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Background: Although small studies have linked poor nutritional status pre-hematopoietic stem cell transplant (HSCT) to metabolic derangements post-HSCT, no large study has studied the influence of nutritional support initially after HSCT on clinical outcomes. We hypothesized that better enteral (EN) or parenteral nutrition (PN) before and peri-HSCT would correlate with improved nutritional status and fewer complications after HSCT including graft-versus-host disease (GVHD). We conducted a multi-institutional, IRB approved retrospective study to compare the nutritional status of patients who received EN, PN, or suboptimal nutrition in the week before and the first 4 weeks post-HSCT using a novel nutritional summary score.

Method: We devised the nutrition summary score by assigning a number from 0-2 (0=no/poor EN/PN, 1=PN for goal calories, and 2=EN for majority of goal) weekly for the 5 weeks (-1, 1, 2, 3, 4) per patient; the scores were summed (total summary score ranged from 0-10). Nutritional assessments and outcomes were abstracted from medical records at day 28, day 100, and 1 year after HSCT.

Results: Data were captured from 162 patients (78% pediatric and 22% adult) from 5 institutions. Patients were a median age of 10.34 years (range: 1-75), 58% male, and 75% received myeloablative, 17% reduced intensity, and 8% non-myeloablative HSCT. At the pre- and peri-HSCT period, few patients had gastric tubes (6/162) but 44% (72/162) had nasogastric tubes for EN. The majority (89%) engrafted by day +28, and GVHD rates reflect the predominance of pediatric patients with only 14% (22/162) grade I-II acute GVHD (aGVHD), 17% (27/162) grade III-IV aGVHD, 10% (17/162) limited chronic, and 10% (16/162) chronic extensive GVHD. Mean summary nutrition scores and % EN for each time point were: pre-BMT: 1.42 and 70% EN, week 1: 1.41 and 64%, week 2: 1.3 and 52%, week 3: 1.3 and 54%, and week 4 1.3 and 58%. The day +28 albumin was correlated directly with the summary nutrition score ($p<0.0001$). The weight 100 days after HSCT was also associated with summary nutritional score ($p=0.017$), while chronic extensive GVHD was associated with lower nutrition score ($p=0.047$). Using only patients who received EN at some point (at least one value of 2 in the 5 weeks), weight at day 28 ($p=0.002$) and day 100 ($p<0.002$), and lower risk of cGVHD ($p< 0.04$) all were significant, suggesting that EN contributed to these outcomes.

Conclusions: Our data suggest that EN and PN in the pre- and peri-HSCT period correlate with better nutrition after HSCT including albumin at day +28 and weight at day +100 and that these may influence risk for chronic extensive GVHD, a major complication of HSCT. Further, our data suggest that EN initially after HSCT may be important, and support a prospective study to evaluate whether interventions to improve enteral alimentation enhance outcomes and diminish the risk of chronic extensive GVHD.

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Incidence and Outcome of Early Hospital Readmission Following Hematopoetic Stem Cell Transplantation in Pediatric and Young Adult Patients

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Introduction: Hematopoietic stem cell transplantation (HSCT) provides potential curative treatment for various benign and malignant conditions. However, there is a high rate of patients requiring readmission to the hospital within six months of transplantation. There is only limited literature evaluating risk factors and causes of readmission of children, adolescents and young adults (AYA) who underwent HSCT.

Materials and Methods: A retrospective analysis of patients aged $\leq$ 26 years treated at University of Texas MD Anderson Cancer Center with HSCT was conducted using descriptive measures.

Results: A retrospective chart review of 435 transplants in pediatric and AYA patients from the period of 2008 to 2013 revealed that 161 (37%) patients had at least one hospital readmission within 180 days of transplant. Ninety-five patients were male. The median age at transplant was 21 (range 1-26) years. Primary diagnoses were as follows: hematologic malignancy (n=115), solid tumor (n=32), and non-malignant conditions (n=17). Lansky or Karnofsky function levels were at a median of 90% at the time of transplant. Amongst patients readmitted, 87% of patients received allogeneic HSCT and 13% had autologous HSCT. The median number of readmissions per patient was 2 (range 1-6). Twenty-nine (18 %) patients were transplanted more than one time including 4 patient readmits as part of tandem transplant. Forty-three (29%) patients with solid and hematological malignancies were not in remission at time of transplant. A total of 276 readmission events were reported in the study. The etiology of readmission was multifactorial, and the event etiologies are summarized in Table I. At a median follow up of 23.5 months (range 0.2-72), 88 of 161 readmitted patients remain alive. Causes of death were due to disease recurrence (n=46) and transplant related mortality (n= 27).

Discussion: This is the largest reported pediatric and young adult cohort reporting the etiology of readmission within 6 months after HSCT. The highest cause of readmission was documented infection. Disease relapse contributed to the high mortality of these patients. We aim to define a risk standardized approach to decrease hospital readmissions post HSCT, identify a low risk group of patients and devise intervention(s) that reduce the rate of readmissions.

Table I
Etiology of re-admission

Reason for admission	Events
Documented infection	95 (34%)
GVHD	58 (21%)
Unexplained fever	58 (21%)
Relapse	29 (10%)
Gastrointestinal symptoms	28 (10%)
Other	8 (2%)
Total events	276

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Pain Following Hematopoietic Stem Cell Transplant: A Prospective Observational Study

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Introduction: Pain following hematopoietic stem cell transplantation (HSCT) is caused by several factors: chemotherapy, radiotherapy, infections, GVHD, and medications. Difficulties in defining and accurately diagnosing pain symptoms can lead to delays in starting effective analgesia and poorer quality of life. Pain syndromes following HSCT have not been well-studied and the actual prevalence is unknown. The goal of this study was to determine incidence, severity, and the time course of pain following HSCT.

Method: We designed a prospective, observational study which enrolled 100 patients undergoing HSCT (60% autologous, 40% allogeneic. 19 unrelated, 13 sibling, 8 double cord. Myeloma 44%, leukemia 29%, lymphomas 26%, and aplastic anemia 1%). Patients enrolling on the study completed 5 questionnaires before HSCT and 1, 2, 3, 6, 9, and 12 months after HSCT. The questionnaires were the Brief Pain Inventory (BPI), the EORTC Quality of Life Questionnaire-Chemotherapy Induced Peripheral Neuropathy (EORTC-CIPN), the Muscle and Joint Measure (MJM), the MD Anderson Symptom Index – Graft-versus-Host Disease module (MDASI-cGVHD), and the Hospital Anxiety and Depression Scale (HADS).

Results: At the 9-month review, we found that there was a significant increase in pain reported after allogeneic HSCT compared to pre-HSCT. (71% increase at 3 months; p=0.01). This difference was independent of conditioning regimen, disease or GVHD. For autologous HSCT, there was an increase in reported neuropathic symptoms (47% increase at 3 months; p=0.02). We also found and increase in muscle cramping and spasms late after HSCT; both autologous and allogeneic (99% increase at 9 months; p=0.03). Muscle cramping interfered with sitting, standing and physical activity (21% at 6 months; p=0.04 and 136% at 9 months; p=0.04). The increase in muscle cramping symptoms was independent of conditioning regimen, disease or GVHD.

Conclusions: Our current review of this study reveals that pain and muscle cramping is a significant symptom that develops after both allogeneic and autologous HSCT. This appears to be independent of conditioning regimen, disease or GVHD.

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Management of Catheter-Related Thrombosis in Patients Undergoing Autologous Stem Cell Transplantation

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Introduction: The optimal management of catheter-related thrombosis (CRT) in patients undergoing autologous stem-cell transplantation (ASCT) remains poorly defined. We reviewed the management of catheter-related thrombosis in ASCT patients in our transplant unit over an 8-year period.

Methods: We reviewed all patients undergoing ASCT at Thomas Jefferson University from 2006-2013. Patients with previous history of venous thrombosis receiving anticoagulation at ASCT were excluded. Patients with CRT were identified and management was reviewed. Three populations were identified: No CRT, CRT no anticoagulation, and CRT on anticoagulation. We performed a Wilcoxon Ranks Sum analysis to evaluate blood and platelet utilization in the three groups. We also reviewed major bleeding events (MBE) and secondary thrombotic events (pulmonary embolism, PE).

Results: We identified 214 patients as described in Table 1. The incidence of CRT for the whole group was 11.2%. Of the 24 patients with CRT, 46% were treated with AC and the remaining was observed without AC. The median number of pooled platelets transfused was 14 in the CRT + AC group, 4 in the no CRT and 4 CRT with no anticoagulation groups (p=0.02). The median number of PRBC transfusions in the no CRT, CRT + AC, and CRT with no AC groups was, 2, 4, and 2, respectively (p=0.01). None of the patients with CRT developed a second thrombotic event (PE). Incidence of major bleeding within the CRT + AC group was 27% while in the CRT and no AC group was 15% (p=NS). One patient expired due to the result of a subarachnoid hemorrhage.

Conclusions: A strategy utilizing AC for CRT in the setting of an autologous transplant results in increased utilization of both platelet and PRBC transfusion and is associated with a trend towards a higher risk of major bleeding. There was no

Table 1
Patient Characteristics

	No CRT	CRT + Anticoagulation	CRT with no anticoagulation
Number of patients	190	11	13
Median age at transplant (year)	58	62	60
Male gender	116	6	10
Ethnicity:			
Caucasian	122	7	12
African	47	2	1
Asian	7	0	0
Hispanic	6	2	0
Other/Unknown	8	0	0
Malignancy:			
Myeloma	132	8	8
Non-Hodgkin's lymphoma	34	2	3
Hodgkin's lymphoma	12	0	0
Primary amyloidosis	3	1	2
CLL	2	0	0
AML	2	0	0
APML	1	0	0
Other	4	0	0
Conditioning:			
Melphalan alone	135	9	10
BEAM	48	2	3
Busulfan/Cyclophosphamide	2	0	0
Cyclophosphamide alone	4	0	0
Unknown	1	0	0
Neutrophil engraftment (in days)	11	12	12
Platelet engraftment (in days)	15	17	17

Table 2
Outcome analysis

	No CRT	CRT + Anticoagulation	CRT with no anticoagulation	p-value
Platelet utilization (Number of pooled platelet units)	4	14	4	0.02
PRBC cell utilization (Number of PRBC transfusions)	2	4	2	0.01