Could insulin-loaded nasal gel mean the end of injections for diabetics?

November 9 2012

(Phys.org)—Scientists have developed a once-a-day nasal gel formulation for the delivery of insulin that could put an end to injections for Type 1 diabetes sufferers.

In results published today in the Royal Society of Chemistry journal *Biomaterials Science*, researchers show that the insulin-loaded gel reduces blood glucose levels over 24 hours in a diabetic-rat model when administered via the nose.

Tests using mucus-producing cells to model conditions in the nose showed that eight times as much insulin was taken up by the cells when incubated with the insulin-loaded gel formulation, compared with a simple solution of insulin in water.

Scientists performed further tests on the gel formulation using diabetic-rat models. Their results showed that the rats' blood glucose levels fell following nasal administration of the insulin-loaded gel and then took around 24 hours to return to their original values.

By comparison, they found that it took only nine hours for blood glucose levels to return to their original values in control models treated with insulin by the normal route of subcutaneous injection.

Treatment for patients with Type 1 diabetes usually involves numerous daily injections of insulin to keep their blood glucose levels under control. This can be distressing and inconvenient.

Administering insulin via a nasal spray is an attractive alternative to injections because it is a much easier and less painful way for diabetic patients to control their condition.

Nasal delivery of insulin is an attractive focus for researchers because enzymatic activity inside the nose is low, meaning that insulin solutions are less likely to be destroyed by the body's natural defence systems.

The main barrier to nasal delivery of insulin is a process called mucociliary clearance, which is designed to remove foreign bodies from the nasal cavity. During this process, nasal cilia beat in a coordinated fashion to transport foreign entities captured in mucus away from the nose.

A further barrier to nasal delivery is the existence of tight junctions between epithelial cells in the mucous membranes inside the nose, which can prevent the penetration of large molecules such as insulin.

A collaborative research team from universities in the UK, Italy, Lebanon and Greece has developed a formulation for the nasal delivery of insulin that overcomes these barriers by using a specific combination of chemicals.

The formulation exists as a liquid at low temperatures, meaning that it can be easily administered as a nasal spray. Once inside the nose, the liquid heats up to body temperature and a chemical component in the formulation causes it to turn into a viscous sticky gel that disturbs the rhythm of the beating nasal cilia. This allows the gel to remain inside the nose with enough time to administer the insulin.

A further chemical component in the gel, called N-trimethyl chitosan, helps to open the tight junctions between cells in the mucous membranes, allowing the insulin to penetrate.

Dr Hamde Nazar from the University of Sunderland in the UK, who led the research said: "Our data highlights the potential of the formulation as a once-a-day dosage form for the delivery of insulin through the nasal route. However, its relative merit for the treatment of the human diabetes condition can only be assessed in the clinic."

Provided by Royal Society of Chemistry