Optimising Autologous Hematopoietic Stem Cell Transplantation in Multiple Myeloma and Lymphoma: The Role of Cryopreservation in Enhancing Feasibility in Lower-Middle-Income Countries

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Introduction

Autologous hematopoietic stem cell transplantation (AHSCT) is a well-established standard of care for patients with multiple myeloma and relapsed or refractory lymphomas, offering improved remission rates and potential cure. However, in lower-middle-income countries (LMICs), the implementation of fresh AHSCT is often challenged by limitations in infrastructure, unpredictable scheduling, and infection risks. Cryopreservation of stem cells provides an opportunity to mitigate these barriers by allowing flexibility in transplantation timing, accommodating logistical delays, and ensuring better planning and resource utilisation. This study evaluates the real-world feasibility, safety, and effectiveness of cryopreserved AHSCT in a tertiary care centre in Nepal, with an aim to inform transplant strategies in similar resource-constrained settings.

Aim

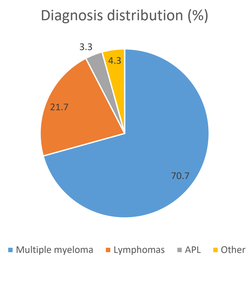
To evaluate the feasibility and effectiveness of cryopreserved autologous hematopoietic stem cell transplantation (AHSCT) in a resource-limited setting and its role in enabling timely transplantation for haematological malignancies.

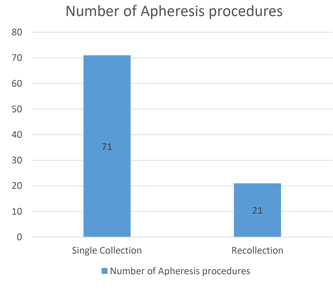
Objectives

- To analyse real-world outcomes of cryopreserved AHSCT.
- To determine CD34+ stem cell viability pre- and post-cryopreservation.
- To evaluate procedure-related complications and engraftment timelines.
- To estimate the cost-effectiveness of cryopreserved AHSCT in a low-resource setting.

Methods

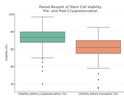
This retrospective study was conducted at the Civil Service Hospital, Nepal, between 2016 and 2025.
Patients undergoing autologous hematopoietic stem cell transplantation (AHSCT) were included.
Stem cell mobilisation was achieved using granulocyte colony-stimulating factor (G-CSF) at a dose of 10 mcg/kg/day for four consecutive days, followed by peripheral blood stem cell collection through apheresis using the Terumo Spectra Optia™ system.
The collected stem cells were cryopreserved using a controlled-rate freezing method. CD34+ cell viability was assessed both before and after cryopreservation using the trypan blue exclusion technique.
Parameters evaluated included patient demographics, diagnosis, apheresis metrics, CD34+ cell yield, stem cell viability, engraftment kinetics, adverse events, and the overall cost of the procedure.





Results

- Eighty-four patients underwent AHSCT, for which 92 procedures were performed, including 21 recollections (22.8%).
- The median patient age was 51 years (range, 4–69), with a male predominance of 65%. Primary diagnoses included multiple myeloma (70.7%), lymphomas (21.7%), acute promyelocytic leukaemia (3.3%), and other malignancies (4.3%).
- The median apheresis run time was 336 minutes, with a median total blood volume processed of 12,477 mL. The median CD34+ cell dose infused was 4.52×10^6 cells/kg (range, 0.09–36.1×10^6 cells/kg), showing a weak positive correlation between pre- and post-collection $CD34^+$ counts ($r=0.17$).
- Stem cell viability declined from a median of 73.5% (range, 20%–97%) pre-cryopreservation to 62.5% (range, 15%–85%) pre-infusion, reflecting a mean viability loss of 10%.
- The median interval from collection to transplantation was 32 days. Seven patients experienced delayed AHSCT—due to the COVID-19 pandemic (n=5) and community-acquired pneumonia (n=2)—resulting in delays of 180 and 60 days, respectively. Infusion-related adverse events occurred in 28 patients (23.5%), predominantly mild reactions such as facial flushing, nausea, and vomiting.
- Median neutrophil and platelet engraftments occurred on days 15 and 18, respectively. Notably, no transplant-related mortality was observed.
- Average cost per AHSCT procedure, including cryopreservation, was approximately $3,300.



Summary

Cryopreserved AHSCT is a safe, effective, and scalable strategy in LMICs like Nepal. It addresses the logistical and clinical challenges of fresh transplants while ensuring high-quality outcomes and expanding access to curative therapies.

Discussion

This study highlights that cryopreserved AHSCT is a viable option in lower-middle-income countries, offering logistical flexibility and safety comparable to fresh transplants. The ability to cryopreserve stem cells allowed for scheduling flexibility, especially critical during delays caused by the COVID-19 pandemic or concurrent infections.(1) Although a modest decline in CD34+ viability post-cryopreservation was observed, it remained within clinically acceptable limits to ensure successful engraftment.(2) The absence of transplant-related mortality and manageable infusion-related reactions underscores the safety of this approach. Furthermore, the affordability of the procedure, approximately $3300, supports its scalability in resource-limited settings, providing access to curative therapies for patients who might otherwise be excluded.(3)

References

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