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Bee venom destroys cancer cells in tests on mice

Bee venom can be engineered to target tumours and could prove an effective future treatment for cancer, a study has found.

During a trial, the poisonous chemical in a bee's sting, melittin, was attached to tiny molecules or "nanoparticles" that then attack and destroy cancer cells, leaving healthy cells intact. The carrier particles, dubbed "nanobees", were also effective in targeting pre-cancerous cells. Nanobees could eventually replace conventional therapy for certain types of cancer, according to scientists behind the study, which is published today in the *Journal of Clinical Investigation*. They said that the treatment would have fewer side-effects than chemotherapy.

"The nanobees fly in, land on the surface of cells and deposit their poisonous cargo," said **Professor Samuel Wickline,** a specialist in nanomedicine at Washington University in St Louis, who led the research.

The treatment was tested on two groups of mice with cancerous tumours. One group had melanoma skin cancer, the other had been implanted with human breast-cancer cells. After four to five injections of the nanobees, the breast-cancer tumours were 25 per cent smaller, and the melanoma tumours were 88 per cent smaller, compared with untreated mice.

The carrier particles used in the study have already been approved for clinical use in various other medical applications. The team plans to begin human trials with the nanobees next year. They predict that the treatment could be effective in treating a wide range of cancers and that it would have fewer side-effects than chemotherapy. They say the treatment could also be more effective than chemotherapy, because it is more targeted. With chemotherapy, patients are given the largest tolerable dose of medication, but because nanobees specifically attack tumours, doses could be much lower.

Melittin works by attaching itself to the surface of cells and ripping holes in the membrane. "In high enough concentration it can destroy any cell it comes into contact with," said Professor Paul Schlesinger, a cell biologist at Washington University and a co-author of the paper. Most cancer treatments target DNA, but cancer cells are frequently able to adapt and develop resistance to DNA damage. It is much harder for cells to defend against damage to the membrane, however, making melittin an attractive treatment. Despite the high toxicity of the bee venom, the mice suffered few side-effects and there appeared to be little damage to non-cancerous cells.

Leaky blood vessels around tumours mean that nanoparticles build up there in high enough quantities to do damage. A chemical tag enhanced this effect by increasing nanobees' affinity for cancerous cells compared with normal cells.

"It's like molecular Velcro," Professor Wickline said. "The toxin doesn't come off the bee until it finds its target." If the melittin had been injected into the bloodstream in its normal form it would lead to widespread destruction of red blood cells. But following the nanobee injection, the blood count of mice was normal, and they showed no signs of organ damage.

A concern with some nanomedicines is that nanoparticles are left circulating in the body after treatment. They are biologically inert, meaning they are do not get metabolised and cleared from circulation in the normal way.

The spherical nanobees, which are about six millionths of an inch in diameter, are, however, quickly cleared from the system after treatment. They are made of perfluorocarbon, an inert non-toxic compound used in artificial blood. Once the melittin has been removed from the nanobee, it dissolves and is evaporated in the lungs.