a k^*_4 term allow for hydrolysis of FDG-6-PO_4 back to FDG which then competes between clearance to the blood (k_2^*) and rephosphorylization (k^*_3) to FDG-6-PO_4 (Fig. 5). The general form of this model for the measurement of the metabolic rate for glucose (MRGlu) is given by:

$$\mathrm{MRGlu} = \frac{C_P\left[C_i(T)^* - \frac{k_1^*}{\alpha_2-\alpha_1}\left((k_4^* - \alpha_1)d^{-\alpha_1 t} + (\alpha_2-k_4^*)e^{-\alpha_2 t}\right)\right] \otimes C_P^*(t)}{LC\left(\frac{k_2^* + k_3^*}{\alpha_2-\alpha_1}\right)\left(e^{-\alpha_1 t} - e^{-\alpha_2 t}\right) \otimes C_P^*(t)} \qquad (3)$$

where $\alpha_1 = \frac{k_2^* + k_4^*}{k_2^* + k_3^* + k_4^*}$, $\alpha_2 = k_2^* + k_3^* + k_4^* - \alpha_1$ and $\otimes$ is the operation of convolution.

We have measured the rate constants and the lump constant for both brain and heart. These rate constants along with the model have been directly incorporated into the software of the tomograph.

A simplified form of the model for the calculation of either the cerebral or myocardial metabolic rate for glucose (MRGlu) is given by:

$$\mathrm{MRGlu} = \frac{\text{Plasma Glucose}}{\text{Lumped Constant}} \; \frac{(\text{Total of } {}^{18}\text{F in tissue} - \text{Free FDG in Tissue } i,T}{(\text{Total FDG delivered to the tissue})} \qquad (4)$$

The total ^{18}F concentration in tissue at region i and time T is measured with the tomograph, the free FDG concentration in region i of the tissue is calculated from the rate constants and the measured plasma FDG concentration of time T, the total FDG delivered to the tissue is the area under the plasma concentration curve. We have shown (8) that all the blood values can be determined from venous blood from a resting arm without loss of accuracy compard to the use of arterial valves as employed by Sokoloff, et al. (19) or Reivich, et al. (20).