Course in Cellular Physiology of the Kidney - MSCBMP 2895

Course Directors:

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Focus of the class:

This course will provide an introduction to the kidney and lower urinary tract, with an emphasis on kidney structure and function. The course, which meets once a week (two hours each session), will be taught through both lecture and in class discussion of the primary literature. Discussion of how bench top findings can be translated to treatments in the clinic will be facilitated by a diverse faculty that includes both basic and physician scientists. You will first learn about the specialized cell types that comprise the kidney and lower urinary tract. Subsequently, you will be introduced to renal stem cells and how they lead to kidney development and repair. Next, you will learn the functions of the kidney, including regulation of water and ion balance. This will be followed by a discussion of the lower urinary tract. Finally, you will learn about acute kidney injury, chronic kidney disease, and end stage kidney disease, and how nephrologists manage these disorders.

Meeting times and place:

Class will meet on Wednesdays from 2:00 and 4:00 in the Cell Biology Conference room, which is located in the office suite in South BST, room 362.

Structure of the course:

The course, which meets once a week, will be taught through both lecture and in class discussion of primary research papers. The lectures will cover basic information needed to understand the topic at hand and then use examples to

understand how the kidney accomplishes its amazing function. Each module may also include one or more discussion sessions in which we will review important papers in the field. We always start these sessions by answering questions about unfamiliar techniques or ideas. No question is stupid, and any question you may have is likely one that other students have as well. We then examine each paper. *Particular emphasis is placed on the hypothesis or questions being answered, the different approaches utilized by the authors, the conclusions of the papers, and the experiments that support these conclusions*. When possible we will also discuss how the experimental findings could be translated for use in a clinical setting.

Attendance:

Attendance at all sessions is required. Any absences must be pre-approved by your course director. In the case of illness or other life events, you must contact the course director.

Course Sessions:

Session I – June 1st, 2016 - (Subramanya) An introduction to the kidney

Paper: Control of glomerular hypertension limits glomerular injury in rats with reduced renal mass. Anderson S. Meyer TW, Renneke HG, Brenner BM J Clin Invest. 1985;76(2):612-619

Review: Homeostasis the Milieu Intérieur and the Wisdom of the Nephron Hoenig M and Zeidel M. Clin J Am Soc Nephrol. 2014 Jul;9(7):1272-81.

Session II – June 8th, 2016 - (Stolz) Renal tissues – histology and function

Paper: none

Session III – June 15th, 2016 - (Hukriede) Kidney development and regeneration

Paper: Humphreys BD, Valerius MT, Kobayashi A, Mugford JW, Soeung S, Duffield JS, McMahon AP, Bonventre JV. Intrinsic Epithelial Cells Repair the Kidney after Injury. Cell Stem Cell. 2008 Mar 6;2(3):284-91.

Session IV – June 22nd, 2016 – (Carattino) How the kidney maintains water homeostasis

Paper: Preston GM, Carroll TP, Guggino WB, Agre P. Appearance of water channels in Xenopus oocytes expressing red cell CHIP28 protein. Science. 1992 April 17;256(5055):385-7.

Review: http://www.sciencedirect.com/science/article/pii/S0304416513005291

Session V – June 29th , 2016 – (Kleyman and Brodsky) How the kidney regulates Na^+ and K^+ homeostasis

Paper: Buck, T. M., L. Plavachak, A. Roy, B.F. Donnelly, O. B. Kashlan, T. R. Kleyman, A. R. Subramanya, J. L. Brodsky. The Lhs1/GRP170 chaperones facilitate the endoplasmic reticulum associated degradation of the epithelial sodium channel. *J. Biol. Chem.* (2013) **288**: 18366-18380

Session VI – July 6th, 2016 - (Johnston) Glomerular filtration

Paper: Robert Faulhaber-Walter, *Limeng Chen,*Mona Oppermann,*Soo Mi Kim,*Yuning Huang,*Noriyuki Hiramatsu,*Diane Mizel,*Hiroshi Kajiyama,*Patricia Zerfas,†Josephine P. Briggs, ‡ Jeffrey B. Kopp, * and Jurgen Schnermann* Lack of A1 Adenosine Receptors Augments Diabetic Hyperfiltration and Glomerular Injury. 1046-6673/1904-722 J Am Soc Nephrol 19: 722-730, 2008

Session VII – July 13th, 2016 - (Kashlan) How the kidney maintains acid-base and divalent ion homeostasis

Paper: Renkema KY, Velic A, Dijkman HB, Verkaart S, van der Kemp AW, Nowik M, Timmermans K, Doucet A, Wagner CA, Bindels RJ, Hoenderop JG. The calcium-sensing receptor promotes urinary acidification to prevent nephrolithiasis. J Am Soc Nephrol. 2009 Aug;20(8):1705-13.

Review: Brown D1, Wagner CA. Molecular mechanisms of acid-base sensing by the kidney. J Am Soc Nephrol. 2012 May;23(5):774-80

Session IX – July 20th, 2016 – (Apodaca) – Lower urinary tract histology and function

Paper: Mysorekar IU and Hultgren SJ (2006) Mechanisms of uropathogenic Escherichia coli persistence and eradication from the urinary tract. PNAS 103:14170-14175.

Reviews:

Silverman JA, Schreiber HL, Hooton TM, and Hultgren SJ (2013) From physiology to pharmacy: developments in the pathogenesis and treatment of recurrent urinary tract infections. Curr. Urol. Rep. 14:448-456.

Hannan TJ, Totsika M, Mansfield KJ, Moore KH, Schembri MA, Hultgren SJ (2012) Host-pathogen checkpoints and population bottlenecks in persistent and intracellular uropathogenic Escherichia coli bladder infection. FEMS (Federation of European Microbiological Societies) Microbiology Reviews 36: 616-648.

Session X – July 27th, 2016 - (Tan and Biswas) – Acute, chronic, and end stage kidney disease

Paper: TBD

Reviews: TBD