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MRD-Negative Response After VRd induction, HD-ASCT, and VRd consolidation in Transplant-Eligible Newly Diagnosed Multiple Myeloma: Phase 2 REMNANT Study with Broad Inclusion Criteria

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Abstract

High-dose melphalan with autologous stem-cell transplantation (HD-ASCT) prolongs progression-free survival (PFS) in transplant-eligible newly diagnosed multiple myeloma (TE-NDMM). However, most transplant trials exclude patients >65 years or those with poor performance status, aggressive disease, or significant comorbidities, limiting data on minimal residual disease (MRD)-negativity in these populations. REMNANT is a multicenter phase 2/3 study of TE-NDMM patients aged 18–75 years with broad eligibility criteria. This primary analysis reports MRD-negative complete response (CR) from the non-randomized phase 2 cohort. Patients received four cycles of bortezomib, lenalidomide, and dexamethasone (VRd) induction, HD-ASCT, and four cycles of VRd consolidation. MRD was tested in patients achieving ≥very good partial response (VGPR) post-consolidation. Between August 2020 and September 2024, 382 patients were enrolled (median age 63; 40% ≥65 years). MRD-negative CR was observed in 127 (33%) of 382 patients' post-consolidation and 327 (86%) achieved ≥VGPR. The 12- and 24-month PFS were 88% and 79% (median follow-up 34.7 months), with comparable outcomes in patients <65 and ≥65 years. The most common adverse events of grade 3-4 were infections (44%) and cytopenias (21%). VRd induction, HD-ASCT, and VRd consolidation were effective and safe in a TE-NDMM cohort representative of the real-word NDMM population in Norway.

Introduction

Multiple myeloma (MM) is a hematologic malignancy in which high-dose melphalan followed by autologous stem-cell transplantation (HD-ASCT) remains a cornerstone of front-line therapy for fit patients up to 70 years of age, improving progression-free survival (PFS), and facilitating deep responses, including minimal residual disease (MRD) negativity (1, 2). Clinical trials of bortezomib, lenalidomide, and dexamethasone (VRd) with HD-ASCT have reported MRD-negative rates ranging from 30% to 66%, depending on timing of assessment and the sensitivity of MRD detection (1-3). However, these trials enrolled selected populations, limiting generalizability, and real-world studies rarely capture MRD data, constraining insights into MRD outcomes in routine clinical practice. Similar limitations apply to health-related quality of life (HRQL) data, which are sparse, largely derived from selected trial populations, and are particularly limited during the consolidation phase, although available evidence generally suggest stable global HRQL during treatment (2, 4). MRD negativity is a strong prognostic indicator in MM, associated with improved PFS and overall survival (OS) (5).

The REMNANT study is an investigator-initiated, multicenter, open-label phase 2/3 trial in transplant-eligible newly diagnosed multiple myeloma (TE-NDMM) patients, designed to evaluate whether treatment of MRD relapse following first-line therapy can prolong PFS and OS (6). The phase 2 component serves as the feeder population for the randomized phase 3, which enrolls patients who achieve MRD-negative complete response (CR) following frontline therapy. Patients are randomized to start second line therapy at MRD resurgence or at progressive disease.

In this article, we report on the primary analysis of MRD-negative CR from the non-randomized phase 2 component of the REMNANT trial, following frontline treatment with VRd induction, single or tandem HD-ASCT, and VRd consolidation in TE-NDMM patients. The trial included patients up to 75 years of age, patients with renal impairment, poor performance status, and significant comorbidities.

Methods

Study design and participants

This investigator-initiated, multicenter, single-arm, open-label, phase 2 trial was conducted at 13 centers across Norway (six academic and seven general hospitals). Eligible patients were adults up to 75 years of age with documented NDMM as defined by the International Myeloma Working Group (IMWG) criteria (7), and measurable disease in serum, defined as serum M-protein ≥10 g/L and/or involved free light chain (FLC) ≥100 mg/L. Urine M-protein was not used, as this test is not routinely conducted in most Norwegian hospitals and offers limited additional diagnostic and prognostic utility in MM (8). Patients had to be eligible for HD-ASCT and have an Eastern Cooperative Oncology Group (ECOG) performance status of 0–3, with ECOG 3 permitted only if attributable to myeloma. There was no restriction in terms of hematological parameters, kidney function, liver function, or other plasma cell malignancies (e.g. systemic AL amyloidosis, POEMS syndrome, primary plasma cell leukemia). Exclusion criteria included prior receipt of more than one cycle of VRd-induction therapy for MM, concurrent active malignancy with a shorter life expectancy than MM, active or ongoing systemic infection, known HIV, hepatitis C, or active hepatitis B infection. Additional eligibility criteria are detailed in the appendix (p 2). The trial was conducted in accordance with the principles of the Declaration of Helsinki and the International Conference on Harmonization Good Clinical Practice guidelines. Approval was obtained from Norwegian Medical Products Agency and from regional Committees for Medical and Health Research in Norway. All patients provided written informed consent prior to enrollment. The trial is registered at ClinicalTrials.gov (NCT04513639).

At the time of study initiation (August 26, 2020), Norwegian national guidelines recommended four cycles of VRd induction, followed by single or tandem HD-ASCT, and four additional cycles of VRd consolidation for TE-NDMM patients up to the age of 75 years. Lenalidomide maintenance was recommended but not reimbursed in Norway before March 2022.

Procedures

Patients received induction therapy consisting of four 21-days cycles of bortezomib, lenalidomide, and dexamethasone. Bortezomib was administered subcutaneously at 1.3 mg/m^2 on days 1, 4, 8, and 11. After inclusion of the first 200 patients, the dosing schedule for bortezomib was changed to days 1 and 8 only. Lenalidomide was given orally at 25 mg on days 1-14 or at 15 mg on days 1-14 in patients with an eGFR <30 mL/min/1.73 m^2. Dexamethasone was given at 20 mg orally on days 1, 2, 4, 5, 8, 9, 11, and 12 of each cycle. Following induction, stem-cell mobilization was performed according to institutional

guidelines. Patients then proceeded to either single or tandem high-dose melphalan (200 mg/m^2) with ASCT. Irrespective of cytogenetic risk status, a second transplant approximately 12-14 weeks after the first, was offered to all patients who demonstrated a reduction in serum M-protein or involved free light chain after the first transplant (patients already in CR before the first transplant were eligible for a second transplant), provided they were considered able to tolerate the procedure by the investigator. Patients had the option to decline the second transplant. Following ASCT, all patients received four additional 21-days cycles of VRd. Most patients subsequently received lenalidomide maintenance therapy.

Participants received prophylaxis for venous thromboembolism using aspirin, low-molecular weight heparin, or direct-acting oral anticoagulation. Prophylaxis against herpes zoster virus and vaccination were recommended in accordance with national guidelines. Supportive therapy was administered according to institutional standards. Prophylactic use of antibiotics or immunoglobulins was not mandated by the study protocol.

High-risk cytogenetic status was defined as the presence of one or more of the following abnormalities detected by local fluorescence in situ hybridization (FISH): del(17p), t(4;14), and t(14;16). Double hit myeloma was defined as the presence of at least two of the following: t(4;14), t(14;16), t(14;20), gain/amp 1q, or del(17p) (9, 10).

Disease assessments were conducted at the start of every cycle by investigators based on local laboratory measurements of serum M-protein (g/L), serum FLC parameters (mg/L), and bone marrow aspirate or biopsy findings. Serum FLC chains were used for response assessment instead of urine M-protein and modified response criteria were applied (appendix p 3). In this modified version, response required a reduction in both serum M-protein and differences in FLC, if both were measurable at diagnosis. Normalization of the FLC ratio was required for CR. Follow-up imaging for response evaluation in all patients presenting with soft-tissue plasmacytomas (paramedullary and extramedullary) was required in accordance with the IMWG response criteria (11). MRD was assessed using next-generation flow cytometry (NGF) on bone marrow samples at designated laboratories in Oslo and Trondheim. The assay had a sensitivity of 2.0×10^{-6} (20 tumor cells per 10 million nucleated cells) (12). A cutoff for MRD-negativity, qualifying for enrollment in the phase 3 REMNANT trial, was set to 1.0×10^{-5} (100 cells per 10 million nucleated cells), following the minimal sensitivity accepted for MRD-negativity in the IMWG criteria (11). MRD testing was performed on bone marrow aspirates collected 30-45 days after the start of the final consolidation cycle in all patients achieving a VGPR or better.

Adverse events (AEs) were graded according to the National Cancer Institute Common Terminology for Adverse Events (CTCAE), version 5.0. Only grade 2 or higher AEs that resulted in clinical intervention were recorded. During the immediate post-transplant period, from administration of high-dose melphalan until day 1 of the first consolidation cycle, cytopenias related to bone marrow aplasia were not reported unless hematologic recovery was insufficient to initiate consolidation. Other expected post-transplant

toxicities, including nausea, vomiting, loss of appetite, dehydration, diarrhea, and fatigue were also not recorded.

HRQL was assessed with the European Organization for Research and Treatment of Cancer (EORTC) Quality of Life Core Module (QLQ-C30) (13), which was completed at screening, day 1 of the first cycle of induction therapy, day 1 of the four cycles of consolidation therapy, and 30-45 days after initiation of the fourth cycle of consolidation.

Outcomes

The primary endpoint was MRD-negative (<1.0 x 10^{-5}) CR, assessed 30-45 days after initiation of the fourth cycle of VRd consolidation.

Secondary endpoints were overall response rate (ORR) including best overall response, PFS and OS and safety assessments from enrollment to the post consolidation visit.

Exploratory endpoint was the mean change scores for the global health status/QoL domain from enrollment to the post consolidation visit.

In this article, we report the primary endpoint of MRD-negative (<1.0 x 10^{-5}) CR 30-45 days after initiation of the fourth cycle of VRd consolidation; the secondary endpoints of ORR and safety from baseline to the post consolidation visit, results for PFS and OS; and the exploratory endpoint of global health status/QoL.

Statistical analysis

The primary analysis and the efficacy and safety analyses were performed in patients who had received at least one dose of study treatment. To enroll approximately 196 MRD-negative CR patients in the randomized part of the study (phase 3 component), we considered 391 patients sufficient in the non-randomized part (phase 2 component) under the assumption that 45% would be MRD-negative following first line treatment (12). Patients tested for MRD status at the post-consolidation visit (VGPR or better) who did not meet the criteria for MRD-negative CR could remain on protocol if they received lenalidomide maintenance. These patients were followed for up to 24 months and became eligible for enrollment into the randomized phase upon achieving MRD-negative CR during this period.

Participant characteristics were summarized using proportions for categorical variables and median for continuous variables. For comparisons between groups, the Chi-Square test or Fisher’s exact test (in case of expected cell count below 5 and low total number) were used for categorical variables, and Mann–Whitney U for continuous variables. Follow-up time was estimated using the reverse Kaplan–Meier method, in which patients without an event were treated as events and those with an event were censored. Median follow-up was calculated separately for OS and PFS to account for differences in censoring patterns between the two endpoints. OS was defined as the time from study inclusion to death from any cause, and PFS as the time from inclusion to disease progression or death, whichever occurred

first. Patients who initiated non-protocol therapy before documented progression were censored at the date of last disease assessment prior to the start of the new therapy. Patients who were randomized to the experimental arm (MRD-guided) were censored. Patients alive (for OS) or without progression (for PFS) at the time of data cutoff were censored at the date of last follow-up. Calculation of the global health status/QoL domain score and handling of missing items were performed according to the EORTC scoring manual (14). Linear mixed model of repeated measures was used to estimate mean score changes over time. P values below 0.05 were determined to be statistically significant. Mean score changes exceeding the medium thresholds for minimal important difference defined as >8 for improvements and <10 for deterioration were determined clinically meaningful (15). The PRO completion rate was calculated as the number of completed questionnaires divided by the number of expected questionnaires. Questionnaires missing due to late inclusion were not considered expected. All calculations were performed using R-Studio (version 4.4.0).

Results

Between August 26, 2020, and September 18, 2024, 394 patients were assessed for eligibility, and 382 patients started protocol-directed therapy and are included in the analysis (figure 1). Demographic and baseline characteristics are listed in table 1. The median age was 63 years (IQR: 56-67, range: 32–75), 153 (40%) were aged ≥65 years, 39 (10%) were ≥70 years, and 229 (60%) were male. Osteolytic lesions (302 [79%]) were the most common diagnostic criterium, followed by anemia (197 [52%]), renal insufficiency (71 [19%]), and hypercalcemia (42 [11%]). 53 (14%) patients had ECOG performance status ≥ 2, 99 (26%) had initiated induction therapy prior to inclusion, and 42 (12%) had a history of previous invasive cancer.

ISS stage III disease was present in 101 (26%) patients, 79 (21%) had cytogenetic high-risk disease, 45 (12%) had double-hit myeloma, and 42 (11%) had soft-tissue plasmacytomas (paramedullary and/or extramedullary). In addition, four (1%) patients had concurrent AL amyloidosis and two (0.3%) had primary plasma cell leukemia.

ISS stage II and III disease, as well as a history of prior invasive malignancy, were more common in patients aged ≥65 years (75% vs 57% and 18% vs 6%, respectively; both p<0.001).

From cycle 1 day 1 to the post-consolidation visit, 82 patients (21%) had discontinued treatment. The most common reasons were disease progression (28[7%]), patient choice (28 [7%]) and physician decision (11 [3%]). Seven patients (2%) died due to adverse events, and four patients (1%) discontinued treatment because of adverse events. Of the 28 patients who discontinued protocol by choice, three did so because their private health insurance covered the addition of daratumumab, and 16 discontinued to participate in maintenance studies, which exclusively included patients with suboptimal response after ASCT.

Of the 345 patients remaining on protocol at the ASCT phase, 189 (55%) underwent a single ASCT, 134 (39%) received tandem ASCT, and 22 (6%) did not undergo transplantation. There were no differences

between age groups regarding ASCT. Reason for not proceeding to transplantation included physician decision (n=17), harvest failure (n=4), and patient choice (n=1).

MRD-negative CR was achieved in 127 (33%) of 382 patients within 30-45 days after initiating the fourth cycle of consolidation therapy. The ORR, defined as partial response or better, was 94%, and 327 (86%) achieved VGPR or better. There were no significant differences in ORR or MRD-negative CR between patients <65 years and those ≥65 years (table 2).

At the time of data cutoff for the primary endpoint (November 5, 2025), the median follow-up was 34.7 months for PFS and 36.8 months for OS. The 12-month PFS was 88% (95% CI 85–92) and the 24-month PFS was 79% (95% CI 75–83). The 12-month OS was 97% (95% CI 95-98) and the 24-month OS rate was 93% (95% CI 90-95) (figure 2). Among patients <65 years the 12-month PFS was 86% (95% CI 81-91), and the 24-month PFS was 79% (95% CI 73-85). The corresponding 12-month and 24-month OS were 97% (95% CI 95-100) and 94% (95% CI 91-97), respectively. For patients ≥65 years the 12-month PFS was 91% (95% CI 87-96), and the 24-month PFS was 79% (95% CI 73-86), while 12-month and 24-month OS were 95% (95% CI 92-99) and 90% (95% CI 86-95), respectively (figure 3).

Table 3 summarizes the AEs of grade ≥2 that occurred in at least 10% of patients as well as all grade 5 events. The most common grade 3-4 AEs were infections (169 [44%] of 382 patients) and cytopenias (83 [22%] of 382 patients). AEs that were significantly more frequent among patients aged ≥65 included thromboembolic events (13% vs 6%, $p<0.05$), musculoskeletal and connective tissue disorders (25% vs 17%, $p<0.05$), gastrointestinal and hepatobiliary disorders (30% vs 21% $p<0.05$), and cardiac disorders (12% vs 5%, $p<0.05$). AEs that led to treatment discontinuation were reported in four (1%) patients, including intractable atrial flutter, diaphragmatic paresis, Stevens-Johnsons syndrome, and rectal bleeding. Seven patients died due to AEs: four from infections, one from cardiac arrest, one from interstitial lung disease, and one from flail chest secondary to myeloma. Three of these deaths were assessed as possibly related to study treatment. Two additional deaths occurred within 30 days after the end of treatment, one due to infection in a patient who was primary refractory to VRd, and one due to progressive disease.

Questionnaire completion rate from screening through the post consolidation visit was 94%. The patients reported statistically significant and clinically meaningful deterioration in global health status/QoL at all post-baseline assessment time points. HRQoL remained stable throughout the consolidation period (appendix p 4).

Discussion

In this single-arm, phase 2 study of TE-NDMM, 40% of patients were aged ≥65 years, 26% had ISS stage III disease, and 19% met diagnostic criteria for renal insufficiency. Treatment with VRd induction, single or tandem HD-ASCT, and VRd consolidation, resulted in an MRD-negative CR in 33% of patients, assessed 30-45 days after initiation of the fourth cycle of VRd consolidation. A VGPR or better was achieved in 86% of patients. PFS rates were 88% at 12 months and 79% at 24 months. Clinical outcomes

were comparable across age groups, with similar response rates, PFS and OS in patients aged ≥65 years and those <65 years.

All patients deemed eligible for a second transplant were offered one. Lenalidomide was dosed higher-than-label for patients with eGFR 30-49 ml/min per 1.73m^2 (25 mg/day) and for those with eGFR <30 ml/min per 1.73m^2 (15 mg/day) (16).

Eligibility criteria in studies of NDMM have historically been relatively restrictive and consistent across trials, often excluding patients with significant comorbidities or advanced disease, limiting the generalizability of trial outcomes to routine clinical practice (17). Therefore, it is essential to design clinical studies in a way that improves the generalizability and real-world relevance of trial outcomes.

The REMNANT study enrolled patients with significant comorbidities, poor performance statuses, and high age. The protocol allowance for one prior cycle of induction therapy further enabled the inclusion of patients with aggressive clinical presentations requiring urgent treatment initiation.

The study population aligns with population-based real-world data from Norway (2008–2020). In a retrospective analysis of 1354 NDMM patients who had received upfront ASCT, the median age was 62, 11% had renal insufficiency (eGFR <40 mL/min per 1.73 m^2 or creatinine >177 µmol/L), 24% had ISS stage III disease, and 21% had high-risk cytogenetics (18).

To contextualize these findings, comparison with contemporary landmark trials is informative. The IFM 2009 (1) and DETERMINATION studies (2), both comparing VRd with or without upfront ASCT in TE-NDMM, and the PERSEUS trial (3), which compared VRd induction and consolidation, ASCT, and lenalidomide maintenance, with or without daratumumab in TE-NDMM, all applied more restrictive eligibility criteria. These studies excluded patients with renal impairment (eGFR<30 in PERSEUS; <50 in IFM 2009 and DETERMINATION), prior induction therapy, or recent invasive malignancy. Furthermore, IFM 2009 and DETERMINATION applied an upper age limit of 65 years, while PERSEUS capped inclusion at 70 years. These criteria are reflected in their respective baseline populations, which were younger (median ages: 60 years in PERSEUS; 60 years in IFM 2009; 55 years in DETERMINATION), fitter (ECOG 2: 5% in PERSEUS; not reported in IFM; 11% in DETERMINATION), and had a lower prevalence of high-risk clinical features (ISS stage III 15% in PERSEUS; 17% in IFM 2009; 13% in DETERMINATION, eGFR<40 not reported in PERSEUS, not allowed in IFM 2009 and DETERMINATION), compared with the study population in REMNANT. High-risk cytogenetics were more comparable across studies (22% in PERSEUS, 13% in IFM 2009, and 19% in DETERMINATION). In addition, 25% of patients included in PERSEUS were ≥65 years. In REMNANT, 85% of patients proceeded to ASCT, which is similar to the 87% reported in the VRd-group in PERSEUS, despite a larger proportion of patients aged ≥65 years in REMNANT (40% vs 26%), showing the feasibility of HD-ASCT in this patient population.

Despite the inclusion of older, more comorbid, and clinically high-risk patients, efficacy outcomes in the REMNANT study were comparable to those reported in the VRd plus ASCT in these phase 3 trials. The rate of VGPR or better was 86%, similar to that observed in the transplant group of the IFM 2009 (78%)

and DETERMINATION (83%), and only slightly lower than in the VRd group of the PERSEUS trial (89%) (1-3). Notably, the MRD-negative CR rate in REMNANT was 33% post consolidation, which closely matches the 35% ≥ CR at the end of consolidation and the 39% MRD-negative CR rate reported at 12-month follow up in the VRd-group of PERSEUS (19). The similar results observed in this higher-risk population, especially when it comes to ISS stage III disease, age, and comorbidity, can result from the more intensive treatment schedule in REMNANT compared with the VRd arm in PERSEUS. In REMNANT, higher-than-label dosing of lenalidomide was administered to patients with renal impairment and tandem ASCT was performed in 39% of those who reached the ASCT phase. Early progressive disease prior to the maintenance phase occurred more frequently in REMNANT than in the VRd-group of PERSEUS (7% vs 3%), reflecting more aggressive disease in the REMNANT trial. However, the incidence of adverse events leading to treatment discontinuation or death was low in our trial (3%), supporting the overall tolerability and safety of this more intensive treatment approach. Importantly, these findings suggest that early discontinuations were primarily attributable to aggressive myeloma biology in our patient population rather than to the intensity of the treatment itself. HRQL was significantly deteriorated at the initiation of consolidation compared to baseline and remained stable throughout the consolidation period indicating a persistent but non-worsening symptom burden during this phase of therapy.

The REMNANT study demonstrates that a VRd-based induction and consolidation strategy combined with single or tandem ASCT can achieve rates of MRD-negative CR comparable to more selected populations, in a clinically diverse NDMM population closely resembling the non-trial myeloma population in Norway. Our results show that NDMM patients up to the age of 75 years can receive HD-ASCT, which can be of importance for patients with high-risk cytogenetics who have demonstrated inferior outcomes in non-transplant trials with an anti-CD-38 monoclonal antibody and VRd (20, 21).

Declarations

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Author Contributions

FBA revised the protocol, conducted the clinical trial, analyzed the data, and wrote the manuscript.

A-MR is the project leader, wrote the protocol, analyzed the data, and revised the manuscript.

AL analyzed the data and revised the manuscript

PA validated and analyzed the data and revised the manuscript.

EH conducted the clinical trial, analyzed the data, and revised the manuscript.

MM conducted the clinical trial, analyzed the data, and revised the manuscript.

ALE conducted the clinical trial, analyzed the data, and revised the manuscript.

GT conducted the clinical trial, analyzed the data, and revised the manuscript.

BDE conducted the clinical trial, analyzed the data, and revised the manuscript.

NML conducted the clinical trial, analyzed the data, and revised the manuscript.

JR conducted the clinical trial, analyzed the data, and revised the manuscript.

VS conducted the clinical trial, analyzed the data, and revised the manuscript.

ES conducted the clinical trial, analyzed the data, and revised the manuscript.

RFH conducted the clinical trial, analyzed the data, and revised the manuscript.

DS conducted the clinical trial, analyzed the data, and revised the manuscript.

LO contributed to the design of the study, analyzed the data and revised the manuscript.

MHF contributed to the design of the study, analyzed the data and revised the manuscript.

APR analyzed the data and revised the manuscript.

BJ analyzed the data and revised the manuscript.

TR analyzed the data and revised the manuscript.

HHT analyzed the data and revised the manuscript.

AAH conducted the clinical trial, analyzed the data, and revised the manuscript.

ASN conducted the clinical trial, analyzed the data, and revised the manuscript.

TSS conducted the clinical trial, analyzed the data, and revised the manuscript.

FS designed the study, revised the protocol, conducted the clinical trial, analyzed the data, and revised the manuscript.

Competing interests

FBA has received honoraria or payments from J&J and Sanofi; and has participated in advisory boards for J&J and Sanofi. EH has received honoraria or payments from J&J; and has participated in advisory

boards for Sanofi. MM has received honoraria or payments from J&J, AstraZeneca, Pfizer and Abbvie; and has participated in advisory boards for Sanofi, Abbvie, Shire and Lilly. ALE has received honoraria or payments from J&J, Bayer, Pfizer and Incyte; and participated in advisory boards for Sanofi, J&J, Pfizer and GSK. GT has received honoraria or payments from J&J, Sanofi, SOBI and Grifols; and has participated in advisory boards for J&J, Sanofi, SOBI and Grifols. VS has received honoraria or payments from J&J. AP-R works at BCNpeptides; has received honoraria from GP-Pharm; has participated in the executive board of GP-Pharm; and holds stocks in BCNpeptides and GP-Pharm. TSS has received honoraria for lectures and educational material from Takeda, Celgene, Amgen, J&J, Abbvie and Pfizer; has received consulting fees from BMS, GSK, Sanofi, Pfizer and Menarini Group; and has participated in advisory boards for Amgen, Celgene, GSK, J&J, Sanofi and BMS; and has received grants from Takeda and J&J. FS has received grants from Targovax; has received consulting fees from Caedo Therapeutics; has received honoraria/payment from Amgen, BMS, Takeda, Sanofi, Menarini, AbbVie, J&J, Oncopeptides and GSK; has participated on advisory boards or data safety monitoring for GSK, Takeda, BMS, J&J, Oncopeptides, Regeneron, Sanofi, XNK Therapeutics, Galapagos and Pfizer; and is the president of the Nordic Myeloma Study Group (academic group). All other authors declare no competing interests**.**

Data Availability Statement

De-identified participant data underlying the results reported in this Article will be made available upon reasonable request directed to the corresponding author. The sponsor of the trial, Oslo University Hospital, via the corresponding author, reserves the right to decide on whether to share the data.

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Tables

Tables are available in the Supplementary Files section.

Figures

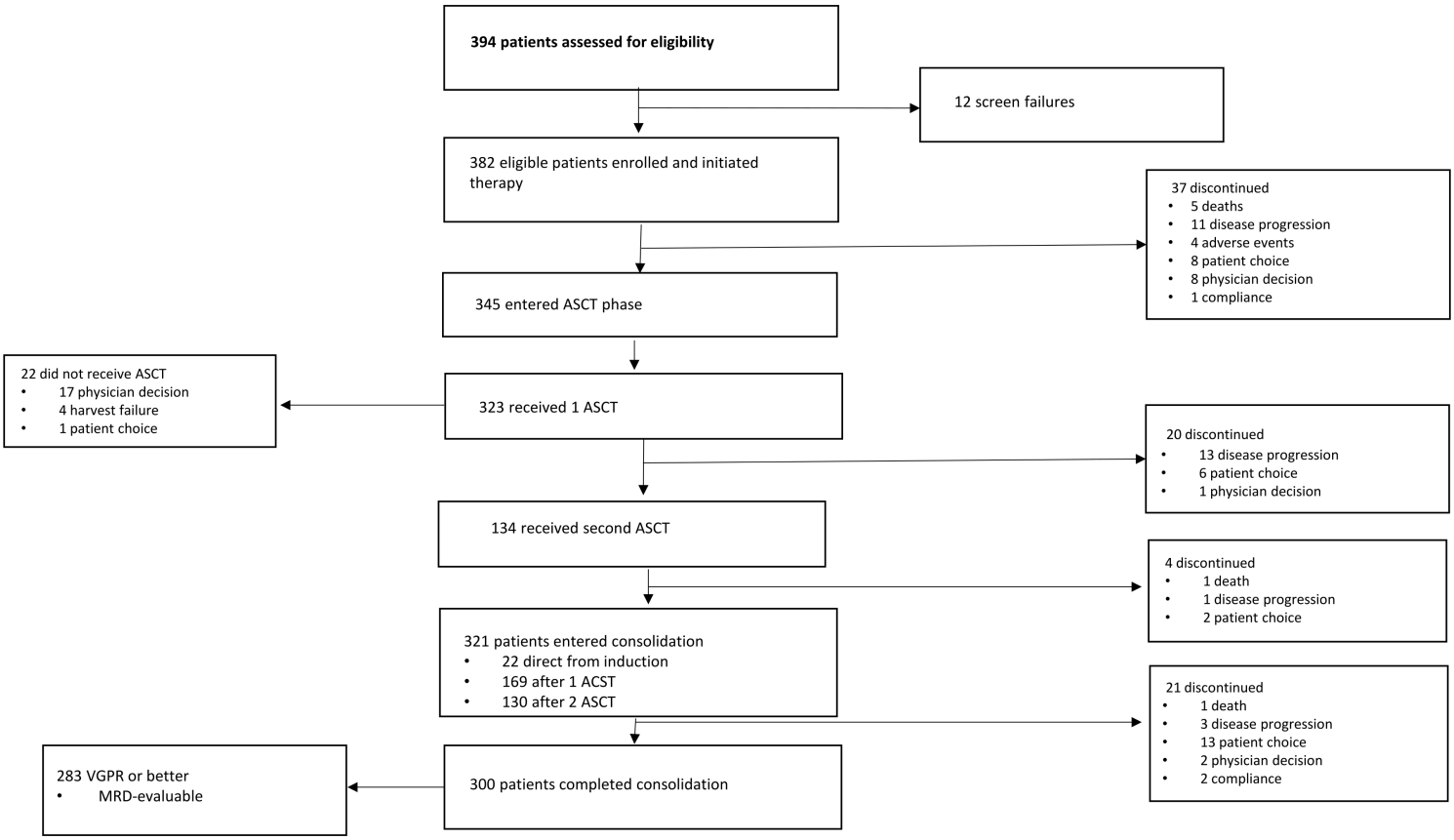


Figure 1

Trial profile

MRD-evaluable patients were those with a very good partial response or better 30-45 days after the initiation of the fourth consolidation cycle. ASCT=autologous stem cell transplantation. VGPR=very good partial response. MRD=measurable residual disease.

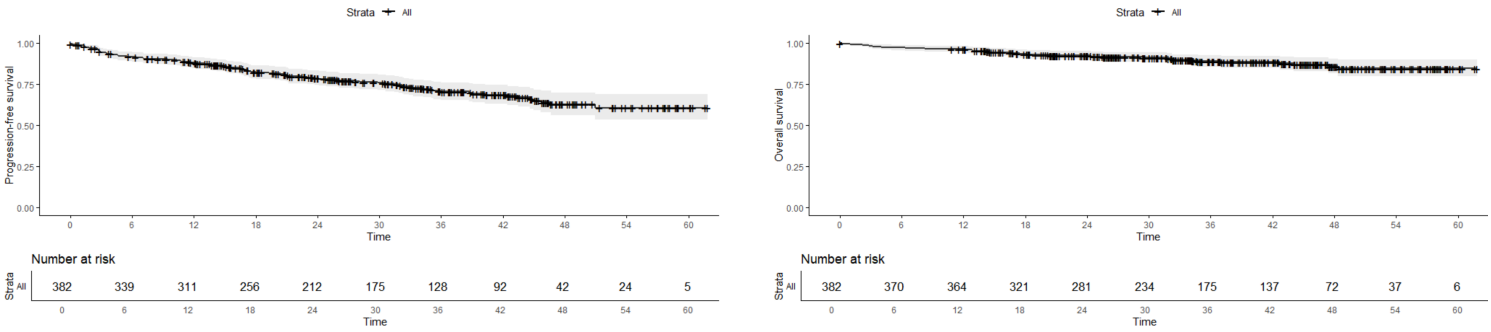


Figure 2

Kaplan-Meier plots of progression-free survival and overall survival in all patients

Shaded area represents 95% confidence intervals. Time 0 corresponds to the time of study inclusion

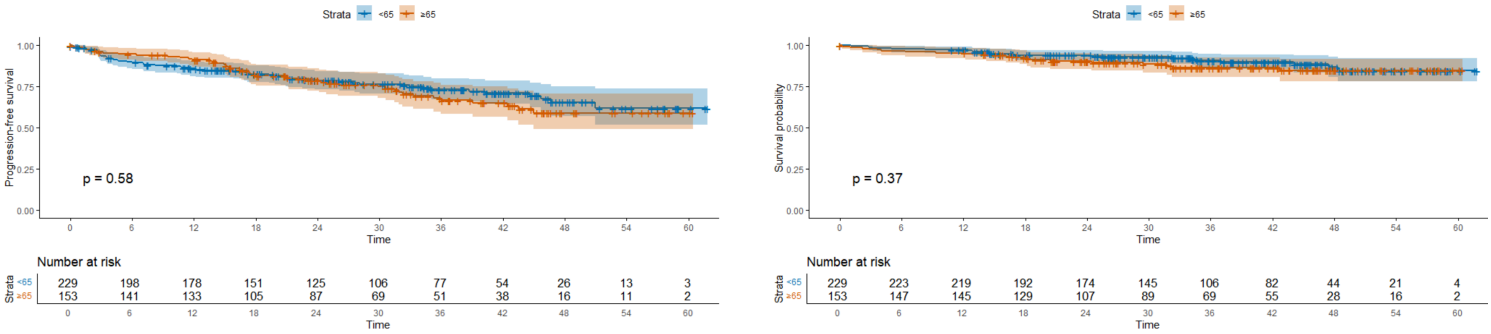


Figure 3

Kaplan-Meier plots of progression-free survival and overall survival by age group

Shaded area represents 95% confidence intervals. Time 0 corresponds to the time of study inclusion

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1BaselineCharacteristics.docx
- Table2Bestoverallresponse.docx
- Table3Advereseevents.docx
- Supplementaryinformation.pdf