Microcannon firing nanobullets: the future of targeted medicine

Tom Whipple Science Editor

The idea of "targeting disease" just got less metaphorical. Scientists have developed microscopic cannons that can be injected into patients and triggered remotely, firing drugs deep into tissue.

The researchers, from the University of California San Diego, hope that the devices will revolutionise the treatment of many diseases, starting with skin cancer. Ironically, they could make therapies less invasive too.

The microcannons, which can be seen only with powerful microscopes, work in much the same way as the macro kind of cannon. Tiny tubes made from graphene oxide are filled first with a special emulsion, then with spherical particles that are referred to by the scientists, writing in the *Journal of the American Chemical Association*, as "nanobullets".

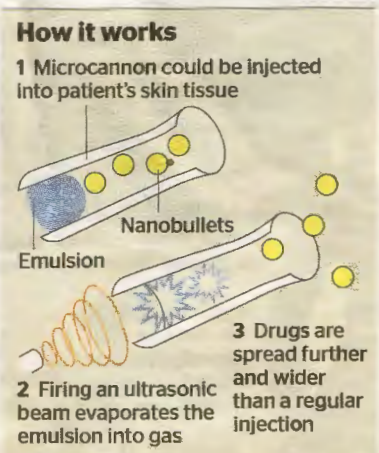
When an ultrasonic beam is fired at the microcannons, the emulsion evaporates, expanding rapidly into gas. This creates enough force to push the nanobullets out at velocities reaching several metres per second. The result is that a single injection can be used to spread drugs over far wider areas, penetrating a centimetre through flesh. A battery of several microcannons can be used to fire the drug cargoes at different times and different depths.

"We have been working on nanomachines over the past decade," Joseph Wang, chairman of nanoengineering at UCSD, said. "One of the challenges we considered is to deliver therapeutic cargo deep. Sometimes with diseases, you need to blast the disease." He and his colleagues drew inspiration from objects that are used to blast things in the non-nano world.

"It's basically like a cannon with a loaded bullet," he said of his resulting creation — cone-shaped tubes anchored to a membrane. "When we apply a pulse, the emulsion evaporates and it shoots the bullet very rapidly. It is so fast you cannot follow it — it's really so powerful. You can imagine there could be multiple cannon, with different cargoes of bullets, that could be shot sequentially.

"We can do it on demand, with multiple loads and with different intensities."

How it works



Having created the cannon, Professor Wang said that he was moving on to the next stage, testing it in animals.

From that he hopes to develop it as a treatment for skin cancer. Certain forms of skin cancer can be treated by injecting drugs into the affected area. Using microcannons would mean fewer injections and a better spread of drugs.

Other applications could involve the blasting of genetic material into cell nuclei as part of gene therapy.

One further innovation that the scientists are interested in is putting ferrous materials in the cannons to enable them to be aimed using magnets — something they say could let them be used almost as a "magic bullet" for disease.

"This study thus paves the way for creating next-generation efficient nanoscale delivery devices capable of delivering their payloads into an identified target, towards the realisation of the 'magic bullets' vision," they write.

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