**Index**

**A**
- acid-citrate dextrose (ACD) solutions, 6, 31, 203, 226
- acute hemolytic transfusion reactions (AHTR), 179, 181
- acute lung injury (ALI), 86, 155
- acute normovolemic hemodilution, 288
- acute respiratory distress syndrome (ARDS), 86
- acute traumatic coagulopathy (ATC), 49
- adenosine triphosphate (ATP), 30, 31, 33, 161
- administration of blood products, 10
- advancements in veterinary transfusion medicine and blood banking, 9
- allogenic transfusions, 10
- blood typing and recipient screening, 9–10
- evidence-based guidelines, 9
- storage and administration of blood products, 10
- storage lesions and leukoreduction, 10
- transfusion triggers, 10
- agglutination typing card, 148–149, 192, 216–217
- albumin, 23, 83
- alternatives to transfusions
  - nutritional support, 92
  - plasma transfusion, 92
- distribution, 85
- functions, 83
  - antioxidant, 84
  - carrier, 83–84
  - coagulation mediation, 84
  - miscellaneous functions, 84
- hypoalbuminemia, 85–86
  - associated conditions, 85
- processing, 248
- structure, 83
- supplementation in small animals, 87
- administration guidelines, 91
- bovine and equine serum albumin, 91
- canine-specific albumin (CSA), 91
- clinical manifestations of hypersensitivity, 92
- conditions and doses, 88
- human serum albumin (HSA) in canine patients, 87–91
- synthesis, 84–85
- transfusion in animals
  - indications, 87
- transfusion in humans, 86
- acute lung injury (ALI), 86
- acute respiratory distress syndrome (ARDS), 86
- current recommendations, 86–87
- fluid resuscitation, 86
- septic patients, 86
- allergic reactions, 179
- plasma transfusions, 52
- signs, 175
- allogenic blood transfusions, limiting, 284, 294
- autologous transfusions, 286
  - acute normovolemic hemodilution, 288
  - cell salvage, 288
  - post-operative autologous donation, 286–288
  - autologous transfusions in veterinary patients, 293–294
  - comparison of reduction techniques, 287
  - paradigm shift in human transfusion medicine, 284
  - patient blood management (PBM), 284–285
  - iatrogenic blood loss, 285
- minimizing blood loss, 285
- optimizing hemopoiesis, 285
- surgical blood loss, 285–286
- proposed procedure for normovolemic hemodilution, 293–294
- safe interoperative blood loss, 290
- transfusion triggers, 288–289
- restrictive versus liberal transfusion strategies, 289
  - veterinary applications, 289–290
- erythropoietin, 290
- minimizing surgical blood loss, 290–292
- systemic hemostatic agents, 292–293
- allogenic transfusions, reduction therapies, 10
- alpacas, 325
- alternative plasma protein products, 83, 99–100
- albumin, 83
  - carrier function and antioxidant properties, 83–84
  - coagulation mediation, 84
  - functions, 83
  - hypoalbuminemia, 85–86
  - miscellaneous functions, 84
  - structure and function, 83
- synthesis and distribution, 84–85
- albumin alternatives
  - nutritional support, 92
  - plasma transfusion, 92
  - albumin supplementation in small animals, 87
- administration guidelines, 91
  - bovine and equine serum albumin, 91
  - canine-specific albumin (CSA), 91
  - clinical manifestations of hypersensitivity, 92
  - conditions and doses, 88
  - human serum albumin (HSA) in canine patients, 87–91
- albumin transfusion in animals
  - indications, 87
- albumin transfusion in humans, 86
  - acute lung injury (ALI) and acute respiratory distress syndrome (ARDS), 86
  - current recommendations, 86–87
  - fluid resuscitation, 86
  - septic patients, 86
  - human intravenous immunoglobulin (hIVIG), 92
  - human use, 94
  - immunomodulation, 92–94
- alternative transfusion methods, 296, 304–305
  - autologous transfusions, 297
    - advantages and disadvantages, 297
    - methods, 298–300
    - theoretical benefits, 297
    - xenotransfusion, 296–297
    - advantages and disadvantages, 297
- American College of Veterinary Anesthesia and Analgesia (ACVAA), 3
- American College of Veterinary Emergency and Critical Care (ACVECC), 3
- American College of Veterinary Internal Medicine (ACVIM), 3
- amphibian transfusion medicine, 358
  - administration, 362–363
  - anemia, 359
  - hemogram variability, 359
  - regeneration, 359
blood collection, 360
anticoagulants, 360–361
sedation and fluid replacement, 361–362
sites, 361
blood groups and types, 360
CBC values, 364
diagnosis, 359
donor selection, 360
compatibility testing, 360
hemoglobin-based oxygen carrier (HBOC) solutions, 364
indications for transfusion, 359–360
monitoring and complications, 363–364
physiology, 358–359
post-transfusion follow-up, 364
anaphylaxis signs, 175
anaplasmosis, 195, 218
anemic dog clinical assessment score (ADCAS), 35
anesthetics, 226
inhalant, 226
animal-to-animal transfusions, first, 4
animal-to-human transfusions, 4
anticoagulants, 202, 225, 315, 337, 326
historical perspective, 6
antifibrinolytics, 292
antiglobulin tests, 125
direct antiglobulin test (DAT), 125–126
indirect antiglobulin test (IAT), 126
apheresis, 7
appreciation of donors, 281
arresting active hemorrhage, 63
arrhythmias, 177, 178–179
artificial oxygen carrier, 70
Association of Veterinary Hematology and Transfusion (AVHTM), 3
Australia, veterinary blood banks, 17
autologous blood patch pleurodesis (ABPP), 106
complications, 108
contraindications, 106
indications, 106
physiology, 106
procedure, 106–108
recommended blood volume, 108
success rate, 108
autologous blood transfusion, 40
autologous conditioned plasma (ACP)
canine osteoarthritis, 111, 112
equine, 112
equine tendon and ligament lesions, 111
hyaluronan, 111
autologous platelet-rich plasma
canine flap perfusion and healing, 108–109
canine tendons, 110
preparation, 110–111
wound healing, 109–110
autologous serum eye drops, 106
comparisons between tears and serum, 103
complications, 106
contraindications, 105–106
cost, 106
indications, 105
physiology of serum for ocular application, 103–104
preparation, 104–105
serum components, 103
storage and stability, 105
autologous transfusions, 286, 297
acute normovolemic hemodilution, 288
advantages and disadvantages, 297
cell salvage, 288
comparison of reduction techniques, 287
horses, 313
methods, 298
cell salvage, 300–304
direct re-infusion, 298–300
post-operative autologous donation, 286–288
theoretical benefits, 297
veterinary patients, 293–294
avian transfusion medicine, 334
administration, 338–340
blood collection, 336–337
anticoagulants, 337
lactate measurement, 337
blood groups and types, 335–336
component processing and storage, 337
leukoreduction, 337–338
donor selection, 336
compatibility testing, 336
erythrocyte physiology, 334–335
hemoglobin-based oxygen carrier (HBOC) solutions, 340–343
hemotologic values, 341–342
indications for transfusion, 335
transfusion triggers, 335
monitoring and complications, 340
post-transfusion follow-up, 340
B
babesia, 195
bacterial infection signs, 175
Bartonellosis, 195, 218
blood banks
Australia, 17
Canada, 17
commercial
examples, 260–261
websites, 260
costs of an animal blood bank, 263–264
average costs, 265
equipment costs, 266
single canine donor, 264
single feline donor, 264
summary, 264
historical perspective, 6
in-clinic blood bank considerations
acquiring animals for blood donor colony, 262–263
costs, 264
establishing animal numbers for blood donor colony, 263
procuring animals, 261–262
requirements for blood donor colony, 263
summary, 262
transfusion demand, 261
reducing demands, 282
component therapy, 282
minimizing product expiration, 282–283
point-of-care assays, 282
type-specific blood products, 282
small mammals, 353
UK, 17
USA, 17
blood collection systems
additional equipment and supplies, 204
small volume whole blood, 203
standard volume whole blood, 203–204
standard volume whole blood for component processing, 204
blood drive coordinator, 279
blood drives, 280
blood filters, 38
blood groups, discovery of, 5–6
blood loss, 285–286
calculating allowable blood loss, 286
minimizing surgical blood loss, 290–292
safe interoperative blood loss, 290
viscoelastic testing, 286
blood pressure, 179
normal/abnormal parameters in dogs and cats, 176
blood products, 14
blood products, miscellaneous usage, 103, 112
autologous blood patch pleurodesis (ABPP), 106, 108
complications, 108
contraindications, 106
indications, 106
physiology, 106
procedure, 106–108
recommended blood volume, 108
success rate, 108
autologous conditioned plasma (ACP)
canine, 112
canine osteoarthritis, 111
equine, 112
equine tendon and ligament lesions, 111
hyaluronan, 111
autologous platelet-rich plasma
canine flap perfusion and healing, 108–109
canine tendons, 110
preparation, 110–111
wound healing, 109–110
autologous serum eye drops, 106
comparisons between tears and serum, 103
complications, 106
contraindications, 105–106
cost, 106
indications, 105
physiology of serum for ocular application, 103–104
preparation, 104–105
serum components, 103
storage and stability, 105
platelet-rich concentrates (PRCs), 108
physiology, 108
blood substitute, 70
blood transfusions
bag labeling, 32
deciding when to transfuse, 34–35
scoring systems, 35
dosage
red blood cell (RBC) products, 37
liberal versus restrictive transfusion practices, 23–24
preparing for transfusions
red blood cell (RBC) products, 35–36
rate
red blood cell (RBC) products, 37–38
blood transfusion request form, 165–166
blood typing methods, 9–10
automated blood typing, 122
blood-typing cards, 119–120
commercial laboratories, 122
comparisons between tests, 121
immunochromatographic cartridges, 120–121
practical considerations, 122–123
test tube method, 119
blood typing tests, 216
card agglutination test, 216–217
immunochromatographic test, 217–218
Bohr effect, 71
 Bordetella bronchiseptica, 220
bovine serum albumin, 91
bradycardia, 177, 178
bridge oxygenation, 70
brucellosis, 195
buprenorphine, 352, 362
butorphanol, 226, 352, 362
C
calcium gluconate, 166
Canada, veterinary blood banks, 17
canine blood collection, 199
pre-donation procedure
donor preparation, 204–205
material preparation, 202–204
preparation, 202
collection techniques
closed system collection, 207
concluding the donation, 208
donor positioning, 205
gravity- vs vacuum-assisted collection, 208
open system collection, 207
procedure, 207
site preparation, 205
staff requirement, 205
venipuncture, 205–206
donor eligibility, 199
blood tests, 200–201
frequency of donation, 200
history and consent, 199–200
physical examination, 200
recommendations for minimizing stress, 201–202
donor selection, 199
post-donation care, 209–211
home care tips for owners, 211
canine donor management, 272
canine donor selection, 189, 199
considerations, 189
age, 189
behavior/temperament, 196
canine blood types, 190–193
donor health, 193–194
infectious disease screening, 194–196
owners, 196
physical characteristics, 190
screening criteria, 190
weight, 189–190
donor eligibility, 199
blood tests, 200–201
frequency of donation, 200
history and consent, 199–200
physical examination, 200
recommendations for minimizing stress, 201–202
incentives, 197
preventative health, 196–197
canine pemphigus foliaceus, 96
canine recipient screening, 117, 127
advanced diagnostics, 125
antiglobulin tests, 125–126
blood group genetics, 117
blood groups, 117–118
pre-transfusion protocol, 118
pre-transfusion testing, 118
other considerations, 119
sample age, 118–119
sample collection, 118–119
tests, 119–124
pre-transfusion tests in unique clinical situations, 126
alloantibody, 127
emergency transfusion, 126
immune-mediated hemolytic anemia, 126–127
massive transfusion, 126
rouleaux formation, 127
canine Stevens–Johnson syndrome (SJS), 96
canine toxic epidermal necrolysis, 96
canine-specific albumin (CSA), 23, 87, 91
capillary refill time, 177, 179
normal/abnormal parameters in dogs and cats, 176
carbon dioxide (CO₂), 71
card agglutination test, 216–217
cardiovascular signs, 177–178
acute hemolytic transfusion reactions, 179
allergic reactions, 179
blood pressure, 179
capillary refill time, 179
heart rate, 178
arrivhythms, 178–179
bradycardia, 178
tachycardia, 178
mucous membrane color, 179
venous distension, 179
cats
see also under feline
anesthesia, 226
blood types, 129–134, 215
cats (continued)
  All blood group system, 129–133, 215–216
  milk antigen, 216
  other blood groups, 133–134
  prevalence by country, non-pedigree cats, 135–136
  prevalence by country, pedigree cats, 137–140
  prevalence by country, pedigree cats, 141–143
blood typing tests, 216
  card agglutination test, 216–217
  immunochromatographic test, 217–218
common transfusion reactions, 156
erythema multiforme, 96
feline packed red blood cells (PRBC), 19
minimizing stress, 233
normal/abnormal monitoring parameters, 176
oxyglobin® indications for use, 77
oxyglobin® side effects
  respiratory signs, 78–79
sedation, 213
sedation protocol, 226
cattle, 324
cell salvage, 288, 300–302
  centrifugation devices, 303–304
  situations in dogs, 302
  ultrafiltration devices, 302–303
centrifuges, 15
  cell salvage, 303–304
  component processing, 242–243
  recommended RPM settings, 243
  relative centrifugal force (RCF) and times, 245
  total centrifugal force (TCF) and relative centrifugal force (RCF), 246
maintenance, 252
Chagas disease, 195
chinchillas, 351
Chlamyphila felis, 220
citrate–phosphate–dextrose (CPD), 6, 225
  circulatory overload, 162, 166
citrate toxicity, 162–163, 166
  signs, 175
citrate–phosphate–dextrose (CPD) anticoagulant, 31
citrate–phosphate–dextrose–adenine (CPDA) anticoagulant, 30, 31, 203, 225
coagulopathies, 34
colloid osmotic pressure (COP), 71, 77–78
albumin, 83
commercial blood banks, 259–260
  examples, 260–261
  websites, 260
component processing, 237
  centrifugation, 242–243
  recommended RPM settings, 243
  relative centrifugal force (RCF) and times, 245
  total centrifugal force (TCF) and relative centrifugal force (RCF), 246
feline blood, 249
  labeling, 248–249
  pre-processing storage, 243
  protocols, 241–242
  supplies and equipment, 237
  atraumatic clamps, 239
  centrifuge, 237
  donor tube stripper, 239
  plasma press, 239
  scales, 237
  tube sealers, 239
  whole blood collection bags, 237
troubleshooting tips, 244–245
component storage
cryoprecipitate (CRYO), 252
  maximum duration suggestions, 249
  packed red blood cells (PRBC), 250–251
  plasma, 251–252
  platelets, 252
  whole blood (WB), 250–251
component therapy, 13, 24
  advantages, 18
background concepts, 14–15
disadvantages, 18
equipment for storage, 16–17
improving product quality, 23
instrumentation for production, 15–16
liberal versus restrictive transfusion practices, 23–24
overview of components
  packed red blood cells (PRBC), 18–19
  plasma, 21–22
  plasma-derived components, 22–23
  platelet products, 19–21
  reducing blood bank demands, 282
  rise of component therapy, 17–18
whole blood (WB)
  advantages, 13
  description and contents, 13
  disadvantages, 13–14
  indications, 13
conjugated hemoglobin, 75
cosent, donor, 223–224, 275–277
costent form, 276
crossmatching test, 125
crossmatching, 123, 143–147
  antibody screening, 147–148
  agglutination typing card, 148–149
  alloantibody titer measurements, 150
  blood typing, 148
  flow cytometry, 150
  gel typing system, 149
  genotyping, 150–151
  immunochromatographic cartridges, 149–150
  gel agglutination method, 124
  general consideration, 143
  immunochromatographic method, 124
  major tube procedure, 123–124
  rapid slide procedure, 144–145
  red cell washing, 143
  tube procedure, 145–146
cryoprecipitate, 14, 22
cryoprecipitate (CRYO), 46
  processing, 242, 248
  quality control (QC), 254
storage, 252
cryoprecipitate-poor plasma (CPP), 46
  transfusion guidelines, 48
cryoprecipitate-poor plasma (CPP), 46
cryopreserved products processing, 248
cytophrematocytes, 14, 22
customer service, 280–281
cutaneous disease, 96
cutaneous signs, 180
cytauxzoonosis, 218

D
dexmedetomidine, 352
dexamethasone, 166
dexametomidine, 226
dextrose solution, 6
diapirin crosslinked hemoglobin, 73
diazepam, 352
dimethyl sulfoxide see DMSO
diphenhydramine, 166
dipyrone, 166
direct re-infusion autologous transfusions, 298
  advantages and disadvantages, 299–300
  equipment requirement, 299
  non-surgical completion procedure, 299
side effects, 300
surgical completion procedure, 299
DMSO-cryopreserved canine platelets, 60–62
DMSO-preserved frozen blood concentrate, 14, 20
dog erythrocyte antigen (DEA), 7, 9, 50
dogs
see also under canine
albumin supplementation with canine-specific albumin (CSA), 91
dosing recommendations, 91
products available, 91
albumin supplementation with human serum albumin (HSA), 87
adverse effects, 87–88
calculating albumin deficiency, 90
dosing protocols, 90–91
log of transfusion, 90
products available, 88–89
anemic dog clinical assessment score (ADCAS), 35
autologous conditioned plasma (ACP), 112
blood groups, 117–118
agglutination test card, 192
DEA system, 190
desirable blood types, 191–192
nomenclature of DEA 1 group, 193
other blood groups, 191
universal donors, 190–191
canine-specific albumin (CSA), 23
common transfusion reactions, 156
flap perfusion and healing, 108–109
normal/abnormal monitoring parameters, 176
osteoarthritis, 111
oxygen
circulation
(r), indications for use, 76
canine babesiosis, 76
hypoperfusion, 76–77
immune-mediated hemolytic anemia, 76
parasite-induced anemia, 76
pemphigus foliaceus, 96
platelet administration, 65
platelet transfusion refractoriness, 65–66
Stevens–Johnson syndrome (SJS), 96
tendon and ligament lesions, 111
tendons, 110
toxic epidermal necrolysis, 96
donor health criteria, 193
history, 193–194
medication, 194
physical examination and blood tests, 194
donor preparation
intravenous catheter placement, 205
sedation, 205
donor program management, 271, 283
blood donor log, 283
blood drives, 280
canine donor management, 272
customer service, 280–281
donor appreciation, 281
donor recruitment, 272
advantages and disadvantages of sources, 273–274
communication with donor’s regular veterinarian, 277
donor consent, 275–277
incentives, 272–275
intake form, 275
scheduling donors, 277
equipment, 278
feline donor management, 271
licensing requirements, 271
management and staffing, 278–280
product demand, 277
reducing blood bank demands, 282
component therapy, 282
minimizing product expiration, 282–283
point-of-care assays, 282
type-specific blood products, 282
dyspnea, 177
E
echocardiography, 214–215
edema, 177
Ehrlichiosis, 195, 218
emergency transfusion, 126
enzyme immunoassay (EIA), 195
epinephrine, 166
equine serum albumin, 91
equine transfusion medicine, 309
anticoagulants, 315
blood collection technique, 313–315
supplies needed, 314
blood groups, 311
blood product administration
plasma transfusion volume, 316–317
transfusion administration, 317
whole blood transfusion volume, 316
commercial sources of equine plasma, 310
compatibility testing
blood typing, 311–312
crossmatching, 312–313
neonatal isoerythrolysis, 311
component processing and storage, 315
plasma, 316
platelets, 316
red cell products, 315–316
donor selection
autologous transfusions, 313
blood groups, 313
estimated blood loss, 310
indication for red blood cell transfusions, 309
clinopathologic indications, 309
oxygen extraction, 309–310
packed cell volume (PCV) and total protein (TP), 310
physical examination, 309
transfusion triggers, 309
indications for plasma product transfusions, 310
colloid support, 310–311
passive transfer of immunity, 311
specific antibodies, 311
monitoring and adverse reactions, 317
acute hemolytic reactions, 317–318
delayed hemolytic reactions, 318
non-hemolytic reactions, 318
storage lesions, 318–319
erythema multiforme (EM), 96
erthrocyte antigens, 129
erythropoietin, 290
eutropenia, 280
toxic epidermal necrolysis, 96
donor health criteria, 193
history, 193–194
medication, 194
physical examination and blood tests, 194
donor preparation
intravenous catheter placement, 205
sedation, 205
donor program management, 271, 283
blood donor log, 283
blood drives, 280
canine donor management, 272
customer service, 280–281
donor appreciation, 281
donor recruitment, 272
advantages and disadvantages of sources, 273–274
communication with donor’s regular veterinarian, 277
donor consent, 275–277
incentives, 272–275
intake form, 275
scheduling donors, 277
equipment, 278
feline donor management, 271
licensing requirements, 271
management and staffing, 278–280
product demand, 277
reducing blood bank demands, 282
component therapy, 282
minimizing product expiration, 282–283
point-of-care assays, 282
type-specific blood products, 282
dyspnea, 177
E
echocardiography, 214–215
edema, 177
Ehrlichiosis, 195, 218
emergency transfusion, 126
Index

F
famotidine, 166
febrile non-hemolytic transfusion reaction signs, 175
feline blood collection, 223
adverse effects, 235
behavioral responses and suggestions, 234
collection techniques, 226–227
collection for immediate use, 229–230
conscious blood collection, 231–234
conscious donor selection, 233
donor monitoring, 234
minimal restraint, 233
minimizing stress, 233
semi-closed systems, 227–229
vascular access ports (VAPs), 230–231
considerations, 235
donor eligibility
blood tests, 224
history and consent, 223–224
physical examination, 224
donor selection, 223
essentials, 223
home care tips for owners, 235
post-donation care, 234–235
pre-collection procedure
anticoagulant calculation, 225
donor preparation, 225
equipment preparation, 224
materials preparation, 225–226
preparation, 224–225
feline calici virus (FCV), 220
feline donor management, 271
feline donor selection, 212, 223
blood types, 215
AB blood group system, 215–216
milk antigen, 216
blood typing tests, 216
card agglutination test, 216–217
immunochromatographic test, 217–218
considerations, 212
behavior, 212–213
history, 212
weight, 213
criteria, 212
donor eligibility
blood tests, 224
history and consent, 223–224
physical examination, 224
health assessment, 213
annual blood tests, 213–214
echocardiography, 214–215
table of assessments, 215
incentives
financial incentives, 221
health incentives, 221
positive reinforcement, 219–221
infectious disease screening, 218–219
recommendations, 218
preventative measures, 219
feline erythema multiforme, 96
feline herpes virus-1 (FHV-1), 220
feline immunodeficiency virus (FIV), 218, 219, 220
feline infectious peritonitis (FIP), 219, 220
feline leukemia virus (FeLV), 218, 219
vaccination, 220
feline lower urinary tract disease (FLUTD), 219
feline packed red blood cells (PRBC), 220
feline recipient screening, 151
blood types, 129–134
AB blood group system, 129–130
acquired blood groups, 134
biochemical characterization, 130
genetic basis, 131
Mk blood group, 134
other blood groups, 133–134
prevalence by country, non-pedigree cats, 135–136
prevalence by country, pedigree cats, 137–140
prevalence by country, pedigree cats, 141–143
transfusion reactions and alloantibodies, 130
type A, 132–133
type AB, 133
type B, 131–132
compatibility testing, 140
crossmatching, 143–151
erythrocyte antigens, 129
fentanyl, 352
ferrets, 349
fever, 177
fluid pumps, 39
fluid resuscitation, 86
food and fiber animal transfusion medicine, 321, 331
administration, 328–329
adverse effects, 330
anticoagulant-related complications, 330
blood volume required, 329–330
delayed reactions, 330–331
duration of effect, 330
immunologic reactions, 330
other reactions, 331
transfusion-associated circulatory overload (TACO), 331
transfusion-related acute lung injury (TRALI), 331
transfusion-related immunomodulation (TRIM), 331
blood collection, 325
anticoagulation, 326
collection kits, 326
field settings, 326–327
preservatives, 326
procedure and equipment, 325–326
blood products
failure of passive transfer, 323
hypoproteinemia, 323
packed red blood cell (PRBC), 323
plasma, 323
serum, 323–324
whole blood (WB), 322–323
component processing
hyperimmune plasma, 328
hyperimmune serum, 328
packed red blood cells (PRBC), 328
plasma, 328
donor selection, 324
alpacas, 325
blood groups and types, 324
cattle, 324
goats, 324–325
llamas, 325
pigs, 325
sheep, 324
indications for transfusion
blood products, 322
clinopathologic triggers, 322
transfusion triggers, 321–322
screening for blood group compatibility, 325
freezers, 16
maintenance, 252–253
fresh frozen plasma (FFP), 14, 21
dosage, 51
preparation, 43–44
quality control (QC), 253–254
thawing, 50
transfusion guidelines, 48
fresh whole blood (FWB), 14, 29
frozen plasma (FP), 14, 21
preparation, 45
thawing, 50
transfusion guidelines, 48
frozen platelet concentrate (FPC), 20
furosemide, 166
G
- gastrointestinal signs, 177
- glutaraldehyde crosslinked hemoglobin, 73–74
- glycopyrrolate, 352
- goats, 324–325
- guinea pigs, 350

H
- Haldane effect, 71
- heart rate, 178–179
  - normal/abnormal parameters in dogs and cats, 176
- heartworm disease, 196
- helminths, 219
- hematopoiesis, 285
- hematocrit monitoring, 181
- hemoglobin (HGB)
  - oxygen affinity, 32–33, 70–71
  - Bohr and Haldane effects, 71
  - hemoglobin encapsulation, 71
- hemoglobin-based oxygen carrier (HBOC) solutions, 70, 80
- amphibian transfusion medicine, 340–343
- avian transfusion medicine, 340–343
- characteristics for use in humans and animals, 74
- development of HBOC solutions for humans, 73
- conjugated hemoglobin, 74
- diaspirin crosslinked hemoglobin, 73
- future considerations, 75
- meta-analyses results, 75
- polymerized hemoglobin, 73–74
- side effects in people, 75
- development of HBOC solutions for veterinary use, 75
- oxyglobin®, 75–80
- development of ideal HBOC solution, 72
- immunomodulation, 73
- oxidation, 73
- purification of hemoglobin, 72–73
- source of hemoglobin, 72
- vasoactive properties, 72–73
- early HBOC solutions, 71–72
- oxygen affinity, 70–71
- Bohr and Haldane effects, 71
- hemoglobin encapsulation, 71
- oxygen delivery and content, 70
- reptile transfusion medicine, 364
- small mammals, 356
- hemoglobin monitoring, 181
- hemoglobinemia, 177, 180
- hemoglobinuria, 177, 180
- hemolysis, 34
- hemolysis reactions, acute, signs, 175
- hemoplasmosis, 195, 218
- hemorrhagic shock, 49
- hemostasis, 65
- hemostatic proteins half-lives, 44
- heparin, 202–203, 225

I
- history of transfusion medicine
  - 18th and 19th centuries, 4–5
  - ancient knowledge, 3
  - anticoagulation, 6
  - blood banking, 6
  - blood groups, 5–6
  - early concepts, 3
  - first animal-to-animal transfusion, 4
  - first animal-to-human transfusion, 4
  - plasma components, 6
    - apheresis, 7
    - leukoreduction, 7
  - plasma protein concentrates, 7
  - plastic bags, 6
  - platelets, 7
  - veterinary development, 7
- horses
  - autologous conditioned plasma (ACP), 112
  - blood groups, 311
  - oxyglobin® indications for use, 77
- human intravenous immunoglobulin (hIVIG), 23, 92
- human use, 94
- immunomodulation, 92–94
- veterinary use, 94
  - administration recommendations, 98–99
  - canine pemphigus foliaceus, 96
  - canine Stevens–Johnson syndrome (SJS), 96
  - canine toxic epidermal necrolysis, 96
  - conditions and doses, 95
  - cutaneous disease, 96
  - dose and rate of administration, 98
  - Evans syndrome, 96
  - feline erythema multiforme, 96
  - immune-mediated hemolytic anemia (IMHA), 94
  - immune-mediated thrombocytopenia (ITP), 94–96
  - monitoring, 98
  - myasthenia gravis, 97
  - safety of repeated administration, 98–99
  - studies, 99
- sudden acquired retinal degeneration syndrome (SARDS), 97
- veterinary use adverse effects, 97
- hypercoagulation, 97–98
- hypersensitivity and anaphylaxis, 97
- kidney failure, 98
- miscellaneous risks, 98
- human serum albumin (HSA), 23
- human-to-human transfusions, 6
- hyaluronan, 111
- hyperammonemia, 180
- signs, 175
- hypercoagulation, 97–98
- hypersensitivity signs, 175
- hyperthermia, 174
- hypoalbuminemia, 49, 85–86
- associated conditions, 85
- hypoproteinemia, 49, 323
- hypotension, 177
- hypothermia, 175–177
- signs, 175

K
- ketamine, 226, 352, 362

L
- lactate measurement, 337
- lactate monitoring, 182
- Leishmania, 195
- leukoreduction (LR), 7, 10, 249–250
- red blood cell (RBC) products, 33–34, 38
- licensing requirements, 271
- lidocaine, 201
- lipemia, 201
- liquid plasma (LP), 21
  - preparation, 46
  - transfusion guidelines, 48
- llamas, 325
- Lyme disease, 195
- lyophilization, 15
- lyophilized canine platelets, 14
- lyophilized cryoprecipitate, 14, 20
- lyophilized platelets, 62–64
- lyophilized products processing, 248
magnesium sulfate, 166
maropitant, 166
massive transfusions, 126
platelet therapy, 49
platelet administration, 55–56
risks, 163
medical director, 279
mentation, normal/abnormal parameters in dogs and cats, 176
metoclopramide, 166
midazolam, 352, 362
milk antigen, 216
minimal restraint, 233
monitoring see recipient monitoring, 172
mucous membrane color, 177, 179
normal/abnormal parameters in dogs and cats, 176
myasthenia gravis, 97
neonatal isoerythrolysis, 311
neorickettiosis, 195, 218
neurologic signs, 177, 180
neuromuscular signs, 177, 180
nitric oxide (NO), 33, 72
nutrient solution, 203
nutritional support alternative to albumin transfusions, 92
O
ondansetron, 166
operational director, 279
Oxyglobin®, 75–76
cost, 80
dose and administration rate, 79–80
indications in cats, 77
indications in dogs, 76
canine babesiosis, 76
hypoperfusion, 76–77
immune-mediated hemolytic anemia, 76
parasite-induced anemia, 76
indications in horses, 77
indications in other species, 77
monitoring patient response, 79–80
side effects, 77
increased pulmonary vascular resistance, 77
respiratory signs in cats, 78–79
volume overload, 77–78
oxymorphone, 352
P
packed cell volume (PCV), 172, 200
equine transfusions, 310
monitoring, 181
packed red blood cells (PRBC), 14, 17–19, 29–30
advantages, 19
feline PRBC, 19
improving product quality, 23
indications, 19
liberal versus restrictive transfusion practices, 23–24
processing, 241
processing, 246–247
quality control (QC), 253
storage, 250–251
storage lesion, 251
pancreatitis, 49
pathogen-reduced plasma products, 47
patient blood management (PBM), 284–285
iatrogenic blood loss, 285
minimizing blood loss, 285
optimizing hematopoiesis, 285
surgical blood loss, 285–286
peristaltic fluid pumps, 39
pigs, 325
plasma, 21
plasma components, 6
processing, 6
protein concentrates, 7
plasma derivatives, 46–47
plasma products, 43
preparation, 43
cryoprecipitate (CRYO), 46
cryoprecipitate-poor plasma (CPP), 46
flow charts, 45
FP24, 44–45
fresh frozen plasma (FFP), 43–44
frozen plasma (FP), 45
liquid plasma (FP), 46
plasma derivatives, 46–47
platelet-rich plasma (PRP), 46
thawed plasma, 45–46
storage, 47
plasma signs
hemoglobinemia, 180
hyperbilirubinemia, 180–181
plasma therapy, 52
administration, 51
adverse reaction, 51–52
dosage, 51
indications
acquired bleeding disorders, 48–49
general use, 47–48
hemorrhagic shock, 49
hypoproteinemia, 49
inherited bleeding disorders, 48
massive transfusion, 49
other uses, 49
pre-transfusion testing, 50–51
thawing of frozen products, 50
transfusion guidelines, 48
plasma
advantages, 22
constituents, 43
disadvantages, 22
fresh frozen plasma (FFP), 21
frozen plasma (FP), 21
half-lives of hemostatic proteins, 44
indications, 21–22
liquid plasma (LP), 21
processing, 242, 247
refrigerated plasma, 21
storage, 251–252
plasma-derived components
albumin, 23
cryoprecipitate, 22
cryosupernatant, 22
other components, 23
plastic bags for transfusions
invention, 6
polyvinyl chloride (PVC) blood bags, 30
platelet concentrate (PC), 14, 20
platelet products, 20, 55, 67
advantages, 21
apheresis platelet products, 20
dosage, 64–65
dogs, 65
extended storage products, 20
indications, 20–21
indications for transfusions
massive transfusion, 55–56
thrombocytopenia and thrombopathia, 55
limitations, 21
preparation, 56
canine apheresis platelets, 58
canine-derived platelets, 56
feline-derived platelets, 57
human apheresis platelets, 57–58
human-derived platelets, 56
storage
 canine chilled platelets, 59–60
 canine cryopreserved platelets, 60–62
 fresh platelets, 58–59
 human chilled platelets, 59
 human cryopreserved platelets, 60
 lyophilized platelets, 62–64
 platelet concentrate characteristics, 59
 transfusion adverse events, 66–67
 transfusion guidelines
doses, 64–65
hemostasis, 65
measures of response, 64
platelet transfusion threshold, 64
prophylactic transfusions, 64
transfusion refractoriness, 65
canine model, 65–66

platelet-rich concentrates (PRCs), 108
physiology, 108
platelet-rich plasma (PRP), 14, 20, 46
preparation, 57
processing, 241–242

platelets
concentrates, 7
processing, 247–248
quality control (QC), 254
storage, 252
point-of-care assays, 282
polymerized hemoglobin, 73
glutaraldehyde crosslinked hemoglobin, 73–74
O-raffinose crosslinked hemoglobin, 74
polyvinyl chloride (PVC) blood bags, 30
prednisolone, 166
prednisone, 166
pre-transfusion tests, 119
blood typing methods, 119
automated blood typing, 122
blood-typing cards, 119–120
commercial laboratories, 122
comparisons between tests, 121
immunochromatographic cartridges, 120–121
practical considerations, 122–123
test tube method, 119
crossmatching methods, 123
gel agglutination method, 124
immunochromatographic method, 124
major tube procedure, 123–124
unique clinical situations, 126
alloantibody, 127
emergency transfusion, 126
immune-mediated hemolytic anemia, 126–127
massive transfusion, 126
rouleaux formation, 127
primate transfusion medicine, 366
administration, 370–371
transfusion volume, 371
blood collection, 369–370
sedation and tranquillization protocols, 370
blood groups and types, 368
typing and compatibility testing, 368–369
component processing and storage, 370
components
 fluid support, 368
 fresh frozen plasma (FFP), 368
 packed red blood cells (PRBC), 367–368
 whole blood (WB), 367
 donor selection, 369
 hematologic values, 372–373
 immunologic transfusion complications, 369
 indication for transfusion, 366
 acute anemia, 366–367
 chronic anemia, 367
 monitoring and complications, 371–374
 post-transfusion follow-up, 374
 processing of blood components, 237
 centrifugation, 242–243
 recommended RPM settings, 243
 relative centrifugal force (RCF) and times, 245
 total centrifugal force (TCF) and relative centrifugal force (RCF), 246
 feline blood, 249
 labeling, 248–249
 pre-processing storage, 243
 protocols, 241–242
 supplies and equipment, 237
 atraumatic clamps, 239
 centrifuge, 238
donor tube stripper, 239
plasma press, 239
scales, 238
tube sealers, 239
whole blood collection bags, 237
troubleshooting tips, 244–245
products supplied by blood banks, 277
propofol, 226, 352, 362
pulmonary air leakage (PAL), 106

Q
quality control (QC)/quality assurance (QA), 252

equipment maintenance
centrifuges, 252
freezers, 252–253
refrigerators, 252
validation, 253

products
cryoprecipitate (CRYO), 254
fresh frozen plasma, 253–254
hemolysis, 253
packed red blood cells (PRBC), 253
platelets, 254
raw products, 253

R
rabbits, 349–350
rabies, 220
O-raffinose crosslinked hemoglobin, 74
recipient monitoring, 172, 184
approach, 172–174
monitoring form, 173
monitoring parameters, 174–179
approach to complications
incidence of complications, 174
signs of complications, 174, 175
initial response to complications, 184
monitoring administration rate, 182
administration method, 182–184
drip rate monitoring, 183
fluid pump monitoring, 183–184
monitoring parameters
clinical signs of complications, 177
cutaneous signs, 180
hemocrit, 181
hemoglobin, 181
lactate monitoring, 182
neurologic signs, 180
neuromuscular signs, 180
normal/abnormal parameters in dogs and cats, 176
packed cell volume, 181
plasma signs, 180–181
respiratory signs, 179–180
urine signs, 180–181
recipient screening, 9–10
recombinant proteins, 46–47
recruitment of donors, 272
advantages and disadvantages of sources, 273–274
communication with donor’s regular veterinarian, 277
donor consent, 275–277
consent form, 276
incentives, 272–275
intake form, 275
scheduling donors, 277
red blood cell (RBC) products, 29
administration methods, 38
blood filter, 38
leukoreduction, 38
syringes and fluid pumps, 39
alternatives to allogenic RBC transfusions, 39
autologous blood transfusion, 40
xenotransfusion, 39–40
blood products, 29
decided when to transfuse, 34–35
scoring systems, 35
dosage and rate, 36–38
indications, 34
preparing for transfusions, 35
general approach, 36
patient preparation, 36
staff preparation, 36
storage, 30
bags and additive solutions, 30–31
leukoreduction, 33–34
RBC products, 31–32
storage lesions, 32
red cell substitute, 70
red cell washing, 217
refrigerated plasma, 14, 21
refrigerators, 16, 17
maintenance, 252
reptile transfusion medicine, 358
administration, 362–363
anemia, 359
diagnosis, 359
hemogram variability, 359
regeneration, 359
blood collection, 360
anticoagulants, 360–361
sedation and fluid replacement, 361–362
sites, 361
blood groups and types, 360
CBC values, 364
common sedation doses, 362
donor selection, 360
compatibility testing, 360
hematologic values, 363
hemoglobin-based oxygen carrier (HBOC) solutions, 364
indications for transfusion, 359–360
laboratory values, 363
monitoring and complications, 363–364
physiology, 358
post-transfusion follow-up, 364
respiratory rate, normal/abnormal parameters in dogs and cats, 176
Rocky Mountain spotted fever, 196
rouleaux formation, 127
S
saline–adenine–glucose–mannitol (SAG-M) solution, 31
screening of blood recipients, 9–10
sedation, 205, 213, 226
sheep, 324
small mammal transfusion medicine, 345, 356
administration, 355
intraosseous catheterization, 354–355
intravenous catheterization, 354
alternatives to blood transfusions
hemoglobin-based oxygen carrier (HBOC) solutions, 356
synthetic colloids, 356
blood banking, 353
blood collection, 348
amount of blood safe to collect, 348
anticoagulants, 353
chemical restraint for collection, 352
chinchillas, 351
ferrets, 349
general anesthesia, 352–353
guinea pigs, 350
other small rodents, 351
rabbits, 349–350
blood types, 347
calculating blood requirements, 353–354
crossmatching, 347–348
major and minor crossmatch, 348
simplified crossmatch, 348
donor evaluation, 346–347
donor selection, 346
indications for transfusion, 345–346
transfusion reactions, 356
sodium citrate, 6
sodium phosphate, 6
sources of blood products, 269
commercial blood banks, 259–260
eamples, 260–261
websites, 260
costs of an animal blood bank, 263–264
average costs, 265
equipment costs, 266
single canine donor, 264
single feline donor, 264
summary, 264
in-clinic blood bank considerations
acquiring animals for blood donor colony, 262–263
costs, 264
establishing animal numbers for blood donor colony, 263
procuring animals, 261–262
requirements for blood donor colony, 263
summary, 262
transfusion demand, 261
product verification, 260
standard operating procedures (SOPs) for an in-hospital blood bank, 266–267
donation day requirements, 267–269
product use documentation, 269
ors and cons, 267
required forms, 267
standard operating procedures (SOPs), 259
canine blood banks
information to be included, 267
in-hospital blood banks, 266–267
donation day requirements, 267–269
product use documentation, 269
ors and cons, 267
required forms, 267
Stevens–Johnson syndrome (SJS), 96
storage lesions, 251
clinical impact on humans, 162
clinical impact on veterinary patients, 162
pathophysiology, 160–162
storage of blood components
cryoprecipitate (CRYO), 252
maximum duration suggestions, 249
packed red blood cells (PRBC), 250–251
plasma, 251–252
platelets, 252
whole blood (WB), 250–251
storage of blood products, 10, 30
additive solutions, 30–31
bags, 30–31
lesions, 10
plasma products, 47
fresh platelets, 58–59
red blood cell (RBC) products, 31
leukoreduction, 33–34
storage lesions, 32
stored whole blood (SWB), 13, 14
sudden acquired retinal degeneration syndrome (SARDS), 97
surveys of current veterinary practices, 7–8
blood banking, 8–9
transfusions, 8
syringe drivers, 39
systemic hemostatic agents, 292
antifibrinolytics, 292
desmopressin, 293
systemic inflammatory response syndrome (SIRS), 87
tachycardia, 177, 178
tachypnea, 177
temperature monitoring
hyperthermia, 174
hypothermia, 175–177
normal/abnormal parameters in dogs and cats, 176
tests on blood, 119
blood typing methods, 119
automated blood typing, 122
blood-typing cards, 119–120
commercial laboratories, 122
comparisons between tests, 121
immunochromatographic cartridges, 120–121
practical considerations, 122–123
test tube method, 119
crossmatching methods, 123
gel agglutination method, 124
immunochromatographic method, 124
major tube procedure, 123–124
thawed plasma, 45–46
thawing of frozen products, 50
thrombocytopenia, 55, 64
thrombopathia, 55, 64
Thrombosomes, 64
tiletamine, 362
total protein (TP) value, 200
Trial to Reduce Alloimmunization to Platelets (TRAP), 66
transfusion-associated circulatory overload (TACO), 50–51, 52, 162, 166, 172, 179, 331
signs, 175
transfusion-associated complications, 155
acute immunological reactions
acute hemolytic reactions, 156–157
allergic/anaphylactic reactions, 157–158
febrile, non-hemolytic reactions, 155–156
transfusion-related acute lung injury (TRALI), 158
acute non-immunological reactions
bacterial contamination of blood products, 163
citrate toxicity, 162–163
hypothermia, 163
massive transfusions, risks of, 163
non-immunologic hemolysis, 160
storage lesions, 160–162
transfusion-associated circulatory overload, 162
approach to reactions, 167
common transfusion reactions in cats and dogs, 156
delayed immunological reactions
delayed hemolytic reactions, 158–159
immune complex (type III hypersensitivity) formation, 159–160
post-transfusion purpura, 160
delayed non-immunological reactions
bloodborne infectious disease transmission, 163
transfusion-related immunomodulation (TRIM), 163–164
diagnosis of reactions, 164
investigation of reactions, 168
preventing complications, 168
treatment of reactions, 164
acute hemolytic reactions, 164
allergic and anaphylactic reactions, 165–167
circulatory overload, 166
citrate toxicity, 166
delayed reactions, 167
febrile, non-hemolytic reactions, 164
premedication, 167
recommended drugs, 166
transfusion-related acute lung injury (TRALI), 50, 51–52, 158, 179, 331
signs, 175
transfusion-related immunomodulation (TRIM), 163–164, 331
tryptosomiasis, 195
UK, veterinary blood banks, 17
ultrafiltration devices, 302–303
urine signs
bilirubinuria, 180–181
hemoglobinuria, 180
uricaria, 177
USA, veterinary blood banks, 17
Vaccinations, feline vaccination recommendations, 220
vascular access ports (VAPs), 230–231
venous distension, 177, 179
Veterinary Emergency and Critical Care Society (VECCS), 3
viscoelastic testing, 286
vomiting, 177
von Willebrand disease (VWD), 48
whole blood (WB), 29
advantages, 13
contents, 13
description, 13
disadvantages, 13–14
indications, 13
processing, 241, 246
products obtained, 30
storage, 250–251
storage lesions, 251
World Small Animal Veterinary Association (WSAVA), 213
body condition score, 214
vaccination guidelines, 219, 220
xenotransfusion, 39–40, 296–297
advantages and disadvantages, 297
zolaxepam, 362