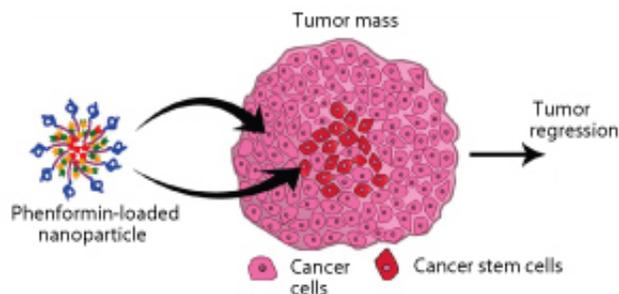


Nano packages for anti-cancer drug delivery

March 18 2015



Phenformin-loaded nanoparticles kill both cancer cells and cancer stem cells, leading to tumor regression. Credit: A*STAR Institute of Bioengineering and Nanotechnology

Cancer stem cells are resistant to chemotherapy and consequently tend to remain in the body even after a course of treatment has finished, where they can often trigger cancer recurrence or metastasis. A new study by researchers from the A*STAR Institute of Bioengineering and Nanotechnology has found that using nanoparticles to deliver an anti-cancer drug that simultaneously kills cancer cells and cancer stem cells significantly reduces the recurrence and metastasis of lung cancer.

The drug phenformin is very effective against cancer stem cells. It is related to the popular anti-diabetic drug metformin but is 50 times more potent against cancer cell lines. However, phenformin is too toxic in its free form to be administered to patients at the doses required to kill both normal [cancer cells](#) and cancer stem cells. Now, Yi Yan Yang and her

colleagues at the Institute of Bioengineering and Nanotechnology in Singapore have found a way to overcome this problem—using self-assembling polymer [nanoparticles](#) to deliver the drug.

In the first study to use [polymer nanoparticles](#) to deliver phenformin to target both cancer cells and cancer stem cells, Yang and co-workers found that phenformin-loaded nanoparticles targeted both kinds of cancer cells in a mouse model of human lung cancer.

The nanoparticles released the drug in a sustained manner due to their hydrophilic shells, which "prevent enzymatic degradation of the cargo and protein adsorption onto the nanoparticles," explains Yang. "This also prolongs blood circulation so that the cargo-loaded nanoparticles have enough time to accumulate in tumor tissues."

This delivery method enabled Yang and her team to arrest the growth of cancer and cancer stem cells when the nanoparticles were delivered to implanted human [lung cancer](#) in mice.

"The results showed that the phenformin-loaded nanoparticles were more effective than free phenformin in inhibiting the growth of both cancer stem cells and normal cancer cells," Yang says. Moreover, the nanoparticles did not induce the liver toxicity observed in systemically administered phenformin.

The method can also be extended to other drugs. The team has used the nanoparticle-based delivery system in a [mouse model](#) of human breast cancer to deliver the [anti-cancer drug](#), doxorubicin—another drug that is toxic at certain doses but is capable of killing [cancer stem cells](#). "The combination shrank tumors by more than 40 per cent and was more effective than treatment with either drug alone," says Yang.

The team is now seeking to collaborate with pharmaceutical companies

to bring this technology to human clinical trials.

More information: Krishnamurthy, S., Ng, V. W. L., Gao, S., Tan, M. H. & Yang, Y. Y. "Phenformin-loaded polymeric micelles for targeting both cancer cells and cancer stem cells in vitro and in vivo." *Biomaterials* 35, 9177–9186 (2014). [dx.doi.org/10.1016/j.biomaterials.2014.07.018](https://doi.org/10.1016/j.biomaterials.2014.07.018)

Provided by Agency for Science, Technology and Research (A*STAR), Singapore

Citation: Nano packages for anti-cancer drug delivery (2015, March 18) retrieved 20 September 2024 from <https://phys.org/news/2015-03-nano-packages-anti-cancer-drug-delivery.html>

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