The SNR Dependance of Response Function in Deconvolution Analysis of MR Perfusion Images

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목적(Purpose): The accurate determination of mean transition time (MTT) is important to obtain rCBF map and MTT is usually acquired by finding the response function with deconvolution analysis. In this study, we investigate the dependency of the tissue response function on the signal to noise ratio(SNR) of the perfusion images and so minimum required SNR for the accurate rCBF map by computer simulation.

대상 및 방법(Materials and Method): For the tissue output functions with various SNR the tissue response functions are simulated. The tissue output function, O(t), is a convolution of the input function, I(t), and the response function, R(t):

$$O(t)=I(t)*R(t).$$

Therefore the response function, R(t), is obtained by the deconvolution of the O(t) and I(t). In this simulation we use the I(t)=Exp(-(t-70)^2/10^2) and R(t)= Exp[-(t-20)^2/10^2] and the normally distributed err, ε, with zero mean and standard deviation, σ. The SNR is determined by dividing the peak value of output function, O(t=peak position), by σ. The simulation for the response function is carried out for each SNR= ∞, 10000, 5000, 1000, 100 and 50.

결과(Results): The simulated response function are in perfect agreement with the noise-free response function for SNR of ∞. Whereas fairly good agreement between the two are obtained for SNR>1000, the considerable disagreement are obseved for SNR<1000.

결론(Conclusion): Since the deconvolution is very sensitive to the error for the output function, it is to be extremely careful to determine the output function by fitting to the noisy experimental output data. That is, to obtain reliable rCBF map, the experimental data should maintain fairly high SNR.