Measurement of Single Kidney Glomerular Filtration Rate by Technetium-DTPA Renography

TO THE EDITOR: In a recent letter to the editor (*1*) Russell and Dubovsky refer to a publication by us (*2*) on a method for calculation of single kidney glomerular filtration rate (SKGFR) from a technetium-99m diethylenetriaminepentaacetic acid (DTPA) renogram without the use of blood sampling. They find our method to be similar to their so called "corrected Assailly method," but with some differences which they summarize in three points. In the interest of others who may wish to apply our method we would like to comment on these points and to draw the attention to some restrictions in the use of the method.

1. They suppose that the cardiac activity does not change much in the time interval used for the calculation of SKGFR. In our hands the cardiac activity decreases by 20% to 25% and the activity in arterial plasma decreases by as much as 35% to 45% in this time interval (personal observation). Therefore, we find it necessary to correct for this fall in activity on both sides of our Eq. (6) [their Eq. (22)] before solving this regression equation.

2. We smooth the cardiac time-activity curve using a biexponential fit to reduce noise in the solution of the regression equation from which the uptake function (SKGFR) and the background subtraction factor were determined.

3. In order to avoid blood sampling and kidney depth measurement we assume that the ratio $E_h V_h/E_k$ have practically the same value in adults [E_h and E_k denote the counting efficiency factors for the heart and the kidney, respectively, and V_h denotes the plasma volume within the cardiac region of interest (ROI)]. This is obviously a simplification, but measurement of kidney depth and blood sampling for estimation of the ratio $E_h V_h/E_k$ will introduce new components of errors. It is important to stress that we use the same number of pixels in the cardiac ROI in all patients.

Further investigations have confirmed the reliability of our simplified method. In 19 unilaterally nephrectomized patients with decreased renal function, GFR of the remaining kidney was calculated from the renogram and compared to the simultaneously measured renal clearance of inulin (*3*). The correlation coefficient was 0.92 and the s.d. was 6.0 ml/min [4.3 ml/min when corrected for imprecision of the renal clearance of inulin (*4*)]. The day-to-day variation of the calculated SKGFR values was 8.8% in 24 patients with varying level of kidney function (*3*). This equals the day-to-day variation of chromium-51 ethylenetriaminetetraacetic acid plasma clearance (*5*). The intra- and interobserver variation was found to be 1.3 and 1.2 ml/min, respectively (*4*).

In our hands the gamma camera technique for calculation of SKGFR has been very useful in daily clinical routine. When established the method is simple. The method may be applied in all adults considering the following reservations. In patients with excessive obesity we have seen a tendency to underestimation of SKGFR. This is due to the fact that the depth of the kidneys increases relatively more than the depth of the heart when viewed in the posterior position. In these few patients correction for kidney depth is recommended.

Since the method does not take the extravascular background activity into account, a "renogram" recorded over an empty kidney region may come out with a SKGFR of 2–3 ml/min. Likewise there is a tendency to overestimate SKGFR in large kidneys with severely decreased function (e.g., polycystic kidneys).

References

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M. Rehling
M. L. Møller
J. O. Lund
J. Trap-Jensen
Frederiksberg Hospital
University of Copenhagen
Denmark

Relationship Between Thallium Uptake and Blood Flow

TO THE EDITOR: Melin and Becker (*1*) conclude that the extraction of thallium-201 (²⁰¹Tl) is greater in the myocardium than in the total body, but their measurements are dependent upon factors other than blood flow. For any freely diffusible tracer, including thallous ion, the initial distribution of the tracer upon leaving the capillary bed is the extracellular fluid space (ECF) of the body, and this is proportional to fractional cardiac output (*2*). Tracer flow between capillary blood and ECF is bidirectional. Subsequently, the tracer may penetrate the intracellular space, and thallous ion rapidly enters myocardial cells. To measure extraction fraction it would be necessary to sample the ECF space, which could be done either with an anatomic probe, or a physiological one, such as a tracer which is distributed only within the ECF space of the body. This is quite feasible, and is the approach we used to study the distribution of the freely diffusible tracer fluorine-