

Use of X-ray contrast agents for kidney phenotyping

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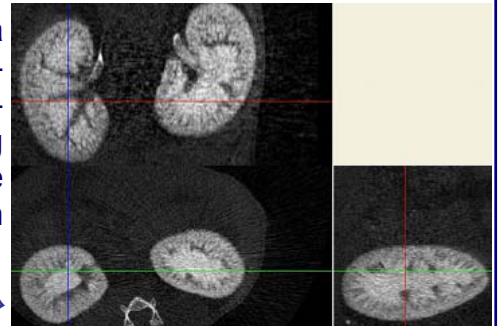
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Animage is a multimodal small animal imaging facility which aims to provide tools for biologists to investigate in-vivo morphological or functional genetic disorders, evolution of physio-pathological mechanisms and therapeutic strategies. The 1076 in-vivo Skyscan μ -CT is used on the platform to perform pre-clinical studies on bone diseases but also to help biologists in mouse kidney phenotyping area. In order to track kidney morphological or functional pathologies, we have developed several standard operating procedures using contrast agent enhancement for imaging kidney soft tissues by μ -CT. Here, we present those developments which deal with renal anatomical imaging by 3D in-vivo tomography of the cortex and medulla and 3D ex-vivo tomography of the kidney vasculature both dedicated to second line phenotyping and finally with renal functional imaging with 2D excretory urography dedicated to first line phenotyping.

1. In-vivo study of mice kidney sub-parts (medulla and cortex).

The alteration of some renal anatomical sub-parts can be a cause of renal dysfunction. We have developed an in-vivo acquisition procedure based on a specific contrast agent enhancement of mouse kidney soft tissues which allows tracking these alterations in the cortex, the outer and inner stripe of the outer medulla, and in the inner medulla. The details provided in the images are sufficient to quantify these alterations.

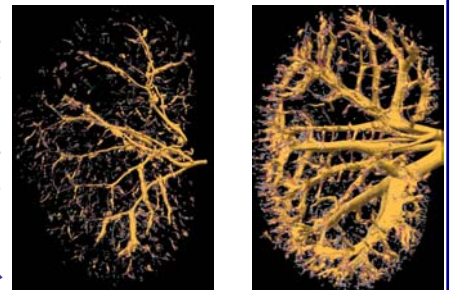
In-vivo X-ray tomography of mouse kidneys with CA →



2. Ex-vivo characterization of rat kidney vasculature.

Some diseases (renal insufficiency, hypertension, polycystic disorder,...) can affect the kidney vasculature and then deteriorate the kidney function. The use of μ -fil contrast agent injection in the kidney (Ortiz et al [1]) allows to accurately characterize, through a μ -CT acquisition and an appropriate image processing steps, these disorders.

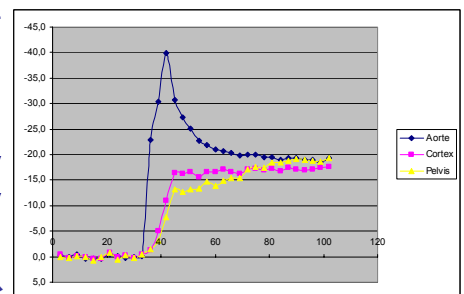
X (left) and control (right) kidney vessel architecture →



3. Examination of Renal Function by 2D Excretory Urography.

Excretory urography [2] allows evaluating renal function by determining the renal uptake and clearance of a contrast medium. The mean and standard deviation gray level values of several region of interest are used to determinate the contrast medium concentration in the kidney to evaluate the renal filtration. Gray level values of the aorta, cortex and renal pelvis of the kidney are measured.

Uptake of the CA in the aorta, cortex and pelvis (in sec) →



References

[1] Michael D. Bentley, Maria C. Ortiz, Erik L. RitmanI, and J. Carlos Romero, The use of microcomputed tomography to study microvasculature in small rodents Am J Physiol Regulatory Integrative Comp Physiol 282: R1267–R1279, 2002;10.1152/ajpregu.00560.2001.

[2] M. Clara Ortiz, Agustin Garcia Heuter KJ, Excretory urography. Clin Tech Small Anim Pract. 2005 Feb;20(1):39-45 tail vein.