A new denoised deconvolution analysis of ^{99m}Tc Mag3 renography.

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AIM: To obtain the relative kidney uptake and renal transit times thanks to a new deconvolution process of noisy renal time activity curves.

Material and methods: The method relies on a previous work of fitting and filtering noisy renogram curves with Legendre polynomials (LP). The mathematical background consists of a convolution of a LP matrix of unknow coefficients with a measured input function (IF). IF is obtained using a region of interest drawn over the heart or the distal aorta near the iliac bifurcation. The deconvolution operation gives the transit curve (TC). After trimming, a plateau is determined at the initial part of the TC curve to obtain the relative renal uptake information.
Minimum (MinTT), maximum (MaxTT) and mean (MTT) transit times are also computed. We used a renal database (http://www.dynamicrenalstudy.org) which contains Monte-Carlo (MC) simulated studies and real patients' data. The MC studies provided Gold Standard with different levels of injected activity, renal clearance and noise in the anterior and posterior views. The new method was compared to the conventional matrix method implemented in a commercial software (Hermes) and to the Fourier deconvolution after preprocessing the IF and the renal curves with the Legendre method mentioned above.

Results: A perfect agreement, demonstrating the correct removal of the vascular contribution, was observed between the measure of the uptake and its ground-truth values for the MC gold standard datasets. The comparison of study with different levels of noise showed a great stability of this method. For the other studies comprising MC and patient data, slope (R^2) of the linear regression between the new method (height of the plateau) and the Hermes (integral method) was: 0.82 (0.96) for uptake, between the new deconvolution process and the matrix method was: 0.71 (0.72) for MTT. Furthermore Mean (SD) for the Bland-Altman analysis was: -0.15 (0.51) for the MTT, similar results were observed for the improved Fourier deconvolution.

Conclusion: The Legendre deconvolution method directly provides renal transit curves and therefore facilitates the computation of the transit and uptake parameters which reveal much less sensitive to noise in the data compared to the usual Fourier or matrix deconvolution. Furthermore, the analysis can be applied regionally on kidney.