Essentials of Clinical Hepatology

Charles F. Gholson *Bruce R. Bacon*

Essentials of Clinical Hepatology

Charles F. Gholson, *M.D.*
Associate Professor of Medicine
Section of Gastroenterology and Hepatology
Department of Medicine
Louisiana State University School of Medicine
Shreveport, Louisiana

Bruce R. Bacon, *M.D.*
Professor of Internal Medicine
Director
Division of Gastroenterology and Hepatology
St. Louis University School of Medicine
St. Louis, Missouri

with 122 illustrations

Mosby Year Book

St. Louis Baltimore Boston Chicago London Philadelphia Sydney Toronto

Mosby Year Book
Dedicated to Publishing Excellence

Editor: Stephanie Manning
Assistant Editor: Jane Petrash
Project Manager: Gayle May Morris
Manuscript Editor: Mary Cusick Drone
Book Designer: Susan Lane

Printed in the United States of America

Mosby-Year Book, Inc.
11830 Westline Industrial Drive
St. Louis, Missouri 63146

Library of Congress Cataloging-in-Publication Data
Gholson, Charles F.
Essentials of clinical hepatology / Charles F. Gholson, Bruce R. Bacon.
p. cm.
Includes bibliographical references and index.
ISBN 0-8016-6428-4
1. Liver—Pathophysiology. I. Bacon, Bruce R. II. Title.
[DNLM: 1. Biliary tract—Pathophysiology. WI 700 G427e]
RC846.9046 1992
616.3'607—dc20
DNLM/DLC
for Library of Congress 92-16186
CIP

93 94 95 96 97 CL/MV 9 8 7 6 5 4 3 2 1

Essentials of Clinical Hepatology

Contributors

Charles H. Andrus, *M.D., F.A.C.S.*
Assistant Professor of Surgery
St. Louis University School of Medicine
St. Louis, Missouri

Frank R. Burton, *M.D.*
Associate Professor of Internal Medicine
St. Louis University School of Medicine
St. Louis, Missouri

Ralph B. Fairchild, *M.D.*
Assistant Professor of Surgery
St. Louis University School of Medicine
St. Louis, Missouri

Shobha N. Joshi, *M.D.*
Associate Professor of Internal Medicine
St. Louis University School of Medicine
St. Louis, Missouri

Donald L. Kaminski, *M.D.*
Professor of Surgery
Chief, Division of General Surgery
St. Louis University School of Medicine
St. Louis, Missouri

Preface

This textbook is designed to fill the gap between descriptions of hepatobiliary disease in textbooks of general internal medicine and large multiauthored textbooks of hepatology. The former are too superficial and the latter too extensive for use by gastroenterology fellows and practicing gastroenterologists who do not specialize in hepatology.

In an effort to fill this gap, we have comprised *Essentials of Clinical Hepatology*. It is our hope that this concise, relatively inexpensive textbook will be useful to the reader seeking the basic concepts necessary to understand and manage common adult liver diseases. To this end, we have made a special effort to summarize relevant, new basic science data into a concise, digested format that individuals who are not basic investigators can understand. Whenever possible, clinical applications of advancements in basic science will be emphasized to provide an enhanced understanding of pathophysiology and pathobiology.

We have made a conscious effort to conclude each chapter with recent (<10 years old if possible) selected references and to eliminate documentary references for well-established facts summarized in the text. It is our hope that the reader will use this bibliography to seek more in-depth knowledge. We hope that the numerous tables will concisely summarize the main facts in each chapter and enable the reader to rapidly review the text.

Whenever possible, we have attempted to integrate the evaluation and management of liver disease into a concise format, with emphasis on pathophysiology, which should be quite useful to practicing physicians. Finally, the surgical principles of therapy for liver disease and liver transplantation will be presented in a format designed to enhance understanding by nonsurgeons. It is our hope that this book will summarize the facts needed to practice modern hepatology and will be especially helpful for gastroenterology fellows, senior internal medicine residents, and practicing gastroenterologists.

We are deeply indebted to a number of individuals, without whom this book could not have been written. Foremost among these is Ms. Careen Bresee for her outstanding secretarial assistance and Drs. Chris Janney and Beth Levy for their assistance in procuring histologic specimens. Finally, we thank our families for tolerating the long hours and many weekends expended in preparation of this text.

Charles F. Gholson, *M.D.*
Bruce R. Bacon, *M.D.*

Essentials of Clinical Hepatology

Contents

PART ONE

Essentials of Hepatic Function

1 Practical Hepatobiliary Anatomy and Physiology

Charles F. Gholson and Bruce R. Bacon

HEPATOBILIARY ANATOMY

Gross Anatomy of the Liver and Biliary Tree

The liver is the largest gland in the body, weighing 1200 to 1400 g in normal females and 1400 to 1600 g in normal males. It is derived from a ventral diverticulum of the embryonic foregut, which forms at 4 weeks' gestation and eventually assumes the configuration of a pyramidal, bilobed dome in the right upper abdomen. The hepatic parenchyma is highly vascular and friable because of its complex network of blood vessels that provide a unique dual afferent blood supply derived from the portal vein and, to a lesser extent, the hepatic artery. Excretory ducts comprising the biliary tree course throughout the liver parallel to these blood vessels and convey bile into the duodenum. The porta hepatis, on the inferior hepatic surface, routes this complex vascular and ductular network to and from the liver. Finally, the hepatic veins deliver venous blood to the vena cava. The embryonic anlagen of these structures are highly variable, creating complex anatomic relationships of the porta hepatis to adjacent vital structures, which complicate the surgical approach to and radiographic evaluation of this multifaceted organ.

Viewed grossly, the entire liver is covered by peritoneum, with the exception of the "bare area" (dorsal right lobe) and the porta hepatis (Fig. 1-1). Glisson's capsule, a thin connective tissue capsule beneath the peritoneal envelope, covers the entire hepatic parenchyma and coats the portal vein, hepatic artery, and bile ducts as they enter the porta hepatis. The diaphragmatic aspect of the liver lies adjacent to the pleura and lungs on the right and the pericardium on the left. The visceral aspect is impressed by the right kidney, the hepatic flexure of the colon and duodenum to the right, and the gastric antrum to the left. The liver is asymmetrically divided into right and left lobes by the falciform ligament. Examination of the larger right lobe from its inferior aspect reveals two smaller lobes: the quadrate lobe located anteriorly and the caudate lobe located posteriorly. Between these subdivisions is the porta hepatis, through which the portal vein, hepatic artery, and biliary tree enter the liver. Occasionally the most lateral aspect of the right lobe extends inferiorly, creating a normal anatomic variant (Riedel's lobe) that must be differentiated from true hepatomegaly.

Detailed studies demonstrate that these lobar divisions are superficial rather than functional in that they fail to correlate with major hepatic functional subdivisions predicted by the portal venous, hepatic arterial, and biliary tributaries within the liver. Injection of the right and left branches of the portal vein with celloidin of differing colors divides the liver into two "halves" by a plane passing inferiorly from the inferior vena cava to the gallbladder fossa (Fig. 1-2, *A* and *B*). The right lobe is

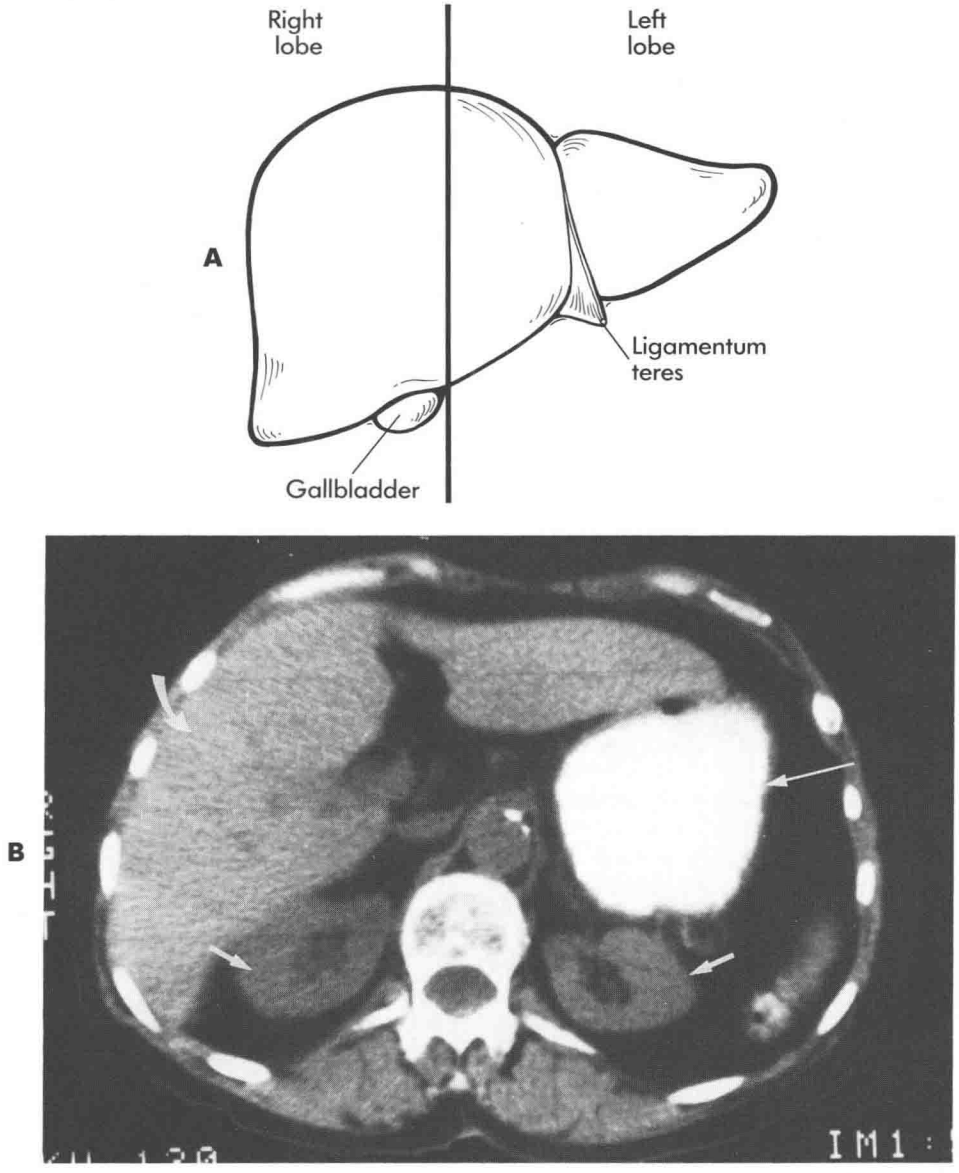
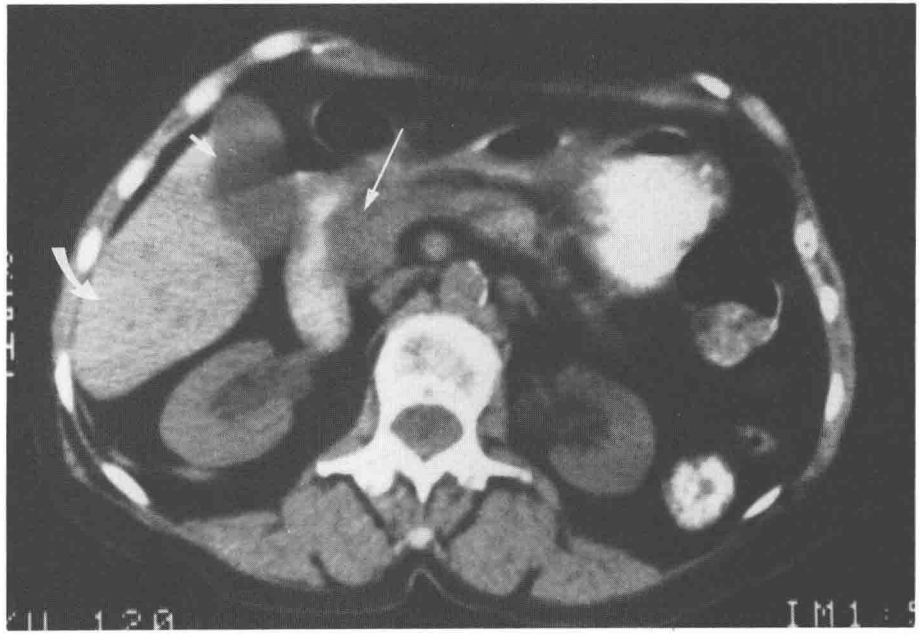


Fig. 1-1 **A,** Gross anatomy of the ventral aspect of the liver. **B,** Computed tomography image of normal liver *(curved arrow),* adjacent kidneys *(short arrows),* and stomach *(long arrow).*



C

Fig. 1-1—cont'd **C,** Scan slightly inferior to **B,** showing gallbladder *(short arrow),* adjacent right lobe of liver *(curved arrow),* and pancreas *(long arrow).*

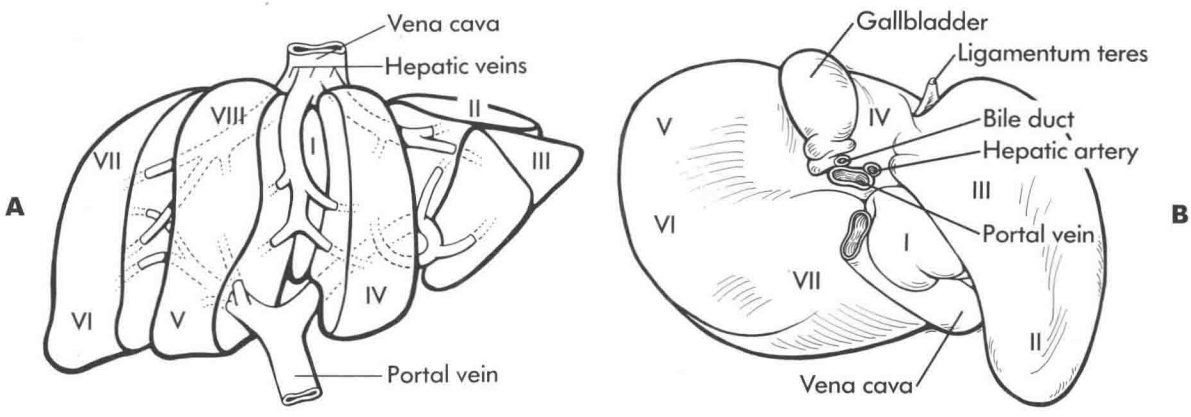


Fig. 1-2 **A,** Functional lobes of the liver. **B,** Inferior aspect of liver depicting porta hepatis and functional lobes.

further subdivided into anterior and posterior segments, and the left lobe into medial and lateral segments by the falciform ligament. Lobar divisions of the liver may be more theoretic than functional because internal fibrous septa do not separate the "lobes." Furthermore, the vascular and biliary supplies of the various lobes are functionally connected. Nevertheless, these "functional lobes" are technically useful when planning surgical resections.

The portal vein, hepatic artery, and biliary tree enter the liver together and maintain their association within the parenchyma to the microscopic level of the hepatic lobule, forming the portal triads. They are ensheathed extrahepatically by the lesser omentum until they enter the hepatic parenchyma at the porta hepatis, which is a fissure on the inferior surface of the right lobe of the liver. As they enter, the common hepatic duct is ventrolateral, the hepatic artery is dorsomedial, and the portal vein is between the two. The gallbladder and its fossa extend ventral to the porta hepatis. The common hepatic duct, hepatic artery, and portal vein generally branch at the porta hepatis into tributaries supplying the right and left functional lobes. The cystic artery, perfusing the gallbladder, usually arises from the right hepatic artery. Anatomic variation may occur as these vessels enter the porta hepatis.

The portal vein, formed by the confluence of the superior mesenteric and splenic veins, provides the majority of hepatic blood flow (Fig. 1-3, *A* to *D*). Because the portal vein

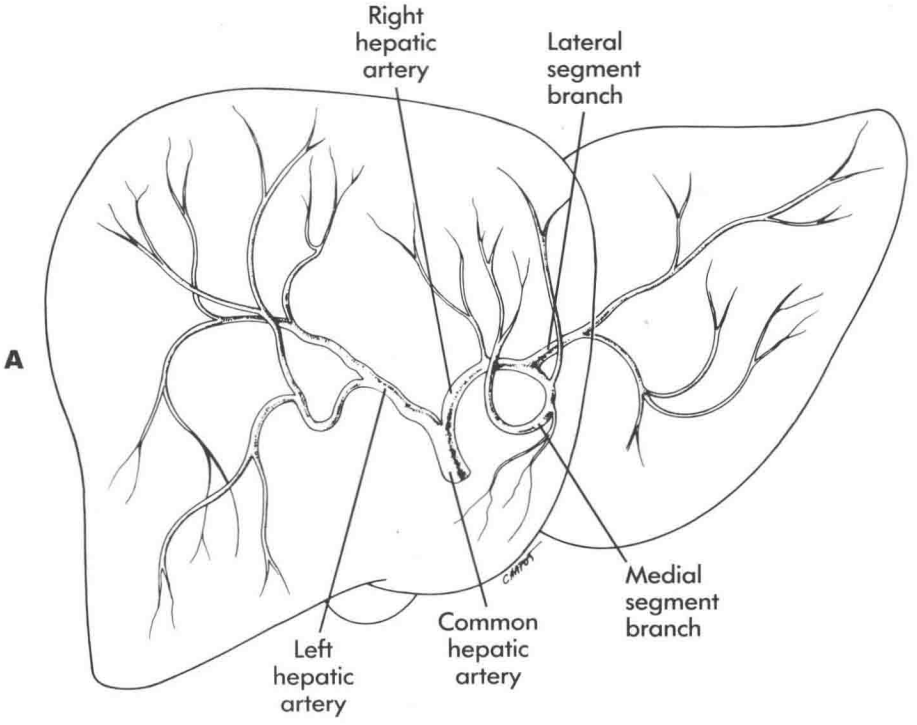
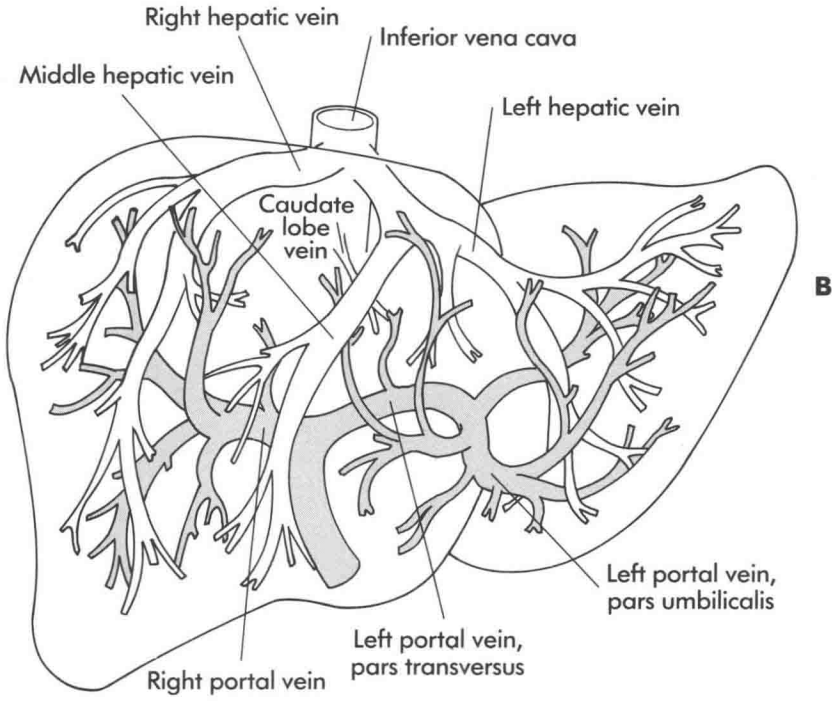


Fig. 1-3 **A,** Hepatic arterial circulation.



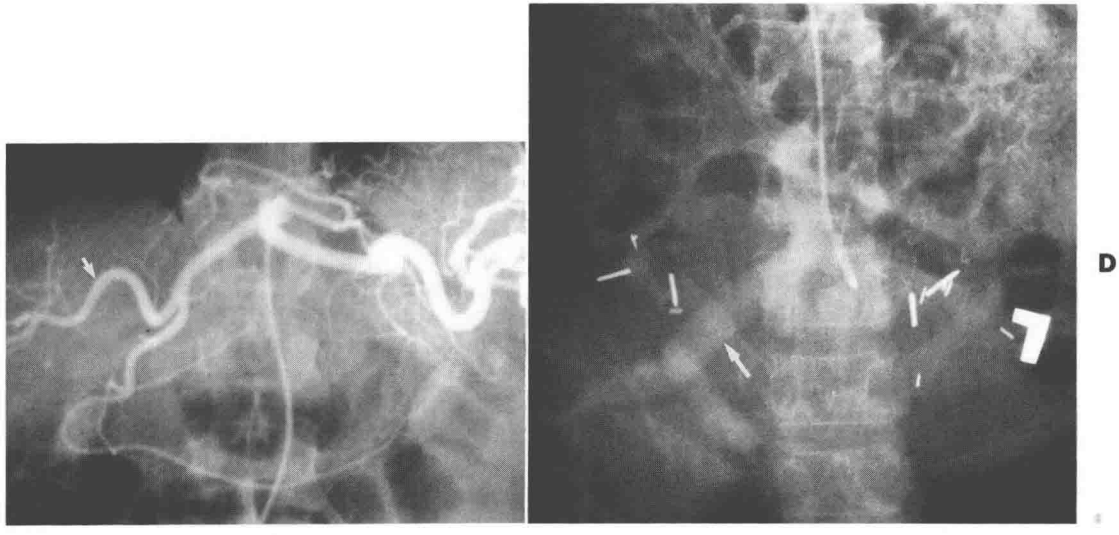


Fig. 1-3—cont'd **B,** Venous drainage. (From Campra JL, Reynolds T: The hepatic circulation. In Arias IM, Jakoby WB, Popper H and others: *The liver: biology and pathobiology,* New York, 1988, Raven Press, pp 912 and 915.). **C,** Celiac angiogram demonstrating hepatic artery *(arrow).* **D,** Venous phase of mesenteric angiogram demonstrating portal vein *(arrow).*

Table 1-1 Common sites of portosystemic collateral engorgement

Location	Clinical result
Squamocolumnar junctions	Esophageal varices Hemorrhoids Enterostomy varices
Umbilicus	Caput medusae
Retroperitoneum	Splenic vein enlarged Left renal vein enlarged
Retroperitoneal gut segments	Duodenal varices Cecal varices Ileal varices
Scars and adhesions	Hemorrhage when incised

lacks valves, retrograde flow can occur in pathologic states associated with portal hypertension, engorging previously collapsed venous collaterals as blood bypasses the liver en route to the heart. This results in pathologically dilated vascular collateral tributaries of the portal venous bed (Table 1-1).

The most important potential collateral channels are those that form esophageal varices. When portal venous pressure rises, as in cirrhosis with portal hypertension, blood is rerouted through the left gastric vein (coronary vein) and esophageal submucosal venous collaterals, which enlarge as flow increases, producing esophageal varices (Fig. 1-4). Blood from varices eventually reaches the heart via the azygous vein and superior vena cava.

Hepatic venous drainage begins as central veins coalesce to form the right, middle, and left hepatic veins, which enter the inferior vena cava just inferior to its entrance into the right atrium. The caudate lobe occasionally has separate drainage directly to the inferior vena cava, accounting for relative caudate lobe hypertrophy in chronic hepatic vein occlusion (Budd-Chiari syndrome).

The biliary tree originates with the coalescence of intrahepatic ductules to form right and left hepatic ducts, which combine to form the common hepatic duct (Fig. 1-5). After it is joined by the cystic duct, the common bile duct courses dorsal to the duodenal bulb and unites with the pancreatic duct to drain bile into the duodenum through the ampulla of Vater. The arterial supply of the biliary tree is distinctive. The proximal common bile duct, common hepatic duct, hepatic ducts, and major intrahepatic ducts are supplied by branches of the hepatic artery; whereas the distal common bile duct is supplied by branches of the gastroduodenal artery.

There is marked anatomic variation in the extrahepatic biliary tree, particularly the cystic duct, which often joins the common hepatic duct distally, near the duodenum. This fact limits biliary drainage via cholecystojejunostomy in patients with progressive, distal, malignant biliary obstruction. Likewise, the union of the common bile duct with the pancreatic duct and the intraduodenal course of the distal common bile duct are subject to extensive anatomic variation, accounting for difficulty when cannulating the bile duct during endoscopic retrograde cholangiopancreatography.

Normal Hepatic Histologic Features

The extensive vascular and biliary network of the liver provides the structural framework for its unique parenchymal architecture. After entering the liver at the porta hepatis, the portal vein, hepatic artery, and bile ducts subdivide together and insinuate the liver, dividing it into hepatic lobules, the histologic unit of hepatic architecture (Fig. 1-6, *A*). Lobules consist of roughly hexagonal columns of hepatocytes arranged in cords radiating centripetally from the central veins, also known as terminal hepatic venules. The portal triads, ensheathed in connective tissue comprising the limiting plate, are located at the periphery of the lobule. The cords of hepatocytes are flanked on either side by sinusoids, which are the microvascular circulatory units of the liver (Fig. 1-6, *B*). The region between the sinusoidal endothelial cell and the hepatocellular membrane is