

## Development of a new method for simultaneously evaluating mucociliary clearance and pulmonary epithelial permeability in rabbit experiments by means of $^{18}\text{F}$ FDG, three-dimensional positron emission tomography and rectilinear scan

Fumiyoshi OJIMA,<sup>\*1</sup> Tatsuo IDO,<sup>\*2</sup> Jun HATAZAWA,<sup>\*3</sup> Masatoshi ITOH,<sup>\*2</sup> Hiroshi SHINOHARA,<sup>\*4</sup>  
Shoichi WATANUKI,<sup>\*2</sup> Shinya SEO,<sup>\*2</sup> Hirofumi KAI,<sup>\*5</sup> Kazuo TAKAHAMA,<sup>\*5</sup> Takayuki ISHII,<sup>\*4</sup>  
Yoshito NAKAGAWA<sup>\*1</sup> and Takeshi MIYATA<sup>\*5</sup>

<sup>\*1</sup>Department of Pharmacy, Yamagata University Hospital

<sup>\*2</sup>Cyclotron and Radioisotope Center, Tohoku University

<sup>\*3</sup>Department of Radiology and Nuclear Medicine, Akita Research Institute for Brain and Blood Vessels

<sup>\*4</sup>MECT Corporation, Tokyo

<sup>\*5</sup>Department of Pharmacological Sciences, Faculty of Pharmaceutical Sciences, Kumamoto University

We tried to simultaneously obtain the elimination constant of mucociliary clearance and the pulmonary epithelial permeability constant after inhalation of 2- $^{18}\text{F}$ fluoro-2-deoxy-D-glucose ( $^{18}\text{F}$ FDG) solution by carrying out whole lung positron emission tomography and a rectilinear scan in rabbit experiments. The elimination constant of pulmonary epithelial permeability was obtained from the decrease in the amount of the radioactivity with time in the region of interest (ROI) confined to the lungs, trachea and tracheal cannula in the rectilinear scan. The total elimination constant of the radioactivity in the lungs was obtained from the ROI confined to the lungs in the tomography. The mucociliary clearance rate constant in the lungs was then obtained after subtracting the elimination constant of the pulmonary epithelial permeability from the total elimination constant of the  $^{18}\text{F}$ FDG in the lungs. The mucociliary clearance constant in the trachea was calculated from the residual radioactivity in the trachea and the mucociliary clearance constant in the lungs. The mean pulmonary epithelial permeability constant was  $0.0020\% \text{ min}^{-1}$  obtained from the rectilinear scan. The mean mucociliary clearance constants of the lungs and the trachea were  $0.0006$  and  $0.025\% \text{ min}^{-1}$ , respectively. These results indicated that the pulmonary epithelial permeability and mucociliary clearance could be evaluated simultaneously with  $^{18}\text{F}$ FDG by using three-dimensional positron emission tomography and a rectilinear scan.

**Key words:**  $^{18}\text{F}$ FDG, mucociliary clearance, PET, pulmonary epithelial permeability, rabbit