Purpose:
Any tracer kinetic analysis requires an arterial input function (AIF) when the analysis is performed for quantitative measurements of concerned variables such as blood flow (BF) or blood volume (BV) as in the case of dynamic CT, PET or MR perfusion studies. The AIF is often measured at the middle cerebral artery (MCA) or only the first pass AIF is modeled using a single gamma variate function. However, the recirculating input, which is sometimes disregarded for the computational convenience or sometime modeled using too simplistic function (e.g. straight line), has not well been formulated. Here, a full AIF including recirculating input is modeled using a series of gamma variate functions that have related parameters, and the feasibility was tested by a computer simulation.

Methods:
The simulation was performed using an in-house program developed in MATLAB. The shape of a gamma variate function was defined using two parameters (α,, reference). In addition, recirculation time (T) and fraction (f), i.e. the first arrival time and fraction after leaving the brain, were included in the simulation. A single recirculation was described as a related gamma variate function (reference), and the total recirculation was described as the sum of all related gamma variate functions.

Results:
The arterial input function, including the first pass and recirculating inputs, can be modeled using the sum of a series of related gamma variate functions.

Conclusions:
The arterial input function in its complete form can be modeled using a series of related gamma variate functions. From this modeling, the AIF can be described as its complete form, which might benefit the quantitative measurements of BF, BV or mean transit time (MTT) in those dynamic contrast based perfusion imaging technique such as in CT, PET or MRI.