Coronary Microangiography System for Rat Heart Functional Imaging at SPring-8

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A rat microangiography system in Fig. 1 was developed for *in vivo* visualization of the coronary, cerebral, and pulmonary arteries without exposure of organs and with spatial resolution in the micrometer range and temporal resolution in the millisecond range [1]. We refined the system continuously in terms of spatial resolution and exposure time using synchrotron radiation in the SPring-8 BL28B2 beamline [2]. The spatial resolution has improved to 6 μm, yielding sharp images of small arteries. Exposure time has been shortened to around 2 ms using a new rotating-disk X-ray shutter, enabling imaging of beating hearts.

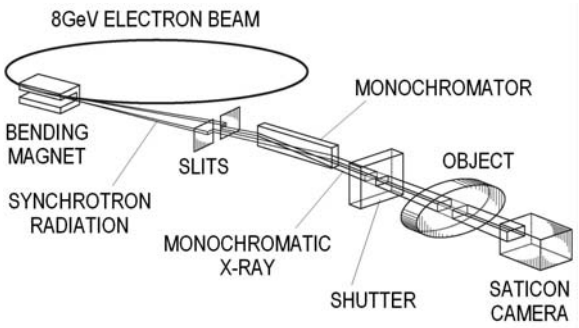

Fig. 1 Experimental arrangement for synchrotron radiation microangiography system

Quantitative evaluations of the rat coronary microangiography system were extracted from measurements of the smallest-detectable vessel size and detection of vessel function. The smallest-diameter vessel viewed for measurements is determined primarily by the concentration of iodinated contrast material. The iodine concentration depends on the injection technique. It is extremely difficult to inject contrast agent directly into small rat coronary arteries. Instead, the contrast agent was injected into the aorta close to the origin of the coronary arteries in the rat coronary angiography.

The vascular internal diameter response of coronary arterial circulation was analyzed to evaluate the vessel function. Small blood vessels of around 50-μm diameter or above were visualized clearly at heart rates of 300–360 per minute. Vasodilation compared to the control was observed quantitatively using drug manipulation. The technique can enable direct investigation of the mechanisms of vascular dysfunction. It is expected to be useful to evaluate the severity of damage to arterial inner walls resulting from diseases.

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[1] M. Shirai, D. O. Schwenke, H. Tsuchimochi, K. Umetani, N. Yagi, J. T. Pearson, Circ Res. **112**, 209–221 (2013).
[2] K. Umetani, K. Fukushima, Rev Sci Instrum. **84**, 034302-1–10 (2013).