Turku PET Centre Modelling report TPCMOD0032 Appendix C 2005-06-23
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Analysis of renal perfusion from [^{15}O]H_2O PET studies: Pixel-by-pixel calculation with and without RBV estimation

Aim

To investigate the feasibility of calculating RBF images with a model that incorporates also RBV as the third parameter. Quantitative RBF estmates from RBF images produced with the two methods (if RBF images with RBV fitting are not too noisy) will be compared to the RBF estimates from regional analysis.

Materials and methods

PET studies: us0568, us0569, us0570, us0571 (subject #1); us0550, us0551, us0552, us0553 (subject #3); and us0490, us0494, us0495, us0496 (subject #3). All studies of one subject are scanned during one session.

Input curve: Arterial blood TACs measured using on-line blood sampler (pump). TACs are calibrated, corrected for physical decay and for the dispersion in collection system and in vasculature. Time delay is corrected before perfusion model fit against regional renal TACs.

Renal data: ROIs were drawn on renal cortex in single image planes and pixel average TACs for left and right kidney were calculated from dynamic PET images. Same ROIs were also placed on parametric images, and average RBF and RBV values inside them were computed.

Procedure and software: Procedure is done using batch file app_c.bat. It contains also the version numbers of the software used; the most important ones are fitdelay 1.9.1, imgflow 0.8.2, fit_h2o 3.1.2.

Results and discussion

By visual inspection, both models produce good quality RBF images. However, comparison of regional averages to RBF values that were calculated from regional TACs (Figure C1), show that RBV must be included in the model (three-parameter model) if similar RBF estimates are required. RBF may be very sensitive to RBV, and if RBV is not fitted as the third parameter, or not corrected based on [^{15}O]CO scan, it may lead to increased variability in addition to strong overestimation of RBF (Figure 1). Pixel-by-pixel and regionally estimated RBV values seem to be well correlated (Figure C2). Examples of RBF and RBV images calculated with the two methods are shown in Figures C3-5.

Conclusion

Multilinear method with RBV as the third parameter produce RBF and RBV images of acceptable quality and similar regional values than analysis from regional average TACs using traditional non-linear one-compartment model.

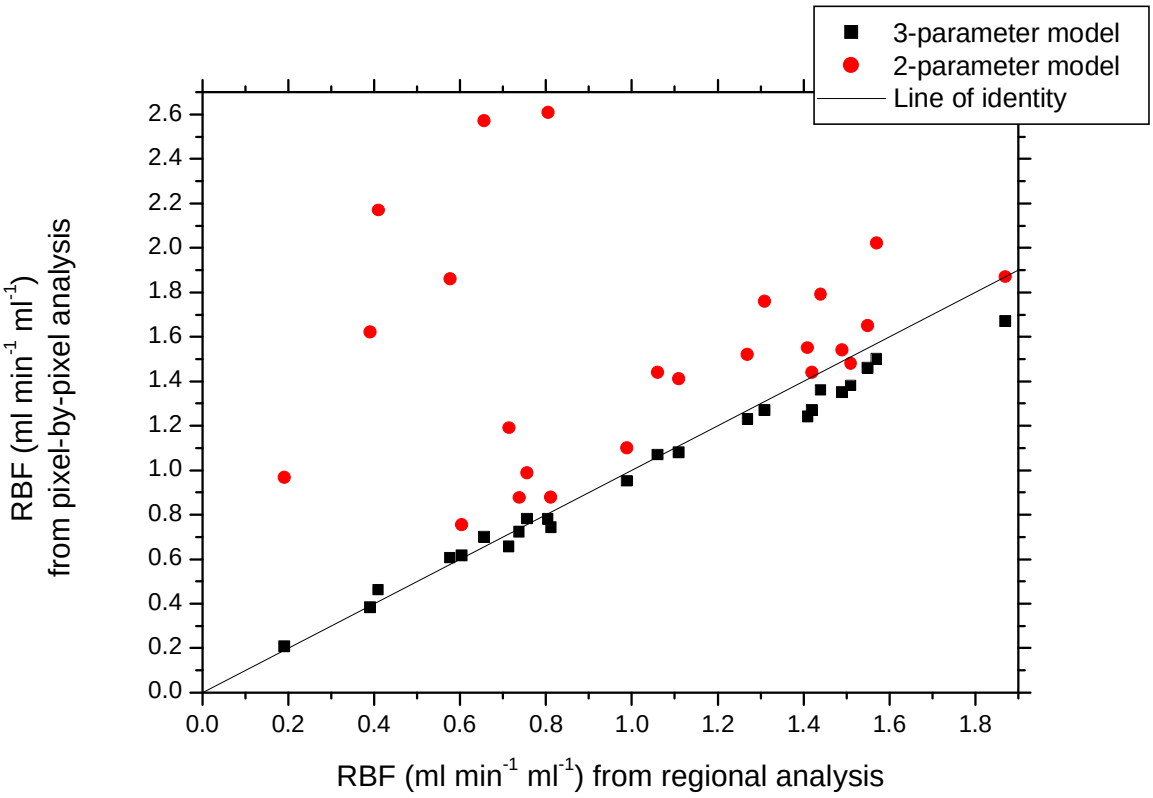

Figure C1. Comparison of regional RBF average values calculated from pixel-by-pixel analysis of dynamic PET images and analysis of regional average TACs. Parametric RBF images were computed with three-parameter (RBF, p and RBV) and two-parameter multilinear models (RBF and p). Graph contains results from ROIs drawn on both right and left renal cortex.

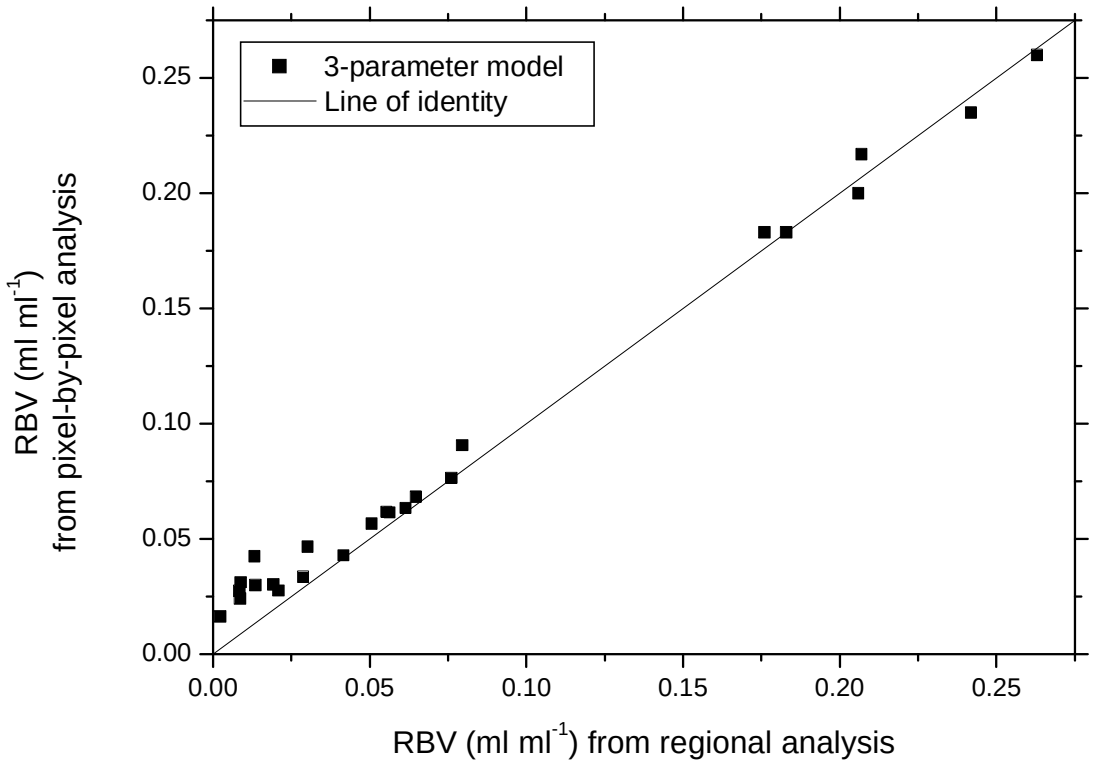

Figure C2. Comparison of regional RBV average values calculated from pixel-by-pixel analysis of dynamic PET images and analysis of regional average TACs. Parametric RBV images were obviously computed only with three-parameter (RBF, p and RBV) model. Graph contains results from ROIs drawn on both right and left renal cortex.

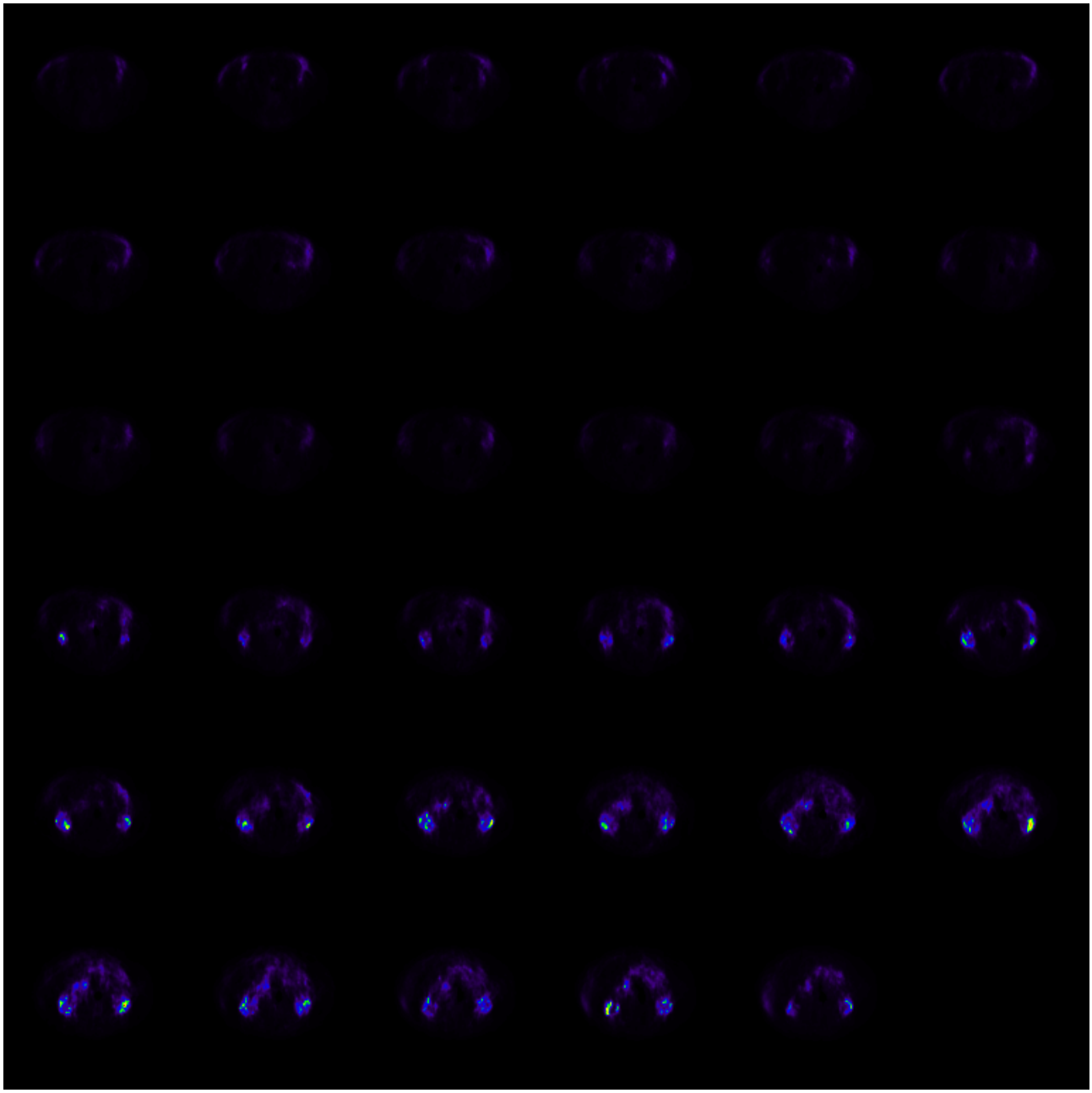

Figure C3. RBF image from study us0550, calculated using 3-parameter model.

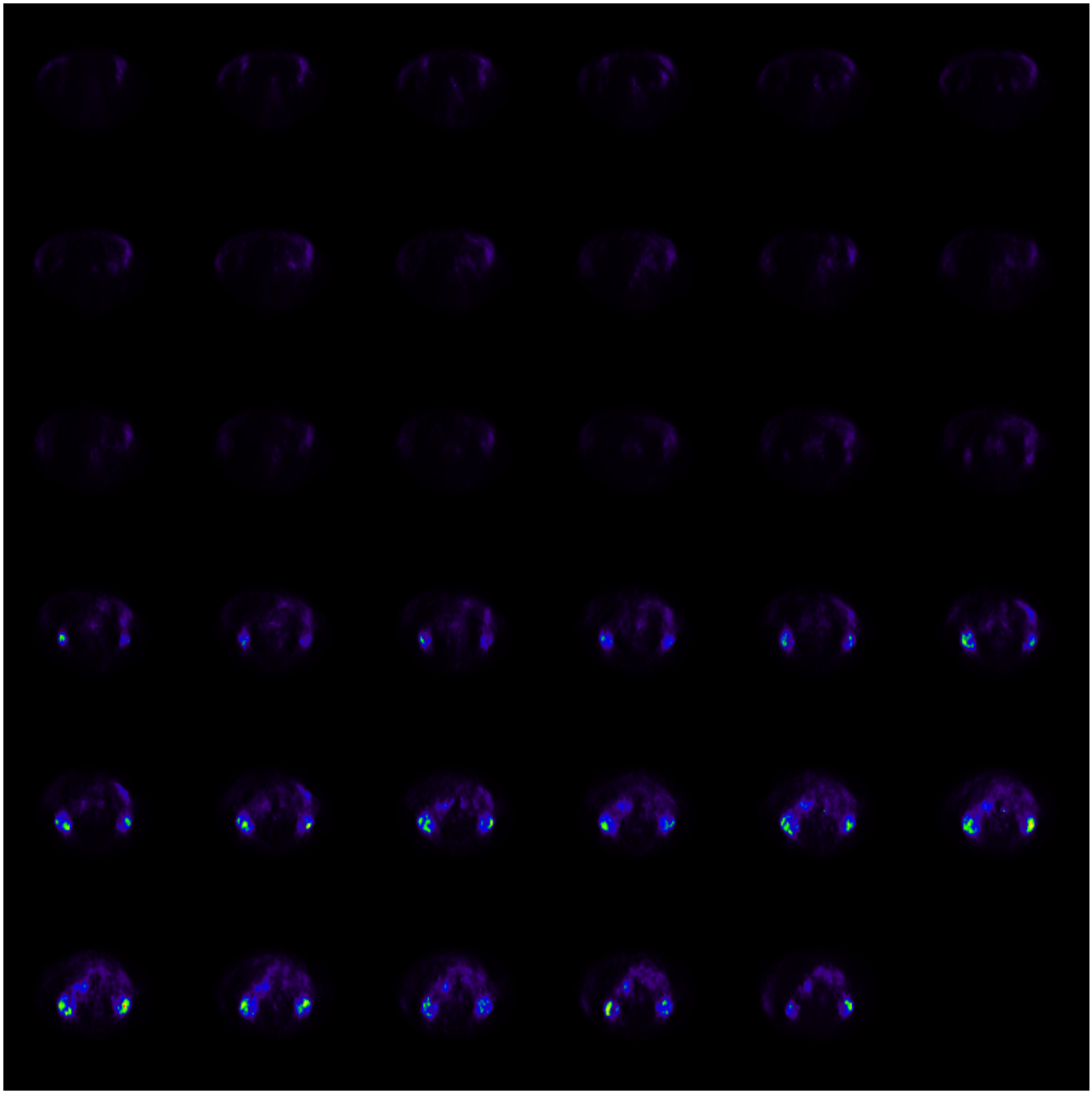

Figure C4. RBF image from study us0550, calculated using 2-parameter model.

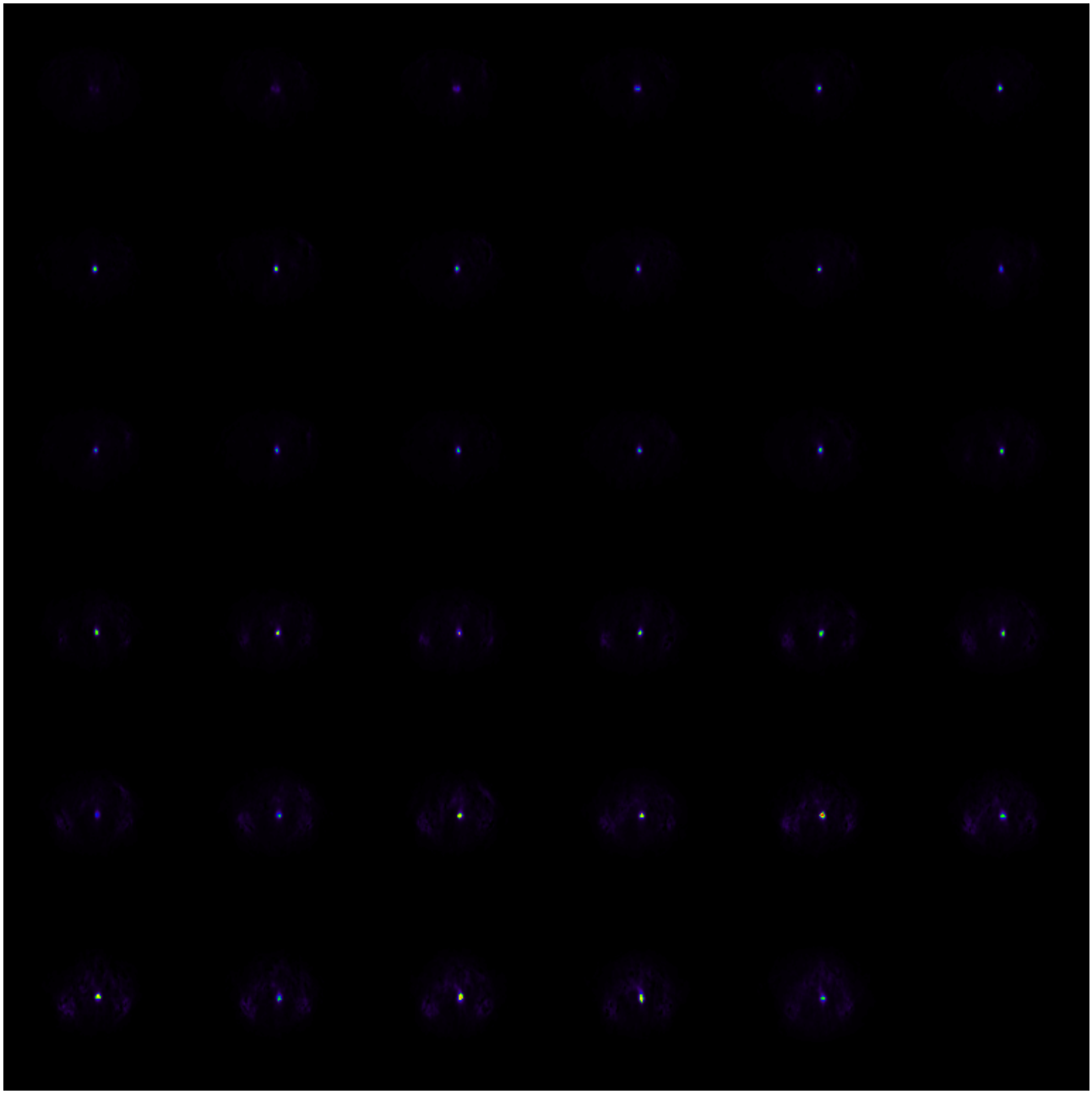

Figure C5. RBV image from study us0550, calculated using 3-parameter model. Colours are scaled to the maximum of all planes, which in these studies resides in the aortic region.