

Evaluation of pulmonary microcirculation in rat pulmonary emphysema model using synchrotron radiation angiography

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1 Introduction

Contrast medium in pulmonary angiography is diluted significantly when it is infused from peripheral vein. If pulmonary microcirculation is a target for visualization, use of highly sensitive receiver and synchrotron radiation angiography (SRA) will be needed. In case of pulmonary emphysema (PE), pulmonary microcirculation is impaired due to compression of enlarged alveolar space and reduction of arterial number. The aim of this study is to investigate whether SRA with highly sensitive receiver can evaluate the degree of severity in pulmonary emphysema through the change of microcirculation.

2 Experiment

SRA was performed at the Photon Factory-Accelerator Ring (PF-AR). SR was obtained from a 6.5 GeV electron beam. The polychromatic SR beam was monochromated to X-rays by reflecting at 13 degree on a silicon crystal. The energy of the monochromatic X-rays was 33.3 keV. The X-rays were converted to visible light on a fluorescent screen made of cesium iodide. Angiographic images were obtained in high-resolution cineangiogram. The exposure time was fixed at 30 msec/frame. A HARP detector (High-Gain Avalanche Rushing amorphous Photoconductor), developed by NHK was used as a highly sensitive detector. PE was induced in Wistar rats by transtracheal infusion of porcine elastase. Angiographic density was evaluated by 256 grayscale from black to white. Rats were divided into two groups according to with or without induction of pulmonary emphysema: group PE (n = 7), group C (control; n = 7). Density of pulmonary microcirculation was picked up every 30 msec in three seconds. Degree of severity in pulmonary emphysema was evaluated by average distance of pulmonary alveoli in histopathology. As PE develops, average distance of each alveolar wall becomes wide in general.

3 Results

Example of SRA in both groups was shown Fig-1. There was significant correlation between pathologic PE and measured angiographic grayscale (p<0.05, Fig-2).

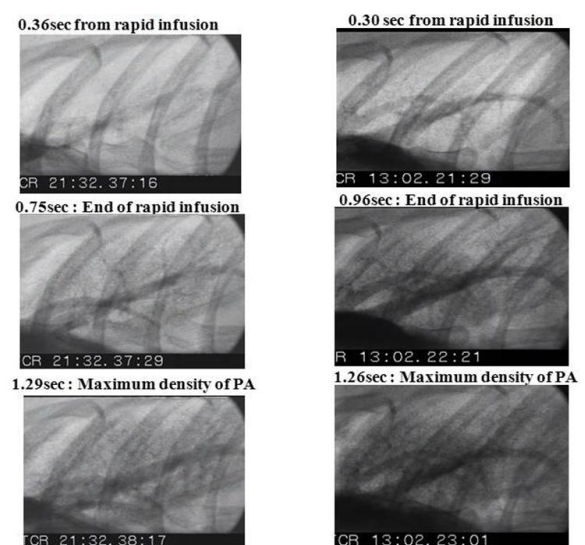


Fig. 1: Example of synchrotron pulmonary angiography (Pulmonary emphysema: left, Control: Right)

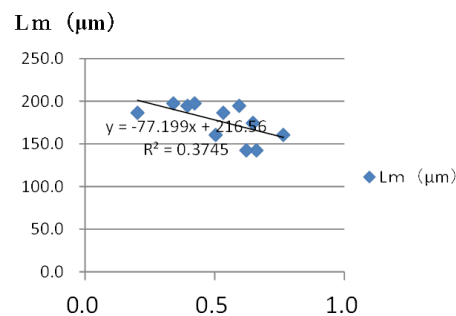


Fig. 2: Significant correlation between alveolar distance (Lm) and angiographic grayscale increment (X-axis)

4. Conclusion

Severity of PE can indicate by SRA through density of pulmonary microcirculation.

References

[1] Ito H, Matsushita S, *et al.*, J Synchrotron Rad 20(2013)376

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