Analysis of Xe-133 Washout Process by Weighted Least Square Fitting

T. Mukai, Y. Ishii, H. Ito, T. Suzuki and K. Torizuka

Department of Radiology, Kyoto University Medical School.

S. Eiho

Department of Technology, Kyoto University

Graphic peeling off method have been extensively used in the past for non-linear parameter estimation of Xe-133 washout curves from the kidney, brain and lung, which is assumed to be the multiexponential function.

However, several limitations of this techniques have been noticed that it is unable to separate parameters of similar magnitude with a high confidence, or to provide confidence limits for the parameter estimation without considering for a series of data to have different variance due to statistical fluctuation of radioactivities. In oder to overcome this problem, a computer program as written to successively fit to sum of two, three and four exponential term to the data by an iterative least squares techniques using a combination of the steepest descent and Newton-Raphson methods for convergence. Each data point was weighted by the reciprocal of its variance, assuming that the errors followed a Poisson distribution.

A compartment, i.e. an exponential term, was declared nonsignificant if it did not significantly reduce theleast squares error about the fitted line as judged by an F-test. Results of the analysis using a composite model curves of multiexponential function with random fluctuation revealed that weighting was essential to determine a plausible combination of compartments. Xe-133 washout process from lung was analyzed using this method, and compared with the result from that of the peeling off method.

Good correlations were found between these two providing that data were recorded long enough with enough radioactivities, suggesting the conventional peeling off method might be liable to be in a subjectivity.

Regional Significance of "Closing Volume"

Y. Ishii, T. Suzuki, H. Itoh,

Department of Radiology, Kyoto University Medical School

T. Mukai, K. Torizuka

Central Clinical Radioisotope Division, Kyoto University Hospital

When considering the effect of prevailing air pollution on lung, early detection of small