Young Doctors Multiple Myeloma

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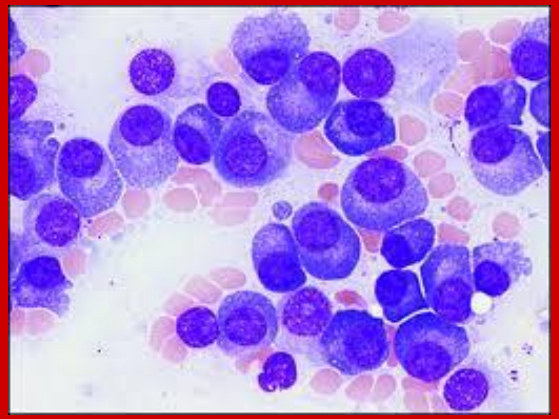
Age Group : (14-19)

Multiple Myeloma Abstract

Cancer is a devastating illness that affects millions of people worldwide. Multiple myeloma is a relatively rare form of cancer, but it is still important for us to be informed about it. The aim of our research is to collect information about the disease. We want to spread knowledge about multiple myeloma because it can help people identity if they have it, and what to do if they have it. We conducted our research online using websites such as Mayo Clinic, the American Cancer Society, and the Memorial Sloan Kettering Cancer Center. Multiple myeloma is a cancer that affects white blood cells. It can be treated with surgery, targeted therapy, and immunotherapy.

What is Multiple Myeloma? [1]



https://cjasn.asnjournals.org/content/1/6/1322

Multiple myeloma is a cancer that forms in a type of white blood cell called a plasma cell. Plasma cells help you fight infections by making antibodies that recognize and attack germs. Multiple myeloma causes cancer cells to accumulate in the bone marrow, where they crowd out healthy blood cells.

Symptoms of Multiple Myeloma [1,2]

1. **Bone pain in spine or chest**
2. **Nausea**
3. **Constipation**
4. **Loss of appetite**
5. **Mental fogginess/confusion**
6. **Fatigue**
7. **Frequent infections**
8. **Weight loss**
9. **Weakness in your legs**
10. **Excessive thirst**
11. **Anemia (shortage of red blood cells)**
12. **Thrombocytopenia (lack of platelets)**
13. **Increased bruising and bleeding**
14. **Leukopenia (shortage of healthy white blood cells)**
15. **Fractured bones**
16. **Weakened immune system**

Causes [1,2]

It is caused by an abnormal plasma cell in the bone marrow that begins to rapidly multiply. These abnormal cells begin to crowd out healthy white and red blood cells, which leads to fatigue and an inability to fight infections. The myeloma cells create abnormal antibodies (M proteins) that build up and cause problems to the kidneys.

Cancer in general is caused when there is a defect in the oncogenes or the tumor suppressor genes that causes unrestricted growth in the abnormal cells. Researchers have seen that patients with plasma cell tumors have abnormalities that cause plasma cell growth. For example, cells in the bone marrow called dendritic cells produce a hormone that causes plasma cell growth. Too much of that hormone can lead to cancer.

Risk Factors [2,8]

The risk of developing multiple myeloma increases if…

1. **You are above the age of 65**
2. **You are male**
3. **You are African American**
4. **You have a family history of multiple myeloma**
5. **You are obese/overweight**
6. **You have plasma cell diseases**

Other risk factors include

7. **Exposure to radiation and chemicals like asbestos, benzene, and pesticides.**
8. **People who have a history with solitary plasmacytoma in their bones.**

Complications [1]

1. **Frequent infections : the disease hinders your body's ability to fight disease**
2. **Bone problems : the disease can affect your bones**
3. **Reduced kidney function : higher calcium in your blood because of eroding bones can affect your kidneys when they filter your blood's waste**
4. **Anemia : myeloma cells can crowd out normal blood cells, causing blood problems like anemia**

US Statistics [2]

- **The lifetime risk of developing multiple myeloma in the United States is about 1/132.**
- **About 32,110 new cases are expected to be diagnosed in 2019**
  - **18,130 in men and 13,980 in women**
- **About 12,960 deaths are expected to occur in 2019**
  - **6,990 in men and 5,970 in women (cancer.org)**
- **African Americans are twice as likely to contract multiple myeloma than white Americans. The reason for this disparity is still unknown as .**

Diagnosis [1,3]

- **Blood tests : Lab analysis can reveal the presence of M proteins produced by abnormal myeloma cells, or of beta-2-microglobulin, another abnormal protein produced by myeloma cells (mayo clinic)**
- **Urine tests : These tests can also reveal M proteins, referred to as Bence Jones proteins because of where they were found. (Mayo clinic)**
- **Bone marrow test : Doctors will perform a bone marrow aspiration and a bone marrow biopsy to collect a bone marrow sample which is analyzed for myeloma and to determine how fast the cells are multiplying. (Mayo Clinic)**
- **Imaging tests : Can be performed to look for bone problems associated with multiple myeloma, such as osteolytic lesions, or soft spots in the bone. This occurs because multiple myeloma cells can cause bone marrow cells to remove calcium from bones. (mskcc.org)**

Stages [4]

There are two main systems that measure the stages of multiple myeloma. (uihc.org)

1. **Durie-Salmon Staging - Has three stages (I, II, III) which are determined by albumin and hemoglobin factors, blood calcium levels, the amount of M-protein in the blood or urine, the number of myeloma cells in the body, and the amount of damage the myeloma cells have caused to the bone**
    a. **Damage to the kidneys further places patients into Groups A or B. Normal kidney function means Group A and abnormal kidney function means Group B**

Stages [4]

2. International Staging System

a. **Albumin level (more or less than 3.5 mg/dL) and B-2-microglobulin level (< 3.5; 3.5-5 or > 5 mg/L) determines the stage. There are three different stages.**
b. **The Revised International Staging System, or the R-ISS also measures the the level of lactate dehydrogenase and chromosomal abnormalities (mskcc.org)**

Treatment [2]

- **Surgery: If the Myeloma has not yet formed a tumor in the bone marrow, surgery can be done to extract the deformed cells. Surgery is usually only done for the early stages of Multiple Myeloma.**
- **Targeted Therapy: Targeted Therapy is a cancer treatment that focuses on killing cancer specific genes, proteins, or the tissue that is crucial to the cancer's growth and survival with drugs or radiation. Drugs such as bortezomib (Velcade), carfilzomib (Kyprolis) and ixazomib (Ninlaro) are used to directly kill Myeloma cells. Radiation can be used instead of drugs to kill tumors. Both drugs and radiation risk killing healthy cells.**

Immunotherapy [2,7]

- **Immunotherapy uses parts of a person's immune system to fight diseases. This can either be done by stimulating the immune system to work harder at attacking cancer cells, or by giving you man made immune system proteins (cancer.org)**
- **Immunotherapy is a type of biological therapy that uses substances made from living organisms to treat cancer (cancer.gov)**
- **There are currently 2 FDA approved immunotherapy treatments for multiple myeloma (cancerresearch.com)**
    - **Daratumumab : a monoclonal antibody that targets the CD38 pathway (cancerresearch.com)**

New solutions [6]

Immunotherapy agents : All three listed are FDA approved

1. **Thalidomide (Thalomid): Side effects of Thalidomide include drowsiness, fatigue, constipation, increased risk of developing blood clots, and nerve damage.**
2. **Lenalidomide (Revlimid): Similar to Thalidomide but with slightly different side effects. The most common of the side effects include low platelet levels (thrombocytopenia), low white blood cell levels, increased risk of blood clots (not as likely as Thalidomide but still increased) and risk of nerve damage.**
3. **Pomalidomide (Pomalyst): The common side effects of Pomalidomide include low red blood cell count (anemia), and low white blood cell counts.**

Statistics in other regions/countries [5,6]

Incidence rates per 100,000

1. **Australasia: 5.8**
2. **North America: 5.2**
3. **West Europe: 4.8**

Death rates per 100,000

1. **North America: 3.0**
2. **Australasia: 2.8**
3. **West Europe: 2.6**

The United States had the most new cases (24,407) and the most deaths (14,212), with China the second most new cases (18,617) and deaths (11,898), while India the third most new cases (9,710) and deaths (9600).

Citations

1. https://www.mayoclinic.org/diseases-conditions/multiple-myeloma/symptoms-causes/syc-20353378
2. https://www.cancer.org/cancer/multiple-myeloma/about/what-is-multiple-myeloma.html
3. https://www.mskcc.org/cancer-care/types/multiple-myeloma/staging
4. https://uihc.org/
5. https://www.mdedge.com/hematology-oncology/article/166076/multiple-myeloma/multiple-myeloma-rates-rising-fastest-east-asia
6. https://jamanetwork.com/journals/jamaoncology/fullarticle/2681640
7. https://www.cancerresearch.org/
8. https://www.cancer.net/cancer-types/multiple-myeloma/risk-factors-and-prevention#targetText=Multiple%20Myeloma%3A%20Risk%20Factors%20and%20Prevention&targetText=Currently%2C%20there%20are%20also%20no,higher%20risk%20for%20developing%20it.