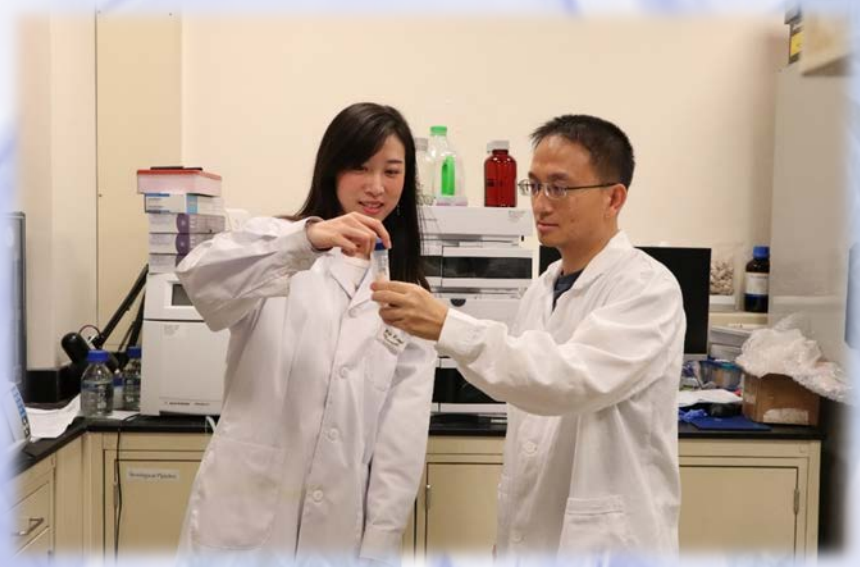
A Novel Bioadhesive Demonstrating pH-independent and Ultrafast Solidification for the Treatment of GI Diseases



A research team led by Prof. Liming Bian has developed a strongly bioadhesive hydrogel that can achieve the pH-independent and exceedingly fast in-situ gelation within 5 seconds. By collaborating with Prof. Philip Wai-Yan Chiu, an internationally renowned expert in gastrointestinal (GI) track endoscopic surgery, Prof. Bian's team demonstrated that such bioadhesive hydrogel can be used to effectively treat GI track diseases via the easy endoscopic delivery. The delivered hydrogel can remain adherent to the gastric ulcers under the harsh gastric environment for a protracted period to promote the healing of ulcers. This research work was recently published in a premiere scientific journal, Science Translational Medicine, a sister journal of Science.

Dr. Xiayi Xu (left) and Prof. Liming Bian (right), Department of Biomedical Engineering

Hydrogels are natural or synthetic polymeric networks containing large amount of water. As soft biomaterials, hydrogels are used in a wide array of biomedical applications such as tissue engineering and drug delivery. However, the prolonged gelation time and insufficient adhesion of most conventional hydrogels to the target site after gelation can lead to loss of hydrogel volume and the loaded therapeutic cargoes, particularly in the fluidically, chemically, and mechanically dynamic environment of GI tract. These limitations of conventional hydrogels compromise the treatment outcomes, thus limiting the broad application of hydrogels. The development of instant-gelation hydrogels with strong in situ adhesion under complex chemical and mechanical environments is therefore critically important.

Inspired by the strong wet adhesion of marine mussels to various inorganic and organic surfaces, Prof. Bian's team designed a new generation of bioadhesive hydrogels based on thiourea–catechol reactions to enhance the wet adhesion, mechanical properties and gelation speed of hydrogels. The impressive ultra-fast in-situ gelation and adhesion of the hydrogels was demonstrated by the instant formation and robust attachment of solid hydrogel alphabets of "CUHK" on culture dish and hydrogel patch on gastric tissue (Figure 1, Figure 2). Prof. Bian's team further collaborated with Prof. Chiu's team to evaluate the efficacy of "hydrogel therapy" via endoscopic delivery to treat gastric ulcers. The treatment with the bioadhesive hydrogels significantly accelerated ulcer healing (Figure 3). Prof. Bian said, "This endoscopically-assisted in-situ gelation hydrogel can be easily integrated with current clinical treatments to address refractory disease conditions, and our findings reveal a promising biomaterial-based approach for treating gastrointestinal diseases."

Figure 1

Figure 2

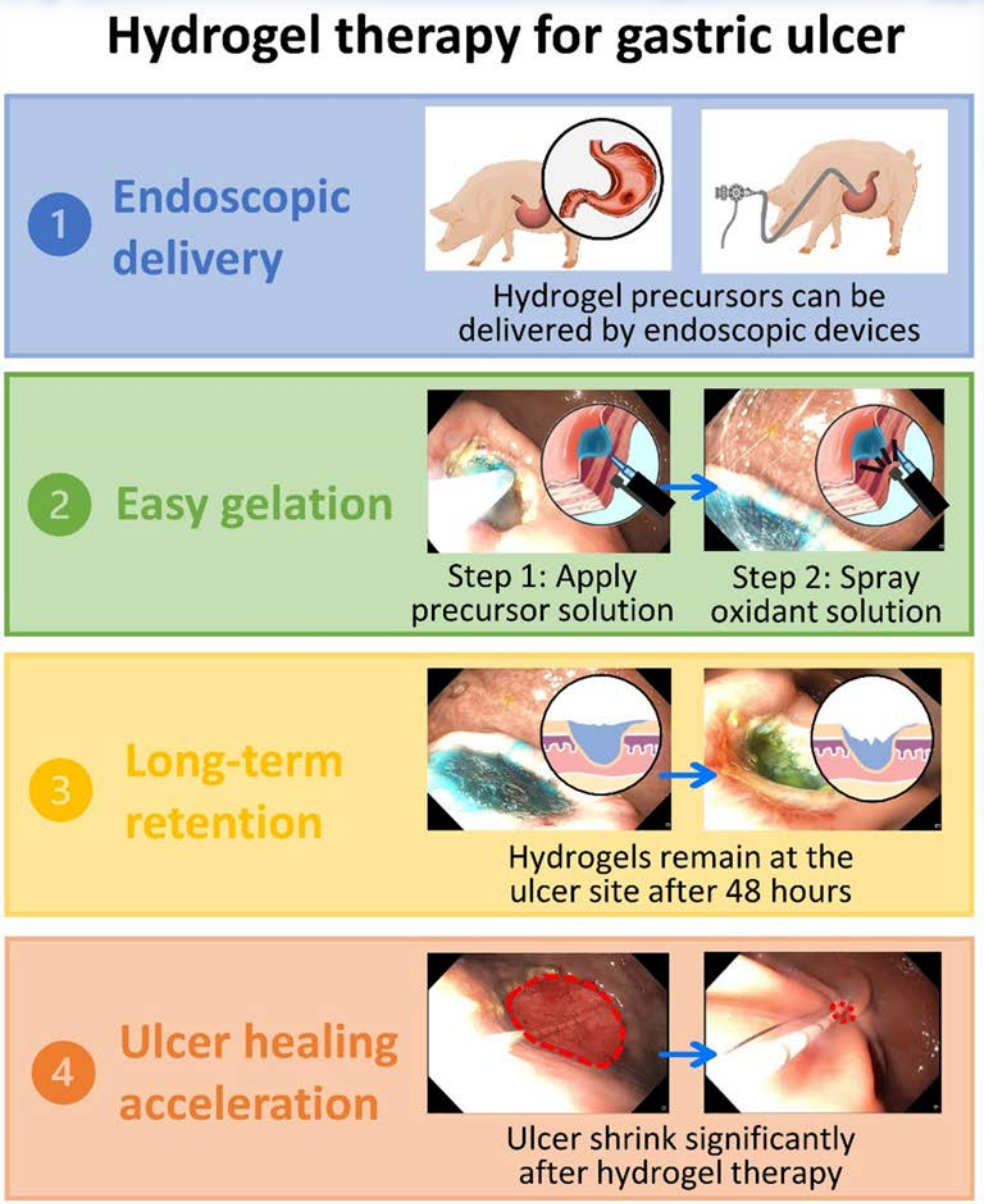


Figure 3

Publication Journal in *Science Translational Medicine:*
https://stm.sciencemag.org/content/scitransmed/12/558/eaba8014.full.pdf