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"Transforming Hope into Healing: The Role of Nursing in Bone Marrow Transplant for Acute Myelogenous Leukemia"

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Abstract: *This case study examines the management and clinical outcomes of a 25-year-old male who have been diagnosed with acute myelogenous leukemia (AML), a rapidly progressing hematologic malignancy. Despite undergoing multiple rounds of chemotherapy, the patient failed to achieve remission, necessitating an allogeneic bone marrow transplant (BMT) from a fully HLA-matched sibling donor. The pre-transplant conditioning regimen involved high-dose chemotherapy, followed by stem cell infusion. The patient was carefully monitored for common post-transplant complications, includes infection, graft-versus-host disease (GVHD), and mucositis. Following a successful engraftment phase and supportive care, the patient showed good outcomes, with improved blood counts and stable recovery. Nursing care was central throughout the process, with key responsibilities including infection prevention, pain management, nutritional support, and monitoring for complications such as graft-versus-host disease (GVHD) and mucositis. Nurses played a vital role in implementing strict infection control protocols, providing education on self-care and signs of complications, and supporting the patient emotionally during the transplant process. In Post-transplant care we monitored blood counts, and took precautions in order to prevent infections, and side effects of chemotherapy were addressed. The successful outcome of this case highlights the importance of comprehensive nursing interventions in improving patient recovery, minimizing complications, and ensuring a smoother recovery process post-BMT.*

Key Words: *Bone marrow transplantation, acute myelogenous leukemia, nursing care.*

1. INTRODUCTION:

Acute myeloid leukemia remains a rare but lethal malignancy. Our understanding of the disease has progressed significantly, and new and evolving therapies are providing hope for improved survival and less toxic treatment. Early diagnosis with rapid analysis of cytogenetic and molecular abnormalities are paramount in tailoring best therapy for patients, especially in light of new treatment modalities that rely on cytogenetic and molecular testing. Chemotherapy remains the backbone of the treatment with stem cell transplantation still the best hopes for cure in many patients with adverse cytogenetic risk profiles.

Bone Marrow Transplant (BMT) is a critical medical procedure used to treat patients with life-threatening blood, immune, or genetic disorders. BMT can be used to treat various conditions, including leukemia, lymphoma, myelodysplastic syndromes (MDS), multiple myeloma, and other non-cancerous conditions like aplastic anaemia and blood disorders. The process involves replacing unhealthy blood-forming cells with healthy, functional ones, typically obtained from a donor who has a compatible genetic match.

Stem cells, either collected from the patient (autologous) or from a donor (allogeneic), are infused into the patient's bloodstream. These stem cells will generate healthy blood cells, restoring the body's ability to produce red blood cells, white blood cells, and platelets. In the case of severe genetic or immune conditions, a bone marrow transplant offers a chance for a cure or long-term remission.

2. OVERVIEW ABOUT THE CONDITION

AML-Acute myeloid leukemia is a disease of the bone marrow, a disorder of hematopoietic stem cells due to genetic alterations in blood cell precursors resulting in overproduction of neoplastic clonal myeloid stem cells. While extra medullary manifestations can occur. The underlying disease is due to abnormalities in hematologic cellular production. A small subset of cases have identified causative factors such as prior chemotherapy or certain chemical exposures, but the large majority are due to genetic alterations, through chromosomal abnormalities or isolated gene mutations, without clear causative agents. Delineating these genetic abnormalities is important in risk stratifying patients and determining appropriate treatment

The recent consensus guidelines established by the European Leukemia NET (ELN) in 2022 have emphasized molecular characterization and risk stratification for individuals with AML, providing updated data on these aspects.

AML should be suspected in individuals presenting with rapid (within days or a few weeks) unexplained cytopenias (decreased leukocytes, haemoglobin, or platelets), circulating blast cells in peripheral blood, easy bruising or bleeding, or recurrent infections. In some cases, patients may present with renal failure due to auto-tumour lysis syndrome (auto-TLS), which, even in the absence of prior chemotherapy, is considered an oncologic emergency.

3. WHAT A NURSE MUST NOTICE WHILE COLLECTING HISTORY AND PERFORMING PHYSICAL EXAMINATION

Due to ineffective erythropoiesis and bone marrow failure, patients may experience various symptoms, including recurrent infections, anaemia, easy bruising, excessive bleeding, headaches, and bone pain. Generalized weakness, fatigue, shortness of breath, and chest tightness may also be observed, depending on the degree of anaemia. The time course associated with such symptoms is relatively fast, often on the order of days to weeks.

Common physical examination findings in (AML) acute myeloid leukemia includes pallor, bruising, and hepatosplenomegaly, while lymphadenopathy is rare. Myeloid sarcoma, a myeloid equivalent, may present as thickened, hyper pigmented, coarse skin lesions. Disseminated intravascular coagulation (DIC), characterized clinically by oral mucosal haemorrhages, purpura, extremity petechiae, and bleeding from intravenous line sites, is common in AML.

4. CASE DESCRIPTION

A 25-year-old male was diagnosed with acute myelogenous leukemia after presenting with symptoms of persistent fatigue, recurrent infections, and abnormal blood counts. Despite undergoing multiple rounds of chemotherapy, his condition worsened, and he was recommended for bone marrow transplant. The patient's HLA-matched sibling was identified as a suitable donor for an allogeneic transplant.

4.1 Diagnosis and Indication for Bone Marrow Transplant:

The patient was diagnosed with **Acute Myelogenous Leukemia (AML)** after confirmation from a bone marrow biopsy. After failing multiple rounds of chemotherapy, the patient was recommended for **autologous bone marrow transplant**. However, due to the patient's condition and the advanced stage of his disease, an **allogeneic transplant** was necessary for a chance of remission.

4.2 Matching Donor Search:

The patient's sibling, a **25-year-old sister**, was found to be a suitable **HLA-matched sibling donor**. The sibling donor was further screened for medical fitness and the absence of any infectious or genetic disorders.

4.3 PRE-TRANSPLANT WORKUP

4.3.1 Clinical Assessment:

Upon admission, the patient was assessed by the BMT team, which included an oncologist, transplant physician, nursing staff, and dietician. His clinical symptoms included persistent fever, severe fatigue, and an enlarged spleen.

4.3.2 Laboratory Workup:

- Complete blood count showed **severe pancytopenia** (low red cells, white cells, and platelets).
- **Bone marrow biopsy** confirmed the diagnosis of **AML**.
- Genetic testing confirmed no resistance to chemotherapy or specific mutations related to the leukemia subtype.
- The **HLA typing** confirmed the patient's sibling as a **10/10 matched donor**.

4.3.3 Treatment Plan:

1. **Conditioning Phase:** The patient was scheduled to undergo a 7-day chemotherapy regimen with **high-dose chemotherapy** (including drugs such as **Melphalan**), followed by the infusion of **donor stem cells**.
2. **Stem Cell Collection (Apheresis):**
    - On **Day -1**, the donor underwent **apheresis** to collect **CD34+ stem cells** from peripheral blood.

- The collected stem cells were processed and cryopreserved until the patient's conditioning regimen was completed.

4.4. THE TRANSPLANT PROCESS

4.4.1 Conditioning Phase (Chemotherapy and/or Radiation)

the patient underwent **high-dose chemotherapy** on **Day -1** of conditioning phase with **Melphalan**, a potent chemotherapeutic agent, to eradicate any remaining leukemic cells and create space in the bone marrow for the new stem cells. The chemotherapy also suppressed the immune system to prevent rejection of the transplanted cells.

Purpose of Conditioning:

- To eliminate the leukemic cells
- To suppress the immune system
- To create space in the bone marrow for the new stem cells

4.4.2 Stem Cell Infusion

On **Day 0 stem cell infusion phase**, after completing the conditioning phase, the donor stem cells were infused into the patient through a central line or PICC line. The infusion process took approximately **1 hour**.

- **Potential complications:**
  - **Anaphylaxis** or severe allergic reactions
  - **Volume overload** due to fluid administration
  - **Transient Graft-Versus-Host Disease (GVHD)**, especially in the early stages

4.4.3 Neutropenic Phase

After the stem cell infusion, the patient entered the **neutropenic phase**, lasting **2-4 weeks**, during which his immune system was severely compromised, leaving him vulnerable to infections.

- **Key interventions during this phase included**:
  - Strict **infection control** protocols
  - **Prophylactic antibiotics** and antifungal treatment to prevent infections
  - **Granulocyte transfusions** to support the immune system

4.4.4 Engraftment Phase

Engraftment is the process by which the transplanted stem cells start to grow and produce new blood cells. This phase is typically marked by the patient's **blood counts** improving, including rising levels of **white blood cells** (neutrophils), red blood cells, and platelets.

Signs of engraftment:

- Improvement in the **patient's white blood cell count**
- Reduction in the **fever** and signs of infection
- Healing of **mucositis** and other transplant-related complications

Post-Engraftment Period

Following successful engraftment, the patient entered the **post-engraftment phase**, which lasted for months to years. In this phase, the patient's immune system gradually reconstituted. The patient was monitored for signs of complications, such as **Graft-Versus-Host Disease (GVHD)** or **viral infections**.

5. Specific Nursing Management and Interventions:

5.1. Infection Prevention and Control:

- **Strict aseptic techniques** during all procedures, especially when handling central lines, to prevent infections.
- **Prophylactic antibiotics**, antivirals, and antifungals were administered as part of routine care.
- **Frequent hand hygiene** education and isolation precautions to reduce exposure to infectious agents.
- Regular **mouth care** to prevent oral mucositis, which is common after high-dose chemotherapy.

5.2. Pain Management:

- The patient experienced **severe mucositis**, leading to painful sores in the mouth and throat. Pain was managed with narcotic analgesics and the use of **magic mouthwash**.
- **IV opioids** (morphine/fentanyl) were used for pain relief during the initial recovery phase.

5.3. Nutritional Support:

- The patient was placed on a **neutropenic diet**, avoiding raw fruits and vegetables to minimize the risk of infection.
- **Enteral nutrition** through a **nasogastric tube** or **Ryle's tube** was initiated due to difficulty eating from mucositis.
- **Weight monitoring** and electrolyte management were critical to ensure proper nutritional support.

5.4. Monitoring for Complications:

- **GVHD** prevention and monitoring were crucial. The patient was closely monitored for signs of GVHD, including skin rashes, gastrointestinal symptoms, and liver dysfunction.
- **Cytokine release syndrome (CRS)** was identified as a complication after stem cell infusion and was treated with **Tocilizumab**.
- **Veno-occlusive disease (VOD)** was ruled out through routine abdominal measurements and weight monitoring.

5.5. Post-Transplant Follow-up

The patient was discharged **Day +30** in stable condition. Follow-up visits were scheduled for:

- **Central line dressing changes**
- **Blood tests** to monitor for early signs of infection or rejection.
- Regular **chimerism testing** to track engraftment success

5.6. Family Education:

The patient's family was educated on the following:

- Importance of **infection control**, hand hygiene, and avoiding crowded places
- Recognition of **symptoms of infection** and signs of **GVHD**
- The need for **regular follow-up visits** for blood tests and monitoring
- **Nutrition guidelines** to prevent infections and maintain weight

6. Nursing Care Plan :

6.1 Nursing Care Plan 1: Risk for Infection

Goal: Prevent infection during hospitalization.

- **Assessment**:
  - Monitor neutrophil count.
  - Check vital signs frequently for signs of infection.
  - Inspect IV sites and invasive devices for infection.
- **Interventions**:
  - **Neutropenic Precautions**: Private room, dedicated equipment, HEPA filtration.
  - **Limit Visitors & Screen for Infection**: Screen visitors for signs of infection.
  - **Administer Medications**: Antibiotics, antifungals, antivirals as per doctor's order.
  - **Hand Hygiene & PPE**: Ensure hygiene and PPE for all.
  - **Monitor Invasive Devices**: Follow sterile techniques for dressings.

6.2 Nursing Care Plan 2: Risk for Bleeding

Goal: Prevent bleeding episodes.

- **Assessment**:
  - Monitor platelet count, signs of bleeding (bruising, petechiae, etc.).
  - Inspect for internal bleeding (abdominal pain, dizziness, etc.).
- **Interventions**:
  - **Monitor Platelet Count**: Assess CBC and platelet levels regularly.
  - **Avoid Invasive Procedures**: Minimize injections, blood draws.
  - **Administer Platelet Transfusions**: As ordered for low platelet counts.
  - **Educate on Bleeding Precautions**: Avoid injury, report unusual bleeding.
  - **Use Pressure Dressings**: For minor bleeding sites.

6.3 Nursing Care Plan 3: Decreased Cardiac Output

Goal: Maintain adequate cardiac output.

- **Assessment**:
  1. **Vital Signs**: Monitor blood pressure, heart rate, and respiratory rate.
  2. **Signs of Shock/Organ Dysfunction**: Check for confusion, cold extremities, etc.
  3. **Cardiac History**: Identify any heart conditions or medications.
  4. **Oxygenation Status**: Monitor SpO_2 and signs of hypoxia.
  5. **ECG Monitoring**: Watch for arrhythmias.
- **Interventions**:
  1. **Administer Fluids**: Cautiously, especially in cardiac patients.

2. **Administer Medications**: Inotropes, vasopressors for support.
3. **Maintain Oxygenation**: Provide oxygen and monitor levels.
4. **Monitor Electrolytes**: Correct imbalances as needed.
5. **Limit Physical Activity**: Reduce heart workload.
6. **Monitor for Complications**: Sepsis, fluid overload.

6.4 Nursing Care Plan 4: Anxiety

Goal: Reduce anxiety and promote coping.

- **Assessment**:
  - Assess emotional state and coping mechanisms.
  - Observe for physical signs of anxiety (tachycardia, restlessness).
- **Interventions**:
  - **Provide Emotional Support**: Reassure and listen.
  - **Educate About Neutropenia**: Reduce fear by explaining the condition.
  - **Encourage Relaxation Techniques**: Deep breathing, guided imagery.
  - **Offer Psychological Support**: Refer for counselling if needed.
  - **Encourage Communication**: Use virtual platforms for social connections.

6.5 Nursing Care Plan 5: Impaired Oral Mucous Membranes

Goal: Maintain oral integrity and minimize discomfort.

- **Assessment**:
  - Inspect oral cavity daily for mucositis, ulcers, and dryness.
  - Monitor for pain, redness, difficulty swallowing.
- **Interventions**:
  - **Provide Regular Oral Care**: Gentle brushing, saline rinses.
  - **Offer Soft, Non-Irritating Foods**: Encourage easy-to-eat foods.
  - **Administer Topical Anesthetics**: For pain relief (e.g., lidocaine).
  - **Monitor for Infection/Bleeding**: Check for signs of infection in mouth.
  - **Encourage Hydration**: Prevent dry mouth and maintain moisture.

6.6 Nursing Care Plan 6: Impaired Nutrition

Goal: Maintain adequate nutrition and prevent malnutrition.

- **Assessment**:
  - Monitor weight, BMI, and nutritional intake.
  - Assess for nausea, vomiting, or diarrhoea.
- **Interventions**:

○ **Monitor Nutritional Intake & Weight**: Record food intake and weight regularly.

  - **Provide High-Protein, High-Calorie Diet**: Encourage nutrient-dense foods.
  - **Offer Small, Frequent Meals**: To ease nausea and promote intake.
  - **Manage Nausea/Vomiting**: Administer antiemetic's and adjust environment.
  - **Educate on Safe Food Choices**: Avoid raw foods, unpasteurized dairy, etc.

7. Discussion :

This case study examines the management and clinical outcomes of a 25-year-old male who have been diagnosed with acute myelogenous leukemia (AML), a rapidly progressing hematologic malignancy Bone marrow transplant remains one of the most effective treatments for certain types of leukemia and other hematologic disorders. Early identification of complications, such as infection, GVHD, and cytokine release syndrome, is crucial for successful outcomes. Close monitoring of the patient's response to treatment and timely intervention during each phase of the transplant process is important to optimize recovery and minimize life-threatening complications. Nurses played a vital role in implementing strict infection control protocols, providing education on self-care and signs of complications, and supporting the patient emotionally during the transplant process. In Post-transplant care we monitored blood counts, and took precautions in order to prevent infections, and side effects of chemotherapy were addressed.

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