Bone Marrow Transplantation

Description/Etiology

Bone marrow transplantation (BMT) is a therapeutic procedure that is used to replace damaged bone marrow (BM) with healthy BM stem cells (i.e., undifferentiated cells). BM produces red blood cells (RBCs), white blood cells (WBCs), and platelets. WBCs are responsible for immune reactions in the body. Abnormal conditions and diseases that affect the growth of BM include specific lymphoma disorders, blood discrasias, and solid tumors, multiple myeloma, aplastic anemia, thalassemia, congenital neutropenia, myeloproliferative disorders, severe combined immunodeficiency disorders (SCIDs), and sickle cell disease.

BMT can be autologous (also called rescue transplant), can involve the use of umbilical cord blood, or can be allogeneic. An autologous BMT involves removing stem cells from a patient before he/she undergoes high-dose chemoradiotherapy; the stem cells are reinfused after the patient completes the course of chemoradiotherapy. Umbilical cord blood, which is rich in stem cells, is harvested from a newborn’s umbilical cord immediately after birth and stored for use in BMT. Allogeneic BMT involves transplanting mature stem cells from a donor who has been tested for histocompatibility antigens (i.e., human leukocyte antigen [HLA]) for a tissue match; the best match for allogeneic BMT is a first-degree relative donor (i.e., a sibling, preferably an identical twin). BMT is the preferred treatment for patients with high-risk acute leukemia, myelodysplasia, chronic myelogenous leukemia (CML), or severe aplastic anemia.

A major complication of allogeneic BMT is graft-versus-host disease (GVHD; i.e., an alloimmune reaction), a condition in which the transplanted donor’s mature BM cells attack the recipient’s body. The presentation of GVHD can be acute or chronic. Acute GVHD occurs within 3 months of receiving BMT; chronic GVHD occurs > 3 months after receiving BMT. There is a lower risk for GVHD when stem cells are used from umbilical cord blood because the cells are immature and not yet differentiated. Other potential complications of BMT include increased susceptibility to infection, mouth sores, bleeding, anemia, and inflammation and damage to vital organs.

Diagnosis of the condition or disease affecting BM involves several diagnostic tests, including CBC and aspiration of BM for analysis. A patient who is in poor health and has multiple health conditions may not be a candidate for BMT. BMT involves bone marrow harvest from iliac crest under general anesthesia or now more commonly, leukapheresis (i.e., separation and collection of stem cells from peripheral blood) is performed to allow for higher chemotherapy dosing. The patient receives BMT via a central venous. Immunosuppression must be initiated in allogeneic BMT to decrease the risk for GVHD and to reduce the severity of GVHD if it develops. Pharmaceutic agents are prescribed for patients receiving BMT, most commonly a calcineurin inhibitor in combination with methotrexate. The treatment regimen for patients who develop infection includes antibiotics for gram-positive bacteria (e.g., fluoroquinolones), gram-negative bacteria (e.g., macrolides), and pseudomonas (e.g., ticarcillin); antivirals (e.g., acyclovir, oseltamivir); and antifungals (e.g., fluconazole, caspofungin). Treatment of infection is important to prevent morbidity and mortality in patients who receive BMT. Some patients require blood transfusions and feeding tubes during hospitalization for BMT. A multidisciplinary team should be involved in the care of patients receiving BMT and their family members, including nursing, oncology, social services, and, in the case of infection, infectious disease clinicians. Prognosis depends on the type of underlying disease and whether or not the
patient develops GVHD or infection. Children with chronic leukemia have a 50%–70% rate of disease-free survival. Patients with aplastic anemia have an 80–90% rate of survival.

**Facts and Figures**

Autologous BMT is associated with a risk of 1–4% that the patient will develop fatal treatment-related complications. Allogeneic donors who are unrelated to the patient are matched through the National Marrow Donor Program (NMDP) in the United States. Twenty-five percent to 35% of sibling donors are confirmed as an HLA match.

**Risk Factors**

Individuals with aplastic anemia, leukemia, lymphoma, and multiple myeloma will require BMT for survival.

**Signs and Symptoms/Clinical Presentation**

Signs and symptoms of acute or chronic GVHD are variable and include rash, alopecia, weight loss, edema, and jaundice. Corticosteroids administered for immunosuppression and to treat GVHD can cause skin rash, thinning of the skin, shingles, weight gain, and loss of muscle mass.

**Assessment**

› **Patient History**
  • Verify the type of BMT the patient is to receive or previously received
  • Patient assessment following BMT should include asking about/evaluating for
  – pain, fever, and chills
  – skin rash, including hives, and flushing
  – chest pain, shortness of breath, and abdominal pain
  – nausea, vomiting, and diarrhea, with or without weight loss
  – headache
  – the presence of an unusual taste in the mouth

› **Physical Findings of Particular Interest**
  • The patient may be hypotensive and/or dyspneic in GVHD
  • The patient may have mouth sores, skin rash, hives, alopecia, and/or jaundice
  • Muscle wasting secondary to nausea and vomiting, weight loss, and/or inactivity may be present
  • Weight gain and/or edema can be evident; patients may have an accumulation of fat around the face, trunk, and/or abdomen

› **Laboratory Tests That May Be Ordered**
  • BM aspiration and/or lymph node biopsy will be performed in order to evaluate for abnormal blood cells
  • Serum CBC will show low levels of RBCs, WBCs, and platelets and severe pancytopenia in patients receiving autologous or allogeneic BMT
  • Serum HLA tests for tissue compatibility of recipients and donors will be performed
  • Serum of the donor and recipient will be tested for HIV, hepatitis, syphilis, and cytomegalovirus (CMV)

› **Other Diagnostic Tests/Studies**
  • CT scan, ultrasound, and/or MRI are typically performed to assess the health status of the patient’s vital organs

**Treatment Goals**

› **Promote Optimum Physiologic Status and Reduce Risk of Complications of BMT**
  • Assess vital signs and for adverse effects and complications of BMT (e.g., GVHD), and review results of laboratory/other diagnostic tests; report findings to treating clinician
  • Depending on patient status, follow facility pre-and post-BMT and blood transfusion protocols; reinforce pre-and postprocedure education and verify completion of informed consent documents. Monitor for complications, including assessing the BMT catheter insertion site frequently for infection and bleeding
  • Follow facility infection control protocols for hygiene, including washing hands prior to and after caring for patient
  • Administer prescribed medications (e.g., antibiotics, antivirals, antifungals), as ordered, and monitor treatment efficacy and for adverse effects
    – Administer prescribed cyclosporine or tacrolimus plus methotrexate for immunosuppression to reduce risk for GVHD
  • Maintain intermittent, bolus, or continuous feeding if enteral feeding is prescribed
    – Monitor skin status surrounding the tube for infection and breakdown
• Request referral to an infectious disease clinician and a registered dietitian, as appropriate

Promote Emotional Well-Being and Educate
• Assess patient/family learning readiness and for knowledge deficits regarding diagnosis and BMT. Assess anxiety level, provide emotional support, and educate regarding patient diagnosis, BMT risks and benefits, and the importance of following the prescribed treatment regimen and continued medical surveillance
• Request referral to a social worker, as appropriate, for identification of information on support groups, financial assistance, and home health services

Food for Thought
› The alloimmune reaction of an allogeneic BMT can result in killing residual cancer cells
› When an adult member of the family is recovering from BMT at home, significant others play an important caregiving role and serve as household managers of the patient’s health. Older children can help with the overall needs of the family, and hired caregivers can help alleviate the family stress related to caring for the recovering patient. It is important for nurses to assess the overall needs of the patient and family prior to patient discharge (Young, 2013)

Red Flags
› Pancytopenia in patients who receive autologous BMT typically lasts for 7–10 days, and can last in patients who receive allogeneic BMT for 10–14 days; patients with pancytopenia should receive blood and platelet transfusions and antibiotics
› GVHD is a significant cause of morbidity and mortality, and risk for GVHD is present even when the donor and recipient have the same HLA compatibility
› Aspergillus infection is associated with a mortality rate of close to 100% in patients who receive BMT

What Do I Need to Tell the Patient/Patient’s Family?
› BMT is similar to receiving a blood transfusion
› Patients receiving autologous BMT will need to be hospitalized for 2–3 weeks
› Patients may require blood transfusions and may require a feeding tube or parenteral nutrition if adverse effects of BMT affect the ability to eat
› Patients will need to take medications to prevent infection and GVHD; most patients who receive allogeneic BMT can stop taking immunosuppressive medications after 6 months
› Patients and their family members should practice good hand hygiene and promptly report signs of infection to the treating clinician; patients should avoid contact with persons who are ill
› Women who receive BMT can develop early menopause; children who receive BMT are at risk for suppressed growth
› It may take up to 1 year to fully recover and return to normal activities after BMT

References