IMAGE SOURCE

BACTERIAL SECRETION

Highly sprung secretion

Type VI secretion systems (T6SSs) are found in approximately 25% of sequenced Gram-negative bacteria and used to deliver toxic effectors into both bacterial and eukaryotic targets. Several components of the T6SS are evolutionarily related to proteins that are found in contractile phage tails, which mediate the injection of phage DNA into target cells. Writing in *Nature*, Mekalanos, Jensen and colleagues now describe a dynamic intracellular tubular structure in *Vibrio cholerae* that functions in a manner analogous to the phage tail to drive T6SS effectors out of the cell.

It was shown previously that two T6SS components, VipA and VipB, can form filaments that bear some visual resemblance to the contracted tail sheath of phage T4. To investigate the role of these tubules during secretion, the authors complemented a *vipA*-null mutant with VipA that was fused at the carboxyl terminus to a robust variant of GFP known as super-folder GFP (sfGFP). Using fluorescence light microscopy, they found that cells expressing the VipA–sfGFP fusion contained up to five long, straight structures that extended through the cytosol across the width of the cell. Importantly, these structures were absent in cells that lacked *vipB*. Time-lapse analysis revealed that these structures grew (over a time frame of tens of seconds) before rapidly contracting (in 5 ms or less) to approximately half the length and were then disassembled (again, over tens of seconds) in a manner that depended on the presence of another T6SS component, the AAA+ ATPase ClpV.

Using cryo-electron tomography (CET) to visualize the structures, the authors observed two distinct conformations: a long, thin 'extended' tubule and a short, wide, hollow 'contracted' tubule. The tubules were perpendicular to the membrane, although they did not contact it directly but instead seemed to connect to a structure that the authors name the T6SS base plate. Mass spectrometry of purified tubules confirmed that they contained VipA, VipB and ClpV as well as three T6SS components of unknown function (VCA0109, VCA0111 and VCA0114). Importantly, CET of the purified tubules revealed them to exhibit a cog wheel-like structure in cross-section, with 12 'teeth' per rotation, similar to the structure seen in contracted sheaths of phage T4 tails.

These findings provide the first view of a contractile sheath powering type VI secretion in the bacterial cell and confirm the previously proposed evolutionary link between the components and mechanisms of action of T6SSs and phage contractile tails.

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ORIGINAL RESEARCH PAPER Basler, M. *et al.* Type VI secretion requires a dynamic contractile phage tail-like structure. *Nature* 26 Feb 2012 (doi:10.1038/nature10846)