A surface-induced asymmetric program promotes tissue colonization by Pseudomonas aeruginosa

ID 4487722
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Year 2019
Title A surface-induced asymmetric program promotes tissue colonization by Pseudomonas aeruginosa
Journal Cell host & microbe
Volume 25
Number 1
Pages / **Article-Number** 140-+
Keywords Surface sensing, Flagella, Type IV pili, C-di-GMP, Second messenger, Asymmetric division, Tissue colonization, Pseudomonas aeruginosa, Virulence
The opportunistic human pathogen Pseudomonas aeruginosa effectively colonizes host epithelia using pili as primary adhesins. Here we uncover a surface-specific asymmetric virulence program that greatly enhances P. aeruginosa host colonization. We show that when P. aeruginosa encounters surfaces, the concentration of the second messenger c-di-GMP increases within a few seconds. This leads to surface adherence and virulence induction by stimulating pili assembly through the activation of the c-di-GMP receptor FimW. Surface attached bacteria divide asymmetrically generating a piliated, surface committed progeny and a flagellated, motile offspring that leaves the surface to colonize distant sites. Cell differentiation is driven by a phosphodiesterase that asymmetrically positions to the flagellated pole thereby maintaining c-di-GMP levels low in the motile offspring. Infection experiments demonstrate that cellular asymmetry strongly boosts infection spread and tissue damage. Thus, P. aeruginosa promotes surface colonization and infection transmission through a cooperative virulence program that we termed Touch-Seed-and-Go.
Publisher Elsevier
ISSN/ISBN 1931-3128 ; 1934-6069
URL https://www.cell.com/cell-host-microbe
edoc-URL https://edoc.unibas.ch/69862/
Full Text on edoc No;
Digital Object Identifier DOI 10.1016/j.chom.2018.11.008
PubMed ID http://www.ncbi.nlm.nih.gov/pubmed/30581112
ISI-Number WOS:000455216900016
Document type (ISI) Article