Impact of the Background Region of Interest in the Relative Renal Function

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Introduction:

Renal scintigraphy with ^{99m}Tc-dimercaptosuccinic acid (^{99m}Tc-DMSA) is performed with the aim of detect cortical abnormalities related to urinary tract infection and accurately quantify relative renal function (RRF). For this quantitative assessment Nuclear Medicine Technologist should draw regions of interest (ROI) around each kidney (KROI) and peri-renal background (BKG) ROI, although, controversy still exists about BKG-ROI.

The **aim** of this work was to evaluate the effect of the normalization procedure, number and location of BKG-ROI on the RRF in ^{99m}Tc-DMSA scintigraphy.

Methods:

Forty seven children (15±11 months; 22 male) referred for ^{99m}Tc-DMSA scintigraphy underwent the following protocol: posterior and posterior oblique static images, acquired approximately 150minutes after the administration of 36.5±11MBq of ^{99m}Tc-DMSA, with a Low Energy High Resolution Collimator, 140keV, 20% window, 256×256 image matrix and zoom=1.66. All studies were conducted using a double-detector gamma-camera during 10minutes or 300kcounts. Data were processed on Xeleris GE™ workstation by one operator, using *Renal DMSA Uptake Analysis* application. KROI were draw manually around each kidney and peri-renal BKG-ROI were automatically generated through three different methods: circumferential ROI around the totality of each kidney (2R); crescent semiROI externally to each kidney (2sR); one rectangular central inferior ROI (1R) (see Figure 1: A), B) and C)). Right and left kidney differential function (RKF;LKF) was assessed for each method. Sample included RKF and LKF between 45-55% in all methods and no evidence of renal scar. We applied a normalization to the data, and a comparison was made between non-normalized and normalized data. The t-test were used to evaluate the statistical differences between genders. To evaluate the association between the variables the ANOVAII and Pearson correlation tests were used.

Figure 1: **A)** Circumferential ROI around the totality of each kidney (2R); **B)** crescent semiROI externally to each kidney (2sR); **C)** one rectangular central inferior ROI (1R).

Figure 2: Boxplots from the analysis of the left kidney function (LKF). S-1 and N-2 referring for normalized and non-normalized data, respectively. Data processed with **a)** Circumferential ROI around the totality of each kidney (2R); **b)** crescent semiROI externally to each kidney (2sR); **c)** one rectangular central inferior ROI (1R).

Table 1: ANOVA's II results for comparison between the type and n.º of ROI used.

Type of ROI	Right Kidney	Left kidney
2R	0.263	0.438
2sR	0.154	0.154
1R	0.249	0.249

Table 2: Pearson's r correlation results for comparison between the type and n.º of ROI used.

Type of ROI	Right Kidney	Left kidney
2R : 2sR	0.948	0.314
2R : 1R	0.994	0.310
2sR : 1R	0.941	0.941

* For all values the correlation is significant at the 0.05 level (2-tailed).

Results:

Paired samples correlations for all non-normalized and normalized data found significant differences in 2sR and 1R ($p<0.001$). From the results obtained, we only used the normalized data (see Figure 2: a), b) and c)). The t-test didn't shown differences between genders. ANOVA II data indicated that there were not significant differences for gender ($p>0.05$) though higher significance values were found in 2R method (see Table 1). Although the Pearson r showed positive correlation between the three methods for both kidneys and excellent correlation for all methods applied to the right kidney ($r≥0.94$, $p>0.01$), it was achieved a low correlation for the left kidney with 2R when compared with the other methods ($r>0.31$, $p>0.05$) (see Table 2).

Conclusion:

Results suggest that normalization should be performed when using 2sR and 1R methods. All three methods originate similar RRF values for normalized data, although the 2R method appears to be more precise. The effect of the location of the BKG-ROI had more impact in the value of the LKF, probably due to the spleen uptake.

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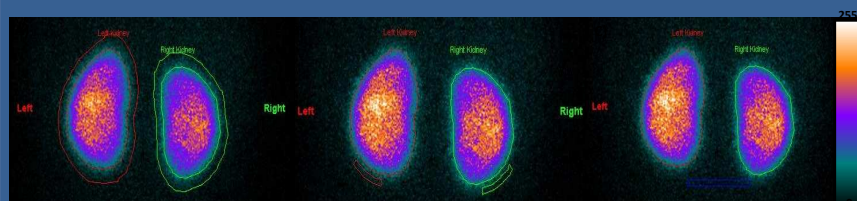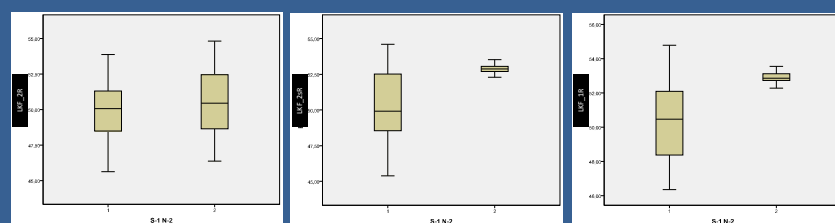• Pestana D, Velosa S. Introdução à probabilidade e à estatística. Lisboa: Fundação Calouste Gulbenkian, Editor; 2002.