Letters to the Editor

Uncontrolled Variables in the Measurement of Renal Function

TO THE EDITOR: Since posture, exercise, time of day, diet, and even emotional state have been reported to influence renal function (*1,2*), it has been suggested that renal function be measured only under conditions of bed rest (*3*). Ideally, clinical measurements should be made under standardized conditions. For example, pathologists know that the most reproducible blood chemistries are those drawn in bed before breakfast. Most nuclear medicine physicians have simply ignored those aspects of patient preparation that are not easily controlled. However, as the methods of measuring renal function become more accurate, one might expect problems.

We have recently encountered such a problem, which arose as follows. The routine renal function measurement in our clinic is a single-sample, single-injection effective renal plasma flow (ERPF) using hippuran. The ERPF is divided between the two kidneys in proportion to their uptake during the first 3 min to obtain separate values for each kidney. Before switching from an iodine-131 (^{131}I) radiopharmaceutical to another labeled with ^{123}I, we took the routine precaution of first comparing the new agent with the old. The results are shown in Fig. 1 (solid circles). To our surprise, there was an obvious difference between ERPF measured with [^{131}I]hippuran and that measured with [^{123}I]hippuran ($p < 0.05$, Student's t test on regression slope). We could think of only three explanations for this difference. The first was technical error, which we ruled out by having several members of the staff independently review both the procedure and the data. Another was the presence of some impurity in the [^{131}I]hippuran (other than free iodide, for which we routinely test). The last was a postural or diurnal difference, since the ^{123}I measurements were usually made before lunch with the patient supine over the gamma camera, while the ^{131}I measurements were made after lunch and ambulation. To distinguish between the latter two possibilities, we changed the protocol to a dual-isotope study in which both ^{123}I and ^{131}I measurements were made simultaneously. The results of the second protocol are shown as open circles in Fig. 1. There was no significant difference when measurements were made simultaneously. The results thus accord with what one would expect and also with what Stadalnik et al. found in dogs, using radiopharmaceuticals from another supplier (*4*). The failure of the two agents to agree in the initial protocol we attribute to diurnal variation or other uncontrolled variables.

Unlike the chemistry laboratory, we cannot send our technologists around to measure ERPF on patients in bed before breakfast. We can, however, recognize that our current methods are accurate enough to show changes in renal function due to factors that are normally ignored.

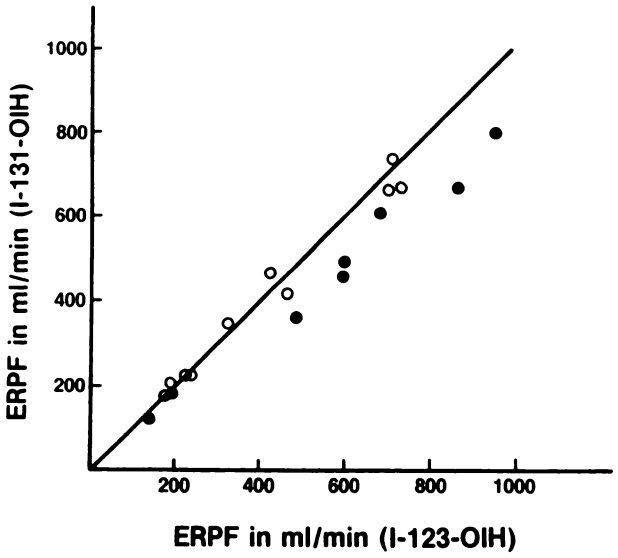

FIGURE 1
Correlation between ERPF calculated from ^{123}I-OIH clearance and that from ^{131}I-OIH clearance. (●)-Sequential measurement; (○)-Simultaneous measurement. Line of identity is plotted

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Charles D. Russell
Eva V. Dubovsky
University of Alabama Hospitals
Birmingham, Alabama

Determination of Glomerular Filtration Rate by Gates' Method

TO THE EDITOR: The poor results reported by Ginjaume and co-workers (*1*) when correlating glomerular filtration rate (GFR) measured with the Gates' method (*2,3*) and creatinine clearance (Cr-Cl) are quite suprising.

Since 1984 we have adopted Gates' method in the routine practice either as a simple split GFR measurement or as a part of the conventional technetium-99m diethylenetriamine pentoacetic acid [^{99m}Tc]DTPA) renogram. In a series of 64 unselected adults (age range 15–64 yr) with different degrees of renal function, in whom 24-hr endogenous Cr-Cl was performed within 48 hr of DTPA-GFR measurement, we

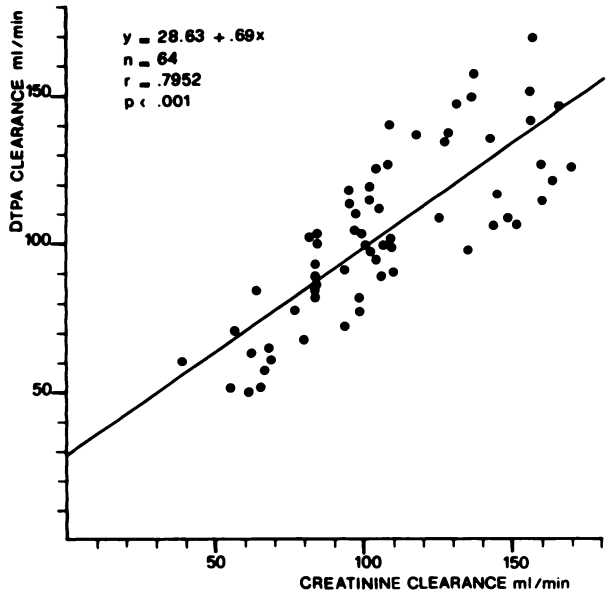

FIGURE 1
Correlation between 24-hr endogenous creatinine clearance and [^{99m}Tc]DTPA clearance (Gates' method) in 64 unselected adults

obtained a correlation of 0.79 (n 64, r 0.79, p <0.001, S x·y 17 ml/min) (Fig. 1).

The standard deviation observed was higher than that reported by Gates (*3*) and more similar to that reported by Russell (*4*) when comparing DTPA-GFR (Gates' method) and eight points plasma clearance of ytterbium-169-DTPA. However, caution must be paid when Cr-Cl is taken as the gold standard of GFR: Improper urine collection especially in the elderly and the children, tubular secretion and intestinal excretion, muscular mass and activity together with day by day variability (*5*) may render this parameter a less accurate reference of GFR.

In this regard, Cachati (*6*) has recently attempted a correlation between GFR determined by Gates' formula and inulin clearance, and obtained good results in both the total group (n 24, r 0.86, p ≤0.001, y = 18.52+ 4.68×) and the unilateral group (n 9, r 0.91, p <0.001, y = 15.89+ .66×), confirming the validity of this method.

In our patients, kidney depth had been previously measured in the lateral position during [^{99m}Tc]Aprotinin Uptake Test (*7*) with the aid of a skin marker. In this regard we agree with Ginjaume's comments: Only in about 50% of our patients, measured and estimated (Tønnesen's method (*8*) organ depth gave similar results, but the error introduced in the attenuation correction does not result in such a remarkable worsening of the correlation.

Although Gates GFR determination seems to provide less accurate results if compared with other methods requiring blood samples (*4*) its advantages in terms of imaging time, reproducibility (*2*), and lower probability of introducing errors in the calculation of blood clearance secure a measurement of glomerular function sufficiently exact for clinical use.

On the basis of these considerations we suggest that GFR determination by Gates' method might be suitably employed in the routine practice while different, more precise approaches should be confined to the research environment only or when a major accuracy is required.

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Carlo Aprile
Raffaella Saponaro
Fondazione Clinica del Lavoro
Pavia, Italy

Sebastiano B. Solerte
S. Matteo Hospital
Pavia, Italy

Measurement of Glomerular Filtration Rate

TO THE EDITOR: There have recently been two articles in the Journal describing methods for calculating glomerular filtration rate (GFR) from the level of tracer activity in one- or two-plasma samples following the injection of technetium-99m diethylenetriaminepentaacetic acid ([^{99m}Tc]DTPA), ytterbium-169 ([^{169}Yb] DTPA) (*1*) and iodine-125 or iodine-131 diatrizoate (DTZ) (*2*). Previous studies of this type have used chromium-51 (^{51}Cr) EDTA (*3,4*) which, although not available for injection in the United States, is available in most western European countries. As a result of such studies, we are confronted by an increasing number of rather similar equations for predicting GFR using a variety of tracers. In order to check whether the tracers are equivalent and to try to establish a "best buy" predictive equation, we have applied several of the equations to data obtained by us using chromium-51 EDTA as tracer. We have measured GFR by the standard technique of multiple blood sampling from 10 min to 3 hr following an i.v. injection of 0.02 mCi (0.75 MBq)