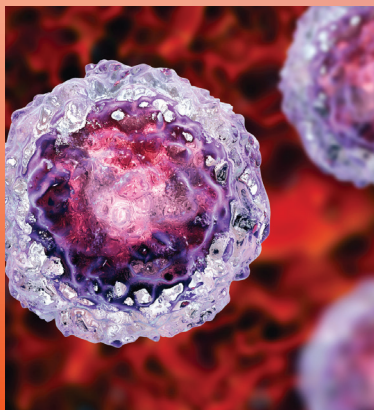
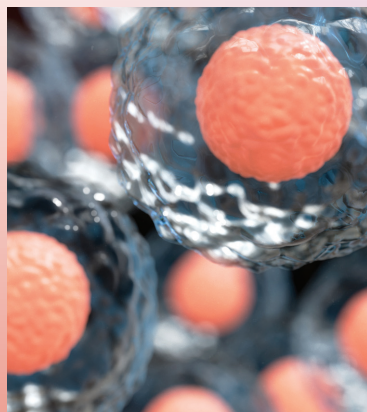
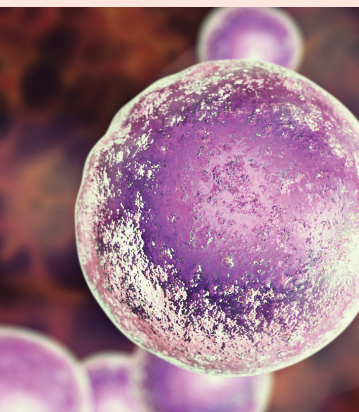


# MULTIPLE MYELOMA AUTOLOGOUS STEM CELL TRANSPLANTATION



MULTIPLE MYELOMA  
Research Foundation

[themmrf.org](http://themmrf.org)

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## ABOUT THE MULTIPLE MYELOMA RESEARCH FOUNDATION

The Multiple Myeloma Research Foundation (MMRF) was established in 1998 by identical twin sisters Kathy Giusti and Karen Andrews shortly after Kathy's diagnosis with multiple myeloma. Kathy and Karen soon learned that little progress against this disease had been made in decades and that myeloma patients had few treatment options. They decided that it was time to accelerate change. Their mission was to ensure more access to better treatments and bring the promise of a cure for every myeloma patient.

Since its founding, the MMRF has remained steadfast in the pursuit of its mission. It is now the leading cancer research organization focused on the development and delivery of more precise therapies, and it is aggressively pursuing a world without myeloma. Working with its partners in industry, research, government, and academia, the MMRF has helped launch 15 new drugs in the past 18 years, an achievement that has almost tripled the life expectancy for myeloma patients. The MMRF is a patient-focused organization that stands with the entire myeloma community and is speeding the discovery of cures through precision medicine. Driven by data and innovative research, the MMRF is committed to empowering every patient with precisely what he or she needs to prevent or defeat multiple myeloma.

As the multiple myeloma community's most trusted source of information, the MMRF supports patients from the time of diagnosis throughout the course of the disease. All information on the MMRF website ([www.themmrf.org](http://www.themmrf.org)) is organized by disease stage, so patients can get the information they need, when they need it.

To learn more about the MMRF, visit [www.themmrf.org](http://www.themmrf.org).

To speak to a Patient Navigator at the Patient Navigation Center, call **1-888-841-MMRF (6673)** or email [patientnavigator@themmrf.org](mailto:patientnavigator@themmrf.org).

*Updates to and distribution of this booklet were supported by Adaptive Biotechnologies, Amgen, Bristol Myers Squibb, CURE Magazine, Genentech, GlaxoSmithKline, Karyopharm Therapeutics, Oncopeptides, and Takeda Oncology.*

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# INTRODUCTION

As part of a comprehensive, personalized treatment plan, an **autologous stem cell transplant (ASCT)**—for those who are eligible—offers myeloma patients their best chance at a deep, long-lasting response (periods in which there are no symptoms of myeloma or detectable abnormal **plasma cells**). According to the National Comprehensive Cancer Network Clinical Practice Guidelines, ASCT remains the standard of care for newly diagnosed, eligible patients. ASCT is the process of using a patient’s own (autologous) blood **stem cells** (cells that give rise to many types of blood cells) to help restore his or her blood supply and **immune system** after receiving melphalan, a potent **chemotherapy** drug that kills cancer cells but also kills blood-forming cells.

This booklet is designed to help patients with **multiple myeloma**—as well as their friends, families, and caregivers—better understand the concept of ASCT. Words that may be unfamiliar are **bolded** and defined in the Glossary (page 11).

The information in this booklet is not intended to replace the services or advice of trained health care professionals. Please consult with your health care professional regarding specific questions relating to your health, especially questions about myeloma diagnosis or treatment.

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For more information about multiple myeloma and its treatment, please refer to the companion booklets (*Multiple Myeloma Disease Overview*, *Multiple Myeloma Treatment Overview*, *Multiple Myeloma Immunotherapy*, and *The Path to Precision Medicine*) and the MMRF website ([www.themmrp.org](http://www.themmrp.org)).

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# HIGH-DOSE CHEMOTHERAPY AND AUTOLOGOUS STEM CELL TRANSPLANTATION PROCEDURE

High-dose chemotherapy (usually melphalan) with ASCT is a treatment that, for eligible myeloma patients, offers the best chance for long-lasting response. Though effective in killing myeloma cells, high-dose chemotherapy also destroys normal blood-forming cells (called **hematopoietic stem cells**) in the **bone marrow**. ASCT replaces these important cells.

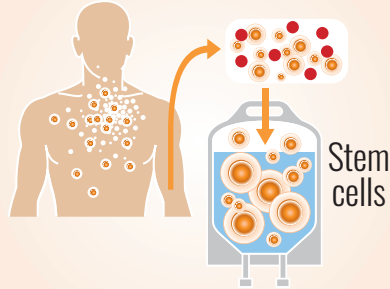
## STEM CELL COLLECTION AND INFUSION

Stem cells are normally found in the bone marrow and in the peripheral blood (blood in the arteries or veins). Virtually all transplants in myeloma are now performed using stem cells from the patient's own peripheral blood and are referred to as ASCT or autologous **peripheral blood stem cell (PBSC)** transplants. Bone marrow transplants are rarely done in multiple myeloma.

In the weeks leading up to the transplant, stem cells are collected from the patient (**Box**)—a process known as **apheresis**—after at least two cycles of **induction therapy** (the first in a series of treatments used to treat multiple myeloma; also referred to as **frontline therapy**) to ensure that the number of myeloma cells in the body is reduced.

### Stem cell collection—apheresis

The process by which PBSCs are removed—or harvested—from a patient's bloodstream is called apheresis. During this process, patients are connected to a machine that separates the PBSCs from the blood and returns the blood to the patient.



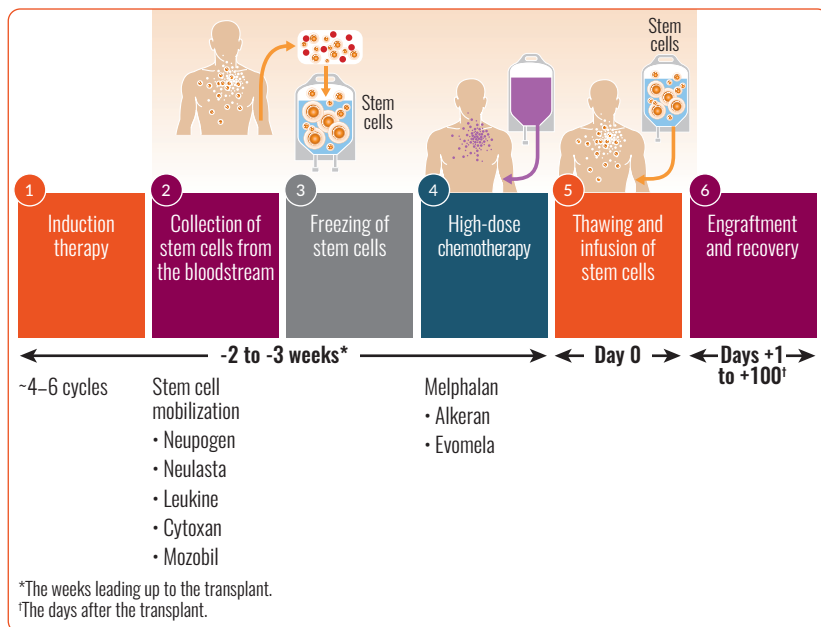
This procedure typically takes 3 to 4 hours over the course of 1 to

5 days and can be performed on an outpatient basis. Patients undergoing this procedure may experience bruising at the site of needle insertion or muscle cramps, twitching, or a tingling sensation in the fingertips or lips.

In the days preceding apheresis, patients receive drugs to ensure that a sufficient number of PBSCs can be collected for several transplants, if needed. These drugs include **colony-stimulating factors** (for example, Neupogen, Neulasta, and Leukine) and a drug called Mozobil (plerixafor). This process of stimulating the growth of PBSCs is known as **mobilization**. Apheresis is tolerable for most patients; common side effects of some of the drugs used for mobilization include bone pain, headaches, flu-like symptoms, or nausea and diarrhea.

Once the cells are collected, they are frozen and stored until the patient is ready for them to be re-infused. The patient receives an infusion of high-dose melphalan, a potent chemotherapy drug that kills most myeloma cells left in the body. After the patient receives high-dose melphalan, the stem cells are thawed and infused back into the patient.

## The process of ASCT.



Patients can undergo ASCT as an inpatient (the patient stays in the hospital before, during, and immediately after the transplant) or an outpatient (the patient makes daily visits to a clinic) procedure. Typically, patients are in the hospital or outpatient clinic for an average of 3 weeks for the administration of the melphalan, stem cell infusion, and initial stages of engraftment and recovery.

### ASCT ENGRAFTMENT, RECOVERY, AND SIDE EFFECTS

Within 2 weeks after the transplant, newly formed blood cells can be detected in the patient's blood. The patient's blood counts will steadily increase over time—a process called **engraftment**. A successful transplant results in the growth of healthy **red blood cells**, **white blood cells**, and **platelets**.

Patients may experience side effects, including fatigue, nausea and vomiting, diarrhea, mouth sores (mucositis), and low blood counts.

**Side effects of high-dose chemotherapy.**

<b>Fatigue</b>	<ul style="list-style-type: none"><li>• Expected</li><li>• May last 1–3 months</li></ul>
<b>Nausea &amp; vomiting</b>	<ul style="list-style-type: none"><li>• Symptoms much more manageable with newer <b>antiemetics</b></li><li>• Try to prevent nausea</li></ul>
<b>Diarrhea</b>	<ul style="list-style-type: none"><li>• May include stomach cramping</li><li>• Encourage small amounts of food, more often</li><li>• Avoid milk, milk products, high-fiber foods</li></ul>
<b>Mucositis</b>	<ul style="list-style-type: none"><li>• Pain, sores in mouth; sore throat</li><li>• Pain meds, mouth swishes</li><li>• Avoid tart, acidic, salty, spicy foods</li><li>• Soft food better tolerated</li></ul>
<b>Low blood counts</b>	<ul style="list-style-type: none"><li>• White blood cells drop to zero, raising infection risk</li><li>• <b>Prophylactic antimicrobials</b></li><li>• Hemoglobin and platelets will drop</li><li>• Transfusion with blood/platelets</li><li>• Counts begin to recover 10–12 days after chemotherapy</li></ul>

Patients undergoing ASCT are carefully monitored, and supportive treatment is provided to minimize and manage side effects.

Because high-dose chemotherapy attacks healthy disease-fighting cells as well as cancerous cells, there is an increased risk of infection. It is important that patients and caregivers follow their health care provider’s directions to minimize the risk of infection. Hair loss is also a common side effect. Other possible but infrequent side effects include damage to the lungs, liver, and kidneys.

The road to recovery takes time. Most patients experience fatigue, which may last 1–3 months. It may take 3–6 months for patients to be able to resume normal activities.

Ongoing monitoring may include blood tests, imaging, **bone marrow biopsies**, and measurement of **minimal (measurable) residual disease (MRD)**, which can determine the number of myeloma cells that remain after ASCT.



## The road to recovery.



After ASCT, the myeloma specialist will recommend a personalized plan for ongoing treatment; this is referred to as consolidation and maintenance therapy.

### CANDIDATES FOR ASCT

More patients are considered to be candidates for ASCT today than in the past, because age is not an absolute barrier to transplant. Rather, a patient's suitability for transplant is based on overall health.

A variety of factors such as fitness and frailty influence a patient's eligibility for ASCT. For example, patients can have multiple **comorbidities** and a range of activity levels that affect their response to, adherence to, and tolerance of treatment approaches including ASCT. It is important that treatment decisions for every patient consider not just age but also clinical and functional status.

Guidelines for patient eligibility may vary between cancer centers; therefore, patients should discuss with a myeloma specialist their eligibility for ASCT, as well as the risks and benefits and—if ASCT is an option—when it should be included in their treatment plan.

All patients who are eligible for transplant are encouraged to have stem cells collected so that the cells are available if the patient chooses to undergo the process at some point during the course of his or her disease.

## THE EVOLVING VIEW OF TIMING FOR ASCT IN MYELOMA

The improved response rates seen in initial therapy with today's myeloma regimens have raised questions about the timing of ASCT in the treatment of myeloma. A European study compared early ASCT (that is, ASCT performed right after induction) to late ASCT (performed after **relapse**) and showed that patients who got an early transplant tended to have a longer time without relapse than did those who got a late transplant. This result does not mean that all patients necessarily live longer after receiving an early transplant; however, those who did receive an early transplant were able to maintain their low disease status without progressing for a longer time than were patients who received a late transplant. For now, early ASCT (for suitable candidates) remains a standard therapy and may offer the best chance for a long-lasting response.

In the United States, **clinical trials** to more accurately determine the advantages of early ASCT are ongoing. For any individual patient, the potential toxicities associated with ASCT must be balanced with the potential benefits.

### ***Questions to ask your doctor about stem cell transplantation.***

- Am I a candidate for high-dose chemotherapy and stem cell transplantation?
- When is the best time for me to undergo transplantation?
- Does your center do stem cell transplants?  
How many transplants has your center performed in multiple myeloma in the last year? Is procedure performed as an inpatient or outpatient?
- How long will I be in the hospital?
- What kind of changes in my lifestyle will I need to make?
- When do I go back to you for follow-up?



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The MMRF would like to thank Amrita Y. Krishnan, MD, Professor, Department of Hematology & Hematopoietic Cell Transplantation, Director, Judy and Bernard Briskin Center for Multiple Myeloma Research at the City of Hope Medical Center in Duarte, California, and our patient advocate Colin Todd Kennedy of Coto de Caza, California, for their contributions to this booklet.

## ASCT RESOURCES

Blood & Marrow Transplant Information Network

Visit [www.bmtinfonet.org](http://www.bmtinfonet.org)

National Bone Marrow Transplant

Visit [www.nbmtlink.org](http://www.nbmtlink.org)

BMT Support Online

Visit [www.bmtsupport.org](http://www.bmtsupport.org)

Bone Marrow and Cancer Foundation

Visit [www.bonemarrow.org](http://www.bonemarrow.org)

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## MMRF PATIENT SUPPORT AND RESOURCES

The MMRF is dedicated to supporting the myeloma community by providing a broad range of resources for myeloma patients and their family members and caregivers. The MMRF is available to help guide you through your multiple myeloma journey every step of the way.



### YOUR QUESTIONS ANSWERED

Speak to an MMRF Patient Navigator at the Patient Navigation Center for answers to your questions about disease management, treatments, clinical trials, and assistance with finding financial and other available resources.

Telephone: 1.888.841.6673

Monday–Friday, 9:00 AM to 7:00 PM ET

Email: [patientnavigator@themmrf.org](mailto:patientnavigator@themmrf.org)

Connect with an MMRF Myeloma Mentor™:

[themmrf.org/resources/myeloma-mentors](https://themmrf.org/resources/myeloma-mentors)

This is a phone-based program offering the opportunity for patients and/or caregivers to connect one-on-one with a trained patient and/or caregiver mentor to share their patient journeys and experiences.

### FIND AND PARTICIPATE IN A CLINICAL TRIAL

Search for a clinical trial in your area or let MMRF Patient Navigators help guide you through the process.

Clinical Trial Search: [themmrf.org/resources/clinical-trial-finder](https://themmrf.org/resources/clinical-trial-finder)

### SUPPORT THE MMRF

Help support the MMRF's efforts to accelerate research and find a cure! Participate in an event or donate today.

Telephone: 1.203.229.0464

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Visit [themmrf.org/get-involved](https://themmrf.org/get-involved)

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## GLOSSARY

**antibody** Protein produced by plasma cells that helps protect the body from infection and disease

**antiemetic** Drug that prevents or relieves nausea and vomiting

**antimicrobial** Drug that kills or slows the growth of bacteria

**apheresis** A procedure in which blood is collected from a patient, part of the blood (such as white blood cells) is taken out, and the rest of the blood is returned to the patient.

**autologous stem cell transplant (ASCT)** Procedure in which stem cells collected from a patient are transplanted back into that patient; the most common type of transplant performed in myeloma

**bone marrow** Soft, spongy tissue found in the center of many bones and site of blood cell production

**bone marrow biopsy** Removal of a sample of bone marrow for examination; performed using a needle

**chemotherapy** The use of drugs to kill rapidly dividing cancer cells

**clinical trial** A study of the safety and effectiveness of a therapeutic agent using consenting human subjects

**colony-stimulating factor (CSF)** Growth factor that stimulates the bone marrow to produce white blood cells

**comorbidity** The existence of other medical condition(s)

**engraftment** When stem cells infused into the body start to grow and make new blood cells.

**frontline therapy** Initial treatment given to a newly diagnosed patient (also known as *induction therapy*, *first-line therapy*, or *frontline treatment*)

**growth factor** Substance that stimulates cells to multiply

**hematopoietic stem cell** Cell that grows and divides to produce red blood cells, white blood cells, and platelets; found in bone marrow and blood

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**immune system** Network of cells that protect the body from foreign substances and destroys infected and cancerous cells

**induction therapy** The first treatment a patient receives for myeloma; also refers to the use of anti-myeloma drugs prior to high-dose chemotherapy and stem cell transplant (see also *frontline therapy*)

**minimal (measurable) residual disease (MRD)** Presence of small numbers of myeloma cells in the bone marrow during or after treatment, even when the patient shows no symptoms or signs of disease

**mobilization** The process of stimulating stem cell growth to ensure that enough stem cells can be collected for transplantation

**multiple myeloma** A blood cancer that develops in the bone marrow, the soft, spongy tissue found in the center of many bones and the location where the blood cells are produced. In myeloma, plasma cells, which are normal cells that produce antibodies, transform into cancerous myeloma cells

**peripheral blood stem cell (PBSC)** Stem cells collected from the blood

**plasma cell** Antibody-secreting immune cell that develops from a B cell; in myeloma, it is this cell that has become cancerous or abnormal platelets

**platelets** Small cell fragments in the blood that help it to clot

**prophylactic** Preventing the spread or occurrence of infection

**red blood cell** Blood cell that carries oxygen

**relapse** Progression of myeloma after an initial response to therapy

**stem cell** Cells that have the ability to develop into many different cell types

**white blood cell** One of the major cell types in the blood; attacks infection and cancer cells as part of the immune system

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