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Measurement of arterial time-activity curve by monitoring continuously drawn arterial blood with an external detector: Errors and corrections

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Accurate description of the arterial time-activity curve (ATAC) is of paramount importance in quantitative determination of the regional cerebral blood flow (rCBF) using positron tomography following bolus i.v. injection of O-15 labeled water. Frequent manual sampling from an arterial catheter does not permit sampling in less than 5-sec intervals and runs the risk of missing the arrival time or the peak count. A continuous ATAC monitoring system has been developed. This system consists of a single bismuth germanate detector in a lead shield and a constant-flow aspirator. The arterial blood was drawn continuously from a catheter within the brachial artery into an extended tube and its activity was monitored by the detector as the detector time-activity curve (DTAC). Comparison with the manual sampling from the contralateral brachial artery in the same run revealed that the DTAC differed from the manual sampling not only in delayed arrival but also in the shape of the curve, which was dispersed because of viscosity and the width of the detector field of view. However, deconvolution of DTAC using the experimentally obtained system step response provided an accurate arterial time course, which successfully filled in the gaps of the manual sampling. Moreover, water and blood showed different dispersion in the step response, suggesting that the system function should be determined using blood or a fluid of similar hydrodynamic nature.

Key words: Positron emission tomography, Input function, Dispersion, O-15 labeled water