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Research Article

REVIEW ARTICLE ON TRANSPLANT OF BONE MARROW (BMT) IN CHILDREN

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A B S T R A C T

Background: The bone marrow transplant is a procedure whereby the normal stem cells obtained from a person and infuse it back to the same person or another person after the process of filtration with an aim to transfuse healthy bone marrow into a person in place of an unhealthy bone marrow.
Methods: In this review the different databases such as PubMed, were searched for articles related to bone marrow transplantation. Additional information were also obtained from different books.
Summary: It is aimed to cure cancer and many other illnesses. When a child's bone marrow has been damaged or destroyed due to a disease or intense treatments of radiation or chemotherapy for cancer, a bone marrow transplant may be needed. As like any other procedure the bone marrow transplant and its prognosis may vary from child to child. New methods to improve treatment and decrease complications and side effects of a transplant are continually being discovered.

INTRODUCTION

A Bone Marrow Transplant (BMT) is a special treatment for patients with particular cancers or other diseases. The bone marrow is a spongy and soft tissue present in the bones such as ribs, hip, spine etc. These tissues contain cells that are capable of producing the blood cell in the body and hence referred as stem cells. The bone marrow transplant is a procedure whereby the normal stem cells obtained from a person and infuse it back to the same person or another person after the process of filtration with an aim to transfuse healthy bone marrow into a person in place of an unhealthy bone marrow. The bone marrow produces mainly three types of blood vessels such as Red Blood Cells, White Blood Cells and Platelets. Each of these cells carries a life-maintaining function. The bone marrow is a vital part of the human body.

In children the BMT is done to treat certain type cancer or other diseases. The BMT is aimed to provide healthy bone marrow and thus healthy stem cells to the children. Every blood cell develops from stem cells that are immature but have the capacity to develop the mature blood cells. The freshly infused bone marrow to the children which is referred as graft will grow and become new and healthy bone marrow.

Need of bone Marrow transplant

It is aimed to cure cancer and many other illnesses. When a child's bone marrow has been damaged or destroyed due to a disease or intense treatments of radiation or chemotherapy for cancer, a bone marrow transplant may be needed. The BMT/replacement is used to treat Leukemia, Aplastic nemia, Sickle cell anemia, Thalassemia, Diamond Blackfan anemia damage due to high dose of chemotherapy such as in case of lymphoma, neuroblastoma and other genetic conditions such as Hurler's syndrome and adreno-leuko-dystrophy disorder. Each child is different and the BMT may not appropriate for all children with these kind of diseases.

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Types of bone marrow transplants

Autologous BMT: Stem cells are taken from the child by bone marrow harvest and then given back to the child after intensive treatment. Sometimes the term rescue is used instead of transplant.

***Allogeneic BMT*:** Stem cells are taken either by bone marrow harvest or apheresis from a genetically-matched donor, often a brother or sister or parent.

Unrelated BMT/MUD (Matched Unrelated Donor). The genetically matched marrow or stem cells are from an unrelated donor. Unrelated donors are found through the national bone marrow registries.

Umbilical cord blood transplant. Stem cells are taken from an umbilical cord immediately after delivery of an infant. These stem cells reproduce into mature, functioning blood cells quicker and more effectively than do stem cells taken from the bone marrow of another child or adult. The stem cells are tested, typed, counted, and frozen until they are needed for a transplant.

Stem Cell Collection

Stem cells can either be collected from either the circulating cells in the blood or from the bone marrow.

Peripheral blood stem cells: this is performed by a process called apheresis in which the donor is connected to cell separation machine via a needle which is connected to a vein on an arm. The blood drawn is filtered for stem cells and rest of the blood and plasma are returned to the donor through another needle connected to second arm. The stem cell are removed and collected by the cell separation machine. Several sessions may be required to collect enough stem cells to assure a chance of successful engraftment in the recipient. Pre medication can used before apheresis to increase the production of new stem cells.

Bone Marrow Harvest. It is the collection of bone marrow/stem cells directly from bone such as hip, rib, sternum etc. commonly used bone is hip as there large number of stem cells in the said bone. The donor will be anesthetized during the procedure. The donor may experience some pain during recovery period at puncture site.

Umbilical Cord Blood. The blood is obtained from the cord after the delivery of the child. It is then tested, analyzed and counted. It is stored in special freezers and entered in the national registry for potential recipient matches

Factors influencing BMT

An extensive evaluation is completed by the bone marrow transplant team. The decision for BMT is based on many factors including

- Age of the child
- Overall health of the child
- Medical and surgical history.
- Duration severity of the disease.
- Availability of the donor.
- Childs tolerance for different medications and therapies.
- Prognosis of disease as well as transplant
- Opinion of the parents and family.

Preparation of the Donor/Recipient

- Donor sources available include self, sibling, parent or relative, nonrelated person, or umbilical cord blood from a related or nonrelated person.
- The matching donor and recipient undergo addition test related to health, exposure to pathogens, complete genetic analysis, etc. The recipient undergoes complete body analysis such as heart, kidney, liver and lungs.
- Stem cell will be collected from the donor through preferable method mentioned above.
- The recipient child is often hospitalized 10 prior to transplant for preparations.
- A central venous catheter is surgically placed in the chest through which the blood products and medications will be infused.
- Carry out cross matching. It includes typing of human leukocyte antigen (HLA) tissue. The antigens on the surface of these special white blood cells determine the genetic make-up of a person's immune system. Since HLA markers are inherited, an identical twin is the best donor match.

Procedure of BMT

The procedure of BMT may vary according type of transplant, need of transplant and the child's tolerance.

- Initially high doses of chemotherapy or radiation are given to prevent the process of blood cell production in the bone marrow. This is usually referred as ablative, or myeloablative therapy. Ablative therapy prevents this process of cell production and the marrow becomes empty. An empty marrow is needed to make room for the new stem cells to grow and establish a new production system.
- Administer the transplant/stem cells, obtained either from bone marrow, cord, or peripheral collection through the central venous catheter into the bloodstream. It is similar to receiving a blood transfusion.
- The stem cells find their way into the bone marrow and begin reproducing and establishing new, healthy blood cells.
- Provide supportive care prevent or treat infection, side effects and complications.
- The supportive care include frequent blood tests, close monitoring of vital signs, strict measurement of input and output, weighing your child daily (or twice daily), and providing a protected and clean environment.
- The process by which newly infused bone marrow become functional in the recipient is called engraftment and it usually takes place from 15 to 30 days after the transplant treatment.

Complications of BMT

The complications of BMT may vary from child to child. It largely depends on type of transplant, age, overall health, variance in cross matching etc. The general complications of BMT include infections, commonly bacterial infections due to bone marrow suppression. Viral and fungal infections can be life threatening. The infection occurs as a result of immunosuppression.

Failure of the graft (transplant) taking hold in the marrow is also a potential complication. Graft failure may occur as a result of infection, recurrent disease, or if the stem cell count of the donated marrow was insufficient to cause engraftment.
Graft-versus-host disease. Graft-versus-host disease (GVHD) can be a serious and life-threatening complication of a bone marrow transplant. GVHD occurs when the donor's immune system reacts against the recipient's tissue. The new cells do not recognize the tissues and organs of the recipient's body. The most common sites for GVHD are the GI tract, liver, skin, and lungs.

The Complications can be Prevented if Adhering to Norms Mentioned Below

- Special air filtered rooms post operatively
- Isolation requirements and restrict visitors post operatively
- Diet restrictions
- Strict hygiene regimen
- Continuous monitoring of risk of infections.
- Blood transfusion in case of low platelets, RBC etc.
- Assess for the symptoms of bleeding.
- Management of pain.
- Treatment of Diarrhea, nausea, and vomiting that may occur with chemotherapy, radiation, etc.
- Prevent fluid overload.
- Assess and prevent respiratory distress.

- Graft failure may be treated with an additional marrow transplant if a source is available.
- Assess for the symptoms of GVHD.

CONCLUSION

As like any other procedure the bone marrow transplant and its prognosis may vary from child to child. New methods to improve treatment and decrease complications and side effects of a transplant are continually being discovered.

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