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for MM patients using non–melphalan-based conditioning regimens. Patients were enrolled in the study after exhibiting response to induction therapy and meeting eligibility criteria. The treatment plan was designed to harvest a dose of 10×10^6 peripheral blood CD34+ cells/kg for the planned 2 transplants; however, a second ASCT would be pursued only in the event that CR/VGPR was not achieved after the first ASCT. The conditioning regimen for the first ASCT included oral busulfan 0.75 mg/kg every 6 hours on days −8 through −5, intravenous (IV) etoposide 10 mg/kg/day on days −4 to −2, and cyclosphosphamide (CP) IV 60 mg/kg/day on days on −3 and −2. The conditioning regimen for the second ASCT included 96-hour (days −6 through −3) continuous infusion of CP (6 g/m^2) and total body irradiation of 600 cGy in 4 fractions (days −2 and −1), followed by reinfusion of stem cell product. Forty evaluable patients have been analyzed. The median patient age was 56 years, with a median time from diagnosis to first ASCT of 8.7 months. Thirteen patients met the criteria for high-risk myeloma. After the first ASCT, 15 patients had CR/VGPR, 11 proceeded to the second ASCT, 8 refused to proceed to the second ASCT, and 6 others did not proceed for other reasons. All patients were offered posttransplantation maintenance therapy and treated with monthly bisphosphonate. There was no treatment-related mortality. Overall, 2 of 29 patients who underwent single transplantation died 17 and 15 months after the transplantation secondary to disease progression (DP) or pneumonia. Three out of 11 patients who underwent tandem transplantations died, 2 of DP at 15 and 26 months after the second transplantation, and 1 patient with a history of gastric bypass died of cryptogenic cirrhosis/liver failure at 7 months. The median time between the two ASCTs was 107 days. Improvement in response category occurred in 34% after the first ASCT and in a total of 55% after the second ASCT. The overall CR/VGPR rate was 20% before ASCT, 52% after single transplantation, and 64% after double transplantation. At a median follow-up of 15 months from the last ASCT, PFS was 14 months after single transplantation (n = 29) and 23 months after double transplantation (n = 11) (P = .46). The overall survival has not been reached for both groups. The median PFS was 41 months for all those with CR/VGPR, versus 26 months for all others (P = .0146). In conclusion, non–melphalan-based conditioning regimens seem to be effective and safe.

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CD34+CD38− AND CD34+HLA−DR− CONTENTS IN BMSC GRAFTS CORRELATE WITH SHORT-TERM ENGRAFTMENT BUT HAVE NO INFLUENCE ON LONG-TERM HEMATOPOIETIC RECOVERY IN PATIENTS WHO RECEIVED AUTOLOGOUS BONE MARROW TRANSPLANTATION

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Previous animal and human studies have demonstrated that the number of CD34+ subsets such as CD34+CD38− and CD34+HLA−DR− subsets in stem cell grafts is significantly associated with the speed of short-term hematopoietic reconstruction (SHR). The aim of this study was to determine whether these CD34+ subsets predict long-term hematopoietic reconstitution (LHR) in recipients of autologous bone marrow transplantation (ABMT).

We have examined 53 lymphoma patients who received ABMTs to determine if total mononuclear cell dose, CFU-GM, CD34+ cell dose and CD34+ cell subsets (CD34+CD38− and CD34+HLA−DR−) correlate with both SHR and LHR. Time to neutrophil engraftment (TNE) and time to platelet engraftment (TPE) were used to measure SHR, and platelet count was used as an indicator of LHR at day 100 and 1 year post-ABMT. A total of 42 and 38 patients were analyzed at day 100 and 1 year post-transplant, respectively. Patients were excluded either because they were deceased or there was lack of follow-up data. Using a univariate unadjusted logistic regression analysis, all of the predictor variables were significantly associated with SHR. However, at day 100, only CFU-GM and CD34+ cell dose significantly predicted LHR. In addition, at 1 year post-ABMT, only CD34+ cell dose predicted LHR. CD34+ cell dose maintained its significance in multivariate analysis adjusting for age, sex, and disease. None of the CD34+ cell subsets predicted LHR.

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ELEVATED MEAN CORPUSCULAR VOLUME (MCV) FOLLOWING AUTOLOGOUS HEMATOPOIETIC STEM CELL TRANSPLANTATION: INCIDENCE AND SIGNIFICANCE

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Background: A relationship between macrocytosis and the risk of secondary leukemia has been suggested in long-term cancer survivors after chemotherapy. The incidence and significance of MCV elevation after high-dose chemotherapy and autologous hematopoietic stem cell transplantation (ASCT) is unknown. **Methods:** A retrospective analysis of 130 consecutive patients who underwent ASCT between January 1999 and December 2003 was performed. Complete blood count profile was analyzed at transplantation and then at 6 months, 1 year, and yearly after transplantation. Patients with relapse of disease within 6 months of transplantation were excluded. Sixty-three of 130 (48%) patients were eligible for the study. Patient characteristics and time to achieve long-term hematologic recovery (hemoglobin > 12 g/dL, WBC > 4000/mm^3, platelets > 150,000/mm^3) were analyzed. When available, history of alcohol abuse, abnormal liver function, thyroid function, vitamin B_{12}, and folate deficiency were recorded. **Results:** At median follow-up of 22 months (range, 6–58 months), 33 of 63 (52.8%) patients displayed elevated MCV 6 months posttransplantation. The median patients age was 12 years (range, 1–76 years). Four patients underwent double transplantation. Median time to engraftment for neutrophils and platelets was 12 and 19 days, respectively. The median time to trilineage hematologic normalcy was 289 days; 27 of 33 (81%) patients had suboptimal long-term hematopoietic recovery at 6 months (WBC, 5 months; hemoglobin, 14 months; platelets, 22 months).

At 6 months posttransplantation, 15 of 43 (35%) adult patients displayed elevated MCV (normal, 81–99 fl); the mean pretransplantation MCV of 97.5 fl increased to 102.7 fl (P = .004). Of the 20 pediatric patients, 18 (91%) displayed elevated MCV at 6 months posttransplantation; mean pretransplantation MCV of 90.8 fl increased to 94.1 fl (P = .001). Persistent MCV elevation was observed in 17 of 26 patients (65%) at 1 years posttransplantation and in 7 of 14 patients (50%) at 2 years posttransplantation. Pretransplantation red cell distribution width (RDW) was higher pretransplantation (63%) than at 6 months posttransplantation (45%). Further investigations of MCV elevation available in 10 patients were negative. No patients developed MDS or leukemia. **Conclusion:** MCV elevation after high-dose chemotherapy and ASCT is frequent, with an incidence of 52.8%. Macrocytosis occurred unrelated to anemia; routine workup of macrocytosis is unnecessary. Longer follow-up is needed to determine its significance, if any.

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MYELOABLATIVE CHEMOTHERAPY AND AUTOLOGOUS PERIPHERAL STEM CELL TRANSPLANTATION WITHOUT THE USE OF BLOOD PRODUCTS

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Background: Refusal of blood products poses a treatment challenge for Jehovah's Witness patients whose malignant diseases require high dose chemotherapy. We report our findings from a series of Jehovah's Witness patients who were enrolled in our

transfusion-free autologous stem cell transplantation protocol. **Methods:** Seven patients were enrolled with malignancies that would be treated with high dose chemotherapy. Four patients had lymphoma, 1 patient had Ph+ acute lymphocytic leukemia, 1 patient had progressive CNS germinoma, and 1 patient had multiple myeloma. All patients underwent autologous stem cell transplantation when in partial or complete remission. Patients entered the study 8 weeks before anticipated stem cell transplantation and received a regimen of recombinant erythropoietin, 40,000 U once or twice weekly with the aim of achieving a hemoglobin level of 15 g/dL. G-CSF 10 μg/kg was given for 5 days for stem cell mobilization. High-dose therapy was disease-specific. **Results:** All patients suffered significant pancytopenia, with no major side effects in 6 of the 7 patients enrolled. One patient with progressive CNS germinoma died from cerebral hemorrhage shortly after stem cell infusion, but her platelet count was 31×10^9/L and hemoglobin level was 16.4 g/dL before death. It is unlikely that her intracranial hemorrhage was due purely to thrombocytopenia, but it may have reflected tumor necrosis secondary to chemotherapy. The other patients all remain in complete remission to date. They are now 45+, 36+, 24+, 9+, 5+, and 1+ months status posttransplantation. **Conclusion:** Autologous stem cell transplantation is a feasible treatment option for Jehovah's Witness patients. Refusal of blood product support should not be considered an absolute contraindication for high-dose chemotherapy and autologous stem cell transplantation.

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HPC IN PERIPHERAL BLOOD PREDICTS CFU ACTIVITY AND TIME TO ENGRAFTMENT IN AUTOLOGOUS APHERESIS PBSC PRODUCTS AS EFFECTIVELY AS CD34 CELL COUNT

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In autologous PBSC products collected after growth factor mobilization, previous studies have shown that measurements of HPC correlate with CD34 cell count in peripheral blood (PB) before apheresis collection. Because CFU activity in the final product is expected to be a standard measure of HSC/HPC content, we compared the HPC and CD34 counts in PB before collection with CFU in the final product, to determine the utility of preapheresis HPC in identifying patients likely to produce a suitable product. By measuring CD34 and total MNC cell content in PB before collection, midway through collection, and in the final product, we found that the ratio of CD34/MNC remained constant. This demonstrates that recovery of progenitor cells and MNC is identical throughout collection and processing. This observation allows calculation of expected CFU content in the final product based on preapheresis HPC and CD34 measurements. Using the observed product ratio of CFU/CD34 (0.192 ± 0.102) and the expected product ratio of CFU/HPC (0.113 ± 0.060) (n = 25 for both values), we compared the predicted product CFU content based on observed HPC and CD34 cell count in preapheresis peripheral blood with the actual CFU content recovered in the final product. **Results:** Autologous products (n = 12) from 10 patients were compared between CFU (10^6) predicted by peripheral blood HPC (median, 21; range, 0–416) and CD34 (median, 11; range, 0–165) with actual CFU (median, 23; range, 4–131) obtained on the final product (P =.08; Freidman test). A strong linear association was noted between actual CFU and preaphersis HPC (Spearman rank correlation = 0.84). **Conclusion:** This pilot study suggests that HPC in peripheral blood predicts CFU content as effectively as CD34. For 75% of the samples, the observed CFU and the CFU predicted by HPC was higher than the CFU predicted by CD34, possibly indicating a CD34 fraction that is capable of colony formation and that can be measured by the HPC parameter.

GRAFT PROCESSING

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EXPERIENCES OF PERIPHERAL BLOOD STEM CELLS COLLECTION FROM RADIAL ARTERY FOR UNRELATED DONOR TRANSPLANTATION

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Many donors with inadequate peripheral venous access were encountered in our center. Central venous access was an alternative method of peripheral blood stem cell (PBSC) collection but posed significant risks to donors. Although the frequency of progenitor cells in the radial arteries was reduced in comparison to that in the central veins, probably associated with pulmonary PBSC trapping, the impact on clinical PBSC transplantation may be negligible. The experiences of 27 PBSC unrelated donors who had inadequate peripheral venous access and were collected from radial arterial line are reported. There were 18 males and 9 females, ranging in age from 23 to 52 years (median, 29 years). The body weight of donors ranged from 50 to 106.5 kg (median, 63 kg); that of recipients, from 20 to 103 kg (median, 62 kg). All donors were treated with 4–5 days of filgramstim at an approximate dose of 10 mg/kg/day and underwent 1–2 days of apheresis with a continuous-flow blood cell separator. Preapheresis white cell and platelet counts were $37.5 \pm 8.9 \times 10^9$/mL and $196 \pm 36 \times 10^9$/mL, respectively. Calcium gluconate replacement was administered while the patients complained of numbness. A total of 19.2 ± 6.6 L of blood was processed per donor. Collection took 5.9 ± 2.1 hours per donor. A total of $501 \pm 155 \times 10^8$ nucleated cells and $347 \pm 188 \times 10^6$ CD34+ cells per donor were collected. These yielded $8.7 \pm 3.6 \times 10^8$ total nucleated cells and $6.0 \pm 3.5 \times 10^6$ CD34+ cells/kg of the recipient weight. None of PBSC donors was noted to have laboratory hypocalcemia. The platelet count ranged from 95 to 179×10^9/mL (median, 132) immediately postapheresis, which corresponded to a decrease of $55 \pm 27 \times 10^9$/mL. Two donors still experienced anorexia, headache, malaise, or myalgia 1 week postapheresis, but none did 1 month postapheresis. The white cell count, lymphocyte count, and platelet count 1 month postapheresis was $5.5 \pm 1.5 \times 10^9$/mL, $1.7 \pm 0.4 \times 10^9$/mL, and $227 \pm 45 \times 10^9$/mL, respectively. Engraftment rate of recipients was 100% after exclusion of 2 early deaths (1 before and another 6 days after PBSC infusion). PBSC collection from a radial arterial line might be acceptable for unrelated donor transplantation when the donor has inadequate peripheral venous access.

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EFFECT OF THE NUMBER OF DAYS REQUIRED FOR COLLECTION OF ALLOGENEIC PERIPHERAL BLOOD STEM CELLS ON ENGRAFTMENT

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The use of peripheral blood stem cells (PBSCs) for allogeneic transplantation continues to increase. The relationship between ease of mobilization of PBSC and engraftment after transplantation has not been extensively studied. We retrospectively analyzed the relationship between days of collection by apheresis (categorized as 1, 2, and > 2) and engraftment in 109 matched sibling donor/recipient pairs who underwent collection between March 1995 and November 2003. All donors recieved G-CSF at 10 μg/kg for 4 days, with collection started on the fifth day. Daily G-CSF administration and collection were continued until a minimum of 3×10^6 CD34+ cells/kg per recipient had been collected. Cells were frozen and stored in DMSO until infusion. All grafts were unmanipulated, and all recipients received G-CSF posttransplantation. Fifty-one donors (47%) required 1 day to collect an adequate graft, 52 donors (48%) required 2 days, and 6 donors (6%) required > 2 days. Females were more likely to require > 1 day of collection (P = .01). Donors who required > 2 days for collection were older than donors who required only 1 or 2 days (P = .015). There was no association between days required for collection and