Micro201
Bernhardt Lecture 5 - Cell division and its regulation
February 12, 2019

OVERVIEW

In this lecture I will present an overview of the bacterial cell division machinery with an emphasis on how the components were discovered and the approaches used to figure out their functions. We will also discuss two classic papers on the Min system and the spatial regulation of cell division in *E. coli*. A recent paper identifying a new spatial regulator of cell division in the pathogen *Streptococcus pneumoniae* will provide a nice (current) example of division regulation in non-model systems.

Some questions to ponder for discussion during the introductory lecture:

1) If you were a researcher back in the early days of the field, how would you go about identifying components of the division machinery? Where do you start? Assume you can use any technique modern or classical.

2) How would you learn the functions of the factors once you identified them? What approaches would you take? What might give you some clues?

3) What about spatial regulators of cell division - how would you identify them?

PAPERS FOR DISCUSSION

1) de Boer, et al. **A division inhibitor and a topological specificity factor coded for by the minicell locus determine proper placement of the division septum in *E. coli*.** (1989) Cell 56:641-9.

This paper describes the identification and characterization of the *min* genes responsible for promoting cell division at midcell in *E. coli*. Be prepared to discuss the results. How many of the *min* genes are needed to properly direct midcell division? What are the functions of the individual components? How was this determined? How is topological specificity conferred to the division inhibitor? What potential models are proposed to explain this (see Discussion)? Be prepared to draw models on the board. How would you experimentally determine which model is correct? What are maxicells? Why were they used? Why don't we use them anymore?

2) Raskin and de Boer**. Rapid pole-to-pole oscillation of a protein required for directing division to the middle of *Escherichia coli*.** (1999) PNAS 96:4971-6**.**

A clear example of the power of GFP fusions and time-lapse microscopy when it comes to figuring things out. In this case, Raskin and de Boer study the subcellular localization of the MinD protein. What they found is remarkable even by today's standards.

Things to ponder: What makes them confident that the GFP fusion is reporting on the normal localization of untagged MinD? What other components of the Min system are required for the oscillation? What determines the speed of oscillation? Why does this appear to be important?

Is new protein synthesis required for oscillation? How do they know? What was the motivation for the experiments in Figure 2? What question were they asking?

3) Aurore Fleurie, Christian Lesterlin, Sylvie Manuse, Chao Zhao, Caroline Cluzel, Jean-Pierre Lavergne, Mirita Franz-Wachtel, Boris Macek, Christophe Combet, Erkin Kuru, Michael S VanNieuwenhze, Yves V Brun, David Sherratt, and Christophe Grangeasse. **MapZ marks the division sites and positions FtsZ rings in *Streptococcus pneumoniae*** (2014) 516:259-262

General Reviews:

1) Du and Lutkenhaus. **Assembly and activation of the Escherichia coli divisome.** *Mol Microbiol* (2017) 105:177-187

2) den Blaauwen, Hamoen, and Levin. **The divisome at 25: the road ahead.** *Curr Opin Microbiol.* (2017) 36:85-94