A procedure for evaluating your approach to Gamma-Camera methods for calculating absolute renal function

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That is the problem...

The Renal Processing activity is used to measure kidney function, such as blood flow, glomerular filtration rate (GFR), effective renal plasma flow (ERPF), split uptake, etc. For more information and instructions, click on the desired processing option.

The following renal methods are included:

- Captopril Comparison
- Gates GFR (DTPA)
- Itoh ERPF (MAG3)
- (MAG3) Without Samples
- Generic
- Oberhausen ERPF (OIH)
- Oriuchi Clearance (MAG3)
- Bubeck (TER)
Baseline principles
(i.e. what to do if the world would be perfect....)

• Evaluate in every patient the clinical & biochemical parameters of renal function

• Check for radiochemical purity the radiopharmaceutical used

• Perform a technically high quality renogram

• Compare the results with a blood sample-based reference method
The world IS not perfect.

- Clinical & biochemical parameters are not always available

- Blood sample-based method requires:
  1. Drawing blood up to 3-4 hours after the injection of radiopharmaceutical; this is boring for outpatients, requires cooperation by the wards’ personnel for inpatients
  2. That the dedicated radiopharmaceutical is always available
  3. An additional, although very low, radiation burden
May we bypass these problems?
What is your first impression about this premises?

1. A waste of time
2. An interesting and logical approach
3. A worthy, probably unsuccessful approach
4. Wait and see
We collect 83 adult patients with various levels of renal function, getting from everyone age, sex, gender, ethnicity, weight, height, plasma creatinine.

We then calculate ARF with

1. Cockroft-Gault formula
2. MDRD formula
3. algorhythm for ERPF with MAG3 provided with the gamma-camera software
   (only pre- and post-injection syringe measurement required)
Methods – 2

We then plotted these measurement against the creatinine levels and against each other, evaluating if there is something like a close statistical relationship.
Correlation between plasma creatinine and GFR by Cockcroft-Gault formula.
ERPF calculation matching vs GFR by Cockcroft-Gault

\[ y = 2.116x + 108.1 \]

\[ R^2 = 0.459 \]
ERPF calculation matching vs GFR by MDRD

\[ y = 0.189x + 21.87 \]
\[ R^2 = 0.477 \]
METHODS – 3

Thereafter, we test again the gamma-camera obtained values changing, once a time:

- the shape of the background ROI
- the setting of $T_0$ time, shifting the time interval used from 60-120” to 90-150”
- the acquisition protocol, including or not an angiographic phase at 1”/ frame
ERPF calculation vs CG-GFR matching according to acquisition parameters

ERPF (OIH) [ml/min]

- No angiogram phase
- Angiogram phase

Equations:
- $y = 2.158x + 102.5$  
  $R^2 = 0.402$
- $y = 1.951x + 104.8$  
  $R^2 = 0.356$
Results – 1

Independently from all attempts, all correlations found were weak, with great intra-patient variability of results between the main methods. No improvement was obtained changing any parameters during the post-processing.
We used two plasma creatinine-based methods. What kind of relationship do you expect between them?

1. Linear, good
2. Identity line
3. Linear, poor
4. Exponential
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GFR calculation matching of 2 plasma creatinine-based methods

\[ y = 0.618x + 21.56 \]

\[ R^2 = 0.647 \]
RESULTS – 2

ARF values obtained with MAG3 were, more or less, always lower than the expected ones, by an at least 25% order:

40 pts had a plasma creatinine $\leq 1.1$ mg%.

Their ERPF was $266\pm160$ ml/min/1.73 m$^2$ BS
What is your impression about these results?

1. As I said before, a waste of time

2. An interesting and unlucky approach

3. A worthy, unsuccessful approach

4. An hole in the water
A really big hole in the water .....
Take home message?

1. I will use these methods nevertheless.

2. I will carefully think about before using these methods in clinical practice.

3. I will suggest to my clinical colleagues to trust only blood sample-based RN methods.

4. I resign to calculate ARF.
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