INDEX

acanthocytosis, 135
accidental hypothermia, 90
acetaminophen, 185
activated coagulation time (ACT), 125
activated prothrombin time (aPTT), 127
activated prothrombin time ratio (APR), 127, 129
acute kidney injury (AKI), 172, 173
acute lung injury, 73
acute mechanical defect, 86
acute respiratory distress syndrome (ARDS), 6
acute respiratory failure, 72
age, 71, 74
air embolism, 115, 116, 177
air entrainment, 37, 49, 58
air transfer of patient, 163
albumin, 183
aminocaproic acid, 138
amiodarone, 187
anaemia, 121, 136
antibiotics, 180
antibodies, 131, 132
anticoagulants, 121–3
anticoagulation, 88, 89
assessment, 51
ECCO₂R, 201
monitoring of, 123–9
need of, 120
renal replacement therapy, 177
antiepileptics, 187
antithrombin, 122, 123, 126, 128
anti-Xa levels, 126, 128
arrhythmias, 83, 115
arterial cannulas, 103, 106, 107, 117
arterial pressure waveform, 64
arterio-venous ECCO₂R, 198–9
artificial lung, 41
aseptic technique, 96, 109, 115
assays, 120
asthma, 70
Avalon Elite®, 108
barotrauma, 148
benchmarking, 23
beta adrenergic receptor antagonists, 79
bleeding. See haemorrhage
blood count abnormalities, 131–4
blood films, changes to, 134
blood flow through the circuit, 51
veno-venous ECMO, 146
blood gas monitoring, 49
blood product transfusion, 131
blood pump, 38–41
blood samples, 120
bone marrow biopsy, 134
brain injury, 75
bridge configuration in tubing, 37
bubble oxygenators, 1, 2
bupropion, 79
calcium channel antagonists, 79
cannulas
circuit configuration, 112
comparisons, 105
dislodgement, 53
double lumen, 105, 108
fixation, 111, 195
insertion, 109
length, 103
main features, 101
materials, 102
pressure monitoring, 59
pump flow and, 40
shape, 103–4
sidearms, 105
side holes, 104, 108
surface coating, 102
veno-arterial ECMO, 103, 106, 107, 117
veno-venous ECMO, 103, 104, 108
cannulation, 96, See also decannulation

angle of, 110
complications, 114
insertion checklists, 97
location of procedure, 100
personnel involved, 96
technique, 109–12
carbohydrates, 191
carbon dioxide removal, 45,
See also ECCO₂R
cardiac arrest, 81, 84, 85
cardiac diseases, 22, 78–90
acute mechanical defect, 86
arrhythmias, 83, 115
ECMO bridge, 86
eCPR, 81–5
pulmonary embolism, 88
reversibility, 80–1
cardiopulmonary bypass, 3, 5, 7, 15, 87, 89, 168
cardiopulmonary resuscitation (CPR), 91
eCPR, 81–5
cardioversion, 83
case selection. See patient selection
caspofungin, 186
catabolism, 188, 190
cavitation, 115
centrifugal pumps, 38–41
pressure monitoring, 48
cerebral haemorrhage, 72, 76
Cesar trial, 3, 6, 72, 77
chest physiotherapy, 194
chronic obstructive pulmonary disease, 71
Index

chronic thromboembolic hypertension, 89
clotting factors, 122, 124, 128
cogulation cascade, 124
competencies
  assessment, 9
  doctors, 12
  ECMO specialist, 13
contamination, water, 45
continuous peritoneal dialysis, 175
continuous veno-venous haemodialysis, 176
continuous veno-venous hemodiafiltration, 176
continuous veno-venous hemofiltration, 176
controlled donors, 205, 206
cyclosporine, 187
cystic fibrosis, 71
decannulation, 96
  arterial cannula, 117
  checklists, 98
  venous cannula, 115–17
dexmedetomidine, 185
digoxin, 79
direct thrombin inhibitors, 123
distal limb ischaemia, 199, 200
doctors, 10, 12
  arbitration role, 21
  cannulation, 96
  ECMO training topics, 11
  patient transfer, 160
double lumen cannulas, 105, 108
drainage cannula, 114
drug availability, changes, 183–4
drug intoxication, 78, 91
duration of ventilation, 72, 76
ECCO₂R, 197–8
  arterio-venous, 198–9
  circuit monitoring, 201
  complications, 200
  veno-venous, 199
echocardiography, 66
ECMO. See also veno-venous
  ECMO
developmental milestones, 1, 2
  first patients, 4
  first trial, 4
  future of, 209
  intensive care management, 171–95
  next generation v2.0, 6
  organ donation, 204–6
  paediatric, 5, 19, 178
  prediction scores, 92
  survival after, x
  weaning patient from, 165–9
  when not to use, 92
ECMO circuit, 12, 25–31, See also cannulas
cannula configuration, 112
  components, 32–46
  diagram illustrating, 35
gas and electric supplies, 19
  maintenance, 55
  monitoring, 46–53
  perfusionist role and, 15
  RRT connection to, 175
Index

- selection, 53
- training in, 9
- ECMO coordinator, 10, 14
- ECMO director, 10, 15
- ECMO service, 6
- co-located clinical services, 18
- infrastructure, 17–21
- key team members, 10
- organisation of, 21–3
- staffing, 9–17
- ECMO specialists, 10, 13
- eCPR, 81–5
- electrolyte plasma levels, 191
- emphysema, 69, 71
- end-of-life care, 168
- enteral nutrition, 189–90
- complications from, 192
- ethics, 78, 205, 206
- extracorporeal life support, 1
- Extracorporeal Life Support Organization (ELSO), 5, 207
- extracorporeal membrane oxygenation. See ECMO
- Factor Xa, 124
- anti-Xa levels, 126, 128
- femoral artery, 112
- fentanyl, 183, 184, 185
- fibrinolysis, 138
- finances, 22
- flecaïnide, 79
- fluid balance, 150, 156
- optimisation, 174
- fluoroscopy, 99, 101, 109, 111
- folic acid, 136
- fondaparinux, 122, 123
- fractionated heparin, 122
- frailty, 71, 74
- free haemoglobin, 51
- furosemide, 187
- gastrointestinal bleeding, 137
- gentamicin, 184, 185
- glucose, 191
- glutamine supplementation, 191
- glyceryl trinitrate, 112
- H1N1 pandemic, 3, 6, 20
- haematology support, 119
- haemofiltration, 175
- haemoglobin, free, 51
- haemoglobinopathy, 136
- haemolysis, 115, 121, 135
- haemophilia, 125
- haemorrhage, 114, 115, 137–40
- cerebral, 72, 76
- ECO2R, 200
- intracranial, 137
- management of, 139
- pulmonary, 137
- risk of, 120
- tracheostomy risk and, 151, 156
- harlequin syndrome, 65
- heart transplantation, 86
- heat exchangers, 45
- heparin, 1, 2, 187
- cannulation and, 112
- coatings, 34, 102, 120
- fractionated, 122
- monitoring, 125–9
- thrombocytopenia, 132, 200
heparin (cont.)
  unfractionated, 121, 126
high arterial blood pressure, 173
high frequency oscillatory ventilation, 148
HIV/AIDS, 71
hydralazine, 187
hypothermia, accidental, 90
hypoxaemia, 73, 147
immune thrombocytopenia, 133
immunoglobulins, 134, 136
immunosuppression, 70
inotropes, 143, 157
insulin, 187
intensive care management, 171-95
intensive care unit, 17, 58
International ECMO Network (ECMONet), 207
international registry, 23, 207
intra-aortic balloon pump, 157
intracranial haemorrhage, 137
intravascular pressures, 58
irreversibility, respiratory diseases, 77
ischaemia, distal limb, 199, 200
isolation facilities, 19
jugular vein, 109
least damaging lung ventilation, 4, 141
levetiracetam, 187
lipaemia, 121
lips, 191
lipophilic drugs, 183, 186
liver failure, 91
lorazepam, 184
low flow alarms, 52
low molecular weight heparin (LMWH), 122
lumbar puncture, 138
lung fibrosis, 71
lung transplantation, 6, 77, 198
magnetically levitated pumps, 38
major bleeding, 137, 139
mattress suture, 116
Mayo-Gibbon pump-oxygenator, 2
mechanical ventilation
  veno-arterial ECMO, 154
  veno-venous ECMO, 142, 148-50
membrane oxygenators, 2, 5, 41
  schematics, 42
meropenem, 184, 186
metabolic response, 188
midazolam, 183, 184
minor bleeding, 137, 139
M-number formalism, 106
monitoring. See also patient monitoring
  ECMO circuit, 46-53
  morphine, 185
  Murray score, 72, 73
National Respiratory ECMO service, 71
negative pressure monitoring, 49
neuraminidase inhibitors, 186
neuromonitoring, 59
nicardipine, 187
nitric oxide, 152, 173
nosocomial infections, 179–80
Novaport Twin cannula, 108
nurses, 10, 14, 193
nutrition, 187–92
obesity, 75
operating theatre, 100
organ donation, 90, 169, 204–6
dead brain donors, 204
non-heart-beating donors, 205
oseltamivir, 186
oxygenation
veno-arterial ECMO, 155
veno-venous ECMO, 145–6
oxygenators, 27, 41–5, See also
membrane oxygenators
bubble, 1, 2
failure, 49
Mayo-Gibbon pump, 2
monitoring, 47, 49
second oxygenator, 44, 145
paediatric ECMO, 5, 19, 178
paralysis, 171
parenteral nutrition, 190
patient monitoring, 58–67
anticoagulation, 123–9
veno-arterial ECMO, 63–7
veno-venous ECMO, 46, 60–2
patient selection, 12, 68
cardiac diseases, 78–90
ECMO prediction scores, 92
other diseases, 90–2
respiratory diseases, 69–78
when not to use ECMO, 92
patient transfer, 159–64
by air, 163
care during, 162
planning, 159
peak inspiratory pressure, 149
pentasaccharides, 123
peptic ulceration, 188
perfusionists, 10, 15
peripheral veno-arterial
configuration, 65, 80, 86
cannulas, 104, 107
personal protection equipment, 20
pharmacists, 10
pharmacokinetics, 181, 184
pharmacology, 181–7
phenobarbital, 187
phenytoin, 187
physiotherapy, 194
piperacillin, 186
plasmapheresis, 178
platelet count, 131, 139
pneumonia, 70, 179, 181
polymethylpentene, 43
polyurethane, 102
polyvinylchloride, 34
positive end-expiratory pressure
(PEEP), 73, 149
post-oxygenator pressure, 48
pre-centrifugal pump pressure, 48
prediction scores, 92
prednisolone, 133
pre-oxygenator pressure, 47
pressure flow tables, 105
pressure monitoring, 47–9, 59
pressure sores, 193
prone positioning, 151
prophylactic antibiotics, 181
propofol, 185
propranolol, 184
protem, 122, 123, 127
proteins, 190
pulmonary embolism, 88
pulmonary haemorrhage, 137
pump afterload, 40
pump preload, 40
pump-oxygenators, 2
pumps
  centrifugal, 38–41
  intra-aortic balloon, 157
  pressure monitoring, 48
  requirement for, 25, 26
ranitidine, 187
recirculation in veno-venous
  ECMO, 61, 145
  recombinant factor VIIa, 139
red cell transfusion, 144
rehabilitation, 194
renal function, 172–8, 184
renal replacement therapy (RRT), 172
anticoagulation with, 177
indications for, 174
methods of, 175–7
nutrition and, 190, 192
reperfusion lines, 60, 105, 107, 111, 156
RESP scores, 92
respiratory diseases, 22, 69–78, 141
ECCO₂R support, 197
irreversibility, 77
reversibility, 70
specifics considerations, 71–7
ventilator-associated lung injury, 148
return cannula, 114
return of spontaneous circulation, 81
reversibility
  cardiac diseases, 80–1
  respiratory diseases, 70
revolutions per minute, 40
rhucus negative women, 131
SAVE scores, 92
sedation, 171
Seldinger technique, 96
sepsis, 178–81, 191
sickle cell disease, 136
side ports in tubing, 36
sidearms in cannulas, 105
side holes in cannulas, 104, 108
staff training, 9, 13
staffing, 9–17
surface area of membrane, 43
survival-to-discharge, 83
sweep gas, 45, 143, 148, 165, 197
tachypnea, 150
theophylline, 186
thrombin, 126
direct inhibitors, 123
thrombocytopenia, 131
Index

heparin-induced, 132, 200
other causes, 133
thromboelastography, 128
thrombosis, 88
ECCO₂R and, 198, 200
veno-arterial ECMO, 63
thrombotic thrombocytopenia purpura, 134
tidal volume, 149
tracheal extubation, 151
tracheostomy, 151, 156
tranexamic acid, 138
transfer equipment, 161–2
transfer team, 16, 160
transmembrane pressure, 49, 50
transplantation, 70, 90
heart, 86
lung, 6, 77, 198
transthoracic pressure, 149
tricyclic antidepressants, 79
tubing, 32–8
ultrasound, 111, 112
in cannulation, 97
uncontrolled donors, 205
unfractionated heparin, 121, 126
valsalva manoeuvre, 116
vancomycin, 184, 185
vasculitis, 70
vasoactive drugs, 143
veno-arterial ECMO, 7, 26, 30, 34, 92, 153–7
arterial pressure waveform, 64
cannulas, 106, 107
cardiac recovery problems with, 80
mechanical ventilation, 154
oxygenation during, 155
patient monitoring, 63–7
peripheral configuration, 65, 80, 86
pump afterload, 40
pump flow and, 41
stabilisation on, 154
weaning patient from, 168
veno-venous ECCO₂R, 199
veno-venous ECMO, 25, 31, 141–2
cannulas, 103, 104, 108
cannulas removal, 115–17
cerebral haemorrhage, 72, 76
fluid balance, 150
mechanical ventilation, 142, 148–50
oxygenation during, 145–6
patient monitoring, 46, 60–2
stabilisation on, 142–5
standard ventilation settings, 143
weaning patient from, 165–8
ventilator-associated lung injury, 148
ventricular assist device, 86
ventricular vents, 157
visual inspection of the ECMO, 53
voriconazole, 186
water drills, 9