

Detailed Contents

Preface *xxiii*
List of abbreviations *xxv*
Contributors *xxvii*

1 The new patient with renal failure

Incidence and prevalence of kidney disease *4*
Definition and prevalence of chronic kidney disease *6*
Causes of end-stage kidney disease *8*
Causes of end-stage kidney disease: details *9*
Causes of acute kidney injury *10*
Modality of renal replacement therapy worldwide *11*
Patient survival with ESKD *12*
Presentation of renal disease *13*
Presenting clinical features of ESKD *14*
Examination findings in ESKD *15*
Investigations for patients with ESKD *16*
Assessment of renal function at/ear end stage: serum
biochemistry *18*
Assessment of renal function at/ear end stage: reciprocal creatinine
plots *19*
Assessment of renal function at/ear end stage: creatinine
clearance *20*
Assessment of renal function at/ear end stage: eGFR and calculated
creatinine clearance *22*
Assessment of renal function at/ear end stage: other methods *24*
Complications of renal failure: symptomatic *26*
Complications of renal failure: renal bone disease *28*
Complications of renal failure: malnutrition *29*
Complications of renal failure: fluid overload *30*
Complications of renal failure: metabolic *32*
Complications of renal failure: cardiovascular *34*
Management of renal failure: aims *35*
Management of renal failure: blood pressure control *36*

viii DETAILED CONTENTS

Management of renal failure: which drugs for BP? 37

Management of renal failure: how to achieve blood pressure control 38

Management of renal failure: slowing the rate of decline 40

Management of renal failure: lipids and fluid balance 41

Management of renal failure: treatment of anaemia 42

Management of renal failure: calcium and phosphate 43

Management of renal failure: metabolic complications 44

Management of renal failure: prevention of symptoms 45

Assessment of patients for dialysis: early referral 46

Assessment of patients for dialysis: when to start 47

Assessment of patients for dialysis: factors to be assessed 48

Assessment of patients for dialysis: when not to dialyse 50

Supportive care in ESKD 51

Assessment of patients for dialysis: role of pre-dialysis nurses 52

Checklist for assessing patients in a low clearance clinic 53

Haemodialysis vs peritoneal dialysis 54

Choosing which dialysis modality 57

Concept of integrated care 58

Education for dialysis 59

Choice of dialysis modality: case histories 60

When to start dialysis in ESKD 61

How to persuade the patient to start dialysis 62

Clinical indications for starting dialysis in ESKD 63

The acutely presenting patient or 'crashlander' 64

Psychosocial effects of starting dialysis in ESKD 66

Psychosocial effects of starting dialysis in ESKD: depression and anxiety 67

Psychosocial effects of starting dialysis in ESKD: others 68

2 Haemodialysis

Principles of haemodialysis 71

Principles of haemodialysis in practice 72

Factors affecting solute clearance on haemodialysis 74

Ultrafiltration during haemodialysis 76

Methods of ultrafiltration during haemodialysis 77

High efficiency and high flux haemodialysis 78

| | |
|---|-----|
| Haemofiltration and haemodiafiltration | 80 |
| Dialysers | 82 |
| Technical specifications | 83 |
| Dialysis membranes | 84 |
| Reactions to membranes | 85 |
| Biocompatibility of membranes | 86 |
| Biocompatibility and acute and chronic kidney disease | 88 |
| Dialysis machines: key features | 90 |
| Dialysis machines: additional facilities | 92 |
| Dialysis machines: monitors | 93 |
| Dialysis machine: patient monitors | 94 |
| Dialysate | 95 |
| Dialysate: sodium | 96 |
| Dialysate: other electrolytes and glucose | 98 |
| Dialysate: acid–base | 99 |
| Water purification | 100 |
| Water purification: treatment and toxicity | 102 |
| Vascular access: overview | 104 |
| Evaluation prior to access surgery | 105 |
| Permanent vascular access | 106 |
| Disadvantages of permanent vascular access | 108 |
| Formation of permanent access | 109 |
| Stenosis of fistulae and grafts | 110 |
| Thrombosis of fistulae and grafts | 111 |
| Screening for arteriovenous fistula/graft stenosis and thrombosis | 112 |
| Other complications of fistulae and grafts | 114 |
| Tunnelled cuffed catheters | 116 |
| Temporary vascular access | 117 |
| Insertion of vascular access catheters | 118 |
| Complications of temporary access insertion | 120 |
| Other complications of temporary access | 121 |
| Management of access (catheter) infections | 122 |
| Prevention of infection of dialysis access | 124 |
| Arteriovenous shunt (Scribner shunt) | 125 |
| Cardiopulmonary recirculation | 126 |
| Access recirculation | 127 |
| The first dialysis session in chronic and acute kidney disease | 128 |

x DETAILED CONTENTS

- The first dialysis session 130
- Complications during dialysis 132
 - Complications during dialysis: hypotension 134
 - Hypotension from excessive ultrafiltration 136
 - Management of hypotension 138
 - Prevention of hypotension 140
 - Prevention of hypotension: blood volume monitoring 142
 - Other complications during dialysis 144
 - Complications during dialysis: dialyser reactions 146
 - Blood clotting during haemodialysis 148
 - Anticoagulation for haemodialysis: heparin 149
 - Anticoagulation for haemodialysis: heparin administration 150
 - Anticoagulation for haemodialysis: heparin-free dialysis 151
 - Regional anticoagulation for haemodialysis 152
 - Other methods of anticoagulation for haemodialysis 154
- Dialysis adequacy: overview 156
- Dialysis adequacy: solute clearance 157
- Dialysis adequacy: urea kinetic modelling 158
- Calculation of Kt/V 160
- Dialysis adequacy: other measures of solute clearance 161
- Dialysis adequacy: online measures of clearance 162
- Residual renal function 163
- Other markers of adequacy: protein catabolic rate 164
- Other markers of adequacy 165
- Targets for adequate dialysis 166
- The HEMO study 168
- Increasing dialysis dose delivered 169
- Prescribing chronic haemodialysis: urea clearance 170
- Prescribing chronic haemodialysis: patient factors 172
- Prescribing chronic haemodialysis: dialyser factors 173
- Laboratory tests for patients on regular haemodialysis 174
- Dry weight 176
- Novel measures of dry weight 177
- Re-use of dialysers 178
- Re-use of dialysers: technique 180
- Home haemodialysis 181
- Daily haemodialysis 182

| | |
|---|-----|
| Haemodialysis and surgery: pre-operative | 184 |
| Haemodialysis and surgery: bleeding risks | 186 |
| Haemodialysis and surgery: peri-operative | 187 |
| Haemodialysis and surgery: post-operative | 188 |
| Haemodialysis in transplant recipients | 189 |
| Haemodialysis in terminal care | 190 |
| Haemodialysis for non-renal disease | 191 |

3 Nursing a patient on haemodialysis

| | |
|--|-----|
| Approaching patients on haemodialysis | 194 |
| Nursing care of vascular access | 195 |
| Pre- and post-operative care of access | 196 |
| Cannulation of fistulae | 198 |
| Complications of fistulae and their management | 200 |
| Grafts | 201 |
| Percutaneous tunnelled vascular catheters | 202 |
| Percutaneous temporary vascular catheters | 203 |
| Complications of vascular catheters and their management | 204 |
| Strategy for improving vascular access | 205 |
| Preparation for haemodialysis | 206 |
| The haemodialysis prescription | 208 |
| Anticoagulation for haemodialysis | 210 |
| Initiation of treatment | 211 |
| Intradialytic monitoring | 212 |
| Discontinuing haemodialysis | 214 |
| Post-dialysis evaluation | 216 |
| Dialysis machine alarms | 218 |
| Care of dialysis machines | 220 |
| Psychological care of haemodialysis patients | 221 |
| The dialysis unit: staffing | 222 |
| The dialysis unit: satellites | 223 |
| The dialysis unit: nursing education and audit | 224 |
| Infection on the dialysis unit | 225 |
| Infection control policies | 226 |

4 Peritoneal dialysis

| | |
|---|-----|
| Principles of peritoneal dialysis | 230 |
| Factors affecting efficiency of peritoneal dialysis | 232 |

xii DETAILED CONTENTS

Effect of dwell time on solute and fluid transfer 233

Modes of peritoneal dialysis: CAPD and intermittent peritoneal dialysis 234

Modes of peritoneal dialysis: automated peritoneal dialysis techniques 236

CAPD technique and systems 238

CAPD technique and systems: disconnect systems 239

Peritoneal dialysis catheters 240

Insertion of peritoneal dialysis catheters 242

Pre-operative preparation for peritoneal catheter insertion 243

Peritoneal dialysis catheter insertion technique 244

Laparoscopic peritoneal dialysis catheter insertion 246

Complications of peritoneal dialysis catheter insertion 247

Malfunctioning catheters 248

Investigation and management of malfunctioning catheters 250

Constipation in peritoneal dialysis patients 252

Repositioning peritoneal dialysis catheters 253

Peritoneal dialysate: composition 254

Peritoneal dialysate: problems with lactate/dextrose 256

Peritoneal dialysate: newer fluids 258

Peritoneal dialysate: new bag designs 260

Advantages and disadvantages of different dialysates 262

Prescribing CAPD 263

Prescribing CAPD: volumes and ultrafiltration requirements 264

Adequacy of peritoneal dialysis 265

Adequacy of peritoneal dialysis: measurement 266

Peritoneal dialysis adequacy: goals 268

Peritoneal dialysis adequacy: key trials 270

Peritoneal dialysis adequacy: targets 272

A practical approach to peritoneal dialysis adequacy 273

Peritoneal equilibration test and modelling 274

Technique for performing the peritoneal equilibration test 275

Peritoneal equilibration test results 276

Other measures of peritoneal membrane function 278

Increasing dialysis delivered by CAPD 280

Examples of alterations in CAPD prescription 282

Prescribing automated peritoneal dialysis 284

| | |
|--|-----|
| Increasing delivered dialysis and ultrafiltration in automated peritoneal dialysis | 286 |
| Examples of alterations in automated peritoneal dialysis prescription | 288 |
| Peritoneal dialysis in anuric patients | 290 |
| Residual renal function | 292 |
| Causes of underdialysis | 293 |
| Some patient examples | 294 |
| Exit site infections | 295 |
| Exit site infections: treatment | 296 |
| Prevention of exit site infections | 298 |
| Performing an exit site dressing | 300 |
| Peritonitis | 301 |
| Risk factors and prevention of peritonitis | 302 |
| Clinical features of peritonitis | 303 |
| Diagnosis of peritonitis | 304 |
| Treatment of peritonitis: principles (1) | 305 |
| Treatment of peritonitis: principles (2) | 306 |
| Treatment of peritonitis | 307 |
| Treatment of peritonitis: treatment based on microbiology | 308 |
| Treatment of peritonitis: clinical monitoring | 309 |
| TB peritonitis | 310 |
| Treatment of automated peritoneal dialysis peritonitis | 310 |
| Treatment of resistant peritonitis | 311 |
| Treatment of resistant peritonitis: removal of catheter | 312 |
| Complications of peritonitis | 313 |
| Encapsulating peritoneal sclerosis: clinical features | 314 |
| Encapsulating peritoneal sclerosis: diagnosis | 315 |
| Encapsulating peritoneal sclerosis: treatment | 316 |
| Encapsulating peritoneal sclerosis: causes | 318 |
| Hernias, leaks, and other complications | 319 |
| Hernias | 320 |
| Fluid leaks | 321 |
| Prolapses and pain | 322 |
| Other complications of peritoneal dialysis | 323 |
| Pre-operative assessment for peritoneal dialysis patients | 324 |
| Post-operative management for peritoneal dialysis patients | 325 |

Peritoneal dialysis and transplantation 326

Transfer of PD patient to HD 328

5 Nursing issues in peritoneal dialysis

Role of the nurse in peritoneal dialysis 332

Nursing care of peritoneal catheters: exit site 333

Nursing care of peritoneal catheters: catheters 334

Line changes 335

Training patients for CAPD 335

Training programme 336

Training patients for APD 338

Organizing outpatient care of peritoneal dialysis patients 340

6 Dialysis in acute kidney injury

Indications for acute dialysis 342

Acute dialysis: choice of modality 343

Psychosocial effects of dialysis in AKI 344

Dialysis adequacy in AKI 345

Prescribing acute haemodialysis 346

Continuous renal replacement therapy: overview 348

Continuous renal replacement therapy: performance 350

Continuous renal replacement therapy: technical 351

Continuous renal replacement therapy: dialysate 352

Other continuous renal replacement techniques 353

Anticoagulation for CRRT: heparin 354

Anticoagulation for CRRT: heparin-free 355

Anticoagulation for CRRT: regional citrate 356

Complications of continuous renal replacement therapy 357

CRRT troubleshooting guide 358

Peritoneal dialysis in acute kidney injury 359

Prescribing peritoneal dialysis in acute kidney injury 360

Haemodialysis and haemoperfusion for poisoning 362

Haemodialysis and haemoperfusion for poisoning: methods 363

Drugs and toxins removed by haemodialysis 364

Drugs and toxins removed by haemoperfusion 365

7 Nutrition on dialysis

Malnutrition in ESKD 368

Nutritional requirements in chronic kidney disease (pre-dialysis) 369

| | |
|---|-----|
| Dietetic treatment plan for pre-dialysis patients | 370 |
| Assessment of nutritional status: clinical (1) | 372 |
| Assessment of nutritional status: clinical (2) | 374 |
| Assessment of nutritional status: food intake | 376 |
| Assessment of nutritional status: biochemical (1) | 377 |
| Assessment of nutritional status: biochemical (2) | 378 |
| Nutritional requirements in haemodialysis and peritoneal dialysis | 380 |
| Strategies for achieving nutritional aims: energy and protein | 382 |
| Strategies for achieving nutritional aims: potassium | 383 |
| Strategies for achieving nutritional aims: phosphate | 384 |
| Dietary problems specific to ethnic minority patients | 385 |
| Supplemental vitamins and trace elements | 386 |
| Use of nutritional supplements | 387 |
| Intradialytic nutrition | 388 |
| Carnitine and ESKD | 389 |
| Fluid requirements in renal failure | 390 |
| Nutrition in acute kidney injury: energy requirements | 391 |
| Nutrition in acute kidney injury: protein requirements | 392 |
| Nutrition in acute kidney injury: electrolyte requirements | 393 |
| Routes for nutritional support in acute kidney injury | 394 |

8 Special situations

| | |
|---|-----|
| Dialysis in the elderly | 396 |
| Assisted PD | 398 |
| Managing diabetic patients on dialysis | 399 |
| Managing diabetic patients on dialysis: initiation of dialysis | 400 |
| Problems for diabetic patients on dialysis | 402 |
| Surgery in dialysis patients | 404 |
| Surgery in dialysis patients: haemodialysis and peritoneal dialysis | 406 |
| Myeloma and renal failure | 407 |
| Myeloma and renal failure: treatment | 408 |
| Myeloma and renal failure: dialysis and outcome | 409 |
| Pain management in ESKD | 410 |
| Difficulty of pain management in renal patients | 411 |
| Managing pain | 412 |
| Analgesic drugs | 414 |
| Pain at the end of life | 416 |
| Pregnancy in dialysis patients | 417 |

| | |
|--|-----|
| Managing pregnancy in dialysis patients | 418 |
| Travelling and holidays | 420 |
| Plasmapheresis | 422 |
| Techniques of plasmapheresis | 424 |
| Techniques of plasmapheresis: ancillary measures | 426 |
| Complications of plasmapheresis | 427 |
| Specific indications for plasmapheresis | 428 |
| Immunoadsorption techniques | 430 |
| Indications for immunoadsorption | 431 |

9 Complications of ESKD: anaemia

| | |
|---|-----|
| Causes of anaemia | 434 |
| Assessment of anaemia and haemolysis | 435 |
| Management of anaemia | 436 |
| Erythropoietin: administration | 438 |
| Erythropoietin: initiating therapy | 439 |
| Erythropoietin: maintenance therapy | 440 |
| Erythropoietin: side effects | 441 |
| Erythropoietin: target haemoglobin | 442 |
| Erythropoietin: failure to respond (resistance) | 443 |
| Iron metabolism | 444 |
| Assessing iron status | 445 |
| Iron supplements: oral iron | 446 |
| Intravenous iron | 447 |
| Intravenous iron preparations: iron sucrose | 448 |
| Intravenous iron preparations: iron gluconate and dextran | 449 |
| High ferritin and low transferrin saturation index | 450 |
| Non-iron adjuvants to EPO treatment | 452 |

10 Complications of ESKD: bone mineral disorders

| | |
|---|-----|
| Renal bone disease | 456 |
| Hyperparathyroidism and hyperphosphataemia | 457 |
| Hyperparathyroid bone disease: clinical features | 458 |
| Hyperparathyroid bone disease: radiology and histology | 459 |
| Hyperparathyroid renal bone disease: biochemical features | 460 |
| Parathyroid hormone assays | 461 |
| Low turnover bone disease: clinical features | 462 |

| | |
|---|-----|
| Low turnover bone disease: radiology and histology | 463 |
| Low turnover bone disease: biochemical features | 464 |
| Medical management of hyperparathyroid bone disease | 465 |
| Maintenance of normal phosphate levels | 466 |
| Vitamin D | 470 |
| Paricalcitol | 472 |
| Systemic effects of vitamin D | 474 |
| Calcimimetics | 476 |
| Examples of treatment plans for renal bone disease | 478 |
| Parathyroidectomy | 481 |
| Parathyroidectomy: pre-operative management | 482 |
| Parathyroidectomy: post-operative management | 483 |
| Calciophylaxis | 484 |

11 Complications of ESKD: cardiovascular disease

| | |
|--|-----|
| Cardiovascular disease | 486 |
| Cardiovascular risk factor intervention in dialysis patients | 488 |
| Management of ischaemic heart disease | 490 |
| Acute coronary syndrome | 491 |
| Acute coronary syndrome: cardiac management | 492 |
| Acute coronary syndrome: renal management | 493 |
| Hypertension | 494 |
| BP control in patients on haemodialysis | 495 |
| Management of BP on haemodialysis | 496 |
| Achieving BP control on haemodialysis | 497 |
| BP control in patients on peritoneal dialysis | 498 |
| Cerebrovascular disease | 499 |
| Peripheral vascular disease | 500 |

12 Complications of ESKD: infection

| | |
|--|-----|
| Infection risk in dialysis patients | 502 |
| Non-access-related infections in dialysis patients | 503 |
| Tuberculosis | 504 |
| Resistant organisms: MRSA | 505 |
| Resistant organisms: VISA, VRSA, VRE, and others | 506 |
| Viral infections: HBV | 507 |
| Viral infections: HCV | 508 |

Viral infections: other viruses 509

Viral infections: HIV 510

13 Symptoms related to ESKD

Introduction 512

Fatigue/lack of energy 514

Pruritus/dry skin 516

Pain 518

Sleep disorders 520

Restless leg syndrome (RLS) 522

Anorexia 523

Constipation 524

Nausea and vomiting 525

Cramps 526

Fluid overload and oedema 527

14 Other complications of ESKD

Dialysis amyloid: clinical features 530

Dialysis amyloid: pathogenesis and risk factors 531

Dialysis amyloid: diagnosis 532

Dialysis amyloid: management 533

Renal cysts and retroperitoneal bleeding 534

Renal cell carcinoma 535

Neurological complications: peripheral neuropathies 536

Neurological complications: CNS disorders 537

Depression 538

Cognitive impairment 540

GI bleeding 542

GI bleeding: management 544

Acidosis: consequences 545

Acidosis: treatment 546

Sexual dysfunction 547

Sexual dysfunction: medical factors 548

Sexual dysfunction: management 549

Aluminium toxicity 550

Aluminium toxicity: diagnosis 551

Aluminium toxicity: management 552

Nephrogenic systemic fibrosis 554
Gadolinium: recommendations 556
Blood biochemistry in ESKD 558
Tumour markers in ESKD 560
Quality of life 561
Compliance 562
Employment and rehabilitation 563

15 Death in dialysis patients

Survival rates 566
Causes of death 568
Cardiac arrest during dialysis 570
Management of cardiac arrest during dialysis 572
End of life issues 574
Palliative care 576
Palliative care: management of symptoms 578
Withdrawal of dialysis 579
Withdrawal of dialysis: case histories 580
Withdrawal of dialysis: discussion of cases 581
Quality of death 582

16 Transplantation for dialysis patients

Assessment for transplant suitability 586
Living donor transplantation 587
Assessment of patients prior to transplantation 588
Pre-transplant management 589
The transplant operation 590
Post-transplant management 592
Delayed graft function 594

17 Drug prescribing in patients on dialysis

Drug handling in renal failure 596
Dosing of commonly used drugs 597
Dosing of antimicrobial drugs 598
Dosing of antifungal drugs 600
Dosing of antiretroviral drugs 602
Dosing of antiviral drugs 604

xx DETAILED CONTENTS

- Dosing of antituberculous drugs 606
 - Dosing of cardiovascular drugs 608
 - Dosing of analgesics 610
 - Dosing of CNS drugs 611
 - Dosing of gastrointestinal drugs 612
 - Dosing of immunosuppressants 613
 - Miscellaneous drugs 614
 - Drugs that do not require dosage alteration in CKD stage 5, haemodialysis, and CAPD 615
 - Drugs to be avoided in CKD stage 5, haemodialysis, and PD 616
 - Notes on specific cardiovascular drugs 617
 - Notes on specific opioid analgesics 618
 - Notes on NSAIDs 619
 - Notes on specific antibiotics 620
 - Factors affecting drug removal by continuous renal replacement therapy 622
 - Dosing of drugs commonly used during continuous renal replacement therapy 624
-

18 Standards documents

- Overview of UK Renal Association clinical practice guidelines 628
- UK Renal Association guidelines: CKD 629
- UK Renal Association guidelines: CKD complications 630
- UK Renal Association guidelines: haemodialysis 632
- UK Renal Association guidelines: peritoneal dialysis 634
- UK Renal Association guidelines: AKI 635
- Overview of American K/DOQI guidelines 636
- K/DOQI: haemodialysis adequacy 637
- K/DOQI: peritoneal dialysis adequacy 638
- K/DOQI: vascular access 640
- K/DOQI: anaemia 642
- K/DOQI: nutrition in dialysis patients 644
- K/DOQI: dyslipidaemia in CKD 646
- K/DOQI: bone metabolism and disease in CKD 648
- K/DOQI: cardiovascular disease in dialysis patients 650
- European Best Practice guidelines: pre-dialysis 651
- European Best Practice guidelines: haemodialysis 652

European Best Practice guidelines: intradialytic hypotension 653

European Best Practice guidelines: infection 654

European Best Practice guidelines: vascular risk factors 655

European Best Practice guidelines: vascular access 655

European Best Practice guidelines: peritoneal dialysis 656

European Best Practice guidelines: nutrition 658

Appendix: useful websites 660

Index 663