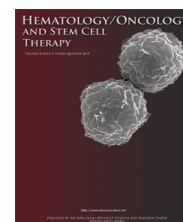


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## Trends in hematopoietic stem cell transplant activity in Lebanon

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### KEYWORDS

Allogeneic stem cell transplantation;  
Autologous stem cell transplantation;  
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### Abstract

Hematopoietic stem cell transplantation (HSCT) has been accessible to the population residing in Lebanon and surrounding countries since 1997. HSCT programs were developed in two major hospitals in Beirut: American University of Beirut Medical Center (AUBMC) and Makassed General Hospital. Mount Lebanon Hospital initiated an autologous HSCT activity later. Between 2012 and 2016, the HSCT activity in Lebanon reached a total of 897 transplants, among which 303 (33.8%) were allogeneic HSCT and 594 (66.2%) were autologous HSCT. Overall, autologous HSCT activity has remained stable over the past 5 years, whereas allogeneic HSCT activity has seen a steep increase between 2012 and 2013 followed by a modest increase later. Haploidentical transplantation has mushroomed and represented almost half of allogeneic HSCT activity in 2016. AUBMC and Makassed General Hospital are members of the European Blood and Marrow Transplantation (EBMT) and East Mediterranean Blood and Marrow Transplantation groups, and AUBMC has been accredited by JACIE (Joint Accreditation Committee – ISCT & EBMT) since 2016. The past 5 years have seen an increase in HSCT-related research and publications, mainly

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from AUBMC. These research activities were predominantly focused on personalized conditioning for allogeneic HSCT and post-transplant maintenance therapy.

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## 50 Introduction

51 Hematopoietic stem cell transplantation (HSCT) became  
52 available in Lebanon in 1997. It is accessible to the popula-  
53 tion residing in Lebanon, as well as the surrounding coun-  
54 tries where HSCT is limited, including Syria, Iraq,  
55 Palestine, and for expatriates living in the Gulf Cooperation  
56 Council countries. Hence, Lebanon has taken a leading role  
57 since the late 1990s in developing HSCT programs in two  
58 major hospitals in Beirut: American University of Beirut  
59 Medical Center (AUBMC) and Makassed General Hospital  
60 (MGH). Later, a third center in the suburbs of Beirut, Mount  
61 Lebanon Hospital, initiated an autologous HSCT activity.

62 The Lebanese population has increased >3-fold in the  
63 past 55 years, from 1.8 million in 1960 to 5.8 million in  
64 2015 [1]. According to the World Bank, Lebanon is one of  
65 the developing countries with a gross domestic product of  
66 \$47 billion in 2015, achieving a significant increase from  
67 \$3.3 billion in 1988 [2]. In 2014, the Human Development  
68 Index of Lebanon was ranked 67 by the United Nations  
69 Development Programme (UNDP) with a gross national  
70 income per capita of \$16,509 [3]. This Human Development  
71 Index of 67 is considered a high rank on the UNDP list, and is  
72 between Oman (52) and Iran (69) [3].

73 According to UNDP, the mean life expectancy of the  
74 Lebanese population is 79.3 years [3]. Lebanon has recently  
75 seen a significant increase in the overall annual cancer inci-  
76 dence from 382 per 100,000 in 2003 to 470 per 100,000 in  
77 2008 [4]. By the year 2018, the incidence rates are foreseen  
78 to be 636 cases per 100,000 [4]. Among hematological  
79 malignancies, lymphoma is one of the top five cancers that  
80 affect the population of Lebanon [4].

## 81 Materials and methods

### 82 Data collection

83 Data from the three Lebanese HSCT centers were collected  
84 retrospectively from the beginning of 2012 till the end of  
85 2016 with regard to total number of transplants per year,  
86 distribution of patients by age group and diagnosis, type  
87 of transplant, type of donor, and stem cell source. A tem-  
88 plate for data collection was sent out to be filled in individ-  
89 ually by the center coordinators or data owners, and  
90 collected into one dataset.

### 91 Participating centers

92 The three HSCT centers of Lebanon have participated in  
93 sharing their data. MGH and AUBMC cater for the needs of  
94 allogeneic and autologous HSCT patients. In addition, Mount  
95 Lebanon Hospital caters only for patients requiring autolo-  
96 gous HSCT.

## Ethical considerations

97  
98 The collection of data was done through a specific spread-  
99 sheet that had no patient identifiers. There has been no  
100 need to check individual patients' medical records to col-  
101 lect the data. Hence, patients' privacy and the confidential-  
102 ity of their records and health status remained intact.

## Results

### Number of transplants

103  
104  
105 For the period between 2012 and 2016, the HSCT activity in  
106 Lebanon reached a total of 897 transplants, among which  
107 303 (33.8%) were allogeneic HSCT and 594 (66.2%) were  
108 autologous HSCT (Fig. 1A). Overall, autologous HSCT activ-  
109 ity has remained stable over the past 5 years (Fig. 1B),  
110 whereas allogeneic HSCT activity has seen a steep increase  
111 between 2012 and 2013 in both centers followed by a mod-  
112 est increase later (Fig. 1C). Over this 5-year period, the  
113 adult patient population represented 85.2% (764 patients),  
114 including 227 allogeneic HSCT and 537 autologous HSCT  
115 (Table 1). Conversely, the pediatric patient population rep-  
116 resented 14.8% (133 patients) distributed between 76 allo-  
117 geneic HSCT and 57 autologous HSCT (Table 1).

### Type of disease

118  
119 Allogeneic HSCT was predominantly performed for acute  
120 leukemia with acute myeloid leukemia representing 35% of  
121 allogeneic HSCT followed by acute lymphoblastic leukemia  
122 (18%). Other minor indications (Fig. 2A) were lymphoprolif-  
123 erative disorders (14%), predominantly Hodgkin's and non-  
124 Hodgkin's lymphoma, bone marrow failure (14%), myelodys-  
125 plasia (5%), chronic myeloid leukemia (5%), inherited meta-  
126 bolic disorders (5%), and immunodeficiency (4%).

127 By contrast, autologous HSCT was mainly performed for  
128 plasma cell disorders (35%), Hodgkin's (26%) or non-  
129 Hodgkin's (27%) lymphoma, and solid tumors (12%), mostly  
130 neuroblastoma, medulloblastoma, and germ cell tumors  
131 (Fig. 2B).

### Type of donor and stem cell source

132  
133 Even though matched related donors (MRDs) were and  
134 remain the major source for allogeneic HSCT, the past 5  
135 years have seen an increase in haploidentical donor trans-  
136 plantation when an MRD was not available. Indeed, hap-  
137 loidentical donors started to be used as early as 2013  
138 when this source represented 5% of allogeneic HSCT to  
139 reach 49% of allogeneic HSCT in 2016 (Fig. 3A). By contrast,  
140 the matched unrelated donor (MUD) program was initiated  
141 as early as 2011 using the National Marrow Donor Program

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