

# Cancer cells take up nanoparticles more rapidly than normal brain cells

December 17 2015, by Lindsay Brooke

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New research carried out by drug delivery experts at The University of Nottingham has highlighted more advantages to using nanoparticles for the delivery of cancer drugs.

This will help in developing improved ways to treat cancer. The new finding, published in the academic journal *Experimental Biology and Medicine*, was discovered using 3-dimensional cell culture (cells grown in spheres or spheroids) instead of growing cells in the common way on flat plastic dishes (2-D cell culture).

Dr Martin Garnett from the School of Pharmacy, the lead author, said: "Spheroids allow experiments on some factors we cannot study in 2-D culture. It not only showed that nanoparticles will penetrate into tumour spheroids but that they are also taken up by [cancer cells](#) more quickly than by normal brain cells in spheroids. This new effect which

distinguishes between normal and [tumour tissue](#) will be particularly important in treating areas such as the edges of tumours where they meet normal tissue."

The work was carried out by Weina Meng who has carried out a number of other useful and important studies in Dr Garnett's team using 3-D [cell cultures](#).

Dr Garnett, said: "This latest discovery is particularly relevant to our work at the Children's Brain Tumour Research Centre, led by David Walker, Professor of Paediatric Oncology, where we are interested in the delivery of drugs locally to the brain. It is likely to be of most significance for development of treatments for administration of drugs after surgery to remove tumours and for injection directly into brain tumours."

For some years there has been great interest in the possibility of using various types of nanoparticles for delivery of drugs, particularly for cancer treatment. When nanoparticles are injected into the bloodstream they tend to accumulate better in cancers than in normal tissues due to an increased 'leakiness' of tumour blood vessels.

## **Research becoming more relevant**

3-D cell culture has been receiving a lot of attention recently as it is believed to be more relevant, showing results closer to that seen in real life tissues. This research showed that in 2-D cell culture the uptake of nanoparticles into [tumour cells](#) was lower than that seen in normal brain cells. The increased uptake by tumour cells was only seen in 3-D culture.

Dr Garnett said: "This is a very useful demonstration further highlighting the importance of nanoparticles in new cancer therapies. The work follows up on some old observations in the 1960's of increased uptake of

certain experimental medicines in tumours grown in experimental animals, but this is the first time that this effect has been demonstrated in cell culture. We now know that our cell culture work on nanoparticle therapies needs to use 3-D cultures to be relevant."

## **A career spent studying drug delivery**

Dr Garnett has spent his whole career researching [drug delivery](#)—making medicines more effective. Much of this work has been in cancer research.

He said: "The main problems in cancer therapy relate not just to finding appropriate drugs which kill cancer cells but how to deliver sufficient drug to the tumour without killing other cells in the patient. It is the effect of [cancer drugs](#) on the other cells in the body that cause the well-known side effects of cancer therapy as only a small fraction of the drug reaches the tumour—the rest causes side effects.

"Many cancer drugs do not penetrate very well into the tumour to kill the [cancer cells](#). In addition delivering drugs to the brain and to [brain tumours](#) is even more difficult than for many other tumours because of the blood brain barrier."

## **Ideas for better drug delivery**

One way to help overcome these problems is to incorporate drugs into [nanoparticles](#). Nanoparticles have been shown to increase the proportion of drug reaching the tumour rather than other parts of the body. However, the effect is relatively small and can be variable. To reduce this problem further Dr Garnett and his team are looking at how drugs can be applied directly to the tumour.

This work is dedicated to the memory of their former colleague Dr Terry Parker, a leading exponent of 3-D culture models and a key member of the team who sadly passed away in October 2013 due to a [brain](#) tumour.

**More information:** W. Meng et al. Penetration and intracellular uptake of poly(glycerol-adipate) nanoparticles into three-dimensional brain tumour cell culture models, *Experimental Biology and Medicine* (2015). [DOI: 10.1177/1535370215610441](https://doi.org/10.1177/1535370215610441)

Provided by University of Nottingham

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