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Contrast renal microangiography with synchrotron radiation

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1 Introduction

Conventional X-ray is not capable of visualizing microvessels with diameter less than 100 µm [1]. Because of this limitation, radiological observation of renal microcirculation has not been realized. Synchrotron radiation is characterized by high photon flux and high natural collimation, and is capable of identifying microvessels with diameter of less than 50 µm [2].
To establish a method which visualizes renal microcirculation with synchrotron radiation on *in vivo* rats.

2 Experiment

1) *Anesthesia and Surgical preparation;*

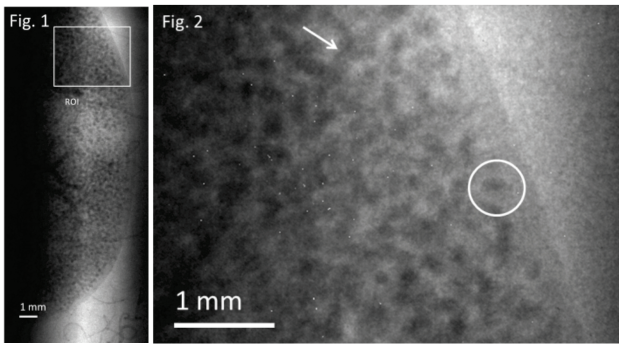
Male Wistar rats were anesthetized with 50 mg/kg of pentobarbital sodium. A catheter was inserted into the descending aorta with its tip placed above renal arteries with laparotomy. Superior mesenteric artery was ligated to avoid steal of contrast agent. Following tracheostomy, artificial ventilation was performed with 5 mL tidal volume, 100 breaths/min. The rats were paralyzed with neuromuscular blocker (vecuronium bromide, 0.1 mg/kg), and vertically positioned in front of the beam pathway.

2) *Synchrotron radiation and microangiographic system;*

The study was performed at KEK PF BL-14C beam line facility, Tsukuba, Japan. An asymmetrically cut silicon crystal is used to select the monochromatic beam by expanding the SR vertically. The imaging energy is 33.21 KeV, which is 40 eV above the iodine K-edge. Inorganic iodine contrast media with an iodine concentration of 35% by weight was injected. X-rays transmitted through a subject were recorded by CCD camera. Two dimensional images with a pixel size of 9 µm were obtained. Exposure time was fixed to 50 ms, with maximum acquisition rate of 3 images / sec.

3 Results and Discussion

In the images obtained in present study, contrast flow in afferent arterioles, glomeruli, and proximal tubules were all traceable, and it is considered to reflect normal renal circulation. In delayed phase, glomeruli (Fig.2, circle) and proximal renal tubules (Fig.2, arrow) were also identified. The average glomerular diameter was 173±22 µm, and the average glomerular density was around 10 /mm^2.
Measurement of glomerular size and density is expected to be predictive factor for prognosis of hypertension and CKD[3], [4].



Figures) Glomeruli were diffusely observed within entire renal cortex (Fig.1).

4 Conclusion

In this study, rat renal arterioles with a diameter of 18 µm, and glomeruli with a diameter of around 170 µm were clearly visualized without exteriorizing kidneys. This method is expected be useful in investigation of renal physiology, as well as pathology.

References
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