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BONE MARROW TRANSPLANTATION – A REVIEW

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ABSTRACT
The core of regenerative medicine is stem cells. These undifferentiated cells have a remarkable capacity to evolve into specialized cell types in the human body, such as heart cells, blood cells, etc., given the correct signal. Therefore, damaged tissues and/or organs can be replaced or repaired using stem cells in cell-based therapies. The main focus of current stem cell research is on how these cells, both adult and embryonic, may be used to replace damaged cells and build specialized tissues. This innovative technology may therefore result in novel approaches to illness detection and treatment. One possible therapy option for some types of cancer is stem cell transplantation. Additional conditions that can be treated with this medical technique include heart, autoimmune, and neurological illnesses. spinal cord injuries, metabolic problems, hepatic diseases, etc. Thus, the current review centers on the expanding application of stem cell transplantation in regenerative medicine to address a range of illnesses. The field's current state is also covered in this review, with a focus on bone marrow transplantation.

KEYWORDS: Parkinson's disease, Bone marrow, Leukemia, Multiple myeloma.

INTRODUCTION

Bone marrow transplantation (BMT) is a well-established treatment option for several non-malignant ailments, such as autoimmune diseases, metabolic disorders, osteoporosis, and haematological failure. This review focusses on cell therapy for bone abnormalities, a rapidly developing field of research that has led to BMT clinical trials for several inherited and acquired bone diseases. Osteoprogenitor cells have been demonstrated to exist within the bone marrow (BM) cell population, and our knowledge of the complex regulatory interactions between the development of normal osteogenesis in recipients of BM stoma cells has been the subject of studies due to the clinical improvements observed in various bone ailments, such as osteoporosis. osteogenesis imperfect (OI), and infantile hypophosphatasia (HPP) have encouraged investigations into how BM stoma cells may lead to development of normal osteogenesis in recipients. Thus far, the treatment options for many disorders of bone metabolism have been supportive in nature, including mainly non-curative approaches associated with persistent morbidity.

Bone Marrow

Bone marrow is the soft, spongy substance found inside bones. Most blood cells in the body proliferate and remain in that location.[1] Blood cells known as stem cells are the progenitors of other blood cells. The most fundamental kind of stem cell is the pluripotent stem cell. This blood cell is distinct from others due to the following qualities

Repleasing: It is able to replicate itself into an identical cell.

Outstanding: It can generate one or more subsets of more developed stem cells, which are necessary for a bone marrow transplant.

Why is a Bone Marrow Transplant Needed?

The aim of a bone marrow transplant is the treatment of many illnesses, including cancer. A bone marrow transplant may be required if the dosages of radiation or chemotherapy required to treat a cancer are so high that the patient's bone marrow stem cells may be irreversibly harmed or destroyed by the treatment. In addition, bone marrow transplants might be required if a condition has destroyed the bone marrow. Using a bone marrow transplant, one can

- Replace sickle cell anaemia, leukemia, and plastic anaemia with healthy working bone marrow in cases when the original bone marrow is damaged and nonfunctioning.

- Create a fresh immune system to combat current or lingering leukemia or other malignancies that were not

eradicated by the radiation or chemotherapy administered during the transplant.[2]

➢ After receiving large dosages of chemotherapy and/or radiation therapy to treat a cancer, replace the bone marrow and return it to its normal function. This is frequently referred to as rescue. To stop further harm from a hereditary disease process (such Hurler syndrome and adrenoleukodystrophy), replace damaged bone marrow with functional, genetically healthy bone marrow.

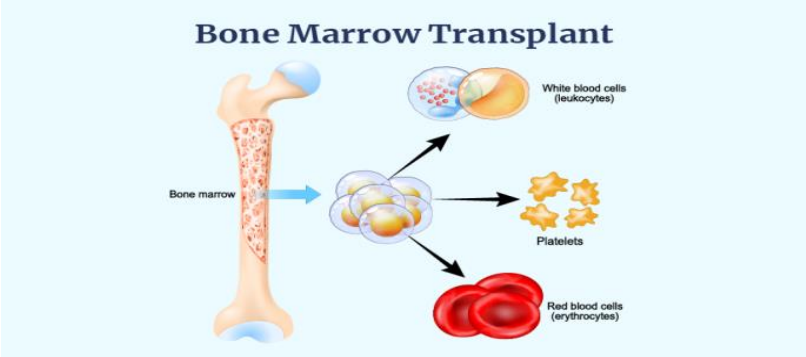

Figure 1: Bone marrow transplant.

TYPES OF STEM CELL TRANSPLANTS

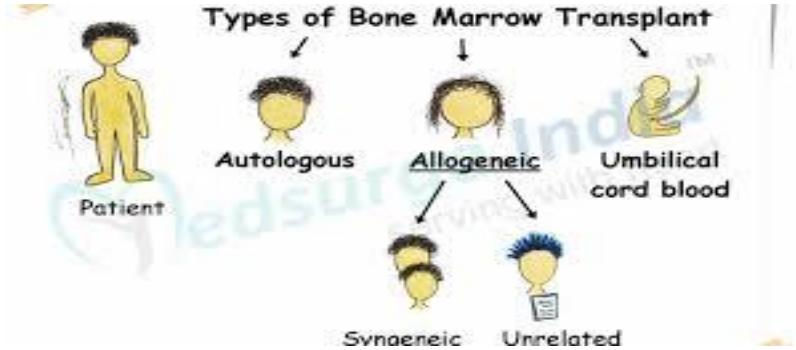

Figure: 2 Types of Bone Marrow Transplant

Autologous bone marrow transplant

The patient is the donor in their own right. After intense treatment, the patient receives frozen stem cells that were extracted from them either by bone marrow harvest or A phrases (a procedure that collects peripheral blood stem cells). The word "rescue" is frequently used in place of "transplant."

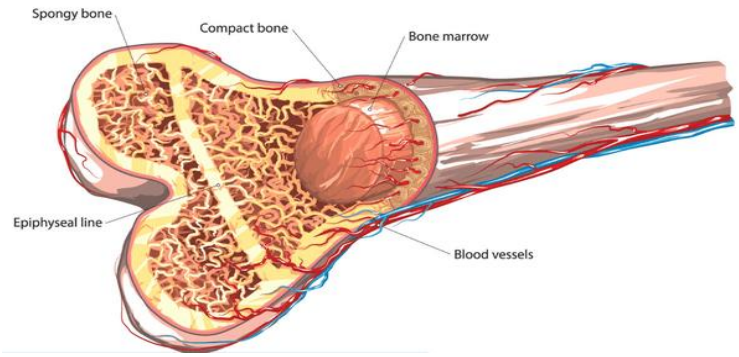

Figure 3: Autologous Bone marrow Transplant.

Allogeneic bone marrow transplant

the patient's allogeneic type. Either a bone marrow transplant or a bone marrow harvest is used to obtain stem cells. The donor and a genetically matched donor—typically a brother or sister—share the same aphaeresis.[3] The following individuals may be additional donors for allogeneic bone marrow transplants: a guardian. When the donor is the recipient's parent and identical to them, this is known as a haploid-

identical match. At least half of the donor's genetic makeup is present.

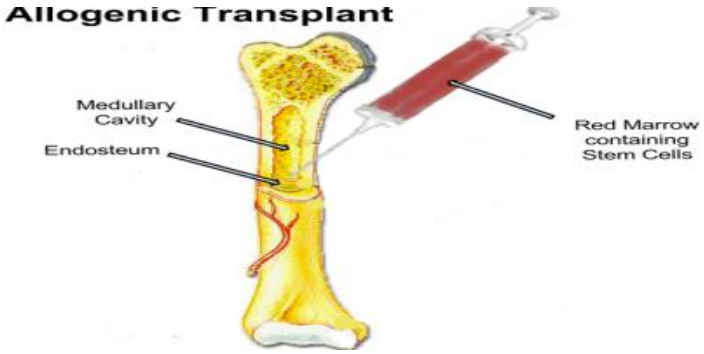

Figure 4: Allergenic bone marrow transplant.

New and Improved Methods and Equipment

One example of how bone marrow transplantation has progressed in India is high-resolution human leukocyte antigen (HLA) typing, which is utilized to match the patient with the ideal donor. Higher transplant success rates and less complications are the outcomes.

Increased Capacity of Donor Database

The size of India's donor registry for bone marrow transplants has grown dramatically thanks to the National Bone Marrow Donor Registry (NMDP India), a part of the larger National Marrow Donor Programmer (NMDP) network.[4] This has increased the pool of possible donors for patients in need of a bone marrow transplant.

Transplantation of Cord Blood

In India, cord blood transplantation, a type of HSCT that uses stem cells taken from umbilical cord blood, has grown in popularity. After delivery, umbilical cords are harvested for donated cord blood, which is then stored in banks for possible future use. This has created a new possible source of stem cells for transplantation for patients who do not have a donor registry or a matched family member.

Conditioning Programmer with Decreased Strength of Effort

Reduced intensity conditioning (RIC) regimens, which use lower doses of radiation and chemotherapy than traditional high-dose conditioning regimens, are becoming more and more common in India for bone marrow transplants. With RIC regimens, patients who are older and have co-morbidities fare better, improving their prognosis and increasing their eligibility for transplants.

Taking a Multi-Pronged Approach

In India, professionals such as hematologists, oncologists, transplant surgeons, radiologists, and supportive care providers collaborate to do bone marrow transplants. Speciality centers have joined forces to offer patients undergoing bone marrow transplantation comprehensive care, hence enhancing patient outcomes.[5]

Science and Creativity

Indian doctors and researchers have made significant contributions to the field of bone marrow transplantation, constantly striving to develop new techniques that improve transplant outcomes. Research on immunotherapy, gene therapy, and haploidentical transplantation (transplanting from a partially matched family donor) may lead to advancements in bone marrow transplantation in India.

Cost Effectiveness

Despite the high cost of bone marrow transplantation, various initiatives have been launched in India to lower the cost to patients. To enable a larger number of patients to have bone marrow transplants, certain hospitals and institutes have offered reduced or discounted costs.

PROCEDURE BEFORE A STEM CELL TRANSPLANT

If you meet the criteria for a stem cell transplant, your doctor will run the following tests to make sure you can handle the physical demands of the procedure, such as conditioning chemotherapy before the transplant and dealing with any adverse effects[6]

- EKG (electrocardiogram). ECHO (echocardiogram).
- CT (computerized tomography) scan.
- Biopsy to analyse malignant cells.¬ Blood tests including liver function or renal function.
- Complete blood count (CBC).

Your healthcare practitioner might insert a central venous catheter (CVC) into one of the big veins in your upper chest prior to your blood tests. Throughout the transplant procedure, CVCs eliminate the need for many needle sticks to install intravenous tubes or take blood samples. Your doctor might prescribe medicine to increase stem cell production if you are receiving your own stem cells. Subsequent blood tests will be performed to monitor stem cell generation. Your healthcare providers will draw blood from you if you are receiving your own stem cells so they may extract healthy stem cells for transplant. This is how it functions

- Your two arms' veins are connected to a cell separator device via providers. The device extracts blood from veins in a single arm.

- Blood enters the device that separates cells by filtering out stem cells.
- Blood returns to the veins in your other arm. It takes three to four hours and doesn't hurt. To ensure they have adequate stem cells for transplant, your healthcare providers might need to draw blood multiple times.

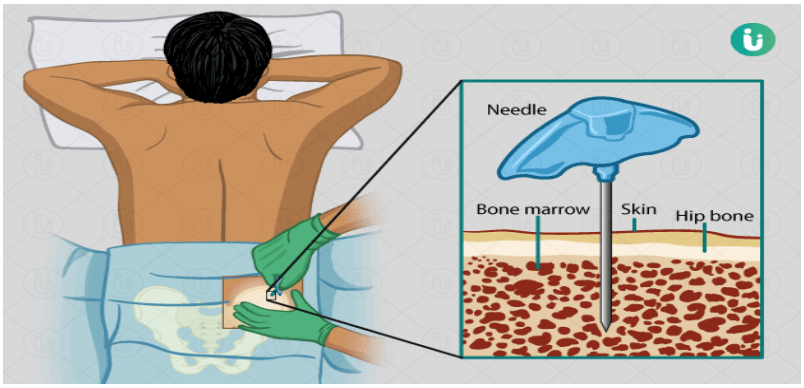

Figure 5: A Stem Cell Transplant.

DISEASES THAT MAY INDICATE FROM BONE MARROW TRANSPLANT

The conditions that benefit from bone marrow transplants most frequently are the following ones.[7]

- Severe Plastic Anemia Due to Leukemia
- Lymphomas Aplastic anaemia, multiple myeloma, immune deficiencies, and Melody's plastic.

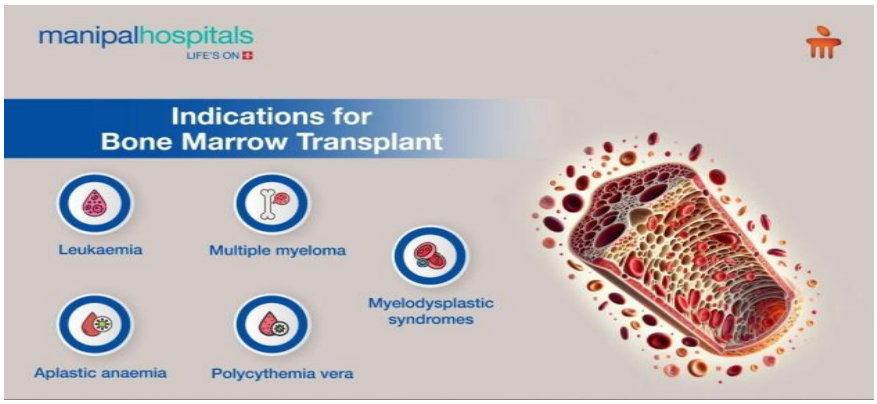

Figure 6: Indications.

Diseases Affected in Bone Marrow Transplantation

Potential risk of graft versus host illness when using donor stem cells Graft-versus-host disease (GVHD) is a possibility if you get an allogeneic transplant, which involves stem cells from a donor.[8] This illness develops when your body's tissues and organs are attacked by donor stem cells that are part of your new immune system because they perceive them as alien. After your transplant, GVHD could occur at any point.

- Pain in the joints or muscles, dyspnoea, and persistent cough
- Modifications in vision, like dry eyes
- Skin alterations, such as subcutaneous scarring or rigidity.

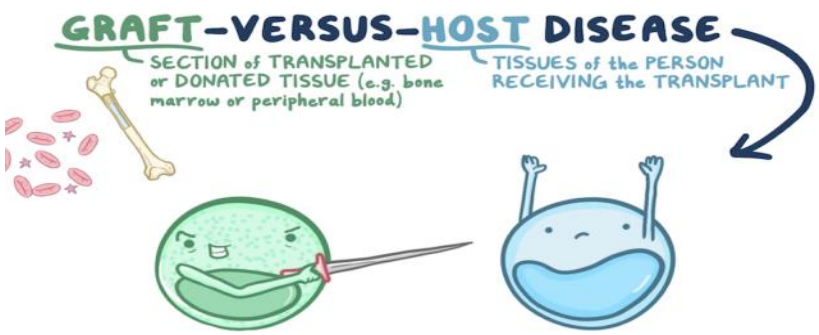

Figure 7: A Bone Marrow Transplant Can Improve Survival Rates and Reduce the Risk of Relapse for Some People.

ADVANTAGES OF A BONE MARROW TRANSPLANT

- Certain diseases can be cured: leukemia and lymphoma are two incurable conditions that can be effectively treated with bone marrow transplants.[9]
- Replaces diseased marrow: By replacing sick or damaged marrow with healthy marrow, a transplant can improve overall health and the immune system.

DISADVANTAGES

- Restricted Graft-versus-Tumor Effect: Autologous operations do not have the same influence on long-term disease treatment techniques as Allogeneic transplants due to their lack of graft-versus-tumor effect. BMT experts investigate different strategies to deal with this constraint.
- Possible Contamination: There is a chance that extracted bone marrow may contain cancer cells, which could lead to a return of the illness after transplantation. To reduce this risk, BMT experts put strict quality control systems in place.

CONCLUSION

For many patients in India, a bone marrow transplant is an opportunity to start over as well as a medical intervention. From diagnosis to recovery, there are many obstacles in the way, but with the correct support and care, the path may also be one of hope and rejuvenation. Offering the greatest bone marrow transplant treatments and care, PSRI Hospital is the top bone marrow transplant hospital in India. Its mission is to make this trip as easy and successful as possible.

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