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Autologous stem cell transplantation for newly diagnosed multiple myeloma - real-world data from 2,149 Czech patients

Tereza Popková[1], Luděk Pour[2], Ivan Špička[3], Jakub Radocha[4], Alexandra Jungová[5], Jiří Minařík[6], Petr Pavlíček[7], Tomáš Jelínek[1], Marta Krejčí[2], Jan Straub[3], Vladimír Maisnar[4], Tereza Dekojová[5], Tomáš Pika[6], Jan Soukup[7], Lenka Pospíšilová[8], David Žihala[1], Roman Hájek[1*]

[1]Department of Haematooncology, University Hospital Ostrava and Faculty of Medicine, University of Ostrava, Ostrava, Czech Republic

[2]Department of Internal Medicine, Hematology and Oncology, University Hospital Brno and Faculty of Medicine Masaryk University, Brno, Czech Republic

[3]1st Medical Department – Clinical Department of Hematology, First Faculty of Medicine and General Teaching Hospital Charles University, Prague, Czech Republic

[4]4th Department of Internal Medicine – Hematology, University Hospital Hradec Kralove, Charles University, Faculty of Medicine in Hradec Kralove, Hradec Kralove, Czech Republic

[5]Hematology and Oncology Department, Charles University Hospital in Pilsen, Pilsen, Czech Republic

[6]Department of Hematooncology, University Hospital Olomouc and Faculty of Medicine and Dentistry, Palacký University Olomouc, Olomouc, Czech Republic

[7]Department of Internal Medicine and Hematology, University Hospital Kralovske Vinohrady, Prague, Czech Republic

[8]Institute of Biostatistics and Analyses, Ltd., Brno, Czech Republic

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*** Correspondence:**

Roman Hájek, M.D., Ph.D.

Department of Haematooncology, University Hospital Ostrava, 17. Listopadu 1790/5,

Ostrava 708 52, Czech Republic

roman.hajek@fno.cz

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Author Contributions

TP and RH designed the study and wrote the manuscript. LePo performed the statistical analysis. LuPo, IS, JR, JM, TJ, MK, VM, DZ contributed substantially to discussion of the content. All authors critically reviewed the manuscript and approved the final manuscript for publication.

Data Sharing Statement

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

High-dose therapy followed by autologous hematopoietic stem cell transplantation (HDT/ASCT) has been the centerpiece of multiple myeloma treatment and plays an important role in the first-line therapy, even in the era of novel drugs enriched by monoclonal antibodies, which has been repeatedly confirmed by prospective randomized trials. However, real-world evidence has been playing an important role. Therefore, using the Registry of Monoclonal Gammopathies (RMG), we conducted a retrospective study to provide an overview of the characteristics of transplant-eligible patients and the effectiveness of first-line treatment. The study was conducted in accordance with the principles of the Declaration of Helsinki. The analysis was approved by the RMG review board. Patients gave their informed consent for inclusion into the registry.

A total of 2,149 newly diagnosed multiple myeloma patients (NDMM) who underwent single or tandem HDT/ASCT (treated between 1995 and 2020) were included in the analysis. The proportion of patients undergoing HDT/ASCT has been fluctuating around 33% within the last 20 years (Supplementary Figure 1). The median age was 59 years (42-68). The International Staging System was I/II/III in 45%/31%/24% of patients. The results of fluorescence in situ hybridization (FISH) testing were available in 35% (746/2,149) of cases. The cohort spans a long period, and earlier patients were more likely to have unknown cytogenetic status. However, the two cohorts (known vs. unknown FISH) differ in age, ISS, PFS and OS ($p<0.001$). The observed differences likely reflect the fact that more aggressive disease typically yields higher proliferation, making FISH analysis easier to obtain valid results.

High-risk cytogenetic features defined by IMWG [del(17p) and/or t(4;14) and/or t(14;16)] were found in 32.6% (243/746) of cases (Table 1). The combination of agents used in the induction regimen included a proteasome inhibitor (PI), an immunomodulatory drug (IMiD) and a

glucocorticoid (GC) in 29.4% (631/2,149) of patients; PI, GC and chemotherapy (CHT) in 24.4% (525/2,149); GC and CHT in 22.6% (486/2,149) and IMiD, GC and CHT in 15.6% (336/2,149).

In the Czech Republic, the combination of bortezomib, thalidomide and dexamethasone (VTD) as an induction regimen was the standard of care (SOC) from 2016 until late 2025. In the past, cyclophosphamide, bortezomib and dexamethasone (CVD) or cyclophosphamide, thalidomide and dexamethasone were frequently used in induction treatment. Monoclonal antibodies played just a marginal role at the analyzed period - 0.5% (10/2,149). Consolidation therapy was given in 3.4% (73/2,149) of patients. In 16.9% (363/2,149) of patients, maintenance was administered, lenalidomide in 43.8% (159/363) of the cases. The median length of maintenance treatment was 12 (6.0, 25.3) months. Tandem HDT/ASCT was given to 12.5% (268/2,149) of patients. Disease status at the time of HDT/ASCT was defined as a stringent complete response (sCR) in 1.8% (32/1,760) of patients, complete response (CR) in 11.3% (199/1,760), very good partial response (VGPR) in 39.1% (689/1,760), partial response (PR) in 40.8% (718/1,760), minimal response (MR) in 3.8%, (66/1,760), stable disease (SD) in 2.4% (42/1,760), and not available in 18.8% (403/2,149). The overall response rate (ORR) on day 100 after HDT/ASCT was 93.1%, VGPR and better was reached by 68% of patients (sCR: 10.3% [210/2,035], CR: 22% [447/2,035], VGPR: 35.7% [726/2,035], PR: 25.2% [512/2,035], MR: 2.6% [53/2,035], SD: 1.3% [27/2,035], PD: 2.9% [60/2,035]). Taking all together, ORR was not improved when comparing the post-induction with post-transplantation period but there was a clear improvement in the depth of response (CR+sCR 13.1% vs. 32.3%).

After a median follow-up of 56.3 months, the median overall survival (mOS) and the median progression-free survival (mPFS) was 97.0 (92.8-105) and 35.5 (34-37.7) months,

respectively (Figure 1A, 2A, Supplementary Table 2), almost identical results as in a large global real-world study published in 2024 (mOS 90.2 months [88.2–93.6]; mPFS 36.5 months [36.1-37.0])[1]. There was no statistically significant difference in survival of patients who initiated treatment between 2005-2009 and 2010-2014: mOS 98.4 vs. 89.2 months (p=0.089); mPFS 32.7 vs. 33.6 (p=0.989) months. The transplant-related mortality was equal to 0.7% (16/2,141).

Age was shown to be a prognostic marker for overall survival – mOS for <49, (50-59), (60-69) and >70-year-olds was 134.7, 100.7, 87.6 and 43.0 months, respectively (p<0.001) (Figure 1B). Nevertheless, the proportion of patients older than 70 was limited (27/2,149) and should be interpreted with caution. There was no statistical difference in the survival of patients aged 61-64 and 66-69 – mOS 86.9 vs. 90.1 months (p=0.711) (Figure 1C). Patients responding with CR after transplantation achieved better OS– mOS was 132.3, 87.6 and 90.4 months for CR+sCR, VGPR, PR and worse, respectively (p<0.001) (Figure 1D). The difference in PFS in favor of tandem transplantation did reach statistical significance – mPFS 47.3 vs. 34.8 months (p=0.003) (Figure 2D). Our data did not show a significant improvement in PFS when tandem transplantation was used for patients with high cytogenetic risk compared to a single transplantation - mPFS 30.9 vs. 24.7 months (p=0.158) (Figure 2E). The use of maintenance was associated with improved OS (median 106.9 vs. 88.4 months, p=0.008) and PFS (median 38 vs. 26.6 months, p<0.001) (Figure 1F, 2F). In the multivariable analysis including cytogenetic risk, age, ISS, Durie-Salmon stage and ECOG, the high-risk cytogenetics (OS and PFS), age >60 years (OS and PFS) and Durie-Salmon stage III (PFS) were independently associated with inferior prognosis (Supplementary Table 1).

Even in the era of novel drugs, HDT/ASCT has repeatedly proved its role in treatment of fit NDMM patients in randomized clinical trials [2,3]. The percentage of patients undergoing

HDT/ASCT in the Czech Republic is comparable to the Finnish real-world study presenting 30% of NDMM in 2015 [4]. High-dose therapy with autologous stem cell transplantation used to be considered exclusively in patients under the age of 65 but has proved itself to be safe and efficient even for patients over this age [5]. The European Society for Blood and Marrow Transplantation registered an increasing use of HDT/ASCT in the first-line treatment of elderly patients, particularly in the 65-69 age group [6] and a more recent analysis of the Center for International Blood and Marrow Transplant Research confirmed this trend by showing almost a 2-fold increase in HDT/ASCT use among NDMM patients aged ≥70 years in 2017 compared to 2013 [7]. Consequently, the latest EHA-EMN guidelines recommend HDT/ASCT for patients under the age of 70. Our analysis confirmed this approach by showing no difference in survival between the age groups of 60-64 and 65-69. The ≥CR rate on day 100 after transplantation was 32%, which is inferior to the data of an Argentinean study that assessed 322 NDMM patients who received a combination of VTD (26%) or CVD (74%) as induction and the CR rate was 49% and 40%, respectively [8]. In contrast, the ORR of 93.1% in our cohort is superior to the Finnish patients treated with bortezomib based induction (ORR 86.9%). The median PFS and OS for our cohort were 35.5 and 97.0 months, respectively, which is considered satisfying in the real world but cannot be compared to clinical trials, indeed- GIMEMA-MMY-3006: CR 48.7%, mPFS 57 months, 10-year OS 60% [9]; CASSIOPEIA: ≥CR 26%, mPFS 52.8 months [10]. However, both studies used consolidation, most of the patients received maintenance, and solely patients <65 years were eligible. Similarly to our results, 10.1% of upfront HDT/ASCT reported in Europe between 2013 and 2017 were tandem [1]. The relevance of tandem HDT/ASCT in first line continues to be debated due to nonuniform outcomes from randomized trials and meta-analyses, moreover real-world data are rarely published. In the contemporary setting of a quadruplet being SOC for treatment of newly diagnosed transplant-eligible patients, a phase 2 study 2018-04 showed

that daratumumab plus carfilzomib, lenalidomide and dexamethasone (KRD) with tandem transplant had led to premaintenance ORR and MRD negativity rate of 100% and 94%, respectively and to 30-month PFS and OS of 80% and 91%, respectively [11]. In the MIDAS trial, no statistically significant difference in the premaintenance MRD-negative status was found between MRD-positive patients consolidated by tandem or by single transplantation followed by 2 cycles of IsaKRD [12]. The IMWG recommends the use of double transplantation for patients with high-risk cytogenetics and the EHA-EMN guidelines have added patients who receive VCD induction [13,14].

In conclusion, our national analysis of transplant-eligible NDMM patients confirms high effectiveness (mPFS 35.5 months) and out-standing safety (TRM 0,7%) of the procedure with long-term survival (mOS 97 months). Maintenance therapy post HDT/ASCT has a beneficial effect on PFS and OS. High-dose therapy with autologous stem cell transplantation remains the cornerstone of treatment for eligible patients even in the rapidly evolving era of modern therapy. Nevertheless, the outcomes of cellular therapy in early management of the disease (CARTITUDE-5, KarMMa-4) are eagerly awaited. In the light of the deep and durable responses achieved by CAR-T therapy in relapsed setting, it may potentially supplant HDT/ASCT in first line.

References

1. Garderet L, Gras L, Koster L, et al. Global characteristics and outcomes of autologous hematopoietic stem cell transplantation for newly diagnosed multiple myeloma: A study of the worldwide network for blood and marrow transplantation (WBMT). Am J Hematol. 2024;99(11):2084-2095.

2. Moreau P, Attal M, Hulin C, et al. Bortezomib, thalidomide, and dexamethasone with or without daratumumab before and after autologous stem-cell transplantation for newly diagnosed multiple myeloma (CASSIOPEIA): a randomised, open-label, phase 3 study. Lancet. 2019;394(10192):29-38.

3. Perrot A, Lauwers-Cances V, Cazaubiel T, et al. Early Versus Late Autologous Stem Cell Transplant in Newly Diagnosed Multiple Myeloma: Long-Term Follow-up Analysis of the IFM 2009 Trial. Blood 2020;136(Supplement 1):39.

4. Toppila I, Miettinen T, Lassenius MI, Lievonen J, Bauer M, Anttila P. Characteristics and survival trends in Finnish multiple myeloma patients-a nationwide real-world evidence study. Ann Hematol. 2021;100(7):1779–1787.

5. Garderet L, Beohou E, Caillot D, et al. Upfront autologous stem cell transplantation for newly diagnosed elderly multiple myeloma patients: a prospective multicenter study. Haematologica. 2016;101(11):1390-1397.

6. Auner HW, Szydlo R, Hoek J, et al. Trends in autologous hematopoietic cell transplantation for multiple myeloma in Europe: increased use and improved outcomes in elderly patients in recent years. Bone Marrow Transplant. 2015;50(2):209-215.

7. Munshi PN, Vesole D, Jurczyszyn A, et al. Age no bar: A CIBMTR analysis of elderly patients undergoing autologous hematopoietic cell transplantation for multiple myeloma. Cancer. 2020;126(23):5077-5087.

8. Schütz NP, Ochoa P, Duarte P, et al. Real world outcomes with Bortezomib Thalidomide dexamethasone and Cyclophosphamide Bortezomib dexamethasone induction treatment for transplant eligible multiple myeloma patients in a Latin American country. A Retrospective Cohort Study from Grupo Argentino de Mieloma Múltiple. Hematol Oncol. 2020;38(3):363-371.

9. Tacchetti P, Pantani L, Patriarca F, et al. Bortezomib, thalidomide, and dexamethasone followed by double autologous haematopoietic stem-cell transplantation for newly diagnosed multiple myeloma (GIMEMA-MMY-3006): long-term follow-up analysis of a randomised phase 3, open-label study. Lancet Haematol. 2020;7(12):e861-e873.

10. Moreau P, Hulin C, Perrot A, et al. Bortezomib, thalidomide, and dexamethasone with or without daratumumab and followed by daratumumab maintenance or observation in transplant-eligible newly diagnosed multiple myeloma: long-term follow-up of the CASSIOPEIA randomised controlled phase 3 trial. Lancet Oncol. 2024;25(8):1003-1014.

11. Touzeau C, Perrot A, Hulin C, et al. Daratumumab, carfilzomib, lenalidomide, and dexamethasone with tandem transplant for high-risk newly diagnosed myeloma. Blood. 2024;143(20):2029-2036.

12. Perrot A, Lambert J, Hulin C, et al. Measurable residual disease-guided therapy in newly diagnosed myeloma. N Engl J Med. 2025;393(5):425-437.

13. Sonneveld P, Avet-Loiseau H, Lonial S, et al. Treatment of multiple myeloma with high-risk cytogenetics: a consensus of the International Myeloma Working Group. Blood. 2016;127(24):2955-2962.

14. Dimopoulos MA, Terpos E, Boccadoro M, et al. EHA–EMN Evidence-Based Guidelines for diagnosis, treatment and follow-up of patients with multiple myeloma. Nat Rev Clin Oncol. 2025;22(9):680-700.

Tables

Table 1 **Baseline characteristics of the study cohort.**

(CHT chemotherapy (cyclophosphamide, doxorubicin, idarubicin, melphalan, vincristine, 2-chlordeoxyadenosin); GC glucocorticoid (dexamethasone, methylprednisolone, prednisone); IMiD immunomodulatory drug (lenalidomide, thalidomide); PI proteasome inhibitor (bortezomib, carfilzomib); * threshold 5%; ** del(17p) and/or t(4;14) and/or t(14;16)

Age at diagnosis (median (95% CI))	59.0 (42.0–68.0)
Sex	**n = 2,149**
male	1,196 (55.7%)
female	953 (44.3%)
Durie-Salmon stage	**n = 2,116**
I	304 (14.4%)
II	374 (17.7%)
III	1,438 (68.0%)
Durie-Salmon subclasiffication	**n = 2,117**
A	1,785 (84.3%)
B	332 (15.7%)
ISS stage	**n = 2,043**
1	911 (44.6%)
2	637 (31.2%)
3	495 (24.2%)
ECOG	**n = 2,087**
0	512 (24.5%)
1	1,166 (55.9%)
2	298 (14.3%)
3	89 (4.3%)
4	22 (1.1%)
FISH	
t(4;14)	**n=858**
negative	719 (83.8%)
positive	139 (16.2%)
t(14;16)	**n=709**
negative	688 (97.0%)
positive	21 (3.0%)
del(17p)*	**n=884**
negative	775 (87.7%)
positive	109 (12.3%)
t(11;14)	**n=759**
negative	636 (83.8%)
positive	123 (16.2%)
amp1q21	**n=935**
negative	561 (60.0%)
positive	374 (40.0%)
Risk status by cytogenetics	**n=746**
high**	243 (32.6%)
standard	503 (67.4%)
Induction treatment	**n = 2,149**

PI + IMiD + GC	631 (29.4%)
PI + GC + CHT	525 (24.4%)
GC + CHT	486 (22.6%)
IMiD + GC + CHT	336 (15.6%)
PI + GC	47 (2.2%)
PI + IMiD + GC + CHT	42 (2.0%)
others	72 (3.4%)
not specified	10 (0.5%)
Dose of melphalan	**n = 1,730**
200mg/m2	1,460 (84.4%)
140mg/m2	183 (10.6%)
100mg/m2	83 (4.8%)
other	4 (0.2%)
Transplantation technique	**n = 2,149**
single	1,881 (87.5%)
tandem	268 (12.5%)
Consolidation/ maintenance	**n = 2,149**
Consolidation	73 (3.4%)
maintenance	363 (16.9%)
lenalidomide	159 (7.4%)
other	204 (9.5%)
Clinical study	**n = 2,149**
yes	198 (9.2%)
no	1,951 (90.8%)

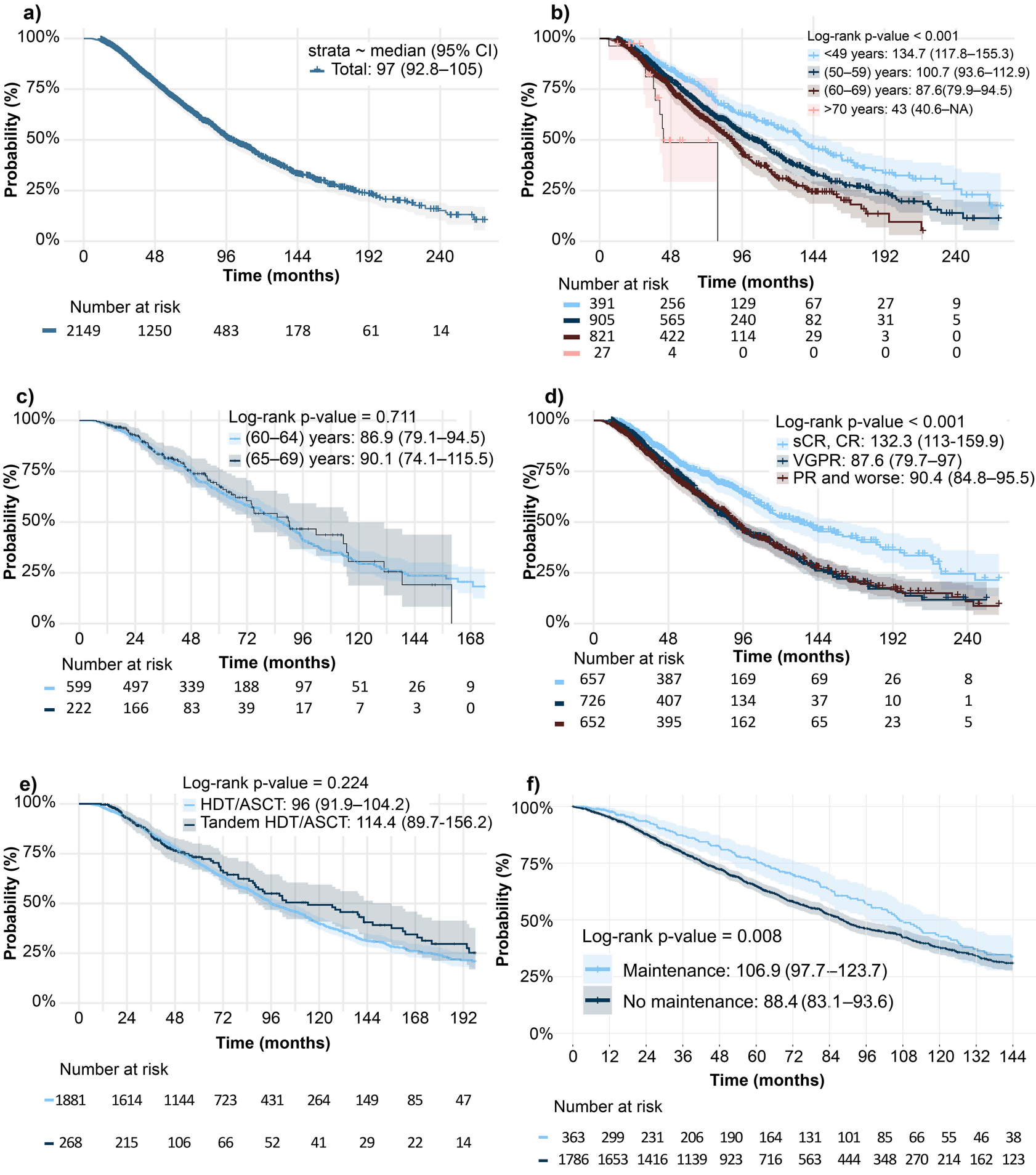
Figure Legends

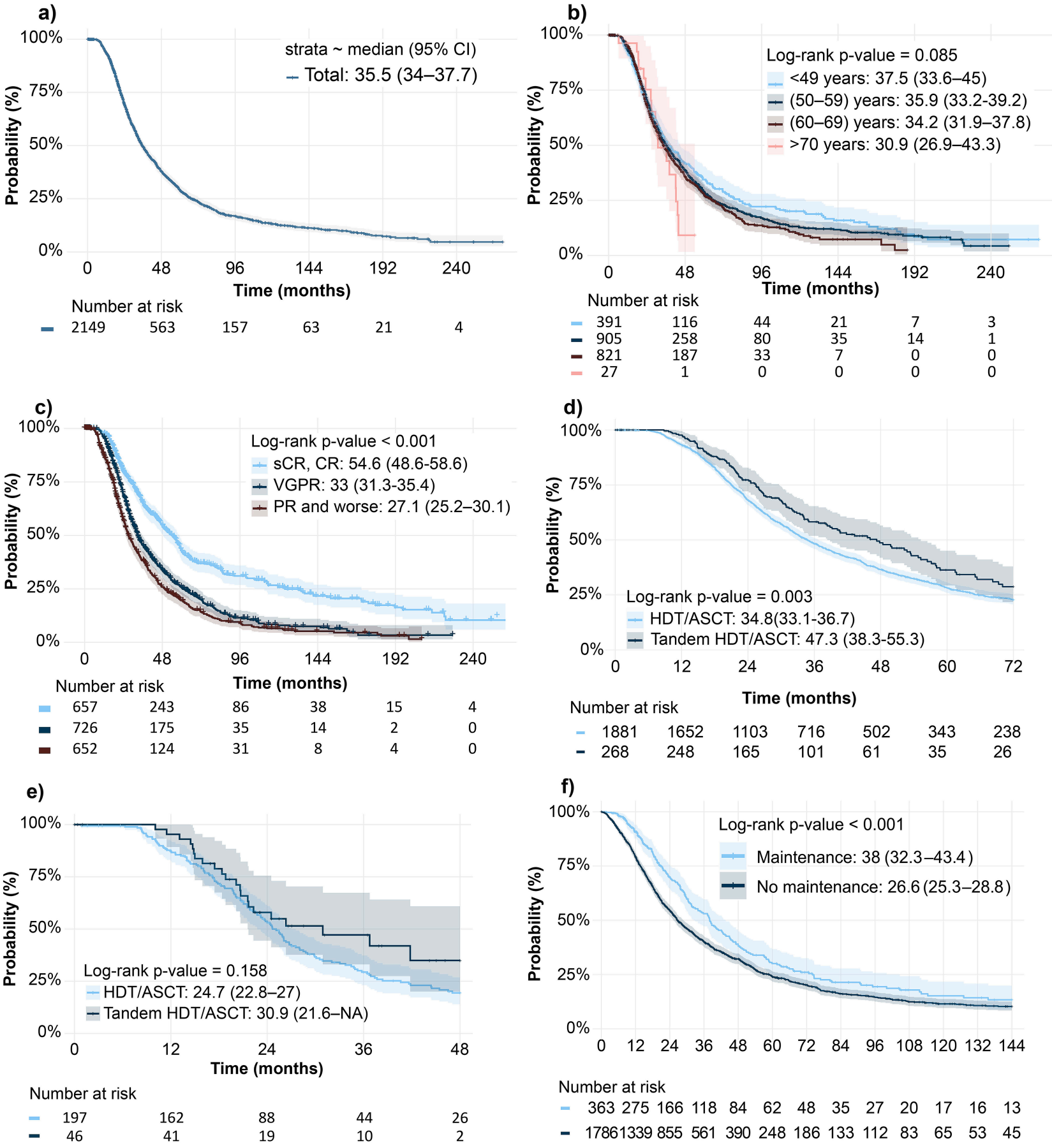
Figure 1: **Overall survival**

(a) Overall survival of the whole cohort; **(b)** Overall survival by age <49, (50–59), (60–69), >70 at diagnosis; **(c)** Overall survival by age (60–64), (65–69) at diagnosis; **(d)** Overall survival by response at day +100; **(e)** Overall survival by transplantation technique; **(f)** Overall survival by the use of maintenance

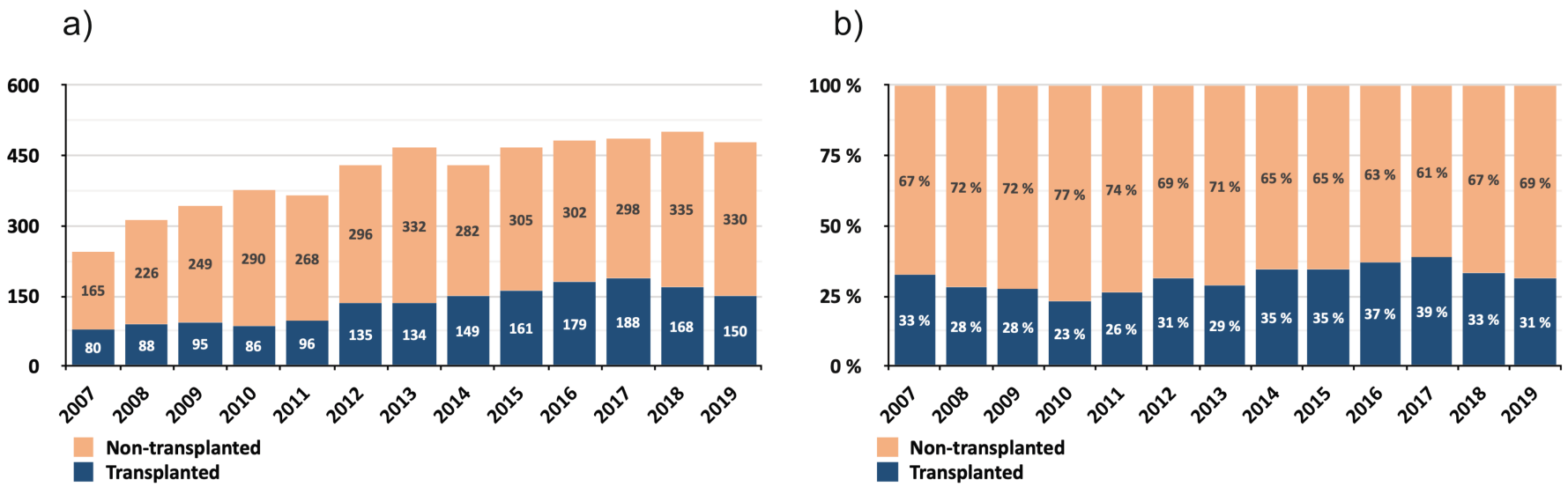
Figure 2: **Progression-free survival**

(a) Progression-free survival of the whole cohort; **(b)** Progression-free survival by age at diagnosis; **(c)** Progression-free survival by response at day +100; **(d)** Progression-free survival by transplantation technique; **(e)** Progression-free survival of patients with high cytogenetic risk by transplantation technique; **(f)** Progression-free survival by the use of maintenance


a)
100%
75%
50%
25%
0%
Probability (%)
strata ~ median (95% CI)
Total: 97 (92.8–105)
0
48
96
144
192
240
Time (months)
Number at risk
2149 1250 483 178 61 14
b)
Log-rank p-value < 0.001
<49 years: 134.7 (117.8–155.3)
(50–59) years: 100.7 (93.6–112.9)
(60–69) years: 87.6(79.9–94.5)
>70 years: 43 (40.6–NA)
Number at risk
391 256 129 67 27 9
905 565 240 82 31 5
821 422 114 29 3 0
27 4 0 0 0 0
c)
Log-rank p-value = 0.711
(60–64) years: 86.9 (79.1–94.5)
(65–69) years: 90.1 (74.1–115.5)
0
24
48
72
96
120
144
168
599 497 339 188 97 51 26 9
222 166 83 39 17 7 3 0
d)
Log-rank p-value < 0.001
sCR, CR: 132.3 (113-159.9)
VGPR: 87.6 (79.7–97)
PR and worse: 90.4 (84.8–95.5)
657 387 169 69 26 8
726 407 134 37 10 1
652 395 162 65 23 5
e)
Log-rank p-value = 0.224
HDT/ASCT: 96 (91.9–104.2)
Tandem HDT/ASCT: 114.4 (89.7-156.2)
192
1881 1614 1144 723 431 264 149 85 47
268 215 106 66 52 41 29 22 14
f)
Log-rank p-value = 0.008
Maintenance: 106.9 (97.7–123.7)
No maintenance: 88.4 (83.1–93.6)
0
12
24
36
48
60
72
84
96
108
120
132
144
363 299 231 206 190 164 131 101 85 66 55 46 38
1786 1653 1416 1139 923 716 563 444 348 270 214 162 123


a)
strata ~ median (95% CI)
Total: 35.5 (34–37.7)
Probability (%)
Time (months)
Number at risk
2149 563 157 63 21 4
b)
Log-rank p-value = 0.085
<49 years: 37.5 (33.6–45)
(50–59) years: 35.9 (33.2-39.2)
(60–69) years: 34.2 (31.9–37.8)
>70 years: 30.9 (26.9–43.3)
Number at risk
391 116 44 21 7 3
905 258 80 35 14 1
821 187 33 7 0 0
27 1 0 0 0 0
c)
Log-rank p-value < 0.001
sCR, CR: 54.6 (48.6-58.6)
VGPR: 33 (31.3-35.4)
PR and worse: 27.1 (25.2–30.1)
Number at risk
657 243 86 38 15 4
726 175 35 14 2 0
652 124 31 8 4 0
d)
Log-rank p-value = 0.003
HDT/ASCT: 34.8(33.1-36.7)
Tandem HDT/ASCT: 47.3 (38.3-55.3)
Number at risk
1881 1652 1103 716 502 343 238
268 248 165 101 61 35 26
e)
Log-rank p-value = 0.158
HDT/ASCT: 24.7 (22.8–27)
Tandem HDT/ASCT: 30.9 (21.6–NA)
Number at risk
197 162 88 44 26
46 41 19 10 2
f)
Log-rank p-value < 0.001
Maintenance: 38 (32.3–43.4)
No maintenance: 26.6 (25.3–28.8)
Number at risk
363 275 166 118 84 62 48 35 27 20 17 16 13
1786 1339 855 561 390 248 186 133 112 83 65 53 45

Supplementary Figure 1: **HDT/ASCT used in newly diagnosed MM patients between 2007-2019 (a)** in absolute numbers; **(b)** proportionally.



Supplementary Table 1: **Multivariable Cox proportional hazard model for OS and PFS**

		OS		PFS	
	number of patients	**HR (95% CI)**	**p-value**	**HR (95% CI)**	**p-value**
Cytogenetic risk at diagnosis					
standard risk – reference	491	–	–	–	–
high risk	234	2.23 (1.74–2.86)	**2.54E-10**	1.73 (1.41–2.11)	**8.01E-08**
Age at diagnosis					
<49 years – reference	113	–	–	–	–
(50–59) years	272	1.37 (0.94–2.01)	0.1032	1.29 (0.97–1.73)	0.0788
> 60 years	340	1.61 (1.10–2.36)	**0.0146**	1.41 (1.05–1.88)	**0.0214**
ISS at diagnosis					
stage 1 – reference	282	–	–	–	–
stage 2	258	1.08 (0.80–1.46)	0.6007	0.94 (0.75–1.18)	0.5889
stage 3	185	1.31 (0.95–1.82)	0.104	1.09 (0.85–1.40)	0.4997
DS at diagnosis					
stage I – reference	92	–	–	–	–
stage II	118	1.08 (0.66–1.77)	0.7586	1.30 (0.90–1.87)	0.1656
stage III	515	1.42 (0.94–2.15)	0.099	1.62 (1.19–2.22)	**0.0026**
ECOG at diagnosis					
grade 0 – reference	183	–	–	–	–
grade 1	395	1.34 (0.97–1.83)	0.0745	0.96 (0.76–1.20)	0.7064
grade 2	108	1.46 (0.96–2.22)	0.0801	1.02 (0.74–1.40)	0.8893
grade ≥3	39	1.34 (0.73–2.45)	0.3448	1.23 (0.80–1.90)	0.3484

Supplementary Table 2: **Univariate analysis for OS and PFS.** **del(17p) and/or t(4;14) and/or t(14;16)

		OS			PFS		
	number of patients	**median (months)**	**95% CI**	**p-value**	**median (months)**	**95% CI**	**p-value**
Whole cohort	2 149	97.0	(92.8-105.0)		35.5	(34.0-37.7)	
Age							
<49 years	391	134.7	(117.8–155.3)		37.5	(33.6–45.0)	
(50–59) years	905	100.7	(93.6–112.9)		35.9	(33.2–39.2)	
(60–69) years	821	87.6	(79.9–94.5)		34.2	(31.9–37.8)	
>70 years	27	43.0	(40.6–NA)	**<0.001**	30.9	(26.9–43.3)	0.088
(60–64) years	599	86.9	(79.1–94.5)		34.0	(31.4–37.7)	
(65–69) years	222	90.1	(74.1–115.5)	0.711	35.4	(31.7–44.7)	0.547
Risk stratification by FISH							
standard	503	100.7	(89.7–134.6)		36.7	(33.5–39.5)	
high**	243	60.8	(51.6–73.3)	**<0.001**	25.4	(23.2–28.0)	**<0.001**
amp1q21							
negative	561	100.7	(87.2–113.4)		38.1	(34.1–42.1)	
positive	374	67.4	(58.4–74.1)	**<0.001**	26.3	(24.5–29.8)	**<0.001**
t(11;14)							
negative	636	95.5	(85.5–105.3)		35.8	(33.6–39.0)	
positive	123	96.2	(79.2–138.3)	0.784	33.3	(29.8–50.0)	0.565
Response after transplantation							
≥CR	657	132.3	(113.0–159.9)		54.6	(48.6–58.6)	
VGPR	726	87.6	(79.7–97.0)		33.0	(31.3–35.4)	
≤PR	652	90.4	(84.8–95.5)	**<0.001**	27.1	(25.2–30.1)	**<0.001**
Transplantation technique							
single	1 881	96.0	(91.9–104.2)		34.8	(33.0–36.7)	
tandem	268	114.4	(89.7–156.2)	0.224	47.3	(38.3–55.2)	**0.024**
Transplantation technique at standard cytogenetic risk							

single	415	105.3	(86.6–135.3)		36.3	(32.6–39.7)	
tandem	88	92.8	(70.8–NA)	0.466	38.3	(33.4–52.8)	0.425
Transplantation technique at high cytogenetic risk							
single	197	61.9	(51.8–75.7)		24.7	(22.8–27.0)	
tandem	46	101.6	(35.2–NA)	0.384	30.9	(21.6–NA)	0.158