Nanocylinders deliver medicine better than nanospheres

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Researchers at the University of Pennsylvania School of Medicine & School of Engineering and Applied Science have discovered a better way to deliver drugs to tumors. By using a cylindrical-shaped carrier they were able sustain delivery of the anticancer drug paclitaxel to an animal model of lung cancer ten times longer than that delivered on spherical-shaped carriers. These findings have implications for drug delivery as well as for better understanding cylinder-shaped viruses like Ebola and H5N1 influenza.

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"These are particles that go with the flow," says Dennis E. Discher, PhD, Professor of Chemical and Biomolecular Engineering at Penn's Institute for Medicine and Engineering. "The blood stream is constantly pumping, and these cylindrical nanoparticles align with the flow and persist in circulation considerably longer than any known spherical particles."

In this study, the research team used skinny cylindrical nanoparticles composed of synthetic polymers to deliver the anticancer drug paclitaxel to a human lung tumor tissue implanted in mice. The cylinders have diameters as small as 20 nm and lengths approaching the size of blood cells. The paclitaxel shrunk the tumors and, because the cylinders remained in circulation for up to one week after injection, they delivered a more effective dose, killing more cancer cells and shrinking the tumors to a much greater extent. Spherical nanoparticles typically only stay in

circulation for a few hours.

The research team used nanoparticles that contained one water-loving chain of a common polymer called polyethyleneglycol (PEG). PEGs are commonly found in everyday items like shampoo and some foods. Although synthetic, PEGs have already been approved as biocompatible to humans, making them ideal carriers, note the researchers.

While these findings could impact the way lung cancer is treated, this discovery of how to more effectively deliver drugs to the body could also improve the treatment of such other illnesses as cardiovascular disease as well as other types of cancers.

This discovery is also helping scientists understand why some viruses are so effective. "Cylindrical delivery systems exist in nature, with two prime examples being the Ebola virus and the H5N1 Influenza virus," says Discher. "These findings can help us understand how this shape evolved in nature and the advantages of using it for treating people."

Source: University of Pennsylvania