Magnetically capturable, adhesive microcarriers for targeted locoregional drug delivery in a hydrodynamic environment of the esophagus

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In the esophagus, where swallowed fluids and muscular contractions constitute a highly dynamic environment, it has been a challenge to achieve targeted administration of therapeutic drugs to a lesion site. Here, we propose intelligent microparticles with magnetically capturable locomotion and dynamic fluid-resistant adhesive properties, using a bioengineered mussel adhesive protein (MAP). Iron oxide (IO) nanoparticles-embedded MAP microparticles (MAP@IO MPs) are readily localized to a specific region in tubular-structured passageway upon exposure to a external magnetic field and adhere for a prolonged period of time without a magnetic field, even in the esophagus tissue *in vivo* after oral administration. Moreover, doxorubicin (DOX)-loaded MAP@IO MPs exhibited a sustainable DOX release profile as well as effective anticancer therapeutic activity. Thus, MAP@IO MPs with the magnetically capturable behavior and robust underwater adhesive properties could provide an intelligent modular approach for targeted locoregional therapeutics delivery to a site of action in dynamic fluid-associated tubular organs such as the esophagus.