

Development of a clinical hematology and stem cell transplantation program to provide state-of-the-art and cost-effective treatment to patients: a successful collaboration between a medical college in India and a leading medical university in the United States

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Introduction

Ramaiah Medical College (RMC) is a medical training institute established in 1979 in Bengaluru, India, that is run by the Gokula Education Foundation (GEF). It is 1 of the 3 centers in the city that provide free cancer care through the national health insurance scheme.

An estimated 1 million patients are diagnosed with cancer annually in India. In our city of 12 million people, about 12 000 new cancer cases are diagnosed each year.¹ India has 69 transplantation centers where only ~2000 patients undergo hematopoietic stem cell transplantation (HSCT) annually for various indications, against the estimated needs of 100 000 eligible patients.² Even though the average cost of allogeneic HSCT in India (USD \$15 000-\$20 000)³ is considerably lower than in the West, the average Indian's per capita income of \$1 666 still makes HSCT cost prohibitive for our patients. There is an acute need for low-cost, high-quality hemato-oncology and HSCT centers in India.

Objectives

Our cancer center sees about 2500 new patients per year, of which ~260 have hemato-lymphoid cancers. The RMC thus decided to establish and expand its hemato-oncology and HSCT programs. In March 2014, the GEF entered into collaboration with the Division of Hematology/Oncology at the University of Illinois, Chicago (UIC) to:

- Develop an HSCT center that delivers treatment that meets global standards to patients at affordable rates,
- Provide financial assistance to patients undergoing treatment at our cancer center,
- Decrease induction mortality in acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML),
- Provide hemato-oncology services dedicated to pediatric patients, and
- Increase the number of patients undergoing HSCT in our patient pool.

The team from UIC helped design the unit, provided initial and ongoing help with training administrative staff, trained faculty, and provided remote assistance.

Development of the Clinical Hematology and Bone Marrow Transplant (CHBMT) Centre

In January 2015, a 4-bed HSCT unit with high efficiency particulate air (HEPA) filters was constructed under the direct supervision of the UIC team. A temporary apheresis and cryopreservation unit was set up in the blood bank until the infrastructure for the stem cell laboratory was completed. Oncologists with training in HSCT, a transfusion medicine specialist, a patient coordinator, nursing staff, and a hemato-pathologist with experience in flow cytometry and immunohistochemistry were recruited.

The need to improve the standards of the program to match the Foundation for Accreditation of Cellular Therapies (FACT) requirements was recognized as a priority from the beginning. Standard operating



Figure 1. Patient rooms in the CHBMT unit have HEPA filters and antimicrobial paint on the walls.

procedures were developed with assistance from the UIC team for all the activities of the transplantation center and the stem cell laboratory. Quality improvement meetings were held on a quarterly basis to assess performance in HSCT volume, patient outcome, hand hygiene, incidence of central line-associated bloodstream and other infections, efficiency of HSC harvests, and viability of cryopreserved HSCs and donor lymphocyte infusions. The UIC team continues to conduct annual site visits to review our progress and provide expert advice. The following were identified as key areas that need to be addressed to improve the survival of non-HSCT hematology patients:

- Induction mortality in ALL and AML patients,
- Infectious complications in patients with hemato-lymphoid malignancies, and
- Financial burden of protracted care resulting in abandonment of treatment and limited access to HSCT.

A hemato-oncology ward was commissioned in 2017, with a cost structure similar to that of a general ward, but with an infrastructure that supports the necessary asepsis and serves as a step-down to the CHBMT unit. Social workers were employed who could identify, apply, and procure enrollment in government insurance schemes for eligible patients. Crowd-funding platforms were used to raise money from donors. The GEF and hospital management also contributed to patient assistance programs that helped eligible patients with discounted hospital rates and free medications.

Results

The first HSCT at CHBMT was performed in March 2015. With substantial efforts to provide financial assistance for patients through various means, including subsidized hospital charges, the number of patients receiving HSCTs per year increased to 19 in 2018. We will complete 10 HSCTs in the first half of 2019, with a projected annual rate of 25 per year. Currently, about 32% of our patients who are eligible for HSCTs are undergoing the procedure annually. We hope to increase this to 50% by the year 2020.

Conclusion

Our partnership with UIC to develop a center of excellence in hematology and HSCT represents a unique model. RMC decided to invest in the technology and quality of our Centre at an early stage, which brought about encouraging results in the treatment of hematologic disorders in both adult and pediatric patients. We are able to deliver high-quality care at subsidized rates to our target population of patients who live below the poverty line. Notwithstanding the low-cost setting, our outcomes are excellent when compared with current national standards. The average cost for an autologous HSCT at our center is US\$8860; an allogeneic HSCT is US\$14 550.

Our aim is to become a transplantation center that meets and potentially exceeds FACT standards in patient care and laboratory practices. We will be working with the FACT India Working Group to obtain our accreditation over a period of 6 years.



Figure 2. The Hemato-Oncology team with the UIC faculty during the annual visit to the center.



Figure 3. The Clinical Hemato-Oncology Ward at Ramaiah Medical College.

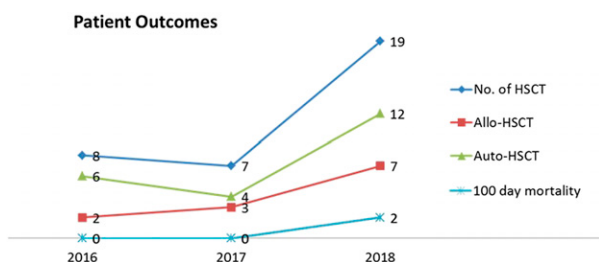


Figure 4. Number of patients who underwent HSCT at our center and the 100-day mortality for the years 2016, 2017, and 2018. Allo-HSCT, allogeneic HSCT; auto-HSCT, autologous HSCT.

Table 1. Number of patients who undergo HSCT from our patient pool vs total number of patients with hemato-lymphoid malignancies who are eligible for HSCT

Year	No. of hemato-oncology patients	No. of patients eligible for HSCT	No. of HSCTs
2016	89	18	8
2017	141	29	7
2018	262	60	19
2019 (until May)	128	53	6

Table 2. Number of pediatric patients registered in our department and their survival rates

Year	No. of patients age <18 y	Survival				No. of HSCTs
		6-mo		1-y		
		No.	%	No.	%	
2016	12	12	100	11	91.6	3
2017	26	24	92	24	92	1
2018	36	33	91.6	NA		4
2019 (until May)	17	NA		NA		2

NA, not applicable.

Table 3. Improvement in induction mortality for ALL and AML patients

Year	No. of ALL patients	Induction mortality		No. of AML patients	Induction mortality	
		No.	%		No.	%
2016	6	0	0	23	5	21.7
2017	9	2	22.2	16	4	25
2018	33	3	9	35	6	17.1
2019 (until May)	19	1	5.2	17	0	0

Table 4. Money raised for patient care through donations and crowd-funding platforms

Year	Amount raised through donations/crowd funding	
	Indian rupees	US dollars
2016	1 424 917	20 411
2017	465 779	6 672
2018	10 911 981	156 309
2019 (until May)	2 313 279	33 137

Authorship

Conflict-of-interest disclosure: The authors declare no competing financial interests.

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