Table S1. Detailed overview on the parameters used for the systematic assessment by both diagnostic techniques

Documented parameters by cytomorphology	**Documented parameters by Histopathology**	
Granulopoiesis		
−Toxic/Dysplastic granulation −Hypogranularity of cytoplasm −Pseudopelger	−Left-shifted −Maturation disorder	
Erythropoiesis		
−Left-shift −Erythroblasts with vacuolated cytoplasm −Megaloblastoid −Irregular nuclei −Nuclear lobulation −Bi-/Multinucleated cells −Fragmentation of nuclei −Internuclear bridges −Pyknosis of nuclei −Erythrons −Gigantism	−Left-shift −Maturation disorder −Megaloblastoid −Irregular nuclei −Bi-/Multinucleated cells	
Megakaryopoiesis		
−Microkaryocytes −Multiple separate nuclei −Poor granulation of cytoplasm −Bizarre nuclear shape −Giant forms	−Microkaryocytes −Multiple separate nuclei −Maturation disorder −Hyperchromatic nuclei −Hyperlobated nuclei −Monolobated nuclei −Hypolobated nuclei −Cluster of megakaryocytes −Giant forms −Abnormal localization	
Special Stains / Immunohistochemistry		
−Non-specific Esterase −Iron (Berliner Blau) −Myeloperoxidase	−CD3 −CD20 −CD34 −CD42b −CD68 −CD71	−CD117 −CD138 −Iron (Berliner Blau) −Myeloperoxidase −Gomori

Table S2A. Dysplasia in in the different hematopoietic lineages detected by cytomorphology and histopathology

	Number of cases (%)		
	Granulopoiesis	**Erythropoiesis**	**Megakaryopoiesis**
Cytomorphology			
Evaluable cases	82	82	65
Dysplasia ≥ 10%	75/82 (91.5%)	82/82 (100.0%)	53/65 (81.5%)
Dysplasia ≥ 10% <30% Dysplasia ≥ 30% Dysplasia ≥ 60%	4/82 (4.9%) 35/82 (42.7%) 36/82 (43.9%)	1/82 (1.2%) 31/82 (37.8%) 50/82 (61.0%)	9/65 (13.8%) 20/65 (30.8%) 24/65 (36.9%)
Histopathology			
Evaluable cases	86	79	82
Maturation disorder	71/86 (82.6%)	77/79 (97.5%)	80/82 (97.6%)
Mild maturation disorder Severe maturation disorder	55/86 (64.0%) 16/86 (18.6%)	49/79 (62.0%) 28/79 (35.4%)	40/82 (48.8%) 40/82 (48.8%)
Correlation of both methods Results of χ^2-Test	$\chi^2(1)=1.176$, p=0.278	Not evaluable	$\chi^2(1)=1.587$, p=0.208

Table S2B. Overall cellularity and cellularity of the distinct hematopoietic lineages as documented by cytomorphology and histopathology

Parameter	Cytomorphology N (%)	Histopathology N (%)
Overall cellularity	**83 (100.0%)**	**90 (100.0%)**
Normal (age-adjusted) Increased Reduced	10 (12.0%) 66 (79.5%) 7 (8.4%)	24 (26.7%) 58 (64.4%) 8 (8.9%)
Correlation of both methods	$\chi^2(4)=7.942$, p=0.094	
Granulopoiesis	**84 (100.0%)**	**87 (100.0%)**
Normal (age-adjusted) Increased Reduced	19 (22.6%) 43 (51.2%) 22 (26.2%)	24 (27.6%) 39 (44.8%) 24 (27.6%)
Correlation of both methods	$\chi^2(4)=13.252$, p=0.010	
Erythropoiesis	**85 (100.0%)**	**88 (100.0%)**
Normal (age-adjusted) Increased Reduced	29 (34.1%) 30 (35.3%) 26 (30.6%)	20 (22.7%) 28 (31.8%) 40 (45.5%)
Correlation of both methods	$\chi^2(4)=26.764$, p<0.001	
Megakaryopoiesis	**82 (100.0%)**	**86 (100.0%)**
Normal (age-adjusted) Increased Reduced	23 (28.0 %) 29 (35.4%) 30 (36.6%)	24 (27.9%) 37 (43.0%) 25 (29.1%)
Correlation of both methods	$\chi^2(4)=36.180$, p<0.001	

Table S3. Results of molecular analysis for selected genes are given either by hotspots analysis and/or by NGS panel sequencing

Detected molecular mutations	
ACD	N=1/27
ASXL1	N=1/27
CEBPA	N=1/27
DNMT3A	N=2/27
ETV6	N=1/27
EVI1	N=1/27
FLT3	N=2/27
JAK2V617F	N=1/27
MECOM	N=1/27
MLL (=KMT2A)	N=3/27
NPM1	N=1/27
NRAS	N=3/27
RTEL1	N=1/27
RUNX1	N=5/27
SRSF2	N=1/27
TERC	N=1/27
U2AF1	N=1/27
TP53[1] analysed positive	 N=8 N=2

Analyses were performed by different laboratories on a physician-driven basis. Molecular analyses were available in 39 patients from the cohort (in 43.4% of all patients). Analysis of *TP53* mutations was performed in 8 patients, [1]*TP53* analysis only in MDS

Table S4. Detailed information of 18 cases with a discrepant final diagnosis by CM and HP

Age[1], Gender[2]	Cytomorphology	Histopathology
69, m	**RCMD**	**reactive**
See Figure 1a	Slight hypercellularity Amount of blasts 4% Distinct dysplastic GP Increased, dysplastic EP Dysplastic MP	60% cellularity CD34+ blasts <5% Reactive GP No dysplasia in EP and MP
	NKT[3], NGS Panel for AML/MDS[4]: no mutation	
79, f	**RCMD**	**reactive**
	Hypercellularity Amount of blasts 2% Dysplastic GP Dysplastic and left-shifted EP Decreased MP	40% cellularity Only slightly dysplastic GP, EP, MP Distinct reactive changes
	NKT[3], no molecular analysis performed, pancytopenia	
75, m	**RAEB-1**	**RCMD**

See Figure 1b	Hypercellularity Amount of blasts 7% Increased, dysplastic, left-shifted GP Dysplastic, slightly left-shifted EP Increased, dysplastic, left-shifted MP	90% cellularity CD34+ blasts <5% CD68+ <5% Distinct dysplastic GP Macrocytic EP Normal MP
	NKT[3], no molecular analysis performed, pancytopenia	
74, m	**RAEB-1**	**RCMD**
	Hypercellularity Amount of blasts 6% Increased, slightly dysplastic GP Decreased, dysplastic, left-shifted EP Increased, slightly left-shifted MP	70% cellularity CD34+ blasts <5% Slightly increased GP Distinct decreased, dysplastic EP Slightly increased, dysplastic MP
	NKT[3], NGS Panel for AML/MDS[4]: no mutation	
74, f	**RAEB-1**	**RCMD**
	Hypercellularity Amount of blasts 5% Distinct increased, dysplastic GP Increased, dysplastic EP, MP	90% cellularity CD34+ blasts <5% Distinct increased, slightly dysplastic, left-shifted GP Decreased, macrocytic EP Dysplastic MP
	NKT[3], PCR negative for: *AML1-ETO*, *CBFβ-MYH11*, *FLT3*-ITD, *PML-RARa*, *EVI*, Sanger sequencing negative for: *CEBPA*, *NPM1*; pancytopenia	
73, m	**RAEB-1**	**RCMD**
	Hypercellularity Amount of blasts 5% Decreased, dysplastic GP Increased, dysplastic EP, MP	50% cellularity CD34+ blasts slightly <5% CD117+ 5% Dysplastic, left-shifted GP, EP Increased, distinct dysplastic MP
	NKT[3], no molecular analysis performed, pancytopenia	
74, f	**RAEB-1**	**RCMD**
	Normocellularity Amount of blasts 6% Increased, dysplastic GP, EP, MP	Insufficient material quality 50% cellularity Amount of blasts <5% Increased, slightly left-shifted GP Decreased, slightly dysplastic EP Slightly increased MP
	del(7q), *NRAS* mutation (Sanger sequencing)	
67, f	**RAEB-1**	**s-AML**
	Hypercellularity Amount of blasts 5% Decreased, dysplastic GP Increased, dysplastic EP Limited quality of MP	98% cellularity CD34+ blasts 20% CD68/CD117 blasts partial positivity Increased, left-shifted GP Decreased EP, MP
	del(20q), clinically driven molecular analysis: no mutation, pancytopenia	
82, f	**RAEB-1**	**suspected MDS**
	Hypercellularity Amount of blasts 5% Dysplastic GP Increased, dysplastic EP Slightly dysplastic MP	60% cellularity CD34+ blasts slightly <5% Reactive GP Increased EP, MP
	No cytogenetics and no molecular analysis performed, pancytopenia	
77, m	**RAEB-2**	**s-AML**
	Insufficient material quality Hypercellularity Amount of blasts 16% Increased, dysplastic GP Dysplastic EP Reduced, dysplastic MP Monocytes increased	80% cellularity CD34+ blasts 30% CD68 blasts partial positivity Increased, dysplastic, left-shifted GP Decreased EP, MP
	NKT[3], clinically driven molecular analysis: no mutation, pancytopenia	
69, f	**CMML-1**	**suspected MDS**
	Hypercellularity Amount of blasts 3% Increased, dysplastic GP Dysplastic EP, MP Increased Monocytes (EST not available)	70% cellularity CD34+ blasts <5% CD117+ blasts <5% CD68 physiological Increased GP Slightly dysplastic EP, MP
	NKT[3], *BCR-ABL1*, *JAK2*V617F, *CALR*, *MPL* negative, Lc[5] 29.0 G/L, monocytes 6.0 G/L	
76, f	**CMML-2**	**RAEB-2**

	Hypercellularity Amount of blasts 16% Increased, reactive GP Dysplastic EP, MP Increased Monocytes (EST not available)	Insufficient material quality 70% cellularity CD34+ blasts 15%, focal up to 20% CD68 not available Increased GP Decreased, macrocytic EP Dysplastic, distinct left-shifted MP
	Complex KYT[6], *BCR-ABL* and *JAK2*V617F negative, bicytopenia	
70, f	**CMML-2**	**suspected MDS**
See Figure 1c	Hypercellularity Amount of blasts 11% Increased, dysplastic GP Dysplastic EP Increased MP Monocytes increased (EST not available)	55% cellularity CD34+ blasts <5% CD68 without abnormality Increased, dysplastic, slightly left-shifted GP Normal EP Slightly dysplastic MP
	NKT[3], *BCR-ABL1* and *JAK2*V617F negative	
59, m	**CMML-2**	**RAEB-2**
	Hypercellularity Amount of blasts 18% Increased, dysplastic, left-shifted GP Dysplastic EP, MP EST positivity 20% POX defect	55% cellularity CD34+ blasts 15% Increased, dysplastic, left-shifted GP Dysplastic EP, MP
	del(7q), *RUNX1* mutation (Sanger sequencing), bicytopenia	
71, m	**s-AML**	**CMML-1**
	Hypercellularity Amount of blasts 30% Increased, dysplastic GP Reduced, dysplastic EP Reduced MP EST positivity 80% Monocytes increased (EST not available)	Insufficient material quality 90% cellularity CD34+ blasts <5% CD117+ >5% CD68 blasts partial positivity Increased GP Decreased, slightly left-shifted EP Increased, dysplastic MP
	der(19),+8, no molecular analysis performed	
76, f	**RARS-T**	**RAEB-1**
	Hypercellularity Amount of blasts 3% Ringsideroblasts >15% Dysplastic GP Dysplastic, left-shifted EP Increased, dysplastic MP	60% cellularity CD34+ blasts 5%, focal 9% Normal maturation of GP Dysplastic, slightly left-shifted EP Increased, dysplastic MP
	NKT[3], PCR negative for: *JAK2*V617F, *CALR*, *MPL*, plt[7] 562 G/L	
78, f	**suspected MDS**	**RAEB-1**
	Insufficient material quality Evidence of blasts Existing GP and EP Absent MP	60% cellularity CD34+ blasts 5% Dysplastic GP Decreased, distinct dysplastic EP Increased, distinct dysplastic MP
	Complex KT[6], *TP53* mutation (Sanger sequencing), pancytopenia	
69, m	**Suspected MDS**	**s-AML**
	Insufficient material quality Amount of blasts cannot be evaluated Dysplastic GP	75% cellularity Amount of blasts 25% CD34+ blasts 6% CD117+ <5% Increased GP Increased, dysplastic EP Increased, dysplastic, left-shifted MP
	NKT[3], clinically driven molecular analysis: no mutation	

[1]Age at first diagnosis; [2]f=female, m=male; [3]NKT=normal karyotype; [4]AML/MDS mutation panel: *ASXL1*, *CBL*, *CEBPA*, *DNMT3A*, *ETV6*, *EZH2*, *GATA2*, *IDH1*, *IDH2*, *JAK2*, *KRAS*, *NRAS*, *RUNX1*, *SETBP1*, *SF3B1*, *SRSF2*, *TET2*, *TP53*, *U2AF*, *ZRSR2*; [5]Lc=leukocytes; [6]KT=karyotype; [7]Plt=platelets