Tiny technology, huge benefits – medical use of nanocrystals

An emerging new use of nanocrystals holds the promise of treating cancer tumours more precisely, and reducing the risk of some illnesses for people working in remote environments such as Antarctica and space, anaesthetists have heard at their conference being held in Dunedin this week.

Keynote speaker, Dr Mark Warner, the Annenberg Professor in Anesthesiology at the Mayo Clinic in the United States, explored the use of various new technologies in his opening address at the NZ Anaesthesia Annual Scientific Meeting. The conference is co-hosted by the Australian and New Zealand College of Anaesthetists and the NZ Society of Anaesthetists.

Professor Warner described the developing use of nanocrystal technology in the medical field – particularly in the treatment of cancer tumours but also as a means of reducing or eliminating the risk of common illnesses, such as appendicitis, that can be deadly for people far from access to medical treatment.

Though very much in its infancy, such technology, he said, was already being used very effectively in medicine.

“It provides huge opportunities to deliver medications exactly where and how we want them delivered.

“The best example is the delivery of chemotherapeutic agents for the treatment of cancer directly into the tumour, thus avoiding the need for surgery to remove the tumour and reducing the extent, length and cost of treatment, as well as reducing debilitating side effects.”

Conventional chemotherapy spreads its effects more widely, damaging healthy parts of the body, with the most obvious side effects being hair loss, nausea, lack of appetite and peripheral nerve pain.

Using nanocrystals, chemotherapeutic agents can be delivered precisely into tumours and then released, preventing damage to the rest of the body. The goal over time, Professor Warner said, is to reduce leaching of the drugs throughout the body, reducing side effects.

A nanocrystal is a tiny microscopic ball that can be filled with the required drug. The hard external surface can be coated in a number of ways. For instance, they can be
made to be attracted to magnets. A patient may swallow magnetised nanocrystals and a magnetic resonance scanner can be used to direct the nanocrystals to the tumour. An energy source such as ultrasound is then used to break open the nanocrystals to release the drug so it can treat the tumour.

“This won’t work for every cancer and in every situation but it has great potential and its promise is already being realised,” he said.

“Another experimental use of nanocrystals is for individuals going into very isolated environments such as space travel, winter in Antarctica and some unique military situations, where you don’t want them having illnesses that require urgent treatment.”

One example being tested now is using ordinary household bleach to eliminate the risk of appendicitis. The individual swallows bleach-filled nanocrystals that are then directed to accumulate in the appendix where the bleach is released. It sterilises the inside of the appendix, causing inflammation that leads to scarring. This closes off the appendix, preventing any bacteria from getting in to cause infection. As it no longer serves any function, the appendix shrivels up and is absorbed by the body.

While not yet being used routinely, Professor Warner said this technique is being trialled on some individuals going to winter over in Antarctica.

In addition, surgery is becoming less invasive. Preliminary studies on the use of endoscopes introduced through the mouth and stomach can allow incision-free surgery in the pelvic and abdominal area, reducing the invasiveness, pain, trauma and recovery time for the patient.

“Both of these new technologies hold great promise in medicine; they are being used effectively in early trials, but we have barely begun to scratch the surface of their potential,” Professor Warner said.

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