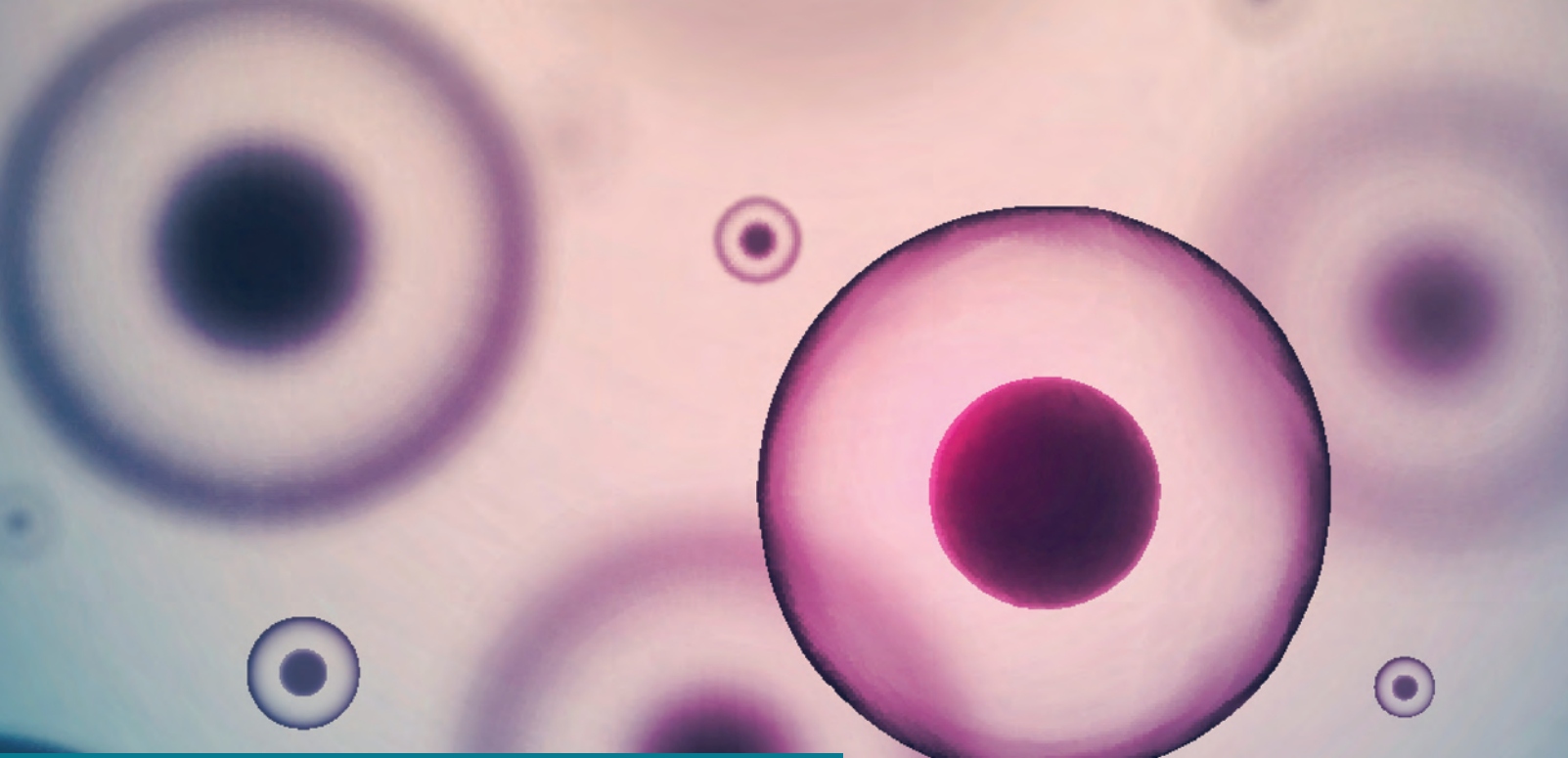

Autologous Stem Cell Transplant

Nutrition as a cornerstone therapy

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Autologous stem cell transplantation (ASCT) is an established therapy for multiple myeloma, lymphoma and selected other haematological malignancies, offering the potential for durable remission, or even cure.[1] Unlike allogeneic transplantation, which involves infusion of donor stem cells and generally has more severe complications, ASCT reinfuses the patient's own stem cells.[1] Survival outcomes have improved considerably over the past two decades owing to advances in conditioning regimens, infection prophylaxis and supportive care.[2]

Despite these advances, malnutrition remains highly prevalent in this patient group and is the most common comorbidity.[3,4] ASCT often causes a reduced nutrient intake and uptake, which are compounded by increased stress metabolism, instigating a catabolic state.[5] Malnutrition, sarcopenia and cachexia are independent predictors of transplant-related morbidity and mortality.[6] Indeed, malnutrition may double the risk of mortality.[2]

Nutrition support, therefore, must be considered a cornerstone intervention. For dietitians, ASCT represents a challenging and high-impact clinical context: where targeted nutrition support can directly influence infection risk, length of stay and overall survival.[1,2] This article aims to outline nutritional considerations and ideal management throughout the adult ASCT continuum.

Nutrition across the ASCT continuum

Stage 1: Induction therapy

The induction phase reduces tumour burden before transplant, often using a combination of chemotherapy, targeted agents and immunotherapy.[6] This often involves 2–4 cycles of treatment, spanning 2–6 months depending on response and patient fitness.[7] Malnutrition at this stage is possible due to the induction therapy itself, as well as tumour burden.[1] Nutritional screening ideally occurs at pre-assessment for induction therapy, as well as every 4-8 weeks during treatment.[4,8] Various screening tools have been shown to have good sensitivity and specificity in identifying malnutrition in oncology outpatients. These include the 'Malnutrition Universal Screening Tool' ('MUST') and Patient-Generated Subjective Global Assessment (Short Form) (PG-SGA SF).[8]

Stage 2: Stem cell mobilisation

Mobilisation begins once bone marrow recovers from induction, typically involving granulocyte-colony stimulating factor (G-CSF) for 4–5 days, sometimes with chemotherapy or plerixafor.[9] The process lasts about a week. Being underweight at this timepoint may reduce a patient's ability to mobilise stem cells, with possible negative downstream effects on clinical outcomes.[10] Whether adequate nutritional intake at this time affects mobilisation is not well described in the literature.

Stage 3: Stem cell harvesting

Following mobilisation, stem cells are collected via apheresis, typically occurring on Days 4–6 of G-CSF administration. Each session lasts around four hours, and most patients complete the process within one to two days.[6] Stem cell harvesting presents a key opportunity for nutritional screening, as it is the final chance to identify nutritional risk before the upcoming conditioning and transplant phases.

Stage 4: Conditioning (high-dose chemotherapy)

Conditioning chemotherapy is given in the inpatient setting just before stem cell transplantation, usually over a period of 1 to 6 days, depending on the specific treatment regimen. For instance, in multiple myeloma, melphalan is typically administered over 1 to 2 days, while in lymphoma, a combination regimen known as BEAM – comprising carmustine, etoposide, cytarabine, and melphalan – is delivered over approximately 6 days.[6] Conditioning is responsible for the nutritional deterioration which often follows in the days to come. Those undergoing high dose melphalan may utilise oral cryotherapy in the form of sucking on ice or ice cream throughout the duration of the melphalan infusion, which reduces the risk of subsequent oral mucositis.[11]

Stage 5: Stem cell return (transplantation) and recovery

Stem cells are reinfused the day after conditioning ends, representing 'Day 0'. Following reinfusion, white cell counts continue to decline in response to the recent conditioning regimen,[6] with neutrophils often reaching undetectable levels (severe neutropenia) around Day +5 to +7, usually remaining there for ~3-6 days.[12] During severe neutropenia, patients frequently experience gastrointestinal toxicities, including oral mucositis, nausea, vomiting and diarrhoea, which typically peak between Day +6 and +10.[13, 14]

Engraftment is the process by which transplanted stem cells make their way to free bone marrow niches, where they find optimal conditions to survive and proliferate.[6] Clinically, engraftment is defined as the first of three consecutive days of achieving an absolute neutrophil count (ANC) >0.5×10^9/L in the post-transplant phase.[6] Engraftment generally occurs by Day +10–14 and represents a major clinical and nutritional milestone, as patients often experience rapid improvement in symptoms and appetite alongside neutrophil increase.[15, 16]

Nutritional support during this stage focuses on maintaining adequate intake despite these challenges, balancing traditional food safety considerations while avoiding overly restrictive 'neutropenic diets', which have not been shown to reduce infection risk (and have been discussed at length in a recent issue of *Complete Nutrition* [CN] Magazine).[17]

Nutritional management in practice

To prevent or minimise the extent of malnutrition faced whilst undergoing ASCT, early involvement and regular assessment by a registered dietitian is recommended.[4, 6] Close working with the nursing and haematology team is of critical importance to ensure that oral health and symptoms such as diarrhoea, nausea and vomiting are monitored and acted upon accordingly.[18] Short-term taste changes are to be expected, and they may be severe.[16] Oral thrush should be an immediate consideration in those with taste changes.[19] **Table 1** highlights the prevalence of common gastrointestinal symptoms in this population.

Usage of oral nutritional supplements (ONS) is frequently required to support oral intake.[23] Establishing patient preferences for ONS before they become symptomatic (i.e. by ~Day +2) may improve adherence once gastrointestinal or taste-related issues do develop.

Fluid retention during ASCT is not well characterised in the literature. However, in clinical practice, fluid-related weight gain is frequently observed between Day -1 and Day +3. This makes bodyweight an unreliable marker of nutritional status during this period. A more accurate reference point is the patient's weight immediately upon, or prior to, admission for conditioning, which can be reassessed once fluid balance has normalised. The likely drivers of fluid accumulation include aggressive intravenous fluids, corticosteroid therapy and treatment-related organ dysfunction.[24] Given these challenges, decisions around nutrition should be guided primarily by estimated energy intake relative to requirements, rather than by short-term weight fluctuations.[18] Functional measures can provide additional insight: handgrip strength, for example, has been shown to correlate closely with calorie intake in patients undergoing ASCT, making it a valuable adjunct.[23] The use of bioelectrical impedance vector analysis (BIVA) also has utility here as it differentiates hydration from cell mass.[4]

Post-ASCT energy requirements are estimated to increase by 30–50%,[2] although ASCT-specific energy recommendations are lacking. Where indirect calorimetry is not possible, an estimated requirement of 25-30 kcal/kg/day can be used.[25] Protein intake should be above 1 g/kg/day and, if possible, up to 1.5 g/kg/ day.[25]

General oncology guidelines suggest artificial nutrition (i.e. tube feeding) should be considered when oral intake provides less than 50% of energy requirements for >1 week or only 50-75% for >2 weeks.[25] Transplant-specific guidelines, however, suggest a more aggressive approach, advising artificial feeding where energy intake is <60% of requirements for 3 consecutive days.[6] The role of pre-emptive nasogastric tube placement (e.g. on Day +1, before mucositis might develop) remains unclear. Indeed, Kiss *et al.* attempted early artificial nutrition in ASCT but encountered resistance from patients and (mostly) physicians, limiting study implementation.[26] Those who present with malnutrition at the time of transplantation, or who develop anorexia even before the occurrence of neutropenia (i.e. ANC <1.5x 10^9/L), are particularly good candidates for early escalation to artificial nutrition, in the author's experience.

Table 1: Prevalence of gastrointestinal symptoms in ASCT[13, 20-22]

Gastrointestinal symptom	Prevalence
Diarrhoea	47-91%
Oral mucositis	30-75%
Taste changes (dysgeusia)	20-100% (subjective) and 21.4% (objective)*
Nausea and vomiting	88% and 60%, respectively**

*In the neutropenic phase. **Based on a singular dataset.

"Preliminary research suggests that those with pre-existing malnutrition suffer from delayed engraftment and an increase risk of oral mucositis.[27]"

Although engraftment is inevitable, its timing is unpredictable, which can lead healthcare professionals to delay initiating artificial nutrition. Teams may defer feeding in the expectation that engraftment, and the associated improvement in appetite and symptoms, will occur imminently, perceiving artificial nutrition as unnecessary. However, this cautious approach can be problematic, as engraftment may take longer than anticipated, resulting in prolonged inadequate nutrition and an increased risk of refeeding complications. Indeed, lack of nutrition itself appears to delay engraftment,[4, 6, 23] supporting the initiation of artificial nutrition in undernourished patients regardless of the expected timing of neutrophil recovery.

Current literature indicates that enteral nutrition (EN) is not inferior to parenteral nutrition (PN) in meeting nutritional needs during ASCT, and it may reduce the risk of mucositis via better maintenance of mucosal permeability.[4, 5] Large scale research is underway to confirm these results.[5] Where the gut is functional and accessible, EN is, therefore, the preferred route for nutrition support.[4, 6] PN is only to be initiated where the gastrointestinal tract is severely compromised (i.e. severe mucositis, intractable vomiting, paralytic ileus, severe diarrhoea).[4]

The emerging role of nutritional prehabilitation

Nutritional prehabilitation seeks to address any pre-existing malnutrition and optimise metabolic reserves before transplantation, an important consideration since 10–50% of patients experience malnutrition prior to the procedure.[2] Preliminary research suggests that those with pre-existing malnutrition suffer from delayed engraftment and an increased risk of oral mucositis.[27] Research investigating the efficacy of prehabilitation in ASCT is underway.[28]

Beyond the optimisation of nutritional status prior to transplantation, prehabilitation provides an opportunity for education and building of rapport whilst the patient is well. Patients can be educated on the role of the dietitian in ASCT, expected nutrition impact symptoms, food safety, the benefits of a high-energy diet and the options available for nutrition support (e.g. ONS, artificial nutrition).[18] Patients should be prepared for a significant reduction in appetite, while understanding that maintaining oral intake and actively engaging with nutrition support can help shorten hospital stay, preserve muscle mass and reduce the risk of infection.

Practical implications

At Salisbury District Hospital, a nutritional prehabilitation service for patients undergoing ASCT is being trialled. Patients are reviewed towards the latter part of their induction therapy to formally assess nutritional status, including the use of the Strength, Assistance with walking, Rising from a chair, Climbing stairs and Falls (SARC-F) questionnaire to screen for sarcopenia.[29] Nutritional support is provided accordingly based on the results, with referral also made to exercise specialists where appropriate. This time is also used as an opportunity to provide ASCT education and build rapport. A retrospective evaluation will be completed, to assess if this intervention reduces malnutrition at time of transplantation and affects clinical outcomes like length of stay, infections, and time to engraftment. The results of this evaluation will be published in a later issue of CN Magazine.

Conclusion

Nutritional status throughout the ASCT continuum is a key mediator of important clinical outcomes. A clear roadmap of how transplanted patients should be nutritionally managed is keenly awaited to promote standardisation and equity across transplantation centres.[4] A better understanding of the impact of nutritional prehabilitation in ASCT is required, though theoretical evidence supports its use. Much research is underway to better understand the role of nutrition support in ASCT. In addition to providing nutrition support, dietitians serve a vital role as educators during, or preferably before, ASCT.

References: **1.** Barban JB, *et al.* (2020). Brazilian Nutritional Consensus in Hematopoietic Stem Cell Transplantation: Adults. Einstein (Sao Paulo).; 18: AE4530. **2.** Pawłowski P, *et al.* (2023). The Critical Exploration into Current Evidence behind the Role of the Nutritional Support in Adult Patients Who Undergo Haematogenic Stem Cell Transplantation. Nutrients; 15(16): 3558. **3.** Lazarow H, *et al.* (2019) Nutrition-Related Outcomes for Autologous Stem Cell Transplantation Patients. Clin Lymphoma Myeloma Leuk.; 19(7): e393-e398. **4.** Casirati A, *et al.* (2023). The European Society for Blood and Marrow Transplantation (EBMT) roadmap and perspectives to improve nutritional care in patients undergoing hematopoietic stem cell transplantation on behalf of the Cellular Therapy and Immunobiology Working Party (CTIWP) and the Nurses Group (NG) of the EBMT. Bone Marrow Transplant.; 58(9): 965-972. **5.** Madill J, *et al.* (2025). Medical and Nutritional Outcomes are Similar Among Autologous Transplant Patients on Enteral Nutrition When Compared to Parenteral Nutrition. A Randomized Pilot Study. Eur J Haematol.; 115(2): 117-124. **6.** Sureda A, *et al.* (ed.) (2024) The EBMT Handbook: Hematopoietic Cell Transplantation and Cellular Therapies, 8th edn., Cham: Springer. doi: 10.1007/978-3-031-44080-9. **7.** Charalampous C, *et al.* (2022) Impact of the time interval between end of induction and autologous hematopoietic transplantation in newly diagnosed patients with multiple myeloma. Bone Marrow Transplant.; 58(1): 46-53. **8.** Trujillo EB, *et al.* (2024) Malnutrition risk screening in adult oncology outpatients: An ASPEN systematic review and clinical recommendations. J Parenter Enteral Nutr.; 48(8): 874-894. **9.** Yuan S, Wang S. (2016) How do we mobilize and collect autologous peripheral blood stem cells? Transfus.; 57(1): 13-23. **10.** Crowther M, Avenell A, Culligan DJ (2010) Being underweight may reduce your ability to mobilise peripheral blood stem cells. Transfus Apher Sci.; 43(3): 365-367. **11.** Jasiński M, *et al.* (2021). Ice-cream used as cryotherapy during high-dose melphalan conditioning reduces oral mucositis after autologous hematopoietic stem cell transplantation. Sci Rep.; 11(1): 22507. **12.** Landau H, *et al.* (2016). Fractionated stem cell infusions for patients with plasma cell myeloma undergoing autologous hematopoietic cell transplantation. Luek Lymphoma.; 57(8): 1781-1785. **13.** Gordillo CA, *et al.* (2021). Gastrointestinal Toxicity of High-Dose Melphalan in Autologous Stem-Cell Transplantation: Identification of Risk Factors and a Benchmark for Experimental Therapies. Ann Hematol.; 100(7): 1863-1870. **14.** Sawyer J, *et al.* (2024). Prevention and management of acute toxicities from conditioning regimens during hematopoietic stem cell transplantation. Clin Hematol Int.; 6(2): 1-10. **15.** Tbakhi B, *et al.* (2020). Autologous stem cell rescue recipient with neutrophil tissue delivery detected prior to blood engraftment: A case report. EJHaem.; 1(1): 330-333. **16.** Shah N, *et al.* (2013). Higher Stem Cell Dose Infusion As Rescue After Intensive Chemotherapy Does Not Improve Symptom Burden in Older Patients with Multiple Myeloma and Amyloidosis. Blood.; 122(21): 2161. **17.** Ward-Ongley P. (2024). The Neutropenic Diet: Origins, Evidence & Clinical Implications. CN; 24(9): 44-46. **18.** Atkins L, *et al.* (2019). Implementing and sustaining an evidence-based nutrition service in a haematology unit for autologous stem cell transplant patients. Supp Care Cancer.; 27(3): 951-958. **19.** Scordo M, *et al.* (2022). A prospective study of dysguesia and related symptoms in patients with multiple myeloma after autologous hematopoietic cell transplantation. Cancer.; 128(21): 3850-3859. **20.** de Castro MC, *et al.* (2018). Infectious diarrhoea in autologous stem cell transplantation: high prevalence of coccidia in a South American centre. Hematol Transfus Cell Ther.; 40(2): 132-135. **21.** Eichhorn S, *et al.* (2025). Elevated Likelihood of Infectious Complications Related to Oral Mucositis After Hematopoietic Stem Cell Transplantation: A Systematic Review and Meta-Analysis of Outcomes and Risk Factors. Cancers (Basel).; 17(16): 2657. **22.** Dequae CGR, *et al.* (2024). Taste alterations after hematopoietic cell transplantation: a scoping review. Supp Care Cancer.; 32(10): 687. **23.** Rupnik E, *et al.* (2024). Changes in Nutritional Intake, Body Composition, and Handgrip Strength in Patients Undergoing Autologous Hematopoietic Stem Cell Transplantation: A Retrospective Study. Nutr Cancer.; 76(5): 424-431. **24.** Elbahlawan L, *et al.* (2024). Fluid Overload in Children Following Hematopoietic Cell Transplant: A Comprehensive Review. J Clin Med.; 13(21): 6348. **25.** Muscaritoli M, *et al.* (2021) ESPEN practical guideline: Clinical Nutrition in cancer. Clin Nutr.; 40(5): 2898-2913. **26.** Kiss N, *et al.* (2014). Challenges and outcomes of a randomized study of early nutrition support during autologous stem-cell transplantation. Curr Oncol.; 21(2): e334-339. **27.** Özkan SG, *et al.* (2025). Optimizing Autologous Stem Cell Transplantation in Multiple Myeloma: The Significance of Pre-Transplant Controlling Nutritional Status Score. Life.; 15(2): 289. **28.** Dennett AM, *et al.* (2025). Prehabilitation to improve function after autologous stem cell transplantation: A pilot randomized controlled trial (PIRATE). Supp Care Cancer.; 33(3): 164. **29.** Williams GR, *et al.* (2020) SARC-F for Screening for Sarcopenia among Older Adults with Cancer. Cancer.; 127(9): 1469-1475.