in forthcoming editions, please contact the publisher (www.cs.amedd.army.mil/borden).

Published by the Office of The Surgeon General
Borden Institute
Fort Sam Houston, Texas 78234-6100

Library of Congress Cataloging-in-Publication Data

Names: Cubano, Miguel A., editor. | Butler, Frank K., editor. | Borden Institute (U.S.), issuing body.
Title: Emergency war surgery / senior editor, Miguel A. Cubano ; co-editors, Frank Butler [and 13 others] ; contributors, Hernan O. Altamar [and 58 others].
Other titles: Emergency war surgery (Borden Institute)
Description: Fifth United States revision. | Fort Sam Houston, Texas : Borden Institute, US Army Medical Department Center and School, Health Readiness Center of Excellence, Fort Sam Houston, Texas, Office of The Surgeon General, United States Army, 2018. | Includes bibliographical references and index.
Identifiers: LCCN 2018046075 (print) | LCCN 2018046660 (ebook) | ISBN 9780160940040 | ISBN 9780160940057 | ISBN 9780160940064 | ISBN 9780160940071 | ISBN 9780160947803 (alk. paper)
Subjects: | MESH: Emergencies | Wounds and Injuries--surgery | Military Medicine | Handbooks
Classification: LCC RD151 (ebook) | LCC RD151 (print) | NLM WO 39 | DDC 617.9/9--dc23
LC record available at Caution-https://lccn.loc.gov/2018046075

PRINTED IN THE UNITED STATES OF AMERICA
24, 23, 22, 21, 20, 19, 18 5 4 3 2 1

Contents

Senior Editor

Miguel A. Cubano, MD, FACS
CAPT, MC, US Navy
Commanding Officer
Naval Health Clinic Corpus Christi
Corpus Christi, Texas
Associate Professor of Surgery
Uniformed Services University of the Health Sciences
Bethesda, Maryland

Co-Editors

Frank Butler, CAPT (Ret), MC, US Navy
Andrew P. Cap, COL, MC, US Army
Michael T. Charlton, Col, MC, US Air Force
Neil B. Davids, LTC, MC, US Army
Mary J. Edwards, COL, MC, US Army
Eric A. Elster, CAPT, MC, US Navy
Michael M. Fuenfer, COL, MC, US Army
John Garr, COL (Ret), MC, US Army
Jennifer M. Gurney, COL, MC, US Army
Stephen A. Harper, LTC, MC, US Army
Brandon R. Horne, Col, MC, US Air Force
Vincent S. Nelson, MAJ, MC, US Army
Curtis D. Schmidt, LTC, DC, US Army
Stacy A. Shackelford, Col, MC, US Air Force

Borden Institute Editorial Staff

Edward A. Lindeke
COL (Ret), US Army
Director

Joan Redding
Senior Production Editor

Aiesha Harvey
Volume Editor

Douglas Wise
Layout Editor

Robert Dredden, Venetia Valiga
Illustrators

Ernest Barner
Public Affairs

Contributors

Hernan O. Altamar, CAPT, MC, US Navy
Jared L. Antevil, CAPT, MC, US Navy
John C. Arnold, CAPT, MC, US Navy
Juli A. Beadleston, RN
Frank Bishop, CAPT, MC, US Navy
Timothy C. Brand, COL, MC, US Army
Frank Butler, CAPT (Ret), MC, US Navy
Matthew Caldwell, Lt Col, MC, US Air Force
Leopoldo C. Cancio, COL (Ret), MC, US Army
Andrew P. Cap, COL, MC, US Army
John B. Cason, CDR, MC, US Navy
Michael T. Charlton, Col, MC, US Air Force
Jason Corley, LTC, MSC, US Army
Miguel A. Cubano, CAPT, MC, US Navy
Neil B. Davids, LTC, MC, US Army
Michael S. Dirks, LTC, MC, US Army
Kurt D. Edwards, COL, MC, US Army
Mary J. Edwards, COL, MC, US Army
Eric A. Elster, CAPT, MC, US Navy
Nathanial Fernandez, CDR, MC, US Navy
Travis Frazier, COL, MC, US Army
Michael M. Fuenfer, COL, MC, US Army
John Garr, COL (Ret), MC, US Army
Jacob J. Glaser, CDR, MC, US Navy
Jennifer M. Gurney, COL, MC, US Army
Stephen A. Harper, LTC, MC, US Army
Linda Hill, LCDR (Ret), MSC, US Navy
Brandon R. Horne, Col, MC, US Air Force
Shannon V. Lamb, CDR, MC, US Navy
Monica A. Lutgendorf, CDR, MC, US Navy
Christopher R. Marshall, SGM, US Army
Jason C. Massengill, Lt Col, MC, US Air Force
Sarah Matthews, CPT, MSC, US Army
Robert A. Mazzoli, COL (Ret), MC, US Army
Kristina V. Morocco, CAPT, MC, US Navy
Philip S. Mullenix, LTC, MC, US Army

Vincent S. Nelson, MAJ, MC, US Army
Trinity Peak, RN, MHA
Timothy M. Phillips, Col, MC, US Air Force
Timothy A. Platz, CDR, MC, US Navy
Travis M. Polk, CDR, MC, US Navy
Alfredo R. Ramirez, CAPT, MC, US Navy
Todd Rasmussen, Col, MC, US Air Force
Robert L. Ricca, CAPT, MC, US Navy
Carlos J. Rodriguez, CAPT, MC, US Navy
James B. Sampson, Col, MC, US Air Force
Katherine I. Schexneider, CAPT, MC, US Navy
Curtis D. Schmidt, LTC, DC, US Army
Christine L. Sears, CAPT, MC, US Navy
Stacy A. Shackelford, Col, MC, US Air Force
Kim P. Shaughnessy, CDR, NC, US Navy
Thomas W. Stamp, Col, MC, US Air Force
Zsolt T. Stockinger, CAPT, MC, US Navy
Jeffrey M. Tomlin, CAPT, MC, US Navy
J. Michael Van Gent, LCDR, MC, US Navy
Susan A. West, BSN
Paul W. White, COL, MC, US Army
Curt J. Wozniak, LtCol, MC, US Air Force
Johnnie Wright Jr, COL, MC, US Army

Acknowledgments

Special acknowledgment to MG Brian Lein, Commander of the AMEDD and School, and COL Tanya Peacock for their leadership and unconditional support to the 5th revision of *Emergency War Surgery*.

The information contained in this book reflects a generous collaborative effort of providers from all three services.

Thanks to the real engine behind this landmark readiness publication, the Borden Institute. They are the driving force and spent countless hours making sure we had the support needed to complete the book on time. They were instrumental in ensuring that this publication was a priority, and selflessly provided guidance and encouragement during all stages of its production.

Special recognition to the many volunteers who embraced the importance of updating this key readiness publication. We met a few days before, and during, the 2017 Labor Day weekend to collectively ensure the best possible outcome. Their contributions made significant practice updates throughout. Thank you.

Miguel A. Cubano, MD, FACS
Captain, MC, US Navy
Naval Health Clinic Corpus Christi

Foreword

Nearly 3 decades ago, I was a young surgeon on my first forward deployment during Operations Desert Shield and Desert Storm. It was the first time I witnessed military surgical teams saving lives in a war zone, often in harsh conditions, with limited resources, and under significant duress. Little did I know then how routine deployed medicine would become.

Military surgeons face unique medical challenges not typically found in civilian settings—from blast wounds, burns, and multiple penetrating injuries to head trauma, hemorrhage control, and amputations. I am deeply honored to recognize their collective knowledge and expertise in this fifth edition of *Emergency War Surgery*. There is no comparable textbook on the best practices and principles of forward deployed trauma surgery.

This update to the 2013 edition includes the latest lessons, techniques, and principles learned from US military engagements in Afghanistan, Iraq, and elsewhere. In the last decade and a half, the exceptional combat casualty care our military medical professionals have provided has led to the lowest mortality rate in the history of warfare. With the inclusion of the substantial advancements recently made in how we treat patients, this edition of *Emergency War Surgery* will become an even more valuable resource, particularly for our military medical personnel who will undoubtedly make even greater strides in the future.

Over the years, this textbook has attracted readers beyond the surgical and critical care communities. It has been translated into 20 languages and has become an important reference for anyone in combat operations. It is especially useful for non-surgical personnel to identify patients who need more advanced care. And, for the first time, it incorporates Tactical Combat Casualty Care (TCCC) to provide evidence-based, lifesaving techniques and strategies for providing the best trauma care on the battlefield.

The authors of the fifth edition of *Emergency War Surgery* represent all three medical services in the US military. Under the leadership of my colleague and friend, CAPT Miguel A. Cubano, MD, their seamless cooperation parallels the way the departments of the Army, Navy, and Air Force work together, not only on the battlefield fighting the enemy, but also in the operating room saving the lives of our wounded, ill, and injured.

All Americans are indebted to those who serve, whether on the front lines of battle or in far-flung operating rooms. Your dedicated service, and that of your families, ensures that we provide the best healthcare to the men and women protecting our nation.

R. C. Bono
VADM, MC, USN
Director, Defense Health Agency

July 2018
Washington, DC

Preface

Readiness is the one aspect of preparation for battle that we can control. A medical force that immediately delivers expert care, treats challenging injuries, improves combat practice among surgeons; a cadre of medical professionals who have relevant skills and knowledge, and can adapt and apply them to current military demands—this is the embodiment of readiness. Service subject matter experts in all medical subspecialty fields continue to shape and align the body of medical battlefield knowledge, as illustrated in this fifth edition of the *Emergency War Surgery* handbook. This edition reflects updates in Clinical Practice Guidelines and other new information accumulated since the 2013 edition's publication, especially in the areas of blood collection and transfusions. A new Tactical Combat Casualty Care (TCCC) chapter is included, and several new illustrations have been created as additional aids for users. Military medicine is committed to train, build, and maintain expert professionals, which continues to yield results in the most valued domain: readiness.

Medical supporting the "tip of the spear."

Nadja Y. West, MD
Lieutenant General
The Surgeon General
Commanding General, U.S. Army Medical Command

C. Forrest Faison III
Vice Admiral, Medical Corps
United States Navy
Surgeon General of the Navy

Dorothy A. Hogg
Lieutenant General, USAF, NC
Surgeon General

July 2018
Washington, DC

Introduction

"Legacy is our most significant contribution."
— CAPT Miguel A. Cubano, February 9, 2018

Thirty-five years ago my father, COL Miguel A. Cubano, gave me his copy of the 1967 edition of the *Emergency War Surgery* (EWS) handbook, developed for countries within the North Atlantic Treaty Organization (NATO). The gift was significant because my father knew of my lifelong dream of becoming a military surgeon. Reflecting on the legacy that continues in this fifth revision of EWS, my old 1967 edition took on a very important role. While reading it again, I realized that many concepts are still as relevant today as they were 50 years ago. The amputation chapter, for example, emphasized the need to remove nonviable tissue and conserve as much length of the limb as possible, and to never close the residual limb (stump) during the first operation due to the increased likelihood of infection. Conversely, many other concepts have been very dynamic or changed completely. This is evidenced in the now obsolete "artificial respiration" using a series of lifting motions of the victim's shoulders, followed by compression of the chest to promote inspiration and expiration. What has remained constant over the years is the commitment of the men and women of the armed forces medical departments, who contribute their knowledge and expertise to provide the best chance for lives to be saved on the battlefield.

The sustained commitment and loyalty of EWS authors and contributors toward those who serve in uniform is a compelling legacy for generations of physicians. Some names that immediately come to mind are Bohman, Holcomb, Jenkins, Rich, DeBakey, Bellamy, Eastridge, and others that for many of our readers are just names, but for me represent the essence of our legacy.

This readiness publication is NOT a collection of anecdotal treatments; rather, it is a comprehensively researched compendium of solutions to the majority of trauma scenarios

seen during combat operations. The subject matter expert (SME) authors have incorporated the latest version of the published Clinical Practice Guidelines (CPGs). This edition has had the largest readiness-focused tri-service SME contribution in the book's history. SMEs from the Army, Air Force, and Navy contributed to each of the 37 chapters, providing their particular perspective (geographical or environmental) to the same pathological situation.

This book does not replace proper surgical and critical care training, but will provide the reader with the readiness skills and proven concepts to maximize the chances for our wounded warriors to survive their injuries. Tactical Combat Casualty Care (TCCC) has been included for the first time as an integral part of the EWS. This chapter will provide first responders with the tools to adequately address wounds at the point of injury.

This revised publication directly supports the ongoing dynamic changes in military medicine as an immediate basic tool for trauma training and education. The execution of these duties and oversight by senior leaders will help us navigate the challenges of the future. Collectively, our medical community will continue finding ways to improve life- and limb-saving as it has done for hundreds of years.

Like my father 35 years ago, once you finish using the book please pass it on to your sons and daughters, nephews or friends, because you never know, maybe one day they will be asked to perform the indescribable honor of leading the next EWS revision . . . our legacy endures!

CAPT Miguel A. Cubano
Commanding Officer
Naval Health Clinic Corpus Christi

Corpus Christi, Texas
June 2018