Hydrogel improves delivery of anti-cancer drug
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The Institute of Bioengineering and Nanotechnology (IBN) and IBM Research (IBM) have developed a new non-toxic hydrogel that is capable of shrinking breast cancer tumors more rapidly than existing therapies. As described in their publication in *Advanced Functional Materials*, the Vitamin E-incorporated hydrogel can be easily injected under the skin without causing any inflammatory response, and releases anti-cancer drugs in a sustained manner over several weeks. This reduces the need for frequent drug administration, paving the way for the tumors to be eradicated in fewer treatments.

According to IBN Executive Director Professor Jackie Y. Ying, "Since 2003, IBN has adopted a multi-pronged approach toward cancer research. Our multidisciplinary research teams are working with various industrial, clinical and academic partners to develop new materials and tools to improve cancer diagnosis and treatment. This latest breakthrough with our long-term partner, IBM Research promises more efficient administration of anti-cancer drugs and more effective treatment of breast cancer, which we hope would benefit breast cancer patients worldwide."

IBN Group Leader, Dr Yi Yan Yang, elaborated, "We have developed new, effective materials for nanomedicine, which has been one of IBN's key research focus areas since 2003. The sustained delivery of Herceptin from our hydrogel provides greater anti-tumor efficacy and reduces injection frequency. Thus, our approach may help to improve patient compliance, offering a better alternative to existing breast cancer treatments. This technology can also be used to deliver other types of antibodies or proteins to treat different diseases."

Breast cancer is the most common invasive cancer affecting women worldwide, including in Singapore. One in four breast cancer patients will have a significantly lower survival rate as they possess a particularly vicious type of cancer gene known as the human epidermal growth factor receptor 2 (HER2+), which causes rapid, unrestrained growth and division of cells in their breasts.

Herceptin, a US Food and Drug Administration approved therapeutic for the treatment of HER2+, helps to combat this type of cancer by regulating the cancer growth. Currently, this drug is administered intravenously in most clinics on a weekly basis, with each treatment session lasting 30 to 90 minutes. The need for frequent infusion of Herceptin and the accompanying discomfort may affect patient compliance adversely. Hence, the IBN and IBM researchers aimed to reduce the number of injections and injection time required by creating a biocompatible, biodegradable and injectable hydrogel that can be conveniently injected into the body and release Herceptin in a sustained manner. Through this, they were able to...
reduce the frequency of drug administration from weekly to only once in four weeks.

Recent clinical trials using subcutaneous injection of Herceptin shortened the injection time to around 5 minutes and were reported to have comparable therapeutic efficacy as traditional methods at the same dosing schedule.

The new drug administration method via IBN's and IBM's hydrogel offers a further improvement on these studies as it supplies Herceptin continuously over a prolonged period of time. It also helped to shrink the tumors over fewer administrations. In animal studies with tumor-bearing mice, the tumors shrank in size by 77% 28 days after the Herceptin-loaded hydrogel was injected subcutaneously. The hydrogel did not evoke any chronic inflammatory response and degraded within 6 weeks post-administration.

"Drawing from our experience in materials innovation for electronics technology, we are now applying these techniques to the quest for improved health," said Dr James Hedrick, Advanced Organic Materials Scientist, IBM Research – Almaden. "This hydrogel can help deliver drugs over an extended period of time without causing a significant immune response, effectively sending its contents directly to the tumor without harming healthy surrounding cells."


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