



The method of peripheral stem cell collection and its effect on the donor

Ebru Eyibilen¹, Funda İfakat Tengiz²

¹Izmir Katip Çelebi University Faculty of Medicine, Izmir, Turkey

²Department of Medical Education, Izmir Katip Çelebi University Faculty of Medicine, Izmir, Turkey

ABSTRACT

Stem cells are the cells that are capable of forming all of the tissues and organs in our body. Certain diseases can be treated by stem cell transplantation. There are three types of stem cell transplantation: syngeneic, autologous, and allogeneic. In allogeneic transplantation, stem cells are obtained from a donor with or without blood relation. Sources such as bone marrow, peripheral blood, and cord blood are used to obtain stem cells. Peripheral stem cell collection is the most common and preferred method of stem cell collection. To obtain stem cells, the bone marrow must first be stimulated with the mobilization drug, which allows the stem cells to pass into the peripheral blood. The stem cells are then filtered from the donor's blood with the help of an apheresis device. The process of deciding to become a donor until the collection of stem cells is very important. The donor is first subjected to a histocompatibility test followed by a physical fitness test for the procedure. The health of the donor is carefully checked during and after the procedure. In this study, the allogeneic method of peripheral stem cell collection and its effect on the donor will be emphasized. The process from the donor's application to the post-transplant period will be discussed.

Keywords: Apheresis method, donor process, peripheral stem cell.

Stem cells are immature (immature) cells found in the bone marrow, peripheral blood, cord blood, and embryo. These special cells have the lifelong ability to regenerate themselves and form all tissues and organs.^[1] Nowadays, stem cell transplantation is performed for the treatment of certain diseases (bone marrow cancers, lymphomas, various organ cancers, insufficient or non-functioning bone marrow, hereditary anemias, immune deficiencies).^[2]

In our country, stem cell transplantation is performed through TURKOK, the Turkish Stem Cell Coordination Center. TURKOK is considered an umbrella organization, consisting of Donor Acquisition (donor candidates are found by the Turkish Red Crescent), Tissue Typing Laboratory, and the Bone Marrow Bank. It became officially operational on April 1, 2015. TURKOK aimed to have a donor pool with a high matching rate. As

of February 2019, 470,260 donor candidates are registered in the system. Since 25.8% of these donor candidates are between the ages of 18-25, they are expected to remain active in the system for a long time.

There are 2,200 patients registered in TURKOK continued to be screened. Suitable donor candidates can be found for 2 out of every 3 patients with screening.

Between the years 2015-2019, 3,950 donor candidates were matched with patients and confirmation tests were requested from these candidates. Due to medical reasons, 284 of the donors have been inactive in the system. Thus, the total number donor candidates for whom confirmation tests are requested is 3,666. Among these candidates, 472 reported that they changed their minds.

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Correspondence: Ebru Eyibilen. İzmir Katip Çelebi Üniversitesi Tıp Fakültesi, 35620, Çiğli, İzmir, Türkiye.
Tel: +90 507 - 572 44 28 e-mail: eeeyibilen@gmail.com

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As a result of the confirmation tests, 1,094 patients underwent transplantations. In our country, the abandonment rate of donors before transplantation is 12.87%. This rate is 20% worldwide.^[3]

For transplantation, stem cells must first be obtained from a source. Bone marrow, peripheral blood, cord blood, fetal liver, embryonic stem cells are used as a source of stem cells.^[1]

In 1981, Kørbling et al.^[4] used peripheral blood instead of bone marrow as a source of hematopoietic stem cells. Peripheral stem cell transplantation was performed for the first time in the world in 1984, and became more widely practiced in the 1990s. In our country, peripheral stem cells began to be more preferred than other stem cells since the 2000s.^[5]

There are three types of stem cell transplantations: allogeneic, autologous, and syngeneic. Allogeneic transplants involve the patient's sibling, relative, or a matching donor without blood relation. There is an evaluation process to determine the compatibility of the donor. If the donor is found compatible during this process, the transplantation is performed. Syngeneic transplantations occur between identical twins. In autologous transplants, the patient's own healthy stem cells are collected and transplanted back to the patient. The risk of rejection of the stem cells by the recipient's body is very low in syngeneic and autologous transplants.^[6] For allogeneic transplants, stem cells must be obtained from a donor.

In this table, the steps required to collect peripheral stem cells for allogeneic transplants are given (Table 1).

1- Donor application and evaluation

Any individual between 18-50 years of age who does not have an infectious diseases or immune system disorders, who has not been diagnosed with cancer, and who does not have a chronic disease can be a stem cell donor.

Table 1. Peripheral stem cell collection process for allogeneic transplant

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| 1. Donor's application process and evaluation |
| 2. Tissue compatibility and patient matching |
| 3. Mobilization and stem cell collection |
| 4. Effects on the donor throughout the process |

The donor candidate first applies to the Red Crescent. After application, an informative interview is conducted. If the donor candidate accepts, they complete the Voluntary Stem Cell Donor Information and Consent Form. After completing the form, three tubes of blood samples are drawn from the donor candidate. Blood type is analyzed from the blood samples and infection risk is tested. If no infection is encountered, the blood sample is delivered to TURKOK (Turkish Stem Cell Coordination Center) Tissue Typing Laboratory and Human Leukocyte Antigen is assessed. The test results are then transferred to the Bone Marrow Bank. The Bone Marrow Bank contains the samples of many donor candidates and patients awaiting stem cell transplantation.^[2]

2- Tissue compatibility and matching

The tissue matching process may take years. The donor's blood sample is kept as long as they can be a donor. Matching is expected during this time. If the tissue type matches with any patient, the donor candidate is contacted again and blood samples are retaken from the donor candidate and the patient to confirm the tissue compatibility. Then, samples are sent to the Tissue Typing Laboratory. After verification, the donor is contacted and the day of the transplantation is reserved. If the donor still wishes to donate, proceedings are initiated. The donor candidate first goes through a health examination. In this examination, ECG, chest X-ray and various tests (urine test, blood test, pregnancy test, etc.) are performed. During this period, no fees are requested from the donor nor is the donor's insurance used. In addition, the donor candidate can give up donation at any stage during this process. However, when a compatible stem cell donor is found, giving up can be risky, especially for the patient after receiving treatment for the transplantation.^[2]

3- Mobilization and stem cell harvesting

Stem cells are harvested through a method known as apheresis.^[6] The apheresis method uses an apheresis apparatus. Before starting apheresis, mobilization agents are administered to the donor. Mobilization is the process of stimulating the bone marrow to increase the low number of stem cells in the peripheral blood and to produce more stem cells. G-CSF (Granulocyte colony-stimulating factor) and is given to the donor as a

subcutaneous injection twice daily for 4-5 days. When the drug administration is completed, stem cells are extracted with apheresis. The donor's blood is drawn from the donor's arm with a sterile needle. The blood enters the apheresis device and is filtered for about four hours. The donor lays in a resting position as though they are donating blood. The blood filtered of stem cells is transferred back to the donor with the device.^[2] The harvested stem cells are counted and frozen for longer preservation.^[6] According to the number of extracted stem cells, it is usually sufficient for the donor to be connected to the device for one day. The procedure rarely continues to the second day.^[2]

4- The effect on the donor during stem cell harvesting

The donor generally does not experience major discomfort during the procedure. During the procedure, ionized calcium level in the blood may decrease. The donor should be watched closely from signs of hypocalcemia such as muscle cramps, tremor, anxiety, chills, and dizziness.^[7] Since the sets used in the apheresis device are a closed system, the donor's blood does not come into contact with the device, in other words, it is impossible to contract a disease from the device.^[2]

5- The effect on the donor after stem cell harvesting

After donation, the donor is monitored until they feel ready to stand. Side effects of G-CSF may be observed within 48 hours after donation. These side effects include bone pains, headache, fever, hypertension, temporary flu-like symptoms, or swelling in the spleen region. These side effects are temporary and disappear within 1-3 weeks. During the 48-hour period, the donor should only use medications recommended by the doctor. Drugs containing acetylsalicylic acid should especially be avoided. Most donors can resume daily activities within one to two days after donation. Within one month after donation, another health examination is conducted by TURKOK. All donors undergo health examinations 3, 6, and 12 months after the donation. Those who are willing can become stem cell donors again six months after their last donation. The donor's information becomes inactive in the bone marrow bank for one year

after the donation. At the end of one year, the application becomes active without the need of taking another blood sample.^[2]

Donor-patient communication after donation

The information of the patient and donor is kept anonymous according to law. The donor is informed of the patient's age, sex, and disease. The patient is only informed of the donor's age and sex.^[2]

The donor is allowed to write a letter to the patient within the first two years after donation. This letter should not include any personal information (name, address, telephone number, city, country, etc.). The letter is delivered to the patient through TURKOK. Two years after donation, an interview can be arranged with the consent of the patient and the donor.^[8]

Conclusion

Peripheral stem cell collection is not a difficult to manage procedure. It can be easily applied and the health of the donor is carefully controlled throughout the process. There is almost no possibility of a permanent discomfort in the donor. It is very important to raise donor awareness of the process and to encourage donation.

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