

Diseases of the Liver and Biliary System

SHEILA SHERLOCK

DBE, FRS

MD (Edin.), Hon. DSc (Edin., New York, Yale),
Hon. MD (Cambridge, Dublin, Leuven, Lisbon,
Mainz, Oslo, Padua, Toronto), Hon. LLD (Aberd.),
FRCP, FRCPE, FRACP, Hon. FRCCP,
Hon. FRCPI, Hon. FACP

*Professor of Medicine,
Royal Free and University College Medical School
University College London,
London*

JAMES DOOLEY

BSc, MD, FRCP

*Reader and Honorary Consultant in Medicine,
Royal Free and University College Medical School,
University College London,
London*

ELEVENTH EDITION

Blackwell
Science

DISEASES OF THE LIVER
AND BILIARY SYSTEM

Diseases of the Liver and Biliary System

SHEILA SHERLOCK

DBE, FRS

MD (Edin.), Hon. DSc (Edin., New York, Yale),
Hon. MD (Cambridge, Dublin, Leuven, Lisbon,
Mainz, Oslo, Padua, Toronto), Hon. LLD (Aberd.),
FRCP, FRCPE, FRACP, Hon. FRCCP,
Hon. FRCPI, Hon. FACP

*Professor of Medicine,
Royal Free and University College Medical School
University College London,
London*

JAMES DOOLEY

BSc, MD, FRCP

*Reader and Honorary Consultant in Medicine,
Royal Free and University College Medical School,
University College London,
London*

ELEVENTH EDITION

Blackwell
Science

© 1963, 1968, 1975, 1981, 1985, 1989, 1993, 1997, 2002 by
Blackwell Science Ltd a Blackwell Publishing Company

Editorial Offices:

Osney Mead, Oxford OX2 0EL, UK

Tel: +44 (0)1865 206206

108 Cowley Road, Oxford OX4 1JF, UK

Tel: +44 (0)1865 791100

Blackwell Publishing USA, 350 Main Street, Malden, MA 02148-5018, USA

Tel: +1 781 388 8250

Iowa State Press, a Blackwell Publishing Company, 2121 State Avenue, Ames,
Iowa 50014-8300, USA

Tel: + 515 292 0140

Blackwell Munksgaard, Nørre Søgade 35, PO Box 2148, Copenhagen, DK-1016, Denmark

Tel: +45 77 33 33 33

Blackwell Publishing Asia, 54 University Street, Carlton, Victoria 3053, Australia

Tel: +61 (0)3 9347 0300

Blackwell Verlag, Kurfurstendamm 57, 10707 Berlin, Germany

Tel: +49 (0)30 32 79 060

Blackwell Publishing, 10 rue Casimir Delavigne, 75006 Paris, France

Tel: +33 1 53 10 33 10

The right of the Author to be identified as the Author of this Work has been asserted in
accordance with the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval
system, or transmitted, in any form or by any means, electronic, mechanical, photocopying,
recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act
1988, without the prior permission of the publisher.

The Blackwell Publishing logo is a trade mark of Blackwell Publishing Ltd.

First published 1955

Reprinted 1956

Second edition 1958

Reprinted 1959, 1961

Third edition 1963

Reprinted 1965, 1966

Fourth edition 1968

Reprinted 1969, 1971

Fifth edition 1975

Sixth edition 1981

Reprinted 1982, 1983

Seventh edition 1985

Reprinted 1986, 1987

Eighth edition 1989

Reprinted 1991

Ninth edition 1993

Reprinted 1993

Tenth edition 1997

Eleventh edition 2002

Catalogue records for this title are available from the Library of Congress and the British
Library

ISBN 0-632-05582-0

Set in 8/10 pt Palatino by Best-set Typesetter Ltd, Hong Kong

Printed and bound in Italy, by Rotolito Lombarda, Milan

For further information on Blackwell Science, visit our website: www.blackwell-science.com

Contents

Preface to the Eleventh Edition, xv

Preface to the First Edition, xvi

1 Anatomy and Function, 1

Functional anatomy: sectors and segments, 2
Anatomy of the biliary tract, 3
Development of the liver and bile ducts, 4
Anatomical abnormalities of the liver, 4
Surface marking, 5
Methods of examination, 5
Hepatic morphology, 6
Electron microscopy and hepato-cellular function, 9
Sinusoidal cells, 11
Hepatocyte death and regeneration, 13
Extra-cellular matrix, 14
 Altered hepatic microcirculation and disease, 14
 Adhesion molecules, 14
Functional heterogeneity, 14
 Sinusoidal membrane traffic, 16
Bile duct epithelial cells, 16

2 Assessment of Liver Function, 19

Selection of biochemical tests, 19
Bile pigments, 20
 Bilirubin, 20
 Urobilinogen, 20
 Bromsulphalein, 21
Serum enzyme tests, 21
 Alkaline phosphatase, 21
 Gamma glutamyl transpeptidase, 22
 Aminotransferases, 22
 Other serum enzyme, 23
Quantitative assessment of hepatic function, 23
 Galactose elimination capacity, 23
 Breath tests, 23
 Salivary caffeine clearance, 24
 Lignocaine metabolite formation, 25
 Arterial blood ketone body ratio, 25
 Antipyrine, 25
 Indocyanine green, 25

Asialoglycoprotein receptor, 25
Excretory capacity (BSP), 25
Lipid and lipoprotein metabolism, 26
 Lipids, 26
 Lipoproteins, 26
 Changes in liver disease, 27
Bile acids, 28
 Changes in disease, 29
 Serum bile acids, 30
Amino acid metabolism, 31
 Clinical significance, 31
Plasma proteins, 32
 Electrophoretic pattern of serum proteins, 33
Carbohydrate metabolism, 34
Effects of ageing on the liver, 34

3 Biopsy of the Liver, 37

Selection and preparation of the patient, 37
Techniques, 37
 Difficulties, 40
 Liver biopsy in paediatrics, 40
Risks and complications, 40
 Pleurisy and peri-hepatitis, 40
 Haemorrhage, 40
 Intra-hepatic haematomas, 41
 Haemobilia, 41
 Arteriovenous fistula, 42
 Biliary peritonitis, 42
 Puncture of other organs, 43
 Infection, 43
 Carcinoid crisis, 43
Sampling variability, 43
Naked eye appearances, 43
Preparation of the specimen, 43
Interpretation, 43
Indications, 44
Special methods, 44

4 The Haematology of Liver Disease, 47

General features, 47
The liver and blood coagulation, 49

- Haemolytic jaundice, 53
- The liver in haemolytic anaemias, 54
 - Hereditary spherocytosis, 54
 - Thalassaemia, 55
 - Paroxysmal nocturnal haemoglobinuria, 56
 - Acquired haemolytic anaemia, 56
 - Haemolytic disease of the newborn, 56
 - Incompatible blood transfusion, 56
- The liver in myelo- and lymphoproliferative disease, 56
- Leukaemia, 57
 - Myeloid, 57
 - Lymphoid, 57
 - Hairy cell leukaemia, 57
- Bone marrow transplantation, 57
- Lymphoma, 58
 - Jaundice in lymphoma, 59
 - Primary hepatic lymphoma, 60
 - Lymphosarcoma, 60
 - Multiple myeloma, 61
 - Angio-immunoblastic lymphadenopathy, 61
 - Extra-medullary haemopoiesis, 61
 - Systemic mastocytosis, 61
 - Langerhans' cell histiocytosis (histiocytosis X), 61
- Lipid storage diseases, 62
 - Primary and secondary xanthomatosis, 62
 - Cholesteryl ester storage disease, 62
 - Gaucher's disease, 62
 - Niemann–Pick disease, 63
 - Sea-blue histiocyte syndrome, 64

5 Ultrasound, Computed Tomography and Magnetic Resonance Imaging, 67

- Radio-isotope scanning, 67
 - Positron emission tomography (PET), 67
- Ultrasound, 67
 - Doppler ultrasound, 69
 - Endoscopic ultrasound, 70
- Computed tomography, 70
- Magnetic resonance imaging, 74
 - MR spectroscopy, 76
- Conclusions and choice, 77

6 Hepato-cellular Failure, 81

- General failure of health, 81
- Jaundice, 81
- Vasodilatation and hyperdynamic circulation, 81
 - Hepato-pulmonary syndrome, 82
 - Pulmonary hypertension, 84
- Fever and septicaemia, 86
- Fetor hepaticus, 87
- Changes in nitrogen metabolism, 87
- Skin changes, 87

- Vascular spiders, 87
- Palmar erythema (liver palms), 88
- White nails, 89
- Mechanism of skin changes, 89
- Endocrine changes, 89
 - Hypogonadism, 90
 - Hypothalamic–pituitary function, 91
 - Metabolism of hormones, 91
- General treatment, 92
 - Precipitating factors, 92
 - General measures, 92

7 Hepatic Encephalopathy, 93

- Clinical features, 93
 - Investigations, 95
 - Neuropathological changes, 96
- Clinical variants in cirrhotics, 97
 - Differential diagnosis, 98
 - Prognosis, 99
- Pathogenetic mechanisms, 99
 - Portal-systemic encephalopathy, 99
 - Intestinal bacteria, 100
 - Neurotransmission, 100
 - Conclusions, 103
- Treatment of hepatic encephalopathy, 104
 - Diet, 104
 - Antibiotics, 105
 - Lactulose and lactilol, 105
 - Sodium benzoate and L-ornithine-L-aspartate, 106
 - Levodopa and bromocriptine, 106
 - Flumazenil, 106
 - Branched-chain amino acids, 106
 - Other precipitating factors, 106
 - Shunt occlusion, 106
 - Temporary hepatic support, 107
 - Hepatic transplantation, 107

8 Acute Liver Failure, 111

- Definition, 111
- Causes, 111
- Clinical features, 113
- Investigations, 113
- Associations, 115
- Prognosis, 118
- Treatment, 119
- Conclusion, 124

9 Ascites, 127

- Mechanism of ascites formation, 127
 - Underfill and peripheral vasodilation hypotheses, 127
 - Overfill hypothesis, 129
 - Other renal factors, 129

- Circulation of ascites, 130
- Summary, 130
- Clinical features, 130
- Spontaneous bacterial peritonitis, 132
- Treatment of cirrhotic ascites, 134
 - Refractory ascites, 138
 - Prognosis, 139
- Hepato-renal syndrome, 140
- Hyponatraemia, 143

10 The Portal Venous System and Portal Hypertension, 147

- Collateral circulation, 147
- Intra-hepatic obstruction (cirrhosis), 147
- Extra-hepatic obstruction, 148
- Effects, 148
- Pathology of portal hypertension, 148
- Varices, 149
- Portal hypertensive intestinal vasculopathy, 151
- Haemodynamics of portal hypertension, 151
- Clinical features of portal hypertension, 152
 - History and general examination, 152
 - Abdominal wall veins, 153
 - Spleen, 154
 - Liver, 154
 - Ascites, 154
 - Rectum, 154
 - X-ray of the abdomen and chest, 154
 - Barium studies, 155
 - Endoscopy, 155
- Imaging the portal venous system, 157
 - Ultrasound, 157
 - Doppler ultrasound, 157
 - CT scan, 158
 - Magnetic resonance angiography, 158
 - Venography, 158
 - Venographic appearances, 158
 - Visceral angiography, 159
 - Digital subtraction angiography, 159
 - Splenic venography, 159
 - Carbon dioxide wedged venography, 160
 - Portal pressure measurement, 160
 - Variceal pressure, 160
 - Estimation of hepatic blood flow, 161
 - Azygous blood flow, 162
 - Experimental portal venous occlusion and hypertension, 163
 - Classification of portal hypertension, 163
 - Extra-hepatic portal venous obstruction, 163
 - Aetiology, 163
 - Clinical features, 165
 - Prognosis, 166
 - Treatment, 167
 - Splenic vein obstruction, 167

- Hepatic arterio-portal venous fistulae, 167
- Porto-hepatic venous shunts, 168
- Intra-hepatic pre-sinusoidal and sinusoidal portal hypertension, 168
 - Portal tract lesions, 168
 - Toxic causes, 168
 - Hepato-portal sclerosis, 168
 - Tropical splenomegaly syndrome, 169
- Intra-hepatic portal hypertension, 169
 - Cirrhosis, 169
 - Non-cirrhotic nodules, 170
- Bleeding oesophageal varices, 170
 - Predicting rupture, 170
 - Prevention of bleeding, 171
 - Diagnosis of bleeding, 172
 - Prognosis, 172
- Management of acute variceal bleeding, 173
 - Vaso-active drugs, 174
 - Sengstaken-Blakemore tube, 174
 - Endoscopic sclerotherapy and banding, 175
 - Emergency surgery, 176
 - Prevention of re-bleeding, 176
- Portal-systemic shunt procedures, 177
 - Porta-caval, 177
 - Meso-caval, 178
 - Selective 'distal' spleno-renal, 178
 - General results of portal-systemic shunts, 178
 - TIPS (transjugular intrahepatic portosystemic shunt), 178
 - Shunt stenosis and occlusion, 179
 - Control of bleeding, 180
 - TIPS encephalopathy, 180
 - Circulatory changes, 180
 - Other indications, 180
 - Conclusions, 180
- Hepatic transplantation, 180
- Pharmacological control of the portal circulation, 180
- Conclusions, 180

11 The Hepatic Artery and Hepatic Veins: the Liver in Circulatory Failure, 187

- The hepatic artery, 187
 - Hepatic artery occlusion, 188
 - Hepatic arterial lesions following liver transplantation, 189
 - Aneurysms of the hepatic artery, 189
 - Hepatic arteriovenous shunts, 190
- The hepatic veins, 190
 - Experimental hepatic venous obstruction, 191
- Budd–Chiari (hepatic venous obstruction) syndrome, 192
 - Pathological changes, 193
 - Clinical features, 193

- Diagnosis, 195
- Prognosis, 196
- Treatment, 197
- Veno-occlusive disease, 198
- Spread of disease by the hepatic veins, 198
- Circulatory failure, 199
 - Hepatic changes in acute heart failure and shock, 199
 - Ischaemic hepatitis, 200
 - Post-operative jaundice, 200
 - Jaundice after cardiac surgery, 201
 - The liver in congestive heart failure, 201
 - The liver in constrictive pericarditis, 203

12 Jaundice, 205

- Bilirubin metabolism, 205
 - Hepatic transport and conjugation of bilirubin, 205
 - Distribution of jaundice in the tissues, 207
 - Factors determining the depth of jaundice, 207
- Classification of jaundice, 208
- Diagnosis of jaundice, 209
 - Clinical history, 209
 - Examination, 211
 - Diagnostic routine, 212
- Familial non-haemolytic hyperbilirubinaemias, 213
 - Primary hyperbilirubinaemia, 213
 - Gilbert's syndrome, 213
 - Crigler–Najjar syndrome, 215
 - Dubin–Johnson syndrome, 216
 - Rotor type, 217
 - The group of familial non-haemolytic hyperbilirubinaemias, 217

13 Cholestasis, 219

- Anatomy of the biliary system, 219
- Secretion of bile, 220
 - Cellular mechanisms, 221
- Syndrome of cholestasis, 223
 - Definition, 223
 - Classification, 223
 - Pathogenesis, 224
 - Pathology, 224
 - Clinical features, 226
 - Diagnostic approach, 231
 - Diagnostic possibilities, 232

14 Primary Biliary Cirrhosis, 241

- Aetiology, 241
- Epidemiology and genetics, 243
- Clinical features, 243
- Diagnosis, 246
- Prognosis, 247

- Treatment, 248
- Immune cholangiopathy, 250
- Autoimmune cholangitis, 253

15 Sclerosing Cholangitis, 255

- Primary sclerosing cholangitis (PSC), 255
- Infective sclerosing cholangitis, 261
 - Bacterial cholangitis, 261
 - Immunodeficiency-related opportunistic cholangitis, 261
 - Graft-versus-host disease, 263
- Vascular cholangitis, 263
- Drug-related cholangitis, 263
- Histiocytosis X, 263

16 Viral Hepatitis: General Features, Hepatitis A, Hepatitis E and Other Viruses, 267

- Pathology, 267
- Clinical types, 268
- Investigations, 271
- Differential diagnosis, 271
- Prognosis, 272
- Treatment, 272
- Follow-up, 272
- Hepatitis A virus, 273
 - Epidemiology, 274
 - Clinical course, 275
 - Prognosis, 275
 - Prevention, 275
- Hepatitis E virus, 276
 - Clinical features, 277
 - Diagnostic tests, 277
 - Liver biopsy, 277
 - Prevention, 277
- Hepatitis G virus, 278
- Hepatitis TT virus, 278
- Yellow fever, 279
 - Pathology, 279
 - Clinical features, 279
 - Treatment, 279
- Infectious mononucleosis (Epstein–Barr virus), 279
 - Hepatic histology, 279
 - Clinical features, 280
 - Diagnosis, 280
 - Distinction from viral hepatitis, 280
- Other viruses, 281
 - Cytomegalovirus, 281
 - Herpes simplex, 281
 - Miscellaneous, 281
- Hepatitis due to exotic viruses, 282
 - Treatment, 283

17 Hepatitis B Virus and Hepatitis Delta Virus, 285

- Hepatitis B virus (HBV), 285
 - Acute hepatitis B, 287
 - Epidemiology, 290
 - Clinical course, 290
 - Prevention, 292
- Chronic hepatitis B, 294
 - Clinical relapse and reactivation, 294
 - Laboratory tests, 295
 - Needle liver biopsy, 295
 - Course and prognosis, 295
 - Treatment, 296
 - Outstanding problems, 298
 - Screening for hepato-cellular carcinoma, 298
- Hepatitis delta virus (HDV), 300
 - Epidemiology, 300
 - Diagnosis, 301
 - Clinical features, 301
 - Hepatic histology, 302
 - Prevention, 302
 - Treatment, 302

18 Hepatitis C Virus, 305

- Molecular virology, 305
- Serological tests, 306
- Immune response, 307
- Epidemiology, 307
- Natural history, 308
- Clinical course, 308
- Hepatic histology, 309
- Hepatitis C and serum autoantibodies, 310
- Associated diseases, 310
- Diagnosis, 311
- Prognosis, 311
- Prevention: vaccines, 312
- Treatment, 312
- Hepatic transplantation, 316

19 Chronic Hepatitis: General Features, and Autoimmune Chronic Disease, 321

- Clinical presentation, 321
- Hepatic histology, 322
- The role of liver biopsy, 322
- Classification, 324
- Autoimmune chronic hepatitis, 325
 - Type 1 (formerly called lupoid), 326
 - Type 2, 326
 - Primary biliary cirrhosis and immune cholangitis, 326
- Chronic autoimmune hepatitis (type 1), 326

- Aetiology, 326
- Hepatic pathology, 328
- Clinical features, 328
- Differential diagnosis, 330
- Treatment, 331
- Course and prognosis, 332
- Syncytial giant-cell hepatitis, 332

20 Drugs and the Liver, 335

- Hepato-cellular zone 3 necrosis, 340
 - Carbon tetrachloride, 342
 - Amanita* mushrooms, 343
 - Paracetamol (acetaminophen), 343
 - Salicylates, 344
 - Hyperthermia, 344
 - Hypothermia, 344
 - Burns, 344
- Hepato-cellular zone 1 necrosis, 344
 - Ferrous sulphate, 345
 - Phosphorus, 345
- Mitochondrial cytopathies, 345
 - Sodium valproate, 345
 - Tetracyclines, 345
 - Tacrine, 345
 - Antiviral nucleoside analogues, 345
 - Bacillus cereus*, 346
- Steato-hepatitis, 346
 - Perhexiline maleate, 346
 - Amiodarone, 346
 - Synthetic oestrogens, 346
 - Calcium channel blockers, 347
- Fibrosis, 347
 - Methotrexate, 347
 - Other cytotoxic drugs, 347
 - Arsenic, 348
 - Vinyl chloride, 348
 - Vitamin A, 348
 - Retinoids, 348
- Vascular changes, 348
 - Sinusoidal dilatation, 348
 - Peliosis hepatis, 349
 - Veno-occlusive disease (VOD), 349
- Acute hepatitis, 349
 - Isoniazid, 350
 - Methyl dopa, 351
 - Halothane, 351
 - Hydrofluorocarbons, 352
 - Systemic antifungals, 352
 - Oncology drugs, 352
 - Nervous system modifiers, 353
 - Sustained-release nicotinic acid (niacin), 353
 - Sulphonamides and derivatives, 353
 - Non-steroidal anti-inflammatory drugs, 353

- Anti-thyroid drugs, 353
- Quinidine and quinine, 353
- Troglitazone, 354
- Anti-convulsants, 354
- Chronic hepatitis, 354
 - Herbal remedies, 354
 - Recreational drugs, 355
- Canalicular cholestasis, 355
 - Cyclosporin A, 355
 - Ciprofloxacin, 355
- Hepato-canalicular cholestasis, 355
 - Chlorpromazine, 356
 - Penicillins, 357
 - Sulphonamides, 357
 - Erythromycin, 357
 - Haloperidol, 357
 - Cimetidine and ranitidine, 357
 - Oral hypoglycaemics, 357
 - Tamoxifen, 357
 - Other causes, 357
 - Dextropropoxyphene, 357
- Ductular cholestasis, 357
- Biliary sludge, 357
- Sclerosing cholangitis, 357
- Hepatic nodules and tumours, 358
 - Hepato-cellular carcinoma, 358
- Conclusions, 359

21 Hepatic Cirrhosis, 365

- Classification of cirrhosis, 368
- Clinical cirrhosis, 371
- Compensated cirrhosis, 374
- Decompensated cirrhosis, 375
- Prognosis, 376
- Treatment, 377

22 Alcohol and the Liver, 381

- Risk factors for alcoholic liver diseases, 381
- Metabolism of alcohol, 382
- Mechanisms of liver injury, 384
- Morphological changes, 386
 - Fatty liver (steatosis), 386
 - Alcoholic hepatitis, 387
 - Cirrhosis, 387
 - Early recognition, 389
 - Investigation, 389
- Clinical syndromes, 390
 - Fatty liver, 390
 - Acute alcoholic hepatitis, 390
 - Hepatic cirrhosis, 391
 - Cholestatic syndromes, 391
 - Relationship to hepatitis B and C, 391
 - Hepato-cellular cancer, 393

- Associated features, 393
- Prognosis, 393
- Treatment, 394
 - Acute alcoholic hepatitis, 394
 - Cirrhosis, 395
 - Hepatic transplantation, 395

23 Iron Overload States, 399

- Normal iron metabolism, 399
- Iron overload and liver damage, 401
- Genetic haemochromatosis, 401
- Other iron storage diseases, 407
 - Non-HFE-related inherited iron overload, 407
 - Dysmetabolic syndrome, 408
 - Erythropoietic siderosis, 408
 - Late stage cirrhosis, 408
 - Chronic viral hepatitis, 408
 - Non-alcoholic fatty liver disease, 408
 - Neonatal haemochromatosis, 409
 - African iron overload (Bantu siderosis), 409
 - Porphyria cutanea tarda, 409
 - Haemodialysis, 409
 - Acaeruloplasminaemia, 409
 - Transferrin deficiency, 409

24 Wilson's Disease, 413

- Molecular genetics: pathogenesis, 413
- Pathology, 414
- Clinical picture, 415
- Hepatic forms, 416
- Neuropsychiatric forms, 417
- Renal changes, 417
- Other changes, 417
- Laboratory tests, 417
- Liver biopsy, 418
- Scanning, 418
- Diagnostic difficulties, 418
- Treatment, 419
- Prognosis, 420
- Indian childhood cirrhosis, 421
- Hereditary acaeruloplasminaemia, 421

25 Nutritional and Metabolic Liver Diseases, 423

- Malnutrition, 423
- Fatty liver, 423
 - Diagnosis, 424
 - Classification, 424
- Non-alcoholic fatty liver disease, 427
 - Non-alcoholic hepatic steatosis, 428
 - Non-alcoholic steatonecrosis, 428
 - Effects of jejuno-ileal bypass, 429

Parenteral nutrition, 429
 Vitamins, 429
 Carbohydrate metabolism in liver disease, 431
 Hypoglycaemia, 431
 Hyperglycaemia, 431
 The liver in diabetes mellitus, 431
 Insulin and the liver, 431
 Hepatic histology, 431
 Clinical features, 432
 Liver function tests, 432
 Hepato-biliary disease and diabetes, 432
 Glucose intolerance of cirrhosis, 432
 Treatment of diabetes in cirrhotic patients, 433
 Glycogen storage diseases, 434
 Type I (von Gierke's disease), 435
 Type II (Pompe's disease), 436
 Type III (Cori's disease), 436
 Type IV (Andersen's disease), 437
 Type VI (Hers' disease), 437
 Hepatic glycogen synthetase deficiency (type 0), 437
 Hereditary fructose intolerance, 438
 Glutaric aciduria type II, 438
 Galactosaemia, 438
 Mucopolysaccharidoses, 439
 Familial hypercholesterolaemia, 439
 Amyloidosis, 440
 α_1 -Antitrypsin deficiency, 443
 Hereditary tyrosinaemia, 445
 Cystic fibrosis, 446
 Liver and thyroid, 447
 Thyrotoxicosis, 447
 Myxoedema, 447
 Changes with hepato-cellular disease, 447
 Liver and adrenal, 448
 Liver and growth hormone, 448
 Hepatic porphyrias, 448
 Acute intermittent porphyria, 449
 Hereditary coproporphyria, 450
 Variegate porphyria, 450
 Porphyria cutanea tarda, 450
 Erythropoietic protoporphyria, 450
 Congenital erythropoietic porphyria, 451
 Hepato-erythropoietic porphyria, 451
 Secondary coproporphyrias, 451
 Hereditary haemorrhagic telangiectasia, 452
 Dystrophia myotonica, 452

26 The Liver in Infancy and Childhood, 453

Neonatal hyperbilirubinaemia, 453
 Unconjugated hyperbilirubinaemia, 453
 Haemolytic disease of the newborn, 454
 Hepatitis and cholestatic syndromes (conjugated hyperbilirubinaemia), 455

Viral hepatitis, 457
 Non-viral causes of hepatitis, 459
 Urinary tract infections, 459
 Neonatal hepatitis syndrome, 459
 Infantile cholangiopathies, 460
 Biliary atresia, 460
 Extra-hepatic biliary atresia, 460
 Alagille's syndrome (arterio-hepatic dysplasia), 462
 Prolonged parenteral nutrition, 462
 Abnormal bile acid synthesis, 463
 Genetic cholestatic syndromes, 463
 Symptomatic treatment of cholestatic syndromes, 464
 Other causes of cholestatic jaundice, 464
 Reye's syndrome, 465
 Reye-like syndromes, 465
 Cirrhosis in infancy and childhood, 465
 Indian childhood cirrhosis, 466
 Non-Indian childhood cirrhosis (copper-associated liver disease), 466
 Hepatic steatosis, 467
 Fetal alcohol syndrome, 467
 Idiopathic steato-hepatitis, 467
 Tumour of the liver, 467
 Hamartomas, 467
 Mesenchymal hamartoma, 467
 Malignant mesenchymoma (undifferentiated sarcoma), 467
 Adenomas, 467
 Hepato-cellular carcinoma, 467
 Hepatoblastoma, 467
 Infantile haemangio-endothelioma, 467
 Nodular regenerative hyperplasia, 468
 Hepatic transplantation, 468

27 The Liver in Pregnancy, 471

Normal pregnancy, 471
 Liver disease in pregnancy, 471
 Hyperemesis gravidarum, 471
 Liver diseases of late pregnancy, 471
 Acute fatty liver of pregnancy, 471
 Pregnancy toxaeias, 474
 The HELLP syndrome, 474
 Toxaemia and the HELLP syndrome, 475
 Hepatic haemorrhage, 475
 Cholestasis of pregnancy, 475
 Budd-Chiari syndrome, 476
 Intercurrent jaundice, 476
 Viral hepatitis, 476
 Biliary tract disease, 477
 Hepato-toxic drugs and the pregnant woman, 478
 Effect of pregnancy on pre-existing chronic liver disease, 478
 Pregnancy in liver transplant recipients, 478

28 The Liver in Systemic Disease, Granulomas and Hepatic Trauma, 481

- The liver in collagen diseases, 481
- Arthropathy associated with liver disease, 481
 - Genetic haemochromatosis, 481
 - Hepatitis B virus (HBV) associations, 481
 - Hepatitis C virus (HCV) associations, 482
- Hepatic granulomas, 482
 - Clinical syndrome of hepatic granulomas, 483
 - 'Granulomatous hepatitis', 484
 - Sarcoidosis, 484
 - Granulomatous drug reactions, 486
 - Granulomas associated with infections, 487
 - Hepatic granulomas in the patient with AIDS, 488
 - Industrial causes, 489
 - Other conditions with hepatic granulomas, 489
- Hepato-biliary associations of inflammatory bowel disease, 490
- Hepatic trauma, 490
 - Rupture of the gallbladder, 492

29 The Liver in Infections, 495

- Pyogenic liver abscess, 495
- Other infections, 498
- Hepatic amoebiasis, 498
- Tuberculosis of the liver, 501
- Hepatic actinomycosis, 502
- Other fungal infections, 502
- Syphilis of the liver, 503
 - Congenital, 503
 - Secondary, 503
 - Tertiary, 503
 - Jaundice complicating penicillin treatment, 504
- Leptospirosis, 504
 - Weil's disease, 504
 - Other types of leptospirosis, 506
- Relapsing fever, 507
- Lyme disease, 507
- Q fever, 507
 - Rocky mountain spotted fever, 508
- Schistosomiasis (bilharziasis), 508
- Malaria, 510
- Kala-azar (leishmaniasis), 511
- Hydatid disease, 511
 - Echinococcus multilocularis* (alveolar echinococcosis), 516
- Ascariasis, 517
- Strongyloides stercoralis*, 518
- Trichiniasis, 518
- Toxocara canis* (visceral larva migrans), 518
- Liver flukes, 518
 - Clonorchis sinensis*, 518

- Fasciola hepatica*, 519
- Recurrent pyogenic cholangitis, 519
- Peri-hepatitis, 520
- Hepato-biliary disease in HIV infection, 520
 - Infections, 521
 - Hepatitis B, C and D co-infection, 522
 - Neoplasms, 522
 - Hepato-biliary disease, 523
 - Acaculous cholecystitis, 524
- Jaundice of infections, 525
 - Bacterial pneumonia, 525
 - Septicaemia and septic shock, 525

30 Nodules and Benign Liver Lesions, 527

- Small hepato-cellular cancer, 527
- Nodules in the absence of underlying liver disease, 528
- Simple cysts, 528
- Haemangioma, 528
- Focal nodular hyperplasia, 530
- Hepatic adenoma, 531
- Focal nodular hyperplasia and adenoma contrasted, 532
- Liver metastases, 532
- Other benign tumours, 534
 - Cholangioma (bile duct adenoma), 534
 - Biliary cystadenoma, 534
- Nodular regenerative hyperplasia, 534
 - Partial nodular transformation, 535

31 Malignant Liver Tumours, 537

- Hepato-cellular cancer, 537
 - Aetiological factors, 537
 - Pathology, 540
 - Clinical features, 541
 - Tumour localization, 543
 - Needle liver biopsy, 546
 - Screening, 546
 - Prognosis and risk factors, 547
 - Surgical treatment, 547
 - Non-surgical treatment, 548
- Fibro-lamellar carcinoma of the liver, 551
- Hepatoblastoma, 551
- Intra-hepatic cholangiocarcinoma, 552
- Combined hepato-cellular–cholangiocarcinoma, 553
- Other primary liver tumours, 553
 - Cystadenocarcinoma, 553
 - Angiosarcoma (haemangio-endothelioma), 553
 - Epitheloid haemangio-endothelioma, 554
 - Undifferentiated sarcoma of the liver, 554
- Benign tumours of the liver, 554
 - Mesenchymal hamartoma, 554
- Paraneoplastic hepatopathy, 554
- Hepatic metastases, 554

32 Imaging of the Biliary Tract: Interventional Radiology and Endoscopy, 563

- Plain film of the abdomen, 563
- Ultrasound (US), 563
 - Bile ducts, 563
 - Gallbladder, 563
- Computed tomography (CT), 564
- Magnetic resonance cholangiopancreatography (MRCP), 565
- Endoscopic ultrasound (EUS), 566
- Biliary scintigraphy, 567
- Oral cholecystography, 567
- Intravenous cholangiography, 568
- Endoscopic retrograde cholangiopancreatography, 568
- Endoscopic sphincterotomy, 570
- Endoscopic biliary endoprosthesis, 573
- Percutaneous trans-hepatic cholangiography, 576
 - Percutaneous bile drainage, 576
- Percutaneous biliary endoprosthesis, 577
- Resectability of tumours, 578
- Choice between surgical and non-surgical palliation of malignant obstruction, 578
- Choice between endoscopic and percutaneous approach, 578
- Percutaneous cholecystostomy, 578
- Operative and post-operative cholangiography, 579

33 Cysts and Congenital Biliary Abnormalities, 583

- Fibropolycystic disease, 583
 - Childhood fibropolycystic diseases, 584
- Adult polycystic disease, 584
- Congenital hepatic fibrosis, 586
 - Congenital intra-hepatic biliary dilatation (Caroli's disease), 588
 - Congenital hepatic fibrosis and Caroli's disease, 589
- Choledochal cyst, 589
- Microhamartoma (von Meyenberg complexes), 591
- Carcinoma secondary to fibropolycystic disease, 591
- Solitary non-parasitic liver cyst, 591
- Other cysts, 591
- Congenital anomalies of the biliary tract, 592
 - Absence of the gallbladder, 592
 - Double gallbladder, 592
 - Accessory bile ducts, 593
 - Left-sided gallbladder, 594
 - Rokitansky–Aschoff sinuses, 594
 - Folded gallbladder, 594
 - Diverticula of the gallbladder and ducts, 594
 - Intra-hepatic gallbladder, 594
 - Congenital adhesions to the gallbladder, 594

- Floating gallbladder and torsion of the gallbladder, 594
- Anomalies of the cystic duct and cystic artery, 595

34 Gallstones and Inflammatory Gallbladder Diseases, 597

- Composition of gallstones, 597
- Composition of bile, 597
- Factors in cholesterol gallstone formation, 598
- Pigment gallstones, 603
- Radiology of gallstones, 603
- Natural history of gallstones, 604
 - Silent gallstones, 605
- Treatment of gallstones in the gallbladder, 605
 - Cholecystectomy, 605
 - Laparoscopic cholecystectomy, 605
- Non-surgical treatment of gallstones in the gallbladder, 607
 - Dissolution therapy, 607
 - Direct solvent dissolution, 608
 - Shock-wave therapy, 608
- Percutaneous cholecystolithotomy, 609
 - Conclusions, 609
- Acute cholecystitis, 610
- Empyema of the gallbladder, 612
- Perforation of the gallbladder, 612
- Emphysematous cholecystitis, 612
- Chronic calculous cholecystitis, 613
- Acalculous cholecystitis, 614
 - Acute, 614
 - Chronic, 614
 - Typhoid cholecystitis, 614
 - Acute cholecystitis in AIDS, 614
 - Other associations, 615
- Other gallbladder pathology, 615
 - Cholesterosis of the gallbladder, 615
 - Xanthogranulomatous cholecystitis, 615
 - Adenomyomatosis, 615
 - Porcelain gallbladder, 615
- Post-cholecystectomy problems, 615
- Sphincter of Oddi dysfunction, 616
- Gallstones in the common bile duct (choledocholithiasis), 616
- Management of common duct stones, 618
 - Acute obstructive suppurative cholangitis, 618
 - Acute cholangitis, 618
- Common duct stones without cholangitis, 619
 - Patients with gallbladder *in situ*, 619
 - Acute gallstone pancreatitis, 619
 - Large common duct stones, 619
 - Trans T-tube tract removal of stones, 620
 - Intra-hepatic gallstones, 620
 - Mirizzi's syndrome, 620
- Biliary fistulae, 621

- External, 621
- Internal, 621
- Gallstone ileus, 621
- Haemobilia, 622
- Bile peritonitis, 622
- Association of gallstones with other diseases, 623
 - Colorectal and other cancers, 623
 - Diabetes mellitus, 623

35 Benign Stricture of the Bile Ducts, 629

- Post-cholecystectomy, 629
- Bile duct/bowel anastomotic stricture, 634
- Post liver transplantation, 635
- Primary sclerosing cholangitis, 636
- Other causes, 636
- Summary, 636

36 Diseases of the Ampulla of Vater and Pancreas, 639

- Peri-ampullary carcinoma, 639
 - Benign villous adenoma of the ampulla of Vater, 644
 - Cystic tumours of the pancreas, 644
 - Endocrine tumours of the pancreas, 644
- Chronic pancreatitis, 644
- Obstruction of the common bile duct by enlarged lymph glands, 645
 - Other causes of extrinsic pressure on the common bile duct, 645

37 Tumours of the Gallbladder and Bile Ducts, 647

- Benign lesions of the gallbladder, 647
- Carcinoma of the gallbladder, 647
 - Other tumours, 648
- Benign tumours of the extra-hepatic bile duct, 648
- Carcinoma of the bile duct (cholangiocarcinoma), 648
- Cholangiocellular carcinoma, 654
- Metastases at the hilum, 655

38 Hepatic Transplantation, 657

- Selection of patients, 657
- Candidates: outcome, 657
 - Cirrhosis, 659
 - Autoimmune chronic hepatitis, 659
 - Chronic viral hepatitis, 659
 - Neonatal hepatitis, 660
 - Alcoholic liver disease, 660
 - Cholestatic liver disease, 660
 - Primary metabolic disease, 661
 - Acute liver failure, 662
 - Malignant disease, 662
 - Miscellaneous, 663
- Absolute and relative contraindications, 663
 - Absolute, 663
 - Relative (higher risk), 664
- General preparation of the patient, 664
- Donor selection and operation, 664
- The recipient operation, 665
 - Segmental (split liver) transplantation, 665
 - Auxiliary liver transplantation, 666
 - Xeno-transplantation, 666
 - Domino liver transplantation, 666
 - Hepatocyte transplantation, 667
 - Liver transplantation in paediatrics, 667
- Immunosuppression, 667
 - Tolerance, 668
- Post-operative course, 668
- Post-transplantation complications, 668
 - Rejection, 671
 - Infections, 673
 - Malignancies, 675
 - Drug-related toxicity, 675
 - Disease recurrence, 675
 - Central nervous system toxicity, 675
 - Bone disease, 675
 - Ectopic soft-tissue calcification, 675
- Conclusion, 675

Index, 681

Preface to the Eleventh Edition

The eleventh edition welcomes the new Millennium. Progress in basic and clinical hepatology remains exponential. Since 1997, the advances have been wide-ranging, with those in molecular and cellular biology, and in diagnosis and treatment, leading the way. In a world in which information technology gives all too ready access to individual publications, the eleventh edition sets the new within established knowledge and practice.

Viral hepatitis remains the worldwide hepatological challenge. This is reflected in a change in format with separate chapters on hepatitis B and C. Molecular virology continues to expose the inner workings of all the viruses. New therapeutic approaches are proving more effective against hepatitis C. Molecular and cellular biologists are showing us the importance of apoptosis and the intricate regulation of fibrosis. Mutation analysis for diagnosis of genetic haemochromatosis is routine, while the identification of the haemochromatosis gene has led to a surge of exploration in iron metabolism. Canalicular transporters have been cloned and linked to cholestatic syndromes, giving a new perspective to the bile plug seen under the microscope. Advances in imaging, particularly magnetic resonance, continue to reduce the need for invasive techniques. Patients needing transplantation benefit from improvements in immunosuppression and surgical techniques, while there is steady progress in the management of complications of cirrhosis.

This edition contains more than 1000 new references and 100 new figures. Developments in publishing allow a more colourful format, but care has been taken to preserve clarity. Experience has shown that students, interns, postgraduate trainees as well as generalists and specialist clinicians have found previous editions useful. The goal of the book remains unchanged: a textbook of manageable size, critical and current.

We are indebted to many colleagues for their generous contributions to this edition including in particular Professor Peter Scheuer, Professor Amar Dhillon and Dr

Susan Davies for histological material, and Dr Robert Dick, Dr Tony Watkinson and Dr Jon Tibballs for radiological images. We would also like to express our great thanks to Dr Leslie Berger, Dr Andrew Burroughs, Dr John Buscombe, Dr Martyn Caplin, Professor Geoffrey Dusheiko, Dr David Harry, Dr Andrew Hilson, Professor Humphrey Hodgson, Professor Neil McIntyre, Dr Kevin Moore, Dr Marsha Morgan, Dr Chris Kibbler and Dr David Patch for their help in the preparation of this edition.

Miss Aileen Duggan and Miss Karma Raines have assisted tirelessly with their meticulous secretarial support. The clarity and style of figures preserved from previous editions owes much to the artistry of Miss Janice Cox over many years.

We are grateful to Blackwell Publishing and, in particular, Rebecca Huxley for her tireless help with both manuscript and proofs, and for responding without a murmur to demands within a tight schedule. We also thank Jane Fallows who has reformatted and coloured all the previous line drawings as well as creating the many new and visually inviting figures for the eleventh edition.

The preface to the first edition which was published in 1955 refers to daughters Amanda and Auriole. Amanda is now an ordained Minister in the Baptist Church, and Auriole is working with Kent Police. Grandchildren have arrived, including Alice aged 9 and Emily aged 6.

On the 13th July 2001, the senior author was elected a Fellow of the Royal Society in its 341st year, a Society founded to improve natural knowledge. This honour was achieved because of the support of all the clinicians and scientists who have contributed to the Liver Unit and its associated departments at The Royal Free. The new Millennium is indeed an exciting time for all those working to solve the puzzles within hepato-biliary disease.

SHEILA SHERLOCK
JAMES DOOLEY
November 2001

Preface to the First Edition

My aim in writing this book has been to present a comprehensive and up-to-date account of diseases of the liver and biliary system, which I hope will be of value to physicians, surgeons and pathologists and also a reference book for the clinical student. The modern literature has been reviewed with special reference to articles of general interest. Many older more specialized classical contributions have therefore inevitably been excluded.

Disorders of the liver and biliary system may be classified under the traditional concept of individual diseases. Alternatively, as I have endeavoured in this book, they may be described by the functional and morphological changes which they produce. In the clinical management of a patient with liver disease, it is important to assess the degree of disturbance of four functional and morphological components of the liver—hepatic cells, vascular system (portal vein, hepatic artery and hepatic veins), bile ducts and reticulo-endothelial system. The typical reaction pattern is thus sought and recognized before attempting to diagnose the causative insult. Clinical and laboratory methods of assessing each of these components are therefore considered early in the book. Descriptions of individual diseases follow as illustrative examples. It will be seen that the features of hepatocellular failure and portal hypertension are described in general terms as a foundation for subsequent discussion of virus hepatitis, nutrition liver disease and the cirrhoses. Similarly blood diseases and infections of the liver are included with the reticulo-endothelial system, and disorders of the biliary tract follow descriptions of acute and chronic bile duct obstruction.

I would like to acknowledge my indebtedness to my teachers, the late Professor J. Henry Dible, the late Professor Sir James Learmonth and Professor Sir John McMichael, who stimulated my interest in hepatic disease, and to my colleagues at the Postgraduate Medical School and elsewhere who have generously invited me to see patients under their care. I am grateful to Dr A. G. Bearn for criticizing part of the typescript and to Dr A. Paton for his criticisms and careful proof

reading. Miss D. F. Atkins gave much assistance with proof reading and with the bibliography. Mr Per Saugman and Mrs J. M. Green of Blackwell Scientific Publications have co-operated enthusiastically in the production of this book.

The photomicrographs were taken by Mr E. V. Willmott, FRPS, and Mr C. A. P. Graham from section prepared by Mr J. G. Griffin and the histology staff of the Postgraduate Medical School. Clinical photographs are the work of Mr C. R. Brecknell and his assistants. The black and white drawings were made by Mrs H. M. G. Wilson and Mr D. Simmonds. I am indebted to them all for their patience and skill.

The text includes part of unpublished material included in a thesis submitted in 1944 to the University of Edinburgh for the degree of MD, and part of an essay awarded the Buckston-Browne prize of the Harveian Society of London in 1953. Colleagues have allowed me to include published work of which they are jointly responsible. Dr Patricia P. Franklyn and Dr R. E. Steiner have kindly loaned me radiographs. Many authors have given me permission to reproduce illustrations and detailed acknowledgments are given in the text. I wish also to thank the editors of the following journals for permission to include illustrations: *American Journal of Medicine*, *Archives of Pathology*, *British Heart Journal*, *Circulation*, *Clinical Science*, *Edinburgh Medical Journal*, *Journal of Clinical Investigation*, *Journal of Laboratory and Clinical Investigation*, *Journal of Pathology and Bacteriology*, *Lancet*, *Postgraduate Medical Journal*, *Proceedings of the Staff Meetings of the Mayo Clinic*, *Quarterly Journal of Medicine*, *Thorax* and also the following publishers: Butterworth's Medical Publications, J. & A. Churchill Ltd, The Josiah Macy Junior Foundation and G. D. Searle & Co.

Finally I must thank my husband, Dr D. Geraint James, who, at considerable personal inconvenience, encouraged me to undertake the writing of this book and also criticized and rewrote most of it. He will not allow me to dedicate it to him.

SHEILA SHERLOCK

Chapter 1

Anatomy and Function

The liver, the largest organ in the body, weighs 1200–1500 g and comprises one-fiftieth of the total adult body weight. It is relatively larger in infancy, comprising one-eighteenth of the birth weight. This is mainly due to a large left lobe.

Sheltered by the ribs in the right upper quadrant, the upper border lies approximately at the level of the nipples. There are two anatomical lobes, the right being about six times the size of the left (figs 1.1–1.3). Lesser segments of the right lobe are the *caudate lobe* on the posterior surface and the *quadrate lobe* on the inferior surface. The right and left lobes are separated anteriorly by a fold of peritoneum called the falciform ligament,

posteriorly by the fissure for the ligamentum venosum and inferiorly by the fissure for the ligamentum teres.

The liver has a double blood supply. The *portal vein* brings venous blood from the intestines and spleen and the *hepatic artery*, coming from the coeliac axis, supplies the liver with arterial blood. These vessels enter the liver through a fissure, the *porta hepatis*, which lies far back on the inferior surface of the right lobe. Inside the porta, the portal vein and hepatic artery divide into branches to the right and left lobes, and the right and left hepatic bile ducts join to form the common hepatic duct. The *hepatic nerve plexus* contains fibres from the sympathetic ganglia

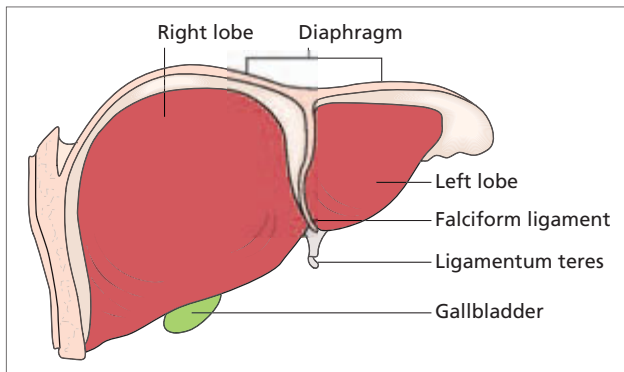


Fig. 1.1. Anterior view of the liver.

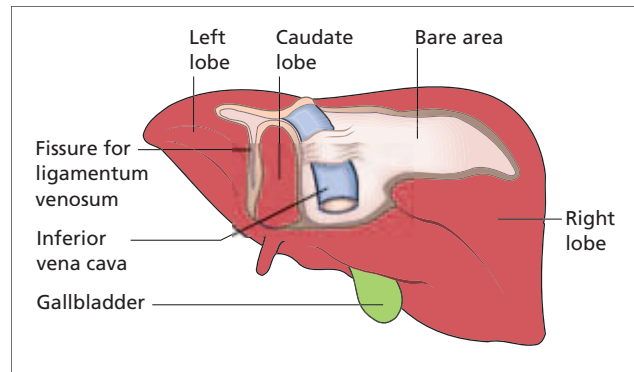


Fig. 1.2. Posterior view of the liver.

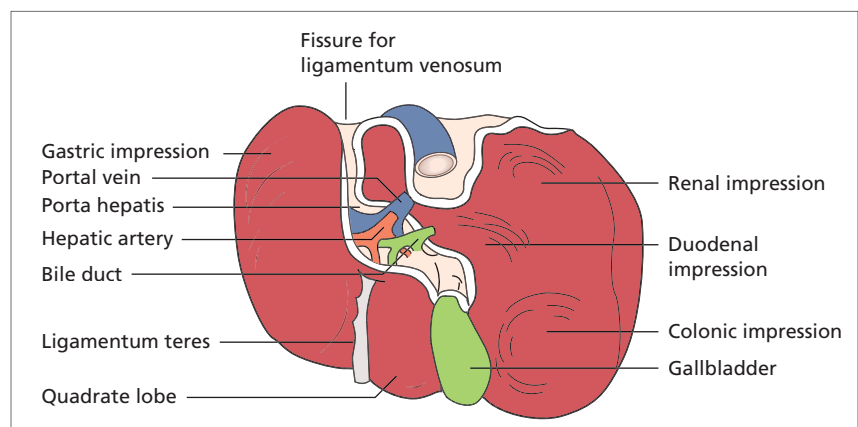


Fig. 1.3. Inferior view of the liver.

T7–T10, which synapse in the coeliac plexus, the right and left vagi and the right phrenic nerve. It accompanies the hepatic artery and bile ducts into their finest ramifications, even to the portal tracts and hepatic parenchyma [4].

The *ligamentum venosum*, a slender remnant of the ductus venosus of the fetus, arises from the left branch of the portal vein and fuses with the inferior vena cava at the entrance of the left hepatic vein. The *ligamentum teres*, a remnant of the umbilical vein of the fetus, runs in the free edge of the falciform ligament from the umbilicus to the inferior border of the liver and joins the left branch of the portal vein. Small veins accompanying it connect the portal vein with veins around the umbilicus. These become prominent when the portal venous system is obstructed inside the liver.

The venous drainage from the liver is into the *right* and *left hepatic veins* which emerge from the back of the liver and at once enter the inferior vena cava very near its point of entry into the right atrium.

Lymphatic vessels terminate in small groups of glands around the porta hepatis. Efferent vessels drain into glands around the coeliac axis. Some superficial hepatic lymphatics pass through the diaphragm in the falciform ligament and finally reach the mediastinal glands. Another group accompanies the inferior vena cava into the thorax and ends in a few small glands around the intrathoracic portion of the inferior vena cava.

The *inferior vena cava* makes a deep groove to the right of the caudate lobe about 2 cm from the mid-line.

The *gallbladder* lies in a fossa extending from the inferior border of the liver to the right end of the porta hepatis.

The liver is completely covered with peritoneum, except in three places. It comes into direct contact with the diaphragm through the bare area which lies to the right of the fossa for the inferior vena cava. The other areas without peritoneal covering are the fossae for the inferior vena cava and gallbladder.

The liver is kept in position by peritoneal ligaments and by the intra-abdominal pressure transmitted by the tone of the muscles of the abdominal wall.

Functional anatomy: sectors and segments

Based on the external appearances described above, the liver has a right and left lobe separated along the line of insertion of the falciform ligament. This separation, however, does not correlate with blood supply or biliary drainage. A *functional anatomy* is now recognized based upon studies of vascular and biliary casts made by injecting vinyl into the vessels and bile ducts. This classification correlates with that seen by imaging techniques.

The main portal vein divides into right and left

branches and each of these supplies two further subunits (variously called sectors). The sectors on the right side are anterior and posterior and, in the left lobe, medial and lateral—giving a total of four sectors (fig. 1.4). Using this definition, the right and left side of the liver are divided not along the line of the falciform ligament, but along a slightly oblique line to the right of this, drawn from the inferior vena cava above to the gallbladder bed below. The right and left side are independent with regard to portal and arterial blood supply, and bile drainage. Three plains separate the four sectors and contain the three major hepatic vein branches.

Closer analysis of these four hepatic sectors produces a further subdivision into segments (fig. 1.5). The right anterior sector contains segments V and VIII; right posterior sector, VI and VII; left medial sector, IV; left lateral sector, segments II and III. There is no vascular anastomosis between the macroscopic vessels of the segments but communications exist at sinusoidal level. Segment I, the equivalent of the caudate lobe, is separate from the other segments and does not derive blood directly from the major portal branches or drain by any of the three major hepatic veins.

This functional anatomical classification allows interpretation of radiological data and is of importance to the

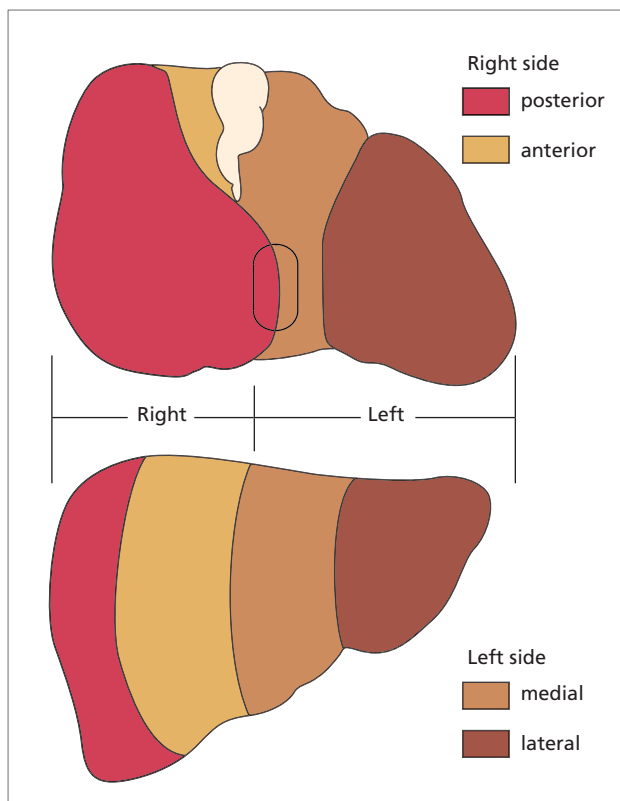


Fig. 1.4. The sectors of the human liver.