Body's Immune Cells 'Betraying' It in Breast Cancer - Insights from Indian Research

Mains: *GS II – Health |GS III – Science and Technology*

Why in News?

A review by Indian researchers highlights how immune cells meant to protect the body can be reprogrammed to assist breast cancer progression.

What is breast cancer?

- **Breast cancer –** It is a disease where cells in the breast grow uncontrollably, forming tumors that can be invasive (spread to other tissues) or, rarely, stay in place.
- **Types –** The most common forms are:
  - Ductal carcinoma (starts in ducts)
  - Lobular carcinoma (starts in glands).
- **In Situ vs. Invasive –** Non-invasive (in situ) cancers remain in their origin spot.
- Invasive cancers spread into surrounding breast tissue, lymph nodes, or other body parts.
- **Prevalence –** Breast cancer is the most common cancer among women globally and remains the leading cause of cancer-related deaths in women.
- Nearly 15% of breast cancer deaths occur due to metastasis and drug resistance, highlighting the need for deeper biological understanding beyond tumour cells alone.
- Recent scientific research has shifted focus towards the tumour microenvironment, especially the role of immune cells in cancer progression.
- **Symptoms –** A new lump, swelling, breast skin dimpling, nipple changes (inversion or discharge), or pain.
- **Detection –** Regular screening, such as mammograms, is crucial for finding cancer early, often before symptoms appear.
- **Risk Factors –** Increasing age, family history, genetic mutations (e.g., *BRCA1*, *BRCA2*), alcohol consumption, and obesity.
- **Causes –** While many cases have no clear cause, they often stem from genetic damage within breast cells.
- **Treatment Options –** Treatment is individualized and often involves a combination of:
  - **Surgery –** Lumpectomy or mastectomy.
  - **Radiation Therapy –** High-energy rays to kill cancer cells.
  - **Systemic Therapies –** Chemotherapy, hormone therapy (e.g., to block estrogen), or targeted therapies (e.g., for HER2-positive).

What are the findings of the new study?

- **Indian Researchers and the Review –** The review was conducted by Nagaland University.
- It was published in the *Breast Global Journal*.
- The review focuses on the behaviour of macrophages within breast tumours and their role in metastasis.
- **Role of the Immune System in Breast Cancer –** Traditionally, cancer was understood as a disease caused by uncontrolled proliferation of tumour cells alone.
- The research shows that *cancer can manipulate the body's own immune system to support tumour growth and spread.*

What are Macrophages?

- **Macrophages** – They are white blood cells that normally eliminate harmful cells through phagocytosis.
- In breast tumours, macrophages undergo behavioural changes and become tumour-associated macrophages (TAMs).
- Instead of destroying cancer cells, TAMs begin supporting tumour growth and survival.
- **Different States of Macrophages –** Macrophages exist in two major functional states:
    - **M1 macrophages** – They are anti-tumour in nature and promote inflammation to destroy abnormal cells.
    - **M2 macrophages** – They are involved in tissue repair and suppression of inflammation.
- Breast cancer cells push macrophages towards the M2 state, thereby weakening anti-cancer immunity.

How Tumor-Associated Macrophages Promote Cancer Progression?

- **Angiogenesis –** M2-type macrophages release cytokines that promote angiogenesis, which is the formation of new blood vessels.
- These blood vessels supply tumours with oxygen and nutrients, enabling rapid tumour growth.
- Tumour-associated macrophages suppress T cells, reducing the immune system's ability to identify and kill cancer cells.
- Cancer cells also display "don't eat me" signals that prevent macrophages from attacking them.
- TAMs remodel the extracellular matrix, making it easier for cancer cells to invade surrounding tissues and spread to distant organs.
- **Role in Metastasis –** By breaking down structural barriers, tumour-associated mac
- rophages facilitate the escape of cancer cells from the breast tissue.
- This enables cancer cells to metastasise to organs such as the lungs and bones.
- The interaction between tumours and macrophages forms a self-reinforcing cycle, where growing tumours attract more macrophages, which further enhance tumour progression.
- **Implications for Future Cancer Therapy –** Understanding the tumour–immune cell

interaction opens new avenues for breast cancer treatment.
- Future therapies may focus on re-educating macrophages to revert them to their tumour-fighting M1 state.
- Another approach involves blocking molecular signals that convert macrophages into cancer-supporting cells.
- Such strategies could complement existing treatments like chemotherapy and radiotherapy.
- **Significance for Targeted Immunotherapy –** Reprogramming M2 macrophages could slow breast cancer progression and reduce metastasis.
- Targeted immunotherapies based on immune cell modulation may offer more precise and less toxic treatment options.
- This approach aligns with the global shift towards personalised and immune-based cancer therapies.

What lies ahead?

- Breast cancer progression is not driven solely by tumour cells but is strongly influenced by the immune microenvironment.
- The 'betrayal' of immune cells like macrophages represents a critical challenge as well as an opportunity in cancer treatment.
- Indian research contributes significantly to understanding this complex interaction and points towards innovative immunotherapeutic strategies for improving long-term survival in breast cancer patients.

Reference

[The Hindu| Breast Cancer]