VIII. Urogenital Organs

A New Method of Radiorenogram Analysis by Gamma Function

T. FURUKAWA, H. MATSUO, K. KIMURA, M. KIMURA, K. TAKAYASU, H. INADA and H. ABE
First Department of Medicine, Osaka University Medical School, Osaka

F. KAIJYA and M. HASHIMOTO
Department of Electronic Engineering, Faculty of Technology, Osaka University, Osaka

The quantitative analysis of radiorenogram has been generally difficult, because the effects of extrarenal factors, i.e., distribution kinetics in the body fluid, change of renal extraction ratio of $^{131}$I-Hippuran, position of collimators, injection speed and so on could not be negligible.

In this report, a curve fitting method by using a gamma function was introduced in order to calculate the simplified parameters of renogram curve. The procedure of curve fitting oconsists of three steps, (1) a fitting of the down slope of radiorenogram to a gamma function $C_1(t)$, (2) a calculation of the difference of original renogram $R(t)$ and function $C_1(t)$, and (3) a fitting of the calculated curve $R(t)-C_1(t)$ to another gamma function $C_2(t)$. In the process of fitting, a weighted least square method was used.

As the results: (1) Radiorenogram curves could be exactly expressed by the sum of two gamma functions,

$$R(t) = C_1(t) + C_2(t) = k(t^1e^{-\alpha_1t} + t^2e^{-\alpha_2t})$$

(2) Not only in the normal but the cases of decreased renal function and urinary tract dysfunction, good agreement between theoretical and those of original curves were observed. (3) In the cases of complete renal artery stenosis and/or bilateral nephrectomized condition, the curve fitting was not so sufficient. However, the fitness in this method was relatively better than the other mathematical models, including an analog simulator. (4) In all cases, the irregularity of collimation could be corrected by the scale factor $k$. (5) Therefore, the most essential parameters of radiorenogram were considered to be only 4 parameters, namely $\alpha_1$, $\alpha_2$, $\beta_1$ and $\beta_2$. (6) These parameters did not correspond to any of renal function tests. So, information analysis such as multivariate statistical method should be necessary before the clinical applications.