Immune system changes linked to inflammatory bowel disease revealed

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Scientists at the Virginia Bioinformatics Institute at Virginia Tech have discovered some of the key molecular events in the immune system that contribute to inflammatory bowel disease. The results, which help researchers move one step further in their efforts to develop new drugs to treat inflammatory and immune-mediated diseases, are reported in the November 2010 edition of the journal *Mucosal Immunology* from the Nature Publishing Group.

Inflammatory bowel disease starts when the gut initiates an abnormal immune response to some of the one hundred trillion or so bacteria that come into contact with the colon of the human body.

More than 1 million people are affected by inflammatory bowel disease in North America alone and direct healthcare expenses for inflammatory bowel disease in the United States are estimated at more than $15 billion annually.

Earlier mathematical and computational work by the scientists pinpointed a special type of immune cell as a possible target for intervention strategies to fight inflammation-related disease in the gut. The immune cells identified in the earlier work, which are known as M1 or classically activated macrophages, cause inflammation and possess a specific molecule, peroxisome proliferator-activated receptor-gamma, that, when activated, favors a switch to a type of macrophage that reduces the impact of inflammation (alternatively activated macrophage or M2) . The activation of the receptor protein and the anti-

inflammatory M2 macrophage switch plays a beneficial role in reducing the severity of the disease in the gut during experimentally induced inflammatory bowel disease.

"We have been able to validate experimentally some of the key events that take place in the regulation of the mucosal immune system when inflammatory bowel disease is triggered in mice," said Josep Bassaganya-Riera, associate professor of immunology at the Virginia Bioinformatics Institute, leader of the Nutritional Immunology and Molecular Medicine Group in the institute's CyberInfrastructure Division, and principal investigator. "When we produce mice that lack the peroxisome proliferator-activated receptor-gamma specifically found in macrophages, the severity of inflammatory bowel disease increases significantly. In parallel, we are able to observe the impact of the onset of disease on key inflammation-related genes and other molecules involved in inflammation and metabolism."

"In this study, we were able to use mouse Affymetrix GeneChips to examine which genes were turned on and off under disease and non-disease conditions," said Clive Evans, director of the Core Laboratory Facility at the institute. "This gave us a comprehensive snap-shot of what is happening in the immune system of mice when inflammation-related disease takes hold in the gut."

"In addition to our observations of what is happening when inflammatory bowel disease is triggered in mice, we showed that peroxisome proliferator-activated receptor-gamma in macrophages is essential for recovery from disease when the drug pioglitazone is used to treat it," said Raquel Hontecillas, assistant professor of immunology at the Virginia Bioinformatics Institute, and lead investigator of the study. "Our group has dissected the role of peroxisome proliferator-activated receptor-gamma as an internal thermostat for inflammation in other cells involved in gut inflammation such as intestinal epithelial cells and T

cells."

Some of the currently available therapies for the treatment of inflammatory bowel disease in humans are effective in treating the disease but are linked to sometimes-drastic side effects in patients. The researchers hope to use their knowledge of the immune system and specific targets for repurposed drugs and naturally occurring compounds to develop safer alternatives for the long-term management of the disease.

"Our combined computer modeling and experimental validation approach, which is part of the work of our Center for Modeling Immunity to Enteric Pathogens, is already generating important clinical leads that should help us in our quest to deliver better therapies for infectious enteric diseases," concluded Bassaganya-Riera.

Provided by Virginia Tech