

# Nursing Ancient and Future of Stem Cell Transplantation in Egypt

Dr. Hanan Mohammed Mohammed<sup>1,4</sup>, Dr. Ragaa Gasim Ahmed Mohammed<sup>2</sup>,  
Dr. Abeer El-Said Hassane El-sol<sup>3,4</sup>

<sup>1</sup>Assistant Professor of Medical-Surgical Nursing Department, Faculty of Nursing, Ain Shams University, Egypt

<sup>2</sup>Assistant professor of Pediatric Nursing, Faculty of Applied Medical Sciences, Nursing Department, Al-Baha University, Saudi - Arabia

<sup>3</sup>Lecturer of Medical-Surgical Nursing, Medical Surgical Department, Faculty of Nursing, Shibin Elkom, Menoufia University, Shibin Elkom, Egypt

<sup>4</sup>Nursing Department, Applied Medical Sciences College, Al-Baha University, Kingdom of Saudi Arabia

Corresponding Author: Dr. Abeer El-said Hassane El- Sol

Email: [ambersepha.56@gmail.com](mailto:ambersepha.56@gmail.com)

---

**Abstract:** All around the world, although enormous technological advancement and improvement of scientific approaches to fight all diseases; especially blood diseases as white blood cell (WBC) disorders, the people still sick and they need treatment. Since hematopoietic stem cell transplantation started, nurses play an important role on this procedure, qualified nurses involved in every step of the stem cell collection process. They prepared with the knowledge and practice about the cord blood gathering and stem cell banking procedure to do; Otherwise nurses acting an accurate group of functions in stem cell banking, from their understanding the structure of the umbilical cord to defining the sites of obtaining stem cells. Furthermore, nurses assisting doctors in stem cell infusion procedures. Specialized nursing care, are essential to avoid and manage the predicted and unpredicted complications of hematopoietic stem cell transplantation.

**Keywords:** Stem cells, Hematopoietic stem cell transplantation, Cord blood banking, Nursing role, Stem cell phases.

---

**Abbreviations:** White Blood Cell; WBC, Stem cells; SCs, Hematopoietic stem cell transplantation; HSCT, Ministry of Health and Population; MOHP, Cord Blood; CB, Stem Cell Transplant; SCT, Granulocyte colony stimulating factor ;GCSF, Human Leukocyte Antigen; HLA.

## 1. INTRODUCTION

Stem cells (SCs) are unspecialized cells that have two essential characteristics: the capability to distinguish into other cells through mitotic cell division and differentiate into a diverse range of specialized cell types and the capability to self-regenerate [1 & 2]. Bone marrow has at least two types of stem cells, hematopoietic stem cells (HSCs) and mesenchymal stem cells or marrow stromal cells (MSCs) [1].

Stem cells have two general kinds of mammalian stem cells are: embryonic stem cells that are obtained from the inner cell mass of blastocysts, and mature stem cells that are found in mature tissues [3].

Hematopoietic stem cell transplantation (HSCT) is the transplantation of multipotent hematopoietic stem cells, generally the main its sources are bone marrow, peripheral blood, or umbilical cord blood, according to the donor it classified into

three types when the donor is patient's own stem cells which called autologous, or the donor stem cells come called allogeneic; or from an identical twin called syngeneic [2,4&5].

It is a medical life-saving treatment for several diseases as haemato-oncological condition, such as leukemia, lymphoma or multiple myeloma and certain inherited metabolic diseases [2, 4&5]. Moreover recently some researches attempt to use hematopoietic stem cell transplantation for the treatment of diabetes, cardiovascular and neuro-generative diseases, but the applications are still undocumented success [6].

Before patient treatment by HSCT need to assess stage of the disease, type of disease, conditioning regimen, type of transplant, human leukocyte antigen-matched compatibility, age of the patient and his or her general health and follow up to decide the patient prognosis [7].

**1.1. Indications for stem cell transplantation:**

Divide into malignant as acute myeloid leukemia (AML), chronic myeloid leukemia (CML), acute lymphoblastic leukemia (ALL), Hodgkin lymphoma (HL) (relapsed, refractory), non-Hodgkin lymphoma (NHL) (relapsed, refractory), neuroblastoma, ewing sarcoma, multiple myeloma, myelodysplastic syndromes, gliomas, and other solid tumors; while non-malignant as thalassemia, sickle cell anemia, aplastic anemia, fanconi anemia, malignant infantile osteopetrosis, mucopolysaccharidosis, immune deficiency syndromes and autoimmune diseases [8].

**1.2. Historical background:**

More than 40,000 stem cell transplants are being performed annually in the world [6].

Egyptian program of hematopoietic stem cell transplant, established in 1989, but it began slow progress, now more transplants performed by peripheral blood than bone marrow [9].

Egyptian Ministry of Health and Population (MOHP) founding a wide policy on CB banking using guiding principle and codes of ethics from the United States and Europe as a template. In 2007 it accepted a National Blood Policy with procedural guidelines for CB collection and storage to be overseen by the country's National Blood Transfusion Standards [10].

In 2011 the MOHP formed the National Stem Cell Committee tasked with creating protocols of for stem cell research and therapy and a national stem cell bank, in 2012a new stem cell research center established at Sheikh Zayed Hospital, otherwise Zewail City of Science and Technology opened a Center for Stem Cell Research and Regenerative Medicine in 2013 [11]. This city is associating with Assiut University to build a public CB bank [12].

Before a CB bank activate in Egypt, it obtain approval from Al-Azhar University, a well-known center for Islamic learning in Cairo. Egypt licenses both private and public banking in the country, an extended confident guidelines are achieved to diminish the possible of marketable manipulation [13]. At Ain Shams University in Cairo; many a clinical trial performed for transplants by autologous CB in neonates [14].

**1.3. Egypt and Arab world:**

Cord blood banking is a public CB bank, which established in five countries; they are Jordan, Saudi Arabia, Egypt, Qatar, and the United Arab Emirates, designated for their diverse CB banking policies and creativities. It responsible for assessing case studies, suggests strong incentives research for increasing the number of CB units that are collected from and available to Arab populations. Furthermore, it concerning with awareness and education of the public to correct the deficit in knowledge related to this issue. It mostly financed by the government, generous sources, and income from exporting CB units to transplant centers [13].

**Table 1. Relevant Demographic, Health, and Economic Indicators of 4 Arab Countries Studied: Jordan, Saudi Arabia, UAE, Egypt [15]**

Country	Population	Arab	Fert	GNI	Health \$	Hosp Beds	Leukemia	Lymphoma
Jordan	7.93M	98%	3.16	\$4.95k	8.4%	1.8	6.1	8.2
Saudi Arabia	27.3M	90%	2.17	\$26.2k	3.7%	2.2	3.8	7.9
UAE	5.63M	13% <sup>1</sup>	2.36	\$38.6k	3.3%	1.9	3.7	6.7
Egypt	86.9M	99%	2.87	\$3.16k	4.9%	1.7	5.9	9.3

International Journal of Novel Research in Healthcare and Nursing

Vol. 4, Issue 3, pp: (80-91), Month: September - December 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

Percent of population of Arab ethnicity (Arab), and total fertility rate (Fert)\*; economics: gross national income per capita (GNI)<sup>†</sup> and percent of gross domestic product for health expenditures (Health \$); and health: hospital bed density<sup>‡</sup> (Hosp beds) and age-standardized incidence rates<sup>§</sup> of leukemia and lymphoma (both Hodgkin and non-Hodgkin).

Table 2. Current CB Banking Options in the Arab World [16]

CB Bank	Type	Storage Location	Collection Office Location(s)
Baby Cord	Priv	USA (Boston), Jordan (Amman)*	Jordan
Biovault Family	Priv	UK (Plymouth)	Lebanon, UAE
Cell Safe	Priv	Egypt (Cairo)	Egypt
Cells4Life	Priv	UK (Burgess Hill, Essex)	Bahrain, Egypt, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, UAE
Center for Stem Cell Research & Regenerative Medicine	Publ	Egypt (Assiut)*	Egypt
Cryo-Save	Priv	UAE (Dubai), Belgium (Niel)	Egypt, Kuwait, Oman, Saudi Arabia, UAE
DCRC <sup>†</sup>	Hybr	UAE (Dubai)	UAE
Future Health Biobank	Priv	UK (Nottingham), Switzerland (Châtel-St-Denis)	Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Qatar, Saudi Arabia, Syria, UAE
KAIMRC	Publ	Saudi Arabia (Riyadh)	Saudi Arabia
KFSH-RC <sup>†</sup>	Publ	Saudi Arabia (Riyadh)	Saudi Arabia
KHCC	Publ	Jordan (Amman)*	Jordan
Precious Cells	Priv	UK (Middlesex)	Jordan, Lebanon, UAE
Smart Cells	Priv	UK (West Drayton)	Egypt, Jordan, Kuwait, Lebanon, Syria, UAE
Sultan Qaboos Univ. Hospital	Publ	Oman (Muscat)	Oman
Virgin Health Bank	Priv, Hybr	Qatar (Doha)	Qatar

Priv means private banks, Publ means public banks, as well as Hybr means hybrids,

\*Indicates the CB bank storage facility is currently under construction.

†Indicates CB banks that are Provisional Members of the NetCord consortium.

Table 3. Timeline of Major CB Banking Developments in the Arab World [13]

Year	Development
1998	First Cord Blood transplant is done in Arab world
2003	Muslim World League's Jurisprudential Council issues a <i>fatwa</i> approving Cord blood transplants and research begun in SA.
2006	UAE: DCRC opens first CB bank in the region, as a public-private hybrid model SA: KFSH-RC opens the Kingdom's first public CB bank UAE: Cryo-Save Arabia, the largest private CB storage facility in the region, opens in Dubai Healthcare City
2007	EG: Guidelines for CB collection and storage process is accepted by National Blood Policy.
2009	QA: Transferring of Virgin Health Bank its headquarters from London to Doha. EG: Cell Safe opens as the country's first private CB bank
2011	QA: Virgin Health Bank is granted the first (and only, to date) license for CB procurement, processing, and storage. SA: KAIMRC opens the country's second public CB bank and creates the Saudi Donor Registry QA: Virgin Health Bank opens storage and processing facility at Qatar Science & Technology Park EG: National Stem Cell Committee is created and tasked with establishing regulations for stem cell

	research and therapy as well as a public CB bank
<b>2012</b>	EG: Stem cell research center opens at Sheikh Zayed Hospital QA: Stem cell research policy is enacted into legislation, allowing research using CB stem cells
<b>2013</b>	EG: Center for Stem Cell Research and Regenerative Medicine opens in Zewail City of Science & Technology
<b>2014</b>	JO: New stem cell research law is passed, including regulations for CB banking
<b>2015</b>	JO: Projected opening of the first in-country private CB storage facility by the company, BabyCord Jordan EG: Projected opening of the country's first public CB bank, located at Assiut University, in partnership with Zewail City of Science & Technology
<b>2016</b>	JO: Projected opening of the country's first public CB bank, located at KHCC

Over the past decade, several Arab countries have had significant activities related to CB banking, starting primarily with Saudi Arabia (SA) and the UAE. More recently, new developments have been centered in Egypt (EG), Qatar (QA), and Jordan (JO).

### 1.3.1. The formal unities and hospitals for HSCT in Egypt:

Health Organization has recently clarified that stem cells treat 90 Disease and success rate 100%. So The Egyptian Ministry of Health has established two stem cell treatment units, they are at Sheikh Zayed Specialized Hospital in 6th of October City and Ahmed Maher Hospital, they started the treatment protocol by HSCT in 2012. The success rate is more than 90%, especially in liver diseases and complications, and the establishment of clinics for the comparison of cases and determine who needs to cultivate stem cells at Ahmed Maher Teaching Hospital in Cairo [17].

Other hospitals are Hospital 57357, Nasser Institute, Ain Shams Hospital, and Demerdash Hospital. All the stem cells transplantation cases which performed in Egypt have all succeeded. Otherwise the Egyptian armed forces began their interesting to this treatment and attention to the idea came to establish the bank of the armed forces of stem cells at the Al El Galaa Medical Complex in January 2015 and was actually operational May 1, 2015[18& 19].

This project was processed within seven months with all the technology in it. The armed forces goal now is to focus with the national project of the armed forces, which will cover all provinces. There will be a law for stem cell treatment to regulate the treatment under the supervision of the armed forces [20].

### 1.3.2. Egyptian experts in HSCT:

There are many doctors specialized in field of treatment by HSCT as Dr. Wael Abou El Kheir Mustafa, Professor of Immunology and Microbiology - Ministry of Health, Consultant of Stem Cell Therapy and Director of Stem Cell Unit, Sheikh Zayed Specialist Hospital, Consultant of Stem Cell Therapy at Ahmed Maher Teaching Hospital, and Secretary of the Egyptian Society for Stem Cell Research [17&21].

Dr. Abdelhamid Abaza, Assistant Minister of Health and Chairman of the National Commission on Stem Cells [22]. Dr. Hisham Issa, Chairman of the Stem Cell Bank [23]. Dr. Sharif Naseh, founder of the first stem cell bank in Egypt. Dr. Hassani Salama, Supervisor of the experiments of stem cell transplantation in the hospital of Qasr al-Aini [24]. Dr. Abdel Hakim Safwat, who has the first founder in the field of stem cells to treat chronic eye disease [25].

### 1.4. Cord Blood Stem Cells vs. Bone Marrow Stem Cells:

The first use of Umbilical Cord blood stem cells transplant in 1988 and it used to treat more than 80 diseases. Umbilical cord stem cell storage is a simple non-invasive procedure and is completely harmless to the mother or the baby. While the collection of stem cells from the bone marrow is an invasive procedure and also requires general anesthesia which comes with its own set of inherent risks [13&26].

### 1.5. The Benefits of Umbilical Cord Blood stem Cell Storage in Stem Cell Banking:

Treatment of cancer cells by chemotherapy or radiation have many complications as cell destruction, this destruction not differentiate between the cancer cells and healthy cells; it destroy the both cells. Stem cell therapy helps to replicate the healthy cells or the disease/free cells in patients. Umbilical cord blood characterized by rich with stem cells. These cells have the ability to reproduce themselves and also chance into any other type of cells as blood vessels, immune-system

cells, bone cartilage, muscle cells, blood cells and nerve cells. So establishment of Stem Cell Banking is important process, wherever cord blood cells are readily used to replenish the immune system after chemotherapy or radiation available any time of need [26].

**1.6. Comparison Between Bone Marrow or Peripheral Blood Stem Cells and Cord Blood Donated for Transplantation [27&28]:**

Bone Marrow/Peripheral Blood	Cord Blood
Bone marrow donation requires surgery under general anesthesia. Donors may experience temporary discomfort and/or pain. Long-term consequences of growth factors used in peripheral blood stem cell donations are uncertain.	Stem cell obtained from the delivered placenta and umbilical cord, no medical risk to mother or infant
A transplant needs donation of a quart or more of bone marrow (mixed with blood).	A small volume (sometimes few ounces) can be used for transplantation. The number of cells needed depends on the recipient's weight.
Bone marrow and peripheral blood grafts have large numbers of stem cells. Engraftment of neutrophil is fast.	Cord blood units contain smaller numbers of stem cells. Slower engraftment may lead to prolonged hospital stay, and in certain cases, to severe complications.
After a formal search is started, it usually takes 2 or more months to transplant, if a donor is available.	When a match is found, it can take only a few days for confirmatory and special testing for shipment to the Transplant Center (less than 24 hours in an emergency).
Potential donors may no longer be available or may have withdrawn consent. Donor must be presented and retested to check the HLA typing and infectious disease results and to ensure that the donor is still willing and able to donate bone marrow. Significant donor attrition.	Once frozen, a cord blood unit is available until used. There is no donor attrition.
Donor may be accessible to give a second transplant or to donate blood for T-cells if needed.	Donor is not existing for a following second donation
Bone marrow is used fresh (shelf-life measured in hours). Peripheral blood stem cells usually stored for short term (days to a few months).	Cord blood units are cryopreserved (stored in special freezers). Frozen cord blood has been transplanted successfully after up to 13 years in storage.
Patient must begin conditioning before the bone marrow or peripheral bloods harvest. Coordination between donation and transplant is critical and complex.	Cord blood graft can be shipped to the transplant center before the patient enters the hospital and begins conditioning for transplantation. Coordination is simple. Cord blood units are shipped on demand.
Latent viral infection in the donor is common	Incidence of viral infection in the cord blood donor is sporadic.
No risk of transplanting a genetic disease.	There is a small probability that a rare, unrecognized genetic disease affecting the blood or immune system of the baby may be given with the cord blood transplant.
Severe graft vs. host disease (GvHD) is common with mismatched grafts.	GvHD less frequent, usually less severe and easier to treat
In general needs a perfect match between donor and recipient for 8/8 HLA-A, -B, -C and -DRB1 antigens. Additional HLA factors (HLA-DQ and -DP) increasingly used to improve prognosis.	HLA-mismatched cord blood transplants are possible, making it easier to find an appropriate match. Role of HLA-C, -DQ and -DP are not yet known.

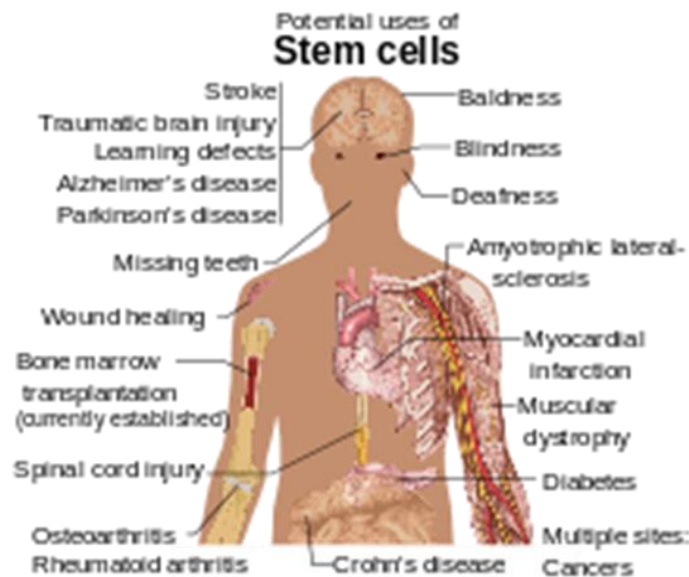


Figure 1. Potential uses of stem cells [29, 30 & 31]

### 1.7. The Nurse's Role in Stem Cell Transplantation:

Stem cell transplantation need to highly qualified nursing team, the nurses efficient practices influence on quality of care and the safety of patients, especially in very ill patients. Their care in transplant process introduced to donors, and recipients; and **classify into three phases:**

**1.7.1. Pre- transplant phase;** within this phase the nurses play an important role in the informed consent process, supporting the medical staff's explanations; nurses should assess; 1). Patient's current fears and concerns; 2). Barriers to learning; 3). Nutrition assessment; 4). Understanding of the complete transplant procedure and needed time; 5). Existing complications symptoms from previous therapies or disease; 6). Present coping ability; 7). Current pain; 8). The need for blood/ its product transfusion; and 9). Type of appropriate anesthesia for transplant [7&32].

**1.7.1.1. Teaching the patients about:** The nurse assist the patient with his/her decision by explaining 1. The procedure extent time, mobilization, and transplant process; 2. Role of caregiver; 3. Care coordination; 4. Confirm family/Friend plan for care giving; 5. Contact referring physician's office to obtain report; 6. Confirm financial clearance; 7. Confirm housing plan [7, 33, 34, 35 & 36].

**1.7.1.2. Carrying out the medical care plan;** by maintain operational information of planned transplant strategy for patient [7, 33, 34, 35 & 36].

**1.7.1. 3. Pre-transplant investigations for donors are;** renal function tests; Electrocardiogram; hepatic function tests; complete blood count; chest X-ray and lung function tests; clotting factors, including thrombin and prothrombin; infection and antibody screen; viral hepatitis screen; disease stages status; bone marrow aspiration biopsy; biochemistry; tissue typing and blood grouping and cross-matching [7,33,34,35 & 36].

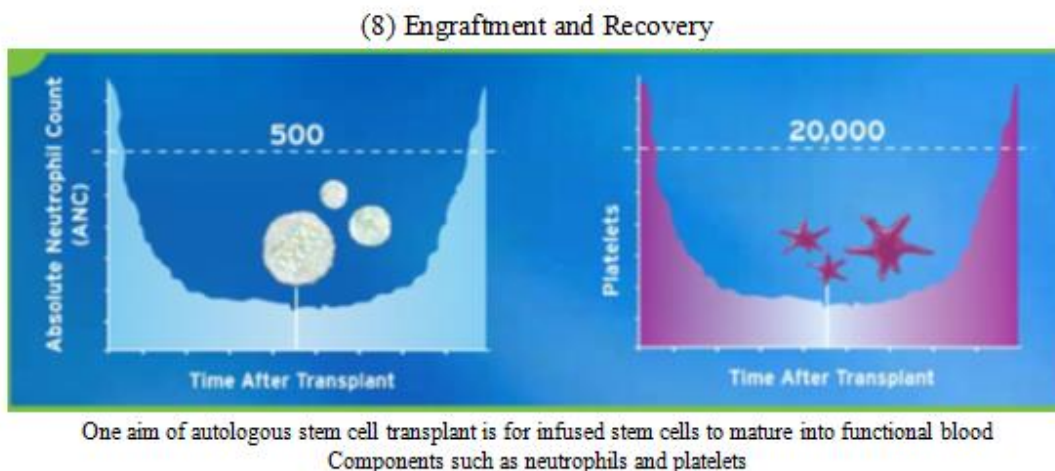
**1.7.1.4. Donors preparation;** before blood collecting from suitable donor; they called the "forgotten patients" of transplant the donor undergoing some investigations as CBC-complete blood count, CMP-comprehensive metabolic panel, pregnancy test (if females), bleeding times, ABO blood type and infectious disease tests — human immunodeficiency virus (HIV), cytomegalovirus (CMV), toxoplasmosis, hepatitis, Epstein-Barr virus (EBV), herpes, HTLV I/II, varicella, and syphilis. Furthermore the donor should take over a 4-day course of Granulocyte colony stimulating factor (GCSF); which are glycoproteins to stimulate the multiplying of white blood cell [37]. The course of Granulocyte colony stimulating factor (GCSF) side effect is minor bone pain as result of the excessive stem cell crowding with new produced cell [7].

**1.7.2. Transplant phase;** Once a patient has met initial screening and ready to undergo HCT at a particular center, the nurse's main responsibility recognize the details of the effective evaluation. The organization and time need for care

during transplant phase is especially critical if the patient has an unrelated donor. The duration of infusion depends up on type of stem cell transplant. Otherwise engraftment of the stem cells can take between 14 and 25 days, depending on the type of stem cells used. Early engraftment high risk of infection so it important that; skilled nursing assess, prevent, detect and treat infections. Any delay in infection diagnosing may lead to increased vulnerability to a wide-ranging of potentially life-threatening organisms [38 & 39].

The circulating blood has many immature hematopoietic stem cells; that are like to those in the bone marrow are harvested by apheresis from a possible donor. The apheresis process usually takes for 4–6 hours, depending on the donors total blood volume. After that the collected stem cell is administered intravenously to the recipient patient. The infused hematopoietic stem cells travel from patient peripheral circulation into the recipient's bone marrow, a process recognized as stem cell homing. This permits the bone marrow to get well, multiply and remain making healthy blood cells [39 & 40].





The first signs of engraftment and recovery include increasing absolute neutrophil and platelet counts

Figure 2. The Stem Cell Transplant Process [41, 42, 43 & 44]

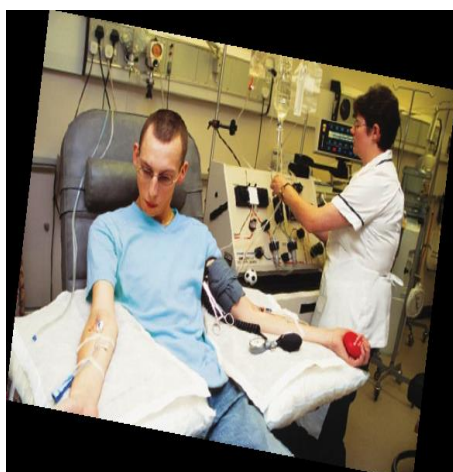


Figure 3. Apheresis Collection [45 &46]

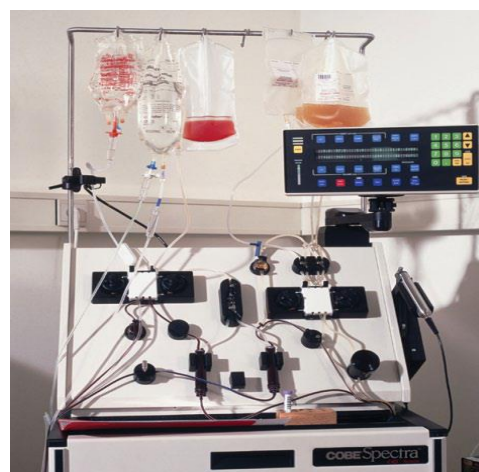


Figure 4. Example of an Apheresis Machine [47&48]

**1.7.3. Post-transplant phase;** to prevent the infection which lead to the graft failure the nurses should apply protective isolation in most transplant centers, for four to six weeks after transplant; check vital signs; and peripheral oxygen saturations every four hours; the best important sign of infection is elevation in body temperature; additional nurses should observe other signs as chills, rigors. Nurses should daily assessment of any signs of infection in the patient’s central venous catheter [7& 49].

In addition, nurses should enquire about and patients rooms with high efficiency particulate air-filtration systems. This system filters the air, reducing microbes and spores entering the room, avoid visiting, not allowed plants and flowers in the patient’s room because of the infection risk; patients wear a mask to decrease the possibility of inhaling aspergillus spores ; all staff and visitors must wash their hands and wear a plastic apron before entering the patient’s room to reduce the risk of cross-infection [50].

The patient should be well hydrated and intravenous fluids. An accurate fluid chart balance for intake and output chart should be performed. As a result of administration of certain drugs electrolytes should be monitored. The nurse educate the patient about personal hygiene It is important as frequent proper hand washing, daily shower using disposable, use individual towel, short clean figure nails, maintain skin clean and dry, oral care and dental checkup are important part of infection control in transplant patients [7 & 51].



**International Journal of Novel Research in Healthcare and Nursing**

Vol. 4, Issue 3, pp: (80-91), Month: September - December 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

Patient pain if present might be managed by medications according to its severity. The patient should have sufficient nutrients. If the patient is not capable to eat, nutritional support may be administered by parenteral nutrition or by enteral feeding using a nasogastric tube [52].

That patient need to psychological support by spending time with the patient and offering him or her opportunity to talk about anxieties; the nurse's providing information, education and guidance may reduce the undesirable psychological effects of isolation [53].

**1.8. Discharge checklist for patients after stem cell transplantation:**

The nurse should instruct patients about the following:

- Avoid contact with people who have respiratory illnesses.
- Care should be taken when around schoolchildren as there is a risk of exposure to sick children.
- Stop smoking and avoid smoky areas for the first few months following transplantation.
- Avoid public swimming pools in the early weeks of discharge.
- Avoid house cleaning, which will disturb dust.
- Avoid travel for the first six to 12 months. When considering travel, patients should seek advice regarding travel vaccinations, particularly if they are live vaccines.
- It is essential that patients continue to take their medication and attend all follow-up outpatient appointments [7].

**1.9. Complications of HSCT:**

HSCT lead to high mortality rate into 38% or higher in the recipient, so its use limits to avoid life-threatening. The most common complications are veno-occlusive disease, mucositis, infections (sepsis), graft-versus-host disease and the development of new malignancies [7, 54 & 55].

**1.10. Future of stem cell transplant in Egypt:**

Improvement in cure rate than standard approaches, which will become suitable for many older patients with hematological conditions and cancer. Enhanced transplantation procedures across different types of human leukocyte antigen (HLA), minimize and controlling the complications of transplant. More public awareness about stem cell transplant for increased availability of umbilicus stem cell donor. Activation of nursing care protocol in stem cell process, educational nursing program and establishment of nursing committee through Ministry of Health and Population.

**2. CONCLUSION**

Stem cells are the body's master cells which have the ability to grow into any one of the body's more than 200 cell types. There are different sources of stem cells; as embryonic stem cells, harvested from umbilical cord blood, other source is adult or mesenchymal stem cells are presented in bone marrow, blood, blood vessels, skeletal muscles, skin and the liver. Stem cell transplantation needs to highly qualified nursing team, their care continuing within phases of transplant for both donors and patients.

**REFERENCES**

- [1] Hoda Al Tayeb, Ahmed El Dorry, Nehad Amer, Nadia Mowafy, Maha Zimaity, Essam Bayoumy, and Shereen A.Saleh. Autologous Stem Cells Transplantation in Egyptian Patients with Liver Cirrhosis on Top of Hepatitis C Virus. International Journal of Stem Cells Vol. 8, No. 2, 2015 <http://dx.doi.org/10.15283/ijsc.2015.8.2.209>
- [2] Hend M. Azzazy and Hanem F. Mohamed. Effect of Educational Intervention on Knowledge and Attitude of Nursing Students Regarding Stem Cells Therapy. IOSR Journal of Nursing and Health Science (IOSR-JNHS) e-ISSN: 2320-1959.p- ISSN: 2320-1940 Volume 5, Issue 2 Ver. IV (Mar. - Apr. 2016), PP 75-80 [www.iosrjournals.org](http://www.iosrjournals.org)

**International Journal of Novel Research in Healthcare and Nursing**

 Vol. 4, Issue 3, pp: (80-91), Month: September - December 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

- [3] American College of Obstetricians and Gynecologists. FAQ 172. Cord blood banking. 2011. Available from: <http://www.acog.org/~media/For%20Patients/faq172.pdf?dmc>.
- [4] Felfly, H; Haddad, GG. Hematopoietic stem cells: potential new applications for translational medicine." *Journal of stem cells*. 9 (3): 163–97. 2014. PMID 25157450.
- [5] Park, B; Yoo, KH; Kim. Hematopoietic stem cell expansion and generation: the ways to make a breakthrough.". *Blood research*. 50 (4): 194–203. doi: 10.5045/br.2015.50.4.194. PMC 4705045 . PMID 26770947.
- [6] Amira Mohammed Saed Mohammed Khali, and Sabah Mohammad El Sayed Sharshor. Pediatric Nurses Knowledge, Awareness and Attitude towards Application of Stem Cells Therapy in Children. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* e-ISSN: 2320–1959,p- ISSN: 2320–1940 Volume 5, Issue 4 Ver. III (Jul. - Aug. 2016), PP 88-96 [www.iosrjournals.org](http://www.iosrjournals.org)
- [7] NS569 Brown M (2010) Nursing care of patients undergoing allogeneic stem cell transplantation. *Nursing Standard*. 25, 11, 47-56.
- [8] Alexander, Tobias; Arnold, Renate; Hiepe, Falk; Radbruch, Andreas (2016-07-01). "Resetting the immune system with immunoablation and autologous haematopoietic stem cell transplantation in autoimmune diseases". *Clinical and Experimental Rheumatology*. 34 (4 Suppl 98): 53–57. ISSN 0392-856X. PMID 27586805.
- [9] H.K. Mahmoud, A.M. El-Haddad, O.A. Fahmy, et al. Hematopoietic stem cell transplantation in Egypt Bone Marrow Transplant, 42 (Suppl.) (2008), pp. S76–S80 CrossRef View Record in Scopus. Citing articles (12).
- [10] Arab Republic of Egypt: Ministry of Health and Population National blood policy available at: [http://www.who.int/bloodsafety/transfusion\\_services/EgyptNationalBloodPolicy2007.pdf](http://www.who.int/bloodsafety/transfusion_services/EgyptNationalBloodPolicy2007.pdf) Accessed December 28, 2013.
- [11] Zewail City of Science and Technology. Mission: The Center of Excellence for Stem Cells and Regenerative Medicine. Available at: <http://www.zewailcity.edu.eg/research-institutes/hims/cesc/mission/>. Accessed September 19, 2014.
- [12] Zewail City of Science and Technology. Dr. Nagwa El-Badri receives STDF contract for Stem Cell Research Center. Available at: <http://www.zewailcity.edu.eg/press-releases/dr-nagwa-el-badri-receives-stdf-contract-for-stem-cell-research-center/>. Accessed August 4, 2014.
- [13] Monica M. Matsumoto, Rana Dajani, and Kirstin R.W. Matthews, Cord Blood Banking in the Arab World: Current Status and Future Developments. *Biology of Blood and Marrow Transplantation* Volume 21, Issue 7, July 2015, Pages 1188–1194. Available at: <https://doi.org/10.1016/j.bbmt.2015.01.012>.
- [14] Hassanein SMA. Autologous umbilical cord blood transfusion for preterm neonates. Available at: <http://clinicaltrials.gov/show/NCT01121328>. Accessed September 19, 2014.
- [15] Sources: Central Intelligence Agency. World Factbook 2014. Available at: <https://www.cia.gov/library/publications/the-world-factbook/index.html>. Accessed October 30, 2014; United Arab Emirates National Bureau of Statistics. Population by Nationality. Available at: <http://www.uaestatistics.gov.ae/ReportPDF/Population%20Estimates%202006%20-%202010.pdf>. Accessed November 1, 2014; WHO International Agency for Research on Cancer. GLOBOCAN 2012: Estimated cancer incidence mortality and prevalence worldwide. Available at: [http://globocan.iarc.fr/Pages/fact\\_sheets\\_population.aspx](http://globocan.iarc.fr/Pages/fact_sheets_population.aspx). Accessed October 30, 2014; The World Bank. Table 1.1 World development indicators: size of the economy. Available at: <http://wdi.worldbank.org/table/1.1>. Accessed November 11, 2014.
- [16] The World Bank. World development indicators: Size of the economy. Available at: <http://wdi.worldbank.org/table/1.1#>. Accessed May 29, 2014.
- [17] <https://www.facebook.com/ESPCR/posts/522809217824195>.
- [18] <https://alwafd.org>.

**International Journal of Novel Research in Healthcare and Nursing**

 Vol. 4, Issue 3, pp: (80-91), Month: September - December 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

- [19] <http://www.alraimedia.com/ar/article/medical/2012/11/14/369600/nr/nc>.
- [20] <http://nisfeldunia.ahram.org.eg/NewsP/46/70168>.
- [21] <http://www.masress.com/gom/1306151700>.
- [22] [http://drkamalfahmy.blogspot.com/2012/10/blog-post\\_24.html](http://drkamalfahmy.blogspot.com/2012/10/blog-post_24.html)
- [23] <https://www.facebook.com/MrDyDmwrAldlatWalhqyqt/posts/712620745438854>
- [24] <http://www.masress.com/baladnews/8658>
- [25] <http://www.tahrirnews.com/posts/3594>
- [26] <http://parentsguidecordblood.org/diseases.php>
- [27] Itr Sirinoglu Demiriz, Emre Tekgunduz, and Fevzi Altuntas. What Is the Most Appropriate Source for Hematopoietic Stem Cell Transplantation? Peripheral Stem Cell/Bone Marrow/Cord Blood. Bone Marrow Research Volume 2012 (2012), Article ID 834040, 5 pages <http://dx.doi.org/10.1155/2012/834040>.
- [28] <http://www.nationalcordbloodprogram.org/contact/index.html>.
- [29] Stem Cell Basics: What are the potential uses of human stem cells and the obstacles that must be overcome before these potential uses will be realized? In Stem Cell Information World Wide Web site. Bethesda, MD: National Institutes of Health, U.S. Department of Health and Human Services, 2009. cited Sunday, April 26, 2009.
- [30] Bubela T, Li MD, Hafez M, Bieber M, Atkins H (2012). "Is belief larger than fact: Expectations, optimism and reality for translational stem cell research"? BMC Med. 10: 133. PMC 3520764 PMID 23131007. doi:10.1186/1741-7015-10-133.
- [31] Ader, M., & Tanaka, E. M. (2014). Modeling human development in 3D culture. Current Opinion in Cell Biology, 31, 23-28. doi:10.1016/j.ceb.2014.06.013.
- [32] <https://www.mskcc.org/blog/msk-s-one-year-survival-rate-after-allogeneic-bone-marrow-transplant-exceeds-expectations>.
- [33] Bakken AM. Cryopreserving human peripheral blood progenitor cells. Curr Stem Cell Res Ther. 2006; 1(1):47-54.
- [34] Devine SM, Flomenberg N, Vesole DH, et al. Rapid mobilization of CD34+ cells following administration of the CXCR4 antagonist AMD3100 to patients with multiple myeloma and non-Hodgkin's lymphoma. J Clin Oncol. 2004; 22(6):1095-1102.
- [35] Cassens U, Barth IM, Baumann C, et al. Factors affecting the efficacy of peripheral blood progenitor cells collections by largevolume leukaphereses with standardized processing volumes. Transfusion. 2004; 44(11):1593-1602.
- [36] Arslan O, Moog R. Mobilization of peripheral blood stem cells. Transfus Apher Sci. 2007; 37(2):179-185.
- [37] Stem cell transplant (peripheral blood, bone marrow and cord blood transplants). American Cancer Society Accessed 2/2/2012.
- [38] Bone marrow and peripheral blood stem cell transplants. American Cancer Society. (2008, April 21). American Cancer Society (ACS). Atlanta, GA: American Cancer Society.
- [39] <http://www.cancer.ca/en/cancer-information/diagnosis-and-treatment/stem-cell-transplant/harvesting-stem-cells/?Region=on#ixzz4jdrM2z8o>.
- [40] Bollard C, Krance RA, Heslop HE. Hematopoietic stem cell transplantation in pediatric oncology. Pizzo, P. A. & Poplack, D. G. (Eds.). (2011). Principles and Practice of Pediatric Oncology. (6th Edition). Philadelphia: Lippincott Williams & Wilkins. 16: 467-490.

**International Journal of Novel Research in Healthcare and Nursing**

Vol. 4, Issue 3, pp: (80-91), Month: September - December 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

- [41] Walker F, Roethke SK, Martin G. An overview of the rationale, process, and nursing implications of peripheral blood stem cell transplantation. *Cancer Nurs.* 1994; 17(2):141-148.
- [42] Kapustay PM. Blood cell transplantation: concepts and concerns. *Semin Oncol Nurs.* 1997; 13(3):151-163.
- [43] National Cancer Institute. Bone marrow transplantation and peripheral blood stem cell transplantation fact sheet. Available at: <http://cancer.gov/cancertopics/factsheet/Therapy/bone-marrow-transplant>. Accessed July 7, 2009.
- [44] Hooper PJ, Santas EJ. Peripheral blood stem cell transplantation. *Oncol Nurs Forum.* 1993; 20(8): quiz 1222-3.
- [45] Kroger N, Renges H, Kruger W, et al. A randomized comparison of once versus twice daily recombinant human granulocyte colony-stimulating factor (filgrastim) for stem cell mobilization in healthy donors for allogeneic transplantation. *Br J Haematol.* 761-765(3)111; 2000.
- [46] Komeno Y, Kanda Y, Hamaki T, et al. A randomized controlled trial to compare once- versus twice-daily filgrastim for mobilization of peripheral blood stem cells from healthy donors. *Biol Blood Marrow Transplant.* 2006; 12(4):408-413.
- [47] Bakken AM. Cryopreserving human peripheral blood progenitor cells. *Curr Stem Cell Res Ther.* 2006; 1(1):47-54.
- [48] Arslan O, Moog R. Mobilization of peripheral blood stem cells. *Transfus Apher Sci.* 2007;37(2):179-185.
- [49] Manuscrito, Mestrem and Doutoraem. NURSING CARE IN A HEMATOPOIETIC STEM CELLS TRANSPLANTATION UNIT. *Texto Contexto Enferm, Florianópolis, 2014 Out-Dez; 23(4): 845-53.* Available at: <http://dx.doi.org/10.1590/0104-07072014000440013>.
- [50] Nihtinen A, Anttila V, Richardson M, Meri T, Volin L, Ruutu T (2007) the utility of intensified environmental surveillance for pathogenic moulds in a stem cell transplantation ward during construction work to monitor the efficacy of HEPA filtration. *Bone Marrow Transplantation.* 40, 5, 457-460.
- [51] Vera-Llonch M, Oster G, Ford CM, Lu J, Sonis S (2007) Oral mucositis and outcomes of allogeneic hematopoietic stem-cell transplantation in patients with hematologic malignancies. *Supportive Care in Cancer.* 15, 5, 491-496.
- [52] Andrykowski MA, Cordova MJ, Hann DM, Jacobsen PB, Fields KK, Phillips G (2008) Patients' psychosocial concerns following stem cell transplantation. *Bone Marrow Transplantation.* 43, 10, 1121-1129.
- [53] Safaa M. Hassanein 1, Zeinab. M. Elsayed 2\*, Mohamed A. Samra. Lived Experience Among Patients With Allogeneic Stem Cell Transplantation: A Single Center Experience. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* e-ISSN: 2320-1959.p- ISSN: 2320-1940 Volume 5, Issue 1 Ver. VI (Jan. - Feb. 2016), PP 16-26 [www.iosrjournals.org](http://www.iosrjournals.org).
- [54] <https://www.mskcc.org/blog/msk-s-one-year-survival-rate-after-allogeneic-bone-marrow-transplant-exceeds-expectations>.
- [55] Elad S, Zadik Y, Hewson I, et al. (August 2010). "A systematic review of viral infections associated with oral involvement in cancer patients: a spotlight on Herpesviridae". *Support Care Cancer.* 18 (8): 993-1006. doi: 10.1007/s00520-010-0900-3. PMID 20544224.