

Index

- A**
- aCML, *see* Atypical chronic myeloid leukemia (aCML)
 - Acquired syndromes
 - aplastic anemia, 33
 - autoimmune etiology, 40
 - somatic mutations, 41
 - Acute leukemia of ambiguous lineage
 - diagnosis, 199
 - immunophenotypic studies, 199
 - subcategories, 199
 - WHO classification, 199
 - Acute lymphoblastic leukemia/lymphoma (ALL)
 - age-adjusted incidence rate, 129
 - chemotherapy, 129, 154
 - cytogenetic study, 142
 - diagnosis, 129, 130
 - DNA index, 138
 - flow cytometric study, 135
 - higher-power view, 129, 132
 - immunohistochemistry, 129, 148
 - immunophenotype, 129, 138
 - karyotype, 129, 144
 - morphology, 129, 131
 - peripheral blood, 129, 133
 - prognosis, 129
 - risk stratification, 153
 - stages, 153
 - T-ALL/LBL, 147
 - Acute megakaryoblastic leukemia, 193, 197, 198
 - Acute myeloid leukemia (AML), 35, 193
 - acute monoblastic/monocytic leukemia, 173, 174, 188
 - BCR-ABL1*, 173, 174, 182
 - categories, 173
 - CBFB-MYH11*, 173, 174, 176
 - CEBPA*, 173, 174, 183
 - cytochemical studies, 173
 - cytogenetic abnormalities, 173, 174, 185
 - DEK-NUP214*, 173, 174, 179
 - disease categories, 173
 - DS, 173, 174, 190
 - erythroid leukemia, 173, 174, 188
 - GATA2*, *MECOM*, 173, 174, 180
 - heterogenous group of disorders, 173
 - KMT2A-MLL3*, 173, 174, 178
 - with maturation, 173, 174, 187
 - without maturation, 173, 174, 186
 - megakaryoblastic, 173, 174, 181
 - megakaryocytic leukemia, 173, 174, 189
 - minimally differentiated, 173, 174, 186
 - myelodysplasia-related changes, 173, 174, 184
 - myeloid proliferations, 174
 - NPM1*, 173, 174, 182
 - panmyelosis, 173, 174, 190
 - RUNX1*, 173, 174, 183
 - RUNX1-RUNX1T1*, 173–175
 - therapy-related, 173, 174, 186
 - WHO classification, 173, 174
 - Acute promyelocytic leukemia (APL), 27, 173, 174, 177
 - Acute undifferentiated leukemia
 - ambiguous lineage, 200
 - flow cytometric findings, 199, 201–203
 - morphologic and cytochemical features, 199, 201
 - myeloid leukemia, 201
 - Adenocarcinoma, 282, 283
 - All *trans* retinoic acid (ATRA), 27
 - Amyloid, 111, 115
 - Amyloid light chain (AL) amyloidosis, 111, 115
 - Angioimmunoblastic T cell lymphoma (AITL), 77, 94
 - Anorexia nervosa, 13, 25
 - Aplastic anemia (AA), 33, 40
 - Arsenic toxicity, 33, 62
 - Atypical chronic myeloid leukemia (aCML)
 - bone marrow, 271
 - clonal malignancy, 271
 - diagnosis, 270
 - dysgranulopoiesis, 272
 - neutrophil, 271
 - peripheral blood smear, 271
 - Autoimmune hemolytic anemia, 13, 14
 - Autoimmune lymphoproliferative syndrome (ALPS), 33, 44
- B**
- B cell prolymphocytic leukemia (B-PLL), 77, 81, 82
 - B12 deficiency, 13, 16
 - Bacille Calmette–Guerin (BCG) infection, 70
 - Barth syndrome, 33, 53
 - Basophil, 8
 - B-cell lymphoma, 117, 120
 - BCR-ABL1*, 199, 200, 206, 207, 223, 230
 - B-lymphoblastic leukemia, 27–29
 - Bone marrow, 221
 - adipocyte, 1, 11
 - aspirate smear, 1, 5
 - biopsy, 1, 4
 - cytologic features, 1
 - erythroid cells, 1, 2, 5
 - examination, 1
 - granulocytes, 3, 4
 - hematopoietic cells, 1, 5
 - hematopoietic maturation, 1, 10
 - identification, 1

- Bone marrow (*cont.*)
 mast cells, 1, 8
 plasma cells, 9
 stages, 1, 7
- Bone marrow failure syndromes
 AA, 33
 CTLA4 deficiency, 33
 cytopenic patients, 33
 germline mutations, 33
- Bone marrow infections
 granulomas, 67
 infiltration, 77, 79, 82
 involvement, 103, 117, 120, 121
 mycobacteria, 67
 necrosis, 67
 peripheral blood, 67
- BRAFV600E* mutation, 77, 85
- Breast carcinoma, 277–279
- Brucellosis, 70
- Burkitt lymphoma (BL), 77, 92, 117
- C**
CALR, 223, 224, 241, 242, 245
 Carcinoma, 277
 CD138 immunohistochemical stain, 103, 104, 111
 CD163 immunohistochemical stain,
 13, 24
 Cellularity, 1, 4, 28
 Cerebrospinal fluid (CSF) staging, 129, 130, 134
 Ceroid lipofuscinosis, 58
 Chédiak-Higashi syndrome, 33, 52
 Chromoblastomycosis, 67, 75
 Chronic eosinophilic leukemia (CEL), 257
 Chronic granulomatous disease (CGD), 33, 55
 Chronic lymphocytic leukemia (CLL), 104
 Chronic myeloid leukemia (CML), 134
 blast phase, 223, 229, 230
 chronic phase, 223, 225, 227
 myeloproliferative neoplasms, 223
 Chronic myelomonocytic leukemia
 (CMML), 257
 bone marrow aspirate, 268
 clonal malignancy, 269
 diagnosis, 270
 hypolobated megakaryocytes, 270
 magnification, 268
 myeloblasts, 270
 peripheral blood smear, 268
 promonocytes, 269
 reticulin fibers, 270
 Chronic neutrophilic leukemia (CNL), 223, 245
 Circulating chronic lymphocytic leukemia/small lymphocytic
 lymphoma (CLL/SLL), 77–80
 Classical Hodgkin lymphoma (cHL), 77, 92, 96,
 99, 100
 Complete blood count (CBC), 129, 131
 Congenital dyserythropoietic anemia (CDA), 33, 48, 49
 Congenital sideroblastic anemia, 33, 50
 Copper deficiency, 13, 17, 33, 62
 CSF3R, 223, 224, 245
 CTLA4 deficiency, 43
 Cyclin D1, 103, 112
 Cytogenetic abnormalities, 153
 Cytokine receptor, 100
 Cytopenia(s), 267
- D**
 del(5q), 160, 168
 Diamond-Blackfan anemia (DBA), 33, 34
 Diffuse large B-cell lymphoma (DLBCL), 77, 80, 90, 91, 120, 123
 Down syndrome (DS), 129, 143, 190
 GATA1-mutant cells, 193
 infants, 193
 megakaryocytic proliferation, 193
 ML-DS, 193
 myeloid proliferations, 193, 194
 non-DS individuals, 193
 peripheral blood smear, 194
 Dyskeratosis congenita, 37
- E**
 Early T precursor (ETP), 129, 152
 EBV-encoded RNA (EBER), 118
 Echinococcus granulosus, 67, 75
 Eosinophilia, 8, 13, 19, 257, 258, 261, 263, 264
 Epstein-Barr virus (EBV), 117, 211, 216
 Erythroid cells, 2
 Erythroid hyperplasia
 anemias, 13
 bone marrow, 13, 14
 cytoplasmic vacuolization, 13, 17
 hemolytic anemia, 13, 14
 RBC destruction, 13, 14
 Essential thrombocythemia, 224
 bone marrow, 243
 H&E-stained trephine biopsies, 223, 244
 megakaryocytes, 223, 243
 Wright-Giemsa-stained bone marrow, 223, 242
 Ewing sarcoma, 277, 280, 285
- F**
 Familial thrombocytopenia, 56
 Fanconi anemia, 33, 35
 Fibrinoid necrosis, 27
 Fibroblast growth factor receptor 1 (*FGFR1*), 257, 263, 264
 Flow cytometric immunophenotyping, 199, 202, 203, 205, 208
 Flow cytometry, 196
 Fluorescence in situ hybridization (FISH), 103, 115, 141, 257, 284
 Follicular dendritic cell sarcoma, 211, 221
 Follicular lymphoma (FL), 77, 86
- G**
 GATA1 mutations, 193, 194
 GATA2 deficiency, 33, 42
 Gaucher disease, 33, 57
 Gaucher-like histiocyte, 67, 71
 Gelatinous transformation, 13, 25, 33, 61
 Granulocytes, 3, 4
 Granulocytic hyperplasia
 bone marrow biopsy, 13, 18
 characteristics, 13, 18
 toxic granulation, 13, 19
 Granuloma, 13, 25
 EBV infection, 70
 HIV infection, 71
 leishmaniasis, 68
 and necrosis, 67
 tuberculoid type, 67, 69
 Growth factor (G-CSF) therapy, 27

H

- Hairy cell leukemia (HCL), 77, 83, 84
- Hematogone hyperplasia, 13, 22
- Hematogones, 9, 13, 21, 155
- Hematopoiesis, 67, 69
- Hematopoietic cells, 1, 4, 6, 9
- Hemophagocytic lymphohistiocytosis (HLH), 33, 60, 211, 212, 217, 222
- Hemophagocytosis, 13, 24, 211, 216–219
- Hemosiderin-laden macrophages, 13, 15
- Hepatosplenic T cell lymphoma (HSTL), 77, 96, 98
- HHV6 infection, 67, 74
- Histiocytic sarcoma
 - autoimmune disease, 211
 - classification, 211
 - macrophage-dendritic cell lineage, 212
 - neoplasm, 211
 - Rosai-Dorfman disease, 211
- Histoplasma, 67, 75
- Histoplasmosis, 67, 75
- Hodgkin lymphoma, 117, 119
- Human herpesvirus 8 (HHV8), 117
- Human immunodeficiency virus (HIV)
 - bone marrow involvement, 121
 - infection, 120
 - LPDS, 117
 - lymphoproliferative disorders, 117
- Hypercellularity, 67, 71
- Hyperdiploid karyotype, 139
- Hypoplasia, 13

I

- Iatrogenic immunodeficiency-related disorders, 121–126
- Idiopathic arthritis, 222
- Idiopathic hypereosinophilia, 223, 247, 248
- Immunodeficiency-associated lymphoproliferative disorder
 - HIV, 117, 121
 - immunocompetent patients, 117
- Immunoglobulins, 103, 105, 106
- Immunohistochemical markers, 77
- Immunohistochemistry, 148
- Immunophenotype, 136, 199
- In situ hybridization, 92, 112
- Inherited syndromes
 - cytopenias, 33
 - genetic testing, 40
 - germline mutations, 34
 - hemoglobinopathy, 46
 - single-lineage cytopenias, 33
- Intravascular large B cell lymphoma (IVLBCL), 77, 99
- Iron deficiency anemia, 13, 16

J

- Janus 2 kinase (*JAK2*), 223, 224, 233, 241
- Juvenile myelomonocytic leukemia (JMML), 257
 - bone marrow, 273
 - erythroid and megakaryocytic abnormalities, 272
 - peripheral blood smear, 272

K

- KMT2A* rearrangement, 199

L

- Langerhans cell histiocytosis (LCH), 211, 212, 214, 220
 - Large granular lymphocytes (LGLs), 77, 93
 - Leishmaniasis, 67, 68
 - bone marrow fibrosis, 69
 - granulomatous reaction, 68
 - hemophagocytic syndrome, 67, 68
 - infectious diseases, 67
 - Leishmania donovani*, 67
 - mucocutaneous and visceral, 72
 - skin lesions, 67, 72
 - Leukocytosis, 110, 193, 194
 - Leukoerythroblastosis, 238
 - Lung carcinoma, 277
 - Lymphoblasts, 129, 155, 199
 - Lymphoid aggregates, 13, 20, 21
 - Lymphomas
 - hematopoietic neoplasms, 77
 - immunohistochemical markers, 77
 - infiltration patterns, 77
 - intrasinusoidal cells, 83
 - PET/CT, 77
 - Lymphoplasmacytic lymphoma (LPL), 77, 87
- M**
- Macrophage-dendritic cell lineage, 212
 - Macrophages, 1, 11
 - Malignancy-associated hemophagocytic syndrome, 211, 218
 - Mantle cell lymphoma (MCL)
 - blastoid variant, 89
 - CD5, 89
 - cyclin D1-negative, 90
 - immunoreactivity, 89
 - lymphoid cells, 89
 - Mast cells, 8, 223, 253, 257, 259
 - Mastocytosis
 - classification, 224
 - and MPN, 223
 - May-Hegglin anomaly, 52
 - MDS with excess blasts-1 (MDS-EB1), 165
 - MDS with multilineage dysplasia (MDS-MLD), 159, 164, 165
 - Megakaryoblastic leukemia, 198
 - Megakaryocyte hyperplasia, 13, 20
 - Megakaryocytes, 1, 4, 7, 10, 159, 169, 243
 - Megaloblastic anemia, 13, 16, 33, 60
 - Metabolic bone marrow disorders, 33, 63
 - Metastasis
 - biopsy, 277
 - bone marrow, 277
 - histomorphologic assessment, 277
 - non-hematolymphoid neoplasms, 277
 - Microorganisms, 67
 - Mixed phenotype acute leukemia (MPAL), 206
 - B/myeloid, NOS, 200
 - T/myeloid, NOS, 199, 200, 203, 204, 209
 - with t(9;22)(q34.1;q11.2), 200
 - with t(v;11q23.3), 200, 203
 - Monoclonal gammopathy of undetermined significance (MGUS), 103, 104, 115
 - Multicentric Castleman disease (MCD), 73
 - Multicolor FISH, 262
 - Myeloablative therapy, 27
 - Myeloblasts, 6, 270

- Myelodysplastic syndrome (MDS), 35
 bone marrow biopsy, 159, 161, 168
 CD34 immunostaining, 166
 CD61 immunostaining, 159, 167
 cytogenetic abnormalities, 160, 171
 dysplastic neutrophils, 160, 169
 fibrosis, 166
 hematopoietic stem cell diseases, 159
 MDS-EB, 159, 167
 MDS-U, 159, 160, 170
 megaloblastoid erythroid, 159, 168
 morphologic dysplasia, 159
 peripheral blood smear, 159, 161, 162
 Prussian blue stain, 159, 163
 WHO classification, 160
 Wright-Giemsa-stained preparation, 159, 163
- Myelodysplastic syndrome with single lineage dysplasia and ring sideroblasts (MDS-RSSLD), 162
- Myelodysplastic/myeloproliferative neoplasm (MDS/MPN), 267
- Myelodysplastic/myeloproliferative neoplasm with ring sideroblasts and thrombocytosis (MDS/MPN-RS-T), 267, 274, 275
- Myelodysplastic/myeloproliferative neoplasm, unclassifiable (MDS/MPN, U), 273, 274
- Myeloid leukemia associated with Down syndrome (ML-DS), 28, 193, 196
- Myeloid sarcoma, 174
- Myeloid to erythroid (M:E) ratio, 13, 18
- Myeloma cells, 103, 109, 113
- Myelomastocytic leukemia, 223, 254, 255
- Myeloproliferative neoplasm (MPN)
 classification, 223
 clinical, morphologic, and genetic findings, 223, 224
 clonal neoplasms, 223
- N**
- Necrosis, 67, 68, 70
- Neoplastic plasma cells, 26, 110
- Neuroblastoma, 277, 283, 284
- Next-generation sequencing (NGS), 163
- Niemann-Pick disease, 33, 58
- Nodular lymphocyte-predominant Hodgkin lymphoma (NLPHL), 101
- Non-Hodgkin lymphoma, 77
- Nutritional deficiency, 13
- O**
- Osteitis fibrosa, 33, 63
- Osteoblasts, 1, 9
- Osteoclasts, 1, 10
- Osteopetrosis, 33, 64
- P**
- Paget disease, 13, 26
- Paroxysmal nocturnal hemoglobinuria (PNH), 41
- Parvovirus B19, 67, 73
- Pearson syndrome, 51
- Pelger-Huët anomaly, 51
- Peripheral blood (PB), 134
- PI3K-delta syndrome, 33, 45
- Plasma cell leukemia (PCL), 110, 113, 115
- Plasma cell myeloma (PCM), 103, 115
 aspirate smears, 103, 108
 bone marrow sampling, 105
 classification schemes, 107
 cytology, 103, 105
 cytoplasmic inclusions, 106
 heterogeneous disease, 107
 hyperdiploid karyotype, 103, 114
 lineage infidelity, 112
 lymphoid/small-cell type, 107
- Plasma cell neoplasms
 biologic implications, 116
 bone marrow involvement, 103
 WHO classification, 115
- Plasmablastic morphology, 108
- Plasmacytoma, 103, 115
- Platelet-derived growth factor receptor alpha (*PDGFRA*), 257–261, 263, 264
- Platelet-derived growth factor receptor beta (*PDGFRB*), 257, 261–264
- Polyclonal plasmacytosis, 13, 22, 23
- Polycythemia vera (PV), 223, 224, 236
 acute myeloid leukemia, 223, 236
 megakaryocytes, 223, 234
 trephine biopsy, 223, 235
 Wright-Giemsa-stained, 223, 233
- Polymorphic lymphoid proliferation, 118
- Post-ATRA findings, 27, 31
- Post-essential thrombocythemia (post-ET) myelofibrosis, 223, 244
- Post-therapy changes
 B-lymphoblastic leukemia, 27, 29
 bone marrow, 28
 chronic myeloid leukemia, 27, 31
 G-CSF, 30
 granulocytic precursors, 27, 30
 multiloculated adipocytes, 27, 28
 reticulin stain, 27, 29
- Post-transplant lymphoproliferative disorder (PTLD), 117–125
- Primary myelofibrosis, 223
 blood and bone marrow, 223, 235
 fibrotic phase, 223, 238
 leukoerythroblastosis, 223, 238
 megakaryocytes, 223, 234, 239
 prefibrotic phase, 223, 237
 transition, 223, 238
- Primitive neuroectodermal tumor (PNET), 277, 285
- Programmed death receptor ligand 1 (PD-L1), 100
- Programmed death receptor-1 (PD-1), 95
- Prostate carcinoma
 intrasinusoidal distribution pattern, 282
 metastatic diseases, 277
- Prostate-specific antigen (PSA), 282
- Prussian blue stain, 13, 15
- Q**
- Quantitative polymerase chain reaction (qPCR), 145
- R**
- Reactive mast cell hyperplasia, 13, 26
- Refractory anemia with excess blasts (RAEB), 165
- Refractory cytopenia with multilineage dysplasia (RCMD), 165
- Renal osteodystrophy, 13, 26, 63
- Reticulin fibers, 270
- Reticulin fibrosis, 77, 84
- Retinoblastoma, 277, 286
- Rhabdomyosarcoma, 277, 286
- Ring sideroblasts (RARS), 162, 163
- Rituximab, 27, 31
- Rosai-Dorfman disease (RDD), 211, 212

S

Sarcoidosis, 211, 220, 221
Sea-blue histiocytosis, 58
Serum and urine protein electrophoresis (SPEP),
103, 104
Severe congenital neutropenia (SCN), 39
SF3B1, 160, 163, 167
Shwachman-Diamond syndrome (SDS), 33, 36
Sickle cell anemia (SCA), 33, 46
Smoldering, 103
Splenic marginal zone lymphoma (SMZL), 77, 82
Stromal cells, 1
Systemic mastocytosis, 223, 249–252

T

T cell lymphomas, 77, 92, 95, 100, 101
T cell prolymphocytic leukemia (T-PLL), 94
T cell-/histiocyte-rich large B cell lymphoma
(T/HRLBCL), 100
Tartrate-resistant acid phosphatase (TRAP), 57
Thalassemia, 33, 47
Thrombocytopenia, 33
T lymphoblastic leukemia/lymphoma (T-ALL), 257
Toxicity, 33, 62

Transient abnormal myelopoiesis (TAM), 193, 194
blasts, 193, 195, 196
leukocytosis, 193, 194
platelet count, 193, 194
Trepine biopsy, 107
Tyrosine kinase inhibitor, 27

V

Viral infection
bone marrow suppression, 71
cytopathic effect, 74
human immunodeficiency, 67
inclusions, 73

W

Warts, hypogammaglobulinemia, infections, and myelokathexis
(WHIM) syndrome, 33, 54
Wolman disease, 33, 59
Wright-Giemsa stain, 13, 15

Z

ZAP-70 immunohistochemistry, 77, 80