Conserved and Divergent Features of Human and Mouse Kidney Organogenesis.

Journal: J Am Soc Nephrol

Publication Year: 2018

Authors: Nils O Lindstrom, Jill A McMahon, Jinjin Guo, Tracy Tran, Qiuyu Guo, Elisabeth Rutledge, Riana K Parvez, Gohar Saribekyan, Robert E Schuler, Christopher Liao, Albert D Kim, Ahmed Abdelhalim, Seth W Ruffins, Matthew E Thornton, Laurence Basking, Brendan Grubbs, Carl Kesselman, Andrew P McMahon

PubMed link: 29449453

Funding Grants: Repair and regeneration of the nephron

Public Summary:
Human kidney function is underpinned by approximately 1,000,000 nephrons, although the number varies substantially, and low nephron number is linked to disease. Human kidney development initiates around 4 weeks of gestation and ends around 34-37 weeks of gestation. In this first paper in a series providing comprehensive insight into human kidney formation, we examined human kidney development at a macroscopic and cellular level. A high-resolution histologic interactive atlas of human kidney organogenesis generated can be viewed at the GUDMAP database (www.gudmap.org) together with three-dimensional reconstructions of key components of the data herein. At the anatomic level, human and mouse kidney development differ in timing, scale, and global features such as lobe formation and progenitor niche organization. The data also highlight differences in molecular and cellular features, including the expression and cellular distribution of anchor gene markers used to identify key cell types in mouse kidney studies. These data will facilitate and inform efforts to generate human kidney structures from stem cells and help in relating findings in the mouse to man.

Scientific Abstract:
Human kidney function is underpinned by approximately 1,000,000 nephrons, although the number varies substantially, and low nephron number is linked to disease. Human kidney development initiates around 4 weeks of gestation and ends around 34-37 weeks of gestation. Over this period, a reiterative inductive process establishes the nephron complement. Studies have provided insightful anatomic descriptions of human kidney development, but the limited histologic views are not readily accessible to a broad audience. In this first paper in a series providing comprehensive insight into human kidney formation, we examined human kidney development in 135 anonymously donated human kidney specimens. We documented kidney development at a macroscopic and cellular level through histologic analysis, RNA in situ hybridization, immunofluorescence studies, and transcriptional profiling, contrasting human development (4-23 weeks) with mouse development at selected stages (embryonic day 15.5 and postnatal day 2). The high-resolution histologic interactive atlas of human kidney organogenesis generated can be viewed at the GUDMAP database (www.gudmap.org) together with three-dimensional reconstructions of key components of the data herein. At the anatomic level, human and mouse kidney development differ in timing, scale, and global features such as lobe formation and progenitor niche organization. The data also highlight differences in molecular and cellular features, including the expression and cellular distribution of anchor gene markers used to identify key cell types in mouse kidney studies. These data will facilitate and inform in vitro efforts to generate human kidney structures and comparative functional analyses across mammalian species.