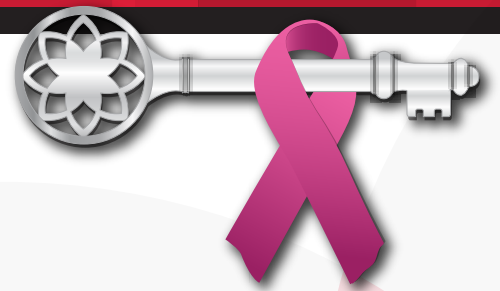




REGENERATIVE MEDICINE FOUNDATION



Every year, 1.3 million women worldwide are diagnosed with breast cancer¹. Breast cancer is the second leading cause of cancer death in women, exceeded only by lung cancer². Everyone has been impacted in some manner by breast cancer, whether as a patient, or as the parent, spouse, child or friend of a breast cancer patient. In the US 12.15% of women (1 in 8) born today will be diagnosed with cancer of the breast at some point during their lifetime. October begins National Breast Cancer Awareness Month, the annual international health campaign organized by major breast cancer charities to increase awareness of the disease and to raise funds for research into its cause, prevention and cure.

The American Cancer Society³ estimates that approximately 207,090 new cases of invasive breast cancer and 54,010 new cases of *in situ* breast cancer will occur among women in the United States during 2010, while approximately 39,840 women will die from breast cancer this year alone. It should not be forgotten, that males can also be victims of this disease as it is estimated that 1,970 men will be diagnosed and 390 men will die of breast cancer during 2010 in the United States.

While these statistics seem quite dismal, data presented at a recent conference⁴, has shown 10-year survival rates at MD Anderson Cancer Center from 1944–2004 to have increased over time for all stages of breast cancer. The observed 10-year survival rate has reached 76.5% for women diagnosed with any stage breast tumor in 1995–2004, up from a mere 25.1% in the period 1944–1954. This data demonstrates how improvements in diagnosis and treatment have profoundly impacted patient care with millions of women surviving breast cancer today. At this time there are over 2.5 million breast cancer survivors in the United States². What might the future bring the management of breast cancer?

Regenerative medicine uses the body's innate ability to heal itself and return function to organs, tissue, limbs and joints affected by age, genetic variability, disease or trauma. Regenerative medicine has already demonstrated success in the treatment of wound care, cartilage and bone injury, using differentiated stem cells, biomaterials and growth factors. Future successes are expected to be realized in cardiovascular disease and neurological disorders. Regenerative medicine therapies hold the promise of more natural and esthetic functional tissue, thus possess profound implications to the management of breast cancer reconstruction.

Earlier this year, for the first time, scientists identified and isolated adult mammary stem cells in mice⁵. They further demonstrated the regenerative ability of these cells by transplanting the cells into the mammary tissue of recipient mice whose own mammary epithelium had been removed. Surprisingly,

¹ American Cancer Society. Global Cancer Facts and Figures 2007. Atlanta, GA: American Cancer Society, 2007.

² <http://www.cancer.org/Cancer/BreastCancer/DetailedGuide/breast-cancer-key-statistics>

³ American Cancer Society. Cancer Facts and Figures 2010. Atlanta, GA: American Cancer Society, 2010.

⁴ Buzdar K, et al. "Improving survival of patients with breast cancer over the past 6 decades: The University of Texas M.D. Anderson Cancer Center Experience" ASCO Breast 2010.

⁵ Bai L and Rohrschneider LR. s-SHIP promoter expression marks activated stem cells in developing mouse mammary tissue. *Genes & Dev.* 2010. 24:1882-1892.



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the transplanted stem cells generated new mammary tissue and produced milk, just like normal mammary epithelial cells. This breakthrough finding, aside from the possibility of someday allowing breast cancer patients the prospect of being able to grow back breast tissue may also provide a better understanding of the role of adult stem cells in breast cancer development and to develop potential new targets for oncology drugs.

While this research is of great clinical importance to tissue regeneration, these isolated stem cells provide a window to better understand how normal stem cells can become cancer stem cells, which are hypothesized to exist in tumors. Cancer stem cells are thought to be responsible for tumor initiation, growth, metastases, therapy resistance and disease relapse⁶. Scientists hope that “by searching for new methods to effectively and specifically target cancer stem cells, we hope we can cure breast cancer someday.”⁶

Because stem cells are critical for both normal tissue development and cancer development, exploring how they are regulated in normal development will help scientists to better understand how they are transformed into breast cancer cells⁶. Since stem cell therapies have shown success in many areas of regenerative medicine, but are also involved in cancer development, can stem cells be safely used in tissue reconstruction in breast cancer patients?

Breast tissue reconstruction may involve moving tissue from other parts of the body into the breast, which may suffer from complications or suffer from varying rates of success. Recently, scientists have considered adding stem cells derived from adipose (fat) tissue or the bone marrow to the transferred fat with the aim of supporting graft integration by enhancing new blood vessel formation⁷, which may help to alleviate some of the problems associated with the fat transfer process. It has not been clear whether these stem cells are safe for breast cancer patients because they could send growth signals that promote tumor reactivation or provide new blood vessels for the tumor. New research suggests that this risk is real if the patient still has active tumor cells, but is safe when the cells are inactive or resting.⁸ Thus, these data in the mouse suggest that dormant cancer cells are not sensitive to the growth signals sent by the adipose-derived stem cells and that fat stem cells safe for breast reconstruction when cancer is dormant.

Taken together, these findings all suggest that regenerative medicine holds great promise to breast cancer patients, in providing a deeper understanding of cancer initiation, growth, metastases, drug-resistance, disease relapse, and ultimately, even provides the possibility of one day regenerating diseased tissue.

⁶http://www.fhcr.org/about/pubs/center_news/online/2010/09/mammary_stem_cell.html

⁷<http://www.sciencedaily.com/releases/2010/09/100916133657.htm>

⁸Zimmerlin L, Donnenberg AD, Rubin JP, et al. Regenerative Therapy and Cancer: In Vitro and In Vivo Studies of the Interaction Between Adipose-Derived Stem Cells and Breast Cancer Cells from Clinical Isolates. *Tissue Eng Part A*. 2010 Sep 17. [Epub ahead of print].