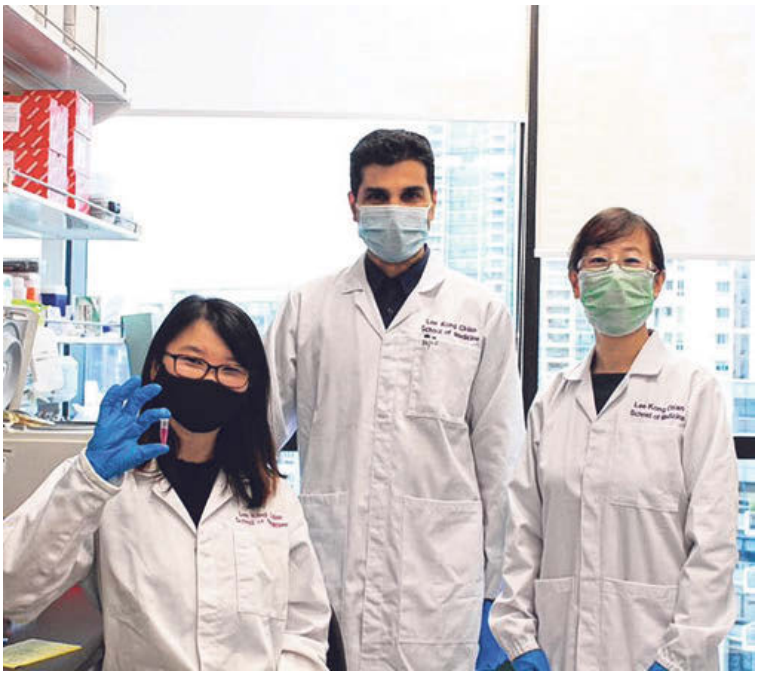
NTU team develops alternative to insulin jabs for diabetics

Nanoparticles that can carry a large amount of the protein could be administered orally



Among the team that came up with the insulin nanoparticles are (from left) former Nanyang Technological University research fellow Zhang Yiming – seen here with a vial of the nanoparticles – Associate Professor Yusuf Ali and Dr Huang Yingying. PHOTO: NANYANG TECHNOLOGICAL UNIVERSITY

Cheryl Tan

Nanyang Technological University (NTU) scientists have developed insulin nanoparticles that could allow diabetic patients to do away with injections.

Some diabetics do not produce enough insulin, which is necessary for regulating blood sugar levels.

Injections typically put insulin into the bloodstream within 30 minutes and work for up to six hours. But when the insulin-containing nanoparticles were fed to rats in a pre-clinical study, the insulin entered their bloodstream within minutes.

Scientists have long been searching for a way to administer insulin orally rather than through injections, which can be daunting for many people with diabetes.

Associate Professor Yusuf Ali from the NTU Lee Kong Chian School of Medicine, who is part of the research team, said taking insulin orally is better than jabs as it is more comfortable and could lead to improved patient compliance.

But administering insulin orally has been a challenge as it is a protein and is broken down in the gastrointestinal tract before it can reach the bloodstream.

NTU researchers sought to overcome this by designing a nanoparticle loaded with insulin at its core, followed by alternating layers of insulin and chitosan, a type of natural sugar that controls the release of insulin. The insulin dosage can be adjusted by controlling the number of layers in the nanoparticle.

Lab experiments using cell cultures and rat models showed that the nanoparticle remained stable as it passed through the stomach into the small intestine, with minimal insulin release in the process, eventually penetrating the intestinal walls.

The nanoparticle also closely mimics the route by which natural insulin enters the bloodstream from the pancreas through the liver, an important organ for controlling blood glucose levels.

After leaving nanoparticles in a fluid that simulates the stomach environment, the team found that 6 per cent of the insulin was released in one hour – the time taken for food to pass through the stomach into the small intestine. The other 94 per cent remained encapsulated.

When researchers tested the nanoparticle on the human cell line, Caco-2, which is a widely used model for studying the transport of molecules across the intestinal wall, they found that the amount of insulin transported was three times higher when administered through the nanoparticle, compared with oral capsules.

When fed to rats orally, the insulin concentration in their blood peaked at the 30-minute mark and was entirely eliminated in four hours.

Dr Huang Yingying from the School of Materials Science and Engineering at NTU, the study's co-lead author, said efforts to develop oral products have met with little success as these either come with a safety risk or require frequent dosages due to the insufficient amounts of insulin they contain.

On the other hand, the nanoparticle has been shown to be able to carry a large amount of insulin for the desired therapeutic effect while being small enough to enter the bloodstream.

"This indicates its potential application for oral insulin delivery in humans. We believe that the same concept could be useful for other protein drugs which normally have to be injected," said Dr Huang.

The NTU team is now in talks with a pharmaceutical company to improve how the nanoparticle functions.

tansuwen@sph.com.sg