Promising vaccine strategy for type 1 diabetes extended to humans

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A molecule that prevents Type 1 diabetes in mice has provoked an immune response in human cells, according to researchers at National Jewish Health and the University of Colorado. The findings, published online in the *Proceedings of the National Academy of Sciences*, suggest that a mutated insulin fragment could be used to prevent Type 1 diabetes in humans.

"The incidence of Type 1 diabetes is increasing dramatically," said John Kappler, PhD, professor of Biomedical Research at National Jewish Health. "Our findings provide an important proof of concept in humans for a promising vaccination strategy."

Type 1 diabetes is an autoimmune disease in which the immune system destroys the body's ability to produce insulin, a hormone essential for

sugar metabolism. Researchers have tried administering insulin to people at risk for the disease as a form of immunotherapy similar to allergy shots. None of the trials has provoked an effective response.

The most recent findings suggest that an insulin fragment with a change to a single amino acid could provoke that elusive immune response. The idea for the substitution comes from more than a decade of work in Dr. Kappler's lab detailing the molecular minutiae of the immune system's response to insulin. This work suggests that insulin is presented to the immune system in an unconventional manner, and that mutating one amino acid in an insulin fragment might provoke better recognition by the immune system.

In 2011, a team from Harvard University and the Dana Farber Cancer Institute reported that the strategy suggested by Dr. Kappler and his colleagues did indeed prevent type 1 diabetes in mice. Mice and humans, however, differ in many ways, and strategies that work in mice often fail to produce any response in humans.

In their current paper, Dr. Kappler, Aaron Michels, MD, at the Barbara Davis Center for Childhood Diabetes, and their colleagues mixed the naturally occurring insulin fragment and the mutated insulin fragment with separate cultures of human cells. They found that human T cells responded minimally to the naturally occurring insulin fragment but quite strongly o the mutated one. The human T cells produced both pro-inflammatory and anti-inflammatory chemicals known as cytokines.

Researchers believe healthy immune responses balance pro- and anti-inflammatory factors. Autoimmune disease occurs when the pro-inflammatory response dominates.

While the current results do not prove that the mutated insulin fragment will work as a vaccine in humans, they do demonstrate a response in

humans consistent with the vaccination response in mice. Some of the signals seen in human cells are associated T regulatory cells, which can dampen the immune response and hold it in check.

"The new findings confirm that the painstaking work we have done to understand the unconventional interaction of insulin and the immune system has relevance in humans and could lead to a vaccine and a treatment for diabetes," said Dr. Kappler. "We are eager to push this promising line of inquiry forward."

More information: Regulatory vs. inflammatory cytokine T-cell responses to mutated insulin peptides in healthy and type 1 diabetic subjects, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1502967112

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