Nutrition in Clinical Surgery

SECOND EDITION

Editor
MERVYN DEITEL, M.D., F.R.C.S.(C),
F.A.C.S., F.I.C.S., F.A.C.G., F.A.C.N.

Nutrition in Clinical Surgery

SECOND EDITION

Editor
MERVYN DEITEL, M.D., F.R.C.S.(C), F.A.C.S., F.I.C.S., F.A.C.G., F.A.C.N.

Associate Professor of Surgery and Associate Professor of Nutritional Sciences, University of Toronto; Surgeon
St. Joseph's Health Centre, Toronto, Canada

WILLIAMS & WILKINS
Baltimore • London • Los Angeles • Sydney

Editor: John N. Gardner
Associate Editor: Joseph E. Seitz
Copy Editor: Shelley Potler
Design: Bert Smith
Illustration Planning: Reginald R. Stanley
Production: Anne G. Seitz

Accurate indications, adverse reactions, and dosage schedules for drugs are provided in this book, but it is possible that they may change. The reader is urged to review the package information data of the manufacturers of the medications mentioned.

Printed in the United States of America

Library of Congress Cataloging in Publication Data

Main entry under title:

Nutrition in clinical surgery.
Includes bibliographies and index.
1. Surgery—Nutritional aspects. 2. Parenteral feeding. 3. Diet therapy. I. Deitel, Mervyn. [DNLM: 1. Nutrition. 2. Postoperative Care. 3. Preoperative Care. WO 178 N976]
RD52.N88N87 1985 617'.919 84-21878
ISBN 0-683-02450-7

Composed and printed at the
Waverly Press, Inc.

86 87 88 89
10 9 8 7 6 5 4 3 2

Foreword

Until the late 1960s and early 1970s, malnutrition was accepted as an inexorable part of disease and trauma. Anorexia, after all, is the first symptom of illness. If that illness was prolonged, the increasing nutritional deficits resulted in a patient less capable of regaining homeostasis. During the last decade, however, the nonvolitional nutritional support techniques described in this book were developed and disseminated to clinicians throughout the world. These clinicians were eager to master such techniques, so that they might break the cycle of disease/malnutrition/worsening disease, which they observed in their critically ill patients. It was learned quickly that, if these patients were placed on nutritional support and the deterioration associated with secondary malnutrition was eliminated from that process, usually the disease itself became more treatable and the patient's survival was enhanced. Also in that decade, we began to ask why what we did worked or did not work, and whether things could be done better. This led to the development of multiple approaches to solve the complex problems of a patient requiring nutritional support. It also led to the birth of a whole industry providing the medical devices, solutions, and delivery systems needed. The fact that this industry grew from nearly nothing in the early 1970s to almost one billion dollars yearly in the early 1980s is testimony to the recognition by the medical community of the value of nutritional support. This intense activity is remarkable, considering that members of the medical community who utilize these techniques are essentially self-taught. There are a few fellowship programs in clinical nutrition and nutritional support, but the vast majority of training is still relegated to on-the-job experience during residency programs and postgraduate courses sponsored by such groups as the American Society for Parenteral and Enteral Nutrition and various other medical and surgical societies. The reason for the acceptance and utilization of nutritional support techniques is obvious. It works; at least as well as any other support technique, and it buys time for the patient and the clinician to diagnose and treat the underlying disease process itself.

The efficacy of nutritional support can be documented through serial nutritional assessments. The indices used in these assessments have been shown to parallel closely morbidity and mortality. In fact, although energy is important, we now realize that protein is the quintessential substrate and that the patient's protein status, particularly the status of the visceral protein compartment, must be maintained or supported. As we learn more, we are constructing formulas to match disease types and stages as well as formulas for types and degrees of stress.

Hyperalimentation, however, does not work *unexpected* wonders. Where malnutrition or energy deficits impact an outcome, the results of nonvolitional feeding are excellent. Where this is not the case, they are not. In addition to chapters devoted to techniques of enteral and parenteral hyperalimentation, specific chapters detail the uses and expectations of nonvolitional feeding in short-bowel syndrome, intestinal complications of radiation therapy and its applications in severe esophageal disease, inflammatory bowel disease, pancreatitis, etc. However, if the patient is dying of malnutrition plus a disease, and the surgeon eliminates malnutrition as a confounding variable, the patient will go on to die of the disease unless it can be treated effectively.

This book, then, does not direct the surgeon to "hyperaliment" a patient who obviously has an intra-abdominal abscess, beyond the point where good surgical judgment dictates that the patient should be brought back to the operating room and the abscess drained. Likewise, hyperalimentation cannot cure cancer, set a fracture, harvest and replace a skin graft, or

drain a pseudocyst. It is a tool—a clinical support system not unlike blood replacement, ventilatory or dialysis support, which has specific indications and expectations. Just as all surgeons have learned to order blood and blood products, intubate and use a ventilator, so too they seek a working knowledge of nutritional support. This book provides that.

Nutrition in Clinical Surgery was written by clinicians who, like you the reader, are "in the trenches." The contributors do not consider themselves to be specialists in nutrition beyond their clinical specialty. The principal charge to the authors was to keep each chapter practical. Therefore, this book does not have to be read from start to finish; each chapter stands on its own and can be consulted as needed.

The importance of this work is that it is designed to serve the practitioner. It reflects a change not only in the knowledge base regarding contemporary clinical nutrition, but also in the expectations of good medical practice in light of developments over the past decade.

In short, this book is full of "need to know" information written clearly by those who care for patients for those who also care for patients. The editor and authors can be proud of a job well done.

Mitchell V. Kaminski, Jr., M.D., F.A.C.S.
Chicago, Illinois

Preface

This book has been written to provide the practical aspects of nutrition for the busy clinical surgeon and surgical resident, without having to wade through overwhelming biochemistry and theoretical research. The book, we believe, also has value for the gastroenterologist, internist, clinical pharmacist, dietician, nurse, and anyone involved in a Nutritional Support Service and clinical care.

Each chapter stands on its own, and can be consulted independently as needed. We are indebted to the renowned authors who are acknowledged experts in their fields for their enthusiasm, universal promptness, cooperation, and friendship. Many chapters have required the collaboration of authors working in different hospitals, different cities, different countries, and even different continents. The result has been a melding of concepts and techniques.

The book begins with the history and basic principles of surgical nutrition and nutritional status. This is followed by the delivery of liquid diets, since they have been slightly overshadowed by parenteral alimentation, but should be a first consideration if the gut is functioning. Next, the practical principles of each aspect of parenteral nutrition are discussed, leading to various roles in the organization of a Nutritional Support Service. Then, applications and principles related to *specific* diseases are individually presented. Then follows a discussion of the relation of dietary fiber to surgical disease. The Index at the back of the book is geared to direct the reader to various parts of the book where a facet may be discussed, e.g., specific chapters are devoted to the important field of home parenteral nutrition, but this topic is also alluded to in other parts of the book where it is relevant. The book has undergone a complete revision, and contains chapters dealing with computers and renal, hepatic, and respiratory failure.

We would like to thank MEDI-EDIT LTD. of Toronto for the efficient and pleasant editorial assistance. We are also indebted for assistance to the Sponsors on the following page, who encouraged this endeavor.

At this time, I would like to thank the following doctors who have helped me at various times in my career—Drs. Leon Ginzburg, William I. Wolff, Max L. Som, Robert A. Mustard, William R. Drucker, G. Tom Shires, J. Alexander McIntyre, Donald R. Wilson, Neil A. Watters, and Bernard Langer. I am grateful to the St. Joseph's Health Centre Research Foundation for encouragement of my projects in earlier years. My wife Frances and sons Kevin and Wayne have been very supportive through this venture.

Clinical nutrition has attained its rightful importance in the past two decades, particularly due to the stimulus given this work by Dr. Stanley J. Dudrick. "Hyperalimentation" has broadened the chances for patients to tolerate disease and undergo operations. Progressive malnutrition can be reversed and survival achieved in situations previously associated with a high mortality. With these goals in mind and in the name of the contributing authors, we offer this book as a contribution to clinical surgery.

Mervyn Deitel, M.D.
Toronto, Canada

Sponsors

Department of Surgery, University of Toronto
Abbott Laboratories
Ross Laboratories
Norwich Eaton Pharmaceuticals Inc.
USV Canada Inc.
Mead Johnson Canada (Bristol-Myers Pharmaceutical Group)
The Hans and Josephine Boergers Family
SensorMedics Corporation (formerly the Physiological Measurements Operation of Beckman Instruments, Inc.)
Cormed, Inc.
Pharmacia (Canada), Inc.
Travenol Laboratories Canada, Inc.
Critikon Canada, Inc.
Ciba-Geigy Canada Ltd.
R.P. Scherer Hardcapsule Ltd. and R.P. Scherer (Canada)
Smith Kline & French Canada Ltd.
Kraft, Ltd.
Kellogg Salada Canada, Inc.
LyphoMed Canada, Inc.
Cutter (Canada) Ltd./Ltée.
Ethicon Sutures, Ltd.
Parke-Davis Canada, Inc. (Warner-Lambert)
Davis & Geck, Cyanamid Canada, Inc.
Rhône-Poulenc Pharma, Inc.
Schering Canada, Inc.
Merck Sharp & Dohme and Frosst, Divisions of Merck Frosst Canada, Inc.
Organon Canada Ltd./Ltée.
CILCO Canada. Mary Anne Thomas, R.N.
Purdue Frederick Inc.
Hoffman-La Roche Ltd.
The Upjohn Company of Canada
The Doyle Pharmaceutical Company (Delmark Company, Inc.)
St. Joseph's Health Centre Research Foundation
Mentor Corporation—Heyer-Schulte Products
The Nelson Arthur Hyland Foundation
Physicians' Services Incorporated Foundation
IVH Services, Inc.
Winthrop Laboratories—Division of Sterling Drug Ltd.
Carnation Healthcare Services
The Weston/Loblaw Group of Companies

Contributors

Michael A.J. Alexander, M.B. B.S., F.R.C.S.(C), F.A.C.S.
Staff Surgeon, Shouldice Hospital, Thornhill, Ontario, Canada.

G. Harvey Anderson, B.Sc., M.Sc., Ph.D.
Professor and Chairman, Department of Nutritional Sciences and Associate Dean, Research, Faculty of Medicine, University of Toronto; Professor, Institute of Medical Sciences and Professor, Department of Physiology, University of Toronto; Chairman, Human Nutrition Research Council of Ontario, Toronto, Ontario, Canada.

Richard J. Andrassy, M.D., F.A.C.S., F.A.A.P., F.A.C.N.
Associate Professor of Surgery and Chief, Pediatric Surgery, University of Texas Health Science Center at San Antonio; Chief, Pediatric Surgery, Medical Center Hospital; Consultant, Audie Murphy Memorial Veterans' Hospital, San Antonio, Texas.

Surinder S. Basi, M.B. B.S.
Research Associate, St. Joseph's Health Centre Research Foundation, Toronto, Ontario, Canada.

George L. Blackburn, M.D., Ph.D., F.A.C.S., F.A.C.N.
Director, Nutrition Support Service and Nutrition/Metabolism Laboratories, Cancer Research Institute, New England Deaconess Hospital, Boston; Associate Professor Surgery, Harvard Medical School, Boston, Massachusetts.

Laurence M. Blendis, M.D., F.R.C.P., F.R.C.P.(C)
Staff Physician, Toronto General Hospital; Professor of Medicine-Gastroenterology, University of Toronto, Toronto, Ontario, Canada.

Rea A. Brown, B.Sc., M.D., M.Sc., F.R.C.S.(C), F.A.C.S.
Associate Professor of Surgery, McGill University; Senior Surgeon, The Montreal General Hospital; Director, Alimentation Service, The Montreal General Hospital; Co-Director, Surgical Intensive Care Unit, The Montreal General Hospital; Consultant Surgeon, Douglas Hospital, Montreal, Québec, Canada.

Jeremy J. Burdge, M.D.
Clinical Assistant Professor of Surgery, Division of Plastic Surgery, University Hospital and Ohio State University College of Medicine, Columbus, Ohio.

Bernard J. Cummings, M.B. Ch.B., F.R.C.P.(C) F.R.C.R., M.R.A.C.R.
Associate Professor of Radiology, University of Toronto; Radiation Oncologist, Princess Margaret Hospital, Toronto, Ontario, Canada.

Mervyn Deitel, M.D., F.R.C.S.(C), F.A.C.S., F.I.C.S., F.A.C.G., F.A.C.N.
Associate Professor of Surgery and Associate Professor of Nutritional Sciences, University of Toronto; Surgeon, St. Joseph's Health Centre, Toronto; Active Staff, Hillcrest Hospital, Toronto, Ontario, Canada.

Harold O. Douglass, Jr., B.A., M.D., F.A.C.S.
Associate Chief, Surgical Oncology, in charge of the Upper Gastrointestinal Service, Roswell Park Memorial Institute; Associate Professor of Research Surgery, State University of New York at Buffalo; Chairman, Gastrointestinal Tumor Study Group; Consultant, Teaching Staff, Buffalo General Hospital; Courtesy Staff (Faculty), Erie County Medical Center, Buffalo, New York.

Richard J. Dowling, R.Ph., B.Sc. (Pharm.)
Director of Clinical Services; Theranutrix Inc., Delran, N.J.; formerly Clinical Assistant

Professor of Pharmacy Practice, Philadelphia College of Pharmacy and Science; Pharmacist Coordinator for the Nutrition Support Service, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania.

Stanley J. Dudrick, M.D., F.A.C.S.
Director, Nutritional Support Services, St. Luke's Episcopal Hospital; Clinical Professor of Surgery, The University of Texas Medical School at Houston, Houston, Texas.

DeAnn M. Englert, M.S.N., R.N.
Nursing Coordinator of Nutritional Support Services, St. Luke's Episcopal Hospital/ Texas Heart Institute, Houston, Texas.

Joel Faintuch, M.D., F.A.C.S., F.I.C.S.
Associate (Docent) Professor of Surgery, São Paulo University Medical School and Hospital das Clínicas, São Paulo, Brazil; Coordinator and Chief, Latinamerican Committee of Parenteral and Enteral Nutrition; Associate of the Directory (Publications), Brazilian Society of Parenteral Nutrition.

Robert J. Fairfull-Smith, M.B. Ch.B. (Glasgow), F.R.C.S.(C)
Assistant Professor of Surgery, University of Ottawa; Active Staff, Division of General Surgery, Ottawa General Hospital; Director of the Nutrition and Metabolism Laboratory, Ottawa General Hospital, Ottawa, Ontario, Canada.

Stephen K. Field, B.Sc., M.D. C.M., F.R.C.P.(C)
Assistant Professor of Medicine, University of Calgary; Physician, Pulmonary Division, Department of Internal Medicine, Foothills Hospital, Calgary, Alberta, Canada.

Robert M. Filler, M.D., F.R.C.S.(C), F.A.C.S.
Professor of Surgery, University of Toronto; Surgeon-in-Chief, The Hospital for Sick Children, Toronto, Ontario, Canada.

Bruce A. Freed, B.S., M.S., R.D.
Research Nutritionist, Metabolic Support Service, Ravenswood Hospital Medical Center, Chicago, Illinois.

Joel B. Freeman, M.D., F.R.C.S.(C), F.A.C.S.
Chief, Division of General Surgery, Ottawa General Hospital; Professor of Surgery, University of Ottawa, Ottawa, Ontario, Canada.

Herbert R. Freund, M.D.
Associate Professor of Surgery, Hebrew University—Hadassah Medical School; Director, Nutritional Support Unit, Hadassah University Medical Center, Jerusalem, Israel.

David S. Gray, M.D.
Assistant Professor of Medicine and Family Medicine, University of Southern California, Los Angeles, California.

Paul D. Greig, B. Math., M.D., F.R.C.S.(C)
Assistant Professor of Surgery, University of Toronto; Surgeon, Division of General Surgery, Toronto General Hospital, Toronto, Ontario, Canada.

Sharon Grundfest-Broniatowski, M.D., F.A.C.S.
Staff Surgeon, Department of General Surgery, Cleveland Clinic Foundation, Cleveland, Ohio.

Farhat N. Homsy, M.D.
Hyperalimentation Fellow, Nutrition Support Service, New England Deaconess Hospital, Boston, Massachusetts.

Khursheed N. Jeejeebhoy, M.B. B.S. (Madras), M.R.C.P. (Lond), Ph.D. (Lond), F.R.C.P. (Edin), F.R.C.P.(C), F.R.C.P.(Lond)
Professor, Department of Medicine, University of Toronto; Chief, Division of Gastroenterology, University of Toronto and Toronto General Hospital, Toronto, Ontario, Canada.

David J.A. Jenkins, D.M., D.Phil.
Professor, Department of Nutritional Sciences, University of Toronto; Associate Physician, Toronto General Hospital; Active Staff Physician, St. Michael's Hospital, Toronto, Ontario, Canada.

Terri G. Jensen, M.S., R.D.
Consultant in Nutritional Support, Columbia, Missouri.

Dennis W. Jirsch, M.D., M.Sc., Ph.D., F.R.C.S.(C)
Associate Professor of Surgery, University of Toronto; Surgeon, Department of General Surgery, St. Michael's Hospital, Toronto; Consulting Staff, Princess Margaret Hospital, Toronto; Surgeon-in-Chief, Credit Valley Hospital, Mississauga, Ontario, Canada.

Shinkichi Kamata, M.D.
Assistant Professor of Pediatric Surgery, Osaka University Medical School, Osaka, Japan.

Mitchell V. Kaminski, Jr., M.D., F.A.C.S., F.I.C.S., F.A.C.N.
Clinical Professor of Surgery, Chief, Division of Surgical Nutrition, University of Health Sciences/The Chicago Medical School; Director, Metabolic Support Services of Saint Mary of Nazareth Hospital Center, Ravenswood Hospital Medical Center; Medical Director, Chicago Medical & Dental Center; Director, Midwest Nutrition, Education and Research Foundation, Chicago, Illinois.

Ruth McPherson-Kay, Ph.D., M.D.
Assistant Professor, Department of Surgery, University of Toronto, Toronto, Ontario, Canada.

Roger G. Keith, M.D., F.R.C.S.(C), F.R.C.S. (Eng), F.A.C.S.
Associate Professor of Surgery, University of Toronto; Surgeon, Sunnybrook Medical Centre, Toronto, Ontario, Canada.

Kenneth A. Kudsk, M.D.
Associate Professor of Surgery, Ohio State University School of Medicine, Columbus, Ohio.

Margaret A. Lahey, B.A.
Administrative Coordinator, Nutrition Support Service, New England Deaconess Hospital, Boston, Massachusetts.

Anne Marie Lang, B.Sc.Pharm., P.E.B.C.
Director of Pharmacy, Credit Valley Hospital, Mississauga, Ontario, Canada.

Robert G. Matheny, M.D.
Fellow, General Surgery and Surgical Nutrition, St. Luke's Episcopal Hospital, Houston, Texas.

Alice Hope McArdle, B.Sc., M.Sc., Ph.D., F.A.C.N.
Associate Professor, Department of Surgery, McGill University; Assistant Director, McGill University Surgical Clinic, Montreal General Hospital; Consultant, Surgical Alimentation Service, Montreal General Hospital; Consultant, Surgical Nutrition, St. Mary's Hospital, Montreal, Québec, Canada.

Christopher B. Mills, M.D., F.A.C.S., F.A.C.N.
Chief of Surgical Nutrition, St. Vincent's Hospital & Medical Center of New York, New York; Clinical Assistant Professor of Surgery, New York Medical School, Valhalla, New York.

Thomas J. Misny, M.D.
General Surgeon, Cleveland, Ohio.

Keyvan Moghissi, B.Sc., M.D., F.R.C.S.(Edin), F.R.C.S. (Eng), Membre Assoc. Etranger, Académie de Chirurgie (Paris)
Consultant Cardio-thoracic Surgeon, Humberside Cardio-thoracic Surgical Centre, Castle Hill Hospital, Cottingham, North Humberside, England.

John A. Morris, Jr., M.D.
Assistant Professor of Surgery, Vanderbilt University, Nashville, Tennessee.

Gerald Moss, MSc., Ph.D., M.D., F.A.C.S., F.A.C.N.
Professor of Biomedical Engineering and Director of the Biomedical Engineering Laboratory, Rensselaer Polytechnic Institute, Troy, New York; Clinical Assistant Professor of Surgery and Research Associate in Biochemistry, Albany Medical College, Albany, New York.

James L. Mullen, M.D., F.A.C.S., F.A.C.N., F.A.C.G.
Director, Nutrition Support Service, Hospital of the University of Pennsylvania; Associate Professor of Surgery, University of Pennsylvania School of Medicine; Chief, Surgical Service, Philadelphia Veterans Administration Medical Center, Philadelphia, Pennsylvania.

Joseph J. O'Donnell, M.D.
Fellow, General Surgery and Surgical Nutrition, St. Luke's Episcopal Hospital, Houston, Texas.

Akira Okada, M.D., Ph.D.
Professor of Pediatric Surgery, Osaka University Medical School, Osaka, Japan.

Carey P. Page, M.D., F.A.C.S., F.A.C.N.
Associate Professor of Surgery, University of Texas Health Science Center at San Antonio; Staff Surgeon and Surgical Oncologist, Medical Center Hospital and Audie Murphy Memorial Veterans' Hospital, San Antonio, Texas.

Alan Pollard, M.A., M.B., B.Chir., M.R.C.P., L.M.C.C., F.R.C. Path.
Associate Professor, Department of Clinical Biochemistry, University of Toronto; Biochemist-in-Chief, Mount Sinai Hospital, Toronto, Ontario, Canada.

Thomas William Rice, B.A.Sc., M.D., F.R.C.S.(C)
Chief Resident in Thoracic Surgery, University of Toronto, Toronto, Ontario, Canada.

Irving B. Rosen, M.D., F.R.C.S.(C), F.A.C.S.
Associate Professor of Surgery, University of Toronto; Attending Surgeon, Mount Sinai Hospital; Attending Surgeon, Toronto General Hospital; Consultant in Surgery, The Princess Margaret Hospital, Toronto, Ontario, Canada.

Robert L. Ruberg, M.D., F.A.C.S.
Associate Professor and Director, Division of Plastic Surgery, Ohio State University College of Medicine; Clinical Associate Professor, Medical Dietetics, School of Allied Medical Professions; Ohio State University, Director of Burn Unit, University Hospitals, Columbus, Ohio.

Robert L. Ruderman, M.D., F.R.C.S.(C), F.A.C.S., D.A.B.S.
Staff Surgeon and former Director of Hyperalimentation, Mount Sinai Hospital, Toronto; Surgeon, the Rudd Clinic for Colon & Rectal Disease, Toronto, Ontario, Canada.

Ian Sanderson, M.B. B.S., F.R.C.S.(C), F.A.C.S., F.A.C.N.
Staff Surgeon and Director of Hyperalimentation Services, Northwestern General Hospital, Toronto, Ontario, Canada.

Jack T. Sandler, M.B. Ch.B., F.R.C.S.(C).
Staff Surgeon, Department of Surgery, The Doctors Hospital, Toronto, Ontario, Canada.

Sister Francis Sauvé, B.Sc.Pharm., F.C.S.H.P.
Former Director of Pharmacy, St. Joseph's Health Centre, Toronto, Ontario, Canada.

Paul R. Schloerb, M.D., F.A.C.S.
Professor of Surgery, University of Rochester, School of Medicine and Dentistry; Attending Surgeon, Strong Memorial Hospital; Director, Surgical Intensive Care Unit, Strong Memorial Hospital, Rochester, New York.

George F. Sheldon, M.D., F.A.C.S.
Professor and Chairman, Department of Surgery, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Ezra Steiger, M.D., F.A.C.S., F.A.C.N.
Staff Surgeon, Cleveland Clinic Foundation; Head, Section of Surgical Nutrition, The Cleveland Clinic; Assistant Clinical Professor of Surgery, Case Western Reserve University, Cleveland, Ohio.

Glen A. Taylor, M.D., F.R.C.S.(C)
Associate Professor of Surgery, University of Toronto; Chief of General and Thoracic Surgery, Sunnybrook Medical Centre, Toronto, Ontario, Canada.

Richard M. Vazquez, M.D., F.A.C.S.
Assistant Professor of Surgery, McGaw Medical School, Northwestern University; Associate Attending Surgeon, and Director, Nutritional Support Service, Northwestern Memorial Hospital; Special Consulting Staff, Northwest Community Hospital of Arlington Heights; Courtesy Staff St. Joseph Hospital, Chicago, Illinois.

Susan Weinmann-Winkler, M.S., R.D./L.D.
Assistant Director, Clinical Nutrition, Education and Nutritional Assessment, St. Luke's Episcopal Hospital, Texas Children's Hospital and Texas Heart Institute, Houston, Texas.

David E. Wesson, M.D., F.R.C.S.(C), F.A.C.S.
Assistant Professor of Surgery, University of Toronto; Staff Surgeon, Department of Surgery, The Hospital for Sick Children, Toronto, Ontario, Canada.

Bruce M. Wolfe, M.D., F.A.C.S.
Associate Professor, Department of Surgery, School of Medicine, University of California, Davis, Sacramento, California.

Kevin H. Wong, M.D., F.R.C.S.(C)
Staff Surgeon, Scarborough General Hospital, Scarborough, Ontario, Canada.

Stanley H. Zlotkin, M.D., Ph.D., F.R.C.P.(C), F.A.C.N.
Attending Staff, Division of Clinical Nutrition, The Hospital for Sick Children, Toronto; Assistant Professor of Nutrition and Paediatrics, University of Toronto; Active Staff, Consultant in Pediatrics, Ontario Crippled Children's Centre, Toronto, Ontario, Canada.

Contents

SECTION I

BASIC PRINCIPLES AND TECHNIQUES

CHAPTER ONE

History of Nutrition in Surgery

IAN SANDERSON, SURINDER S. BASI, and MERVYN DEITEL

An understanding of the role of nutrition in the treatment or prevention of disease before the 18th century was minimal. Treatment was confined to the use of emetics, purgatives and enemas, to herbal remedies, and to various dietary alterations, including starvation. As far back as 1500 B.C., the Egyptians were using clysters (enemas) as part of a ritual of fasting, purging, and rectal feeding for the preservation of health (1). It would have been impossible to contemplate infusing nutrients, fluids, or drugs intravenously before 1616, when William Harvey (2) first described the circulation of blood. However, once the nature of the circulatory system had become established, it was not long before scientists began to investigate the possibilities (Table 1.1).

In 1656, when he was Savilian Professor of Astronomy at Oxford, Sir Christopher Wren (better known as the architect of St. Paul's Cathedral in London) infused ale and wine into the veins of dogs, using a goose quill attached to a pig's bladder (3, 4). These substances were known to be safe to ingest and to have some nutritional value. He also infused opium, which stupefied the dog but did not kill him, and *Crocus mettalorum*, which caused the dog to "vomit up life and all." This was probably the first instance of an intravenously administered medication. This experiment was repeated at Pisa by Carolo Fracassato in 1658, with similar results (4). Wren was also reported to have tried to infuse vinum emeticum into the vein of an inferior servant of a European prince. The patient apparently swooned and the experiment had to be abandoned.

In 1664, Caspar Scotus administered wine and purgatives intravenously to dogs (4, 5). In the following year, Escholtz published a book containing an account of the new method of intravenous (IV) infusion plus details concerning three patients whom he had treated with IV medications (4, 6). M. Hoffman of Altdorf is said by several writers to have been the inventor of infusion, but his experiments seem to have been contemporaneous with those of Escholtz (4).

In 1670, techniques of IV entry and infusion were described in a book entitled *Clysmatica Nova*, published in Holland. In 1678, William Courten (7) of Montpellier injected numerous substances (olive oil, sugar, vinegar, wine, purgatives, opium, urine, and salt solutions) intravenously into animals and diligently recorded his results. Many others followed, injecting a variety of substances with variable consequences, and the subject was reviewed comprehensively by Fortescue-Brickdale (4) in 1904. Considering how little was known about biochemistry, microbiology, blood types, and immunology, it is not surprising that problems arose and little progress was made for more than a century.

Nasoenteric tube-feeding had been used sporadically since ancient times, but the father of modern-day enteral feeding was John Hunter, the surgeon to King George III. In 1793, in London, he used an eel-skin over a whalebone to feed a patient with "paralysis of the muscles of glutition" (1).

In 1831, a severe cholera epidemic in England proved to be a new stimulus to the development of IV infusion techniques (Fig. 1.1 [8]). Fluid losses from vomiting and diarrhea frequently led to fatal dehydration, and because giving fluid by mouth or rectum was impossible, the use of IV fluids had to be considered in spite of the potential problems. In that year, Thomas Latta (9) of Leith, Scotland, infused saline solutions into cholera patients, with great success. His decision to use saline was based on work describing the blood of cholera victims, which was thick, black, and cold. He therefore diluted their blood with water and salt, and naturally this was successful. He selected a patient who "had apparently reached the last moments of their earthly existence and now nothing could injure her. Indeed so entirely was she reduced that I fear that I shall be unable to get my apparatus ready ere she expire." He injected ounce after ounce