N. Kidney and Urinary Tracts

NEW RENAL DYNAMIC IMAGING WITH DECONVOLUTION ANALYSIS OF ^{131}I-HIPPURAN FLOW DATA USING AN ON-LINE COMPUTER SYSTEM

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Deconvolution analysis of a renogram derives the transfer function which is the response of the kidney to a bolus injection of radionuclide into the renal artery and gives useful information relating to the spread of renal transit times. In this study, a new computer processing method by which new renal dynamic images reconstructed from regional transfer functions was devised.

A joint system of a gamma-camera (GCA-202) with a 1000-hole collimator and an on-line computer system (DAP-5000N) was used in this study. Following intravenous injection of 350 μCi of ^{131}I-Hippuran, sequential 60 frames were collected at three per minute in a frame mode with 64x64 matrix.

A regional renal transfer function can be solved by

$$n=1 \quad H(1) = R(1)/I(1)$$

$$n>1 \quad H(n) = [R(n) - \sum_{\tau=1}^{n} H(n+1-\tau)\cdot I(\tau)]/I(1)$$

,where n is the number of time intervals, I(n) is the time-activity curve over the cardiac region (input function) and R(n) is the regional renogram.

The regional transfer function was computed from the input function and the regional renogram in each element of the matrix. New dynamic images were obtained by rearranging each of the data of these transfer functions in the sequential frame and the element of the matrix where each of the corresponding data of original renograms is filed.

Prior to deconvolution analysis, the original sequential images were smoothed with the filter factor of 15.1, the regional renogram in each element of the matrix was filtered with "Iterative Filtering Method" and the input function was fitted to bi-exponential function with weighted least-squere method.

Our renal reconstructed dynamic images correspond to serial images obtained following direct injection of ^{131}I- Hippuran into the renal artery and visualized more simplified and clarified information on the regional tubular transit of ^{131}I-Hippuran than original serial images.

THE ^{131}I-HIPPURAN DYNAMIC RENAL STUDY WITH DECONVOLUTION ANALYSIS (FOR THE STUDY IN ESSENTIAL, MALIGNANT AND RENOVASCULAR HYPERTENSION.)

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As we have already shown, the transfer function which is derived by deconvolution of ^{131}I-Hippuran renogram is theoretically and clinically equal to the response function of a kidney to a bolus injection of a radionuclide into the renal artery.

In this study we have utilized this method to investigate the pathophysiologies of the kidneys in cases with essential, malignant and renovascular hypertension. In all cases the transfer functions are evaluated for both the whole and the regional kidney and functional images are made by using several parameters for analyzing the regional transfer function. At the same time effective renal plasma flow (ERPF) has been obtained by the time-activity curve for the cardiac region normalized by Cohen's method. Estimated value for ERPF is divided into right and left kidney according to the initial height of the transfer function of each kidney.

The transfer functions for normal subjects are composed of succesive populations of transit times between 1 minute and 4 minutes.

In patients with essential hypertension, bilateral transfer functions show bimodal patterns composed of normal and prolonged transit times. The delay of this prolonged portion is apt to become extensive in malignant hypertension. Those functional images show bilaterally irregular distributions of delayed transit.

As concerns the affected kidney of patients with renovascular hypertension, the transfer functions are similar in the pattern to those of essential hypertension and the values of ERPF are decreased moderately. In a case with segmental arterial stenosis functional images, especially that of skewness, clearly show focal abnormality in transits consistent with the area supplied by the stenotic artery. It is shown by the postoperative study that the transfer functions of the affected kidneys have returned to normal, but it is of interest that, in a few cases, those of healthy kidneys show transiently bimodal patterns.