# Genetically-Engineered Vaccine for Peptic Ulcers

Tonya Ruggieri
Department of Electrical, Computer, and Biomedical Engineering

It is estimated that over half of the world's population suffers from peptic ulcers or some form of gastritis (Pirc 2008). A peptic ulcer can occur in the stomach (gastric ulcer), duodenum of the small intestine (duodenal ulcer), or the esophagus (esophageal ulcer). They occur when a hole in the lining of the digestive system is eroded by acid produced by the stomach. The cost of treatment of ulcers and their related complications can reach billions of dollars, especially because effective treatments have been scarce. If left untreated, gastric ulcers are known to cause cancer of the organs affected since the bacterium that causes it is a Type 1 carcinogen, meaning it has been proven to directly cause cancer (Pirc 2008).

A bacterial infection is the cause for the overproduction of digestive acid in the stomach. Helicobacter pylori invades the stomach, and since it can endure its harsh environment, it flourishes. For many years, the only treatment available has been a mix of three antibiotics. The problem with this treatment is that it does not prevent probable reinfection, and increased resistance to antibiotics hampers its effectiveness. To add to the difficulty in exterminating this bacteria from the stomach, H. pylori has the ability to evade the body's natural immune response by manipulating its flagellum to appear invisible to cells' receptors (Bland 2009). Another treatment and preventative approach for gastric ulcers involves taking a supplement for L-glutamine which bodybuilders use to increase muscle mass. The problem with this supplement is that if the body already has a festering ulcer in the stomach or the duodenum, the probability that enough of this supplement will be absorbed to be effective is low (Bid 2009).

However, there is hope for the countless humans battling with debilitating gastric ulcers. A team of undergraduate students and their professors from the University of Ljubljana in Slovenia have created a genetically engineered vaccine to eradicate H. pylori from the stomach. The vaccine works by transplanting flagellum from other types of bacterium onto the H. pylori cells. In doing so, the other bacterium's flagella activates cell receptors and causes the H. pylori to become visible to the immune system. An immune response ensues, and the newly visible bacterium is wiped out from the body.

This project took about 5 months to complete, and was submitted to the iGEM, the International Genetically Engineered Machines Competition held at MIT in Cambridge, MA. The team also proposed another strategy to exterminate H. pylori from the body. It involved changing the receptors within cells to better register when H. pylori bacterium are introduced into the body (Bland 2009). This research earned these students the first place prize and possibly two patents.

Unfortunately, this vaccine has only been tested remotely with mice and in test tubes. The team predicts that it will be some time before the vaccine is deemed safe enough to test on humans. Even if it is safe to administer to humans, there is the risk that it will not be effective in treating and curing gastric ulcers in them (Bland 2009). However, there remains much enthusiasm in the reliability of this particular vaccine. Once the Slovenian team receives the patents for their work, it is only a manner of time before they are able to continue clinical trials with their vaccine.

Another positive aspect of this new vaccine is the fact that when it is developed to the point where it can be administered to humans, it is expected to be affordable to even those living in third-world countries. This is especially important because infection of H. pylori is extremely common in areas lacking clean water and practiced self hygiene. It is suspected to be transferred through oral/fecal or fecal/oral contact, which is prevalent in countries that cannot afford simple hygiene and medical attention. If this project receives adequate funding, it has the potential to eradicate H. pylori and stomach ulcers from the human race. This means that rates of stomach and intestinal cancers could also show a dramatic decline with time.

However, with all projects involving genetic engineering, there are a few roadblocks that this team have and will face. The most significant question that arises is whether or not genetically mutating H. pylori will have adverse effects on the environment, and potentially humans if it is introduced to the stomach (MacDonald 2004). This question can only be answered once funding arrives and clinical trials can begin.

**Works Cited**

"Amino acid glutamine show promise in treating stomach ulcers." The Medical News. 15 September 2009. <http://www.news-medical.net/news/2009/05/17>

"Ethical Issues in Transgenics." Action Bioscience. 16 September 2008. <http://www.actionbioscience.org/biotech/glenn.html>

"Hi-tech vaccine designed by students shows promise against ulcer-causing bacteria." Innovations Report. 16 September 2009. <http://www.innovations-report.com>

"Undergrad competition inspires ulcer-vaccine." msnbc.com. 15 September 2009. <http:www.msnbc.msn.com/id/27647947/>