In situ Cryo-Em Structures Reveal Mechanisms of Sheathed Flagellar Assembly, Rotation, and Disassembly in Vibrio cholerae

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The bacterium Vibrio cholerae has evolved unipolar sheathed flagellum as the main organelle to drive motility and facilitate biofilm formation and colonization in host cells although the underlying mechanisms remain unclear. In this study, I investigated the functional mechanisms underlying stator-driven rotation and flagellar dynamics using in situ single-particle cryo-electron microscopy (cryo-EM), a technique that preserves biological structures by rapidly freezing samples in vitreous ice and reconstructs near-atomic models through computational averaging of thousands of particle images. My work focused on the Na?-driven PomAB stator complex and its interaction with the flagellar protein MotX, analyzing how this interaction activates torque generation and enables high-speed rotation of the sheathed flagellum. I further examined how the stator complex exhibits structural flexibility to accommodate fluctuations in the bacterial envelope while maintaining functional stability. In addition, I contributed to the analysis of flagellar assembly and disassembly by examining how stator engagement correlates with functional motor states in intact cells using cryo-electron tomography data. Collectively, this work provides mechanistic insights into assembly, rotation, and disassembly of the sheathed flagellum as well as lay the foundation for developing novel strategies to inhibit V. cholerae motility and prevent infection.

Awards Won:

Third Award of $1,200