Intestine-specific delivery of insulin demonstrates promise with new oral formulation

October 27 2015

An intestinal patch device containing insulin that can be swallowed in the form of a capsule, in development by researchers at University of California Santa Barbara, has demonstrated efficacy of blood glucose management in diabetic rats. This work is being presented Oct. 27 at the 2015 American Association of Pharmaceutical Scientists (AAPS) Annual Meeting and Exposition, the world's largest pharmaceutical sciences meeting, in Orlando, Fla. Oct. 25-29.

Diabetes is a group of metabolic disorders that are caused by a deficiency in the ability to make insulin, a hormone that regulates glucose levels. According to the Center for Disease Control, diabetes affects roughly 29.1 million people in the U.S. alone, and is one of the major contributors to mortality, leading to over 230,000 deaths annually with its associated comorbidities. Insulin therapy is an important part of diabetes treatment - used to regulate the level of sugar in the bloodstream and storage of glucose. Existing marketed insulin formulations are injectables - currently, it is not possible for insulin to be taken by mouth, as digestive enzymes in the gastrointestinal tract break down the protein so that it is no longer active.

Samir Mitragotri, Ph.D., a professor in the College of Engineering at the University of California Santa Barbara, and Amrita Banerjee, a postdoctoral fellow, developed patches made of mucoadhesive polymers loaded with insulin and an intestinal permeation enhancer, then placed

the patch devices in enteric-coated capsules. Once in the intestine, the patch-containing pills are specially designed to dissolve, releasing the patches so that they can attach to the intestinal wall for site-specific delivery of the insulin. "We've created a technology with several innovative features. Our mucoadhesive devices fit inside of a small capsule and then deliver the drug in the intestine in a very effective manner," said Mitragotri. "There are many possible benefits and advantages of an oral delivery for insulin."

The mucoadhesive strength of the patches was determined by placing patches on porcine intestine. After 30 minutes, the patches were gradually pulled away from the intestine and the strength required to completely detach the patches from the intestine was quantified using a microbalance. To further assess the efficacy of the patches, diabetic rats were fasted overnight and orally fed the capsules. Blood glucose levels were thereafter determined at different time points for up to eight hours using a commercial blood glucose meter to calculate the percent drop in glucose levels.

The patches showed a complete drug release profile, releasing 100 percent of the insulin and permeation enhancer content within five hours of study and demonstrated an excellent mucoadhesive strength of 24.22 ± 2.85 mN, which corresponded to greater than 100 times the individual patch weight. In vivo efficacy studies revealed that insulin patches containing 10 percent permeation enhancer were the most effective formulation, where the blood glucose levels dropped significantly to 69 ± 2.41 percent of initial levels in comparison to the no treatment control group, which showed no decrease in blood glucose levels over time.

"Diabetes is a growing problem in the U.S., with new survey data showing that 50 percent of adults living in the U.S. have diabetes or pre-diabetes," said Banerjee. "The outcome of our studies suggest that this unique drug delivery approach could be used to deliver insulin orally in a

continuous, time-dependent manner."

The next stage of Banerjee's research is to continue in vivo rat studies to evaluate the intestinal patches for faster or extended release of insulin. Mitragotri's group will also assess the oral delivery of other peptide drugs for diabetes (exenatide) and even osteoporosis (calcitonin).

More information: T2299 - Oral Insulin Delivery Using Novel Mucoadhesive Intestinal Patches will be presented during the Tuesday Morning Poster Session from 8:30 a.m. - noon on Oct. 27 in OCCC - Exhibit Hall WB1-WB2.

Provided by American Association of Pharmaceutical Scientists