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inStem in a global joint research develops inflamed tissue-targeting hydrogel to treat Crohn's disease

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Institute for Stem Cell Biology and Regenerative Medicine (inStem), Bengaluru, Brigham and Women's Hospital (BWH), Massachusetts Institute of Technology (MIT) and Massachusetts General Hospital (MGH), Boston, USA have developed drug-loaded hydrogel-microfibers system to enhance the therapeutic efficacy for the treatment of ulcerative colitis or Crohn's disease, a form of inflammatory bowel disease (IBD).

The researchers developed an inflammation-targeting hydrogel-microfiber loaded with anti-inflammatory corticosteroid dexamethasone, which was administered through enema.

The study spanned four years and much of it was carried out at Brigham and Woman's Hospital, Massachusetts General Hospital in Boston. However, inStem developed the hydrogel, Dr. Praveen Kumar Vemula, principal investigator, inStem and department of biotechnology, Ramalingaswami Re-Entry Fellow told Pharmabiz.

According to Dr. Vemula, one of the hallmarks of the therapy was that it targets and selectively adheres to ulcerative colon mucosa compared to healthy colon mucosa which enabled to release the drug to only the diseased tissue and eliminate systemic toxicity.

Millions globally suffer from IBD, but treatment options are limited. This targeted delivery of drugs has multi-fold advantages such as effective local treatment, lower doses of drug needed and eliminate systemic exposure to avoid side effects, stated the researchers in a study is published in Science Translational Medicine of August 12, 2015.

"Targeting diseased tissue has been a challenging task in biomedical research. Developing custom-designed biomaterials by harnessing the specific characteristics of disease tissue had the solution," said Dr. Vemula.

"We realized that if we could develop a disease-targeted hydrogel system that rapidly attaches to ulcers and slowly release the drug at the site of inflammation, then we could create a better way to deliver medicine only where the drug is needed," said Dr. Jeff Karp, BWH department of medicine and a principal investigator at Harvard Stem Cell Institute.

"Maximising treatment of first line topical therapies for IBD and simultaneously minimising the potential for side effects is an extremely appealing option for patients and doctors," said Dr. Giovanni Traverso, division of gastroenterology, MGH.

The team used an FDA approved ascorbyl plamitate (AP) which is a negatively charged material that would automatically be attracted to positively charged sites of tissue damage, allowing the gel to anchor to these sites. The gel was loaded with a corticosteroid drug routinely used to treat IBD.

The team of reseachers engineered the inflammation-targeting (IT) hydrogel to contain sites that could be cut by enzymes found only where inflamed tissue is present. With a snip from the enzyme, the molecules in the gel breaks apart and disassembles to slowly release the medicine.

The corticosteroid-loaded IT hydrogel underwent two preclinical models of IBD, which indicated inflammation reduction with less frequent dosing when compared to traditional corticosteroid-containing enemas. Further corticosteroid concentrations were 5-10 times lower in the bloodstream.

"We are now applying for grants for the next phase of the study to test this technology in larger animal models such as pigs or dogs. If we see great efficacy in larger animals, then we will move into human studies which typically might take 3 to 5 years. Right now we are looking at hospitals including CMC Vellore and AIIMS, New Delhi to identify clinicians treating IBD/Ulcerative Colitis," said Dr. Vemula.