Summary

Development of Method to Estimate Delay Time for Arterial Imput Function with $[^{15}O]CO_2$-PET Study Using Sinogram Data and Attenuation Map

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The difference in tracer arrival times between the external radiation detector and the brain following administration of radioactivity (delay time) must be estimated correctly in order to quantitatively measure regional cerebral blood flow (rCBF) with positron emission tomography and $[^{15}O]H_2O$ by autoradiographic method. Instead of intervenous injection of $[^{15}O]H_2O$, bolus inhalation of $[^{15}O]CO_2$ gas is sometimes used to simplify the measurement of rCBF. In the case of $[^{15}O]CO_2$, radioactive gas in mask and nasal cavity contributes large artifact on the sinogram data and it is difficult to estimate delay time from the sinogram data. In this paper, we proposed a new method to estimate the delay time using the sinogram data and the attenuation map (attenuation weighted sinogram method). In the present method, the attenuation map was used to eliminate the effect of the gas outside the brain region from the sinogram data. For the validation of the present method, PET data with $[^{15}O]CO_2$ (n＝10) were analyzed. Three methods, namely the image method, the sinogram method and the attenuation weighted sinogram method were used to estimate the delay time. The estimated delay times and calculated rCBF images by three methods were compared. Due to the radioactivity outside of the brain, the sinogram method significantly overestimated the delay time and thus underestimated the rCBF value compared with the image base method. On the other hand, there were good agreements between the delay times estimated by the attenuation weighted sinogram method and the image method. The present method can eliminate the effect of the radioactivity outside of the brain on the sinogram data and estimate the delay time accurately and fast enough for clinical use.

Key words: Positron emission tomography, Regional cerebral blood flow, Delay time.