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Introduction

The deoxyglucose method originally developed by Sokoloff et al.[1] for measurement of the local cerebral metabolic rate for glucose is widely applied in human studies employing positron emission tomography.[2,3] Estimation of local metabolic rate for glucose of human cancers using the FDG method and positron emission computed tomography (PET) requires definition of the rate constants and "lumped constant" for FDG of the Sokoloff model describing the kinetics of glucose metabolism. But there were no reported values of these constants in lung cancers. We tried to calculate the individual rate constants k*1, k*2 and k*3 by dynamic scanning of human lung cancers.

Materials and Methods

FDG was synthesized by method developed by Ido et al.[4] Quality assurance tests of FDG for clinical use were performed according to the safety guidelines of the clinical research committee of our institution.[5] The radiochemical purity of FDG was greater than 96% and the specific activity at the time of injection ranged from 2-4 mCi/mol. Three patients (Table 1) with histologically proved lung cancer were studied before anti-cancer treatment using ECAT II (EG&G Ortec). Written informed consent was obtained in all cases. After transmission scanning, 3 to 4 mCi of FDG were injected intravenously as a bolus. Serial tomographic scans were taken every five minites for 1 hour at the slice level through the tumor. Arterial blood sampling was also performed after injection of FDG. Samples were immediately centrifuged to separate plasma for the determination of plasma glucose and FDG concentrations. Based on the three compartment model (Figure 1), three parameters of a 3-exponential functions were calculated by nonlinear least-square curve fitting.

Results

The measured rate constants for FDG from lung cancer patients are shown in the Table 1. Since no prior values for rate constants of FDG have yet been

published for human lung cancers, the rate constants for the brain glioblastoma patients (Kato et al.[6], Sasaki et al.[7]) are given for comparison.

Discussion

The lumped constant is an essential term in the measurement of local tissue metabolic rate for glucose. But there are no values reported in the tumor. We calculated the rate constants as the parameters of the glucose metabolism instead of the metabolic rate for glucose itself. The values of k*1 and k*2 have varied each other among lung cancer and differed from reported data of the glioblastoma. k*3 values were lower than those of the glioblastoma. Tha values of case 3 appear similar to those measured with FDG in the normal human gray matter. Kato et al.[6] reported that the regional rate constants of the glioblastoma showed large difference between the medial and lateral part of the tumor. Although we have no knowledge about these differences of values, we felt that these differences represent the pathophysiological characters of tumor cells, since rate constants could reflect the true physical characteristics of the glucose transport and metabolic machinery.

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Table 1

Calculated rate constants of 18-F-FDG in lung cancers (min^{-1})

	k*1	k*2	k*3	(k*1Xk*3)/(k*2+k*3)
1. T.C. squamous cell carcinoma	0.077	0.053	0.062	0.0415
2. S.S. small cell carcinoma	0.212	0.566	0.080	0.0263
3. H.N. large cell carcinoma	0.105	0.102	0.057	0.0376
Glioblastoma (Sasaki)	0.152	0.181	0.128	0.0630
Glioblastoma (Kato)	0.092	0.435	0.107	0.0181

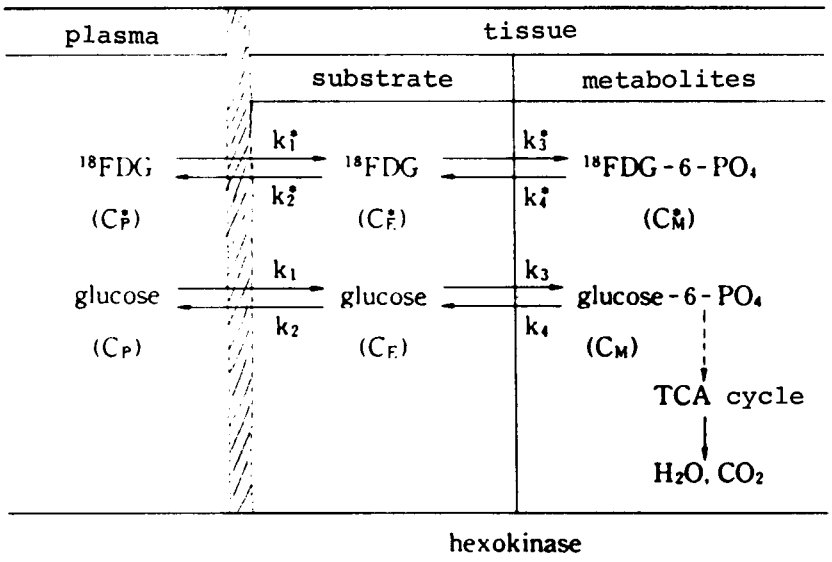

Fig. 1.