UNIVERSITY OF DELAWARE

CENTER FOR BIOINFORMATICS & COMPUTATIONAL BIOLOGY

BIOINFORMATICS SEMINAR

ALEX HUGHES

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UNIVERSITY OF PENNSYLVANIA

HOW THE KIDNEY NEGOTIATES A TUBULE PACKING CONFLICT DURING DEVELOPMENT

Developing organs must progressively increase their complexity in space, while adhering to physical rules and changing boundary conditions. One fundamental question is how tissue structures resolve conflicts between increases in complexity and physical constraints, while avoiding the formation of irreversible defects. We describe one such conflict in the developing ureteric epithelial tree of the kidney, which later becomes the collecting duct tree that transports urine from nephrons towards the bladder. A unique feature of the kidney is that all of the epithelial tips remain at the kidney surface as it develops. However, this eventually creates a conflict between an increase in tip number and the decreasing surface area available to each one. We use computational modeling to predict how this conflict arises, and its potential to either create defects or to resolve. We then connect the resolution outcome to a remodeling phase associated with the development of the renal “pelvis” by presenting evidence from literature, computational modeling, physical modeling, and perturbations of embryonic kidney explants. Our work has fundamental implications for understanding the wide variability in nephron number between humans, which in turn correlates with the probability of adult kidney disease.

BIOGRAPHY

Alex Hughes is an Assistant Professor of Bioengineering at the University of Pennsylvania. Originally from California and New Zealand, he graduated with a B.E./B.Sc. in Chemical & Materials Engineering/Pharmacology at the University of Auckland, NZ in 2008. He completed his graduate studies at UC Berkeley in 2013 working with Amy Herr on microfluidic and single-cell electrophoretic separations in diagnostics and cell signaling/differentiation. Dr. Hughes then completed a Jane Coffin Childs postdoctoral fellowship with Zev Gartner at UC San Francisco, where he developed DNA-based cell patterning technologies to study the mechanical and cell collective basis of curvature at tissue interfaces during embryonic development.

Dr. Hughes's research focuses on engineered models of mammalian morphogenesis, most recently the cellular, signaling, and mechanical basis of kidney development using human kidney organoids, advanced cell patterning and imaging technologies, and dynamic tissue scaffolds. Dr. Hughes's honors and awards include a 2021 NSF CAREER Award; Jane Coffin Childs, American Cancer Society and NIH F32 postdoctoral fellowships; Society of General Physiologists Scholarship at the Woods Hole Marine Biological Laboratory and a National Defense Science & Engineering Graduate (NDSEG) Fellowship.

CBCB SEMINAR
9/27/2021

3:30-4:30PM
AP BioPharma Room 140
(590 Avenue 1743)

or via ZOOM:
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