Hematol Oncol Stem Cell Ther 13 (2020) 202–207

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Special report: Summary of the first meeting of African Blood and Marrow Transplantation (AfBMT) group, Casablanca, Morocco, April 19—21, 2018 held under the auspices of the Worldwide Network for Blood and Marrow Transplantation (WBMT)

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Received 14 May 2019; accepted 20 May 2019
Available online 04 June 2019

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https://doi.org/10.1016/j.hemonc.2019.05.003

KEYWORDS
Africa;
Hematopoietic stem cell transplantation

Abstract
The first meeting of the African Blood and Marrow Transplantation (AfBMT) was held in Casablanca from April 19, 2018 to April 21, 2018, with the aim of fostering hematopoietic stem cell transplantation (HSCT) activity in Africa. Out of the 54 African countries, HSCT is available only in six (Algeria, Egypt, Morocco, Nigeria, South Africa, and Tunisia). During this meeting, African teams and international experts from the Worldwide Network for Blood and Marrow Transplantation (WBMT) gathered to share their experience and discussed ways to help fill the gap. Nurses and patients held their meeting in parallel. International support and collaboration can help by providing expertise adapted to local resources and regional population needs. Local engagement including government and private participants are necessary to initiate and develop local HSCT capability.

Introduction

Hematopoietic stem cell transplantation (HSCT) is established as life-saving approach in many hematological malignancies and irreversible bone marrow failures [1]. It is, however, one of the most complicated procedures in medical practice. It requires highly specialized teams, good hospital infrastructure, and coordination with other consultants, laboratory services, and pharmacy support. It is also a high cost procedure.

According to the 2006—2013 report of the Worldwide Network for Blood and Marrow Transplantation (WBMT) (www.wbmt.org) [2], HSCTs in the African/Eastern Mediterranean (AFR/EMRO) region represent only 3% of the total transplant activity reported. Transplant rate (TR) defined as the number of HSCT per 10 million inhabitants is 67.7, the lowest in the world. HSCT is not developed in Africa because of the limited resources available, other health issues for the populations, and limited interest amongst regional stakeholders and policy makers.

In order to encourage this activity in the continent, the African Blood and Marrow Transplantation Society (AfBMT) has been established with the support of the WBMT. The main objectives are to improve awareness among health workers, to improve the skills of healthcare teams through sharing experiences, and adapt the knowledge and potential of HSCT therapy to local resources and needs. The first meeting of the AfBMT was organized in Casablanca from April 19, 2018 to April 21, 2018, with the support of Moroccan Society of Hematology and the WHO. A total of 166 participants including 120 physicians and 46 nurses/quality managers from 14 countries participated. The program reviewed all aspects of HSCT with a special focus on African experiences and included affiliated meetings for a nursing education program and parents/patients/nongovernmental organizations (NGOs).

Adapted quality approach

A preconference workshop on quality management was held on April 19, 2018. E. Mc Grath, from the Joint Accreditation Committee International society for cell therapy-Europe and European society for blood and marrow transplantation (EBMT) (JACIE) and P.W. Eldridge from the Foundation for the Accreditation of Cellular Therapy (FACT) reviewed basic concepts of quality management in HSCT and the importance of establishing a quality management program as a tool for improving patients' outcome as reported [3,4]. Moroccan initiatives to establish adapted quality management in HSCT centers were presented by M. Amrani on behalf of the Moroccan teams. Adapting the accreditation requirements to countries with limited resources was discussed. Evaluation and validation of adapted approaches are necessary requirements for modification of the existing international standards. an example of an adapted approach is the use of noncryopreserved stem cells in autologous HSCT.

African HSCT programs

In Africa, where the healthcare systems are not well developed, among the 54 countries, HSCT is available only in six (Fig. 1). Summary of infrastructure and activity is shown in Table 1.

For Algeria, M. Benakli reported for the Hematology and Bone Marrow Transplantation department in Pierre and Marie Curie Center in Algiers, where comprehensive activity has been in place since 1998. The infrastructure includes inpatient ward for myeloablative conditioning with eight laminar flow equipped rooms, four posttransplant rooms, and 11 single protected rooms used for reduced conditioning, autologous HSCT, and induction therapy of acute leukemias. There is an apheresis unit in the center used for stem cell and platelet collections and a cell processing facility. There is also a cord blood bank. From March 1998 to December 2017, 2828 HSCTs have been performed including 2059 (73%) allogeneic of which 28.5% were on children and 769 (27%) autologous HSCTs. Transplants are increasing from 29 in 1998 to 190 allogeneic in 2017. The main graft source is peripheral blood stem cells for 1989 (96.6%). Cord blood has been used in 11 cases (0.5%) and bone marrow in 59 cases (2.8%). Matched related siblings represent 97% of

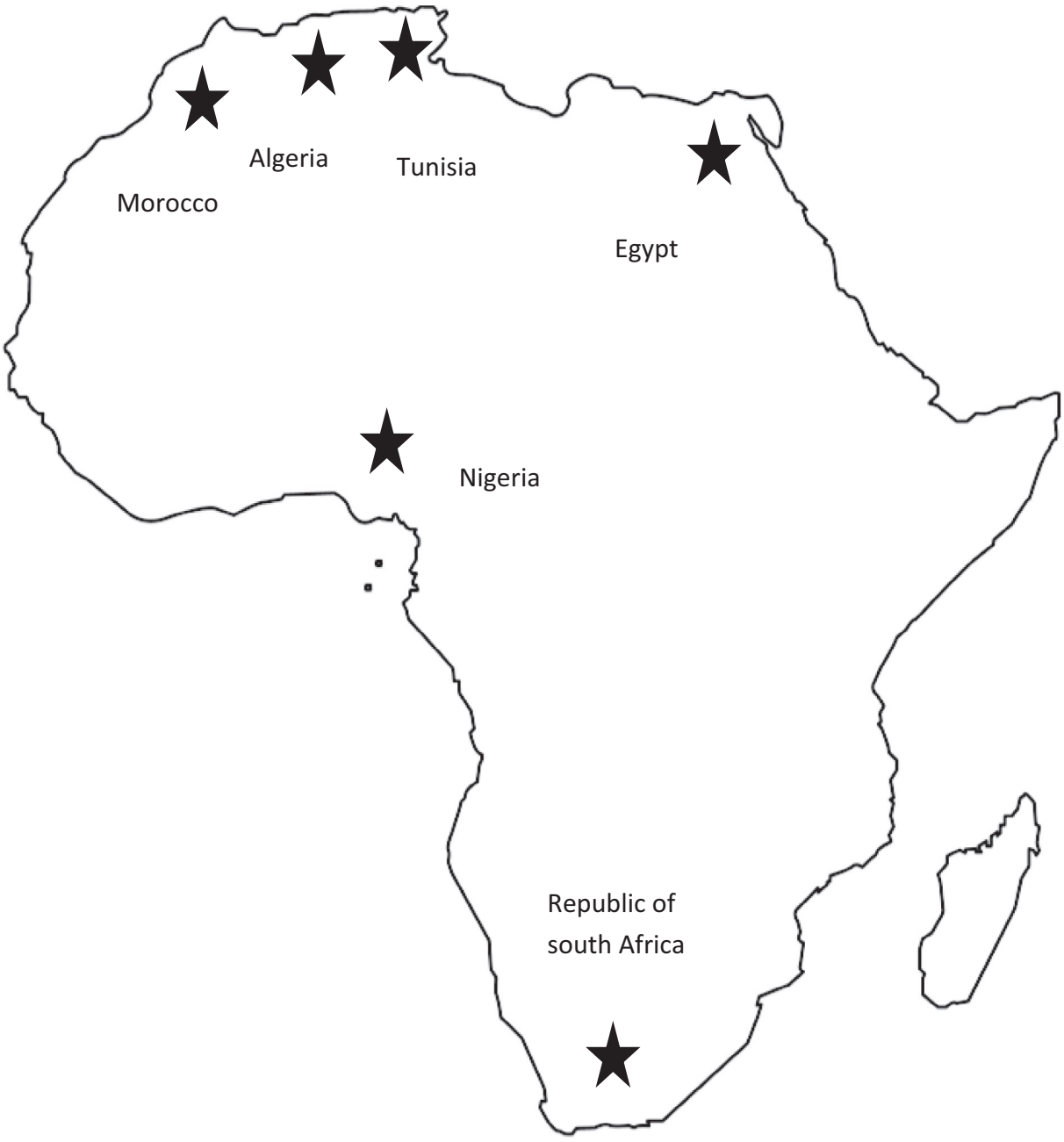

Fig. 1 Map showing the 6 African countries where hematopoietic stem cell transplantation is available.

donors. Haploidentical HSCT program started in 2013 with 61 cases to date. The main indications for autologous HSCT are lymphomas (57%) and multiple myeloma (38.5%). A total of 506 (24.5%) patients had allogeneic HSCT for nonmalignant diseases, mainly aplastic anemia (82%) and thalassemia (13%). Hematological malignancies represent 75.5%, mainly acute leukemias (65.8%). In Algeria, a second HSCT program is active in the city of Oran.

HSCT is performed in three university hospitals and in three private clinics in Morocco. There is no national dedicated center. L. Mahmal from University Hospital Mohammed VI of Marrakech reported on the infrastructure and bone marrow transplant programs. In the public sector the activity is active in three university hospitals. In Marrakech, Casablanca, and Rabat there are, respectively, six, four, and five air-controlled rooms dedicated to HSCT available. In private clinics, six and three rooms are available in Casablanca and Rabat, respectively, and in a not-for-profit hospital in Casablanca, four beds are used for HSCT. Autologous HSCT started in 2004 and allogeneic HSCT in 2010. HLA antigen typing is provided in four laboratories. Peripheral stem cell collection is performed in five centers. Stem cell processing is available in two centers with controlled freezing and liquid nitrogen and with noncontrolled rate mechanical freezing at $-80\,^{\circ}C$ in two other centers. Chimerism evaluation is possible in the Marrakech centre and extracorporeal phototherapy capacity is available in two centers (1 in University Hospital of Marrakech and 1

Table 1 Reported Infrastructure and Activity of HSCT in Africa.

Country	Period	No. of centers	Infrastructure	Auto-HSCT	Allo-HSCT
Algeria	1998—2017	2 public (Algiers, Oran)	Algiers Center: HSCT unit: 8 laminar flow rooms, 4 posttransplant rooms, 11 single protected rooms Apheresis unit Cell irradiation Freezing facility Cord blood bank TBI	*N* = 769 MM (38.5%) NHL (33%) HL (24%) Others (4.5%)	*N* = 2059 Sibling MRD: 1998 Haplo: 61 Hem. malignancies (75.5%) Nonmalignant hem. diseases (24.5%)
Morocco	2004—2017	7 (3 public, 4 private)	Casablanca, Marrakech, Rabat HSCT units: public 15 rooms; private 13 rooms Cryobiology units: 5 units Cord blood bank	*N* = 615 Public 365 Private: 250 MM (56%) NHL (13%) HL (23%) NB (8%)	*N* = 35 Hem. malignancies (32%) Nonmalignant hem. Diseases (68%)
Nigeria	2011—2017	2	NA	NA	*N* = 6 (SCD)
South Africa	1976—2017	9 (2 public, 7 private)	NA Donor registry	*N* = 250/year	*N* = 175/year
Tunisia	1998—2017	1 public	NA	*N* = 962 MM (70%) NHL (16%) HL (13.5%) AML (0.5%)	*N* = 789 Hem. malignancies (62.5%) nonmalignant hem. diseases (37.5%)

AML = acute myelocytic leukemia; Hem = hematological; HL = Hodgkin lymphoma; MM = multiple myeloma; NA = no available data; NB = neuroblastoma; NHL = nonHodgkin lymphoma; SCD = sickle cell disease.

private clinic in Casablanca). Total body irradiation as preparative regimen for HSCT is not available in the country. Allogeneic HSCT has been performed in 45 patients and autologous in 615 including the public (365 cases) and private sector (250 cases).

Forty-four posters reported on experience of various centers in Morocco. Experience of autologous HSCT in children was reported from Children's Hospital of Rabat (Agir Laaraj) describing 32 patients including 25 high-risk neuroblastoma, seven lymphoma, and 20 (4 high-risk neuroblastomas and 16 lymphomas) at Casablanca University Hospital (D. Dassouli).

Extensive experiences were reported with noncryopreserved grafts for multiple myeloma from various teams including 93 HSCT from the University Hospital of Casablanca (R. Farhane), 28 patients from the Cheikh Khalifa Hospital (L. Loukhmas), and 43 from the Mohammed V Military University Hospital (S. Ahchouch). No graft failures were reported. Other approaches reported by various teams included nonrate-controlled freezing at −80 °C with a mechanical freezer. The feasibility study in 10 cases was reported by the team of Cheikh Khalifa hospital (M. Ahnach) for lymphomas. The incidence of bacteremia was evaluated in 267 patients receiving autologous HSCT at the University Hospital of Casablanca (R. Massi). Among 193 (72%) febrile neutropenia episodes, 31 (16%) had bacteremia and Gram-positive pathogens were identified in 125 (65%) and in six patients (19%), infections were associated with indwelling central venous catheters. Three patients died from septic shock. Invasive fungal infections (IFI) included 17 cases in 193 febrile episodes. Aspergillosis was found in five cases (29%) and 12 *Candida* infections including *Candida parapsilosis* in five (29%), *Candida albicans* in five (29%), *Candida krusei* in one (6%), and *Candida glabrata* in one (6%). Two patients died due to IFIs.

In Nigeria, N. Bazuaye reported the experience of six first allogeneic HSCT for sickle cell disease performed from 2011 to 2018. Patients were aged 7—15 years. All patients are alive with two rejections. Autologous HSCT has not been performed in the country. The limited availability and cost of certain drugs, shortage of trained personnel, lack of radiotherapy facilities, molecular diagnostics laboratories, and limited government commitment and financial support have been recognized as obstacles to development of HSCT.

In the Republic of South Africa, HSCT was initiated at the University of Cape Town in 1976. Since then at this centre, >500 allogeneic transplants were performed. Currently, there are two programs at government funded academic centers and seven private units that perform autologous and allogeneic stem cell transplants. There are two stem cell donor registries. The South African Bone Marrow registry was created in 1992 and is the only bone marrow registry in Africa with World Marrow Donor Association (WMDA) Qualification status. This registry has over 73,000 donors and has provided over 400 unrelated grafts. The Sunflower Fund is another donor registry that has opened its doors as a registry in 2018. There is an active National stem cell transplantation society (SASCeTS) that runs a transplant activity registry. Yearly, ∼250 allogeneic and 175 autologous stem cell transplants are performed in the country.

The program in Tunisia started in 1998. In this country, health insurance covers 80% of the population. L. Torjemane reported for the National center for stem cell transplantation-the only facility in Tunisia performing HSCT. The center is performing 40—50 allogeneic HSCTs yearly for a total of 789. The main indications are leukemia (48%) and aplastic anemia (36%). A total of 60—70 autologous HSCTs are performed yearly for a total of 1,713; 70% are for multiple myeloma and nearly 30% for lymphomas. Twenty percent of the patients have a history of aspergillosis and require secondary prophylaxis. There is limited access to TBI.

The nurses' workshop was organized by R. Belkhedim, a transplant clinical nurse specialist from King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia. Fundamentals of nursing practice were reviewed including preparative regimens, stem cell collection, mobilization, harvest types, and infusion of hematopoietic stem cells along with other complications of HSCT. For most of the nurses, this was their first comprehensive course on HSCT.

The NGO workshop addressed their role in promoting HSCT program including improving patient quality of life during hospitalization and at home, financial support (drugs, blood tests, rent, transport, etc.), patient and family information and therapeutic education, public awareness campaigns on the value of BMT and advocacy for BMT with governmental decision-makers. NGOs in Morocco have had a crucial role in developing the HSCT programs. The Agir association was the initiator of HSCT in Casablanca and Lalla Salma for Prevention and Treatment of Cancer has been a major actor supporting HSCT in all public centers. The involvement of NGOs include broad aspects of HSCT including support for hospital infrastructure, purchasing medications, and direct support for patients and families.

Discussion

Africa is the second most populated continent with 1.3 billion inhabitants equivalent to 16.64% of the world population [5]. Of the 54 African countries, HSCT is possible only in six countries. The latest published report of WBMT [2] showed that AFR/EBMT region represented only 3% of reported activity worldwide. In the African continent, this is even lower. The healthcare systems in Africa are the least developed. Previous publications from the WBMT reported a close relationship of the per capita gross national income (GNI) is closely related to HSCT activity with a threshold of ~700 US$ [6]. Most African countries including subSaharan region do exceed this GNI per capita [7]. Governmental healthcare expenditures have also been shown to be closely associated with transplant rates [6]. This may not reflect all expenditures because private expenditures contribute significantly to healthcare spending in countries where health coverage is low. Communicable diseases including human immunodeficiency virus/AIDS, viral hepatitis, tuberculosis, and malaria are still a great burden in Africa, but considerable improvements in the treatment of these diseases were achieved. Noncommunicable diseases (NCD) are now a priority and the WHO is encouraging African member states to put in place strategic planning for NCD [8]. In this context, HSCT is recognized as life-saving. It may also be cost-effective in many diseases especially in hemoglobinopathies [9]. Besides its direct impact, HSCT can have a positive impact in the general quality of healthcare through improvement of diagnostic capabilities, development of infection controls, blood transfusion systems, and coordination of care. The role of NGOs and patient/parents' associations can advance the initiation of HSCT programs in developing countries [10]. They can help improve awareness, support all aspects of care, and provide support for families.

The road to further development of bone marrow transplantation in Africa still needs extensive work. Yet with the involvement of many stakeholders, more patients can get access to HSCT. International organizations including WBMT can provide impact in guidance, collaboration, and support. Adapting the available knowledge to local needs is an important step to make HSCT available for patients. This may be partly available [11]. but more remains to be done. Local leadership is the key to success for any national or regional development of HSCT. The meeting in Casablanca was just the first step and with the help of all institutions and persons involved we are looking forward to continue the progress initiated while using also new tools such as telemedicine. This will be a step forward to implementing the guiding principles of the WHO.

Declaration of Competing Interest

All authors have no conflicts of interest to declare.

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