A promising discovery for breast cancer therapy

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(Medical Xpress) -- Could engineered human stem cells hold the key to cancer survival? Scientists at the Institute of Bioengineering and Nanotechnology (IBN), the world's first bioengineering and nanotechnology research institute, have discovered that neural stem cells possess the innate ability to target tumor cells outside the central nervous system. This finding, which was demonstrated successfully on breast cancer cells, was recently published in leading peer reviewed journal, Stem Cells.

Despite decades of cancer research, cancer remains a leading cause of death worldwide, accounting for 7.6 million deaths in 2008, and breast cancer is one of the most common causes of cancer deaths each year . In Singapore, more than 1,400 women are diagnosed with breast cancer and more than 300 die as a result of breast cancer each year . The high fatality rate of cancer is partially attributed to the invasive ability of malignant tumors to spread throughout the human body, and the ineffectiveness of conventional therapies to eradicate the cancer cells.

A team of researchers led by IBN Group Leader, Dr Shu Wang, has made a landmark discovery that neural stem cells (NSCs) derived from human induced pluripotent stem (iPS) cells could be used to treat breast cancer. The effectiveness of using NSCs, which originate from the central nervous system, to treat brain tumors has been investigated in previous studies. This is the first study that demonstrates that iPS cell-derived NSCs could also target tumors outside the central nervous system, to treat both primary and secondary tumors.

To test the efficiency of NSCs in targeting and treating breast cancer, the researchers injected NSCs loaded with a suicide gene (herpes simplex virus thymidine) into mice bearing breast tumors. They did this using baculoviral vectors or gene carriers engineered from an insect virus (baculovirus), which does not replicate in human cells, making the carriers less harmful for clinical use. A prodrug (ganciclovir), which would activate the suicide gene to kill the cancerous cells upon contact, was subsequently injected into the mice. A dual-colored whole body imaging technology was then used to track the distribution and migration of the iPS-NSCs.

The imaging results revealed that the iPS-NSCs homed in on the breast tumors in the mice, and also accumulated in various organs infiltrated by the cancer cells such as the lung, stomach and bone. The survival of the tumor-bearing mice was prolonged from 34 days to 39 days. This data supports and explains how engineered iPS-NSCs are able to effectively seek out and inhibit tumor growth and proliferation.

Dr Shu Wang shared, "We have demonstrated that tumor-targeting neural stem cells may be derived from human iPS cells, and that these cells may be used in combination with a therapeutic gene to cripple tumor growth. This is a significant finding for stem cell-based cancer therapy, and we will continue to improve and optimize our neural stem cell system by preventing any unwanted activation of the therapeutic gene in non-tumor regions and minimizing possible side effects."

"IBN's expertise in generating human stem cells from iPS cells and our novel use of insect virus carriers for gene delivery have paved the way for the development of innovative stem cell-based therapies. With their two-pronged attack on tumors using genetically engineered neural stem cells, our researchers have discovered a promising alternative to conventional cancer treatment," added Professor Jackie. Y. Ying, IBN Executive Director.

Compared to collecting and expanding primary cells from individual patients, IBN's approach of using iPS cells to derive NSCs is less laborious and suitable for large-scale manufacture of uniform batches of cellular products for repeated patient treatments. Importantly, this approach will help eliminate variability in the quality of the cellular products, thus facilitating reliable comparative analysis of clinical outcomes.

Additionally, these iPS cell-derived NSCs are derived from adult cells, which bypass the sensitive ethical issue surrounding the use of human embryos, and since iPS cells are developed from a patient's own cells, the likelihood of immune rejection would be reduced.

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