

Supplementary Table 1 Candidate adjustment variables for the propensity score-matched cohort analysis

Outcomes	Candidate adjustment variables
Neutrophil engraftment	patient age, sex, PS, HCT-CI, disease risk, conditioning intensity, graft type, donor age, transplantation period
Platelet engraftment	patient age, sex, PS, HCT-CI, disease risk, conditioning intensity, graft type, donor age, transplantation period
Grade II–IV aGVHD	patient age, sex, conditioning intensity, graft type, donor age, transplantation period
Grade III–IV aGVHD	patient age, sex, conditioning intensity, graft type, donor age, transplantation period
cGVHD	patient age, sex, conditioning intensity, graft type, donor age, transplantation period
cGVHD requiring systemic therapy	patient age, sex, conditioning intensity, graft type, donor age, transplantation period
OS	patient age, sex, PS, HCT-CI, disease risk, conditioning intensity, graft type, donor age, transplantation period
PFS	patient age, sex, PS, HCT-CI, disease risk, conditioning intensity, graft type, donor age, transplantation period
GRFS	patient age, sex, PS, HCT-CI, disease risk, conditioning intensity, graft type, donor age, transplantation period
Rel/Prog	patient age, sex, disease risk, conditioning intensity, graft type, donor age, transplantation period
NRM	patient age, sex, PS, HCT-CI, conditioning intensity, graft type, donor age, transplantation period

Abbreviations: aGVHD, acute graft-versus-host disease; cGVHD, chronic graft-versus-host disease; GRFS, graft-versus-host disease-free, relapse-free survival; HCT-CI, hematopoietic cell transplantation-comorbidity index; NRM, non-relapse mortality; OS, overall survival; PFS, progression-free survival; PS, performance status; Rel/Prog, relapse or progression.

Supplementary Table 2 Patient characteristics of the entire cohort before propensity score matching

Donor type	Matched donor (n = 63)	Haploidentical donor (n = 1261)	<i>P</i> value
Patient age, median (range, IQR)	49 (20–69, 40–57)	56 (16–77, 44–63)	0.001
Sex, <i>n</i> (%)			
Male	29 (46.0)	793 (62.9)	0.011
Female	34 (54.0)	468 (37.1)	
PS (ECOG), <i>n</i> (%)			
0–1	62 (98.4)	1167 (92.5)	0.082
≥ 2	1 (1.6)	94 (7.5)	
HCT-CI, <i>n</i> (%)			
0–1	45 (71.4)	886 (70.3)	1.00
≥ 2	18 (28.6)	370 (29.3)	
Missing	0 (0.0)	5 (0.4)	
Disease type, <i>n</i> (%)			
AML	24 (38.1)	477 (37.8)	0.76
ALL/LBL	14 (22.2)	215 (17.0)	
MDS	10 (15.9)	184 (14.6)	
Lymphoma	13 (20.6)	314 (24.9)	
Others	2 (3.2)	71 (5.6)	
Disease risk, <i>n</i> (%)			
Low	42 (66.7)	653 (51.8)	0.027
High	21 (33.3)	608 (48.2)	
Conditioning intensity, <i>n</i> (%)			
MAC	45 (71.4)	546 (43.3)	< 0.001^a
CY + ADR + VCR + TBI	0 (0.0)	1 (0.2)	
CY + ETP + TBI	0 (0.0)	1 (0.2)	
CY + TBI	0 (0.0)	2 (0.4)	
ETP + TBI	0 (0.0)	1 (0.2)	
MEL + BU + TBI	0 (0.0)	1 (0.2)	
FLU + AraC + BU	0 (0.0)	2 (0.4)	
FLU + AraC + BU + TBI	0 (0.0)	2 (0.4)	
FLU + AraC + MEL + BU	0 (0.0)	1 (0.2)	
FLU + AraC + TBI	0 (0.0)	3 (0.5)	
FLU + BU	19 (42.2)	15 (2.7)	
FLU + BU + TBI	6 (13.3)	257 (47.1)	
FLU + CY + BU	0 (0.0)	13 (2.4)	
FLU + CY + BU + TBI	0 (0.0)	4 (0.7)	
FLU + CY + TBI	0 (0.0)	2 (0.4)	
FLU + ETP + MEL + TBI	0 (0.0)	1 (0.2)	
FLU + ETP + TBI	2 (4.4)	0 (0.0)	
FLU + MCNU + MEL + TBI	0 (0.0)	1 (0.2)	
FLU + MEL	0 (0.0)	1 (0.2)	
FLU + MEL + BU	1 (2.2)	5 (0.9)	
FLU + MEL + TBI	0 (0.0)	7 (1.3)	
FLU + R + TBI	0 (0.0)	2 (0.4)	
FLU + TBI	17 (37.8)	223 (40.8)	
FLU + Thiotepa + BU + TBI	0 (0.0)	1 (0.2)	
RIC	18 (28.6)	715 (56.7)	
CY + AraC + TBI	0 (0.0)	1 (0.1)	
CY + BU + TBI	0 (0.0)	1 (0.1)	
CY + ETP + TBI	0 (0.0)	1 (0.1)	
TBI	0 (0.0)	1 (0.1)	
FLU	0 (0.0)	2 (0.3)	
FLU + AraC + BU + TBI	0 (0.0)	7 (1.0)	

FLU + AraC + MEL	0 (0.0)	40 (5.6)	
FLU + AraC + MEL + TBI	0 (0.0)	2 (0.3)	
FLU + BU	0 (0.0)	3 (0.4)	
FLU + BU + TBI	5 (27.8)	421 (58.9)	
FLU + CY + BU	0 (0.0)	3 (0.4)	
FLU + CY + BU + TBI	0 (0.0)	17 (2.4)	
FLU + CY + MEL	0 (0.0)	6 (0.8)	
FLU + CY + MEL + TBI	0 (0.0)	1 (0.1)	
FLU + CY + TBI	0 (0.0)	8 (1.1)	
FLU + ETP + AraC + ADR + CDDP + VCR + TBI	0 (0.0)	1 (0.1)	
FLU + ETP + BU	0 (0.0)	1 (0.1)	
FLU + ETP + MEL + TBI	0 (0.0)	1 (0.1)	
FLU + ETP + TBI	0 (0.0)	1 (0.1)	
FLU + MEL	7 (38.9)	9 (1.3)	
FLU + MEL + BU	0 (0.0)	23 (3.2)	
FLU + MEL + TBI	6 (33.3)	153 (21.4)	
FLU + R + BU + TBI	0 (0.0)	1 (0.1)	
FLU + R + MEL + TBI	0 (0.0)	1 (0.1)	
FLU + TBI	0 (0.0)	10 (1.4)	
Donor relationship, <i>n</i> (%)			
Related	33 (52.4)	1261 (100.0)	< 0.001
Unrelated	30 (47.6)	0 (0.0)	
Graft type, <i>n</i> (%)			
BM	21 (33.3)	42 (3.3)	< 0.001
PBSCs	42 (66.7)	1219 (96.7)	
GVHD prophylaxis, <i>n</i> (%)			
PTCy + CNI	33 (52.4)	28 (2.2)	< 0.001
PTCy + CNI + MMF	30 (47.6)	1233 (97.8)	
Infused total nucleated cells ($\times 10^8/\text{kg}$), median (IQR) (BM donor only) ^{b)}	2.32 (1.80–2.85)	2.09 (1.47–2.75)	0.45
Infused CD34+ cells ($\times 10^6/\text{kg}$), median (IQR) (PBSCs donor only) ^{c)}	3.81 (2.79–6.03)	4.59 (3.19–6.00)	0.80
PTCy dose, <i>n</i> (%)			
75–80 mg/kg	4 (6.3)	489 (38.8)	< 0.001
81–100 mg/kg	59 (93.7)	772 (61.2)	
G-CSF use			
Yes	63 (100.0)	1183 (93.8)	0.048
No	0 (0.0)	78 (6.2)	
Donor age, median (range, IQR)	43 (23–65, 34–50)	34 (13–65, 26–42)	< 0.001
Transplantation period, <i>n</i> (%)			
2013–2017	12 (19.0)	244 (19.3)	1.00
2018–2021	51 (81.0)	1017 (80.7)	

Statistically significant results ($P < 0.05$) are shown in bold.

^{a)} Comparison between the MAC and RIC groups

^{b)} Available data: 43/63 patients (68.3%)

^{c)} Available data: 648/1261 patients (51.4%)

Abbreviations: ADR, doxorubicin; AML, acute myeloid leukemia; ALL/LBL, acute lymphoblastic leukemia/lymphoblastic lymphoma; AraC, cytarabine; BM, bone marrow; BU, busulfan; CDDP, cisplatin; CNI, calcineurin inhibitor; CY, cyclophosphamide; ECOG, Eastern Cooperative Oncology Group; ETP, etoposide; FLU, fludarabine; G-CSF, granulocyte colony-stimulating factor; GVHD, graft-versus-host disease; HCT-CI, hematopoietic cell transplantation-comorbidity index; IQR, interquartile range; MAC, myeloablative conditioning; MCNU, ranimustine; MDS, myelodysplastic syndrome; MEL, melphalan; MMF, mycophenolate mofetil; PBSCs, peripheral blood stem cells; PS, performance status; PTCy, post-transplantation cyclophosphamide; R, rituximab; RIC, reduced intensity conditioning; TBI, total body irradiation; VCR, vincristine.

Supplementary Table 3 Patient characteristics after propensity score matching (variables not included in the propensity score model)

Donor type	Matched donor (n = 50)	Haploidentical donor (n = 100)	<i>P</i> value
Conditioning regimen, <i>n</i> (%)			
MAC	34 (68.0)	75 (75.0)	0.44 ^{a)}
CY + ETP + TBI	0 (0.0)	1 (1.3)	
CY + TBI	0 (0.0)	1 (1.3)	
ETP + TBI	0 (0.0)	1 (1.3)	
FLU + BU	12 (35.3)	1 (1.3)	
FLU + BU + TBI	6 (17.6)	34 (45.3)	
FLU + CY + BU	0 (0.0)	1 (1.3)	
FLU + CY + BU + TBI	0 (0.0)	2 (2.7)	
FLU + CY + TBI	0 (0.0)	1 (1.3)	
FLU + ETP + TBI	2 (5.9)	0 (0.0)	
FLU + MEL + BU	1 (2.9)	1 (1.3)	
FLU + MEL + TBI	0 (0.0)	2 (2.7)	
FLU + TBI	13 (38.2)	30 (40.0)	
RIC	16 (32.0)	25 (25.0)	
FLU + AraC + BU + TBI	0 (0.0)	1 (4.0)	
FLU + AraC + MEL	0 (0.0)	1 (4.0)	
FLU + AraC + MEL + TBI	0 (0.0)	1 (4.0)	
FLU + BU + TBI	5 (31.2)	14 (56.0)	
FLU + CY + BU	0 (0.0)	1 (4.0)	
FLU + MEL	6 (37.5)	0 (0.0)	
FLU + MEL + TBI	5 (31.2)	7 (28.0)	
Donor relationship, <i>n</i> (%)			
Related	30 (60.0)	100 (100.0)	< 0.001
Unrelated	20 (40.0)	0 (0.0)	
GVHD prophylaxis, <i>n</i> (%)			
PTCy + CNI	22 (44.0)	3 (3.0)	< 0.001
PTCy + CNI + MMF	28 (56.0)	97 (97.0)	
Infused total nucleated cells ($\times 10^8/\text{kg}$), median (IQR) (BM donor only) ^{b)}	2.32 (1.83–2.50)	2.44 (1.83–2.86)	0.60
Infused CD34+ cells ($\times 10^6/\text{kg}$), median (IQR) (PBSCs donor only) ^{c)}	3.81 (2.79–6.03)	4.23 (3.13–5.02)	0.76
PTCy dose, <i>n</i> (%)			
75–80 mg/kg	4 (8.0)	17 (17.0)	0.21
81–100 mg/kg	46 (92.0)	83 (83.0)	
G-CSF use			
Yes	50 (100.0)	93 (93.0)	0.096
No	0 (0.0)	7 (7.0)	

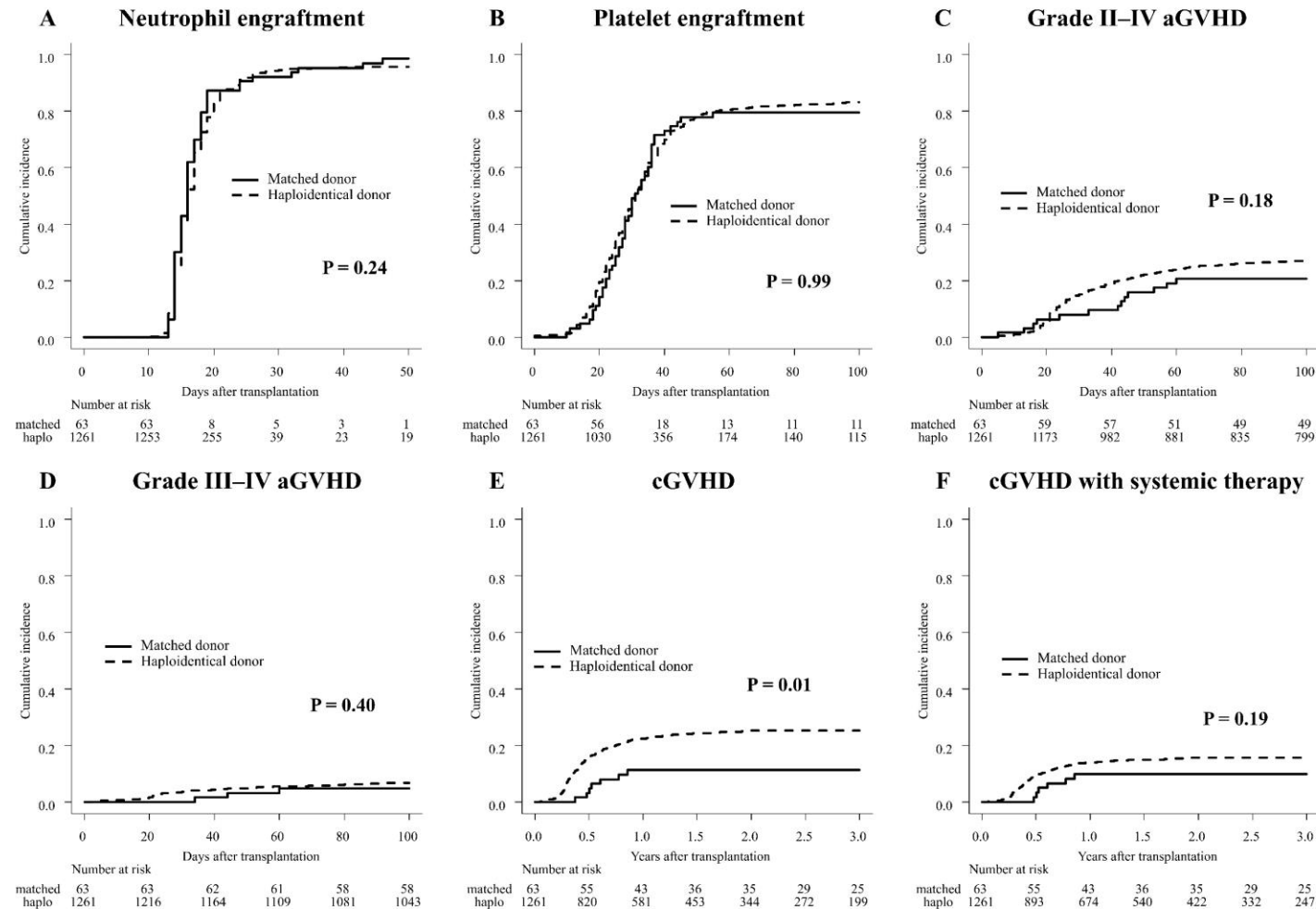
Statistically significant results ($P < 0.05$) are shown in bold.

^{a)} Comparison between the MAC and RIC groups

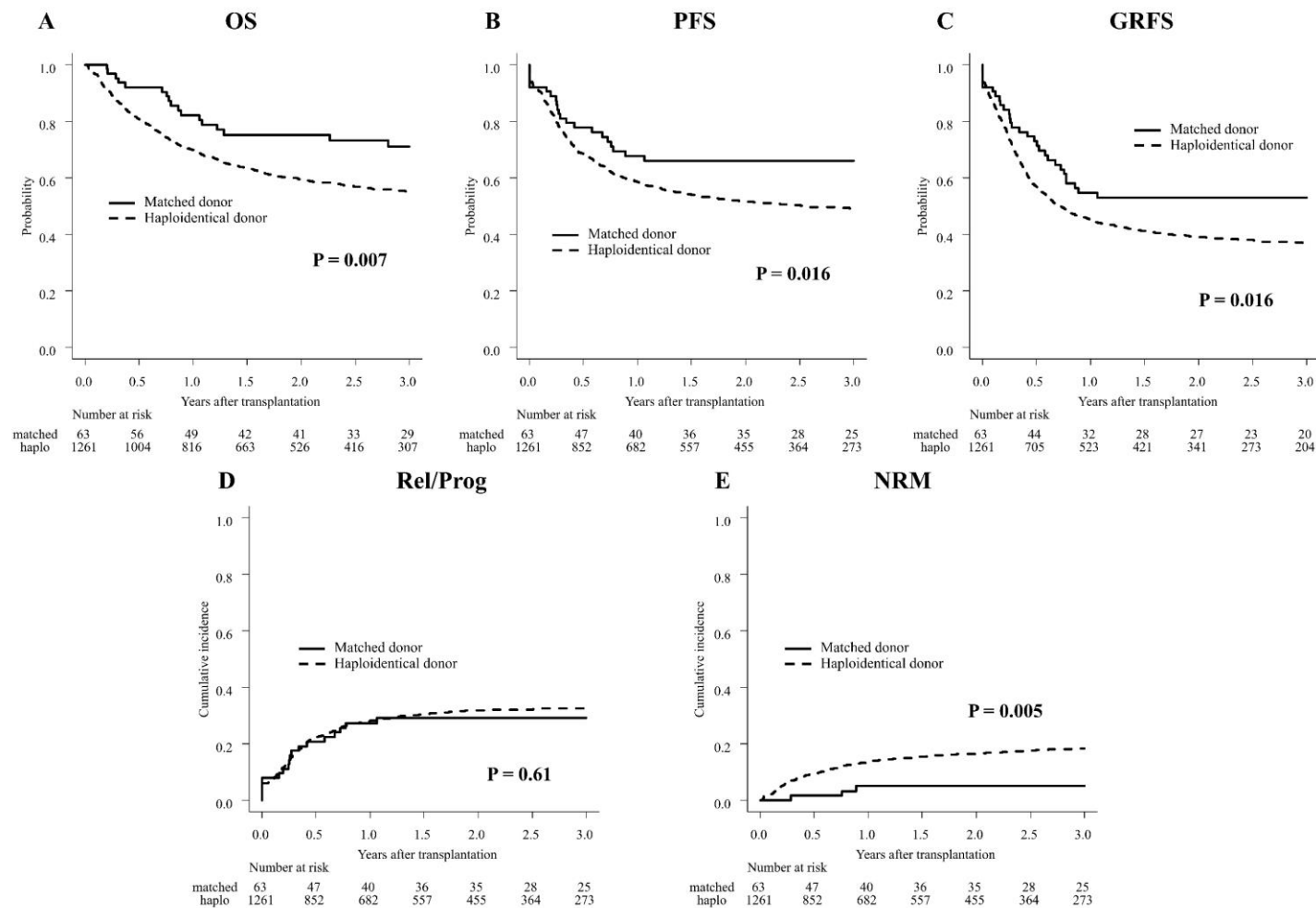
^{b)} Available data: 18/23 patients (78.3%)

^{c)} Available data: 57/127 patients (44.9%)

Abbreviations: AraC, cytarabine; BU, busulfan; CNI, calcineurin inhibitor; CY, cyclophosphamide; ETP, etoposide; FLU, fludarabine; G-CSF, granulocyte colony-stimulating factor; GVHD, graft-versus-host disease; MAC, myeloablative conditioning; MEL, melphalan; MMF, mycophenolate mofetil; PTCy, post-transplantation cyclophosphamide; RIC, reduced intensity conditioning; TBI, total body irradiation.



Supplementary Figure 1 Cumulative incidences of neutrophil engraftment (A), platelet engraftment (B), grade II–IV acute graft-versus-host disease (aGVHD) (C), grade III–IV aGVHD (D), chronic graft-versus-host disease (cGVHD) (E), and cGVHD requiring systemic therapy (F) according to the donor type in the entire cohort before propensity score matching.



Supplementary Figure 2 Probabilities of overall survival (OS) (A), progression-free survival (PFS) (B), graft-versus-host disease-free, relapse-free survival (GRFS) (C), cumulative incidences of relapse or progression (Rel/Prog) (D), and non-relapse mortality (NRM) (E) according to the donor type in the entire cohort before propensity score matching.

Supplementary Table 4 Covariates included in the adjusted models for the propensity score-matched cohort

Outcomes	Adjustment variables
Neutrophil engraftment	HCT-CI, disease risk, conditioning intensity, donor age
Platelet engraftment	HCT-CI, disease risk, conditioning intensity, donor age
Grade II–IV aGVHD	conditioning intensity, donor age
Grade III–IV aGVHD	conditioning intensity, donor age
cGVHD	conditioning intensity, donor age
cGVHD requiring systemic therapy	conditioning intensity, donor age
OS	HCT-CI, disease risk, conditioning intensity, donor age
PFS	HCT-CI, disease risk, conditioning intensity, donor age
GRFS	HCT-CI, disease risk, conditioning intensity, donor age
Rel/Prog	disease risk, conditioning intensity, donor age
NRM	HCT-CI, conditioning intensity, donor age

Abbreviations: aGVHD, acute graft-versus-host disease; cGVHD, chronic graft-versus-host disease; GRFS, graft-versus-host disease-free, relapse-free survival; HCT-CI, hematopoietic cell transplantation-comorbidity index; NRM, non-relapse mortality; OS, overall survival; PFS, progression-free survival; PS, performance status; Rel/Prog, relapse or progression.

Supplementary Table 5 Multivariable analyses in the entire cohort before propensity score matching

	Model 1 ^{a)}		Model 2 ^{b)}		Model 3 ^{c)}	
	HR (95% CI)	<i>P</i> value	HR (95% CI)	<i>P</i> value	HR (95% CI)	<i>P</i> value
Neutrophil engraftment						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	1.34 (1.05–1.72)	0.019	1.43 (1.11–1.85)	0.006	1.38 (1.02–1.86)	0.036
Platelet engraftment						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	1.07 (0.79–1.45)	0.64	1.11 (0.82–1.52)	0.50	1.12 (0.78–1.62)	0.55
Grade II–IV aGVHD						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	0.68 (0.39–1.21)	0.19	0.68 (0.38–1.20)	0.18	0.71 (0.38–1.31)	0.27
Grade III–IV aGVHD						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	0.59 (0.17–1.99)	0.39	0.58 (0.17–1.96)	0.38	0.53 (0.12–2.33)	0.40
cGVHD						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	0.42 (0.19–0.93)	0.033	0.42 (0.19–0.93)	0.033	0.48 (0.21–1.09)	0.08
cGVHD requiring systemic therapy						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	0.66 (0.29–1.52)	0.33	0.69 (0.30–1.61)	0.39	0.81 (0.35–1.89)	0.63
OS						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	0.55 (0.33–0.93)	0.027	0.56 (0.33–0.94)	0.03	0.60 (0.33–1.09)	0.092
PFS						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	0.62 (0.38–0.99)	0.045	0.62 (0.39–1.00)	0.05	0.71 (0.42–1.21)	0.21
GRFS						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	0.70 (0.47–1.04)	0.078	0.70 (0.47–1.05)	0.088	0.78 (0.50–1.21)	0.26
Rel/Prog						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	1.02 (0.61–1.71)	0.94	1.03 (0.62–1.74)	0.90	1.15 (0.66–2.02)	0.62
NRM						
Haploidentical donor	1.00	Reference	1.00	Reference	1.00	Reference
Matched donor	0.23 (0.07–0.76)	0.016	0.22 (0.07–0.76)	0.016	0.24 (0.06–0.95)	0.043

^{a)} Model 1: Adjusted for the same variables used in the propensity score calculation.

^{b)} Model 2: Adjusted for the variables used in Model 1, with additional adjustment for PTCy dose.

^{c)} Model 3: Adjusted for the variables used in Model 2, with additional adjustment for MMF.

Statistically significant results ($P < 0.05$) are shown in bold.

Abbreviations: aGVHD, acute graft-versus-host disease; cGVHD, chronic graft-versus-host disease; CI, confidence interval; GRFS, graft-versus-host disease-free, relapse-free survival; HR, hazard ratio; MMF, mycophenolate mofetil; NRM, non-relapse mortality; OS, overall survival; PFS, progression-free survival; PTCy, Post-transplantation cyclophosphamide; Rel/Prog, relapse or progression.

Supplementary Table 6 Multivariable analyses of neutrophil engraftment among G-CSF users in the entire cohort before propensity score matching

	Model 1 ^{a)}			Model 2 ^{b)}			Model 3 ^{c)}	
	HR (95% CI)	<i>P</i> value		HR (95% CI)	<i>P</i> value		HR (95% CI)	<i>P</i> value
Neutrophil engraftment								
Haploidentical donor	1.00	Reference		1.00	Reference		1.00	Reference
Matched donor	1.32 (1.03–1.70)	0.03		1.41 (1.08–1.83)	0.011		1.36 (1.00–1.84)	0.051

^{a)} Model 1: Adjusted for the same variables used in the propensity score calculation.

^{b)} Model 2: Adjusted for the variables used in Model 1, with additional adjustment for PTCy dose.

^{c)} Model 3: Adjusted for the variables used in Model 2, with additional adjustment for MMF.

Statistically significant results ($P < 0.05$) are shown in bold.

Abbreviations: CI, confidence interval; G-CSF, granulocyte colony-stimulating factor; HR, hazard ratio; MMF, mycophenolate mofetil; PTCy, post-transplantation cyclophosphamide.

Supplementary Table 7 Cause of death in the entire cohort

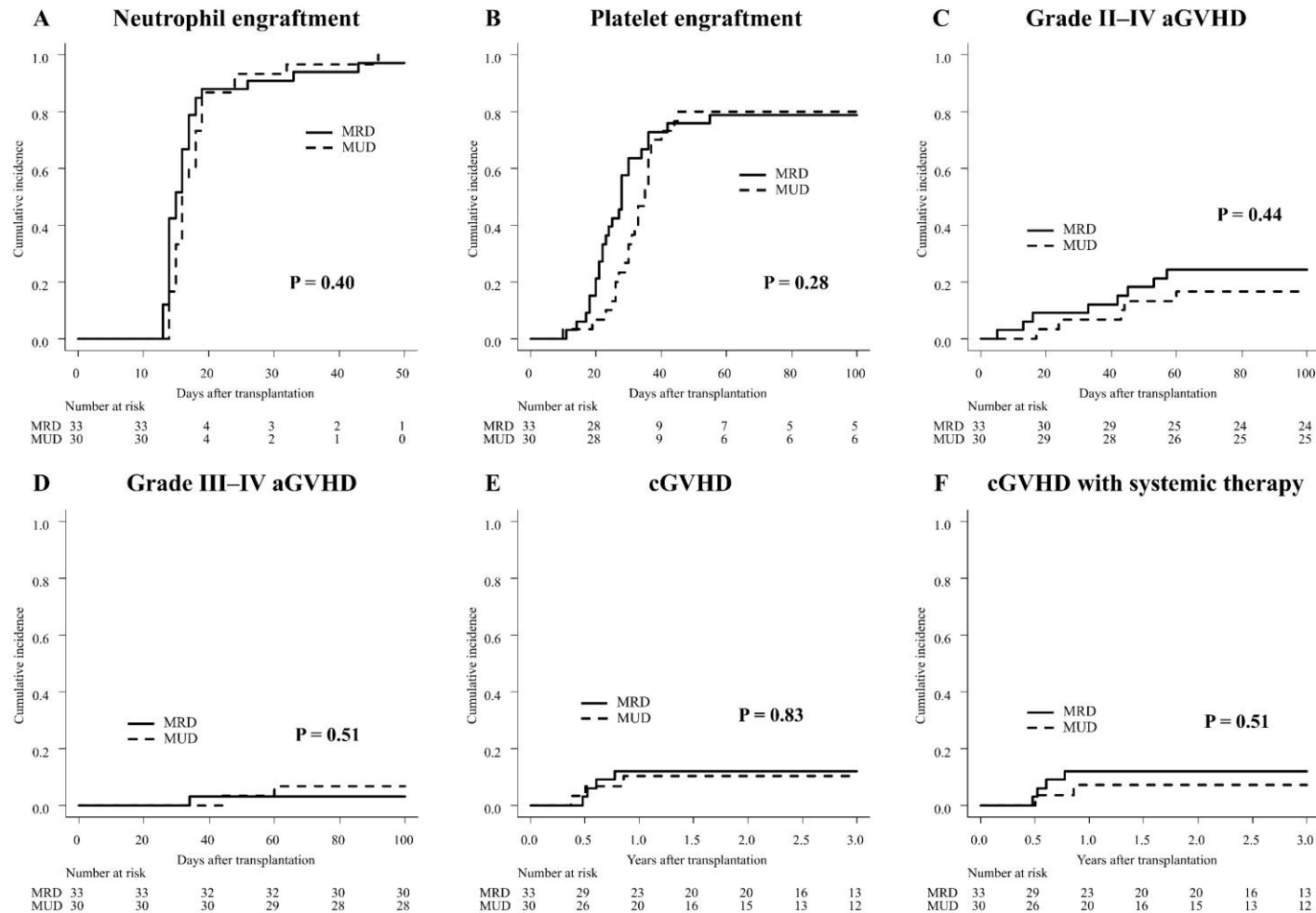
	Matched donor (n = 17)	Haploidentical donor (n = 540)
Primary disease, <i>n</i> (%)	7 (41.2)	246 (45.6)
Infection, <i>n</i> (%)	1 (5.9)	86 (15.9)
Organ failure, <i>n</i> (%)	2 (11.8)	52 (9.6)
GVHD, <i>n</i> (%)	3 (17.6)	27 (5.0)
Secondary malignancy, <i>n</i> (%)	0 (0.0)	5 (0.9)
ARDS, <i>n</i> (%)	0 (0.0)	12 (2.2)
Graft failure, <i>n</i> (%)	0 (0.0)	4 (0.7)
Hemorrhage, <i>n</i> (%)	0 (0.0)	15 (2.8)
Pulmonary complication, <i>n</i> (%)	2 (11.8)	28 (5.2)
VOD/SOS, <i>n</i> (%)	1 (5.9)	15 (2.8)
TMA, <i>n</i> (%)	1 (5.9)	12 (2.2)
Others, <i>n</i> (%)	0 (0.0)	37 (6.9)
Missing, <i>n</i> (%)	0 (0.0)	1 (0.2)

Abbreviations: ARDS, acute respiratory distress syndrome; GVHD, graft-versus-host disease; SOS, sinusoidal obstruction syndrome; TMA, thrombotic microangiopathy; VOD, veno-occlusive disease.

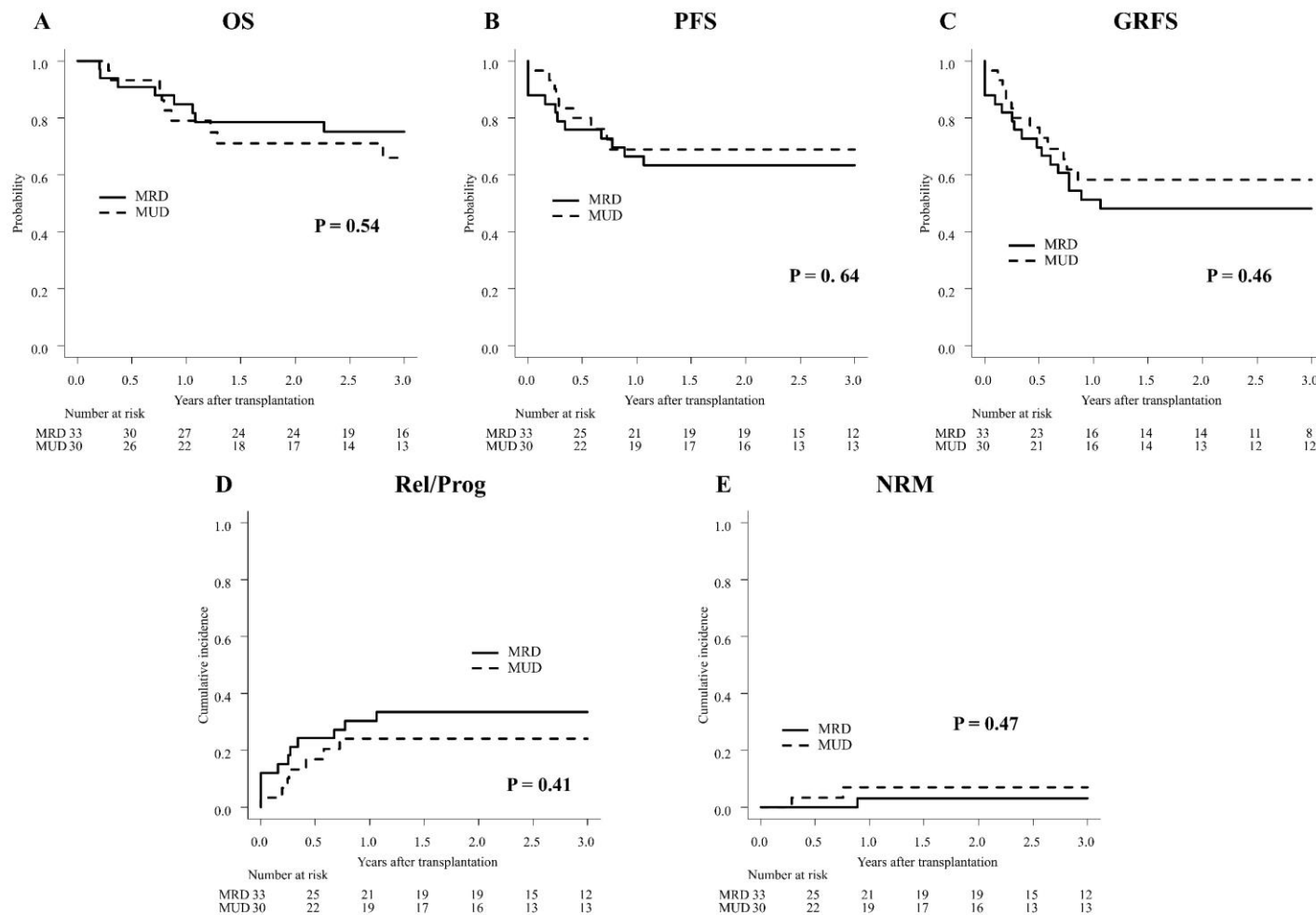
Supplementary Table 8 Infectious complications in the entire cohort

	Matched donor (n = 63)	Haploidentical donor (n = 1261)	<i>P</i> value
Bacterial infection, <i>n</i> (%)	17 (27.0)	270 (21.4)	0.28
Fungal infection, <i>n</i> (%)			
Aspergillus	0 (0.0)	25 (2.0)	0.63
Candida	1 (1.6)	31 (2.5)	1.00
Others	0 (0.0)	2 (0.2)	1.00
Mucor	0 (0.0)	1 (0.1)	
Pneumocystis jirovecii	0 (0.0)	1 (0.1)	
Viral infection, <i>n</i> (%)			
CMV antigenemia	26 (41.3)	530 (42.0)	1.00
CMV disease	1 (1.6)	69 (5.5)	0.25
EBV	0 (0.0)	2 (0.2)	1.00
HHV6 encephalitis	0 (0.0)	5 (0.4)	1.00
HSV	0 (0.0)	2 (0.2)	1.00
VZV	1 (1.6)	8 (0.6)	0.36
Hemorrhagic cystitis, <i>n</i> (%)			
ADV	1 (1.6)	27 (2.1)	1.00
BKV	7 (11.1)	89 (7.1)	0.21
ADV + BKV	0 (0.0)	9 (0.7)	1.00

Abbreviations: ADV, adenovirus; BKV, BK virus; CMV, cytomegalovirus; EBV, Epstein-Barr virus; HHV6, human herpesvirus 6; HSV, herpes simplex virus; VZV, varicella-zoster virus.



Supplementary Figure 3 Cumulative incidences of neutrophil engraftment (A), platelet engraftment (B), grade II–IV acute graft-versus-host disease (aGVHD) (C), grade III–IV aGVHD (D), chronic graft-versus-host disease (cGVHD) (E), and cGVHD requiring systemic therapy (F) according to the donor type in the HLA-matched cohort before propensity score matching. Abbreviations: MRD, matched related donor; MUD, matched unrelated donor.



Supplementary Figure 4 Probabilities of overall survival (OS) (A), progression-free survival (PFS) (B), graft-versus-host disease-free, relapse-free survival (GRFS) (C), cumulative incidences of relapse or progression (Rel/Prog) (D), and non-relapse mortality (NRM) (E) according to the GVHD regimen in the HLA-matched cohort before propensity score matching. Abbreviations: MRD, matched related donor; MUD, matched unrelated donor.