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Original Article

Assessing Nutritional Status of Patients Undergoing Autologous and Allogeneic Hematopoietic Stem Cell Transplant: An Experience from a Developing Country

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Abstract

Objective: To compare the nutritional status of patients undergoing hematopoietic stem cell transplant (HSCT) at three stages: admission to the Bone Marrow Transplant ward (BMTW), discharge, and one-month post-discharge.

Study Design: Analytical cross sectional study.

Place & Duration: Armed Forces Bone Marrow Transplant Center, January 2022 – December 2023.

Methodology: 25 adult patients with hematological disorders undergoing HSCT were included. Patients are admitted 7 days before transplant for conditioning chemotherapy and discharged once bone marrow is functional. Nutritional assessments were conducted at three time points: within 24 hours of admission (T1), at discharge (T2), and 30 days' post-discharge (T3), using the PG-SGA score. Data were collected via a self-administered questionnaire.

Results: Of the 25 patients, 64% were male; the mean age was 32.48 ± 11.9 years. According to BMI, 12.0 % patients were underweight, 28.0% were of normal weight, 20.0% overweight and 40.0% were found to be obese. At T1, all patients were well-nourished (PG-SGA category A); however, by T2, nutritional status had significantly declined (mean PG-SGA score 16.48 ± 4.58). By T3, partial recovery was noted (mean score 2.04 ± 1.7). No significant correlation was found with gender, age, or type of transplant. Neutropenic fever was identified as a major contributor to nutritional decline during hospitalization.

Conclusion: Patients were nutritionally stable at admission but experienced marked deterioration during hospitalization, with partial recovery post-discharge. A tailored nutrition plan is recommended to support recovery, improve appetite, and enhance quality of life in HSCT patients.

Keywords: Nutritional status, Bone Marrow Transplantation, Developing Countries

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Introduction

Hematopoietic Stem Cell Transplant (HSCT) is a well-recognized intense and potentially life threatening therapy for various malignant and nonmalignant hematological disorders. It involves cytotoxic therapy, immunosuppressive agents and sometimes radiation, followed by infusion of Hematopoietic Stem Cells (HSC).¹ Globally, around 90,000 HSCTs are performed annually, with increasing indications and improved outcomes.²

Despite of advancements HSCT is associated with several adverse effects including mucositis, nausea, vomiting and diarrhea, which can significantly impact a patient's nutritional status. Malnutrition has been recognized risk

factor for delayed engraftment, increased infections, prolonged hospitalization and higher mortality.³ Some studies report that 10-50% patients are already malnourished prior to HSCT and this often worsens during and after the HSCT.⁴

In Pakistan, nutritional assessment and intervention are often not integrated into standard care protocols and to our knowledge no literature is available. Developed countries, have timely interventions to manage nutritional deterioration, as part of transplant care,⁵ most centers solely rely on anthropometric or biochemical markers alone which doesn't reflect the true nutritional decline.⁶ While in resource limited countries the nutritional assessment is untouched area. The patient-generated subjective global assessment (PG-SGA) is a reliable tool used internationally to assess nutrition in oncology and transplant patients, but its utility remains underexplored locally.⁷

Authorship Contribution: ^{1,4}Conceived and planned the idea of the study, ^{3,5}drafting the work or revising it critically for important intellectual content, ²final approval of the version to be published,

Funding Source: none
 Conflict of Interest: none

Received: Jan 15, 2025
 Accepted: July 01, 2025

Given the lack of local data and lack of standardized nutritional assessment protocols, this study aimed to evaluate and compare the nutritional status of HSCT patients at three stages: upon admission, at discharge, and at 1 month post discharge. By identifying the prevalence and progression of malnutrition in this cohort, one can improve clinical outcomes for HSCT patients.

Methodology

This Analytical cross sectional study was conducted at the Armed Forces Bone Marrow Transplant Center (AFBMT) from September 2022 to August 2023. Keeping a confidence level of 95 %, sample size (n, 25) was calculated.

Inclusion Criteria: All adult (defined as; age >16 Years) patients diagnosed with hematological disorder, regardless of gender, who were admitted and underwent HSCT during the defined duration, were included.

Exclusion Criteria: Patients with incomplete history, documents, or insufficient data in the registry or shifted to ICU care during count recovery period or expired before completing one-month post HSCT or lost to follow up before completing one-month post HSCT, were excluded from the study.

The BMTW of AFBMT is one of the highly specialized center and main referral hospital for the transplant. As per policy cases are generally admitted to the BMTW 7-8 days before transplant for conditioning therapy and are discharged from BMTW once bone marrow becomes functional, the blood counts are stable, unsupported, patients can take oral medication and without any active complaints. Follow-up scheduling is communicated to the patient at the time of discharge. The study received ethical clearance from the institutional review board of AFBMT. Written informed consent was obtained from all patients or their legal guardians for both the transplant procedure and the use of their data for research purposes.

The nutritional assessments were conducted at three particular times i.e. the first assessment (T1), was conducted within 24 hours of admission to the BMTW, measuring the patients' pre-transplant nutritional status. The second evaluation (T2) assessed the impact of intensive chemotherapy, the transplantation process, and hospitalization, with measurements taken at discharge from BMTW. The last and the final assessment (T3), was

performed at a follow-up visit 30 days' post-discharge, to determine nutritional changes occurring after leaving the hospital. Demographic information, primary diagnoses, and transplant types were obtained from medical records. The median length of stay in the BMTW at AFBMT was 21 ± 2 days, with a prolonged stay defined as hospitalization exceeding 25 days. Measurements of height and weight were taken using a, ensuring standard procedures, with patients wearing a hospital gown designed for HSCT recipients and no undergarments. Since the validity of Body Mass Index (BMI) as a measure of nutritional status in our population is an issue, we have used the PG-SAG.

The difference was then derived between PG-SGA score at each of these points to assess the change in nutritional status. All data were analyzed with SPSS version 23. Categorical data, e.g., gender and BMI category, were reported as percentages of the study population. Continuous data, e.g., mean weight change, were reported as means with standard deviations. To establish statistical significance, Chi-square tests were employed with a p-value of < 0.05 being a significant result. Patients who were transferred to ICU or whose HSCT was postponed were excluded analyses.

Results

A total of 25 patients underwent HSCT during the defined study duration and all were included in the study, and T1 was assessed by using PG-SGA. There were 16 (64%) males and 9 (36%) females. The mean age of the patients was 32.48 ± 11.9 years. The details of their primary diagnosis are shown below. According to BMI, there were three patients who were underweight and 20.0% were overweight and 40.0% were found to be obese. The demographics of the patients included in the study are given in Table-I.

T1 was assessed of all patients before the initiation of conditioning regimen. All the patients were well-nourished (category A) status as per PG-SGA. There was a not statistically significant difference between nutritional status at admission then on discharge from BMTW and 30 days' post HSCT follow-up. with mean PG-SGA score was recorded as: $1.04 (\pm 0.2)$ at T1, $16.48 (\pm 4.58)$ at T2, and $2.04 (\pm 1.7)$ at T3 (Table II), with no statistical significance

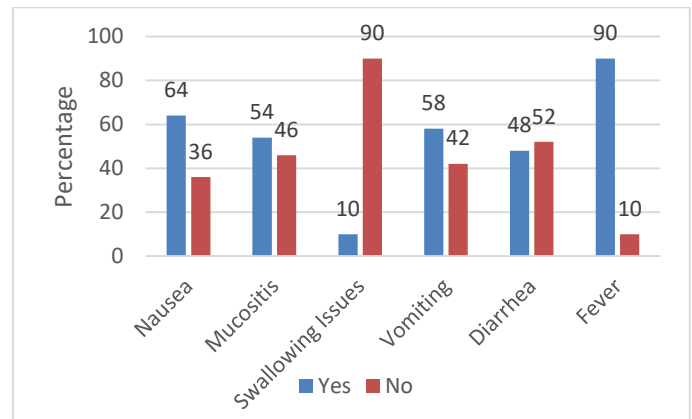
Table I: Demographics of the patients with undergoing Hematopoietic Stem Cell Transplant (n=25)

	N	Percentage
Mean Age of the Patients: 32.48 ± 11.9 years		
Gender of the Patients		
Male	16	64
Female	9	36
Body Mass Index of the Patients		
Under weight (< 18.5)	3	12
Normal Weight (18.6 – 24.9)	7	28
Over Weight (25.0-30.9)	5	20
Obese (> 31)	10	40
Primary Diagnosis of the Patients		
Acute Myeloid Leukemia	2	8
Acute Lymphoblastic Leukemia	6	24
Multiple Myeloma	3	12
Hodgkin Lymphoma	2	8
Fanconi Anemia	1	4
Myelodysplastic Syndrome	1	4
Chronic Myeloid Leukemia	2	8
Chronic Myelomonocytic Leukemia	1	4
Aplastic Anemia	4	16
Chronic Lymphocytic Leukemia	1	4
Neuromyelitis Optica	1	4
Glanzmann Thrombocythemia	1	4
Type of Transplant		
Autologous Hematopoietic Stem Cell Transplant	8	8
Allogeneic Hematopoietic Stem Cell Transplant	17	68

found among genders, age and type of transplant the patient underwent. At T2 nutritional status of the patients shows that around 96% of the patients were severely malnourished (category C). Mean PG-SGA score ± SD at T2 was 16.48 ± 4.58. Despite of such drastic change in the nutritional status no patient required parenteral nutrition during hospitalization. Table II shows the mean patients falling in each category. PG-SGA scores at T2 were less favorable in patients above 50 years of age than in those

below 50 ($p = 1.04$). Also, At T2, higher PG-SGA scores were observed in individuals who received allogeneic HSCT than autologous HSCT ($p=6.41$). The mean PG-SGA score at T3 was 2.04 ± 1.7, showing nutritional recovery from T2. Our data shows T3 median score is 2.04 ± 1.7 points almost comparable to T1 score.

Patients were also analyzed for causes of this drastic changes in their nutritional status during transplant and the fall for majority of the patients from well-nourished to severely malnourishment. The most common cause was neutropenic fever. Patients tend to decline their food intake during the days of fever which affected their PG-SGA score. Second most common factor that affected the dietary intake of the patient was the development of mucositis post allogeneic HSCT. Figure-1 shows the most common reasons for the decline of nutritional status.

**Figure 1: Reasons of nutritional decline (n=25)**

Discussion

This study evaluated the nutritional status of patients undergoing HSCT at three points: admission, discharge, and 30 days' post-discharge using the validated PG-SGA tool. Consistent with global literature our findings indicated

Table II: Categorizing as per Patient-generated subjective global assessment scores. (n 25)

	At admission (T1) n (%)	At Discharge (T2) n (%)	At Follow up (T3) n (%)
Well Nourished	25 (100%)	0 (0%)	0 (0%)
Mild Malnourished	0 (0%)	0 (0%)	18 (72%)
Moderate Malnourished	0 (0%)	1 (4%)	0 (0%)
Severe Malnourished	0 (0%)	24 (96%)	7 (28%)
Gender (Mean PG-SGA score)			
Male	1.06	16.31	1.43
Female	1	16.77	2.3
Age (Mean PG-SGA score)			
< 30 Years	1	15.72	1.90
30-50 Years	1.04	17.30	1.84
>50 Years	1	14	2

that patients admitted for HSCT at the BMTU generally had good nutritional status prior to the transplant, likely reflecting the pre-transplant selection criteria that favor patients in relatively stable condition. However, there was a significant deterioration in nutritional status during the transplant process, likely due to the intensive therapy. By the time of discharge, the majority of patients were severely malnourished. While nutritional status showed improvement 30 days' post-discharge, though it did not return to pre-transplant levels.

Multiple studies have documented the body mass loss is frequent among patients undergoing Allo-HSCT and significant body mass loss is associated with a poor clinical outcome. [8] Internationally, studies showed that almost 25% of patients lose more than 10% of their body mass from baseline 3 months' post allo-HSCT. They report a cumulative incidence of non-relapse mortality among malnourished group was 27.3% with a median follow up of the 2-year.⁹ In our study, we did not find statistically significant differences in the nutritional status between men and women. A study reported that younger patients had inferior nutritional outcomes relative to older individuals.¹⁰ These findings might be influenced by diagnosis-specific factors, as older patients in this study predominantly had multiple myeloma, which could contribute to more favorable nutritional outcomes. However, our results did not reveal any significant correlation between age and nutritional status decline. Another study stated that lower BMI was found to be independently associated with poorer post-transplant survival in patients undergoing allogeneic HSCT (RR 1.46, 95% CI 1.01–2.12, $p = 0.045$), although it did not significantly impact the likelihood of relapse.¹¹ Conversely, some studies have reported that obesity in adults undergoing HSCT¹² is linked to inferior outcomes, including lower engraftment rates, delayed graft function, increased infections, and decreased survival.^[13] However we did not find any significant associations between patients' body mass index (BMI), previous treatment history, or the type of transplant (autologous versus allogeneic) to the deterioration of nutritional status during stay.

The PG-SGA is a simple, cost-effective tool that requires minimal training and can easily detect changes in nutritional status, enabling timely interventions. Emerging evidence supports the use of the PG-SGA for timely detection and detailed assessment of cancer cachexia

during routine patient care.¹⁴ In our study, as expected, nutritional status declined post-transplant, primarily due to the adverse effects of the conditioning regimen. This decline was evident through weight loss and changes in body composition, with the differences in PG-SGA scores between admission and discharge reflecting these challenges. We observed a modest recovery in nutritional status at follow-up relative to the state at discharge, particularly in oral intake and functional capacity, as patients were no longer bedridden and resumed eating home-cooked meals. These improvements resulted in lower PG-SGA scores, though they did not return to pre-HSCT levels. It is important to note that our follow-up period was limited to 30 days post-discharge, unlike other studies with longer observation periods.

Physicians play a crucial role in mitigating nutritional decline by encouraging oral intake, recommending nutritional support as needed, and tailoring dietary advice based on individual symptoms and preferences. As per ASPEN recommendations providing nutritional counseling on foods that may pose a risk of infection to neutropenic patients will prevent neutropenic morbidity and mortality. According to ESPEN, there is currently no conclusive evidence to routinely endorse a low-microbial diet for patients during the neutropenic period.^{15,16}

Dietary management usually involves a flexible meal plan with frequent small meals, use of nutritional supplements and avoidance of foods that may aggravate gastrointestinal discomfort. Studies suggest that early nutritional intervention eternal nutrition can result in encouraging outcomes among patients undergo Allo-HSCT.¹⁷ Data available in retrospective studies report an event rates for overall survival post Allo-HSCT with myeloablative conditioning as 33% in parenteral nutrition group vs 8% in eternal nutrition group, suggesting that 75% of early deaths could be avoided.¹⁸ According to our findings, greater attention may be needed for patients with extended lengths of stay (LOS), as prolonged hospital stays are associated with worsened food intake, especially in BMT patients experiencing gastrointestinal symptoms and chemotherapy-induced taste alterations.

Limitations: Our study has several limitations. We did not assess body composition objectively, as it was evaluated using the PG-SGA, a subjective tool. Furthermore, we did not assess caloric intake of the patients and its clinical outcomes, which limits the scope of our findings. The PG-SGA, relies on subjective components that can lead to variations in assessment; however,

we minimized it through training and involving a dietitian. Additionally, the generalizability of our findings for the general populations is uncertain since this was a single-center study. Further research involving a larger patient population, including those receiving alternative conditioning regimens such as total body irradiation, is warranted. Moreover, while our follow-up period was substantial, it may not have captured all late-onset complications or long-term outcomes.

Conclusion

Patients who receive HSCT tend to be of good nutritional status at admission. Conditioning therapy, though, tends to impair nutrition during the period of hospital stay. While some recovery after discharge is noted, suboptimal nutrition persists on follow-up in most patients. Strategies to treat malnutrition vary between nations and even among the same centers in one region. We suggest that each patient should have a tailored nutrition program which assist in early recovery, increase appetite, and enhance quality of life. The same has been attempted by the French Health Agency and they have implemented their national guidelines to standardize nutritional support in cancer patients. Providing a supervised nutritional support can further enhance caloric intake and patient outcomes.

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