



Prometheus, chained to the rocky Mount Caucasus, has his liver eaten by the eagle of Zeus. (Engraving, 1566, possibly after a work by Titian. Reproduced by permission of the Hulton Getty Picture Collection, London.)

BLUMGART'S

Surgery of the Liver, Biliary Tract, and Pancreas

6th EDITION

EDITOR-IN-CHIEF

William R. Jarnagin, MD, FACS

ASSOCIATE EDITORS

Peter J. Allen, MD

William C. Chapman, MD, FACS

Michael I. D'Angelica, MD, FACS

Ronald P. DeMatteo, MD, FACS

Richard Kinh Gian Do, MD, PhD

Jean-Nicolas Vauthey, MD, FACS

EDITOR EMERITUS

Leslie H. Blumgart, BDS, MD, DSc(Hon), FACS, FRCS(Eng, Edin), FRCPS(Glas)

VOLUME 1

ELSEVIER

ELSEVIER

1600 John F. Kennedy Blvd.
Ste 1800
Philadelphia, PA 19103-2899

Blumgart's Surgery of the Liver, Biliary Tract, and Pancreas
Copyright © 2017 by Elsevier, Inc. All rights reserved.

ISBN: 978-0-323-34062-5

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

With respect to any drug or pharmaceutical products identified, readers are advised to check the most current information provided (i) on procedures featured or (ii) by the manufacturer of each product to be administered, to verify the recommended dose or formula, the method and duration of administration, and contraindications. It is the responsibility of practitioners, relying on their own experience and knowledge of their patients, to make diagnoses, to determine dosages and the best treatment for each individual patient, and to take all appropriate safety precautions.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Previous editions copyrighted 2012, 2007, 2000, 1994, and 1988 by Saunders, an imprint of Elsevier Inc.

Library of Congress Cataloging-in-Publication Data

Names: Jarnagin, William R. (Surgeon), editor.

Title: Blumgart's surgery of the liver, biliary tract, and pancreas / editor-in-chief, William R. Jarnagin ; associate editors, Peter J. Allen, William C. Chapman, Michael I. D'Angelica, Ronald P. DeMatteo, Richard Kinh Gian Do, Jean-Nicolas Vauthey ; editor emeritus, Leslie H. Blumgart.

Other titles: Surgery of the liver, biliary tract, and pancreas

Description: Sixth edition. | Philadelphia, PA : Elsevier, [2017] | Includes bibliographical references and index.

Identifiers: LCCN 2016013975 | ISBN 9780323340625 (hardcover)

Subjects: | MESH: Liver—surgery | Biliary Tract Surgical Procedures | Pancreas—surgery

Classification: LCC RD669 | NLM WI 770 | DDC 617.5/56—dc23 LC record available at <http://lcn.loc.gov/2016013975>

Executive Content Strategist: Michael Houston
Senior Content Development Specialist: Dee Simpson
Publishing Services Manager: Patricia Tannian
Project Manager: Stephanie Turza
Design Direction: Maggie Reid

Printed in China

Last digit is the print number: 9 8 7 6 5 4 3 2 1



This book is dedicated to
the development of surgery of the liver, biliary tract,
and pancreas as a specialty.

EDITOR-IN-CHIEF**William R. Jarnagin, MD, FACS**

Chief, Hepatopancreatobiliary Surgery
Benno C. Schmidt Professor of Surgical Oncology
Memorial Sloan Kettering Cancer Center;
Professor of Surgery
Weill Medical College of Cornell University
New York, New York

ASSOCIATE EDITORS**Peter J. Allen, MD**

Professor of Surgery
Department of Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

William C. Chapman, MD, FACS

Professor
Chief, Division of General Surgery
Chief, Abdominal Transplantation Section
Washington University School of Medicine
St. Louis, Missouri

Michael I. D'Angelica, MD, FACS

Attending Surgeon
Hepatopancreatobiliary Surgery
Enid A. Haupt Chair in Surgery
Memorial Sloan Kettering Cancer Center;
Associate Professor
Department of Surgery
Weill Medical College of Cornell University
New York, New York

Ronald P. DeMatteo, MD, FACS

Vice Chair, Department of Surgery
Chief, Division of General Surgical Oncology
Leslie H. Blumgart Chair in Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Richard Kinh Gian Do, MD, PhD

Associate Professor of Radiology
Weill Medical College of Cornell University;
Assistant Attending Physician
Department of Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

Jean-Nicolas Vauthey, MD, FACS

Professor of Surgical Oncology
Chief, Hepato-Pancreato-Biliary Section
Bessie McGoldrick Professor in Clinical Cancer Research
Department of Surgical Oncology
University of Texas MD Anderson Cancer Center
Houston, Texas

EDITOR EMERITUS**Leslie H. Blumgart, BDS, MD, DSc(Hon), FACS,
FRCS(Eng, Edin), FRCPS(Glas)**

Member
Professor of Surgery and Attending Surgeon
Memorial Sloan Kettering Cancer Center;
Professor of Surgery
Weill Medical College of Cornell University
New York, New York

CONTRIBUTORS

Ghassan K. Abou-Alfa, MD

Assistant Attending Physician
Memorial Sloan Kettering Cancer Center;
Assistant Professor
Weill Medical College of Cornell University
New York, New York

Jad Abou Khalil, MD, CM

Chief Resident
McGill University Health Centre
Montreal, Quebec, Canada

Pietro Addeo, MD

Attending Surgeon
Hepato-Pancreato-Biliary Surgery and Liver Transplantation
University of Strasbourg
Strasbourg, France

N. Volkan Adsay, MD

Professor and Vice-Chair
Director of Anatomic Pathology
Emory University
Atlanta, Georgia

Anil Kumar Agarwal, MCh, FRCS, FACS

Professor
Director
Department of GI Surgery and Liver Transplant
Govind Ballabh Pant Institute of Postgraduate Medical
Education & Research
Maulana Azad Medical College
New Delhi, India

Farzad Alemi, MD

Assistant Professor and Section Chief
Department of Hepatopancreatobiliary Surgery
University of Missouri–Kansas City
Kansas City, Missouri

Peter J. Allen, MD

Professor of Surgery
Department of Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Ahmed Al-Mukhtar, MD

Consultant
Hepatobiliary Surgeon
Sheffield Teaching Hospitals
Sheffield, England

Thomas A. Aloia, MD

Associate Professor of Surgical Oncology
Department of Surgical Oncology
University of Texas MD Anderson Cancer Center
Houston, Texas

Jesper B. Andersen, MD

Biotech Research and Innovation Centre (BRIC)
Department of Health and Medical Sciences
University of Copenhagen
Copenhagen, Denmark

Christopher D. Anderson, MD

James D. Hardy Professor and Chair
Department of Surgery
University of Mississippi Medical Center
Jackson, Mississippi

Vittoria Arslan-Carlon, MD

Assistant Anesthesiologist
Department of Anesthesiology and Critical Care
Memorial Sloan Kettering Cancer Center
New York, New York

Horacio J. Asbun, MD, FACS

Professor of Surgery
Department of Surgery
Mayo Clinic
Jacksonville, Florida

Béatrice Aussilhou, MD

Department of Hepato-Pancreatic-Biliary Surgery and Liver
Transplantation
Beaujon Hospital
Clichy, France

Joseph Awad, MD

Professor of Medicine
Department of Gastroenterology and Hepatology
Vanderbilt University;
Chief
Transplant Center
Tennessee Valley Healthcare System
Nashville, Tennessee

Daniel Azoulay, MD, PhD

Professor of Surgery
Department of Digestive, HPB and Liver Transplant Surgery
Hôpital Henri Mondro
Assistance Publique-Hôpitaux de Paris Faculté de Médecine
Université Paris-Est-Créteil
Créteil, France

Philippe Bachellier, MD, PhD

Professor and Chairman
Hepato-Pancreato-Biliary Surgery and Liver Transplantation
Pôle des Pathologies Digestives
Hépatiques et de la Transplantation
Hôpital de Hautepierre-Hôpitaux
Universitaires de Strasbourg
Strasbourg, France

Talia B. Baker, MD

Associate Professor of Surgery
Division of Transplantation
Department of Surgery
Northwestern University Feinberg School of Medicine
Chicago, Illinois

Zubin M. Bamboat, MD

Department of Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Jeffrey Stewart Barkun, MD, FRSC(C)

Professor of Surgery
Department of Hepatobiliary & Transplant Surgery
McGill University Health Centre
Montreal, Quebec, Canada

Claudio Bassi, FRCS, FACS, FEBS

Professor of Surgery
Pancreas Institute
Verona University Hospital Trust
Verona, Italy

Olca Basturk, MD

Assistant Attending Physician
Department of Pathology
Memorial Sloan Kettering Cancer Center;
Assistant Professor
Department of Pathology and Laboratory Medicine
Weill Medical College of Cornell University
New York, New York

Rachel E. Beard, MD

Resident Physician
Department of Surgery
Beth Israel Deaconess Medical Center
Boston, Massachusetts

Pierre Bedossa, MD, PhD

Professor
Department of Pathology
Beaujon Hospital
Paris, France

Jacques Belghiti, MD

Professor
Physician
Department of Hepato-Pancreatic-Biliary Surgery and Liver
Transplantation
Beaujon Hospital
Clichy, France

Omar Bellorin-Marin, MD

Administrative Chief Resident
Department of Surgery
New York Presbyterian Queens/Weill Medical College of
Cornell University
Flushing, New York

Marc G. H. Besselink, MD, PhD

Hepato-Pancreato-Biliary Surgeon
Academic Medical Center
Amsterdam, The Netherlands

Anton J. Bilchik, MD, PhD

Professor of Surgery
Chief of Medicine
Chief of Gastrointestinal Research Program
John Wayne Cancer Institute
Providence Saint John's Health Center
Santa Monica, California

**Leslie H. Blumgart, BDS, MD, DSc(Hon), FACS,
FRCS(Eng, Edin), FRCPS(Glas)**

Member
Professor of Surgery and Attending Surgeon
Memorial Sloan Kettering Cancer Center;
Professor of Surgery
Weill Medical College of Cornell University
New York, New York

Franz Edward Boas, MD, PhD

Assistant Attending Physician
Department of Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

Lynn A. Brody, MD

Attending Interventional Radiologist
Department of Diagnostic Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

Karen T. Brown, MD, FSIR

Attending Radiologist
Department of Radiology
Memorial Sloan Kettering Cancer Center;
Professor of Clinical Radiology
Department of Radiology
Weill Medical College of Cornell University
New York, New York

Jordi Bruix, MD, PhD

Senior Consultant
Liver Unit, BCLC Group
Hospital Clinic
University of Barcelona
Centro de Investigación Biomédica en Red de Enfermedades
Hepáticas y Digestivas (CIBERehd)
Barcelona, Spain

David A. Bruno, MD

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

Elizabeth M. Brunt, MD

Professor
Pathology and Immunology
Washington University School of Medicine
St. Louis, Missouri

Justin M. Burns, MD

Assistant Professor of Surgery
Department of Transplantation
Mayo Clinic
Jacksonville, Florida

Giovanni Butturini, MD, PhD

Department of Surgery
The Pancreas Institute
Verona University Hospital Trust
Verona, Italy

Juan Carlos Caicedo, MD

Adult and Pediatric Transplant Surgeon
Associate Professor of Surgery
Department of Surgery
Northwestern Memorial Hospital
Northwestern University;
Pediatric Transplant Surgeon
Department of Surgery
Lurie Children's Hospital
Chicago, Illinois

Mark P. Callery, MD

Professor of Surgery
Harvard Medical School;
Chief, Division of General Surgery
Beth Israel Deaconess Medical Center
Boston, Massachusetts

Abdul Saied Calvino, MD

Assistant Professor of Surgery
Boston University School of Medicine/Roger Williams
Medical Center
Providence, Rhode Island

Danielle H. Carpenter, MD

Assistant Professor
Pathology and Immunology
Washington University School of Medicine
St. Louis, Missouri

C. Ross Carter, MD, FRCS

Consultant Pancreatic Surgeon
Glasgow Royal Infirmary
Glasgow, Scotland

François Cauchy, MD

Physician
Hepatobiliary Surgery and Liver Transplantation Unit
Beaujon Hospital
Clichy, France

**Chung Yip Chan, MBBS, MMed(Surgery),
MD, FRCSEd**

Senior Consultant
Department of Hepatopancreatobiliary and Transplant
Surgery
Singapore General Hospital
Singapore

See Ching Chan, MD, PhD

Clinical Professor
Department of Surgery
The University of Hong Kong
Hong Kong, China

William C. Chapman, MD, FACS

Professor
Chief, Division of General Surgery
Chief, Abdominal Transplantation Section
Washington University School of Medicine
St. Louis, Missouri

Daniel Cherqui, MD

Professor
Hepatobiliary Surgery and Liver Transplantation
Paul Brousse Hospital
Villejuif, France

Clifford S. Cho, MD

Chief, Division of Surgical Oncology
University of Wisconsin School of Medicine and Public
Health
Madison, Wisconsin

Jin Wook Chung, MD, PhD

Professor
College of Medicine
Seoul National University
Seoul, Korea

Jesse Clanton, MD

Hepatopancreatobiliary Surgery Fellow
Section of General, Thoracic and Vascular Surgery
Virginia Mason Medical Center
Seattle, Washington

Bryan Marshall Clary, MD

Department of Surgery
University of California, San Diego
San Diego, California

Sean Patrick Cleary, MD, FRCS

Associate Professor
Department of Surgery
University of Toronto
Toronto, Ontario, Canada

Kelly M. Collins, MD

Senior Staff Surgeon, Transplant and Hepatobiliary Surgery
Henry Ford Hospital
Surgical Director, Liver Transplant
Children's Hospital of Michigan
Detroit, Michigan

John Barry Conneely, MCh, FRCSI

Consultant
Hepatopancreatobiliary Surgeon
Department of Surgery
Mater Misericordiae Hospital
Dublin, Ireland

Louise C. Connell, MD

Fellow
Memorial Sloan Kettering Cancer Center
New York, New York

Carlos U. Corvera, MD, FACS

Professor of Surgery
Chief, Liver, Biliary and Pancreatic Surgery
Department of Gastrointestinal Surgical Oncology
Maurice Galante Distinguished Professorship in
Hepatobiliary Surgery
UCSF Helen Diller Family Comprehensive Cancer Center
San Francisco, California

Guido Costa, MD

Resident
Division of Hepatobiliary and General Surgery
Humanitas Research Hospital
Rozzano-Milan, Italy

Anne M. Covey, MD

Attending Interventional Radiologist
Department of Diagnostic Radiology
Memorial Sloan Kettering Cancer Center;
Professor of Radiology
Department of Diagnostic Radiology
Weill Medical College of Cornell University
New York, New York

Jeffrey S. Crippin, MD

Marilyn Bornefeld Chair in Gastrointestinal Research and
Treatment
Department of Internal Medicine
Washington University School of Medicine
St. Louis, Missouri

Kristopher P. Croome, MD

Assistant Professor
Department of Transplant Surgery
Mayo Clinic
Jacksonville, Florida

Hany Dabbous, MD

Professor of Tropical Medicine and Liver Diseases
Ain Shams University
Cairo, Egypt

Michael I. D'Angelica, MD, FACS

Attending Surgeon
Hepatopancreatobiliary Surgery
Enid A. Haupt Chair in Surgery
Memorial Sloan Kettering Cancer Center;
Associate Professor
Department of Surgery
Weill Medical College of Cornell University
New York, New York

Michael D. Darcy, MD

Professor of Radiology and Surgery
Washington University in St Louis;
Chief of Interventional Radiology
Mallinckrodt Institute of Radiology
St. Louis, Missouri

Jeremy L. Davis, MD

Assistant Research Physician
Center for Cancer Research
National Cancer Institute, NIH
Bethesda, Maryland

Jeroen de Jonge, MD, PhD

Assistant Professor
Department of Hepatobiliary and Transplant Surgery
Erasmus MC Rotterdam
Rotterdam, The Netherlands

Ronald P. DeMatteo, MD, FACS

Vice Chair, Department of Surgery
Chief, Division of General Surgical Oncology
Leslie H. Blumgart Chair in Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Danielle K. DePeralta, MD

Surgical Resident
Department of General Surgery
Massachusetts General Hospital
Boston, Massachusetts

Niraj M. Desai, MD

Assistant Professor
Department of Surgery
Johns Hopkins University School of Medicine
Baltimore, Maryland

Eduardo de Santibañes, MD, PhD

Chairman
General Surgery and Liver Transplantation
Professor
Department of General Surgery
Hospital Italiano
Buenos Aires, Argentina

Martin de Santibañes, MD

Associate Professor of Surgery
Hepato-Biliary-Pancreatic Unit
Liver Transplantation Unit
Hospital Italiano
Buenos Aires, Argentina

Euan J. Dickson, MD, FRCS

Consultant Pancreatic Surgeon
University of Glasgow
Glasgow, Scotland

Christopher John DiMaio, MD
Director of Therapeutic Endoscopy
Division of Gastroenterology
Icahn School of Medicine at Mount Sinai
New York, New York

Richard Kinh Gian Do, MD, PhD
Associate Professor of Radiology
Weill Medical College of Cornell University;
Assistant Attending Physician
Department of Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

Safi Dokmak, MD
Physician
Hepatobiliary Surgery and Liver Transplantation Unit
Beaujon Hospital
Clichy, France

Marcello Donati, MD, PhD
Assistant Professor of Surgery
General and Oncologic Surgery Unit
Department of Surgery and Medical-Surgical Specialties
University of Catania
Catania, Italy

M. B. Majella Doyle, MD, FACS
Director, Liver Transplant
Director, Transplant HPB Fellowship Program
Section of Abdominal Transplantation
Washington University School of Medicine
St. Louis, Missouri

Vikas Dudeja, MBBS
Assistant Professor
Department of Surgical Oncology
Miller School of Medicine
University of Miami
Miami, Florida

Mark Dunphy, DO
Assistant Attending Physician
Department of Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

Truman M. Earl, MD
Associate Professor
Department of Surgery
Division of Transplant and Hepatobiliary Surgery
University of Mississippi Medical Center
Jackson, Mississippi

Tomoki Ebata, MD
Associate Professor
Division of Surgical Oncology
Department of Surgery
Nagoya University Graduate School of Medicine
Nagoya, Japan

Imane El Dika, MD
Fellow
Memorial Sloan Kettering Cancer Center
New York, New York

Yousef El-Gohary, MA, MD, MRCS (Glasg)
Physician
Department of Surgery
Stony Brook University Medical Center
Stony Brook, New York

Itaru Endo, MD, PhD
Professor and Chairman
Department of Gastroenterological Surgery
Yokohama City University Graduate School of Medicine
Yokohama, Japan

C. Kristian Enestvedt, MD, FACS
Assistant Professor of Surgery
Division of Abdominal Organ Transplantation/Hepatobiliary
Surgery
Oregon Health & Science University
Portland, Oregon

N. Joseph Espat, MD, FACS
Professor of Surgery
Department of Surgery
Roger Williams Medical Center
Boston University School of Medicine
Providence, Rhode Island

Cecilia G. Ethun, MD
Research Fellow
Division of Surgical Oncology
Department of Surgery
Winship Cancer Institute of Emory University
Atlanta, Georgia

Sheung Tat Fan, MD, PhD, DSc
Director
Liver Surgery Centre
Hong Kong Sanatorium and Hospital;
Honorary Clinical Professor of Surgery
Department of Surgery
The University of Hong Kong
Hong Kong, China

Paul T. Fanta, MD
Associate Clinical Professor
Division of Hematology and Oncology
Department of Medicine
University of California, San Diego
San Diego, California

Olivier Farges, MD, PhD
Department of Hepato-Pancreatic-Biliary Surgery and Liver
Transplantation
Beaujon Hospital
Clichy, France

Cristina R. Ferrone, MD

Associate Professor of Surgery
Massachusetts General Hospital
Boston, Massachusetts

Ryan C. Fields, MD

Assistant Professor of Surgery
Section of Hepatopancreatobiliary, Gastrointestinal, and
Oncologic Surgery
Department of Surgery;
Associate Program Director
General Surgery Residency Program;
Director
Resident Research;
Barnes-Jewish Hospital
Washington University School of Medicine
St. Louis, Missouri

Mary Fischer, MD

Anesthesiologist
Department of Anesthesiology and Critical Care
Memorial Sloan Kettering Cancer Center;
Associate Professor
Department of Anesthesiology
Weill Medical College of Cornell University
New York, New York

Sarah B. Fisher, MD

Department of Surgery
Division of Surgical Oncology
Emory University
Atlanta, Georgia

Devin C. Flaherty, DO, PhD

Fellow
Department of Surgical Oncology
John Wayne Cancer Institute
Providence Saint John's Health Center
Santa Monica, California

Yuman Fong, MD

Chairman
Department of Surgery
City of Hope National Medical Center
Duarte, California

Scott L. Friedman, MD

Fishberg Professor of Medicine
Division of Liver Diseases
Icahn School of Medicine at Mount Sinai
New York, New York

Ahmed Gabr, MD

Clinical Research Fellow
Department of Radiology
Northwestern University Feinberg School of Medicine
Chicago, Illinois

John R. Galloway, MD

Professor of Surgery
Emory University School of Medicine
Atlanta, Georgia

David A. Geller, MD

Richard L. Simmons Professor of Surgery
Chief, Division of Hepatobiliary and Pancreatic Surgery
Department of Surgery
University of Pittsburgh
Pittsburgh, Pennsylvania

Hans Gerdes, MD

Attending Physician
Department of Medicine
Memorial Hospital for Cancer and Allied Diseases;
Professor of Clinical Medicine
Weill Medical College of Cornell University
New York, New York

Scott R. Gerst, MD

Associate Attending Radiologist
Department of Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

George K. Gittes, MD

Professor of Surgery and Surgeon-in-Chief
Department of Surgery
Children's Hospital of Pittsburgh
University of Pittsburgh School of Medicine
Pittsburgh, Pennsylvania

Jaime Glorioso, MD

Resident
Department of General Surgery
Mayo Clinic
Rochester, Minnesota

Jill S. Gluskin, MD

Assistant Attending Radiologist
Department of Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

**Brian K. P. Goh, MBBS, MMed(Surgery), MSc,
FRCSEd**

Senior Consultant
Department of Hepatopancreatobiliary and Transplant
Surgery
Singapore General Hospital
Singapore

Stevan A. Gonzalez, MD

Medical Director of Liver Transplantation
Department of Hepatology
Baylor All Saints Medical Center
Fort Worth, Texas

Karyn A. Goodman, MD

Professor
Department of Radiation Oncology
University of Colorado
Denver, Colorado

Gregory J. Gores, MD

Professor of Medicine
Transplant Center
Mayo Clinic
Rochester, Minnesota

Eduardo H. Gotuzzo, MD, FACP, FIDSA

Director
Instituto de Medicina Tropical Alexander von Humboldt
Universidad Peruana Cayetano Heredia;
Head, Enfermedades Ifeccionas y Tropicales
Hospital Nacional Cayetano Heredia
Lima, Peru

Dirk J. Gouma, MD

Professor
Department of Surgery
Academic Medical Center
Amsterdam, The Netherlands

Paul D. Greig, MD, FRCSC

Professor
Department of Surgery
University of Toronto;
Staff Surgeon
Department of Surgery
Toronto General Hospital
Toronto, Ontario, Canada

James F. Griffin, MD

Assistant Resident
Department of Surgery
Johns Hopkins Hospital
Baltimore, Maryland

Christopher M. Halloran, MD, FRCS, FAcadTM

Clinical Senior Lecturer/Consultant
Pancreato-Biliary Surgeon
Department of Molecular and Clinical Cancer Medicine
University of Liverpool
Liverpool, England

Neil A. Halpern, MD

Chief, Critical Care Medicine
Department of Anesthesiology and Critical Care Medicine
Memorial Sloan Kettering Cancer Center;
Professor of Clinical Anesthesiology and Medicine
Department of Anesthesiology
Weill Medical College of Cornell University
New York, New York

Chet W. Hammill, MD, MCR, FACS

Department of Liver and Pancreas Surgery
The Oregon Clinic
Portland, Oregon

Paul D. Hansen, MD, FACS

Medical Director
Department of Surgical Oncology
Providence Portland Cancer Center;
Department of Liver and Pancreas Surgery
The Oregon Clinic
Portland, Oregon

James J. Harding, MD

Assistant Attending Physician
Memorial Sloan Kettering Cancer Center;
Instructor
Weill Medical College at Cornell University
New York, New York

Ewen M. Harrison, MB ChB, PhD, FRCS

Senior Lecturer
Department of Clinical Surgery
University of Edinburgh;
Consultant
Hepatopancreatobiliary Surgeon
Department of Clinical Surgery
Royal Infirmary of Edinburgh
Edinburgh, Scotland

Werner Hartwig, MD

Associate Professor
Deputy Medical Director
Head, Division of Pancreatic Surgery and LMU Munich
Pancreatic Center;
Department of General, Visceral, and Transplantation Surgery
LMU University Hospital
Munich, Germany

Kiyoshi Hasegawa, MD, PhD

Associate Professor
Division of Hepato-Biliary-Pancreatic Surgery
Graduate School of Medicine
University of Tokyo
Tokyo, Japan

Jaclyn F. Hechtman, MD

Assistant Member
Department of Pathology
Memorial Sloan Kettering Cancer Center
New York, New York

Julie K. Heimbach, MD

Professor of Surgery
Division of Transplantation Surgery
Mayo Clinic
Rochester, Minnesota

William S. Helton, MD

Director, Liver, Biliary and Pancreas Surgery Center
Department of General, Vascular and Thoracic Surgery
Virginia Mason Medical Center
Seattle, Washington

Alan W. Hemming, MD

Professor and Chief
Division of Transplantation and Hepatobiliary Surgery
University of California, San Diego
San Diego, California

J. Michael Henderson, MB, ChB, FRCE(Ed), FACS

Chief Medical Officer
University of Mississippi Medical Center
Jackson, Mississippi

Asher Hirshberg, MD, FACS

Director of Emergency Vascular Surgery
Kings County Hospital Center
Brooklyn, New York

James R. Howe V, MD

Director
Division of Surgical Oncology and Endocrine Surgery
Department of Surgery
Carver College of Medicine
University of Iowa
Iowa City, Iowa

Christopher B. Hughes, MD

Associate Professor of Surgery
Surgical Director
Department of Liver Transplantation
Starzl Transplantation Institute
University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania

Christine Iacobuzio-Donahue, MD, PhD

Attending Pathologist
Department of Pathology
Affiliate Member
Human Oncology and Pathogenesis Program
Associate Director for Translational Research
David M. Rubenstein Center for Pancreatic Cancer Research
Memorial Sloan Kettering Cancer Center
New York, New York

William R. Jarnagin, MD, FACS

Chief, Hepatopancreatobiliary Surgery
Benno C. Schmidt Professor of Surgical Oncology
Memorial Sloan Kettering Cancer Center;
Professor of Surgery
Weill Medical College of Cornell University;
New York, New York

Roger L. Jenkins, MD

Professor of Surgery
Tufts Medical School
Boston, Massachusetts;
Chief of Surgery
Division of Hepatobiliary Surgery
Department of Transplantation
Lahey Hospital and Medical Center
Burlington, Massachusetts

Zeljka Jutric, MD

Fellow, Liver and Pancreas Surgery
Providence Portland Cancer Center
Portland, Oregon

Christoph Kahlert, MD

Universitätsklinikum Carl Gustav Carus Dresden
Klinik und Poliklinik für Viszeral-, Thorax- und
Gefäßchirurgie
Dresden, Germany

Joseph Ralph Kallini, MD

Clinical Research Fellow
Department of Radiology
Northwestern University Feinberg School of Medicine
Chicago, Illinois

Ivan Kangrga, MD, PhD

Professor and Chief of Clinical Anesthesiology
Department of Anesthesiology
Washington University School of Medicine
St. Louis, Missouri

Paul J. Karanicolas, MD, PhD

Assistant Professor
Department of Surgery
University of Toronto
Toronto, Ontario, Canada

Seth S. Katz, MD, PhD

Assistant Clinical Member
Department of Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

Steven C. Katz, MD, FACS

Associate Professor of Surgery
Boston University School of Medicine
Director, Complex Surgical Oncology
Fellowship Director, Surgical Immunotherapy
Roger Williams Medical Center
Providence, Rhode Island

Kaitlyn J. Kelly, MD

Assistant Professor of Surgery
Division of Surgical Oncology
University of California, San Diego
San Diego, California

Nancy E. Kemeny, MD

Professor of Medicine
Weill Medical College of Cornell University;
Attending Physician
Solid Tumor–GI Division
Memorial Sloan Kettering Cancer Center
New York, New York

Eugene P. Kennedy, MD

Associate Professor
Department of Surgery
Sidney Kimmel Medical College
Thomas Jefferson University
Philadelphia, Pennsylvania

Korosh Khalili, MD, FRCPC

Associate Professor
Department of Medical Imaging
University of Toronto
Toronto, Ontario, Canada

Adeel S. Khan, MD, FACS

Instructor of Transplant Surgery
Department of Surgery
Washington University School of Medicine
St. Louis, Missouri

Saboor Khan, PhD, FRCS, FACS

Consultant Hepatobiliary Pancreatic and General Surgeon
University Hospitals Coventry and Warwickshire NHS Trust;
Associate Professor of Surgery (Hon.)
Department of Surgery
Warwick Medical School
Coventry, England

Heung Bae Kim, MD

Weitzman Family Chair in Surgical Innovation
Department of Surgery
Director
Pediatric Transplant Center
Boston Children's Hospital;
Associate Professor of Surgery
Harvard Medical School
Boston, Massachusetts

T. Peter Kingham, MD

Assistant Professor
Department of Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Allan D. Kirk, MD, PhD, FACS

David C. Sabiston, Jr. Professor and Chairman
Department of Surgery
Duke University
Durham, North Carolina

David S. Klimstra, MD

Chairman and James Ewing Alumni Chair in Pathology
Department of Pathology
Memorial Sloan Kettering Cancer Center;
Professor
Department of Pathology and Laboratory Medicine
Weill Medical College of Cornell University
New York, New York

Michael Kluger, MD

Assistant Professor of Surgery
Division of GI and Endocrine Surgery
Columbia University College of Physicians and Surgeons
New York-Presbyterian Hospital
New York, New York

Stuart J. Knechtle, MD

Professor of Surgery
Department of Surgery
Duke University School of Medicine
Durham, North Carolina

Jonathan B. Koea, MD, FACS, FRACS

Hepatobiliary Surgeon
Upper Gastrointestinal Unit
Department of Surgery
North Shore Hospital
Auckland, New Zealand

Norihiro Kokudo, MD, PhD

Professor
Division of Hepato-Biliary-Pancreatic Surgery
Graduate School of Medicine
University of Tokyo
Tokyo, Japan

Dionysios Koliogiannis, MD

Resident Surgeon
Department of General, Visceral, and Transplantation Surgery
LMU University Hospital
Munich, Germany

David A. Kooby, MD

Professor of Surgery
Directory of Surgical Oncology
Emory St. Joseph's Hospital;
Associate Professor of Surgery
Director of Minimally Invasive Gastrointestinal Oncologic
Surgery
Emory University School of Medicine
Atlanta, Georgia

Kevin Korenblat, MD

Professor of Medicine
Department of Medicine
Washington University School of Medicine
St. Louis, Missouri

Simone Krebs, MD

Department of Radiology
Molecular Imaging and Therapy Service
Memorial Sloan Kettering Cancer Center
New York, New York

Michael J. LaQuaglia, MD

General Surgery Resident
Department of Surgery
Albert Einstein College of Medicine and Montefiore Medical
Center
Bronx, New York

Michael P. LaQuaglia, MD

Chief, Pediatric Service
Department of Surgery
Memorial Sloan Kettering Cancer Center;
Professor of Surgery
Department of Surgery
Weill Medical College of Cornell University
New York, New York

Nicholas F. LaRusso, MD

Medical Director
Center for Connected Care
Mayo Clinic;
Charles H. Weinman Professor of Medicine
Biochemistry and Molecular Biology
Mayo Clinic College of Medicine;
Distinguished Investigator
Mayo Foundation
Rochester, Minnesota

Alexis Laurent, MD, PhD

Professor of Surgery
 Department of Digestive, HPB and Liver Transplant Surgery
 Hôpital Henri Mondor
 Assistance Publique-Hôpitaux de Paris Faculté de Médecine
 Université Paris-Est-Créteil
 Créteil, France

Konstantinos N. Lazaridis, MD

Professor of Medicine
 Division of Gastroenterology & Hepatology
 Center for Basic Research in Digestive Diseases
 Mayo Clinic College of Medicine
 Rochester, Minnesota

Julie N. Leal, MD, FRCSC

Fellow
 Division of Hepatopancreatobiliary Surgery
 Memorial Sloan Kettering Cancer Center
 New York, New York

Eliza J. Lee, MD

Resident
 Department of Surgery
 Beth Israel Deaconess Medical Center
 Boston, Massachusetts

Major Kenneth Lee IV, MD, PhD

Assistant Professor of Surgery
 Department of Surgery
 University of Pennsylvania Perelman School of Medicine
 Philadelphia, Pennsylvania

**Ser Yee Lee, MBBS, MMed(Surgery), MSc,
FAMS, FRCSEd**

Consultant
 Department of Hepatopancreatobiliary and Transplant
 Surgery
 Singapore General Hospital
 Singapore

Riccardo Lencioni, MD

Professor of Radiology
 Vice-Chair for Clinical and Translational Research
 Department of Interventional Radiology
 University of Miami Miller School of Medicine
 Sylvester Comprehensive Cancer Center
 Miami, Florida

Alexandre Liccioni, MD, PhD

Gastroenterologist
 Barcelona Clinic Liver Cancer (BCLC) Group, Liver Unit
 Hospital Clinic Barcelona, IDIBAPS
 University of Barcelona
 Barcelona, Spain

Michael E. Lidsky, MD

Resident
 Department of Surgery
 Duke University School of Medicine
 Durham, North Carolina

Chung-Wei Lin, MD

Attending Physician
 Department of Surgery
 Koo Foundation Sun Yat-Sen Cancer Center
 Taipei, Taiwan

David C. Linehan, MD

Seymour I. Schwartz Professor and Chairman
 Department of Surgery
 University of Rochester
 Rochester, New York

Roberto Carlos Lopez-Solis, MD, FACS

Assistant Professor of Surgery
 Director of Organ Procurement
 Department of Transplant Surgery
 University of Pittsburgh Medical Center;
 Department of General Surgery
 McGowan Center of Regenerative Medicine
 University of Pittsburgh
 Pittsburgh, Pennsylvania

Jeffrey A. Lowell, MD, FACS

Professor of Surgery and Pediatrics
 Department of Surgery
 Washington University School of Medicine
 St. Louis, Missouri

David C. Madoff, MD

Professor of Radiology
 Chief
 Division of Interventional Radiology
 Department of Radiology
 Weill Medical College of Cornell University
 New York, New York

Jason Maggi, MD

General Surgeon
 Department of General Surgery
 Naval Hospital Camp Pendleton
 United States Navy
 Oceanside, California

Shishir K. Maithel, MD, FACS

Associate Professor of Surgery
 Division of Surgical Oncology
 Department of Surgery
 Winship Cancer Institute of Emory University
 Atlanta, Georgia

Ali W. Majeed, MD, FRCS(Edin), FRCS(Gen)

Consultant
 Hepatobiliary Surgeon
 Department of Hepatobiliary Surgery
 Northern General Hospital
 Sheffield, England

Peter Malfertheiner, MD

Department of Gastroenterology
 University of Magdeburg
 Magdeburg, Germany

Giuseppe Malleo, MD, PhD

Department of Surgery
The Pancreas Institute
Verona University Hospital Trust
Verona, Italy

Shennen A. Mao, MD

Resident
Department of General Surgery
Mayo Clinic
Rochester, Minnesota

Giovanni Marchegiani, MD

Pancreas Institute
University of Verona
Verona, Italy

Luis A. Marcos, MD

Associate Professor of Clinical Medicine, Molecular Genetics
and Microbiology
Division of Infectious Diseases
Stony Brook University (State University of New York)
Stony Brook, New York

James F. Markmann, MD, PhD

Chief
Division of Transplant Surgery
Claude E. Welch Professor of Surgery
Department of Surgery
Harvard Medical School
Massachusetts General Hospital
Boston, Massachusetts

J. Wallis Marsh, MD, MBA

Raizman-Haney Professor of Surgery
Starzl Transplantation Institute
University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania

Robert C. G. Martin II, MD, PhD, FACS

Professor of Surgery
Sam and Loita Weakley Endowed Chair of Surgical Oncology
Director, Division of Surgical Oncology
University of Louisville
Louisville, Kentucky

Ryusei Matsuyama, MD, PhD

Assistant Professor
Department of Gastroenterological Surgery
Yokohama City University Graduate School of Medicine
Yokohama, Japan

Matthias S. Matter, MD

Institute of Pathology
Molecular Pathology Division
University Hospital of Basel
Basel, Switzerland

Francisco Juan Mattera, MD

Surgeon
Liver Transplantation Unit
Hospital Italiano
Buenos Aires, Argentina

Jessica E. Maxwell, MD, MBA

Surgery Resident
Department of General Surgery
Carver College of Medicine
University of Iowa
Iowa City, Iowa

Oscar M. Mazza, MD

Professor of Surgery
Staff Surgeon
Hepato-Biliary-Pancreatic Unit
Hospital Italiano
Buenos Aires, Argentina

Ian D. McGilvray, MDCM, PhD

Associate Professor
Department of Surgery
Staff Surgeon
University Health Network
University of Toronto
Toronto, Ontario, Canada

Colin J. McKay, MD, FRCS

Consultant Pancreatic Surgeon
Glasgow Royal Infirmary;
Hon. Clinical Associate Professor
University of Glasgow
Glasgow, Scotland

Doireann M. McWeeney, MB, FFRRCSI

Joint Department of Medical Imaging
University Health Network
Toronto, Ontario, Canada

Jose Melendez, MD

Associate Chair of Anesthesiology
Associate Professor of Anesthesiology
University of Colorado School of Medicine
Denver, Colorado

Robin B. Mendelsohn, MD

Assistant Attending Physician
Department of Medicine
Gastroenterology and Nutrition Service
Memorial Sloan Kettering Cancer Center
New York, New York

George Miller, MD

Assistant Professor
Department of Surgery and Cell Biology
New York University School of Medicine
New York, New York

Klaus E. Mönkemüller, MD, PhD, FASGE

Professor
Director, Division of Gastroenterology and Hepatology
Hirschowitz I. Endoscopy Center of Excellence
University of Alabama
Birmingham, Alabama

Ryutaro Mori, MD, PhD

Assistant Professor
Department of Gastroenterological Surgery
Yokohama City University Graduate School of Medicine
Yokohama, Japan

Vitor Moutinho, MD

Surgical Oncology Fellow
Department of Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Masato Nagino, MD, PhD

Professor and Chairman
Division of Surgical Oncology
Department of Surgery
Nagoya University Graduate School of Medicine
Nagoya, Japan

David M. Nagorney, MD

Professor of Surgery
Department of Surgery
Mayo Clinic
Rochester, Minnesota

Satish Nagula, MD

Associate Professor of Medicine
Division of Gastroenterology
Department of Medicine
Icahn School of Medicine at Mount Sinai
New York, New York

Attila Nakeeb, MD

Professor
Department of Surgery
Indiana University of School of Medicine
Indianapolis, Indiana

Geir I. Nedredal, MD, PhD

Assistant Adjunct Professor
Department of Surgery
University of California, San Francisco
San Francisco, California

John P. Neoptolemos, MD, FRCS, FMedSci

Chair of Surgery
Department of Molecular and Clinical Cancer Medicine
University of Liverpool
Liverpool, England

James Neuberger, DM, FRCP

The Liver Unit
Queen Elizabeth Hospital
Birmingham, England

Scott L. Nyberg, MD, PhD

Professor
Department of Surgery
Mayo Clinic
Rochester, Minnesota

Rachel O'Connor

Division of Surgical Oncology
University of Louisville School of Medicine
Louisville, Kentucky

John G. O'Grady, MD, FRCPI

Professor
Institute of Liver Studies
King's College Hospital
London, England

Frances E. Oldfield, MBChB (Hons), MRCS

Clinical Research Fellow
University of Liverpool
Liverpool, England

Karl J. Oldhafer, MD, PhD

Professor
Department of Surgery
Asklepios Hospital Barmbek
Simmelweis University Budapest
Asklepios Campus Hamburg
Hamburg, Germany

Kim M. Olthoff, MD

Donald Guthrie Professor of Surgery
Division of Transplantation
Department of Surgery
University of Pennsylvania
Philadelphia, Pennsylvania

Susan L. Orloff, MD, FACS, FAASLD

Professor of Surgery
Chief
Division of Abdominal Organ Transplantation/Hepatobiliary
Surgery
Department of Surgery;
Adjunct Professor
Department of Microbiology and Immunology
Oregon Health & Science University;
Chief
Transplant Program
Portland VA Medical Center
Portland, Oregon

Alessandro Paniccia, MD

General Surgery Resident
Department of Surgery
University of Colorado Anschutz Medical Campus
Aurora, Colorado

Valérie Paradis, MD, PhD

Professor
Department of Pathology
Beaujon Hospital
Paris, France

Rowan W. Parks, MD, FRCSI, FRCSEd

Professor of Surgical Sciences
Department of Clinical Surgery
University of Edinburgh
Edinburgh, Scotland

Gérard Pascal, MD

Department of Digestive, HPB and Liver Transplant Surgery
Hôpital Henri Mondro
Assistance Publique-Hôpitaux de Paris Faculté de Médecine
Université Paris-Est-Créteil
Créteil, France

Stephen M. Pastores, MD

Program Director, Critical Care Medicine
Department of Anesthesiology and Critical Care Medicine
Memorial Sloan Kettering Cancer Center
New York, New York;
Professor of Clinical Anesthesiology and Medicine
Department of Anesthesiology
Weill Medical College of Cornell University
New York, New York

Timothy M. Pawlik, MD, PhD

Professor of Surgery and Oncology
Chair, Department of Surgery
The Urban Meyer III and Shelley Meyer Cancer Research
Chair
The Ohio State Wexner Medical Center
Columbus, Ohio

Venu G. Pillarisetty, MD

Assistant Professor
Department of Surgery
University of Washington;
Attending Surgeon
University of Washington Medical Center
Seattle, Washington

James Francis Pingpank Jr., MD

Associate Professor of Surgery
Department of Surgery
University of Pittsburgh
Pittsburgh, Pennsylvania

C. Wright Pinson, MD, MBA

Deputy Vice Chancellor for Health Affairs
Vanderbilt University Medical Center;
Chief Executive Officer
Vanderbilt Health System
Nashville, Tennessee

Henry Anthony Pitt, MD

Chief Quality Officer
Temple University Health System;
Associate Vice Dean for Clinical Affairs
Department of Surgery
Lewis Katz School of Medicine at Temple University
Philadelphia, Pennsylvania

James J. Pomposelli, MD

Professor of Surgery
University of Colorado
Denver, Colorado

Fabio Procopio, MD

Staff Surgeon
Division of Hepatobiliary and General Surgery
Humanitas Research Hospital
Rozzano-Milan, Italy

Michael J. Pucci, MD

Assistant Professor of Surgery
Department of Surgery
Sidney Kimmel Medical College
Thomas Jefferson University
Philadelphia, Pennsylvania

Motaz Qadan, MD, PhD

Surgical Oncology Fellow
Department of Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Khemar Rajkomar, FRACS

Hepatopancreatobiliary Fellow
Upper Gastrointestinal Unit
Department of Surgery
North Shore Hospital
Auckland, New Zealand

Srinevas K. Reddy, MD

Associate Professor of Oncology
Department of Surgical Oncology
Roswell Park Cancer Institute
Buffalo, New York

Maria E. Reig, MD, PhD

Hepatologist
Barcelona Clinic Liver Cancer (BCLC) Group, Liver Unit
Hospital Clinic Barcelona, IDIBAPS
University of Barcelona
Centro de Investigación Biomédica en Red de Enfermedades
Hepáticas y Digestivas (CIBERehd)
Barcelona, Spain

Joseph Arturo Reza, MD

Resident in General Surgery
Department of Surgery
University of California San Francisco
San Francisco, California

John Paul Roberts, MD

Chief
Division of Transplantation
Department of Surgery
University of California San Francisco
San Francisco, California

Piera Marie Cote Robson, MSN

Clinical Nurse Specialist
Departments of Nursing and Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

Flavio G. Rocha, MD

Staff Surgeon, Hepatopancreatobiliary Service
Section of General, Thoracic and Vascular Surgery
Virginia Mason Medical Center;
Clinical Assistant Professor of Surgery
University of Washington
Seattle, Washington

Garrett Richard Roll, MD

Liver Transplant and Multiorgan Retrieval Surgeon
Liver Unit
Queen Elizabeth Hospital
Birmingham, England

Sean M. Ronnekleiv-Kelly, MD

Surgical Oncology Fellow
Department of Surgical Oncology
Johns Hopkins Hospital
Baltimore, Maryland

Alexander S. Rosemurgy II, MD

Director of Hepatopancreatobiliary Surgery
Florida Hospital Tampa
Tampa, Florida

Charles B. Rosen, MD

Professor of Surgery
Chair, Division of Transplantation Surgery
Mayo Clinic
Rochester, Minnesota

Pierre F. Saldinger, MD

Chairman and Surgeon-in-Chief
Department of Surgery
New York Hospital Queens
Flushing, New York
Professor of Clinical Surgery
Weill Medical College of Cornell University
New York, New York

Riad Salem, MD, MBA

Professor
Departments of Radiology, Medicine (Hematology-
Oncology), and Surgery
Northwestern University Feinberg School of Medicine;
Director, Interventional Oncology
Robert H. Lurie Comprehensive Cancer Center
Northwestern Memorial Hospital
Chicago, Illinois

Suhail Bakr Salem, MD

Advanced Endoscopy Fellow
Department of Gastroenterology
Memorial Sloan Kettering Cancer Center
New York, New York

Roberto Salvia, MD

Professor of Surgery
Pancreas Institute
University of Verona
Verona, Italy

Charbel Sandroussi, MMSc, FRACS

Clinical Associate Professor
Department of Hepatobiliary and Upper Gastrointestinal
Surgery
Royal Prince Alfred Hospital
Sydney, Australia

Dominic E. Sanford, MD

Department of Surgery
Washington University School of Medicine
St. Louis, Missouri

Olivier Scatton, MD, PhD

Professor
Physician
Hepatobiliary Surgery and Liver Transplantation Unit
Pitié-Salpêtrière Hospital
Paris, France

Mark Andrew Schattner, MD

Associate Clinical Member
Department of Medicine
Memorial Sloan Kettering Cancer Center;
Associate Professor of Clinical Medicine
Department of Medicine
Weill Medical College of Cornell University
New York, New York

William Palmer Schecter, MD

Professor of Clinical Surgery Emeritus
Department of Surgery
University of California, San Francisco
San Francisco, California

Hans Francis Schoellhammer, MD

Assistant Clinical Professor
Department of Surgery
City of Hope National Medical Center
Duarte, California

Richard D. Schulick, MD, PhD

Professor and Chair
Department of Surgery
University of Colorado School of Medicine
Aurora, Colorado

Lawrence H. Schwartz, MD

Professor of Radiology
Columbia University College of Physicians and Surgeons
New York Presbyterian Hospital
New York, New York

Kevin N. Shah, MD

Department of Surgery
Duke University Medical Center
Durham, North Carolina

Ross W. Shepherd, MD, FRACP, FRCP

Adjunct Professor
Pediatric Gastroenterology and Hepatology
Baylor College of Medicine
Houston, Texas;
Honorary Professor
Queensland Institute for Medical Research
University of Queensland School of Medicine
Brisbane, Australia

Hiroshi Shimada, MD, PhD

Professor
Department of Gastroenterological Surgery
Yokohama City University Graduate School of Medicine
Yokohama, Japan

Masafumi Shimoda, MD, PhD

Assistant Professor
Department of Surgery
Osaka University Graduate School of Medicine
Osaka, Japan

Junichi Shindoh, MD, PhD

Attending Surgeon
Division of Hepatobiliary-Pancreatic Surgery
Toranomon Hospital
Tokyo, Japan

Hosein Shokouh-Amiri, MD, FACS

Clinical Professor of Surgery
Louisiana State University Health Sciences Center;
Surgical Director, Liver Transplantation
John C. McDonald Regional Transplant Center
Willis-Knighton Health System
Shreveport, Louisiana

Jason K. Sicklick, MD, FACS

Assistant Professor of Surgery
Division of Surgical Oncology
Moores UCSD Cancer Center
University of California, San Diego
UC San Diego Health System
San Diego, California

Robert H. Siegelbaum, MD

Assistant Attending Radiologist
Department of Radiology, Interventional Radiology Service
Memorial Sloan Kettering Cancer Center
New York, New York

Gagandeep Singh, MD, FACS

Chief, Division of Surgical Oncology
Head, Hepatobiliary and Pancreatic Surgery
Department of Surgery
City of Hope National Medical Center
Duarte, California

Rory L. Smoot, MD

Assistant Professor of Surgery
Department of Surgery
Mayo Clinic
Rochester, Minnesota

Stephen B. Solomon, MD

Chief, Interventional Radiology Service
Director, Center for Image-Guided Intervention
Memorial Sloan Kettering Cancer Center
New York, New York

Olivier Soubrane, MD

Professor
Physician
Hepatobiliary Surgery and Liver Transplantation Unit
Beaujon Hospital
Clichy, France

Nicholas Spinelli, MD

General Surgery
Hepatobiliary and Pancreatic Surgery
Sentara Martha Jefferson Hospital
Charlottesville, Virginia

John A. Stauffer, MD, FACS

Associate Professor of Surgery
Department of Surgery
Mayo Clinic
Jacksonville, Florida

Lygia Stewart, MD

Professor of Clinical Surgery
Department of Surgery
University of California, San Francisco;
Chief, General Surgery
San Francisco VA Medical Center
San Francisco, California

Matthew S. Strand, MD

Resident Physician in General Surgery
Surgical Oncology Research Fellow
Department of Surgery
Washington University School of Medicine
St. Louis, Missouri

James H. Tabibian, MD, PhD

Instructor of Medicine
Division of Gastroenterology and Hepatology
Mayo Clinic
Rochester, Minnesota;
Instructor of Medicine
Division of Gastroenterology
University of Pennsylvania
Philadelphia, Pennsylvania;
Assistant Professor of Medicine
Division of Gastroenterology and Hepatology
UC Davis Medical Center
Sacramento, California

Guido Torzilli, MD, PhD, FACS

Professor of Surgery
School of Medicine
Humanitas University;
Chairman of the Department of Surgery
Director of the Division of Hepatobiliary and General
Surgery
Humanitas Research Hospital, IRCCS
Rozzano-Milan, Italy

James F. Trotter, MD

Medical Director of Liver Transplantation
Department of Hepatology
Baylor University Medical Center
Dallas, Texas

Simon Turcotte, MD, FRCSC

Assistant Professor of Surgery
Université de Montréal;
Hepatopancreatobiliary and Liver Transplantation Service
Centre Hospitalier de l'Université de Montréal;
Scientist
Centre de Recherche du Centre Hospitalier de l'Université
de Montréal
Montreal, Quebec, Canada

Yumirle P. Turmelle, MD

Associate Professor
Department of Pediatrics
Washington University School of Medicine
St. Louis, Missouri

Demetrios J. Tzimas, MD

Assistant Professor of Medicine
Division of Gastroenterology and Hepatology
Department of Medicine
Stony Brook University Hospital
Stony Brook, New York

Thomas Van Gulik, MD, PhD

Professor
Department of Surgery
Academic Medical Center
Amsterdam, The Netherlands

Andrea Vannucci, MD

Associate Professor of Anesthesiology
Department of Anesthesiology
Washington University School of Medicine
St. Louis, Missouri

Jean-Nicolas Vauthey, MD, FACS

Professor of Surgical Oncology
Chief, Hepato-Pancreato-Biliary Section
Bessie McGoldrick Professor in Clinical Cancer Research
Department of Surgical Oncology
University of Texas MD Anderson Cancer Center
Houston, Texas

Diana Vetter, MD

Physician
Department of Abdominal Surgery
University Hospital Zurich
Zurich, Switzerland

Valérie Vilgrain, MD

Professor of Radiology
Beaujon Hospital
Paris Diderot University
Paris, France

Alejandra Maria Villamil, MD

Universidad de Buenos Aires;
Liver Transplantation Unit
Hospital Italiano de Buenos Aires;
Director,
Argentine School of Hepatology
Argentine Association for the Study of Liver Disease
Buenos Aires, Argentina

Louis P. Voigt, MD

Associate Attending Physician
Department of Anesthesiology and Critical Care Medicine
Memorial Sloan Kettering Cancer Center;
Assistant Professor of Clinical Anesthesiology and Medicine
Department of Anesthesiology
Weill Medical College of Cornell University
New York, New York

Charles M. Vollmer Jr., MD

Professor of Surgery
Department of Surgery
University of Pennsylvania Perelman School of Medicine
Philadelphia, Pennsylvania

Jack R. Wands, MD

Jeffrey and Kimberly Greenberg-Artemis and Martha
Joukowsky Professor in Gastroenterology
Professor of Medical Science
Director, Division of Gastroenterology and Liver Research
Center
Rhode Island Hospital
Warren Alpert Medical School of Brown University
Providence, Rhode Island

Julia Wattacheril, MD

Assistant Professor of Medicine
Division of Digestive and Liver Diseases
Center for Liver Disease and Transplantation
Columbia University College of Physicians and Surgeons
New York, New York

Sharon Marie Weber, MD

Tim and MaryAnn McKenzie Chair of Surgical Oncology
Department of General Surgery
Vice Chair, General Surgery
University of Wisconsin;
Director for Surgical Oncology
University of Wisconsin Carbone Cancer Center
Madison, Wisconsin

Matthew J. Weiss, MD

Assistant Professor of Surgery and Oncology
Department of Surgery
Johns Hopkins Hospital
Baltimore, Maryland

Jürgen Weitz, MD

Chair, Department of Gastrointestinal, Thoracic and Vascular
Surgery
Medizinische Fakultät Carl Gustav Carus
Technische Universität Dresden
Dresden, Germany

Jens Werner, MD

Director and Chairman
Professor of Surgery
Department of General, Visceral, and Transplantation Surgery
LMU University Hospital
Munich, Germany

Megan Winner, MD

Attending Surgeon
Winthrop University Hospital
Mineola, New York

John Wong, MD, PhD

Honorary Clinical Professor
Department of Surgery
The University of Hong Kong
Hong Kong, China

Dennis Yang, MD

Assistant Professor of Medicine
Division of Gastroenterology
University of Florida College of Medicine
Gainesville, Florida

Hooman Yarmohammadi, MD

Assistant Professor of Radiology
Department of Radiology
Memorial Sloan Kettering Cancer Center
New York, New York

Charles J. Yeo, MD

Samuel D. Gross Professor and Chair
Department of Surgery
Sidney Kimmel Medical College
Thomas Jefferson University
Philadelphia, Pennsylvania

Theresa Pluth Yeo, PhD, MPH, ACNP-BC

Co-Director, Jefferson Pancreas Tumor Registry
Department of Surgery
Thomas Jefferson University Hospital;
Adjunct Associate Professor
Jefferson College of Nursing
Philadelphia, Pennsylvania

Chang Jin Yoon, MD, PhD

Professor
College of Medicine
Seoul National University
Seoul, Korea;
Professor
Department of Radiology
Seoul National University Bundang Hospital
Gyeonggi, Korea

Adam Yopp, MD

Assistant Professor of Surgery
Department of Surgery
University of Texas Southwestern Medical Center
Dallas, Texas

D. Owen Young, MD

General Surgery Resident
Department of Graduate Medical Education
Virginia Mason Medical Center
Seattle, Washington

Kai Zhao, MD

Department of Surgery
Stony Brook University
Stony Brook, New York

Gazi B. Zibari, MD, FACS

Director of Transplantation Services
Director of Advanced Surgery Center
John C. McDonald Regional Transplant Center
Willis-Knighton Health System;
Clinical Professor of Surgery
Malcolm Feist Chair in Transplant Surgery
Louisiana State University Health Sciences Center
Shreveport, Louisiana

George Zogopoulos, MD, PhD, FRCS(C), FACS

Assistant Professor of Surgery, McGill University
Hepato-Pancreato-Biliary and Abdominal Organ Transplant
Surgery
McGill University Health Centre
Montreal, Quebec, Canada

The sixth edition of *Blumgart's Surgery of the Liver, Biliary Tract, and Pancreas* is the largest and most ambitious effort in the long history of this textbook and maintains the tradition of embracing change in order to keep the book relevant to what Dr. Leslie H. Blumgart established long ago.

The sixth edition continues the tradition of using associate editors to comprehensively cover the extraordinary growth of knowledge and advances over the past four years. The associate editors are all world-class experts in the field and bring great insight to the book based on personal experience. Dr. Jean-Nicolas Vauthey of University of Texas MD Anderson Cancer Center joins Dr. William Chapman of Washington University in St. Louis in taking primary oversight of sections dealing largely with hepatic resection and transplantation, reflecting the substantial contributions they have made in these areas. My colleagues at Memorial Sloan Kettering Cancer are owed a great debt of gratitude for their great efforts. Drs. Ronald DeMatteo and Michael D'Angelica once again brought their expertise to bear in the sections on basic science/physiology and biliary tract disease, respectively. Drs. Peter Allen and Richard Kinh Gian Do joined the editorship with this edition and made substantive improvements in the sections on pancreatic disease and radiology, respectively.

The current edition reflects the ongoing and major changes in the field of hepatopancreatobiliary (HPB) surgery, including minimally invasive resection techniques, molecular biology of HPB malignancy, and advances in systemic and ablative therapies. The organization of the book remains similar to the fifth edition; several new chapters have been added while others have been expanded. We have maintained the general format by covering all surgical aspects of the management of HPB disorders, while the radiologic, endoscopic and other nonsurgical approaches are presented in detail and highlighted when they represent the preferred therapy. As with past editions, contributors were chosen largely based on their expertise and were asked

to discuss specific topics based not only on the published literature but on their own views. To that effect, overlap between chapters and discussion of controversy was encouraged in order to allow for conflicting points of view.

The initial section of the book remains dedicated to HPB anatomy and physiology, with Chapter 2, "Surgical and Radiologic Anatomy of the Liver, Biliary Tract, and Pancreas," forming the backbone of this section. Chapter 2 is one of the most important chapters in the entire book and forms the foundation for understanding much of the discussion in the subsequent sections on physiology, molecular biology and immunology, imaging, and perioperative management. Technical advances in liver, biliary and pancreatic resection, transplantation, and minimally invasive surgery are covered in detail, particularly in the new chapters "Advances in the Molecular Characterization of Liver Tumors" and "Stones in the Bile Duct: Minimally Invasive Surgical Approaches." Recent advances in the imaging field are highlighted in Chapter 14, "Emerging Techniques in Diagnostic Imaging," which should be an invaluable resource to those in the field of radiology. We have again included a great deal of technical detail, which can be viewed with the expanded list of videos on the Expert Consult website.

In summary, the sixth edition attempts to include all aspects of the anatomy, pathology diagnosis, and surgical and non-surgical treatments related to HPB disorders. We hope the work is of value to a wide range of readers, from seasoned HPB practitioners to surgical trainees and physicians in related disciplines. We have expanded our list of contributors in order to ensure the broadest and most contemporary viewpoints possible. I would like to again express sincere thanks to the co-editors who have collaborated with me in this project. We hope that the readers find this text to be a valuable resource for many years to come.

W.R. Jarnagin, MD
New York, 2016

ACKNOWLEDGMENTS

The Editors are very grateful to our colleagues in surgery and other disciplines who have contributed to the current edition. Without their enthusiastic support and insightful contributions, often highlighting areas of controversy and differing opinion, this project would never have been possible. Special thanks to our respective staffs in New York, St. Louis, and Houston who have assisted in the preparation of this work. Finally, thanks and appreciation are due to Dee Simpson, Michael Houston, and all of the staff of our esteemed publisher, Elsevier, for their great support throughout the project.

VIDEO CONTENTS

T. Peter Kingham, MD/Video Editor

CHAPTER 2 Surgical and Radiologic Anatomy of the Liver, Biliary Tract, and Pancreas

- [Basic Hepatic Anatomy: Three-Dimensional Model](#)

CHAPTER 6 Liver Regeneration: Mechanisms and Clinical Relevance

- [Atrophy/Hypertrophy Complex of the Liver](#)

CHAPTER 31 Bile Duct Exploration and Biliary-Enteric Anastomosis

- [Exploration of Common Bile Duct](#)
- [Biliary Enteric Anastomosis—Running, Interrupted](#)

CHAPTER 33 Cholecystitis

- [Mirizzi Syndrome](#)

CHAPTER 49 Tumors of the Gallbladder

- [General Principles for Gallbladder and Hilar Cholangiocarcinoma](#)
- [Biliary and Liver Resection for Gallbladder and Hilar Cancer](#)

CHAPTER 66 Techniques of Pancreatic Resection: Pancreaticoduodenectomy, Distal Pancreatectomy, Segmental Pancreatectomy, Total Pancreatectomy, and Transduodenal Resection of the Papilla of Vater

- [Pylorus-Preserving Pancreaticoduodenectomy for Adenocarcinoma of the Pancreas](#)
- [Central Pancreatectomy and Pancreaticogastrostomy for Endocrine Tumor](#)
- [Distal Pancreatectomy and Splenectomy](#)
- [Ampullectomy for Ampullary Tumors](#)

CHAPTER 67 Minimally Invasive Pancreatic Resectional Techniques

- [Laparoscopic Distal Pancreatectomy](#)
- [Laparoscopic Pancreaticoduodenectomy](#)

CHAPTER 74 Hydatid Disease of the Liver

- [Right Hepatectomy and Pericystectomy for Hydatid Disease](#)

CHAPTER 99 Regional Chemotherapy for Liver Tumors

- [Robotic Hepatic Artery Pump Placement](#)

CHAPTER 103B Hepatic Resection for Benign Disease and for Liver and Biliary Tumors

TECHNIQUES OF HEPATIC RESECTION

Inflow Control

- [Extrahepatic Approach, Right Hepatic Artery and Portal Vein](#)
- [Extrahepatic Approach, Left Hepatic Artery and Portal Vein](#)

- [Pedicle Ligation, Right Pedicle](#)
- [Pedicle Ligation, Left Pedicle](#)

Outflow Control

- [Right Hepatic Vein](#)
- [Left and Middle Hepatic Veins](#)
- [Left Hepatic Vein](#)

Parenchymal Transection

- [Clamp Crushing](#)
- [Stapler](#)
- [Water Jet](#)

Major Hepatic Resections

- [Right Hemihepatectomy](#)
- [Extended Right Hepatectomy](#)
- [Left Hemihepatectomy](#)
- [Extended Left Hepatectomy](#)

Hepatic Tumors

- [Enucleation of Benign Hepatic Tumors](#)

Resection for Biliary Malignancy

- [Left Hepatectomy with En Bloc Resection of the Bile Duct and Caudate Lobe](#)
- [Right Hepatectomy with En Bloc Resection of the Bile Duct](#)

Gallbladder Cancer

- [Porta Hepatitis Lymphadenectomy with Bile Duct Preservation for Incidental Gallbladder Cancer](#)
- [Segmentectomy Ib/V for Gallbladder Cancer](#)

CHAPTER 104 Resection Technique for Live-Donor Transplantation

- [Resection for Living Donor Transplantation: Donor Right Hepatectomy Including the MHV](#)

CHAPTER 105 Minimally Invasive Techniques in Hepatic Resection

- [Laparoscopic Right Hepatectomy](#)
- [Laparoscopic Left Lateral Sectionectomy](#)

CHAPTER 107 Vascular Reconstruction Techniques

- [Reconstruction During Hepatectomy](#)

CHAPTER 108B Segment-Oriented Anatomic Liver Resections

Segmental Resections

- [Left Lateral Sectionectomy, Segments 2 and 3](#)
- [Right Posterior Sectionectomy, Segments 6 and 7](#)
- [Central Hepatectomy, Segments 4, 5, and 8](#)
- [Resection of Segment 3](#)
- [Caudate Hepatectomy, Segment 1](#)

CHAPTER 116 Orthotopic Liver Transplantation

- [Orthotopic Liver Transplantation](#)

Hepatobiliary and pancreatic surgery: historical perspective

Leslie H. Blumgart

A cursory examination of the Table of Contents of this book reveals how some of the extraordinary achievements of modern medical science and clinical practice have been applied to the management of liver, biliary, and pancreatic disease. The near-miraculous developments in our understanding of the molecular nature of disease, combined with the wonders of modern imaging technology, advances in anesthesiology, and refinements in surgical technique, can be so absorbing as to blind a contemporary physician to the rich history that lies behind today's practice. This introductory essay examines the key achievements of the past, on which the modern practice of liver, biliary, and pancreatic surgery depends.

ANCIENT HISTORY UNTIL THE EIGHTEENTH CENTURY

“For the King of Babylon stood at the parting of the way, at the head of the two ways, to use divination: he made his arrows bright, he consulted with images, he looked in the liver.”

EZEKIEL 21:21

In ancient societies, the priest had the simultaneous duties of divination, protection, and treatment of the ill. For individuals with the responsibility of divining the future, the liver was of central importance. As exposed by wounds sustained in combat, at sacrificial offerings, and at incisions after death, the liver is the most obvious organ in the abdomen and was observed to contain the most blood; because life and blood were perceived to be synonymous, the liver was considered the seat of the soul.

A tablet believed to be from the time of Hammurabi (about 2000 BCE), now in the British Museum, names the various parts of the liver and indicates the prognostic significance of each (Jastrow, 1908). The liver was divided into about 50 portions for individual inspection in an effort to overlook as little as possible. Such hepatoscopy was widely in vogue over the following centuries and was practiced by the Etruscans, as evidenced by a bronze tablet in a museum at Piacenza depicting the liver, this being strikingly similar to the Babylonian clay tablet in the British Museum.

The Roman Celsus in his text *De Medicina*, translated by W.G. Spencer in 1935, mentioned the liver and described its anatomic location: “[T]he liver, which starts from the actual partition under the praecordia on the right side, is concave within (that is on the inferior surface) and convex without; its projecting part rests lightly on the stomach and it is divided into four lobes. Outside its lower part, the gallbladder adheres to it”

(Celsus, 1935). Celsus lived in the first century and described symptoms attributable to liver disease. Gallstones were recognized in the embalming of mummies in ancient Egypt. In 1909 a mummy with a preserved liver and a gallbladder containing 30 gallstones was presented to the Museum of the Royal College of Surgeons in London. This mummy came from Deir-el-Bahn at Thebes and was that of a priestess of the 21st dynasty around 1500 BCE. Elliot-Smith, an outstanding English anatomist and Egyptologist, described the gallbladder as being large and containing “many spherical calculi.” The specimen was destroyed by German bombs during World War II, but the description of it was accepted as evidence that the gallstones contained therein were the earliest specimen of such calculi to have survived from antiquity (1971). Gordon-Taylor, a noted surgical historian in England, had likewise called attention to the terminal illness of Alexander the Great at the age of 34 (323 BCE) as an example of fatal biliary tract disease. The description of Alexander’s illness, as recounted by Weigall (1933), suggests that Alexander died of complications culminating in peritonitis.

Rhazes (850–923) and Avicenna (980–1037), two Persians, wrote on general surgical topics and the nature of disease and appreciated the gallbladder but lacked knowledge of the common bile duct. Biliary fistulae were known to have formed after the drainage of an abdominal wall abscess, and it was known that individuals with fistulae had a better prognosis than those who had an external communication with the intestines (Glenn, 1971).

Greek academic achievements surpassed that of all other civilizations until the fifth century BCE. Hippocrates, widely acclaimed in medicine then and since that time, recognized the seriousness of biliary tract disease as evident in the following passage from *The Genuine Works of Hippocrates* (translated by Adams in 1939): “[I]n a bilious fever, jaundice coming on with rigor before the seventh day carries off the fever, but if it occurs without the fever, and not at the proper time, it is a fatal symptom.” He also noted that in the case of jaundice, “[I]f the liver hardens it is a bad sign.”

A few centuries after Aristotle recognized jaundice as an element of disease, Galen viewed biliary tract disease as a recognized clinical entity to be treated successfully in part by diet. Although Celsus had drawn attention to the gallbladder and liver in the first century CE, in the second century, Galen was the most noted author of the Greco-Roman age. Galen named three main organs that govern the body: the *heart*, the source of heat and the principal organ; the *brain*, the source of sensitivity for all parts; and the *liver*, as a principal part of the nutritive organs (Green, 1951). Galen considered jaundice to be due to yellow bile flowing into the skin and recognized that although

jaundice could be the result of hepatic disease, it also could arise when the liver was not involved at all. Galen's teaching persisted for centuries, and until the middle of the 17th century, many disorders were described as alterations in the balance of the main humors of the body brought about by hepatic dysfunction. As recorded by Rosner (1992), ancient Hebrew physicians used pigeons to treat jaundice by placing the pigeon on the patient's umbilicus and believed the pigeon would cure the patient: "The pigeon will draw all yellowness out."

Many subsequent advances came from Italy about the time of the Renaissance. Benivieni (1506) in Florence described a series of autopsies in his patients, which was the first record of special reference to biliary tract disease and its clinical manifestations. Two such examples are cited in the translation by Singer and Long (1954) of Benivieni's book, *The Hidden Causes of Disease*:

"A case of stones found in the coat of the liver—a woman of noble birth had been for long tormented by pain in the region of the liver. She had consulted many physicians but could not drive out the evil by any remedy ... a few days afterward, the disease took stronger hold and she departed this life. ... I then had her dead body cut open. There were found in the lower part of the membrane around the liver a collection of small stones varying in shape and color. Some were round, some pointed, some square, according as position and chance had determined, and they were also marked with reddish, blue and white spots. These stones by their weight had caused the membrane to hang down in a bag a palm's length and two-fingers wide. This we judge the cause of her death."

The second quotation also suggests death from gallstones:

"Stone in the middle of the gallbladder—there died recently a noble lady, Diamantes, laid low by the pain due to stones. As she had felt no harm from it before, the physicians decided to cut open her body. A great many stones were found but none in the urinary bladder as they had expected, but save for one, which was in the gallbladder, was black and as big as a dried chestnut. [A]ll were in the covering of the liver and made its coat hang down in a little bag. This we decided was the cause of her death and declared that a wise man would be well advised to make no definite pronouncements on obscure and uncertain diseases."

Much of the next phase of development of knowledge was centered around northeast Italy, particularly Padua, and many of the eponyms that we now use in surgery evolved from that period. The publication of Vesalius's *De Humani Corporis Fabrica* in 1543 (Fig. 0.1), and Harvey's *De Mortu Cordis* 100 years later, marked the emergence of a new scientific spirit in anatomy and physiology. As was the custom of the time, Vesalius often recorded descriptions of findings of dissections on individuals who had recently died, and expressed an opinion on the cause of death. Rains (1964), in his treatise *Gallstones—Causes and Treatment*, stated: "Vesalius found [that he had] a hemoperitoneum coming from an abscess, which had eroded the portal vein. The gallbladder was yellow and contained 18 calculi. Very light, of a triangular shape with even edges and surfaces everywhere, green by color somewhat blackish. The spleen was very large." Similarly, Rains recounted that Falloppio described stones in the gallbladder and common bile duct

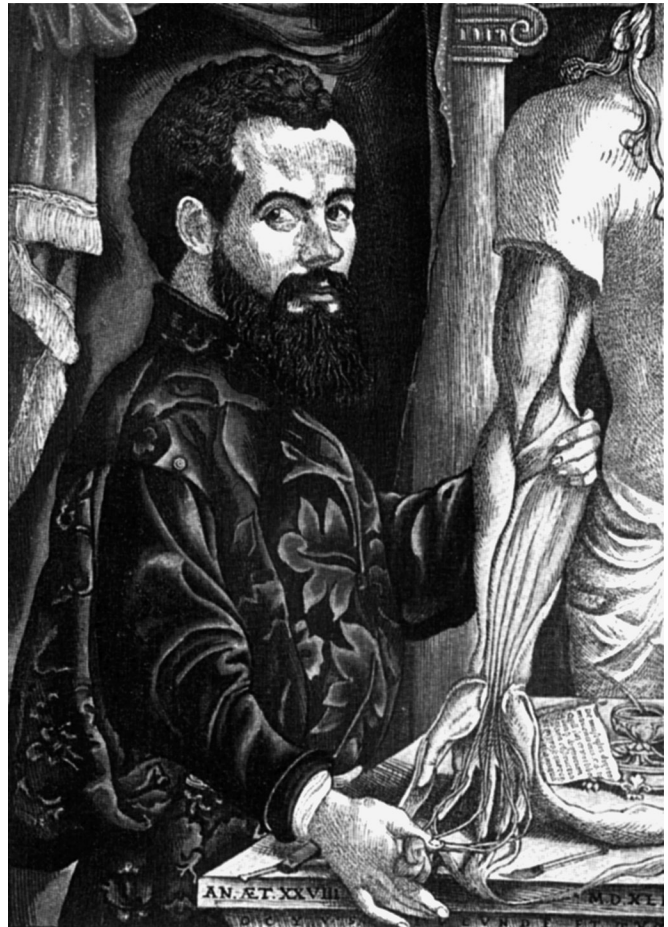


FIGURE 0.1 Andreas Vesalius, anatomist. (From *De Humani Corporis Fabrica*, 1543.)

in 1543, and that Fernell, in his *De Morbis Universilibus et Particularibus* (1588), proposed that the predisposing cause of gallstone formation was stasis and observed that in jaundice the feces become white and the urine dark, and that stones may be passed per anum. Falloppio, Vesalius, and Fernell all were active in the first half of the 16th century and probably discussed with one another their theories of the cause of gallstones and the changes in the liver with which gallstones were associated.

William Harvey (1578–1657), who also worked in Padua, is held by many to be the greatest of the contributors to the study of anatomy and physiology, in addition to his having established a clear understanding of the circulation. There is little doubt that Harvey also gave thought to the liver and its relation to the circulation and to the heart in particular. Harvey's student and younger contemporary, Francis Glisson, investigated the structure and function of the liver extensively. His book *Anatomia Hepatis* was published in 1654 and is the first major modern work on hepatology. Glisson gave a clear description of hepatic anatomy, especially of the hepatic capsule and of the investment of the hepatic artery, portal vein, and bile duct. He described the fibrous framework of the liver and illustrated hepatic vascular and biliary anatomy on the basis of cast and injection studies (Fig. 0.2). Glisson was the first to mention a sphincteric mechanism around the orifice of the common bile duct (Boyden, 1936). He also deduced the flow of blood through the portal

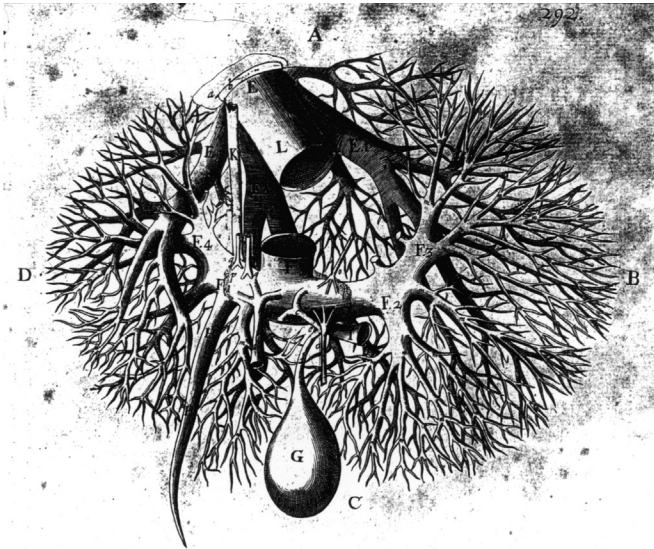


FIGURE 0.2 Illustration of the vasculature of the liver. (From Glisson F, 1654, *Anatomia Hepatis*.)

veins traversing the capillaries into the vena cava at a time when no microscopic studies of the liver had been done (Walker, 1966). Some of his illustrations are remarkably similar to those of Couinaud (1954, 1957, 1981) and to the images displayed today in three-dimensionally constructed computed tomography (CT) scans. Glisson was one of the great clinical physicians of all time, yet his name is related to an anatomic structure of limited importance.

In the century that followed the time of Harvey, great activity in publication among individuals engaged in medicine occurred. As today, senior professors often held opposing opinions and expressed their feelings based on fact or fancy with equal fervor. In an attempt to select the factual, Morgagni (Fig. 0.3), senior professor of anatomy and president of the University of Padua, published in 1761 an analysis of disease (translated by Benjamin Alexander in 1960) under the title *Seats and Causes of Disease*, among which are those of the liver and biliary tract. In referring to gallstones, Morgagni analyzed the distribution of stones in male and female patients, including age, incidence, and treatment:

[A]s to the lithotomy, which has also lately been thought of, in the gallbladder, do not be surprised that I made no mention of it above. For in the first place, the pains which were excited by gallstones, that were endeavoring to discharge themselves, are not only brought on by those which come from the cysts but also by those that come from the hepatic duct. In the second place, those cystic stones which are the largest, and on account of which lithotomy seems, to some persons, to be chiefly desirable, neither endeavor to disengage themselves nor create any great uneasiness; or at least for the most part.

This is a remarkable analysis recognizing the presence of stones in the common bile duct and the relatively innocuous nature of the large stone. A further quotation is as follows:

Last of all, although there were no danger in cutting, can you suppose there would be of no great difficulty in healing the wound? We have, before our eyes, examples of three women, one of Bologna, of Frankfurt, and of Göttingen, in whom a



FIGURE 0.3 Giovanni Battista Morgagni (1682–1771), physician.

tumor, having arisen in the epigastrium, and being opened, either by art or spontaneously discharged cystic calculi at its aperture ... the first was cured; the second had a fistula left, by which a thin and chylous kind of liquor, but of a yellow color, distilled; and the third had an ulcer remain, which with its sanies discharged bilious calculi at times.

Morgagni, as is evident in his text, presented the matter of biliary tract disease in logical sequence. He considered the incidence and the population affected in the different decades of the life span. His descriptions of the possible mechanisms by which calculi might be formed remind one of much of the writings today. Finally, he considered therapy under conservative medical management and warned about attempting to treat the condition by operation (Morgagni, 1960).

As outlined by Wood (1979), numerous eponyms currently used pertain to the names of these early physicians. Johann Wirsung (1600–1643) also studied in Padua and was the first to dissect the human pancreatic duct and to describe it in a 1642 letter to Riola, professor of anatomy and botany at the University of Paris. Wirsung was subsequently murdered by a Dalmatian physician, in a dispute probably related to who had described the duct first (Major, 1954; Morgenstern, 1965). Abraham Vater (1684–1751) was the first to describe the papilla of the duodenum. In 1720 he wrote that “those double ducts (bile and pancreatic ducts) ... come together in single combination” (Boyden, 1936). He described not an ampulla but an elevation of the mucosa of the duodenum and described the first reported case of an ampulla with two orifices. Likewise, the duct of Santorini takes its name from the Venetian Giovanni Domenico Santorini (1681–1737), a brilliant anatomist and

one of the most exact and careful dissectors of his day. While Vater was describing the tubercle at the confluence of the pancreatic and bile ducts, Santorini was relating the first detailed observation of the orifice of the two ducts (Boyden, 1936). In observations printed posthumously, Santorini noted a second pancreatic duct of normal occurrence and named the upper one the superior pancreatic duct and the lower one the main pancreatic duct. It was not until Oddi in 1864, working in Bologna, rediscovered “Glisson’s sphincter” and did studies in dogs that the holding quality of the sphincter of the outlet of the choledochus was recognized (Boyden, 1936).

The work of Morgagni was seminal in the understanding of liver and biliary disease. It started the movement toward anatomic and pathologic appreciation. Belief in the humoral causation of disease became untenable, and scientific medicine was launched. The end of the 17th century and the beginning of the 18th could be said to mark the initiation of modern medical science.

EIGHTEENTH CENTURY TO MODERN TIMES

The period from 1700 to the present day can be considered in two phases: the era before the discovery of general anesthesia, antisepsis, and x-rays in the middle of the 19th century and the period that followed, bringing important discoveries in blood transfusion, antibiotics, and immunology. These major developments have been followed by the birth of the electronic age, the flowering of radiologic imaging, and the increasing power of genetics and gene manipulation. The passage of surgery through these milestones is fascinating to observe, and the enormous strides in the maturation of hepatobiliary and pancreatic surgery to a recognized specialty are an important part of this story.

IMAGING IN HEPATOBILIARY AND PANCREATIC SURGERY

“Where there is no vision, the people perish. ...”

Proverbs 29:18

After the discovery of x-rays by Roentgen (Fig. 0.4) in 1895, there have been continual important and extraordinary developments in radiology. A contemporary surgeon who examines images to determine the cause of disease, sometimes before taking a history or examining the patient, can hardly contemplate a time when precise imaging was not available. A landmark development in hepatobiliary imaging occurred when, after experimenting with various iodine compounds, Graham, a North American surgeon, developed oral cholecystography (Graham & Cole, 1924). Although biliary calculi had been observed using x-rays alone (Buxbaum, 1898), the problem of detecting radiotransparent calculi was evident, and the development of oral cholecystography marked an important turning point. Postoperative cholangiography was soon developed by Mirizzi (1932) in Argentina. Intraoperative cholangiography (Mirizzi, 1937) and choledochoscopy (Bakes, 1923; McIver, 1941) also were developed.

In the 1970s, endoscopic cholangiopancreatography (Blumgart et al, 1972; Cotton et al, 1972a, 1972b; Demling & Classen, 1970; McCune et al, 1968; Oi et al, 1970) and endoscopic papillotomy (Classen & Demling, 1974) revolutionized

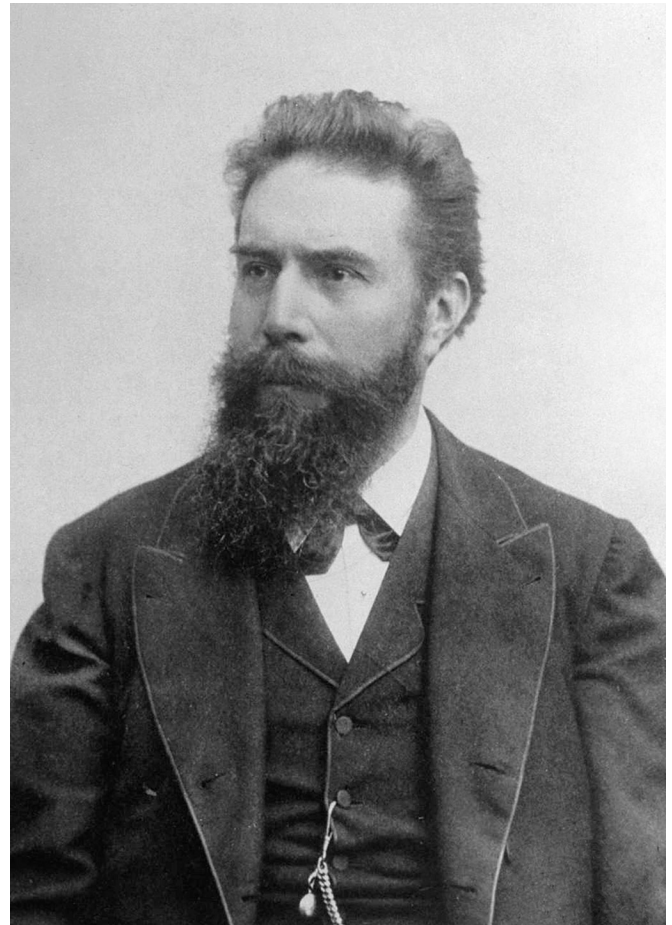


FIGURE 0.4 W.K. Roentgen (1845–1923). He discovered x-rays on November 8, 1895.

biliary and pancreatic radiology and approaches to common bile duct stones. The 1970s saw not only the introduction of endoscopic approaches to the biliary tract but also the development of good methods for percutaneous transhepatic cholangiography (Ohto & Tsuchiya, 1969; Okuda et al, 1974), CT of the liver (Grossman et al, 1977), and the use of ultrasound (Bryan et al, 1977) in liver and biliary surgery. Magnetic resonance (MR) axial imaging (Damadian, 1971; Lauterbur, 1973) was conceived and has led to the development of magnetic resonance imaging cholangiopancreatography (MRCP).

Not only were endoscopic and transhepatic approaches to stones now possible, endoscopic and percutaneous transhepatic intubation of the biliary tree for the relief of jaundice and for dilation of strictures became a reality. Arteriography developed to a fine degree, so that good hepatic arteriography and portography were developed (Hemingway & Allison, 1988), which inevitably led to the development of techniques for hepatic artery embolization in the management of liver tumors and of hemobilia (Allison et al, 1977).

Surgeons today have experienced their world transformed by imaging; it may be said that the extraordinary developments in the radiology of the liver, biliary tract, and pancreas have enabled the rapid progress in the management of the diseases of these organs. The extraordinary advances in image-guidance technology have progressed to a level that CT, ultrasound, and angiography now allow percutaneous image-guided methods

for tumor ablation, arterial embolization, alcohol injection, and injection of other substances directly into tumors. A host of other techniques are currently in development. It is of note that advances in imaging have enabled the development of stereotactic approaches in the management of liver tumors.

SURGERY OF THE BILIARY TRACT AND PANCREAS

Biliary Tract

The early part of the 18th century saw rapid development in the understanding of biliary disease. The ideas of Morgagni rapidly spread and were a firm basis for the changes to come. Studies regarding the structure, origin, and functions of bile were initiated in the latter half of the 18th century and culminated in Wieland's clarification of the structure of the various bile acids and Windaus's demonstration of the relationship of bile acids to steroids. For his contribution, Windaus was awarded a Nobel prize in 1928. Boerhaave (1668–1738) established a wide surgical reputation at the University of Leiden in Holland and worked extensively on diseases of the liver and biliary tract. In 1743 Jean Louis Petit presented to the Paris Academy of Surgery a paper entitled "*Considerations Concerning Tumors Produced by Retained Bile in the Gallbladder of the Liver, Sometimes Taken for Liver Abscesses.*" He introduced the term *biliary colic* (*colique hépatique*) and established the clinical treatment of it and of obstructive cholecystitis. In cases in which the gallbladder adhered firmly to the abdominal wall, Petit advised that it be punctured and opened to remove calculi, and he applied this procedure successfully in the case of one patient; this preceded Morgagni's publication of 1761 referred to earlier.

Biliary surgery began in Indiana on July 15, 1867, when John Bobbs operated on a woman who had a large tumor that he believed to be an ovarian cyst. To his amazement, when the abdomen was opened, he found an enormous gallbladder filled with stones. He opened it and extracted the calculi, sutured it carefully, and placed it back in the abdomen (Bobbs, 1868). It was nearly a decade before a similar cholecystostomy was performed. As is happenstance, this was accomplished almost simultaneously by a Swiss, Theodore Kocher (Fig. 0.5); a North American, Marion Sims; and an Englishman, Lawson Tait. All three surgeons planned operations in which the gallbladder was affixed to the abdominal wall to allow extraction of stones and pus and to leave it open to the exterior, so that peritonitis as a result of maneuvers within the abdomen could be avoided.

Sims worked on both sides of the Atlantic, and in Paris he operated on a patient with long-standing jaundice and a tumor in the right hypochondrium. With antiseptic technique, he opened the gallbladder and extracted 60 calculi, and then sutured the gallbladder to the abdominal wall; this was perhaps the first elective surgical procedure for obstructive jaundice (Sims, 1878). In the same year, in Bern, Switzerland, Kocher performed a cholecystostomy in two stages (Glenn, 1971). In the first stage, he packed the wound with gauze to the bottom of the gallbladder, and 8 days later, he emptied the residual stones from the gallbladder. Incidentally, Kocher, who won the Nobel prize in medicine in 1909 for his work on the physiology and surgery of the thyroid gland, also described sphincterotomy, or internal choledochoduodenostomy. His name is remembered by every biliary surgeon who performs mobilization of the

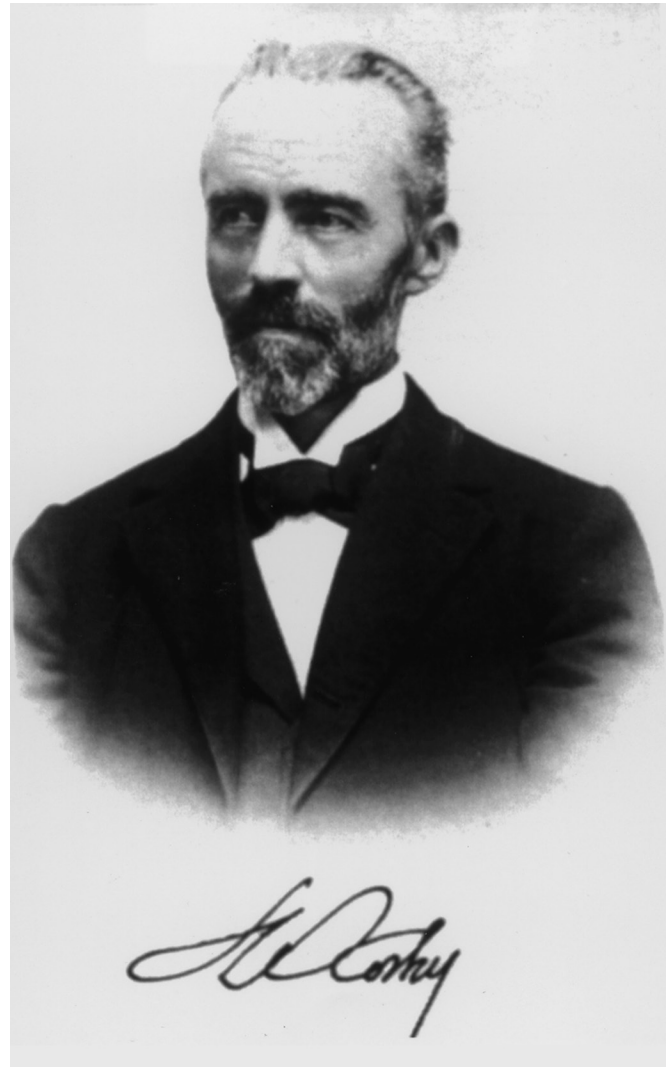


FIGURE 0.5 Theodore Kocher (1841–1917), surgeon.

duodenum as described by the great master (Kocher, 1903). Kocher originally described the maneuver for use in gastric surgery, but similar to so many other firsts in surgery at that time, the maneuver was first described by Jourdan (1895) and was first performed in biliary surgery by Vautrin (1896). Perhaps the maneuver should be referred to as "Vautrin's maneuver" rather than Kocher's. Tait, the great British surgeon, is given credit for performing the first cholecystostomy for gallbladder lithiasis in one stage. The patient, a 40-year-old woman, survived, and by 1884, he had performed the procedure in 14 cases with only one death (Tait, 1885).

The first elective cholecystectomy was done by Langenbuch (Fig. 0.6). While others were pursuing the construction of biliary fistulae and direct removal of gallstones, Langenbuch observed that because stones were known to recur, others had "busied themselves with the product of the disease, not the disease itself" (Langenbuch, 1882). As he was later to recount, two thoughts kept occurring to him: first, that in animal experiments, Zambecari in 1630 and Teckoff in 1667 had performed cholecystostomy and cholecystectomy in dogs and had shown that the gallbladder was not essential to life (Langenbuch, 1896); second, that his medical colleagues believed that the



FIGURE 0.6 Karl Langenbuch (1846–1901), surgeon.

gallbladder itself gave rise to stones. He developed the technique for cholecystectomy over several years of cadaver dissection and performed the operation at the Lazarus hospital in Berlin on July 15, 1882. The patient had experienced biliary colic for 16 years and was addicted to morphine. He was afebrile the day after the operation, had little pain, and was smoking a cigar; the patient was walking at 12 days and left the hospital 6 weeks later, pain free and gaining weight (Traverso, 1976). Report of this case (Langenbuch, 1882) led to a controversy over cholecystostomy as championed by Tait. Langenbuch's operation was the new cholecystectomy.

In 1886 Gaston had tabulated 33 cholecystostomy operations with a mortality rate of 27%, compared with 8 cholecystectomies (5 by Langenbuch) with one death recorded, a mortality rate of 12%. By 1890, 47 cholecystectomies had been done by 27 surgeons, and in 1897, the number had increased to nearly 100 operations with a mortality rate of less than 20% (Gaston, 1897).

The most important recent advance in surgery of the gallbladder came 100 years after Langenbuch's first cholecystectomy. Laparoscopic cholecystectomy was conceived and first performed in Germany by Muhe in 1985. Between 1985 and 1987, he performed 94 laparoscopic cholecystectomies (Muhe, 1986, 1991). Mouret, in Lyon, France, performed the first

video laparoscopic cholecystectomy. He did not publish his experience, but the news spread rapidly, and Dubois in Paris published the first series of laparoscopic cholecystectomies (Dubois et al, 1989, 1990). Perissat, working in Bordeaux, further developed the laparoscopic approach and introduced it to the United States in 1989 (Perissat et al, 1990). The procedure has since been extended, so that laparoscopic exploration of the common bile duct is now possible and is carried out routinely. Today, most cholecystectomies are done using laparoscopic techniques, such that the modern surgical trainee often has little or no experience in open cholecystectomy. More recently, cholecystectomy has been done via minimally invasive techniques using robotics (Marescaux et al, 1998; Satava, 1999) to manipulate the instruments.

Not long after the performance of the first cholecystectomy, attempts were made to remove stones from the bile ducts. In 1898 Thornton performed the first removal of a stone from the common bile duct. A year later Courvoisier operated successfully on another case of choledocholithiasis and published his well-known monograph on the pathology and surgery of the biliary ducts. He also enunciated the law that was to bear his name, which established that in patients with jaundice, if the gallbladder is not distended, the case is more likely to be one of stones. The operative procedure for exploration of the common bile duct for choledocholithiasis was not popularized, however, because of the risk of peritoneal infiltration by bile.

In 1897 Kehr (Fig. 0.7) performed exploration of the common bile duct and placed a rubber tube in the common bile duct through the cystic duct; this was the first systematic use of biliary intubation. Kehr's name is properly associated with the development of biliary intubation; Kehr (1912) and Quenu and Duval (1908) were able to extract stones along the tunnels created by the drainage tubes. These were the precursors for techniques later developed by Mondet (1962) and Mazzariello (1966, 1974). Kehr had developed numerous combinations of drainage in patients with biliary stones, and many other surgeons rapidly developed choledochotomy without suture and using tube drainage.

Surgery of the bile ducts rapidly disseminated across Europe, England, and the United States, and in 1912, Kehr developed what came to be known as the *T-tube*. Not only was choledochotomy simplified, but biliary tract repair was done over these tubes. Kehr became justly famous for his introduction of biliary intubation and was probably the most outstanding biliary surgeon of his day. In 1913 he published a treatise entitled *Surgery of the Biliary Tract*, which for more than 40 years was the most respected text on the subject. Kehr (1908a, 1908b) described the resection of cancerous gallbladders, including hepatic resection, and he resected hepatic tumors and aneurysms of the hepatic artery. He also performed the first hepaticoenteric anastomosis.

Before the development of Kehr's tubes, choledochotomies often became biliary fistulae, either because of residual supraampullary stones, or because the surgeon had inadvertently opened the bile duct proximal to a cancer. German and Austrian surgeons were the first to perform supraduodenal choledochoduodenostomy (Riedel, 1892; Sprengel, 1891). Sprengel's operation described a side-to-side choledochoduodenostomy, and it subsequently became popular in Europe and the United States (Madden et al, 1965). Cholecystenterostomy also was developed initially by von Winiwarter (1882) and was used later by many surgeons, including Oddi (1888).



FIGURE 0.7 Hans Kehr (1862–1916), surgeon.

Transduodenal surgery was not long in developing. In 1895 **Kocher** wrote an article on internal choledochoduodenostomy to remove supraampullary choledochal calculi; by 1899 he had performed the operation 20 times. **MacBurney** (1898) published his experience with duodenostomy and papillotomy in patients with impacted periampullary calculi. These early procedures of a choledochotomy and choledochenteric anastomosis for the treatment of jaundice and of stones in the biliary tract are still used today, with frequent application of the same principles but with aid of the endoscope.

At about the same time, surgeons began to operate on cancer of the papilla. In Baltimore in 1900, **Halsted** resected a portion of the duodenum that included a tumor and reimplemented the common duct, at the same time performing a cholecystostomy. He then reoperated to remove the gallbladder. **Mayo** (1901) reported an operation on a 49-year-old man with papillary cancer. Mayo opened the duodenum, removed the tumor, and carried out a choledochoduodenostomy. This was the first transduodenal ampullectomy. **Kausch** (1912) in Germany and **Hartmann** (1923) in France gave accounts of resections of ampullary tumors. In Lausanne, Switzerland, Roux, a disciple of Kocher, had described preparation of a “jejunal loop” for use in gastric surgery, and it soon became an adjunct in biliary surgery (**Roux, 1897**). This Roux-en-Y procedure was soon used by **Monprofit** (1904) in the performance of cholecystojejunostomy, and he proposed it for

hepaticojejunostomy at the French Congress of Surgery in 1908. **Dahl** (1909), in what he called “a new operation on the bile ducts,” advocated the Roux anastomosis in biliary surgery.

With the advent of cholecystectomy and choledochostomy came the inevitable sequelae of residual bile duct stones and iatrogenic lesions. Initially, these were treated by various forms of intubation, similar to the techniques advocated by Kehr, but many leading surgeons, such as Moynihan and Mayo, used hepaticoduodenal anastomoses (**Estefan et al, 1977**). **Dahl** (1909) used the Roux-en-Y loop, but more recently, other authors (**Madden et al, 1965**; **Schein & Gliedman, 1981**) have preferred choledochoduodenostomy as described previously.

Operative biliary drainage in upper biliary tract cancer and in patients with severe scarring in the porta hepatis is always difficult. **Kehr** (1913) successfully performed three operations in which he fixed a jejunal loop to a cut section of a hepatotomy wound; similar procedures were done by others, as cited by **Praderi** (1982). **Longmire and Sanford** (1948) performed a similar operation, resecting the end of the left lobe of the liver and anastomosing it to a jejunal loop. This technique, although popular for a short time, was complicated by stenosis and has fallen out of favor.

Goetze (1951) developed a procedure of transanastomotic drainage with a catheter that went through the hepatic parenchyma, the anastomosis, and the jejunal loop. Goetze’s contribution was apparently forgotten but was reinvented and popularized by others, including **Praderi** in 1962 (**Praderi, 1982**). **Praderi** argued strongly that Goetze’s procedure was the answer to difficult operations in the high biliary tract, but he conceded that the emergence of transhepatic percutaneous cholangiography (**Okuda et al, 1974**) allowed the development of transhepatic percutaneous methods for intubation and dilation of the biliary tract, which are now common procedures throughout the world.

The greatest advances in techniques for repair of biliary injuries came from two sources. At the Lahey clinic in the United States, three generations of famous surgeons, Lahey, Cattell, and Warren, perfected the reconstruction of the common bile duct as an immediate or delayed procedure and splinted their anastomoses with a variety of tubes (**Estefan et al, 1977**). The results of these techniques were unsatisfactory, with numerous recurrent strictures. However, after the detailed study of the anatomy by **Couinaud in France** (1954), **Hepp and Couinaud** (1956) and **Soupault and Couinaud** (1957) developed techniques for direct biliary-enteric anastomosis, either to the left hepatic duct or to the segment III duct of the left liver. These surgical techniques have become widely accepted and are used throughout the world (**Bismuth & Corlette, 1956**; **Bismuth et al, 1978**; **Voyles & Blumgart, 1982**; **Warren & Jefferson, 1973**).

Pancreas

Like liver surgery, pancreatic surgery developed largely as a result of responding to wounds inflicted in wars. **Claessen** (1842), **Ancelet** (1866), **Da Costa** (1858), and **Nimier** (1893) documented the early development of pancreatic surgery. In 1923 **Hartmann** wrote an extensive review of the French, German, and English literature. Early efforts at elective pancreatic surgery largely revolved around drainage of cysts (**Thiersch, 1881**). In 1883 **Gussenbauer** marsupialized a pancreatic pseudocyst, and the patient survived. Other surgeons, including **Senn** (1886), soon performed similar procedures.

Direct anastomosis of the pancreatic duct to the gastrointestinal tract followed in the early part of the 20th century, when Coffey (1909) performed an anastomosis of the tail of the pancreas to the small bowel. Ombredanne (1911) anastomosed a pancreatic cyst to the duodenum, and Jedlicka (1923) anastomosed a cyst to the posterior wall of the stomach. Chesterman (1943) performed a cystojejunostomy, and König (1946) carried out the same operation to a Roux-en-Y loop of jejunum.

Operations for pancreatic tumors were being done at about the same time. Ruggi (1890) reported a resection of a large lesion of the tail of the pancreas, and Briggs (1890) performed a similar operation. Biondi (1897) reported resection of a tumor arising from the inferior part of the head of the pancreas, and the patient was still alive 18 months later.

Whipple (Fig. 0.8) and associates (1935) published a technique for cephalic duodenopancreatectomy, done in two stages, for cancer of the ampulla of Vater. In the first operation, they performed a cholecystogastrostomy and gastroenterostomy. In the second and subsequent procedure, they resected the head of the pancreas with a portion of the duodenum without anastomosis to the stump of the pancreas, which they sutured. Whipple (1941) subsequently performed this operation in one stage and reported 41 cases, with a mortality rate of 27%. Eventually the technique of this operation was perfected. Although English-speaking surgeons throughout the world continue to call this operation “Whipple’s operation,” the procedure had been done many years earlier.

Sauve (1908) reviewed the literature on pancreatectomy and reported that several surgeons had resected small tumors from the head of the pancreas, and larger ones from the body of the

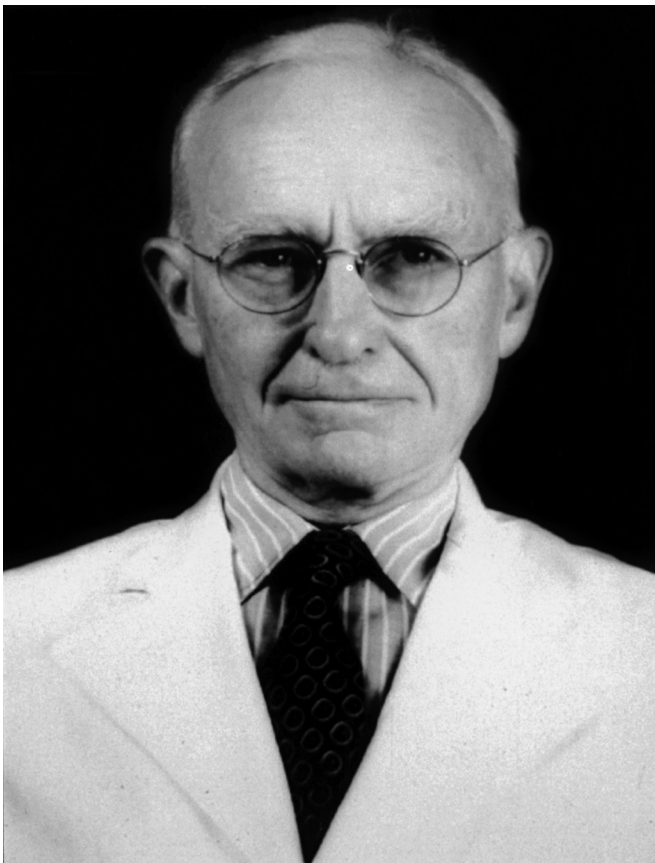


FIGURE 0.8 Allen O. Whipple (1881–1963), surgeon.

organ, without touching the duodenum. Codivilla of Italy is reported to have resected the duodenum and head of the pancreas and performed a cholecystojejunostomy in 1898, but the patient died in the postoperative period (Codivilla, 1898). The first surgeon to perform cephalic pancreaticoduodenectomy successfully was Kausch, a professor of surgery in Breslau and later in Berlin. On June 15, 1909, he performed a cholecystojejunostomy on a jaundiced 49-year-old man; on August 21, 1909, Kausch reoperated, performing a posterolateral gastroenterostomy and resection of the head of the pancreas with the tumor, the pylorus, and the first and second part of the duodenum. He anastomosed the third portion of the duodenum to the pancreatic stump. Kausch (1912) published a report entitled “Cancer of the Duodenal Papilla and Its Radical Treatment.” He gathered in that publication all reports that included excisions of the papilla. Tenani (1922) reproduced this operation with success, also in two stages but with one difference: Tenani performed a choledochojejunostomy, and the patient survived 3 years. Kausch and Tenani, although cited by Whipple (1941), are generally ignored in the English and American literature.

Pancreatic resection was extended to manage cancers of the common bile duct and of the duodenum. Recognition of endocrine tumors of the pancreas later led to operations for these conditions. Wilder and colleagues (1927) reported the first case of resection of an insulinoma arising from the islet cells of the pancreas. Mayo operated on a patient in whom he found a tumor of the pancreas with metastases to the liver, and an extract from one of the metastases produced an insulin-type reaction when injected into a rabbit. Graham and Hartmann (1934) reported subtotal pancreatectomy for hypoglycemia, and total pancreatectomy was performed by Priestley and colleagues (1944) for a patient in whom there was proven hyperinsulinism, but in whom no tumor of the pancreas was evident. The patient was cured by the operation, and the small tumor causing the syndrome was discovered during the pathology examination.

Later, Fallis and Szilagy (1948) performed total pancreatectomy for cancer in the hope that removal of the whole gland would reduce rates of morbidity and mortality and perhaps lead to better results. ReMine and colleagues (1970) and Brooks and Culebras (1976) adopted this approach, but early suggestions regarding efficacy were not fulfilled, and total pancreatectomy for pancreatic cancer has largely been abandoned. Fortner (1973) described the even more extensive procedure of regional pancreatectomy. The operation included an extensive total pancreatectomy and resection of the pancreatic segment of the portal vein—and sometimes the hepatic and superior mesenteric arteries, if these vessels were invaded by tumor—together with subtotal gastrectomy and regional lymph node dissection. Fortner’s results have not been reproduced by others.

Surgery for pancreatitis also developed over the same period, and the severity of acute pancreatitis was recognized. Ockinczyk (1933) revealed the frustration of the times in the surgical management of pancreatitis. He advocated “the use of drainage of the pancreas and hope.” Because the mortality rate of emergency surgery reached 78%, the conservative approach to acute pancreatitis was advocated. Nevertheless, some patients with acute pancreatitis still came to operation because of the necessity to treat gallstone-related pancreatitis or to manage complications, such as abscess and pseudocyst (Cattell & Warren, 1953).

The development of intensive care, antibiotics, and better metabolic management of patients with acute pancreatitis led to improvements in outcome, although the death rates remained unacceptably high. [Ranson and colleagues \(1976\)](#) and [Imrie \(1978\)](#) made important contributions in that they defined the evaluation of the severity of an attack. The surgical treatments of abscess and peritonitis were made systematic. The role of gallstones in acute pancreatitis was defined, particularly by [Acosta and Ledesma \(1974\)](#), and endoscopic papillotomy to extract calculi impacted at the papilla of Vater was also described.

Surgical procedures aimed at the treatment of chronic pancreatitis had been developing since the beginning of the 20th century. As mentioned previously, [Coffey \(1909\)](#) had anastomosed the tail of the pancreas to a loop of jejunum, and in 1953, [Link](#) reported external drainage of a pancreatic duct in a patient who lived for a prolonged period but expelled calculi periodically from the fistula tract. [Roget \(1958\)](#) described 50 cases treated this way, but only a few patients were cured by drainage. [Doubilet and Mulholland \(1948\)](#) attempted sphincterotomy in the treatment of pancreatitis. As a result of the success of cystojejunostomy in the treatment of pancreatic pseudocyst mentioned earlier, [Cattell in 1947](#) used a side-to-side anastomosis between a loop of jejunum and the pancreatic duct in an attempt to relieve pain in a patient with cancer of the head of the pancreas. Subsequently, [Longmire and associates \(1956\)](#) carried out end-to-end pancreaticojejunostomy to a Roux-en-Y loop of jejunum; however, this procedure proved unsuccessful. [Du Val \(1957\)](#) performed a similar operation in an attempt to drain the pancreatic duct, but this too was unsuccessful.

[Leger and Brehand \(1956\)](#) and von [Puestow and Gillespy \(1958\)](#) performed pancreatic ductal drainage in chronic pancreatitis patients for the relief of pain. Longitudinal opening of the pancreatic duct allowed better decompression after anastomosis to a jejunal loop. [Mercadier \(1964\)](#) performed a similar operation without the need for splenectomy, and further technical variations were introduced more recently by [Prinz and Greenlee in 1981](#) and by [Frey and Smith in 1987](#). [Mallet-Guy \(1952\)](#) and [Mercadier \(1964\)](#) performed resection of the left pancreas for chronic pancreatitis. This approach subsequently was extended, so that only a small portion of the head of the pancreas remained. A more modern approach aimed at conserving pancreatic parenchyma has since been developed ([Beger et al, 1985](#)) and was further promoted by Buchler and colleagues ([Di Sebastiano et al, 2007](#)).

Liver Surgery

Liver surgery has evolved from being almost nonexistent to comprising a repertoire of operations that can safely remove nearly any amount of liver tissue ([Chakravorty & Wanebo, 1987](#); [Fortner & Blumgart, 2001](#)). These operations are now performed at numerous hospitals and medical centers throughout the world. Courageous surgeons were enabled by extraordinary developments in anesthesiology, blood transfusion, infectious disease, and radiologic imaging.

Features of the anatomy and physiology of the liver that allow major resection were known in ancient times. The structural arrangement of the liver into lobes was apparent to individuals preparing animals for food or for ceremony or to those preparing humans for mummification. Two other properties of the liver, functional reserve and rapid regeneration, were suggested by the early Greek mythology of Prometheus, in

which Prometheus's liver grew back nightly after the eagle's daily and apparently bloodless "resections." This oft-cited myth does not necessarily mean that the ancient Greeks knew about liver regeneration; however, more recent evidence provides dramatic proof of the liver's power to grow back rapidly ([Blumgart et al, 1971](#)).

Knowledge of the liver's lobar and segmental structures, functional reserves, and capacity to regenerate, as well as techniques to prevent intraoperative hemorrhage are essential for major surgical resection. This knowledge also is relevant to transplantation, particularly to split-liver homograft transplantation and in the use of living, related donors.

Early descriptions of operations on the liver usually concerned complete or partial avulsion of some portion that was protruding externally as a result of abdominal trauma. [Berta in 1716](#) amputated a portion of liver protruding from the abdomen after a wound, and Von Bruns in 1870 ([Beck, 1902](#)) removed a lacerated part of the liver of a soldier wounded in battle. Despite these anecdotal descriptions, true hepatobiliary operations were not possible until the advent of anesthesia ([Fig. 0.9](#)) and antisepsis ([Lister, 1867a, 1867b](#); [Fig. 0.10](#)). Although [Warvi \(1945\)](#) recounted that Couzins performed a liver resection in 1874, [Langenbuch \(1888\)](#) recorded the first planned hepatic resection in Germany. In the United States, [Tiffany \(1890\)](#) resected a liver tumor, and [Lucke \(1891\)](#) reported a liver resection for cancer. [Keen \(1899\)](#), in the United States, reported 76 liver resections, of which 37 were for benign or malignant tumors.

About the time of these surgical developments, [Rex \(1888\)](#) and later [Cantlie \(1897\)](#) did detailed anatomic studies of the liver and its intrahepatic architecture. These studies established the lobar and segmental structure of the liver and of the Glissonian sheath enclosing structures that enter or leave the organ at the porta hepatis. They delineated the planes within the parenchyma of the organ that were relatively devoid of major blood vessels and bile ducts. These descriptions would make possible controlled hepatic resection.



FIGURE 0.9 *The First Operation with Ether*, by Robert Cutler Hinckley, 1893. (Courtesy of Boston Medical Library in the Francis A. Countway Library of Medicine.)

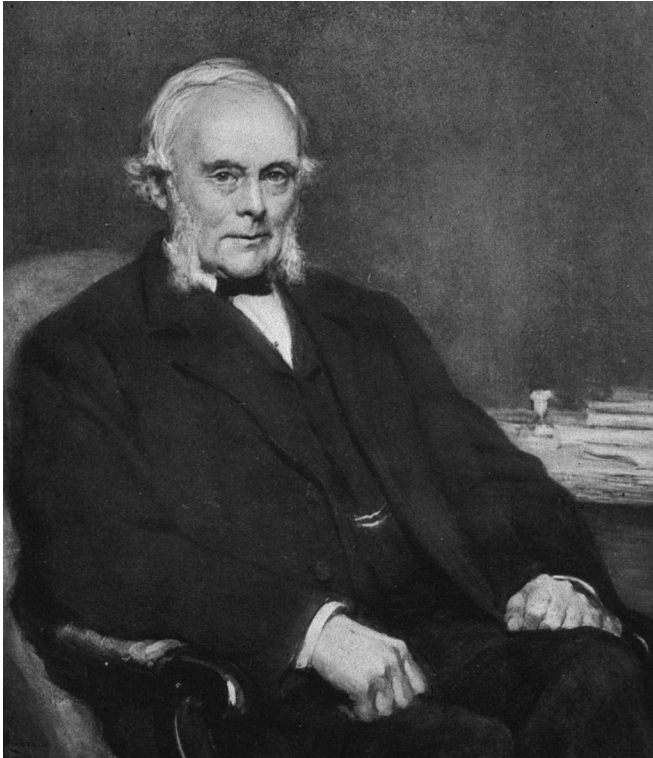


FIGURE 0.10 Joseph Lister (1827–1927), surgeon.

Surgeons quickly learned to fear the liver's friability and capacity for bleeding and its propensity for biliary leakage after operation. Elliot (1897) wrote that the liver is "so friable, so full of gaping vessels and so evidently incapable of being sutured that it seemed impossible to successfully manage large wounds of its substance." Kousnetzoff and Pensky (1896) reported, however, passing ligatures in the liver substance at a sufficient distance from the margins of the wound to ensure that they would not slip, and reported that, by pulling these up tightly, it was possible to allow them to cut into the liver parenchyma and compress the blood vessels. In writing about surgical approaches for parenchymal transection of the liver and the arrest of bleeding during operations on the liver, Garre (1907) paid respect to Kousnetzoff and Pensky's work, in which they had essentially shown that the vessels in human liver are no less resistant than arteries and veins of similar caliber in other parts of the body, and that they were suitable for ligation. These basic techniques for suture of the liver substance and ligation of vessels as a means of controlling hemorrhage have persisted to modern times and find recent application in the control of the pedicles of the liver within its parenchyma, as described by Ton (1979), and more recently in approaches to the control of the pedicles of the liver described by Couinaud (1954), Patel and Couinaud (1952a, 1952b), Takasaki and others (1986), and as developed and practiced by Launois and Jamieson (1992). Although ligatures and suture ligation remain the basic mainstays for the control of intrahepatic vessels, stapling techniques are now used for the same purpose (Fong & Blumgart, 1997).

Garre (1907) described the use of Doyen's elastic stomach clamp to provide compression of the liver before it is transected, and he referred to the work of Masnata and Lollini in Bologna, who used a similar clamp. This method also has been used more recently by Storm and Longmire (1971) and Balasegaram

(1972a, 1972b). Although almost totally abandoned in recent times, such clamps still are occasionally employed. Garre (1907) mentioned attempts to provide perforated plates to be used on either side of a wound of the liver, through which sutures could be passed to allow compression of liver tissue and bleeding vessels. This technique also was conceived more recently for the management of bleeding after elective liver resection (Wood et al, 1976) and for the control of bleeding from liver injury (Berne & Donovan, 2000).

Garre (1907) also emphasized the use of packing bleeding hepatic wounds, and he advocated that packing ought to be considered more frequently in cases of injury; this, too, was prophetic. Having passed through the phases of vascular ligation and hepatic resection for wounds of the liver, modern surgeons now rely much more frequently on packing to control oozing and hemorrhage for ragged and exposed liver lacerations (Berne & Donovan, 2000). The use of such packing recognizes, but does not specifically state, that major hemorrhage in the liver does not usually occur from the cut surface of the parenchyma but rather occurs from the main hepatic veins or lacerations to the vena cava.

In a seminal contribution in 1908, Pringle described a method of temporarily compressing the portal inflow vessels so as to reduce liver bleeding, but all eight patients he described died during surgery or shortly thereafter. Later, Pringle described the method as being uniformly successful in animals and used the technique successfully on a patient. This technique has been used ever since to control hepatic inflow, and although initially used to occlude the inflow for periods of 1 hour or more, it is now employed in an intermittent fashion.

The early understanding of liver structure and function and of the first operations on the liver in the latter half of the 19th century set the scene for the rapid advances of the 20th century. Not only did anatomic description reach a high level of accuracy relevant to the operating surgeon, advances in operative technique and extraordinary developments in diagnostic imaging as outlined previously allowed the flowering of hepatobiliary surgery as a specialty.

Major Hepatic Resection

Wendell (1911) was the first to perform a successful right hepatic lobar resection using hilar ligation. Nevertheless, his achievement was lost to his colleagues for many years, and it was not until the detailed anatomic studies of Hjortsjo in 1951, Healey and Schroy in 1953, and Couinaud in 1954 that the concept of segmental anatomy as originally described by Rex and Cantlie was finally accepted. Couinaud's (Fig. 0.11) seminal work in 1954 simplified the understanding of segmental liver anatomy and made it easily applicable by numbering the liver segments I through VIII. Goldsmith and Woodburne (1957) used a different nomenclature but subdivided the liver similarly. Subsequent refinements in the description of the liver were offered by Couinaud (1981) in a monograph, which contributed greatly to the understanding of practical surgical anatomy.

In 1950 Honjo published a case of anatomic right hepatectomy; the operation was performed in Kyoto, Japan, on March 7, 1949, and was later reported by Honjo and Araki (1955) in English. In 1952 Lortat-Jacob (Fig. 0.12) and Robert performed a true anatomic liver resection with preliminary vascular control. These reports opened the way for the development of liver surgery. The Lortat-Jacob operation captured much



FIGURE 0.11 Claude Couinaud (1922–2008), surgical anatomist.

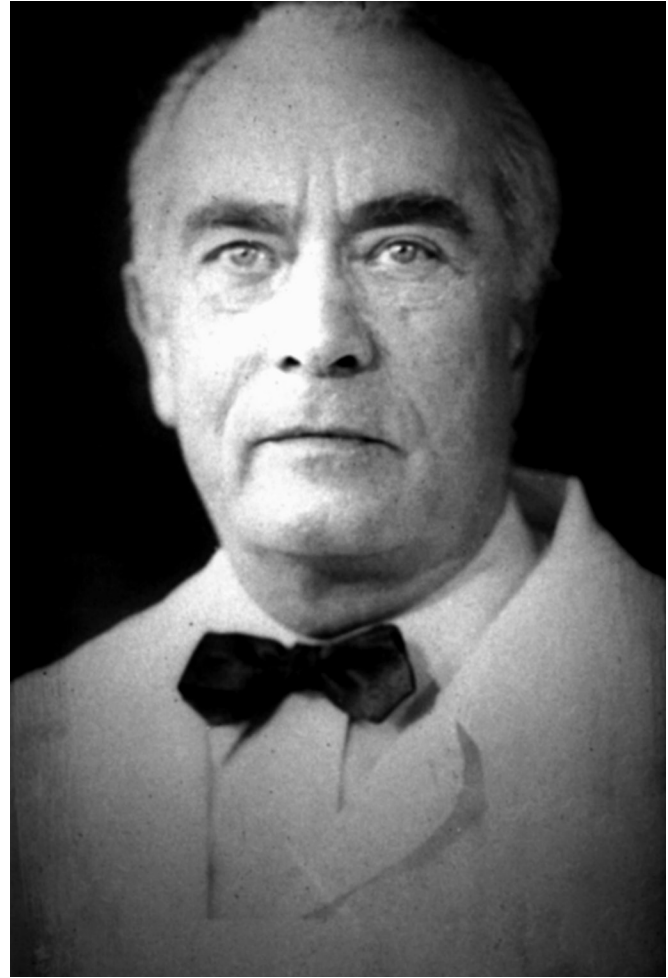


FIGURE 0.12 Jean Louis Lortat-Jacob (1908–1992), surgeon.

attention, and many further case reports followed. As recounted by Fortner and Blumgart (2001), at the Southern Surgical Association meeting in the United States on December 10, 1952, Quattlebaum (1953) described a right hepatic lobectomy for hepatoma. The operation had been done about 4 months after that of Lortat-Jacob and Robert. Apparently unaware of Quattlebaum's achievement, and thinking he would be the first to do a so-called *right hepatic lobectomy* in the United States, Pack at Memorial Sloan Kettering Cancer Center in New York performed the operation on a 40-year-old woman on December 14, 1952 (Pack et al, 1955).

Pack and colleagues (1962) recognized quickly the opportunity to study liver regeneration. Their studies were the first to describe and document regeneration of the human liver after major resection and suggested that complete regeneration occurs over 3 to 6 months. Later, Lin and Chen (1965) studied metabolic function and regeneration of the cirrhotic liver and found no discernible regeneration after resection. Blumgart and colleagues (1971) described the speed of liver regeneration as recovery of liver size within 10 to 11 days after major hepatic resection for trauma.

Contrary to the trends toward anatomic precision, Lin (1958) advocated a finger-fracture technique for liver resection, removing a hepatic lobe in 10 minutes with an average of 2000

mL of blood replacement. The surgical bluntness of this approach and the absence of the customary surgical principles and techniques precluded widespread acceptance of the technique. Similarly, a prominent figure in the early development of liver surgery, Brunschwig (1953; Serrea & Brunschwig, 1955) advocated nonanatomic resection, but his results—with a very high operative mortality rate for so-called *simple right lobectomy*, mostly from uncontrolled hemorrhage—led him to accept the approach of Lortat-Jacob. Brunschwig's report of long-term survivors after hepatic resection for advanced cancer challenged the prevailing skepticism about resecting liver tumors.

The laparothoracotomy approach of Lortat-Jacob and Robert in 1952 quickly became the standard for major hepatic resection. Opening the chest added operating time and increased morbidity but gave needed exposure to the liver. Later, the introduction of costal arch retractors made thoracotomy extension obsolete for most hepatic resections. Steps generally considered unnecessary, such as T-tube drainage of the common bile duct, were eliminated in the 1970s. Opinions were divided in the 1970s and 1980s about the superiority of either intrahepatic or extrahepatic management of the major hepatic veins. Closed drainage was substituted for multiple Penrose drains and packing, although these were still advocated by some in the 1980s. Many hepatic resections have been done without

drainage, as described by [Franco and associates \(1989\)](#) and subsequently at Memorial Sloan Kettering Cancer Center by Blumgart and colleagues ([Fong et al, 1996](#)).

Methods for anatomically based segmental liver resection that conserves parenchyma were developed and have proved valuable in hepatic resection for tumor. Numerous methods to transect the liver parenchyma had been advocated, including the knife handle ([Quattlebaum, 1953](#)), nitrogen knife ([Serrea & Brunschwig, 1955](#)), electrocautery ([Fortner et al, 1978](#)), microwave tissue coagulator ([Tabuse, 1979](#)), waterjet ([Papa-christou & Barters, 1982](#)), ultrasonic aspiration dissector ([Hodgson & DelGuercio, 1984](#)), and harmonic scalpel; other techniques are described on an almost daily basis, and simple crushing of the liver tissue remains in use by many.

Bleeding has remained a problem, and preliminary vascular control is difficult or impossible in some clinical settings. Inflow occlusion using the Pringle maneuver for longer than 15 to 20 minutes was considered hazardous. Local and general hypothermia was used in an effort to increase the liver's tolerance of the presumed ischemic anoxia associated with the procedure ([Longmire & Marable, 1961](#)). More complete vascular control was obtained by [Heaney and colleagues \(1966\)](#), without hypothermia, by employing aortic cross clamping and temporary occlusion of the porta hepatis and vena cava for 24 minutes without ill effect. [Fortner and colleagues \(1971\)](#) described isolation-hypothermic perfusion of the liver, making prolonged vascular isolation for complicated resections possible. [Huguet and associates \(1978\)](#) challenged the long-held belief that the liver could tolerate only 15 to 20 minutes of normothermic perfusion by extending the period to 65 minutes. This observation was subsequently confirmed ([Bismuth et al, 1989](#); [Huguet et al, 1992, 1994](#)). As described previously, however, major bleeding during liver resection usually arises from the major hepatic veins or vena cava, and development of techniques of low central venous pressure anesthesia during liver resection, as first described by Blumgart and colleagues ([Cunningham et al, 1994](#), [Melendez et al, 1998](#)), have proved simple and efficacious and have rendered vascular isolation techniques rarely necessary ([Jarnagin et al, 2002](#)).

Apart from hepatic resection, many other techniques for the enucleation of tumors and of hydatid cysts have been developed. [Garre \(1907\)](#) had first noted that if he kept close to the line of the dense membrane around hydatid cysts—so as not to enter the tissues of the liver too deeply, where large vessels may be encountered—it was possible to resect such lesions with minimal blood loss. Enucleative techniques are now used by contemporary surgeons, not only for the removal of hydatid cysts but also for the enucleation of giant hemangiomas ([Baer et al, 1992](#); [Blumgart et al, 2000](#); [Hochwald & Blumgart, 2000](#)). As described in this book, enucleation also may be used for resection of certain neoplasms of the liver, such as fibronodular hyperplasia.

The widespread use of laparoscopic cholecystectomy led to the development of techniques for laparoscopic resection of the liver. First used by [Gagner and colleagues \(1992\)](#), laparoscopic partial hepatectomy has been used by many surgeons. [Ferzli and colleagues \(1995\)](#) and [Azagra and colleagues \(1996\)](#) developed the operation for anatomic resection of the left lateral segment, and most such resections have involved this procedure. More recently, major hepatectomy has been performed using laparoscopic techniques ([Gigot et al, 2002](#)). Experience remains limited, however, and the indications and place of

laparoscopic liver resection remain under active investigation. Robotic operative approaches to liver resection have been devised ([Choi et al, 2012](#)).

Liver Tumors

The management of liver tumors has a relatively short history. After the initial reports of hepatic resection for tumors performed by [Langenbuch \(1888\)](#), [Tiffany \(1890\)](#), [Lucke \(1891\)](#), and [Keen \(1899\)](#), no significant reports were published until [Foster's review in 1970](#). He reported a multi-institutional survey conducted on 296 adults who had liver resection for primary cancer and were followed for at least 5 years or until death. The operative mortality rate was 24%. Foster also studied the records of 115 patients who had undergone hepatic resection for metastatic colorectal cancer. Operative mortality was 17.3%, and 21% survived for at least 5 years. Hemorrhage during operation was still a problem, and the operative mortality rate was essentially the same or higher than the cure rate so that skeptics remained unconvinced.

In the 1970s, major hepatic resection for tumors became more frequent, and this coincided with improvements in anesthesia, surgical technique, and postoperative support, and significantly, with the development of better imaging modalities. In the United States, [Wilson and Adson \(1976\)](#), [Fortner and colleagues \(1974\)](#), and [Thompson and colleagues \(1983\)](#) were major figures in this area of endeavor. In Asia, [Ong \(1977\)](#) and others were early explorers in the field, and other major centers made significant technical improvements with encouraging results ([Attiyeh et al, 1978](#); [Cady et al, 1979](#); [Starzl et al, 1975](#)).

Morbidity and mortality rates decreased dramatically, and major centers began to provide encouraging preliminary long-term survival figures. As described by [Fortner and Blumgart \(2001\)](#), by the 1980s the early reluctance by many surgeons to accept the therapeutic benefit of hepatic resection for tumors faded before the onslaught of encouraging reports from a variety of institutions in the United States, Europe, and Southeast Asia.

Methods for limiting the extent of the parenchymal transection developed along with the emergence of surgical resection for tumors in cirrhotic and noncirrhotic livers. Although suggested originally by [Pack and Miller \(1961\)](#) and by [McBride and Wallace \(1972\)](#), Asian and European surgeons soon assumed a leadership role in developing isolated segmental resection and described various operations ([Bismuth et al, 1982](#); [Hasegawa et al, 1989](#); [Scheele, 1989](#); [Ton, 1979](#)). The development of reliable intraoperative ultrasound allowed further developments in liver resection ([Bismuth et al, 1982](#); [Makuuchi et al, 1985](#)), and subsegmental resection was developed. More recently, the segmental approach was reported and popularized in the United States, particularly by Blumgart and others ([Billingsley et al, 1998](#); [DeMatteo et al, 2000](#)). The difficulty of the approach to the caudate lobe was addressed, and the surgical anatomy and technique for caudate resection, either as an isolated segment or in combination with major resections, was described by Blumgart and colleagues ([Lerut et al, 1990](#); [Bartlett et al, 1996](#)).

Probes to perform cryosurgical ablation were developed ([Ravikumar & Kaleya, 2000](#)), and cryosurgery-assisted segmental resection has been described ([Polk et al, 1995](#)). Radio-frequency ablation for liver tumors also has been evaluated ([Curley et al, 1999](#); [Wood et al, 2000](#)). Surgeons now perform

controlled tumor ablation or hepatic resection for tumors using robotic techniques and refinements in the development of virtual reality techniques as originally suggested by [Marescaux and colleagues in 1998](#) and by [Satava and colleagues in 1999](#) ([Marescaux et al, 1998](#); [Satava, 1999](#)). Image-guided surgery opens great possibilities for developments in hepatic surgery in the future ([Lang et al, 2004](#)).

The evolution of liver surgery for cancer was influenced profoundly by the geographic distribution of the disease. Surgeons in the United States and Europe were confronted much more often with metastatic cancer or hepatocellular carcinoma (HCC) in otherwise normal livers. In the 1980s and early 1990s, surgeons in the United States had no great drive to conserve normal liver tissue. By contrast, surgeons in Asia were confronted frequently with HCC in patients with hepatitis B and cirrhosis of the liver. Estimating the functional reserve of the cirrhotic liver became a major concern, and methods for limiting the resection of nontumorous liver were developed. Screening programs for the detection of HCC at an early stage were a natural corollary.

Primary liver cancer (HCC) occurs mainly in areas where viral hepatitis is endemic. Because of the prevalence of hepatitis B infection in Southeast Asia, most of the initial, significant, published experiences examining the treatment of primary HCC are from Southeast Asia. Improved diagnostic and surgical approaches in Japan permitted the [Liver Cancer Study Group of Japan \(1990\)](#) to report a 5 year survival rate of 57.5% for HCC; a high proportion of the cases were small, encapsulated tumors. From China, [Tang \(1993\)](#) reported a 5 year survival rate of 40.2%.

In the West, experience with HCC differed from that reported in the East in material ways: Tumors were generally large at presentation, the incidence of viral hepatitis was much lower, and many patients did not have underlying cirrhosis. There were several reports of surgical mortality rates for hepatic resection in cirrhotic patients, ranging from 15% to 100%. In recent years, spread of hepatitis B and hepatitis C has changed the demographics of the disease in the United States and in Western Europe. This change has allowed a much greater surgical experience, and better techniques and improved patient selection have led to vastly improved results. Blumgart's group ([Fong et al, 1999](#)) reported a mortality rate of 5% in 100 resections, 57 being major resections, in patients with HCC and cirrhosis, and a 5-year survival rate of 37% was reported among patients operated on since 1990.

Today the surgical mortality rate in noncirrhotic patients, even for the most extensive resections, is uniformly less than 5% in major centers. The overall 5 year survival rate is approximately 35% in patients with HCC reported from Western series, in which small HCC is relatively rare ([Bismuth et al, 1986](#); [Ringe et al, 1991](#)). In a study reported by Blumgart and others ([Fong et al, 1999](#)), patients who had HCC with a median tumor size of 10 cm but no cirrhosis had hepatic resection with a surgical mortality rate of 3.7% and a 5 year survival rate of 42%. Although survival rates have not changed substantially, a great improvement has been seen in rates of morbidity and mortality.

In recent years a move toward hepatic transplantation has been seen in selected patients with small HCCs within a cirrhotic liver. Patients with small HCCs and compromised liver function seem to be ideal candidates for total hepatectomy and allotransplantation.

The treatment of metastatic liver tumors by hepatic resection was viewed initially as highly dubious. Many regarded the removal of tumor from the liver by hepatic resection as an irrational approach. The natural history of colorectal cancer offered the opportunity for resection of liver metastases more often than any other cancer in Western countries. The multiinstitutional report from [Foster \(1970\)](#) in the United States suggested a 5 year survival rate of 25%, and multiple other reports supported that view. However, the question remained: How long could patients have lived without surgical operations?

A landmark article from Glasgow ([Wood et al, 1976](#)) described the natural history of colorectal hepatic metastases. It was shown that survival depended on the extent of the disease, and that multiple bilobar metastases indicated a much more serious prognosis than single or multiple nodules on one side of the liver. In Wood's study, only one patient survived for 5 years (1%). It was clear that if the operative mortality rate declined, as it had in many reported series, the issue was closed. A major study from Blumgart's group at Memorial Sloan Kettering Cancer Center ([Fong et al, 1999](#)) described the results in 1001 consecutive patients with a 5 year overall survival rate of 37% and an operative mortality rate of 3.4%. Five year survival reached more than 50% in patients with favorable prognostic factors. Similar results are reported from many institutions worldwide. Tumor recurrence with the liver the only site of recurrence is common, and such hepatic recurrences are often amenable to repeated resections, with risks and results similar to those of the initial operation ([Elias et al, 1992](#); [Fong et al, 1994](#); [Scheele & Stangl, 2000](#)).

More recently, the Memorial Sloan Kettering group reported a series of 1600 patients with metastatic colorectal cancer treated since 1985 ([House et al, 2010](#)). They demonstrated an improvement in results over time between 1999 and 2004, with a 5 year survival rate of 51% in 563 patients and an operative mortality rate of only 1%.

[Pichlmayr and colleagues \(1990\)](#) did the first ex situ tumor resection on the liver, removing the liver for bench surgery, then autotransplanting it back into the patient. The liver was preserved by hypothermic perfusion, as had been described earlier for the in situ procedure ([Fortner et al, 1974](#)). This approach may prove to have merit in highly selected cases, but it has not been accepted generally.

Although initially completely ineffective, systemic chemotherapy improved dramatically with the development of new agents, and its use as a neoadjuvant agent and as adjuvant chemotherapy after resection has been extensively explored. The use of neoadjuvant chemotherapy to convert unresectable tumors to resectable ones was reported by [Bismuth and colleagues \(1996\)](#), and extensive studies were reported regarding the possible benefits of chemotherapy after hepatic resection using hepatic arterial infusion of chemotherapy ([Kemeny et al, 1999](#)). Kemeny's study followed the demonstration in 1982 by [Ensminger and colleagues](#) of an implantable pump for hepatic arterial infusion therapy. Others have studied regression of advanced refractory cancer in the liver using isolated hepatic perfusion chemotherapy ([Alexander et al, 2000](#)).

As described in this book, hepatic resection also has been shown to yield satisfactory results in terms of relief of symptoms and prolongation of life in the management of hepatic metastases from neuroendocrine cancer and sarcoma. Hepatic resection for biliary and gallbladder cancer also has developed in a

remarkable fashion. [Launois and associates in France \(1979\)](#) reported the first major series of patients in whom hepatic resection was performed to ensure clearance of hilar cholangiocarcinoma. Working contemporaneously, [Fortner and colleagues \(1976\)](#) and [Blumgart and Beazley and associates \(Beazley et al, 1984; Blumgart et al, 1984\)](#) reported similar results, and in some patients, hepatic resection was accompanied by resection of the portal vein and portal venous reconstruction ([Blumgart et al, 1984](#)). Multiple other reports have confirmed that hepatic resection offers advantages in the management of hilar cholangiocarcinoma and helps achieve negative tumor margins that are associated with long-term survival ([Hadjis et al, 1990; Jarnagin et al, 2001; Klempnauer et al, 1997; Nimura et al, 1990](#)). Surgeons in Southeast Asia and Japan have contributed considerably in this area and in particular have contributed to the development of caudate lobe resection and vascular reconstruction ([Mizumoto & Suzuki, 1988; Nimura et al, 1990](#)).

[Pack and colleagues \(1955\)](#) advocated a similar radical approach for gallbladder cancer. They believed that an extended right hepatic lobectomy had its greatest applicability for gallbladder cancer, and they recommended an en bloc lymph node resection of the porta hepatis to be included with the operation. [Brasfield \(1956\)](#) reported a microscopic focus of metastatic cancer in a patient without gross liver involvement and helped establish the need for hepatic resection for gallbladder cancer. More recent reports indicate that for more invasive lesions and for patients seen after initial cholecystectomy, at which cancer was inadvertently found, an extensive resection seems to be effective ([Fong et al, 2000](#)). [Fortner and colleagues \(1970\)](#) performed total hepatectomy and orthotopic liver transplantation in two such patients with short-term survival.

Tumor ablation has been a major feature of the recent history of liver surgery for tumors. Cryosurgery ([Adam et al, 1997; Crews et al, 1997; Zhou et al, 1988](#)) has been used for treatment of small tumors and for the management of recurrent disease after resection or for the management of unresectable tumors in combination with chemotherapy. More recently, radiofrequency ablation of tumors has been developed, and its use in primary and metastatic cancer was reported ([Curley et al, 1999; Wood et al, 2000](#)) and is now established. The technique can be used at open operation or percutaneously.

Ethanol injection has been used in the management of small HCCs ([Ebara et al, 1990; Tanikawa, 1991](#)). It is of particular interest because it is inexpensive, widely available, and easily used with a low complication rate even in poor-risk patients, and it can be repeated frequently. Hepatic arterial embolization can also be used to ablate tumors and may be particularly effective in primary HCCs and in metastatic tumors arising from primary neuroendocrine sources ([Allison et al, 1977; Allison, 1978](#)).

Liver Transplantation

[Starzl \(2001\)](#) has provided a fascinating overview of the origins of clinical organ transplantation. A historical consensus development conference was convened in March 1999 at the University of California, Los Angeles, to identify the principal milestones leading to the clinical use of various transplantation procedures; the conclusions were published in the July 2000 issue of the *World Journal of Surgery* ([Groth & Longmire, 2000](#)). The early history of the evolution of organ transplantation followed the first convincing evidence that organ rejection is a



FIGURE 0.13 Thomas Starzl (1926–), surgeon.

host-versus-graft immune response ([Gibson & Medawar, 1943; Medawar, 1944](#)). For further details, the reader is referred to the publications of [Starzl \(2001\)](#) and of [Murray and Hills \(2005\)](#). This portion of the review of the history of liver surgery is concerned with the history of liver transplantation.

In a magnificent leap forward, [Starzl \(Fig. 0.13\)](#) and associates (1968), in the United States, did the first successful total hepatectomy with orthotopic liver transplantation. [Calne and Williams \(1968\)](#), in the United Kingdom, reported similar studies. The contributions of both groups to the development of liver transplantation and immunosuppressive therapy have been monumental. [Fortner and colleagues \(1970\)](#) reported the first successful heterotopic (auxiliary) liver homograft. This contribution was the forerunner of the further development of heterotopic liver transplantation and of split-liver and living related-donor transplants. Liver transplantation underwent continued evolution despite the modestly effective immunosuppressive therapy initially available. One-year survival rates slowly reached 50% by 1979 ([Calne & Williams, 1979; Starzl et al, 1979](#)). Chronic infection, rejection, and surgical infections diminished the small group to only a few long-term survivors. The report in 1979 of immunosuppression with cyclosporine by [Calne and associates \(1979\)](#) transformed the field rapidly. A consensus conference held in 1983 declared that liver transplantation was now an acceptable therapy and no longer an experimental procedure. [Zeevi and colleagues](#)

(1987) reported on another powerful immunosuppressive agent, tacrolimus.

Serious complications of immunosuppressive therapy for liver and other organ transplants have been described, including de novo malignancy (Penn, 1988; Penn & Brunson, 1988; Penn & Starzl, 1972). In 1988 Iwatsuki and associates reported an overall 54% survival rate of patients at 5 years. Development was rapid, and by 1992, more than 3000 orthotopic liver transplantations were done annually in the United States (United Network for Organ Sharing).

Total hepatectomy and liver transplantation were initially disappointing for liver cancer. Iwatsuki and colleagues (1988) reported that three of every four patients who lived at least 2 months after transplantation for cancer had recurrence, and adjuvant chemotherapy had no demonstrable benefit. Ringe and associates (1989) reported a 5 year survival rate of 15.2% for such patients, and Calne and colleagues (1986) had similar results. The best results and apparent cure were obtained when a cancer was an incidental finding in a liver removed for non-cancerous disease (e.g., alcoholic cirrhosis). Geevarghese and associates (1998) reported a 1 year survival rate of 85% and a 5 year survival rate of 78% for such cases. Liver transplantation for HCC was transformed with a publication by Mazzaferro and colleagues (Milan criteria, Mazzaferro et al, 1996), which showed excellent long-term survival in patients with limited disease and generated the patient selection criteria that are still widely used today.

Current adjuvant chemotherapy may improve the results. Olthoff and colleagues (1995) reported a 3 year survival rate of 45% using fluorouracil, doxorubicin, and cisplatin, but only three survivors had cancers larger than 5 cm. Laine and associates (1999) reported five children with advanced hepatoma who were alive at a mean of 4.6 years after transplantation that was preceded by induction chemotherapy.

Improved immunosuppression has allowed surgical techniques to blossom. Bismuth and Houssin (1984) reported reduced-size orthotopic liver grafts in children, and Pichlmayr and colleagues (1988) reported the use of one donor liver for two recipients (split-liver transplantation). Raia and associates (1989), in a letter to the *Lancet*, and Strong and colleagues

(1990) were the first to report living-donor liver transplantation using segments II and III of the liver; Yamaoka and colleagues (1994) reported using the right lobe of the liver. Use of split-liver grafts and living, related donors for grafts of both the right and left lobes has been driven by cultural restrictions and by a shortage of donor organs. This has been a major development, and the potential for mortality and morbidity not only of recipients but also of the live donors has remained a major ethical concern.

Liver transplantation for tumors has evolved considerably in the field of primary HCC. Although liver resection remains the treatment of choice for HCC in patients with good liver function, similar patients with compromised liver function and patients with hepatitis C and a small tumor in a portion of the liver geographically unfavorable for resection are now considered best treated by liver transplantation. Liver transplantation has come to be a recognized therapy for many patients with small HCCs (Bismuth et al, 1999), a wide range of benign disease, and in particular for patients with compromised liver function as a result of cirrhosis of the liver, Budd-Chiari syndrome, polycystic liver and kidney disease, sclerosing cholangitis, and for patients with a wide variety of other parenchymal and metabolic liver diseases. Liver transplantation for patients with hilar cholangiocarcinoma is occasionally indicated, and good results have been achieved in selected patients treated with aggressive neoadjuvant chemotherapy and radiotherapy (Rea et al, 2005). Some patients with widespread neuroendocrine metastatic disease of the liver may benefit from liver transplantation. Patients with metastatic disease from adenocarcinoma have had poor results, and transplantation is no longer used for this indication.

In writing this historical account, I have drawn freely on the work of the following excellent publications: Chakravorty and Wanebo (1987), Glenn (1971), Praderi (1982), and Starzl (2001). I have no doubt that there will be some inaccuracies and disputed claims as to “firsts,” but I have attempted to relate a fascinating surgical story. I apologize for any disagreement I may ignite.

References are available at expertconsult.com.

REFERENCES

- Acosta JM, Ledesma CL: Gallstone migration as a cause of acute pancreatitis, *N Engl J Med* 290:484–487, 1974.
- Adam R, et al: Place of cryosurgery in the treatment of malignant liver tumors, *Ann Surg* 225:39–50, 1997.
- Adams F: *The genuine works of Hippocrates*, Baltimore, 1939, Williams & Wilkins.
- Alexander B: *Translation of seats and causes of disease, facsimile of London*, ed 1769, New York, 1960, Hafner.
- Alexander HR Jr, et al: Current status of isolated hepatic perfusion with or without tumor necrosis factor for the treatment of unresectable cancers confined to liver, *Oncologist* 5:416–424, 2000.
- Allison DJ, et al: Treatment of carcinoid liver metastases by hepatic-artery embolisation, *Lancet* 2:1323–1325, 1977.
- Allison DJ: Therapeutic embolization, *Br J Hosp Med* 20:707–715, 1978.
- Ancelet E: *Étude sur les maladies du pancréas*, Paris, 1866, Savy.
- Attiyeh FF, et al: Hepatic resection for metastasis from colorectal cancer, *Dis Colon Rectum* 21:160–162, 1978.
- Azagra JS, et al: Laparoscopic anatomical left lateral segmentectomy: technical aspects, *Surg Endosc* 10:758–761, 1996.
- Baer HU, et al: Enucleation of giant hemangiomas of the liver: technical and pathologic aspects of a neglected procedure, *Ann Surg* 216:673–676, 1992.
- Bakes J: Die Choledochopapilloskopie, *Arch Klin Chir* 126:473–483, 1923.
- Balasegaram M: Hepatic surgery, *J R Coll Surg Edinb* 17:85–89, 1972a.
- Balasegaram M: Hepatic surgery: a review of a personal series of 95 major resections, *Aust N Z J Surg* 42:1–10, 1972b.
- Bartlett D, et al: Complete resection of the caudate lobe of the liver: technique and results, *Br J Surg* 83:1076–1081, 1996.
- Beazley RM, et al: Clinicopathological aspects of high bile duct cancer: experience with resection and bypass surgical treatments, *Ann Surg* 199:623–636, 1984.
- Beck C: Surgery of the liver, *J Am Surg Assoc* 78:1063, 1902.
- Beger HG, et al: Duodenum-preserving resection of the head of the pancreas in patients with severe chronic pancreatitis, *Surgery* 97:467–473, 1985.
- Berne TV, Donovan AJ: Liver and bile duct injury. In Blumgart LH, Fong Y, editors: *Surgery of the liver and biliary tract*, ed 3, Philadelphia, 2000, Saunders, pp 1277–1301.
- Berta G: cited by Chen TS, Chen PS, 1984: *Understanding the liver: a history*, Westport, CT, 1716, Greenwood Press, p 293.
- Billingsley KG, et al: Segment-oriented hepatic resection in the management of malignant neoplasms of the liver, *J Am Coll Surg* 187:471–481, 1998.
- Biondi G: Contributo clinico e sperimentale al achirurgia del pancreas, *Clin Chir* 5:132, 1897.
- Bismuth H, Corlette MB: Intrahepatic cholangiojejunostomy: an operation for biliary obstruction, *Surg Clin North Am* 36:849–863, 1956.
- Bismuth H, Houssin D: Reduced-sized orthotopic liver graft in hepatic transplantation in children, *Surgery* 95:367–370, 1984.
- Bismuth H, et al: Long-term results of hepaticojejunostomy Roux-en-Y, *Surg Gynecol Obstet* 146:161–167, 1978.
- Bismuth H, et al: Major and minor segmentectomies “régliées” in liver surgery, *World J Surg* 6:10–24, 1982.
- Bismuth H, et al: Liver resections in cirrhotic patients: a Western experience, *World J Surg* 10:311–317, 1986.
- Bismuth H, et al: Major hepatic resection under total vascular exclusion, *Ann Surg* 210:13–19, 1989.
- Bismuth H, et al: Resection of nonresectable liver metastases from colorectal cancer after neoadjuvant chemotherapy, *Ann Surg* 224:509–522, 1996.
- Bismuth H, et al: Liver transplantation for hepatocellular carcinoma, *Semin Liver Dis* 19:311–322, 1999.
- Blumgart LH, et al: Observations on liver regeneration after right hepatic lobectomy, *Gut* 12:922–928, 1971.
- Blumgart LH, et al: Endoscopy and retrograde choledochopancreatography in the diagnosis of the jaundiced patient, *Lancet* 2:1269–1273, 1972.
- Blumgart LH, et al: Surgical approaches to cholangiocarcinoma at confluence of hepatic ducts, *Lancet* 1:66–70, 1984.
- Blumgart LH, et al: Liver resection for benign disease and for liver and biliary tumors. In Blumgart LH, Fong Y, editors: *Surgery of the liver and biliary tract*, ed 3, Philadelphia, 2000, Saunders, pp 1639–1715.
- Bobbs J: Case of lithotomy of the gallbladder, *Trans Med Soc Indiana* 68, 1868.
- Boyden E: The pars intestinalis of the common bile duct, as viewed by the older anatomists (Vesalius, Glisson, Bianchi, Vater, Haller, Santorini et al), *Anat Rec* 66:217, 1936.
- Brasfield RD: Prophylactic right hepatic lobectomy for carcinoma of the gallbladder, *Am J Surg* 91:829–832, 1956.
- Briggs E: Tumor of the pancreas, laparotomy, recovery, *St Louis Med Surg J* 58:154, 1890.
- Brooks JR, Culebras JM: Cancer of the pancreas: palliative operation, Whipple procedure or total pancreatectomy, *Am J Surg* 131:516–520, 1976.
- Brunschwig A: Surgery of hepatic neoplasms, with special reference to secondary malignant neoplasms, *Cancer* 6:725–742, 1953.
- Bryan PJ, et al: Correlation of CT, gray scale ultrasonography, and radionuclide imaging of the liver in detecting space-occupying processes, *Radiology* 124:387–393, 1977.
- Buxbaum A: Über die Photographie von Gallensteinen in vivo, *Wein Med Presse* 39:534, 1898.
- Cady B, et al: Elective hepatic resection, *Am J Surg* 137:514–521, 1979.
- Calne RY, Williams R: Liver transplantation in man: I. observations on technique and organization in five cases, *BMJ* 4:535–540, 1968.
- Calne RY, Williams R: Liver transplantation, *Curr Probl Surg* 16:1–44, 1979.
- Calne RY, et al: Cyclosporin A initially as the only immunosuppressant in 34 recipients of cadaveric organs: 32 kidneys, 2 pancreases, and 2 livers, *Lancet* 2:1033–1036, 1979.
- Calne RY, et al: Liver transplantation in the adult, *World J Surg* 10:422–431, 1986.
- Cantlie J: On a new arrangement of the right and left lobes of the liver, *J Anat Physiol Proc Anat Soc Great Brit Ire* 32:4–9, 1897.
- Cattel RD: Anastomosis of the duct of Wirsung: its use in palliative operations for cancer of the head of the pancreas, *Surg Clin North Am* 27:636–643, 1947.
- Cattell RB, Warren W: *Surgery of the pancreas*, Philadelphia, 1953, WB Saunders.
- Celsus AC, editor: *De medicina, loeb classical library ed*, Cambridge, MA, 1935, Harvard University Press.
- Chakravorty RC, Wanebo HJ: Historic preamble: liver and biliary cancer. In Wanebo HJ, editor: *Science and practice of surgery*, vol 8, *Hepatic and biliary cancer*, New York, 1987, Marcel Dekker, pp xiii–xxvii.
- Chesterman JT: Treatment of pancreatic cysts, *Br J Surg* 30:234–235, 1943.
- Choi GH, et al: Robotic liver resection: technique and results of 30 consecutive procedures, *Surg Endosc* 26:2247–2258, 2012.
- Claessen F, 1842: *Krankheiten der Bauchspeicheldrüse*. Cologne, Germany, Schauberg.
- Classen M, Demling L: Endoscopic sphincterotomy of the papilla of Vater and extraction of stones from the choledochal duct (author's transl), *Dtsch Med Wochenschr* 99:496–497, 1974.
- Codivilla A: *Rendiconto statistico della sezione chirurgica dell'ospedale di imola*, 1898.
- Coffey RC: Pancreato-enterostomy and pancreatectomy: a preliminary report, *Ann Surg* 50:1238–1264, 1909.
- Cotton PB, et al: Endoscopic transpapillary radiographs of pancreatic and bile ducts, *Gastrointest Endosc* 19:60–62, 1972a.
- Cotton PB, et al: Cannulation of papilla of Vater via fiber-duodenoscope: assessment of retrograde cholangiopancreatography in 60 patients, *Lancet* 1:53–58, 1972b.
- Couinaud C: Bases anatomiques des hepatectomies gauche et droite réglées, *J Chir* 70:933–966, 1954.
- Couinaud C: *Le foie: étude anatomique et chirurgicale*, Paris, 1957, Masson.
- Couinaud C: *Controlled hepatectomies and controlled exposure of the intrahepatic bile ducts: anatomic and technical study*, Paris, 1981, Author.
- Crews KA, et al: Cryosurgical ablation of hepatic tumors, *Am J Surg* 174:614–617, 1997.
- Cunningham JD, et al: One hundred consecutive hepatic resections: blood loss, transfusion, and operative technique, *Arch Surg* 129:1050–1056, 1994.

- Curley SA, et al: Radiofrequency ablation of unresectable primary and metastatic hepatic malignancies: results in 123 patients, *Ann Surg* 230:1–8, 1999.
- Da Costa JM: Cancer of the pancreas, *North Am Med-Chir Rev* 2:883, 1858.
- Dahl R: Eine Neue operation des gallenwege, *Zb F Chir* 36:266, 1909.
- Damadian R: Tumor detection by nuclear magnetic resonance, *Science* 171:1151–1153, 1971.
- DeMatteo RP, et al: Anatomic segmental hepatic resection is superior to wedge resection as an oncologic operation for colorectal liver metastases, *J Gastrointest Surg* 4:178–184, 2000.
- Demling L, Classen M: Duodenojejunostomy, *Dtsch Med Wochenschr* 95:1427–1428, 1970.
- Di Sebastiano P, et al: Management of chronic pancreatitis: conservative, endoscopic, and surgical. In Blumgart LH, et al, editors: *Surgery of the liver, biliary tract, and pancreas*, vol II, ed 4, Philadelphia, 2007, Saunders, pp 1341–1386.
- Doubilet H, Mulholland JH: The surgical treatment of recurrent acute pancreatitis by endocholedochal sphincterotomy, *Surg Gynecol Obstet* 86:295–306, 1948.
- Dubois E, et al: Cholecystectomy by coelioscopy, *Presse Med* 18:980–982, 1989.
- Dubois E, et al: Coelioscopic cholecystectomy: preliminary report of 36 cases, *Ann Surg* 211:60–62, 1990.
- Du Val MK: Pancreaticojejunostomy for chronic pancreatitis, *Surgery* 41:1019–1028, 1957.
- Ebara M, et al: Percutaneous ethanol injection for the treatment of small hepatocellular carcinoma: study of 95 patients, *J Gastroenterol Hepatol* 5:616–626, 1990.
- Elias D, et al: Another failure in the attempt of definition of the indications to the resection of liver metastases of colorectal origin, *J Chir Surg (Paris)* 129:59–65, 1992.
- Elliot J: Surgical treatment of tumor of the liver with report of a case, *Ann Surg* 26:83, 1897.
- Ensminger W, et al: Effective control of liver metastases from colon cancer with an implanted system for hepatic arterial chemotherapy, *Proc Am Clin Oncol* 1:94, 1982.
- Estefan A, et al: Anastomosis colangiodigestivas en cancer bilar, *Cir Uruguay* 47:51, 1977.
- Fallis LS, Szilagyi DE: Observations on some metabolic changes after total pancreatoduodenectomy, *Ann Surg* 128:639–667, 1948.
- Ferzli G, et al: Laparoscopic resection of a large hepatic tumor, *Surg Endosc* 9:733–735, 1995.
- Fong Y, Blumgart LH: Useful stapling techniques in liver surgery, *J Am Coll Surg* 185:93–100, 1997.
- Fong Y, et al: Repeat hepatic resections for metastatic colorectal cancer, *Ann Surg* 220:657–662, 1994.
- Fong Y, et al: Drainage is unnecessary after elective liver resection, *Am J Surg* 171:158–162, 1996.
- Fong Y, et al: Clinical score for predicting recurrence after hepatic resection for metastatic colorectal cancer: analysis of 1001 consecutive cases, *Ann Surg* 230:309–318, 1999.
- Fong Y, et al: Gallbladder cancer: comparison of patients presenting initially for definitive operation with those presenting after prior noncurative intervention, *Ann Surg* 232:557–569, 2000.
- Fortner J: Regional resection of cancer of the pancreas: a new surgical approach, *Surgery* 73:307–320, 1973.
- Fortner JG, Blumgart LH: A historic perspective of liver surgery for tumors at the end of the millennium, *J Am Coll Surg* 193:210–222, 2001.
- Fortner JG, et al: Orthotopic and heterotopic liver homografts in man, *Ann Surg* 172:23–32, 1970.
- Fortner JG, et al: A new concept for hepatic lobectomy: experimental studies and clinical application, *Arch Surg* 102:312–315, 1971.
- Fortner JG, et al: Major hepatic resection using vascular isolation and hypothermic perfusion, *Ann Surg* 180:644–652, 1974.
- Fortner JG, et al: Surgical management of carcinoma of the junction of the main hepatic ducts, *Ann Surg* 184:68–73, 1976.
- Fortner JG, et al: Major hepatic resection for neoplasia: personal experience in 108 patients, *Ann Surg* 188:363–371, 1978.
- Foster JH: Survival after liver resection for cancer, *Cancer* 26:493–502, 1970.
- Franco D, et al: Hepatectomy without abdominal drainage: results of a prospective study in 61 patients, *Ann Surg* 210:748–750, 1989.
- Frey C, Smith G: Description and rationale of a new operation for chronic pancreatitis, *Pancreas* 2:701–707, 1987.
- Gagner M, et al: Laparoscopic partial hepatectomy for liver tumor, *Surg Endosc* 6:99, 1992.
- Garre C: On resection of the liver, *Surg Gynecol Obstet* 5:331, 1907.
- Gaston J: *Surgery of the gall bladder and ducts*, vol IX, New York, 1897, William Wood.
- Geevarghese SK, et al: Outcomes analysis in 100 liver transplantation patients, *Am J Surg* 175:348–353, 1998.
- Gibson T, Medawar PB: The fate of skin homografts in man, *J Anat* 77:299–310, 1943.
- Gigot JF, et al: Laparoscopic liver resection for malignant liver tumors: preliminary results of a multicenter European study, *Ann Surg* 236:90–97, 2002.
- Glenn F: Biliary tract disease since antiquity, *Bull N Y Acad Med* 47:329–350, 1971.
- Goetze O: [Transhepatic permanent drainage in high-seated stenosis of the common bile duct]. Eine transhepatische Dauer Drainage bei der hohen Gallengang stenose, *Langenbecks Arch Klin Chir Ver Dtsch Z Chir* 270:97–101, 1951.
- Goldsmith NA, Woodburne RT: The surgical anatomy pertaining to liver resection, *Surg Gynecol Obstet* 105:310–318, 1957.
- Graham EA, Cole WH: Roentgenologic examination of the gallbladder, *JAMA* 82:613, 1924.
- Graham EA, Hartmann AF: Subtotal resection of the pancreas for hypoglycemia, *Surg Gynecol Obstet* 59:474–479, 1934.
- Green R: *A translation of Galen's hygiene*, Springfield, IL, 1951, Thomas.
- Grossman ZD, et al: RN Imaging, CT and gray-scale ultrasonography of the liver: a comparative study, *J Nucl Med* 18:327–332, 1977.
- Groth CG, Longmire WP: Historical landmarks in clinical transplantation, *World J Surg* 24:755–843, 2000.
- Gussenbauer G: Zur operativen Behandlung der Pancreascysten, *Arch Klin Chir* 29:355, 1883.
- Hadjis NS, et al: Outcome of radical surgery in hilar cholangiocarcinoma, *Surgery* 107:597–604, 1990.
- Halsted W: Contributions to the surgery of the bile passages, especially of the common bile duct, *Johns Hopkins Hosp Bull* 11:1, 1900.
- Hartmann H: *Chirurgie des voies biliaires*, Paris, 1923, Masson.
- Hasegawa H, et al: Central bisegmentectomy of the liver: experience in 16 patients, *World J Surg* 13:786–790, 1989.
- Healey J, Schroy P: The anatomy of the bile ducts within the human liver: an analysis of the prevailing patterns of branching and their major variants, *Arch Surg* 66:599–616, 1953.
- Heaney JP, et al: An improved technique for vascular isolation of the liver: experimental study and case reports, *Ann Surg* 163:237–241, 1966.
- Hemingway AP, Allison DJ: Complications of embolization: analysis of 410 procedures, *Radiology* 166:669–672, 1988.
- Hepp J, Couinaud C: [Approach to and use of the left hepatic duct in reparation of the common bile duct]. L'abord et l'utilisation du canal hépatique gauche dans les réparations de la voie biliare principale, *Presse Med* 64:947–948, 1956.
- Hjortsjo C: The topography of the intrahepatic duct systems, *Acta Anat* 11:599–615, 1951.
- Hochwald SN, Blumgart LH: Giant hepatic hemangioma with Kasabach-Merritt syndrome: is the appropriate treatment enucleation or liver transplantation?, *HPB Surg* 11:413–419, 2000.
- Hodgson WJ, DeGuercio LR: Preliminary experience in liver surgery using the ultrasonic scalpel, *Surgery* 95:230–234, 1984.
- Honjo I: Resection of the right lobe of the liver, *Shujutsu* 4:345–349, 1950.
- Honjo I, Araki C: Total resection of the right lobe of the liver, *J Int Coll Surg* 1:23–28, 1955.
- House M, et al: Survival after hepatic resection for metastatic colorectal cancer: trends in outcomes for 1,600 patients during two decades at a single institution, *J Am Coll Surg* 210:744–752, 752–755, 2010.
- Huguet C, et al: Normothermic hepatic vascular exclusion for extensive hepatectomy, *Surg Gynecol Obstet* 147:689–696, 1978.
- Huguet C, et al: Technique of hepatic vascular exclusion for extensive liver resection, *Am J Surg* 163:602–605, 1992.
- Huguet C, et al: Hepatic resection with ischemia of the liver exceeding one hour, *J Am Coll Surg* 178:454–458, 1994.
- Imrie CW: Medical treatment of acute pancreatitis, *Gastroenterology* 75:766–767, 1978.
- Iwatsuki S, et al: Experience in 1,000 liver transplants under cyclosporine-steroid therapy: a survival report, *Transplant Proc* 20(Suppl 1):498–504, 1988.

- Jarnagin WR, et al: Staging, resectability, and outcome in 225 patients with hilar cholangiocarcinoma, *Ann Surg* 234:507–519, 2001.
- Jarnagin WR, et al: Improvement in perioperative outcome after hepatic resection: analysis of 1,803 consecutive cases over the past decade, *Ann Surg* 236:397–406, 2002.
- Jastrow M: The liver in antiquity and the beginnings of anatomy, *Trans Col Phila* 39:117–138, 1908.
- Jedlicka R: Eine neue Operations methode der Pankreaszysten, *Zentralbl Chir* 50:132, 1923.
- Jourdan M: *De la choledochotomie stenheil*, Paris, 1895.
- Kausch W: Das Carcinoma der Papilla duodeni und seine radikale Entfernung, *Beitr Klin Chir* 78:29, 1912.
- Keen W: Report of a case of resection of the liver for the removal of a neoplasm, with a table of seventy-six cases of resection of the liver for hepatic tumors, *Ann Surg* 30:267, 1899.
- Kehr H: Die Behandlung der kalkulösen Cholangitis durch die direkte Drainage des Ductus Hepaticus, *Munch Med Wochenschr* 44:1128, 1897.
- Kehr H: *Drei jahre gallensteinechirurgie*, München, 1908a, Lehmann.
- Kehr H: Gallensteine, *Congr Soc Int Chir* 20:341, 1908b.
- Kehr H: Zur Verbesserung der Hepaticus Drainage, *Zbl B Chir* 40:1017, 1912.
- Kehr H: *Chirurgie der gallenwege*, Stuttgart, 1913, Ferdinand Enke.
- Kemeny N, et al: Hepatic arterial infusion of chemotherapy after resection of hepatic metastases from colorectal cancer, *N Engl J Med* 341:2039–2048, 1999.
- Klempnauer J, et al: What constitutes long-term survival after surgery for hilar cholangiocarcinoma?, *Cancer* 79:26–34, 1997.
- Kocher T: Ein Fall von Choledoch-Duodenostomia interna wegen Gallenstein, *Korrespondenbl Schweizer Arzte* 1:192, 1895.
- Kocher T: Mobilisierung des Duodenum und Gastroduodenostomie, *Zentralbl Chir* 30:333, 1903.
- König E: Die innere Anastomose in de Behandlung der Pankreaszyten, *Der Chirurg* 17:24, 1946.
- Kousnetzoff M, Pinsky J: Sur la resection partielle du foie, *Rev Chir* 16:954, 1896.
- Laine J, et al: Successful liver transplantation after induction chemotherapy in children with inoperable, multifocal primary hepatic malignancy, *Transplantation* 67:1369–1372, 1999.
- Lang H, et al: Extended left hepatectomy—modified operation planning based on three-dimensional visualization of liver anatomy, *Langenbecks Arch Surg* 389:306–310, 2004.
- Langenbuch C: Ein Fall von extirpation der Gallenblase wegen chronischer Cholelithiasis, *Heilung Berl Klin Wochenschr* 19:725, 1882.
- Langenbuch C: Ein Fall von Resektion eines linksseitig Schnur Lappens der Leber, *Heilung Klin Wochenschr* 25:37, 1888.
- Langenbuch C: Ein Rückblick auf die Entwicklung der Chirurgie des Gallen Systems, *Verh Dtsch Ges Chirurgie* 68, 1896.
- Launois B, Jamieson GG: The posterior intrahepatic approach for hepatectomy or removal of segments of the liver, *Surg Gynecol Obstet* 174:155–158, 1992.
- Launois B, et al: Carcinoma of the hepatic hilus: surgical management and the case for resection, *Ann Surg* 190:151–157, 1979.
- Lauterbur PC: Image formation by induced local interactions: examples employing nuclear magnetic resonance, *Nature* 242:190–191, 1973.
- Leger L, Brehand J: *Chirurgie de pancreas*, Paris, 1956, Masson.
- Lerut J, et al: Resection of the caudate lobe of the liver, *Surg Gynecol Obstet* 171:160–162, 1990.
- Lin T: Study of a lobectomy of the liver, *J Formosa Med Assoc* 57:742–759, 1958.
- Lin TY, Chen CC: Metabolic function and regeneration of cirrhotic and non-cirrhotic livers after hepatic lobectomy in man, *Ann Surg* 162:959–972, 1965.
- Link G: Pancreatostomy for chronic pancreatitis with calculi in the duct of Wirsung and diffuse calcinosis of the pancreatic parenchyma, *Ann Surg* 138:287, 1953.
- Lister J: On a new method of treating compound fracture, abscess, and observations on the condition of suppuration, *Lancet* i:326, 357, 387, 507, 1867a.
- Lister J: On the antiseptic principle in the practice of surgery, *Br J Surg* ii:246, 1867b.
- Liver Cancer Study Group of Japan: Primary liver cancer in Japan: clinicopathologic features and results of surgical treatment, *Ann Surg* 211:277–287, 1990.
- Longmire WP, Marable SA: Clinical experiences with major hepatic resections, *Ann Surg* 154:460–474, 1961.
- Longmire WP, Sanford M: Intrahepatic cholangiojejunostomy with partial hepatectomy for obstruction, *Surgery* 24:264, 1948.
- Longmire WP, et al: Experience with resection of the pancreas in treatment of chronic relapsing pancreatitis, *Ann Surg* 14:681, 1956.
- Lortat-Jacob J, Robert H: Hépatectomie droite réglée, *Presse Med* 60:549–551, 1952.
- Lucke T: Entfernung des Linken krebs Leber Lappans, *Zentralbl Chir* 18:115, 1891.
- MacBurney C: Removal of biliary calculi from the common duct by the duodenal route, *Ann Surg* 28:481, 1898.
- Madden JL, et al: Obstructive (surgical) jaundice: an analysis of 140 consecutive cases and a consideration of choledochoduodenostomy in its treatment, *Am J Surg* 109:89–99, 1965.
- Major R: *History of medicine*, Springfield, IL, 1954, Thomas.
- Makuuchi M, et al: Ultrasonically guided subsegmentectomy, *Surg Gynecol Obstet* 161:346–350, 1985.
- Mallet-Guy P: Pancréatectomie gauche pour pancréatite chronique récidivante, *Lyon Chir* 47:385–399, 1952.
- Marescaux J, et al: Virtual reality applied to hepatic surgery simulation: the next revolution, *Ann Surg* 228:627–634, 1998.
- Mayo W: Cancer of the common bile duct: report of a case of carcinoma of the duodenal end of the common duct with successful excision, *St Paul Med J* 3:374, 1901.
- Mazzaferro V, Regalia E, et al: Liver transplantation for the treatment of small hepatocellular carcinomas in patients with cirrhosis, *N Engl J Med* 334:693–699, 1996.
- Mazzariello RM: La extracción instrumental de los calculos biliares residuales, *Bol Soc Arg Cir* 27:640–660, 1966.
- Mazzariello RM: Transcholecystic extraction of residual calculi in common bile duct, *Surgery* 75:338–347, 1974.
- McBride CM, Wallace S: Cancer of the right lobe of the liver: a variety of operative procedures, *Arch Surg* 105:289–296, 1972.
- McCune WS, et al: Endoscopic cannulation of the ampulla of Vater: a preliminary report, *Ann Surg* 167:752–756, 1968.
- McIver MA: An instrument for visualization of the interior of the common bile duct at operation, *Surgery* 9:112–114, 1941.
- Medawar PB: The behavior and fate of skin autografts and skin homografts in rabbits, *J Anat* 78:176–199, 1944.
- Melendez JA, et al: Perioperative outcomes of major hepatic resections under low central venous pressure anesthesia: blood loss, blood transfusion, and the risk of postoperative renal dysfunction, *J Am Coll Surg* 187:620–625, 1998.
- Mercadier M: Les pancréatectomies presque totales de gauche à droite: nouvelle tentative de traitement chirurgical de la pancréatite, *Mem Acad Chir (Paris)* 90:84–88, 1964.
- Mirizzi P: La colangiografia durante las operaciones de las vias biliares, *Bol Soc Cir Cuenos Bires* 16:1133, 1932.
- Mirizzi P: Operative cholangiography, *Surg Gynecol Obstet* 65:702–710, 1937.
- Mizumoto R, Suzuki H: Surgical anatomy of the hepatic hilum with special reference to the caudate lobe, *World J Surg* 12:2–10, 1988.
- Mondet AF: Technic of blood extraction of calculi in residual lithiasis of the choledochus, *Bol Trab Soc Cir B Aires* 46:278–290, 1962.
- Monprofit A: Une nouvelle methode de cholecystenterostomie: la cholecystentero-stomie en Y, *Arch Provinc Chir* 13:380, 1904.
- Morgagni G: *Seats and causes of disease, facsimile of London 1769 ed*, New York, 1960, Hafner.
- Morgenstern L: The murder of Johann Georg Wirsung, *Surgery* 57:906, 1965.
- Muhe E: Die erste Cholecystectomie durch das Laparoskop, *Langenbecks Arch Chir* 369:804, 1986.
- Muhe E: Laparoscopic cholecystectomy: late results, *Langenbecks Arch Chir (Suppl)*:416–423, 1991.
- Murray JE, Hills W: The first successful organ transplants in man, *J Am Coll Surg* 200:5–9, 2005.
- Nimier H: Notes sur la chirurgie du pancréas, *Rev Chir* 13:41, 1893.
- Nimura Y, et al: Hepatic segmentectomy with caudate lobe resection for bile duct carcinoma of the hepatic hilus, *World J Surg* 14:535–543, 1990.
- Ockinczyc P: *Technique opératoire du pancréas et de la rate*, Paris, 1933, Doin.

- Oddi R: Effetti dell'estirpazione della cistifella, *Arq Ital Biolog* 10:425, 1888.
- Ohto M, Tsuchiya Y: Non-surgically available percutaneous transhepatic cholangiography: technique and cases, *Medicina (Tokyo)* 6:735–739, 1969.
- Oi I, et al: Endoscopic pancreaticholangiography, *Endoscopy* 2:103–106, 1970.
- Okuda K, et al: Nonsurgical, percutaneous transhepatic cholangiography: diagnostic significance in medical problems of the liver, *Am J Dig Dis* 19:21–36, 1974.
- Olthoff KM, et al: Adjuvant chemotherapy improves survival after liver transplantation for hepatocellular carcinoma, *Ann Surg* 221:734–741, 1995.
- Ombredanne L: Kysto duodenostomie pancréatique, *Bulletin de la Societe Nationale de la Chirurgie* 37:977, 1911.
- Ong GB: Techniques and therapies for primary and metastatic liver cancer, *Curr Probl Cancer* 2:1–48, 1977.
- Pack GT, Miller TR: Middle hepatic lobectomy for cancer, *Cancer* 14:1295–1300, 1961.
- Pack GT, et al: Total right hepatic lobectomy for cancer of the gallbladder: report of three cases, *Ann Surg* 91:829–832, 1955.
- Pack GT, et al: Regeneration of human liver after major hepatectomy, *Surgery* 52:617–623, 1962.
- Papachristou DN, Barters R: Resection of the liver with a water jet, *Br J Surg* 69:93–94, 1982.
- Patel J, Couinaud C: Au sujet du “premier cas d'hépatomie droite réglée”, *Mem Acad Chir* 78:253–254, 1952a.
- Patel J, Couinaud C: Remarques techniques sur l'hépatomie droite par ligature première des pédicule vasculaires, *Presse Med* 60:1819–1820, 1952b.
- Penn I: Secondary neoplasms as a consequence of transplantation and cancer therapy, *Cancer Detect Prev* 12:39–57, 1988.
- Penn I, Brunson ME: Cancers after cyclosporine therapy, *Transplant Proc* 20(Suppl 3):885–892, 1988.
- Penn I, Starzl TE: Malignant tumors arising de novo in immunosuppressed organ transplant recipients, *Transplantation* 14:407–417, 1972.
- Perissat J, et al: Gallstones: laparoscopic treatment: cholecystectomy, cholecystostomy, and lithotripsy, *Surg Endosc* 4:1–5, 1990.
- Pichlmayr R, et al: Transplantation of a donor liver to 2 recipients (splitting transplantation): a new method in the further development of segmental liver transplantation, *Langenbecks Arch Chir* 373:127–130, 1988.
- Pichlmayr R, et al: Technique and preliminary results of extracorporeal liver surgery (bench procedure) and of surgery on the in situ perfused liver, *Br J Surg* 77:21–26, 1990.
- Polk W, et al: A technique for the use of cryosurgery to assist hepatic resection, *J Am Coll Surg* 180:171–176, 1995.
- Praderi R: One hundred years of biliary surgery, *Surg Gastroenterol* 1:269, 1982.
- Priestley JT, et al: Total pancreatectomy for hyperinsulinism due to islet cell adenoma: survival and cure at 16 months after operational presentation of metabolic studies, *Ann Surg* 119:221, 1944.
- Pringle JH: Notes on the arrest of hepatic hemorrhage due to trauma, *Ann Surg* 48:514–519, 1908.
- Prinz R, Greenlee H: Pancreatic duct drainage in 100 patients with chronic pancreatitis, *Ann Surg* 194:313–320, 1981.
- Quattlebaum J: Massive resection of the liver, *Ann Surg* 137:787–796, 1953.
- Quenu A, Duval P: Les angiocholites aiguës, *Aiguës Congres Soc Int Chir* 20:453, 1908.
- Raia S, et al: Liver transplantation from live donors, *Lancet* 2:497, 1989.
- Rains H: *Gallstones: causes and treatment*, London, 1964, Heinemann.
- Ranson JHC, et al: Prognostic signs and non-operative peritoneal lavage in acute pancreatitis, *Surg Gynecol Obstet* 143:595, 1976.
- Ravikumar TS, Kaleya RN: Cryotherapy for liver tumors. In Blumgart LH, Fong Y, editors: *Surgery of the liver and biliary tract*, ed 3, Philadelphia, 2000, Saunders, pp 1577–1589.
- Rea DJ, et al: Liver transplantation with neoadjuvant chemoradiation is more effective than resection for hilar cholangiocarcinoma, *Ann Surg* 242:451–461, 2005.
- ReMine W, et al: Total pancreatectomy, *Ann Surg* 172:595–604, 1970.
- Rex H: Beitrage zur Morphologie der Saugerleber, *Morphol Jahrb* 14:517–617, 1888.
- Riedel B: *Erfahrungen über die gallensteinkrankheit mit und ohne ikterus*, Berlin, 1892, Hirschwald.
- Ringe B, et al: The role of liver transplantation in hepatobiliary malignancy: a retrospective analysis of 95 patients with particular regard to tumor stage and recurrence, *Ann Surg* 209:88–98, 1989.
- Ringe B, et al: Surgical treatment of hepatocellular carcinoma: experience with liver resection and transplantation in 198 patients, *World J Surg* 15:270–285, 1991.
- Roget C: *La pancreatectomie gauche d'amont dans le traitement de la lithiase du canal de wirsung*, thesis, Lyon, 1958.
- Rosner F: Pigeons as a remedy (segulah) for jaundice, *NY State J Med* 92:189–192, 1992.
- Roux C: De la gastro-entérostomie, *Rev Gynecol Chir Abdom* 1:67–122, 1897.
- Ruggi G: Intorno ad un caso di carcinoma primitivo del pancreas, curato e guarito con l'asportazione del tumore, *Giornale Internazionale della Scienza Medica* 12:81, 1890.
- Satava RM: Emerging technologies for surgery in the 21st century, *Arch Surg* 134:1197–1202, 1999.
- Sauve L: Des pancreatectomies et spécialement de la pancreatectomie céphalique, *Rev Chir (Paris)* 37:335, 1908.
- Scheele J: Segment oriented resection of the liver: rationale and technique. In Lygidakis NJ, Tygart G, editors: *Hepatobiliary and pancreatic malignancies*, Stuttgart, 1989, Thieme, pp 219–246.
- Scheele J, Stangl R: Segment-orientated anatomical liver resections. In Blumgart LH, Fong Y, editors: *Surgery of the liver and biliary tract*, ed 3, Edinburgh, 2000, Churchill Livingstone, pp 1743–1764.
- Schein CJ, Gliedman ML: Choledochooduodenostomy as an adjunct to choledocholithotomy, *Surg Gynecol Obstet* 152:797–804, 1981.
- Senn N: Surgery of the pancreas as based upon experiments and clinical researches, *Trans Am Surg Assoc* 4:99, 1886.
- Serrea P, Brunschwig A: Freezing of liver parenchyma with liquid nitrogen for hemostasis in excisional liver surgery: an experimental study, *Cancer* 8:1234–1238, 1955.
- Sims J: Remarks on cholecystotomy in dropsy of the gallbladder, *BMJ* 1:811, 1878.
- Singer CJ, Long ER: *Translation of benivieni's “the hidden causes of disease.”*, Springfield, IL, 1954, Charles C. Thomas.
- Soupault R, Couinaud C: Sur un procédé nouveau de dérivation biliaire intrahépatique: la cholangio-jéjunostomie gauche sans sacrifice hépatique, *Presse Med* 65:1157, 1957.
- Spencer WG: *Translation of celsus's “de medicina,” loeb classical library ed*, Cambridge, MA, 1935, Harvard University Press.
- Sprengel O: Über einen Fall von Exstirpation der Gallenblase mit anlegung einer Communication zwischen Ductus choledochus und Duodenum, *Arch Klin Chir* 42:550, 1891.
- Starzl TE: The birth of clinical organ transplantation, *J Am Coll Surg* 192:431–446, 2001.
- Starzl TE, et al: Orthotopic homotransplantation of the human liver, *Ann Surg* 168:392–415, 1968.
- Starzl TE, et al: Hepatic trisegmentectomy and other liver resections, *Surg Gynecol Obstet* 141:429–437, 1975.
- Starzl TE, et al: Fifteen years of clinical liver transplantation, *Gastroenterology* 77:375–388, 1979.
- Storm FK, Longmire WP Jr: A simplified clamp for hepatic resection, *Surg Gynecol Obstet* 133:103–104, 1971.
- Strong RW, et al: Successful liver transplantation from a living donor to her son, *N Engl J Med* 322:1505–1507, 1990.
- Tabuse K: A new operative procedure of hepatic surgery using a microwave tissue coagulator, *Nippon Geka Hokan* 48:160–172, 1979.
- Tait L: Cholecystotomy versus cholecystectomy, *BMJ* 1:1224, 1885.
- Takasaki K, et al: New developed systematized hepatectomy by Glissonian pedicle transaction method, *Syujutu (Operation)* 40:7–14, 1986.
- Tang ZY: Liver cancer surgery, *Semin Surg Oncol* 9:291–292, 1993.
- Tanikawa K: Advancement of ethanol injection therapy for hepatocellular carcinoma, *Shokoki Geka* 14:1389–1395, 1991.
- Tenani O: Contributo alla Chirurgia della Papilla di Vater, *Policlinico* 29:291, 1922.
- Thiersch A: Operative Drainage einer Cyste des Pankreas, *Berl Klin Wochenschr* 18:591, 1881.
- Thompson HH, et al: Major hepatic resection: a 25-year experience, *Ann Surg* 197:375–388, 1983.
- Thornton H: Removal of a calculus from the common bile duct—2 inches long and 3/2 inches in circumference—without suturing the duct, *Lancet* 2:22, 1898.

- Tiffany L: The removal of a solid tumor from the liver by laparotomy, *Md Med J* 23:531, 1890.
- Ton TT: *Les resections majeurs et mineurs du foie*, Paris, 1979, Masson.
- Traverso LW: Carl Langenbuch and the first cholecystectomy, *Am J Surg* 132:81–82, 1976.
- Vautrin A: De l'obstruction calculeuse du choledoque, *Rev Chir* 16:446, 1896.
- von Puestow CB, Gillespy WJ: Management of pancreatic cysts and pancreatic lithiasis, *Am Surg* 20:355–362, 1958.
- von Winiwarter A: Ein Fall von Gallenretention bedingt durch impermeabilität des Ductus choledochus anlegung einer Gallenblasen Darmfistel, heilung, *Prager Mediz Wochensf* 7:201, 1882.
- Voyles CR, Blumgart LH: A technique for the construction of high biliary-enteric anastomoses, *Surg Gynecol Obstet* 154:885–887, 1982.
- Walker R: Francis Glisson and his capsule, *Ann R Coll Surg Engl* 38:71–91, 1966.
- Warren KW, Jefferson MP: Prevention and repair of strictures of the extra-hepatic bile ducts, *Surg Clin North Am* 152:797–804, 1973.
- Warvi W: Primary tumors of the liver, *Surg Gynecol Obstet* 80:643–650, 1945.
- Weigall A: *Alexander the great*, London, 1933, Putnam's Sons.
- Wendell W: Beiträge zur Chirurgie der Leber, *Arch Klin Chir* 95:887–892, 1911.
- Whipple AO: Rationale of radical surgery of cancer of the pancreas and ampullary region, *Ann Surg* 114:612–615, 1941.
- Whipple AO, et al: Treatment of carcinoma of the ampulla of Vater, *Ann Surg* 102:765–769, 1935.
- Wilder RM, et al: Carcinoma of the islands of the pancreas, hyperinsulinism and hypoglycemia, *JAMA* 89:348–355, 1927.
- Wilson SM, Adson MA: Surgical treatment of hepatic metastases from colorectal cancers, *Arch Surg* 111:330–334, 1976.
- Wood CB, et al: A retrospective study of the natural history of patients with liver metastases from colorectal cancer, *Clin Oncol* 2:285–288, 1976.
- Wood M: Presidential address: eponyms in biliary tract surgery, *Am J Surg* 138:746–754, 1979.
- Wood TF, et al: Radiofrequency ablation of 231 unresectable hepatic tumors: indications, limitations, and complications, *Ann Surg Oncol* 7:593–600, 2000.
- Yamaoka Y, et al: Liver transplantation using a right lobe graft from a living related donor, *Transplantation* 57:1127–1130, 1994.
- Zeevi A, et al: Immunosuppressive effect of FK-506 on in vitro lymphocyte alloactivation: synergism with cyclosporine A, *Transplant Proc* 19(Suppl 6):40–44, 1987.
- Zhou XD, et al: Clinical evaluation of cryosurgery in the treatment of primary liver cancer: report of 60 cases, *Cancer* 61:1889–1892, 1988.