Index

Page numbers in italic refer to figures.
Page numbers in bold refer to tables.

3q21q26 syndrome, 176–179
3q21.3
chronic myeloid leukaemias, 382
myelodysplastic syndromes, 310
3q26.2
chronic myeloid leukaemias, blast crisis, 382
myelodysplastic syndromes, 310
4q12, chronic eosinophilic leukaemia, 392, 393
5q− syndrome, 313, 333–335, see also del(5q)
7q abnormalities, 456
8p11 syndrome, 398–402
8p21–p23 loss, mantle cell lymphoma, 465
9q34 genes on episomes, T-lineage ALL, 272
11q23.3 breakpoint, B lymphoblastic leukaemia/lymphoma with, 256–261
11q23.3/KMT2A rearrangement, mixed phenotype acute leukaemia with, 277
12p13.1 deletions, T-cell prolymphocytic leukaemia, 485
13q12 rearrangements, chronic lymphoid leukaemias, 423
13q14 rearrangements
chronic lymphocytic leukaemia, 438
chronic lymphoid leukaemias, 423
13q14.3 rearrangements, chronic lymphocytic leukaemia, 438–439
14q32 rearrangements, chronic lymphocytic leukaemia, 439–440
17p− syndrome, 312–313

a
ABCB7 gene, myelodysplastic syndromes, 327
ABL1-BCR fusion gene, 375, see also BCR-ABL1 fusion
ABL1 gene, see also Ph-like B lymphoblastic leukaemia/lymphoma amplification, 275
Ph-positive ALL, 257
abnormal localization of immature precursors (ALIP), 306, 308
ABX instruments, automated full blood counts, 61
accelerated phase, chronic myeloid leukaemia, 380, 382
acid phosphatase stain, 4, 530, see also tartrate-resistant acid phosphatase
M1 acute myeloid leukaemia, 19
M5 acute myeloid leukaemia, 38
acquired abnormalities, cytogenetic analysis, 109
acute ATLL, 487
acute leukaemias, 2, 4–5, 11–12, see also specific types
after chemotherapy, 190–192
of ambiguous lineage, 250, 275–278
automated full blood counts, 59–61
genetic analysis, 117–123
immunophenotyping, 85–103
incidence, 13
international consortia, 526
acquired abnormalities, cytogenetic analysis, 109
acute ATLL, 487
acute leukaemias, 2, 4–5, 11–12, see also specific types
after chemotherapy, 190–192
of ambiguous lineage, 250, 275–278
automated full blood counts, 59–61
genetic analysis, 117–123
immunophenotyping, 85–103
incidence, 13
international consortia, 526
from myelodysplastic syndromes, 316
from neoplasms with FIP1L1-PDGFRα fusion, 390
resource-poor countries, 527–532
WHO classification, 136–138
acute lymphoblastic leukaemia see lymphoblastic leukaemia, acute
acute megakaryoblastic leukaemia see megakaryoblastic leukaemia, acute
acute myeloid leukaemia see myeloid leukaemia, acute
acute transformation, see also blast transformation
chronic myeloid leukaemias, 6, 215
myelodysplastic syndromes, 316
refractory anaemia with excess of blasts, 331
adult T-cell leukaemia/lymphoma (ATLL), 7, 420, 485–489
immunophenotyping, 475
resource-poor countries, 534
AFF1-KMT2A fusion gene, B lymphoblastic leukaemia/lymphoma with t(4;11)(q21.3;q23.3), 260
aggressive NK-cell leukaemia, 479–481
ALAS2 mutation, 327
alcian blue stain, acute basophilic leukaemia, 50
alkaline phosphatase, 70, see also neutrophil alkaline phosphatase
ALK-positive anaplastic large cell lymphoma, 495–496, 497
alkylating agents, acute leukaemia after, 190, 191
allophycocyanin, 73
all-\textit{trans}-retinoic acid
AML with t(15;17)(q24.1;q21.2), 148–149
M3 acute myeloid leukaemia, 26
\(\alpha\)-naphthyl acetate esterase stain
acute leukaemias, 4
M1 acute myeloid leukaemia, 19
ambiguous lineage, acute leukaemias
of, 250, 275–278
amplifications: iAMP21, B
lymphoblastic leukaemia/
lymphoma with, 267, 268
anaemias, see also refractory anaemia,
aplastic anaemia, leukaemias from, 3
autoimmune haemolytic anaemia in
chronic lymphocytic
leukaemia, 431, 432
chronic lymphocytic leukaemia, 432
Fanconi anaemia, 3, 297, 336
germs cell tumours with i(12p), 208
sideroblastic anaemia, 327
SRP72-associated familial aplastic
anaemia/MDS, 297
T-cell large granular lymphocyte
leukaemia, 476
anaplastic large cell lymphoma,
495–496, 497
aneuploidy, defined, 107
angioimmunoblastic T-cell lymphoma, 495, 497
Ann Arbor staging, 424
annexin A1, hairy cell leukaemia, 451
anthracyclines, AML with t(15;17)
(q24.1;q21.2), 150
antibody panels, 82, 85–89
European LeukemiaNet, 89, 529
anti-HLA-DR, flow cytometry, 86
anti-immunoglobulin antibodies, flow
cytometry, 86
anti-\(\kappa\) antibodies, B-lineage
lymphoproliferative disorders, 104
anti-\(\lambda\) antibodies, B-lineage
lymphoproliferative disorders, 104
antimetabolites, acute myeloid
leukaemia after, 192
anti-TCR \(\alpha\), flow cytometry, 87
anti-TCR \(\gamma\), flow cytometry, 87
anti-terminal deoxynucleotidyl
transferase, flow cytometry, 86
aplastic anaemia, leukaemias from, 3
apoptosis, myelodysplastic syndromes, 5
\textit{ARC} gene, 213
arsenic trioxide, acute myeloid
leukaemia
M3, 26
with t(15;17)(q24.1;q21.2), 150
Asia, antibody panels, 529
atra blue stain, acute basophilic
leukaemia, 50
\textit{ASXL1} genes
acute myeloid leukaemia, 146, 212
chronic neutrophilic leukaemia, 385
juvenile myelomonocytic leukaemia, 350
ataxia telangiectasia, 482
\textit{ATM} gene
chronic lymphocytic leukaemia, 441
mantle cell lymphoma, 465
T-cell prolymphocytic leukaemia, 485
atypical chronic myeloid leukaemia, 6,
337, 339–342
resource-poor countries, 534
Auer rods, 8, 18
AML with t(8;21)(q22;q22.1), 139,
141, 142, 143
AML with t(15;17)(q24.1;q21.2),
absence, 153
M1 acute myeloid leukaemia, 21
M2 acute myeloid leukaemia, 21
M3 acute myeloid leukaemia, 23, 24,
25, 30
naphthol AS-D chloroacetate
esterase stain, 4
autoantibodies, splenic lymphoma
with villous lymphocytes, 455
autofluorescence, acute promyelocytic
leukaemia, 150
autoimmune diseases, T-cell large
granular lymphocyte
leukaemia, 475
autoimmune haemolytic anaemia,
chronic lymphocytic
leukaemia, 431, 432
autoimmune leucoproliferative
disorder, RAS-associated, 350
autoimmune thrombocytopenia,
chronic lymphocytic
leukaemia, 431–432
automated differential counts, M2
acute myeloid leukaemia, 23
automated full blood counts, see also
white blood cell counts
acute leukaemias, 59–61
myelodysplastic syndromes,
315–316
azacitidine, monosomy 7, 313
azurophilic granules, 8

\textit{b}
\textit{BAALC} gene, 212, 269, 271
balanced translocations, 106
acute myeloid leukaemia, 118,
138–147
B-ALL (term), 250
bands (chromosomal), defined, 107
basophil(s)
chronic myeloid leukaemias, blast
crisis, 382
M4Eo AML, 162
t(8;21)(q22;q22.1) AML, 143
basophil granules, M0 AML, 14
basophilia, t(8;21)(q22;q22.1) AML, 139
basophilic differentiation, t(6;9)
(p23;q34.1) AML, 174, 175–176
basophilic leukaemia
acute, 49–50, 195, 196
immunophenotyping, 94
chronic, 402–403
basophilic maturation, M2 AML, 21
basophilic precursors, antigen
eexpression, 83
basophil lineage, myeloblasts
cytchemistry, 17
ultrastructure, 16
basophil-lobularity histogram, 60
B cell(s), see also B lineage; large B cell
counts, chronic lymphocytic
leukaemia, 429
gating on CD22, 422
mature, lymphoid leukaemias
having, 417–425, 534–535
B-cell lymphocytosis, monoclonal,
445–446
B-cell prolymphocytic leukaemia,
446–448
\textit{BCL2} gene, follicular lymphoma,
460–461
BCL2 protein
acute lymphoblastic leukaemia, 99
chronic lymphocytic leukaemia,
436–437
\textit{BCL2} mutation, chronic lymphocytic
leukaemia, 441
\textit{BCL2} rearrangements, follicular
lymphoma, 460–461
\textit{BCR-ABL1} fusion, see also Ph-like B
lymphoblastic leukaemia/
lymphoma; t(9;22)(q34.1;q11.2)
analysis, resource-poor countries,
531, 534
chronic myeloid leukaemias, 112,
375–376
mixed phenotype acute leukaemia
with, 276–277
blast crisis in CML, 382
blast cells, 7–8, 9f
442
Binet staging system, 442
BLN2-PDGFB fusion, chronic eosinophilic leukaemia, 395
Binet staging system, 442
blast cells, 7–8, 9f
acute lymphoblastic leukaemia, 250
L3, 58
acute myeloid leukaemia
M0, 16
M1, 18
M4Eo, 159–162
M6, 42–43
M7, 45
t(8;21)(q22;q22.1), 143
with cup-shaped nuclei, 184
immunophenotyping, 73, 95
myelodysplastic syndromes, 304
transient abnormal myelopoiesis, 200
WHO vs FAB classification, 136
blast crisis in CML, 382
acute myeloid leukaemia vs, 183
atypical CML, 341
lymphoid, 381
blastic plasmacytoid dendritic cell neoplasm, 203–204, 205, 206, 480
blastoid variant, mantle cell lymphoma, 461–463, 464, 465
blast transformation
chronic myeloid leukaemia, 381–382
chronic neutrophilic leukaemia, 385
blast window, flow cytometry, 74
B lineage, chronic leukaemias/
lymphomas of, 425–445
B-lineage acute lymphoblastic leukaemia
cytogenetics, 115, 122
flow cytometry, 97–98
hyperdiploidy, 115, 251–253
minimal residual disease, 102
periodic acid–Schiff stain, 530
prognosis, 251
B-lineage lymphoproliferative disorders,
immunophenotyping, 103–104
blood (peripheral), acute leukaemias, 11–12
blood transfusion, red cell histograms,
60–61
B lymphoblastic leukaemia/lymphoma
with hyperdiploidy, 251–253
with hypodiploidy, 264–266
with iAMP21, 267, 268
not otherwise specified, 268–269
Ph-like, 266–267
t(1;19)(q23;p13.3), 261–263
(t;4;11)(q21.3;q23.3), 258–261
(t;5;14)(q31.1;q32.1), 263–264, 265
t(2;22)(q34.1;q11.2), 255–258
t(12;21)(p13.2;q22.1), 253–255
B-lymphoid antigens see CD10; CD19;
CD20; CD22; CD24; CD79a; CD79b
B/myeloid MPAL, 277–278
bone, adult T-cell leukaemia/
lymphoma, 489
bone marrow, see also fibrosis;
trephine biopsy
acute leukaemias, 12
aspirates, clotted, 529
chronic lymphocytic leukaemia,
432–433, 438
chronic lymphoid leukaemias, 422
chronic myeloid leukaemia,
374–375
effect of leukaemia, 2
follicular lymphoma, 460
hairy cell leukaemia, 451
M3 acute myeloid leukaemia,
24–26
M7 acute myeloid leukaemia, 45, 47
mantle cell lymphoma, 463–464
myelodysplastic syndromes, 5,
296–297, 299, 304, 324
culture, 316
prognosis, 317–318
trephine biopsy, 306–310
sampling
immunophenotyping, 83
resource-poor countries, 529
secondary dysplasias, 321
splenic lymphoma with villous
lymphocytes, 455
T-cell large granular lymphocyte
leukaemia, 478
bone marrow transplantation, adult
T-cell leukaemia/lymphoma, 487
books, resource-poor countries, 536
bortezomib, 5q− syndrome, 335
brackets (square), 108
BRAF gene, hairy cell leukaemia,
451–452
break-apart FISH, M4Eo AML, 165,
166
Burkitt lymphoma, 55, 466–468, 534
acute lymphoblastic leukaemia vs,
97, 269
cytogenetics, 115
from follicular lymphoma, 457
genetic abnormalities, 424
karyogram, 106
L3 acute lymphoblastic leukaemia
vs, 58–59
leukaemic presentation, 420
rhabdomyosarcoma vs, 532
C
c (abbreviation), 107
cadherin-E, 194
CAE see naphthol AS-D chloroacetate
esterase stain; ‘specific’ esterase
calprotectin, antibody, trephine
biopsy, 96
CALR mutation, chronic myeloid
leukaemias, 379
CASP8AP2 gene, T-ALL, 271
CBFB gene, fusion with MYH11 gene,
164–166
CBL mutation-associated syndrome, 3,
347
CCD6-PDGFRB fusion, chronic
eosinophilic leukaemia, 395
CCND1 gene, mantle cell lymphoma,
464, 465
CCND2 gene, mantle cell lymphoma,
465
CD (antigens), 70
acute myeloid leukaemia, 90–95
flow cytometry, 86–89
M0 acute myeloid leukaemia, 14
normal cells, 83
CD1a, acute lymphoblastic leukaemia,
100
CD2
acute myeloid leukaemia, 94
acute promyelocytic leukaemia,
151–152
chronic T-cell leukaemias, 475
CLL of T and NK lineages, 474
CD3
chronic T-cell leukaemias, 475
CLL of T and NK lineages, 474
early T-cell precursor ALL, 271
natural killer-lineage
lymphoproliferative disorders, 105
resource-poor countries, 529
T-ALL, 270
trephine biopsy, 96

CD4
acute lymphoblastic leukaemia, 97
acute myeloid leukaemia, 91
chronic T-cell leukaemias, 475
CLL of T and NK lineages, 474

CD5
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426
chronic T-cell leukaemias, 475
CLL of T and NK lineages, 474
haematogones, 99

CD7
acute myeloid leukaemia, 94, 95
chronic T-cell leukaemias, 475
CLL of T and NK lineages, 474
myelodysplastic syndromes, 306
Sézary syndrome and, 491
T-cell prolymphocytic leukaemia, 484

CD8
acute lymphoblastic leukaemia, 97
chronic T-cell leukaemias, 475
CLL of T and NK lineages, 474

CD9, acute promyelocytic leukaemia, 152
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426
follicular lymphoma, 457–459
trephine biopsy, 96

CD10
acute lymphoblastic leukaemia, 97, 98, 99, 100
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426
trephine biopsy, 96

CD11a, acute promyelocytic leukaemia and, 151

CD11b, CLL of T and NK lineages, 474

CD11c
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426

CD13
acute lymphoblastic leukaemia, 101
acute myeloid leukaemia, 91
chronic lymphoblastic leukaemia and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426

CD14
acute lymphoblastic leukaemia, 97, 99, 100
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426

CD15
acute myeloid leukaemia, 91, 94
NPM1 mutation, 184

CD16
acute myeloid leukaemia, 94
CLL of T and NK lineages, 474

CD18
acute myeloid leukaemia, 91, 95, 144
B-lineage chronic lymphoid leukaemias, 426
B-lineage lymphoproliferative disorders, 104
chronic B-cell leukaemias and lymphomas, 427

CD19
acute lymphoblastic leukaemia, 99
acute myeloid leukaemia, 95
t(8;21)(q22;q22.1), 144
chronic lymphocytic leukaemia, 436

CD20
acute lymphoblastic leukaemia, 97, 99
pre-B, 99
B lymphoblastic leukaemia/lymphoma, 254
chronic B-cell leukaemias and lymphomas, 427

CD21, chronic lymphoid leukaemias of B lineage, 426
chronic lymphoid leukaemias and lymphomas, 427

CD22
acute lymphoblastic leukaemia, 97, 99
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426

CD23
chronic B-cell leukaemias and lymphomas, 427

CD24
acute lymphoblastic leukaemia, 97
chronic lymphoid leukaemias of B lineage, 426

CD25
acute myeloid leukaemia, 95, 213
adult T-cell leukaemia/lymphoma, 488
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426
hairy T-cell leukaemias, 475

CD26
Sézary syndrome and, 491
T-cell prolymphocytic leukaemia, 484
T-cell large granular lymphocyte leukaemia, 477

CD30
CLL of T and NK lineages, 474

CD33
acute lymphoblastic leukaemia, 99, 101
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426
chronic myeloid leukaemia, 436, 441, 443
chronic lymphoid leukaemias of B lineage, 426

CD34
acute lymphoblastic leukaemia, 97, 99, 100
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426
chlorambucil, 443

CD34-positive cells, 5q− syndrome, 334

CD36, acute myeloid leukaemia, 92

CD38
chronic B-cell leukaemias and lymphomas, 427
chronic lymphocytic leukaemia, 436, 441, 443
chronic lymphoid leukaemias of B lineage, 426
mantle cell lymphoma, 463
monoclonal B-cell lymphocytosis, 446

CD40, B-lymphoblastic leukaemia, 99

CD42b
trephine biopsy, 96

CD43
chronic lymphocytic leukaemia, 436
chronic lymphoid leukaemias of B lineage, 426
CD45
acute lymphoblastic leukaemia, 97
chronic lymphocytic leukaemia, 436
flow cytometry, 74, 75–76, 77–80, 86
hairy cell leukaemia, 451
lymphoproliferative disorders, 105
trephine biopsy, 96
CD49d, chronic lymphocytic leukaemia, 444
CD52, chronic lymphocytic leukaemia, 444
CD56
CD52, chronic lymphocytic leukaemia, 444
CD61, trephine biopsy, 96
CD64
96
cD64, acute myeloid leukaemia, 91
acute promyelocytic leukaemia, 151
CD65, acute promyelocytic leukaemia, 151
CD68
96
cD68, chronic lymphocytic leukaemia, 99
CD68, chronic lymphoid leukaemias of B lineage, 426
resource-poor countries, 529
t(8;21)(q22;q22.1), 144
acute promyelocytic leukaemia, 151
CD79A gene, hairy cell leukaemia, 450
cD79B gene, chronic lymphocytic leukaemia, 444
CD79B gene, chronic lymphocytic leukaemia, 444
cD81, acute lymphoblastic leukaemia, 99
CD87, acute myeloid leukaemia, 91
cD94, CLL of T and NK lineages, 474
CD103 chronic lymphoid leukaemias of B lineage, 426
hairy cell leukaemia, 450
CD105, myelodysplastic syndromes, 306
CD116, acute myeloid leukaemia, 91
CD117 acute myeloid leukaemia, 90–91, 96
acute promyelocytic leukaemia, 151
CD123 chronic lymphoid leukaemias of B lineage, 426
hairy cell leukaemia, 450
CD133 acute myeloid leukaemia, 94
B lymphoblastic leukaemia/lymphoma with t(4;11)
(q21.3;q23.3), 259–260
CD138 chronic lymphocytic leukaemia, 436
chronic lymphoid leukaemias of B lineage, 426
gating, 422
plasma cell leukaemia, 473
CD158 acute promyelocytic leukaemia, 151
CLL of T and NK lineages, 474
cD158, T-cell large granular lymphocyte leukaemia, 477
T-lineage lymphoproliferative disorders, 105
CD160 chronic lymphocytic leukaemia, 436
hairy cell leukaemia, 450
CD161, CLL of T and NK lineages, 474
CD200 chronic B-cell leukaemias and lymphomas, 427
chronic lymphocytic leukaemia, 436
chronic lymphoid leukaemias of B lineage, 426
CD200, chronic B-cell leukaemias and
lymphomas, 427
chronic lymphocytic leukaemia, 436
chronic lymphoid leukaemias of B lineage, 426
CD235a, trephine biopsy, 96
CD236R, trephine biopsy, 96
CDK5RAP2-PDGFRB fusion, 392
CDKN1B gene, hairy cell leukaemia, 452
CDKN2B gene, promoter methylation, 314
CEBPA-associated familial MDS/AML, 297
CEBPA gene acute myeloid leukaemia, 121, 186, 210
biallelic mutation, 186–187, 210
central nervous system, see also
leucoencephalopathy
T lymphoblastic leukaemia/lymphoma, 269–272
centromeres, 107
centromeric probes, 110
CEP85L-PDGFRB fusion, chronic eosinophilic leukaemia, 395
cervical lymphadenopathy, 428
Charcot–Leyden crystals, 49, 161, 387
chemotherapy
AML with t(8;21)(q22;q22.1), 143
AML with t(15;17)(q24.1;q21.2), 149–150
leukaemias from, 3, 190–192
Ph-positive ALL, 256
CHIC2 loss, neoplasms with
FIP1L1-PDGFR fusion, 393
children, see also juvenile myelomonocytic leukaemia
acute leukaemias, incidence, 13
myelodysplastic syndromes, 336
chloroacetate esterase see naphthol AS-D chloroacetate esterase stain
chondroitin sulphate proteoglycan, 168
chromatin, lymphoblasts, 56–57
chromosome 13, chronic lymphocytic leukaemia, 441
chromosomes, see also rearrangements; specific abnormalities e.g. 3q21.3
bands defined, 107
examination, 106
paints, 110
regions, 108
chronic adult T-cell leukaemia/lymphoma, 485, 486
chronic eosinophilic leukaemia see eosinophilic leukaemia, chronic
chronic granulocytic leukaemia see granulocytic leukaemia, chronic
chronic leukaemias, 2, see also specific types
of B lineage, 425–445
chronic lymphocytic leukaemia see lymphocytic leukaemia, chronic
chronic lymphoproliferative disorder of NK cells, 480
chronic myelogenous leukaemia see
myeloid leukaemia, chronic
chronic myeloid leukaemia see myeloid leukaemia, chronic
chronic myelomonocytic leukaemia see
myelomonocytic leukaemia, chronic
chronic neutrophilic leukaemia see neutrophilic leukaemia, chronic classifications, see also French–American–British classification; WHO classification
acute lymphoblastic leukaemia, 250
EGIL classification, B-lymphoblastic leukaemia, 98
leukaemias, 2
acute, 4–5
myelodysplastic syndromes, 302–304
clinical diagnosis, resource-poor countries, 531
clonal evolution, 2, 106
acute myeloid leukaemia, 183
chronic myeloid leukaemia, 379–380
myelodysplastic syndromes, 302
clonal haematoipoiesis of indeterminate potential (CHIP), 320, 321
clonality, 2, 420–421
molecular genetics, 117
clone names, gene names vs, 110
clones defined, 107, 116
two of, 118
cloud computing, 526
CNTRI(CEP110)-FGFR1 fusion, neoplasms, 399
cogulation, M3 acute myeloid leukaemia, 23, 24
cold haemagglutinin disease, 471
colours, flow cytometry, 74
commas, 108
common acute lymphoblastic leukaemia, 98
comparative genomic hybridization, 112, 113
con (abbreviation), 110, 111
congenital amegakaryocytic thrombocytopenia, 297
congenital leukaemia, t(8;16) (p11.2;p13.3), 205
congenital neutropenia, 3
consortia, international, 526
copy number alterations, myelodysplastic syndromes, 314
core biopsy see trephine biopsy
corticosteroids, B-lymphoblastic leukaemia, 99
cough, neoplasms with FIP1L1-PDGFRα fusion, 389
cp (abbreviation), 107
CPSF6-FGFR1 fusion, neoplasms, 399
CPSF6-PDGFRβ fusion, chronic eosinophilic leukaemia, 395
CREBBP gene, t(8;16)(p11.2;p13.3) AML, 208
CRFL2 gene, ALL, 267
CRM1 gene, 213
cryptic TAL deletion, T-lineage ALL, 272
crystals
acute eosinophilic leukaemia, 46, 49
cystic, 146
acute mast cell leukaemia, 52
Charcot–Leyden crystals, 49, 161, 387
chronic lymphocytic leukaemia, 431
M4 acute myeloid leukaemia, 208
CSF3R gene, atypical CML, 342
CSFR3 gene
chronic myeloid leukaemia, 385
T-ALL, 273
CSNK1A1 gene, 5q− syndrome, 334
cyanide-resistant peroxidase, 49
cyclical changes, chronic myeloid leukaemia, 374
cyclical thrombocytopenia, T-cell large granular lymphocyte leukaemia, 475
cyclin D1, mantle cell lymphoma, 463
cyclin D2, mantle cell lymphoma, 465
CyIg, chronic B-cell leukaemias and lymphomas, 427
cytarabine, t(9;11)(p21.3;q23.3) AML, 168
cytotoxic granule proteins
hepatosplenic T-cell lymphoma, 494
T-cell large granular lymphocyte leukaemia, 477
d
D816V mutation, KIT gene, 51–52
decimal point, 108
del (abbreviation), 107
del(5q)
chronic eosinophilic leukaemia, 395
lenalidomide, 313, 335
myelodysplastic syndromes with, 298, 303, see also 5q− syndrome
resource-poor countries, 533
del(6)(q21), chronic lymphocytic leukaemia, 439
del(7q), acute myeloid leukaemia, 120
del(9)(p21.3), T-ALL, 271
del(9)(q34.11q34.13), T-lineage ALL, 272
del(11q), chronic lymphocytic leukaemia, 439, 440
del(11)(q22.3) chronic lymphocytic leukaemia, 438, 439
del(11)(q22.3) chronic lymphoid leukaemias, 423
direct labelling, flow cytometry, 80
disseminated intravascular coagulation, AML
M3, 23
M5, 35
t(15;17)(q24.1;q21.2), 148
dmin (abbreviation), 107
DNA index
ALL with hypodiploidy, 266
flow cytometry, 101
DNMT3A mutations, 210
myelodysplastic syndromes, 314
NPM1 mutation with, 185
doublets, flow cytometry, 81
Down syndrome, 3
acute lymphoblastic leukaemia,
266–267
B-lineage, 268, 269
GATA1 mutations, 200
with myeloid leukaemias,
202–203
M7 acute, 44–45
myeloid proliferation related to,
197–203
DTD1-PDGFRB fusion, chronic eosinophilic leukaemia, 396
dual-colour probes, FISH, 110,
377, 378, 379, 380
dup (abbreviation), 107
dyskeratosis congenita, 3,
297, 336
dysplasia, see also myelodysplasia
myelodysplastic syndromes, 5,
321–330
e
eye
early T-cell precursor ALL, 271–273
education, resource-poor countries,
535–536
EGIL classification, B-lymphoblastic
leukaemia, 98
e-mail, 526
demic Burkitt lymphoma, 466,
534
ehn (abbreviation), 111
enteropathy-associated T-cell
lymphoma, 494–495, 497
enzymes see immunoenzymatic
techniques
eosinophil(s)
AML with t(8;21)(q22;q22.1),
143
AML with t(16;16)(p13.1;q22), 159,
162
B lymphoblastic leukaemia/
lymphoma with t(5;14)
(q31.1;q32.1), 263, 265
chronic eosinophilic leukaemia,
386–387, 396
neoplasms with FIP1L1-PDGFRB
fusion, 389, 390, 391
eosinophilia
AML with t(8;21)(q22;q22.1),
139–143
B lymphoblastic leukaemia/
lymphoma, 268
CMML with, 394
resource-poor countries, 533
eosinophilic leukaemia
acute, 45–49
automated full blood counts, 60–61
chronic cytogentic, 115
with FIP1L1-PDGFRB fusion,
389–394
not otherwise specified, 386–389
PDGFRB rearrangements with,
395–396, 397
eosinophilic maturation, M2 acute
myeloid leukaemia, 21
eosinophil lineage, myeloblasts
cytochemistry, 17
ultrastructure, 16
epidermotropism
mycosis fungoides, 493
Sézary syndrome, 491
episomes, 275
9q34 genes on, T-lineage ALL, 272
EPOR gene, ALL, 267
e-aminocaproate, acute basophilic
leukaemia, 50
Epstein–Barr virus
aggressive NK-cell leukaemia, 479
Burkitt lymphoma, 466
Richter syndrome, 434
ER1-PDGFRB fusion, chronic
eosinophilic leukaemia, 395
ERG gene, 202, 212
E-rosette-forming cells, acute
lymphoblastic leukaemia, 100
erthroblasts
flow cytometry, 73
myelodysplastic syndromes,
304–305
erthrocytes
aplasia see pure red cell aplasia
histograms, 60–61
lysis, flow cytometry, 76–79
myelodysplastic syndromes, 315
erthroderma, mycosis fungoides, 492
erthroblast dysplasia, myelodysplastic
syndromes, 321
erthroblasts, 307
erythroid leukaemia, acute, 194–195
erythroid precursors
antigen expression, 83
CD antigens, 92–93
ultrastructure, 16
erythroid predominance, bone
marrow, 12
erthroleukaemia
acute, 194–195, see also M6 acute myeloid leukaemia
erythropoiesis, MDS, 299
5q− syndrome, 333
essential thrombocythaemia, 6, 533
FISH, 377, ethnicity
acute leukaemias, incidence, 13
acute lymphoblastic leukaemia, 250
ethylenediaminetetra-acetic acid, 81
ETV6 (gene), B lymphoblastic leukaemia/lymphoma with iAMP21, 268
ETV6-ACSL6 fusion gene, 388
ETV6-JAK2 fusion, neoplasms, 402
ETV6-PDGFRA fusion, 392
ETV6-PDGFRA fusion, 394
clonal eosinophilic leukaemia, 395
ETV6-RUNX1 fusion gene, 122, 253–255
European LeukemiaNet, antibody panels, 89, 529
European Treatment and Outcome Study, staging score, 375
Evans syndrome, 432
extranodal NK/T-cell lymphoma, nasal type, 481–482
extra-signal FISH, 377, 378, 379, 380

F
FAB classification see French–American–British classification
faggots, Auer rods, 23, 25
familial platelet disorder with propensity to AML, 297
familial syndromes, 2–3
Fanconi anaemia, 3, 297, 336
FBXW7 gene, T-ALL, 271
ferritin, myelodysplastic syndromes, 316
FGFR1 gene rearrangements, neoplasms with, 398–402
FGFR1OP2-FGFR1 fusion, neoplasms, 399
FGFR1OP-FGFR1 fusion, neoplasms, 399
fibrosis, see also myelofibrosis
myelodysplastic syndromes, 337, 338
with excess blasts, 330
FIP1L1-PDGFRα fusion, neoplasms with, 389–394
flow cytometry, 71–87
acute myeloid leukaemia
cytchemistry vs, 91
M4Eo, 162, 163
acute promyelocytic leukaemia, 150, 151
B-lineage acute lymphoblastic leukaemia, 97–98
CD (antigens), 86–89
DNA index, 101
gating, 74, 75–76
acute lymphoblastic leukaemia, 97
B-lineage lymphoproliferative disorders, 104
lymphoid leukaemias of mature cells, 421–422
hairy cell leukaemia, 450–451
immunobead techniques, 82–83
lymphoid leukaemias of mature cells, 421–422
multicolour analysis, 74, 99
multiparameter, 85
myelodysplastic syndromes, 305–306
resource-poor countries, 526, 529
strengths of expression, 80
FLT3 gene
acute myeloid leukaemia, 118, 145, 210, 211
myelodysplastic syndromes, 314
T-lineage ALL, 273
FLT3-internal tandem duplication
acute myeloid leukaemia, 118, 210, 211
M3, 27
M4Eo, 165
NPM1 mutation, 185
t(6;9)(p23;q34.1), 174
acute promyelocytic leukaemia, 154
FLT3-TKD mutations, 210, 211
acute promyelocytic leukaemia, 154
fluorescein isothiocyanate, 73
fluorescence in situ hybridization (FISH), 110–114
5q− syndrome, 334–335
Burkitt lymphoma, 467
chronic lymphocytic leukaemia, 438, 439
chronic myeloid leukaemia, 377–378, 379, 380
M4Eo AML, 165–166
mantle cell lymphoma, 464–465
myelodysplastic syndromes, resource-poor countries, 533–534
fluorochromes, 71, 73–74, 104
comparative genomic hybridization, 112
FMC7 (marker)
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426
follicular lymphoma, 456–461
cytogenetics, 115
genetic abnormalities, 423
immunophenotyping, 427, 457–459
International Prognostic Index, 425
forward scatter (FSC), flow cytometry, 71–72
hairy cell leukaemia, 450
M4Eo AML, 162, 163
French–American–British classification, 3, 11–58
acute basophilic leukaemia, 49
acute eosinophilic leukaemia, 45
acute leukaemias, 11, 12
WHO classification vs, 136
acute lymphoblastic leukaemia, 54–55
acute myeloid leukaemia, 13–53
hypoplastic, 53
blast cells, 7
chronic lymphocytic leukaemia, 445
myelodysplastic syndromes, 296, 302–303
full blood counts, automated, see also white blood cell counts
acute leukaemias, 59–61
myelodysplastic syndromes, 315–316
full stops, FISH, 111
FUS-ERG, acute myeloid leukaemia, 208
fusion genes, see also specific fusions
acute lymphoblastic leukaemia, 122
acute myeloid leukaemia, 118
molecular genetics, 115, 116
fusion proteins, immunobead techniques, 82–83
fusion signals, FISH, 110, 111

g
γ heavy chain disease, 471
GATA1 gene
M7 acute myeloid leukaemia, 44–45
transient abnormal myelopoiesis, 200, 202
Granulocytic component, M4 acute granulocyte-macrophage colony-forming units, myelodysplastic syndromes, 316
GATA2 gene, 212
biaffalic CEBPA mutation and, 186–187
haploinsufficiency, 179, 297
GATA3 gene, Ph-like ALL, 266
gating, flow cytometry, 74, 75–76
acute lymphoblastic leukaemia, 97
B-lineage lymphoproliferative disorders, 104
lymphoid leukaemias of mature cells, 421–422
gemtuzumab ozogamicin, AML with t(15;17)
(tq4.1;q21.2), 147
gene expression profiling, 114–115
gene analysis, 105–123, see also comparative genomic hybridization; cytogenetics;
fluorescence in situ hybridization; molecular genetics
haploinsufficiency, 265
GATA2 defined, 107
GATA3, 297
myelodysplastic syndromes, 314
myelodysplastic syndrome, 5q– syndrome, 334
Hasford score, chronic myeloid leukaemia, 375
heavy chain diseases, 471
heavy chains, antibodies against, 86
HECW1-PDGFRB fusion, chronic eosinophilic leukaemia, 395
hepatosplenic T-cell lymphoma, 493–494, 495
HERVK-FGFR1 fusion, neoplasms, 399
heterozygosity, 114–115
hiatus leukaemicus, 11
high hyperdiploidy, B lymphoblastic leukaemia/lymphoma with, 251, 252
high hypodiploidy, 265
HIP1-PDGFRB fusion, chronic eosinophilic leukaemia, 395
histamine excess, acute basophilic leukaemia, 49
histiocytosis, malignant, leukaemic phase, 37, 38
histograms automated full blood counts, 60 red cells, 60–61
histology, immunophenotyping, 95
HIV infection, Burkitt lymphoma, 466
HLA-DR, 94
acute promyelocytic leukaemia, 150, 151
B-lymphoblastic leukaemia, 98
chronic B-cell leukaemias and lymphomas, 427
chronic lymphoid leukaemias of B lineage, 426
HLF gene see TCF3-HLF fusion gene
Hodgkin lymphoma
from CLL, 434
staging, 424, 425
HOXA gene, acute lymphoblastic leukaemia, 122
hrs (abbreviation), 107
human T-cell lymphotropic virus 1, 485, 489, 534
hybridoma technology, 70
hyperbasophilic promyelocytes, M3 variant AML, 27, 29, 30
hypercalcaemia, TCF3-HLF fusion gene, 263
hyperdiploidy
acute lymphoblastic leukaemia, 122, 251
B-lineage, 115, 251–253
defined, 107
hypergranular promyelocytic leukaemia, 148, 529, see also M3 acute myeloid leukaemia
hypocellular acute myeloid leukaemia, 53
hypocellular myelodysplastic syndrome, 337
hypodiploidy
acute lymphoblastic leukaemia, 122
B lymphoblastic leukaemia/lymphoma with, 264–266
defined, 107
hypogranular promyelocytic leukaemia, 529, see also M3 variant acute myeloid
leukaemia
prognosis, 150
hypoplastic acute myeloid leukaemia, 53
immunoglobulins

immunoenzymatic techniques, 70

immunocytochemistry, 70

immune deficiency, adult T‐cell

imatinib

lymphocyte count, CLL, 431

mantle cell lymphoma, 463

idem, defined, 107

IDH1 mutation, 210, 211

myelodysplastic syndromes, 314

IDH2 mutation, 121, 212

idic (abbreviation), 107

i (abbreviation), 107

iAMP21, B lymphoblastic leukaemia/

i(12p), germ cell tumours with, AML

i (abbreviation), 107

i

Index
inv(11)(p15q11), AML, 209
inv(11)(p15q23.3), AML with, 171
inv(11)(q14.2q23.1), AML with, 171
inv(14)(q11.1q32), T-lineage ALL, 273
inv(14)(q11.2q32.1), T-cell prolymphocytic leukaemia, 484
inv(14)(q11.2q32.1), t(14;14)(q11;q32), T-cell prolymphocytic leukaemia, 424
inv(14)(q11.2q32.31), T-lineage ALL, 273
inv(16)
  acute myeloid leukaemia, 119, 120
  chronic myeloid leukaemias, 383
inv(16)(p13.1q22), AML, 158–166
inv(16)(p13.1q22)/t(16;16)(p13.1q22), AML, 303–304
inv(16)(p14.1q22), M4Eo AML, 164, 165–166
 q
iron overload, myelodysplastic syndromes, 316, 327
ish (abbreviation), 107, 111
iso 

J
JAK1 mutations, T-ALL, 271
JAK2 V617F mutation, 211
chronic myeloid leukaemias, 378–379
chronic myelomonocytic leukaemia, 347, 351
chronic neutrophilic leukaemia, 385
Japanese variant, hairy cell leukaemia, 453
juvenile myelomonocytic leukaemia, 6, 347–351, 534
k
KANK1-PDGFRB fusion, chronic eosinophilic leukaemia, 395
karyograms, defined, 107
karyotypes, see also specific karyotypes e.g. t(8;14)(q24;q32)
defined, 107
monosomal, myelodysplastic syndromes, 313
KAT6A-CREBBP, acute myeloid leukaemia, 204–208
Ki-67, Burkitt lymphoma, 467
KIF5B-PDGFR fusion, 392
chronic eosinophilic leukaemia, 392
killer inhibitory receptor see CD158
kinase receptor genes, ALL, 267
KIT gene, 51–52
acute myeloid leukaemia, 145–146, 211
M4Eo AML, 165
M541L mutation, 388
KMT2A-AFF1 fusion gene see t(4;11)
(q21.3q23.3)
KMT2A fusion genes, see also t(4;11)
(q21.3q23.3)
T-ALL, 271
KMT2A-MLLT3 fusion gene, AML with, 166–169
KMT2A rearrangement
  acute lymphoblastic leukaemia, 122
  acute myeloid leukaemia with, 169–173
  therapy-related, 192
  mixed phenotype acute leukaemia, 276, 277
  pre-B acute lymphoblastic leukaemia, 98
KMT2A tandem partial duplication, 172, 210, 211

L
L1 acute lymphoblastic leukaemia, 54, 55, 56
L2 acute lymphoblastic leukaemia, 54–55, 56, 528
L3 acute lymphoblastic leukaemia, 54, 57, 58–59
labelling
  flow cytometry, 80
  specimens, 526–527
lactoferrin, antibodies against, 88
Langerhans cell leukaemia, 529
light chain restriction, 420–421
light chain restriction, 420–421

M
M4Eo AML, 165
M541L mutation, 388
KMT2A-AFF1 fusion gene see t(4;11)
(q21.3q23.3)
KMT2A fusion genes, see also t(4;11)
(q21.3q23.3)
T-ALL, 271
KMT2A-MLLT3 fusion gene, AML with, 166–169
KMT2A rearrangement
  acute lymphoblastic leukaemia, 122
  acute myeloid leukaemia with, 169–173
  therapy-related, 192
  mixed phenotype acute leukaemia, 276, 277
  pre-B acute lymphoblastic leukaemia, 98
KMT2A tandem partial duplication, 172, 210, 211

N

O

P

Q

R

S

T

U

V

W

X

Y

Z
lymphoblastic lymphoma, 7, 250–275
lymphoblasts, 7, 8, 56
chromatin, 56–57
cup-shaped nuclei, 57, 58
lymphocytes
counts, chronic lymphocytic leukaemia, 430–431, 443
myelodysplastic syndromes, 316
villous, 454–455, see also splenic lymphoma with villous lymphocytes
lymphocytic leukaemia
chronic (CLL), 420, 427–445
genetic abnormalities, 438–442
immunophenotyping, 104, 427, 434–438
monoclonal antibodies for diagnosis, 474
from monoclonal B-cell lymphocytosis, 446
prognosis, 442–444
resource-poor countries, 535
lymphocytosis (monoclonal B-cell), 445–446
lymphoid antigens, see also specific antigens
acute myeloid leukaemia, 94–95
lymphoid blast crisis, CML, 381
lymphoid blast transformation, CML, 381–382
lymphoid enhancer-binding factor 1, CLL, 437
lymphoid leukaemias, 6–7, see also specific types
of B lineage, 426
of mature B, T and natural killer cells, 417–425, 534–535
of mature T and natural killer cells, 474–497
originating cells, 2
lymphoma cells, follicular lymphoma, 456–457
lymphomas, 7, see also specific types of B lineage, 425–445
leukaemia vs, 420
lymphoblastic, 7, 250–275
of mature B, T and natural killer cells, 417–425, 534–535
lymphoma-type ATLL, 486
lymphoplasmacytoid lymphoma, 470–471
genetic abnormalities, 424
lysozyme
acute myeloid leukaemia, 95
M4, 33
M5, 38, 39
antibody
resource-poor countries, 529
trephine biopsy, 96
chronic myelomonocytic leukaemia, 343
obsolescence, 14
m
M0 acute myeloid leukaemia, 12–13, 14–18, 53
automated full blood counts, 59
basophilic, 49
cytchemistry, 17–18
immunophenotyping, 14, 71
M1 acute myeloid leukaemia, 18–21
automated full blood counts, 59–60
basophilic, 49
cytchemistry, 19–21
M2 acute myeloid leukaemia, 21–23
basophilic, 49
M3 acute myeloid leukaemia, 23–26, 53
immunophenotyping, 91, 93
promyelocytes, 16, 17, 23
M3 variant acute myeloid leukaemia, 26–30
automated full blood counts, 60–61
immunophenotyping, 91
M4 acute myeloid leukaemia, 30–35, 53, see also myelomonocytic leukaemias
automated full blood counts, 60–61
flow cytometry, 77–80
M4Eo acute myeloid leukaemia, 159–166
M5 acute myeloid leukaemia, 35–40, 53, see also monocytic/myelomonocytic leukaemia
immunophenotyping, 91
M6 acute myeloid leukaemia, 40–44, 53
immunophenotyping, 92
M7 acute myeloid leukaemia, 44–45, 46
automated full blood counts, 59
immunophenotyping, 93
macrocytosis, myelodysplastic syndromes, 323
macrophages
M3 acute myeloid leukaemia, 24, 25
M4 acute myeloid leukaemia, 33
major breakpoint region, BCL2 gene, 460
malignant histiocytosis, leukaemic phase, 37, 38
mantle cell lymphoma, 461–466
B-cell prolymphocytic leukaemia vs, 448
CD200, 436
chronic lymphocytic leukaemia vs, 437
cytogenetics, 115
flow cytometry, 75–76
genetic abnormalities, 424
immunophenotyping, 427
mar (abbreviation), 108
marginal zone lymphoma, see also splenic marginal zone lymphoma
leukaemic phase, 471–472
mast cell(s)
FGFR1 gene rearrangements, 398
neoplasms with FIP1L1-PDGFRA fusion, 389–390, 393
t(8;21)(q22;q22.1) AML, 143
mast cell leukaemia, acute, 50–52
immunophenotyping, 94
mast cell lineage
antigen expression, 83
myeloblasts
cytchemistry, 17
ultrastructure, 16
mastocytosis, systemic, 50–51
hairy cell leukaemia vs, 452
maturation
acute lymphoblastic leukaemia, 99–100
acute myeloid leukaemia with, 193–194
differentiation vs, 12n
flow cytometry, 74
M2 acute myeloid leukaemia, 21
Max Foundation, 532–533
May–Grünewald–Giemsa stain, acute mast cell leukaemia, 52
MDS/MPN see myelodysplastic/myeloproliferative neoplasms
MECOM gene, 179, 212
megakaryoblastic leukaemia, acute, 195, see also M7 acute myeloid leukaemia
Down syndrome with, 197, 202
t(1;22)(p13;q13.1) with, 180–182
megakaryoblastic transformation, chronic myeloid leukaemia, 382
megakaryoblasts
cytchemistry, 17
immunophenotyping, 93–94
M7 acute myeloid leukaemia, 45, 46
ultrastructure, 16
myelodysplastic syndromes (MDS) (cont’d)
cytogenetics, 310–313, 317–320
diagnostic criteria, 321
differential diagnosis, 320–321
with excess of blasts, 330–332, 336
fibrosis, 337, 338
with excess blasts, 330
hypocellular, 337
hypoplastic acute myeloid leukaemia, see also
myelofibrosis, 103, 305–306
incidence, 296
with isolated del(5q) see
5q– syndrome
molecular genetics, 313–315
with multilineage dysplasia, 328–330
mutations, 2–3, 298, 313–315
prognosis, 316–320
resource-poor countries, 531, 533–534
with single lineage dysplasia, 321–324
unclassifiable, 335–336
WHO classification, 302, 303–304, 321–337
prognosis, 317
myelofibrosis, see also fibrosis
acute, 45, 47
acute panmyelosis with, 195–197, 198–199
primary, 6, 533
myeloid antigens, see also CD13; CD15; CD33
acute lymphoblastic leukaemia, 97, 100, 101
CD14, acute myeloid leukaemia, 91, 96
CD65, acute promyelocytic leukaemia, 151
myeloid leukaemias
acute, 4, 11, 13–53, see also specific variants and types
acute lymphoblastic leukaemia vs, 12–13
antibodies in diagnosis, 96
cytogenetics see under
cytogenetics
French–American–British classification, 13–53
immunophenotyping see under
immunophenotyping
incidence, 13
inv(16)(p13.1q22)/t(16;16)
(p13.1;q22), 303–304
with maturation, 193–194
with minimal differentiation, 193
molecular genetics see under
molecular genetics
with myelodysplasia, 187–190
not in WHO classification, 204–213
not otherwise specified, 193–197
prognosis, 213–214
from RARS, 327
from RCMD-RS, 328
with recurrent genetic abnormalities, 138–187
from refractory anaemia, 324
resource-poor countries, 527, 531
secondary, 215
t(8:21)(q22;q22.1), 138–147, 303–304
therapy-related see under
therapy-related leukaemia
WHO classification, 303
without maturation, 193
chronic, 5–6, 371–416
atypical, 6, 337, 339–342, 534
BCR-ABL1 fusion, 112, 375–376
BCR-ABL1-positive, 372–383
chronic phase, 373–380
cytogenetics, 115, 342, 375–380, 382–383
molecular genetics, 375–380, 382–383
resource-poor countries, 532–533
t(9;22), 256–257
Down syndrome with, 202–203
M7 acute, 44–45
originating cells, 2
myeloid markers, ALL, minimal residual disease, 101
myeloid sarcoma, 159, 169, 197
myelomatocytic leukaemia, 51–52
myelomonocytic leukaemias, 6
acute, 194, see also M4 acute
myeloid leukaemia
chronic (CML), 298, 342–347
atypical CML vs, 341
with eosinophilia, 394
prognosis, 345–346
resource-poor countries, 534
WHO classification, 303, 339, 342
juvenile, 6, 347–351, 534
myeloperoxidase (MPO), 4
acute myeloid leukaemia, 91
ALL vs, 13
M0, 14
antibodies against, 88
resource-poor countries, 529, 531
trephine biopsy, 96
myelodysplastic syndromes, 304
Sudan black B stain vs, 12–13
myeloproliferative neoplasms (MPN), see also myelodysplastic
myeloproliferative neoplasms
immunophenotyping and, 103
myelodysplastic syndromes vs, 298, 302
MYH11 gene, fusion with CBFB gene, 164–166
Mylotarg, AML with t(15;17)
(q24.1;q21.2), 150
MYO18A-PDGFBR fusion, chronic eosinophilic leukaemia, 396
naphthol AS-D chloroacetate esterase
stain (CAE), 4
M1 acute myeloid leukaemia, 19
M2 acute myeloid leukaemia, 22
myelodysplastic syndromes, 304
nasal type, extranodal NK/T-cell
lymphoma, 481–482
natural killer cell(s), see also NK-cell-like T-cell lymphoma
mature, lymphoid leukaemias
having, 417–425, 474–497, 534–535
natural killer cell lymphoblastic
leukaemia/lymphoma, 275
natural killer cell markers see CD16; CD56
natural killer-lineage
lymphoproliferative disorders, 478–481
immunophenotyping, 105
NDE1-PDGFBR fusion, chronic eosinophilic leukaemia, 396
near diploidy, 265
near haploidy, 264–266
near triploidy, 266
nested PCR, 117
neuroblastoma, 531
neurofibromatosis, 3
neutrophil(s), 10
acute myeloid leukaemia
M0, 16
M2, 22–23
t(8;21)(q22;q22.1), 139, 141
antigen expression, 83
chronic myelomonocytic leukaemia, 344
myelodysplastic syndromes, 298, 300
peroxidase deficiency, 315
neutrophil alkaline phosphatase (NAP score)
M2 acute myeloid leukaemia, 23
M5 acute myeloid leukaemia, 38–39
myelodysplastic syndromes, 304
neutrophilia
adult T-cell leukaemia/lymphoma, 487
plasma cell neoplasms, 385
neutrophilic leukaemia, chronic, 6, 383–386
neutrophilic leukaemoid reaction, 385
neutrophil lineage, myeloblasts, cytochemistry, 17
next generation sequencing (NGS)
chronic eosinophilic leukaemia, 389
myelodysplastic syndromes, 314
Nijmegen breakage syndrome, 482
N‐PDGFRB fusion, chronic eosinophilic leukaemia, 395
nitrosoureas, acute leukaemia after, 190, 191
NK‐cell‐like T‐cell lymphoma, 476, 477
NPM1 gene mutation, 183, 210
nodular infiltration, bone marrow, 422
nuclei, packed marrow see diffuse infiltration of bone marrow
pamnnylosis, acute immunophenotyping, 95
myelofibrosis with, 195–197, 198–199
Pappenheimer bodies, 325
paracentric inversion, defined, 108
paratrabecular infiltration, bone marrow, 422
parentheses, 108
paroxysmal nocturnal haemoglobinuria clone, 306
Pautrier microabscesses, 489, 491, 493
PAX5 gene
acute lymphoblastic leukaemia, 97
lymphoplasmycytoid lymphoma, 471
t(8;21)(q22;q22.1) AML, 144
PBX1 gene see TCF3‐PBX1
PCM1‐JAK2 fusion, neoplasms, 401, 402
PDE4DIP‐PDGFRB fusion, chronic eosinophilic leukaemia, 395
NR3C1 mutation, blastic plasmacytoid dendritic cell neoplasm, 204
NRAS gene
inv(3)(q21.3q26.2) AML, 179
mutation, 211
nuc ish (abbreviation), 110, 111
nuclei
cup‐shaped see cup‐shaped nuclei
M3 acute myeloid leukaemia, 23
nucleophosmin, 183–184
NUMA1‐RARA rearrangement, 155
NUP98‐FGFR1 fusion, neoplasms, 399
NUP98‐NSD1 fusion gene, 210
NUP98‐RARG fusion gene, 155
NUP214‐ABL1 fusion, T lymphoblastic leukaemia/lymphoma with, 274–275
NUP214 gene, t(6;9)(p23;q34.1) AML, 174
O
oncogenes, 2
outsourcing, from resource‐poor countries, 526
p
p, p+, p− (abbreviations), 108
p53, myelodysplastic syndromes, 310
p, p+, p− (abbreviations), 108
 Pelger–Huet anomaly, 316
PHEL gene mutation, 255
M2 acute myeloid leukaemia, 374
M5 acute myeloid leukaemia, 376
M3 acute myeloid leukaemia, 38, 40
M6 acute myeloid leukaemia, 43–44
M7 acute myeloid leukaemia, 45
myelodysplastic syndromes, 304
resource‐poor countries, 529–530
Peripheral blood, acute leukaemias, 11–12
Perls stain, 4
M6 acute myeloid leukaemia, 44
permeabilized cells, flow cytometry, 72, 73
peroxidase, cyanide‐resistant, 49
peroxidase deficiency, neutrophils, 315
peroxidase reaction, 70
automated full blood counts, 59–60
M2 acute myeloid leukaemia, 23
phagocytic leukaemic cells, M5 acute myeloid leukaemia, 35
phagocytosis, M7 acute myeloid leukaemia, 45
PHF6 mutation
acute myeloid leukaemia, 212
T‐ALL, 271
Philadelphia chromosome, 6, 255, 375
phlebotomy, diffuse large B‐cell lymphoma, 468, 469
Ph‐like B lymphoblastic leukaemia/lymphoma, 266–267
phones, mobile, 526
phycoerythrin, 73
plasma cell leukaemia, 472–473
immunophenotyping, 427
plasma cell neoplasms, neutrophilia, 385
plasmacytoid dendritic cell neoplasm, 480
plasmacytoid dendritic cells, antigen expression, 83
platelets
chronic myeloid leukaemia, 374
myelodysplastic syndromes, 315–316
function, 316
plus signs, 109
FISH, 111
PML protein, acute promyelocytic leukaemia, 152, 153–154
PML–RARA fusion gene, AML with t(15;17)(q24.1;q21.2), 152–153, 154
polyclonal antibodies, 70, 74
polycythaemia, FGFR1 gene rearrangements, 398
polycythaemia vera, 6, 533
polymerase chain reaction, 113–114, 114, 117
porphyria (case), 327
positive controls, flow cytometry, 81
postage, 526
PRAME (antigen), acute myeloid leukaemia, 144, 212
PRDM16 gene, 213
pre-B acute lymphoblastic leukaemia, 98–99, 253, 261
t(1;19)(q23;p13.3), 261
precursor phenotype, T-cell acute leukaemia, 100
pregnancy
chronic myeloid leukaemia, 373
T-cell large granular lymphocyte leukaemia, 476
pre-leukaemic ATLL, 485
primary myelofibrosis see myelofibrosis, primary
PRKAR1A–RARA fusion gene, 157
PRKG2–PDGFRB fusion, chronic eosinophilic leukaemia, 395
probes, FISH, 110
dual-colour, 110, 111, 377, 378, 379, 380
pro-B acute lymphoblastic leukaemia, 101
proerythroblasts, 307–308
cytochemistry, 17
proliferation centres, chronic lymphocytic leukaemia, 438
prolymphocytes, 446, 447
chronic lymphocytic leukaemia, 429
prolymphocytic leukaemia
B-cell, 446–448
genetic abnormalities, 423
immunophenotyping, 427
T-cell, 482–485
prolymphocytoid transformation, 433–434, 435, 438, 442
promonocytes, 10–11
chronic myelomonocytic leukaemia, 347
cytochemistry, 17
promyelocytes, 7–8, 9
hyperbasophilic, M3 variant acute myeloid leukaemia, 27, 29, 30
M1 acute myeloid leukaemia, 20
M3 acute myeloid leukaemia, 16, 17, 23
promyelocytic leukaemia
acute (APL), see also hypergranular promyelocytic leukaemia;
hypogranular promyelocytic leukaemia; microgranular promyelocytic leukaemia
chronic myelomonocytic leukaemia after, 394
FISH, 111
international consortium, 526
resource-poor countries, 529
with t(15;17)(q24.1;q21.2), 147–154
translocation, 109
with variant RARA translocation, 155
promyelocytic transformation, chronic myeloid leukaemias, 383
proto-oncogenes, 2
pseudo-Chédiak–Higashi granules, 8, 298
pseudodiploidy, defined, 108
pure red cell aplasia
chronic lymphocytic leukaemia, 432
T-cell large granular lymphocyte leukaemia, 476–477
q
question marks, 109
r
r (abbreviation), 108
RABE1–PDGFRB fusion, chronic eosinophilic leukaemia, 396
radiation, leukaemias from, 3
radiotherapy, acute myeloid leukaemia after, 192
Rai staging system, 442
RANBP2–FGFR1 fusion, neoplasms, 399
random focal infiltration, bone marrow, 422
RARα gene
FISH, 111
rearrangements, 154–158
RARα–PML fusion gene, acute promyelocytic leukaemia, 154
RARα–ZBTB16 fusion gene, 158
RAS-associated autoimmune leucoproliferative disorder, 350
RAS mutations
acute lymphoblastic leukaemia, 267
acute myeloid leukaemia, 146
chronic myelomonocytic leukaemia, 346
juvenile myelomonocytic leukaemia, 350
myelodysplastic syndromes, 314
RBMI5–MKL1 fusion gene see megakaryoblastic leukaemia
real-time quantitative PCR (RQ-PCR), 114
acutem promyelocytic leukaemia, minimal residual disease, 154
chronic myeloid leukaemias, 377, 378
M4Eo AML, 166
rearrangements, chromosomal, 117
chronic myeloid leukaemias, 6
cytogenetics, 109–110, 115
FISH, 111, 112
KMT2A, 98
molecular genetics, 113, 117
red cell histograms, 60–61
referrals, from resource-poor countries, 526
refractory anaemia, 298, 303
with excess of blasts (RAEB), 296, 303, 330–332
in transformation (RAEB-T), 303, 336
myelodysplastic syndromes, 321–324
resource-poor countries, 533–534
with ring sideroblasts (RARS), 298
children, 336
with multilineage dysplasia, 327–328
thrombocytosis and, 351
with unilineage dysplasia, 324–327
refractory cytopenia, MDS
childhood, 336
with multilineage dysplasia, 327–328
with unilineage dysplasia, 327–330
with unilineage dysplasia, 321–324
refractory thrombocytopenia, myelodysplastic syndromes, 321–324
regional laboratories, immunophenotyping, 526
regions (chromosomal), 108
relapses, B lymphoblastic leukaemia/lymphoma, 253
remission criteria, 13
rates, t(8;21)(q22;q22.1) AML, 143
resource-poor countries, leukaemia diagnosis, 525–537
reticulocytes, myelodysplastic syndromes, 315
reverse transcriptase PCR (RT-PCR), 113
chronic myeloid leukaemias, 377, 378
M4Eo AML, 166
revised International Prognostic Scoring System, myelodysplastic syndromes, 320
rhabdomyosarcoma, 531, 532
ribosomal lamellar complex, hairy cells, 449
Richter syndrome, 433–434, 435, 424, 425
myelodysplastic syndromes, 314, 327, 328
smear cells, chronic lymphocytic leukaemia, 429, 430
smouldering ATLL, 485, 486
smouldering chronic lymphocytic leukaemia, 442
smudge cells (smear cells), 429, 430
soft tissue tumours, see also myeloid sarcoma
SOL, chronic B-cell leukaemias and lymphomas, 427
smouldering chronic lymphocytic leukaemia, 442
spectral karyotyping, 113
Southern blot, 113
Sokal score, chronic myeloid leukaemia, 375
specimens see samples
spectral karyotyping, 113
ran

M0 acute myeloid leukaemia, 14
myelodysplastic syndromes, 314
RUNX1-RUNX1T1 fusion gene, 145, 146
acute myeloid leukaemia with, 138–147
ruthenium red, acute basophilic leukaemia, 50
ruxolitinib, 402
s
salmon–pink cytoplasm, t(8;21)(q22;q22.1) AML, 139
samples immunophenotyping, 82
transport in resource-poor countries, 526
SART3-PDGFRB fusion, chronic eosinophilic leukaemia, 395
scatterplots
acute lymphoblastic leukaemia, 99
automated full blood counts, 60
chronic lymphocytic leukaemia, 432, 433
myelodysplastic syndromes, 315
scoring systems, see also staging hairy cell leukaemia, 450
lymphomas, 424, 425
myelodysplastic syndromes, 306
prognosis, 318–320
sdl (abbreviation), 108
second events
B lymphoblastic leukaemia/lymphoma with t(12;21)(p13.2;q22.1), 253
Burkitt lymphoma-related translocation, 55
FLT3-ITD, 154, 174
NMP1 gene mutation, 183
smIl (abbreviation), 108
slashes, 109
small lymphocytic lymphoma, 7, 427
small Sézary cells, 489–490
small t(9;11)(p21.3;q23.3) AML, 166
T lymphoblastic leukaemia/lymphoma, 269–270
Sokal score, chronic myeloid leukaemia, 375
Southern blot, 113
SOX11, mantle cell lymphoma, 464
SPECCI-PDGFRB fusion, chronic eosinophilic leukaemia, 396
'specific' esterase (CAE), see also naphthol AS-D chloroacetate esterase stain
acute eosinophilic leukaemia, 49
specimens see samples
spectral karyotyping, 113
sialylated CD15, acute promyelocytic leukaemia, 151
sideroblastic anaemia, 327
side scatter (SSC), flow cytometry, 71, 72, 74
acute promyelocytic leukaemia, 150
hairy cell leukaemia, 450
M4Eo AML, 162, 163
Siemens Advia 120 blood cell counter, 59
single nucleotide polymorphisms (SNP)
microarray analysis, 114–115
myelodysplastic syndromes, 314
skin
acute mast cell leukaemia, 50
adult T-cell leukaemia/lymphoma, 486, 487, 489
chronic myelomonocytic leukaemia, 343
M5 acute myeloid leukaemia, 38
mycosis fungoides, 493
Sézary syndrome, 489, 490, 491
smaldo (abbreviation), 108
smoulder, 427
small lymphocytic lymphoma, 7, 427
small Sézary cells, 489–490
SmCd3–Cd1–T-cell acute leukaemia, 100
smear cells, chronic lymphocytic leukaemia, 429, 430
Smlg, chronic B-cell leukaemias and lymphomas, 427
smouldering ATL, 485, 486
smouldering chronic lymphocytic leukaemia, 442
smudge cells (smear cells), 429, 430
soft tissue tumours, see also myeloid sarcoma
B lymphoblastic leukaemia/lymphoma, 268
t(9;11)(p21.3;q23.3) AML, 166
T lymphoblastic leukaemia/lymphoma, 269–270
Sokal score, chronic myeloid leukaemia, 375
Southern blot, 113
SOX11, mantle cell lymphoma, 464
SPECCI-PDGFRB fusion, chronic eosinophilic leukaemia, 396
'specific' esterase (CAE), see also naphthol AS-D chloroacetate esterase stain
acute eosinophilic leukaemia, 49
specimens see samples
spectral karyotyping, 113

t(5;15)(q33;q22), chronic eosinophilic leukaemia, 396

FISH, 146

t(8;22)(p11;q11), neoplasms, 399

AML, 118, 119, 120, 138–147, 303–304

B lymphoblastic leukaemia/lymphoma, 424

t(9;11), Burkitt lymphoma, 424

AML, 171

t(9;11)(p21–22;q23.3), AML, 170

AML, 171, 173

T-lineage ALL, 273

T(14)q(34)q(23), T-lineage ALL, 272

T(9;14)(q24;q32), Burkitt lymphoma, 272

T(9;14)(q24;q32) (cryptic), T-lineage ALL, 272

B lymphoblastic leukaemia/lymphoma with, 255–258

chronic myeloid leukaemia, 6, 375

mixed phenotype acute leukaemia with, 276–277

T(10;11)(p12;q23.3), AML, 169, 171

T(10;12–13q14–21), AML, 209

T(10;12)(p12;q23.3), AML, 169, 171

T(10;11)(p12–22q23.3)

AML, 170

T-lineage ALL, 272

T(11;22)(q12;q13.1), T-cell prolymphocytic leukaemia, 484

T(14;18)(q32;21.3)

folicular lymphoma, 423

L3 acute lymphoblastic leukaemia, 58

T(14;18)(q32.3;q21.3), B-lineage neoplasms, 269

T(15;17)

AML, 119, 120

chronic myeloid leukaemias, 383

t(15;17)(q24.1;q21.2)

acute promyelocytic leukaemia with, 147–154

M3 AML, 23

T(15;17)(q24.3;q21.2), AML, 156

T(16;16)(p13.1;q22)

AML, 158–166

M4Eo, 164, 165

T(16;21)(p11.2;q22.2), AML, 208

T(16;21)(q24.3;q22.1), AML, 147

T(17;19)(q21–22p13), 263

T(18;22)(q21.3;q11.2), follicular lymphoma, 423

T674I mutation, neoplasms with

FIP1L1–PDGFRA fusion, 393

Taiwan, chronic lymphocytic leukaemia, 427
TAL1 gene, T-ALL, 271, 274
TAL1 deletion (cryptic), T-ALL, 272, 274
tartrate-resistant acid phosphatase, hairy cell leukaemia, 449, 450
T-bet, hairy cell leukaemia, 451
T cell(s)
detecting clonality, 104–105
immunophenotyping, 83
large granular lymphocyte leukaemia of, 475–478, 480
T-cell acute leukaemia (T-ALL), immunophenotyping, 95, 100–101
minimal residual disease, 101, 102
T-cell prolymphocytic leukaemia, 482–485
T-cell receptor antibodies, acute lymphoblastic leukaemia, 97, 100–101
T-cell receptor (T) loci
Sézary syndrome, 492
T-ALL, 271
T-cell large granular lymphocyte leukaemia, 478
t/dic(12;13)(p11.2–13;p11.2–q13), AML, 209
t/dic(12;20)(p12–13;p11.2–q13), AML, 209
TdT see terminal deoxynucleotidyl transferase
Teaching Aids at Low Cost, 536
tele-haematology, 526
ter (abbreviation), 108
terminal deoxynucleotidyl transferase (TdT), 94
antibody
acute lymphoblastic leukaemia, 97
trephine biopsy, 96
lymphoproliferative disorders, 105
t(6;9)(p23;q34.1) AML, 174
t(8;21)(q22;q21.1) AML, 144
TET2 mutation, 211
atypical CML, 342
chronic myelomonocytic leukaemia, 346
myelodysplastic syndromes, 314
tetra-arsenic tetra-sulphide, AML with t(15;17)(q24.1;q21.2), 150
tetraploidy, defined, 108
TGFβ1 gene, T-ALL, 271
therapy-related leukaemia
acute lymphoblastic, 275
cytogenetics, 123
cytoplasmic, defined, 108
WHO classification, 137
chronic myelomonocytic, 342
therapy-related myelodysplastic syndromes, 336–337
trephine biopsy, 309–310
therapy response monitoring, chronic myeloid leukaemias, 377–378
third world, leukaemia diagnosis, 525–537
thrombocytopenia
autoimmune, chronic lymphocytic leukaemia, 431–432
congenital amegakaryocytic, 297
cyclical, T-cell large granular lymphocyte leukaemia, 475
refractory, myelodysplastic syndromes, 321–324
thromboembolism (venous), M3 acute myeloid leukaemia, 23
thrombopoietin, myelodysplastic syndromes, 316
thymidine kinase, CLL prognosis, 443
thymus, T-ALL, 270
tildes, 109
T-lineage acute lymphoblastic leukaemia
cytogenetics, 122–123
prognosis, 251
T-lineage antigens, B-lymphoblastic leukaemia, 97
T-lineage lymphoproliferative disorders,
immunophenotyping, 104–105
TLX genes, T-ALL, 271
TLX1 gene, 274
TLX3 gene, 274
T lymphoblastic leukaemia/lymphoma, 269–275
not in WHO classification, 273–275
with NUP214-ABL1 fusion, 274–275
T-lymphoid antigens see CD2; CD3;
CD4; CD7; CD8
T/myeloid MPAL, 278
TNIP1-PDGFRB fusion, chronic eosinophilic leukaemia, 395
TNKS2-PDGFRB fusion, 392
toluidine blue stain, 4
acute basophilic leukaemia, 49–50
topoisoenzyme II–interactive drugs, acute leukaemia after, 190–192, 275
TP53BP1-PDGFRB fusion, chronic eosinophilic leukaemia, 396
TP53 mutation, 212
5q− syndrome, 335
ALL with hypodiploidy, 266
chronic lymphocytic leukaemia, 441
TPM3-PDGFRB fusion, chronic eosinophilic leukaemia, 395
TPR-FGFR1 fusion, neoplasms, 399
training, resource-poor countries, 535–536
transient abnormal myelopoiesis, 197, 200–202
transitional pre-B ALL, 99
translocations, 106–109, see also specific translocations e.g.
t(15;17)(q24.1;q21.2) or t(X;7) (q22;q34)
AML with t(15;17)(q24.1;q21.2), 153
balanced see balanced translocations chronic myeloid leukaemias, 375–376
FISH, 110
myelodysplastic syndromes, 314
therapy-related, 336
tyroisine kinase-responsive, 267
unbalanced see unbalanced translocations
trephine biopsy
chronic lymphoid leukaemias, 422
hairy cell leukaemia, 451
immunophenotyping, 83, 95, 96
M7 acute myeloid leukaemia, 45
myelodysplastic syndromes, 306–310
trials of therapy, 531
TRIM24-FGFR1 fusion, neoplasms, 399
TRIM33 gene, chronic myelomonocytic leukaemia, 346–347
TRIP11, chronic eosinophilic leukaemia, 396
triploidy, see also near triploidy defined, 108
tumour suppressor genes chronic myeloid leukaemias, progression, 383
unclassifiable acute leukaemia, 278
unclassifiable myelodysplastic/malignant neoplasms, 335–336, 351, 384
unbalanced translocations, 106
B lymphoblastic leukaemia/lymphoma with t(1;19) (q23;p13.3), 263
Down syndrome, 203
myelodysplastic syndromes, 311
urokinase-type plasminogen activator (CD87), AML, 91
urticaria pigmentosa, 398
variant translocations, chronic myeloid leukaemias, 375–376
VEGFC gene, 213
venous thromboembolism, M3 acute myeloid leukaemia, 23
villous lymphocytes, 454–455, see also splenic lymphoma with villous lymphocytes
viral infections
Burkitt lymphoma, 466
juvenile myelomonocytic leukaemia vs, 350
von Willebrand factor antibody, trephine biopsy, 96
Waldenström macroglobulinaemia, 470–471
wcp (abbreviation), 111
WDR48-PDGFRB fusion, chronic eosinophilic leukaemia, 395
white blood cell counts, see also automated full blood counts
acute lymphoblastic leukaemia, 95–96
acute myeloid leukaemia with t(15;17)(q24.1;q21.2), 148, 149
M3, 27
WHO classification, 3, 136–138
5q− syndrome, 333
acute lymphoblastic leukaemia, 250
chronic eosinophilic leukaemia, 386
chronic lymphocytic leukaemia, 429
chronic myeloid leukaemias, 371
accelerated phase, 380
blast transformation, 381
chronic myelomonocytic leukaemia, 303, 339, 342
chronic neutrophilic leukaemia, 385
follicular lymphoma, 456
hairy cell leukaemia variant, 452
juvenile myelomonocytic leukaemia, 348
mixed phenotypic and undifferentiated acute leukaemia, 276
myelodysplastic/myeloproliferative neoplasms, 338, 339–352
myelodysplastic syndromes, 302, 303–304, 321–337
prognosis, 317
plasma cell leukaemia, 472
Sézary syndrome, 489
WHO classification-based Prognostic Scoring System, MDS, 318, 319
whole chromosome paints, 110
WT1 gene, 117, 211
chronic eosinophilic leukaemia, 388–389
Y chromosome loss, 109, 116, 117
t(8;21)(q22;q22.1) AML, 145
ZAP70 chronic lymphocytic leukaemia, 437, 441
chronic lymphoid leukaemias of B lineage, 426
monoclonal B-cell lymphocytosis, 446
ZBTB16-RARA fusion gene, 155, 157–158
ZMYM2(ZNF198)-FGFR1 fusion, neoplasms, 399
ZNF145-RARA fusion see t(11;17) (q23.2;q21.2)