

Includes interactive eBook with complete content

NMS

National Medical Series For Independent Study

# Surger<sup>y</sup>

Bruce E. Jarrell  
Stephen M. Kavic

Sixth Edition

- ◆ Complete outline review for course study and standard examinations
- ◆ USMLE-style questions at the end of every part
- ◆ New four-color design

 Wolters Kluwer



NMS

National Medical Series for Independent Study

# Surger<sup>y</sup>





NMS

National Medical Series for Independent Study

# Surger<sup>y</sup>

Sixth Edition

## Bruce E. Jarrell, MD

Professor  
Department of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

## Stephen M. Kavic, MD

Associate Professor  
Department of Surgery  
Program Director  
Residency in General Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland



Philadelphia • Baltimore • New York • London  
Buenos Aires • Hong Kong • Sydney • Tokyo

Acquisitions Editor: Tari Broderick  
Product Development Editor: Amy Weintraub  
Editorial Assistant: Joshua Hafner  
Marketing Manager: Joy Fisher-Williams  
Production Project Manager: Priscilla Crater  
Design Coordinator: Terry Mallon  
Manufacturing Coordinator: Margie Orzech  
Prepress Vendor: Absolute Service, Inc.

Sixth Edition

Copyright © 2016 Wolters Kluwer

Copyright © 2008, © 2000, Lippincott Williams & Wilkins, a Wolters Kluwer business

All rights reserved. This book is protected by copyright. No part of this book may be reproduced or transmitted in any form or by any means, including as photocopies or scanned-in or other electronic copies, or utilized by any information storage and retrieval system without written permission from the copyright owner, except for brief quotations embodied in critical articles and reviews. Materials appearing in this book prepared by individuals as part of their official duties as U.S. government employees are not covered by the above-mentioned copyright. To request permission, please contact Wolters Kluwer at Two Commerce Square, 2001 Market Street, Philadelphia, PA 19103, via email at [permissions@ww.com](mailto:permissions@ww.com), or via our website at [lww.com](http://lww.com) (products and services).

9 8 7 6 5 4 3 2 1

Printed in China

#### **Library of Congress Cataloging-in-Publication Data**

NMS surgery / [edited by] Bruce E. Jarrell, Stephen M. Kavic. — Sixth edition.

p. ; cm. — (National medical series for independent study)

National medical series surgery

Includes index.

ISBN 978-1-60831-584-0

I. Jarrell, Bruce E., editor. II. Kavic, Stephen M. (Stephen Michael), editor. III. Title: National medical series surgery. IV. Series: National medical series for independent study.

[DNLM: 1. Surgical Procedures, Operative—Examination Questions. 2. Surgical Procedures, Operative—Outlines. 3. General Surgery—methods—Examination Questions. 4. General Surgery—methods—Outlines. WO 18.2]

RD37.2

617.0076—dc23

2015010501

This work is provided “as is,” and the publisher disclaims any and all warranties, express or implied, including any warranties as to accuracy, comprehensiveness, or currency of the content of this work.

This work is no substitute for individual patient assessment based on healthcare professionals’ examination of each patient and consideration of, among other things, age, weight, gender, current or prior medical conditions, medication history, laboratory data, and other factors unique to the patient. The publisher does not provide medical advice or guidance and this work is merely a reference tool. Healthcare professionals, and not the publisher, are solely responsible for the use of this work including all medical judgments and for any resulting diagnosis and treatments.

Given continuous, rapid advances in medical science and health information, independent professional verification of medical diagnoses, indications, appropriate pharmaceutical selections and dosages, and treatment options should be made and healthcare professionals should consult a variety of sources. When prescribing medication, healthcare professionals are advised to consult the product information sheet (the manufacturer’s package insert) accompanying each drug to verify, among other things, conditions of use, warnings, and side effects and identify any changes in dosage schedule or contraindications, particularly if the medication to be administered is new, infrequently used, or has a narrow therapeutic range. To the maximum extent permitted under applicable law, no responsibility is assumed by the publisher for any injury and/or damage to persons or property, as a matter of products liability, negligence law or otherwise, or from any reference to or use by any person of this work.

LWW.com

We both thank the many mentors who have advised us each throughout our careers. We are forever indebted to them.

I wish to thank my wife, Leslie, and my wonderful children for all of their support during my career, and for their understanding during the writing of the many editions of NMS Surgery – BEJ

Dedicated to my loving wife Jennifer and to my lovely daughter Emily – SMK

# Foreword

It is with tremendous pride that I introduce the sixth edition of NMS Surgery. This work has occupied a central role in the education of a generation of medical students. The outline format makes it a superb reference for those learning the basics of surgery and a thorough review for those who already practice our art.

The current edition has special significance to the University of Maryland School of Medicine. Dr. Jarrell is the Chief Academic and Research Officer and Dean of the Graduate School. He also was my predecessor as Chair of the Department of Surgery. Dr. Kavic is the current program director of our surgery residency. The chapter authors and contributors include a virtual directory of our trainees and faculty. It is a privilege to be associated with these esteemed educators.

I am continually impressed by the talents of the surgeons and surgeons-in-training at the University of Maryland. That quality is reflected in the following chapters. I know that you will enjoy this edition as much as I take pride in it.

Stephen T. Bartlett, MD  
Peter Angelos Distinguished Professor of Surgery  
Chair  
Department of Surgery  
Surgeon-in-Chief  
University of Maryland Medical System  
University of Maryland School of Medicine  
Baltimore, Maryland



# Preface

Welcome to the sixth edition of NMS Surgery.

This book aims to build on the legacy of the previous five editions. We have retained much of the organization and format from the last versions. At the same time, we have strived to make this volume more readable.

It is an increasing challenge to limit content in the face of rapidly expanding surgical knowledge. As in previous editions, the text is not meant to be all-inclusive but rather serves as an introduction for the student of surgery. All of the chapters have been thoroughly reviewed, rewritten, and updated to reflect the current state of the art in surgery.

There are dramatic differences in the format of this volume. Perhaps most importantly, each section now begins with “Chapter Cuts and Caveats,” which are some of the most important principles worthy of the reader’s attention. Within each chapter, we have added “Quick Cuts,” which are highlights that have been brought out separately from the text. In addition, we have added a new section at the end, “Grade A Cuts,” which are pairings that highlight associations in surgical thinking.

For the tremendous work put into this edition, we are indebted to the authors. Their high-quality and frequently punctual contributions have made our jobs as editors pleasant. We are also grateful to the editorial team at Wolters Kluwer for their guidance and support throughout the process.

The sixth edition of NMS Surgery is written primarily for students and residents in general surgery, but practicing surgeons as well as physicians in other specialties will no doubt find it a useful reference. We hope that all readers will find that the book represents a declaration of the state of surgical art in 2015.

—Bruce E. Jarrell, MD  
—Stephen M. Kavic, MD

# Contributors

**William R. Alex, MD, FACS**  
Cardiothoracic Surgery  
Riverside, California

**H. Richard Alexander, MD, FACS**  
Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Andrea C. Bafford, MD, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Emily Bellavance, MD, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Hugo Bonatti, MD, FACS**  
General and Minimally Invasive Surgery  
Easton, Maryland

**Cherif Boutros, MB, CHB, MSc, FACS**  
Associate Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Jonathan Bromberg, MB, PhD, FACS**  
Professor of Surgery  
Chief  
Division of Transplantation  
University of Maryland School of Medicine  
Baltimore, Maryland

**Brandon Bruns, MD, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Laura S. Buchanan, MD, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Whitney Burrows, MD, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Clint D. Cappiello, MD**  
Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Kenneth M. Crandall, MD**  
Resident in Neurosurgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Robert S. Crawford, MD, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Peter E. Darwin, MD**  
Professor of Medicine  
University of Maryland School of Medicine  
Baltimore, Maryland

**Jose J. Diaz, MD, FACS**  
Professor of Surgery  
Chief  
Division of Acute Care Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Garima Dosi, MD**  
Fellow in Vascular Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Richard N. Edie, MD, FACS**  
Cardiothoracic Surgery  
Philadelphia, Pennsylvania

**Steven Feigenberg, MD**  
Professor of Radiation Oncology  
University of Maryland School of Medicine  
Baltimore, Maryland



**Jessica Felton, MD**

Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**James S. Gammie, MD, FACS**

Professor of Surgery  
Chief, Division of Cardiac Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Jinny Ha, MD**

Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Natasha Hansraj, MD**

Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Andrea Hebert, MD**

Resident in Otolaryngology  
University of Maryland Medical Center  
Baltimore, Maryland

**Tripp Holton, MD, FACS**

Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Helen G. Hui-Chou, MD**

Fellow in Plastic Surgery  
University of Maryland  
Johns Hopkins University  
Baltimore, Maryland

**Ajay Jain, MD, FACS**

Associate Professor of Surgery  
State University of New York Upstate Medical University  
Syracuse, New York

**Steven B. Johnson, MD, FACS, FCCM**

Professor and Chairman  
Department of Surgery  
University of Arizona  
Phoenix, Arizona

**Jessica Joines, MA, MGC**

Instructor of Medicine  
University of Maryland School of Medicine  
Baltimore, Maryland

**Stephen M. Kavic, MD, FACS**

Associate Professor of Surgery  
Program Director  
Residency in General Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Edwin Kendrick, MD**

Fellow in Vascular Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Susan B. Kesmodel, MD, FACS**

Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Mark D. Kligman, MD, FACS**

Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Andrew Kramer, MD, FACS**

Associate Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Natalia Kubicki, MD**

Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Katherine G. Lamond, MD, FACS**

Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Matthew Lissauer, MD, FACS, FCCM**

Associate Professor of Surgery  
Rutgers Robert Wood Johnson Medical School  
New Brunswick, New Jersey

**Daniel E. Mansour, MD**

Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Daniel Medina, MD, PhD**

Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Mayur Narayan, MD, MPH, MBA, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Silke Niederhaus, MD, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**John A. Olson Jr, MD, PhD**  
Professor of Surgery  
Chief  
Division of General Surgery and Surgical Oncology  
University of Maryland School of Medicine  
Baltimore, Maryland

**Natalie A. O'Neill, MD**  
Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**D. Bruce Panasuk, MD, FACS**  
Chief of Surgery  
Wilmington VA Medical Center  
Wilmington, Delaware

**Jonathan P. Pearl, MD, FACS**  
Assistant Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Srinevas K. Reddy, MD, FACS**  
Surgical Oncology and Hepatobiliary Surgery  
Minneapolis, Minnesota

**Daniel Reznicek, MD**  
Resident in Urologic Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Ernest L. Rosato, MD, FACS**  
Professor of Surgery  
Director  
Division of General Surgery  
Thomas Jefferson University  
Philadelphia, Pennsylvania

**Francis E. Rosato Jr, MD, FACS**  
General and Minimally Invasive Surgery  
Pennington, New Jersey

**Charles A. Sansur, MD**  
Assistant Professor of Neurosurgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Rajabrata Sarkar, MD, FACS**  
Professor of Surgery  
Chief  
Division of Vascular Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Joseph R. Scalea, MD**  
Transplant Surgery Fellow  
University of Wisconsin  
Madison, Wisconsin

**Thomas Scalea, MD, FACS**  
Professor of Surgery  
Physician-in-Chief  
R Adams Cowley Shock Trauma Center  
University of Maryland School of Medicine  
Baltimore, Maryland

**Max Seaton, MD**  
Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Devinder Singh, MD, FACS**  
Associate Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Alexis D. Smith, MD**  
Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Robert Sterling, MD**  
Assistant Professor of Surgery  
Johns Hopkins University School of Medicine  
Baltimore, Maryland

**Eric Strauch, MD, FACS**  
Associate Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Oliver Tannous, MD**  
Resident in Orthopedic Surgery  
University of Maryland Medical Center  
Baltimore, Maryland



**Julia Terhune, MD**  
Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Douglas J. Turner, MD, FACS**  
Associate Professor of Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

**Keli Turner, MD**  
Resident in Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**A. Claire Watkins, MD**  
Resident in Cardiothoracic Surgery  
University of Maryland Medical Center  
Baltimore, Maryland

**Ronald J. Weigel, MD, PhD, MBA, FACS**  
Professor and Chair of Surgery  
University of Iowa  
Iowa City, Iowa

**Niluka A. Wickramaratne, MD**  
Resident in Surgery  
Virginia Commonwealth University  
Richmond, Virginia

**Jeffrey S. Wolf, MD**  
Associate Professor of Otolaryngology—Head and Neck  
Surgery  
University of Maryland School of Medicine  
Baltimore, Maryland

# Contents

Preface vii  
Acknowledgments  
Contributors viii

## Part I: Introduction

1 Principles of Surgical Physiology.....3  
Steven B. Johnson and Matthew Lissauer  
Fluid and Electrolytes 3  
Acid–Base Disturbances 11  
Coagulation 13  
Packed Red Blood Cell Transfusion Therapy 16  
Nutrition and the Surgical Patient 17  
The Intensive Care Unit 22  
Shock 27

2 Essentials of General Surgery..... 30  
Natasha Hansraj and Douglas J. Turner  
Wounds 30  
Surgical Tubes and Drains 33  
Hernias 35  
Postoperative Complications 39  
Surgical Infections 40  
Gastrointestinal Fistula 41

3 Medical Risk Factors in Surgical Patients..... 43  
Susan B. Kesmodel, Natalia Kubicki, and Mayur Narayan  
General Aspects for Evaluation and Management of the Surgical Patient 43  
Evaluation of the Surgical Patient with Cardiac Disease 46  
Evaluation of the Surgical Patient with Lung Disease 51  
Evaluation of the Surgical Patient with Renal Disease 53  
Evaluation of the Surgical Patient with Liver Disease 55

<b>4</b>	<b>Life-threatening Disorders: Acute Abdominal Surgical Emergencies</b> .....	<b>58</b>
	Laura S. Buchanan and Jose J. Diaz	
	Acute Abdomen	58
	Obstruction	63
	Hemorrhage	65
	Study Questions for Part I	67
	Answers and Explanations	73

## Part II: Thoracic Disorders

<b>5</b>	<b>Principles of Thoracic Surgery</b> .....	<b>78</b>
	Jinny Ha and Whitney Burrows	
	General Principles of Thoracic Surgery	78
	Chest Wall Disorders	83
	Pleural and Pleural Space Disorders	83
	Pulmonary Infections	85
	Solitary Pulmonary Nodules (Coin Lesions)	85
	Bronchogenic Carcinoma	85
	Bronchial Adenomas	88
	Metastatic Tumor	89
	Tracheal Disorders	89
	Mediastinal Lesions	90
	Thoracic Trauma	90
<b>6</b>	<b>Heart</b> .....	<b>93</b>
	A. Claire Watkins, D. Bruce Panasuk, William R. Alex, Richard N. Edie, and James S. Gammie	
	Acquired Heart Disease	93
	Congenital Heart Disease	102
	Study Questions for Part II	108
	Answers and Explanations	113

## Part III: Vascular Disorders

<b>7</b>	<b>Arterial Disease</b> .....	<b>118</b>
	Garima Dosi and Robert S. Crawford	
	General Principles	118
	Lower Extremity Arterial Occlusive Disease	118
	Aortoiliac Occlusive Disease (AIOD)	120
	Femoropopliteal Occlusive Disease	122
	Infrageniculate Tibial Disease	123
	Acute Arterial Insufficiency	124
	Amputations	125
	Extracranial Cerebrovascular Disease	125

Aortic Dissection 127  
Arterial Aneurysms 128  
Mesenteric Vascular Disease 130  
Renal Artery Stenosis 132  
Miscellaneous 133

**8 Venous and Lymphatic Disease .....135**

Edwin Kendrick and Rajabrata Sarkar

Acute Deep Venous Thrombosis 135  
Acute Pulmonary Embolism 138  
Chronic Venous Disorders: Varicose Veins and Chronic Venous Insufficiency 140  
Superficial Venous Thrombophlebitis 142  
Lymphedema 142

Study Questions for Part III 144  
Answers and Explanations 148

**Part IV: Gastrointestinal Disorders**

**9 Esophagus .....153**

Jonathan P. Pearl

Introduction 153  
Esophageal Motility Disorders 154  
Esophageal Strictures 158  
Esophageal Tumors 158  
Esophageal Perforation 160  
Mallory-Weiss Syndrome 160

**10 Stomach and Duodenum .....161**

Cherif Boutros, Ernest L. Rosato, and Francis E. Rosato Jr.

Stomach 161  
Peptic Ulcer Disease 163  
Gastric Cancer 168  
Postgastrectomy Syndromes 170  
Benign Stomach Lesions 171  
Gastritis 171

**11 Small Intestine .....173**

Katherine G. Lamond

Introduction 173  
Diseases 175



<b>12</b>	<b>Colon, Rectum, and Anus</b> .....	<b>180</b>
	Julia Terhune and Andrea C. Bafford	
	Introduction 180	
	Evaluation 182	
	Bowel Preparation 184	
	Benign and Malignant Colorectal Tumors 184	
	Diverticular Disease 189	
	Angiodysplasia 192	
	Inflammatory Bowel Disease 192	
	Pseudomembranous Colitis (Antibiotic-Associated Colitis) 196	
	Ischemic Colitis 196	
	Volvulus 197	
	Anorectal Dysfunction 198	
	Benign Anorectal Disease 199	
	Perianal and Anal Canal Neoplasms 202	
<b>13</b>	<b>Liver, Gallbladder, and Biliary Tree</b> .....	<b>204</b>
	Daniel Medina and Srinevas K. Reddy	
	General Aspects 204	
	Hepatic Tumors 207	
	Hepatic Abscesses and Cysts 209	
	Gallbladder Pathology 212	
	Biliary Tree Pathology 213	
<b>14</b>	<b>Pancreas</b> .....	<b>215</b>
	H. Richard Alexander, Peter E. Darwin, and Ronald J. Weigel	
	Anatomy and Physiology 215	
	Pancreatitis 217	
	Pancreatic Malignancies 225	
<b>15</b>	<b>Spleen</b> .....	<b>230</b>
	Daniel E. Mansour, Mayur Narayan, and Ajay Jain	
	Introduction 230	
	Pathology 231	
	Technical Aspects of Splenectomy 234	
	Complications after Splenectomy 235	
	Study Questions for Part IV 237	
	Answers and Explanations 248	

## Part V: Breast and Endocrine Disorders

<b>16</b>	<b>Breast</b> .....	<b>256</b>
	Emily Bellavance, Steven Feigenberg, and Jessica Joines	
	Introduction 256	
	Breast Evaluation 256	
	Benign Breast Disease 259	
	Malignant Diseases 260	

17	Thyroid, Parathyroid, Adrenal Glands, and Thymus.....	266
	John A. Olson Jr.	
	Thyroid Gland	266
	Abnormalities of Thyroid Descent	268
	Thyroid Dysfunction Requiring Surgery	269
	Parathyroid Glands	276
	Adrenal Gland	279
	Tumors of the Endocrine Pancreas	285
	Multiple Endocrine Neoplasia	287
	Thymus Gland	289
	Study Questions for Part V	290
	Answers and Explanations	294

## Part VI: Special Subjects

18	Head and Neck Surgery.....	299
	Andrea Hebert and Jeffrey S. Wolf	
	Components of the Head and Neck Exam	299
	Benign Lesions of the Head and Neck	300
	Neck Abscesses	300
	Congenital Masses	302
	Acquired Lesions	305
	Head and Neck Infections	308
	Malignant Lesions of the Head and Neck	308
	Neck Cancer	311
	Nasal Cavity and Paranasal Sinus Cancer	312
	Nasopharynx Cancer	313
	Oral Cavity Cancer	314
	Oropharynx Cancer	315
	Hypopharynx and Cervical Esophagus Cancer	316
	Larynx Cancer	317
	Skin Cancer	318
	Head and Neck Lymphoma	319
	Unusual Tumors	320
	Parotid Gland	320
	Evaluation and Management of Parotid Masses	322
	Parotid Neoplasms	322
	Parotid Trauma	323
	Inflammatory Disorders	324
19	Bariatric Surgery.....	326
	Mark D. Kligman	
	Background	325
	Surgical Treatment of Obesity	326
	Postoperative Mortality and Complications	329

<b>20</b>	<b>Minimal Access Surgery</b> .....	<b>335</b>
	Daniel Medina, Hugo Bonatti, and Stephen M. Kavic	
	History 335	
	General Principles 335	
	Selected Laparoscopic Procedures 338	
	Robotic Technology 343	
<b>21</b>	<b>Surgical Oncology</b> .....	<b>344</b>
	Keli Turner, Natalie A. O'Neill, and Stephen M. Kavic	
	Cancer 344	
	Cancer Etiology and Epidemiology 344	
	Screening and Diagnosis 346	
	Diagnostic Procedures 347	
	Staging 348	
	Surgical Treatment 348	
	Multidisciplinary Treatment 350	
	Research and Training 351	
<b>22</b>	<b>Trauma and Burns</b> .....	<b>352</b>
	Brandon Bruns and Thomas Scalea	
	Trauma 352	
	Specific Injuries 354	
	Burns 359	
<b>23</b>	<b>Organ Transplantation</b> .....	<b>362</b>
	Joseph R. Scalea, Max Seaton, Silke Niederhaus, and Jonathan Bromberg	
	Overview 362	
	Organ-Specific Considerations 368	
<b>24</b>	<b>Pediatric Surgery</b> .....	<b>376</b>
	Clint D. Cappiello, Alexis D. Smith, and Eric Strauch	
	Introduction 376	
	Congenital Hernias 376	
	Abdominal Wall Defects 379	
	Esophageal Atresia and Tracheoesophageal Malformations 381	
	Intestinal Malrotation 383	
	Intestinal Atresia 385	
	Hirschsprung Disease 387	
	Disorders of Infancy 390	
	Solid Tumors 395	
	Study Questions for Part VI 397	
	Answers and Explanations 405	

## Part VII: Surgical Subspecialties

<b>25</b>	<b>Urologic Surgery</b> .....	<b>412</b>
	<i>Jessica Felton, Daniel Reznicek, and Andrew Kramer</i>	
	Urologic Emergencies	412
	Urinary Tract Stones	414
	Benign Prostatic Disorders	415
	Genitourinary Malignancies	417
	Male Erectile Dysfunction	423
	Voiding Dysfunction	424
	Urologic Trauma	427
<b>26</b>	<b>Plastic and Reconstructive Surgery</b> .....	<b>430</b>
	<i>Niluka A. Wickramaratne, Helen G. Hui-Chou, Devinder Singh, and Tripp Holton</i>	
	Overview	430
	Reconstructive Plastic Surgery	430
	Wound Healing and Diseases of Skin and Soft Tissue	442
	Craniofacial Surgery	444
	Hand Surgery	445
	Aesthetic Plastic Surgery	446
	Innovations and Devices in Plastic Surgery	449
<b>27</b>	<b>Neurosurgery</b> .....	<b>450</b>
	<i>Kenneth M. Crandall and Charles A. Sansur</i>	
	Anatomy	450
	Pathophysiology	451
	Evaluating the Neurosurgical Patient	453
	Head Injury	454
	Spinal Cord Injury	457
	Central Nervous System Tumors	462
	Congenital Nervous System Lesions	466
	Functional Neurosurgery	466
	Degenerative Spine Disease	467
	Spine Tumors	470
	Peripheral Nerves	470
<b>28</b>	<b>Orthopedics</b> .....	<b>472</b>
	<i>Oliver Tannous and Robert Sterling</i>	
	Orthopedic Emergencies	472
	Orthopedic Urgencies	475
	Trauma	478
	Arthritis	486
	Infections	488
	Tumors	489
	Adult Orthopedics	491
	Study Questions for Part VII	494
	Answers and Explanations	499
	Appendix A Grade “A” Cuts	503
	Index	509



# Introduction

## Chapter Cuts and Caveats

# Part I

## CHAPTER 1

### Principles of Surgical Physiology:

- Management of sick patients requires resuscitation, with the goal of restoration of perfusion. Quickly and accurately finding the source of the clinical deterioration and fixing that problem is crucial; otherwise, the resuscitation will ultimately fail to allow adequate oxygen delivery.
- Shock is the state of physiologic decompensation resulting in inadequate tissue perfusion (oxygen demand outstrips oxygen supply).
- Ultimately, no one formula best determines postoperative fluid and electrolyte management.
- High insensible losses (both evaporative losses and leakage into the third space) occur during and after surgical procedures that involve open body cavities; that are invasive and open many tissue planes; that are prolonged; that are associated with sepsis, inflammatory conditions, and ischemia of organs; that result in hypotension; and that are done in emergent settings.
- Hyperkalemia must be treated aggressively to avoid life-threatening arrhythmias. The best emergent treatment is IV bicarbonate and IV insulin and glucose, which moves potassium intracellularly and lowers serum levels. IV calcium is also useful by affecting the threshold for action potential and decreasing cardiac membrane excitability.
- Adequate oxygenation is assessed by more than blood pressure and pulse. It is also monitored by assessing markers of tissue perfusion (urine output and renal function), oxygenation (chest x-ray and lung auscultation for signs of pulmonary edema, blood oxygenation, and other measures), serum electrolyte levels, pH, arrhythmias, mentation, external signs of hydration state, hematocrit, and the patient's overall appearance.
- When evaluating a patient who is clinically deteriorating, always prioritize the evaluation of diagnoses in your differential that will lead to the fastest and greatest deterioration.
- New anemia in a postoperative patient is surgical bleeding until proven otherwise. Packed RBC transfusion provides excellent physiologic support but has side effects including allergic reactions and the potential for infectious transmission—treat blood like a drug! Clerical error is the most common cause for transfusion reaction.
- Enteral nutrition is preferred in most patients. The risk of central venous catheters outweighs nutritional benefits for short-term supplementation if nutritional support is needed for less than 1 week. Low albumin levels correlate with mortality.
- Patients with inadequate oxygenation or increased work of breathing should have ventilatory support: When in doubt, intubate.

## CHAPTER 2

### Essentials of General Surgery:

- For wound infections: Abscess must be drained, necrotic tissue must be debrided, crepitus suggests a necrotizing gas-forming infection demanding that the wound be opened, foreign bodies (including tubes or drains) must be removed, and enteric leak must be controlled.



- Systemic antibiotics are not the primary treatment for wound infections.
- Perioperative antibiotics given to patients with clean-contaminated wounds (which are usually closed primarily) reduce the incidence of wound infections and the subsequent risk of hernia.
- Any condition that interferes with the four phases of wound healing (hemostasis, inflammation, proliferation, and remodeling) will impair the rate of healing and the final wound strength. Both local and systemic factors have an effect.
- Local factors: Wounds should be free of bleeding, hematoma, gross contamination, and necrotic tissue; wound edges should be free of tension; and local tissue should be healthy and well vascularized.
- Systemic factors that impair wound healing: metabolism, poor nutritional state, zinc and vitamins A and C deficiency, presence of infection, hypoxia, low-flow states, smoking, poorly controlled diabetes, obesity, collagen vascular diseases, and renal and liver failure
- Medications: systemic glucocorticoids, some chemotherapeutic and immunosuppressive drugs, and angiogenesis inhibitors
- Postoperative fevers may result from the 5 W's: wound, water, wind, walking, and wonder drugs.
- Surgical site infections are a major source of morbidity and are most commonly due to skin flora (especially Staphylococcus).
- Nonhealing GI fistulas may result from FRIEND (foreign body, radiation, inflammation, epithelialization, neoplasia, distal obstruction) and often respond to nonoperative management.

## CHAPTER 3

### Medical Risk Factors in Surgical Patients:

- Assessment of medical risk for invasive surgical procedures includes a thorough history, physical, and laboratory examination.
- Patients with cardiac conditions are at increased risk for cardiac complications following noncardiac surgery, and standardized classification systems help stratify risk. Functional capacity more than 4 METs predicts a low risk of postoperative cardiac events. Elective surgery should be postponed at least 4 weeks following acute cardiac events or revascularization.
- All patients should be assessed for the degree of risk for venous thromboembolic events, and prophylaxis with heparin is appropriate for most surgical patients.

## CHAPTER 4

### Life-Threatening Disorders: Acute Abdominal Surgical Emergencies:

- When evaluating a patient for acute abdominal pain, first determine whether the patient has a surgical abdomen on examination, judged by a distressed patient with pain that is severe and generalized and associated with rebound or guarding. Clinical judgment is supplemented by radiographic studies, such as extraluminal peritoneal free air, and laboratory studies, such as findings supportive of ischemia, inflammation, acute hemorrhage into the peritoneal cavity, or infection. If the judgment of a surgical abdomen is made, immediate intervention after resuscitation is indicated.
- GI hemorrhage necessitates localizing the bleeding and formulating a plan to control it before surgery. Identifying the source of bleeding in the operating room by evaluating the external surface of the GI tract is very difficult.
- To manage a significant GI hemorrhage, balancing three problems simultaneously becomes necessary: volume resuscitation, coagulation defect correction, and identification and control of the site of hemorrhage. Transfusion of blood and blood products may be critical in managing all three problems. Transfusion beyond several units results in increased morbidity and mortality because blood and its products have many potential side effects, such as transfusion reactions with anaphylaxis and hemolysis, infectious agent transmission, and immune suppression, among others.
- Location can indicate common pathology: RUQ suggests the biliary tree; RLQ, the appendix; and LLQ, the sigmoid colon.



# Principles of Surgical Physiology

Steven B. Johnson and Matthew Lissauer



## FLUID AND ELECTROLYTES

### Normal Body Composition

- I. **Body water:** Water accounts for 50%–70% of body weight (the higher percentage in young people, thin people, and men—the lower percentage in older people, obese people, and women). Body water is divided into various intracellular and extracellular compartments (Fig. 1-1).
  - A. **Two-thirds rule:** This is a simple method of approximating compartment volume because of the variation among patients and within the same patient. Total body water comprises slightly less than two-thirds body weight.
  - B. **Plasma volume:** Using the above rule, ~5% of body weight is plasma volume (e.g., 3.5 L for a 70-kg male). Plasma is ~60% of the blood volume (if the hematocrit is 40%); therefore, the 70-kg male has 5 L of blood.
- II. **Electrolyte composition:** Electrolytes determine the amount of water that exists in any one space at any time, and their concentrations and compositions differ between intracellular and extracellular spaces due to ion pumps (principally  $\text{Na}^+/\text{K}^+$  ATPase), as shown in Table 1-1. Change in osmotic pressure in one compartment causes water to redistribute from the other compartments to regain equilibrium.
  - A. **Intracellular (principal osmotic cation is potassium):** has higher concentration of osmotic and oncotic (protein) particles than the extracellular compartment, thus allowing water to flow into the cell, creating turgidity
  - B. **Extracellular (principal osmotic cation is sodium):** Interstitial and plasma composition is nearly but not quite identical.

### Water and Electrolyte Maintenance

- I. **Water:** Required amount depends on the person's weight, age, gender, and illness.
  - A. **Water calculation methods**
    1. **Amount of body water excreted**
      - a. Most water lost from the body is through urine production; generally, 0.5 mL/kg/hr is the minimum needed to excrete the daily solute load.



#### Quick Cut

The compartments are important because calculating fluid losses, blood losses, and amount of resuscitation needed is key to ensuring patients' survival.



#### Quick Cut

Two-thirds rule: Total body water = (slightly less than) two-thirds total body weight.



#### Quick Cut

Of total body water, two thirds is intracellular and one third extracellular (three fourths = interstitial and one fourth = intravascular).



#### Quick Cut

Water follows electrolytes across cell membranes to equilibrate osmolality.



#### Quick Cut

Adequate urine output is  $\frac{1}{2}$  mL/kg/hr, or about 250 mL/8 hr in adults.

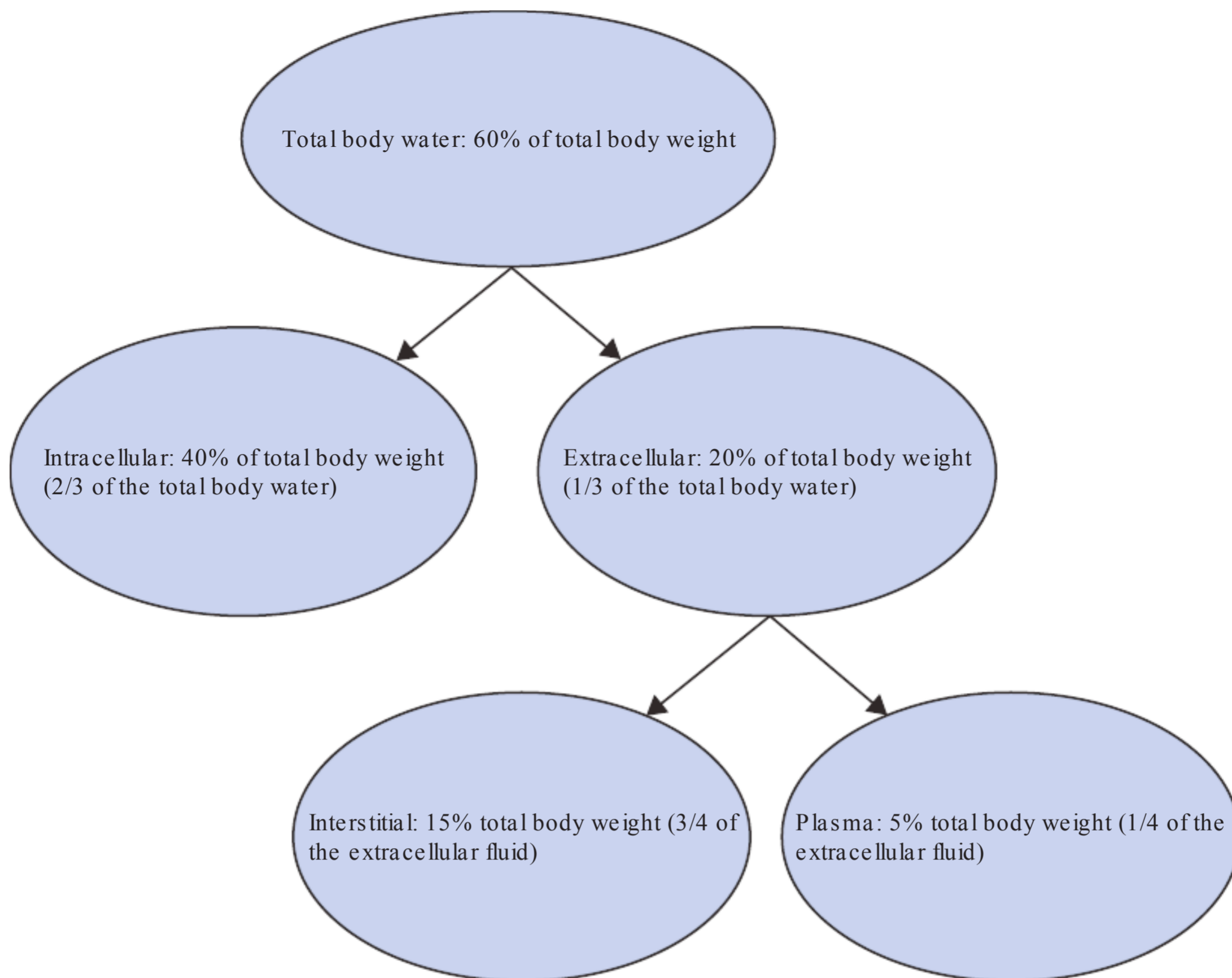


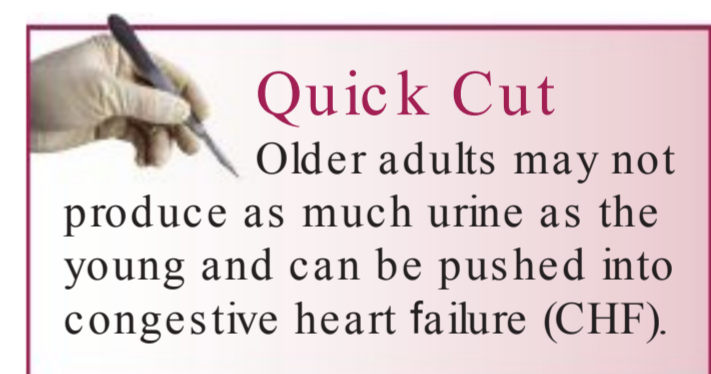
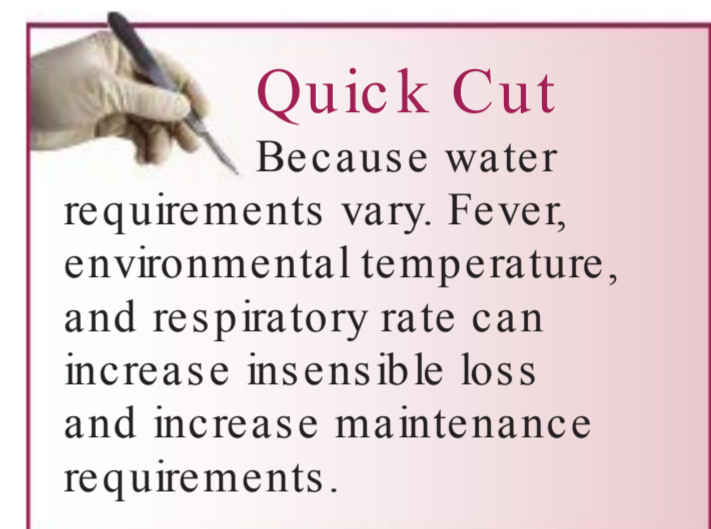
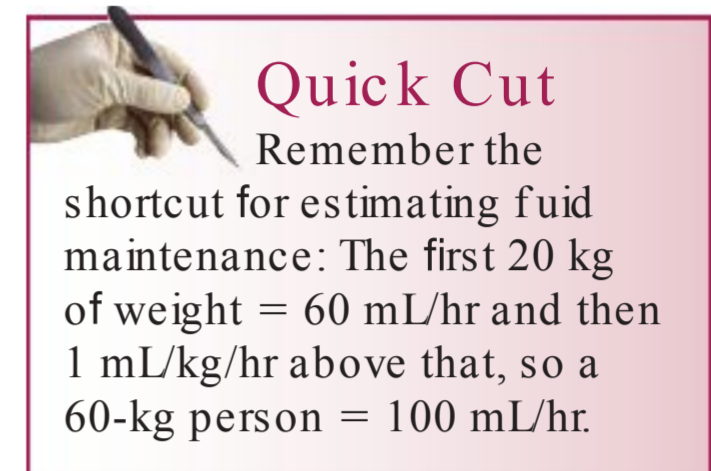
Figure 1-1: Water compartments.

Table 1-1: Electrolyte Composition of Various Water Compartments

Electrolytes	Intracellular Compartment	Extracellular Compartment
Anions		
Sodium (Na <sup>+</sup> )	10 mEq/L	142 mEq/L
Potassium (K <sup>+</sup> )	140 mEq/L	4 mEq/L
Chloride (Cl <sup>-</sup> )	4 mEq/L	103 mEq/L
Bicarbonate (HCO <sub>3</sub> <sup>-</sup> )	10 mEq/L	28 mEq/L
Phosphate (PO <sub>4</sub> <sup>3-</sup> )	75 mEq/L	4 mEq/L
Sulfate (SO <sub>4</sub> <sup>2-</sup> )	2 mEq/L	1 mEq/L
Calcium (Ca <sup>++</sup> )	<1 mEq/L	5 mEq/L
Magnesium (Mg <sup>++</sup> )	18 mEq/L	2 mEq/L
Organic acids	—	5 mEq/L
Various proteins	40 mEq/L	1 mEq/L



- b. The next highest daily water loss is insensible loss (i.e., sweat, respiration, stool), which is estimated as 600–900 mL/24 hr.
- c. Minimal water maintenance for a 70-kg man:  $(70 \text{ kg} \times 0.5 \text{ mL/kg/hr} \times 24 \text{ hours}) + 750 \text{ mL/24 hr} + 1,590 \text{ mL/24 hr}$ . (Again, this is the minimum and does not take into account any excess loss such as fever, which will increase the insensible loss.)
- 2. Body weight:** This method is often used for pediatric patients because their body weights vary widely; estimations are 100 mL/kg/day or 4 mL/kg/hr for the first 10 kg of body weight, 50 mL/kg/day or 2 mL/kg/hr for the second 10 kg of body weight, and 20 mL/kg/day or 1 mL/kg/hr for each additional kilogram of body weight.
- 3. Given amount of water per kilogram of body weight:** The value used for this method is generally 35–40 mL/kg/day, adjusted higher or lower based on age (older adults often require only 15 mL/kg/24-hr maintenance due to higher fat/lower muscle mass).
- B. Evaluating maintenance rates:** Patients not only have different maintenance needs, but replacing water or removing excess water may also be of concern (see I C 1). Simple methods in the noncritically ill population to monitor adequacy of fluid administration include the following:
- 1. Urine output variations:** If urine output is high (i.e.,  $>1 \text{ mL/kg/hr}$ ), then less water may be required; if urine output is low, more water may be required, or further assessment may be necessary.
  - 2. Tachycardia:** can be a sign of dehydration or low intravascular volume
- C. Adjusting fluid rates and type for individual patients:** First, calculate the patient's maintenance rate, then adjust the amount up or down based on the need for resuscitation, or replacement of gastrointestinal (GI) losses, and the type based on type of losses (Table 1-2).
- 1. Injury, illness, and surgery:** Can result in fluid losses due to blood loss, third spacing, insensible losses from diarrhea, fever, etc. Providing more than calculated maintenance fluid to replace losses (e.g.,  $1.5$  or  $2 \times$  maintenance) is necessary, and rate adequacy can be judged from the above criteria.
  - 2. Hypervolemia and diuresis:** Patients who require diuresis already are overloaded with fluid, and intravenous (IV) fluids should be withheld; however, electrolyte or nutritional aspects of fluid administration may require water as a carrier for other substances during diuresis.



**Table 1-2: Electrolyte Composition of Gastrointestinal Secretions**

Organ	Volume/day	Na <sup>+</sup> (mEq/L)	K <sup>+</sup> (mEq/L)	Cl <sup>-</sup> (mEq/L)	HCO <sub>3</sub> <sup>-</sup> (mEq/L)
Stomach	1–5 L	20–150	10–20	120–140	Nil
Duodenum	0.1–2 L	100–120	10–20	110	10–20
Ileum	1–3 L	80–140	5–10	60–90	30–50
Colon	0.1–2 L	100–120	10–30	90	30–50
Gallbladder	0.5–1 L	140	5	100	25
Pancreas	0.5–1 L	140	5	30 (higher when not stimulated)	115 (lower when not stimulated)