«Adhesive Bonds that Strengthen under Tensile Force»

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Mechanism and physiological implications of shear-enhanced E. coli adhesion

Bacterial adhesion to body surfaces often occurs in the presence of fluid flow, for example in the circulatory system, urinary tract, and intestines. It is generally thought that the mechanical forces resulting from these flows act as a natural body defense against bacterial adhesion by inhibiting initial attachment or by forcibly detaching bacteria. In contrast, we show here that FimH, a common adhesive protein on Escherichia coli and other bacteria, adheres to surfaces coated with its binding partner mannose using a so-called “catch-bond”, a type of bond whose adhesion lifetime increases when the fluid shear stress increases. As mannose is found on cells and surfaces throughout the human body, the FimH-mannose catch bond may therefore potentially allow bacteria to overcome the body’s fluid shear defense. Here we will present a structural model of how the adhesion of the FimH protein can be enhanced by mechanical force. In addition, we demonstrate several potential physiological and biomedical implications for bacterial colonization, biofilm formation, and the response of bacteria to anti-adhesive therapies.