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Sequential Response of the Iodine-131 Hippuran Renogram in Renal Homotransplantation[7]

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The clinical usefulness of the ^{131}I Hippuran renogram in assessing renal function has been confirmed by reports from a number of centers (1, 2, 3). In order to determine the value of this method following renal transplantation, serial studies have been obtained on the transplanted kidney and correlated with conventional studies.

METHOD

Four hundred and eighty-four serial renograms were performed on 39 patients at one, three and five days following transplantation and then at weekly intervals. Ten microcuries of ^{131}I labeled iodohippurate (Hippuran, Abbott) was injected intravenously for each study. Renograms were performed with a single thallium activated 2 × 1.5 inch crystal probe connected to a ratemeter, pulse height analyzer and high voltage source. The crystal was shielded with a 1.5 inch thick, 36° flat field collimator and was recessed 8 cm from the collimator face. Renogram tracings were recorded on a linear chart recorder run at 12 inches per hour for twenty minutes. A time constant of ten seconds and a count rate of 10K were used. Curves were recorded in the recumbent position with a probe positioned to avoid bladder radioactivity. The kidney was easily localized by direct palpation in the iliac fossa.

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Tracings were analyzed for T ½ as previously described (3, 6) where the fall-off of the excretory phase was exponential. This was not possible in all tracings. Renogram results were correlated with conventional tests of renal function. A T ½ of infinity was used to indicate no excretion during the initial twenty-minute period following injection of the ortho-iodo-hippurate.

RESULTS

Patients were divided into groups depending on the initial and subsequent renogram response following transplantation as follows:

Group I. Eight patients had normal renograms which remained normal

Group II. Thirteen patients had normal renograms which evolved to an abnormal pattern

TABLE I

	T ½	*BUN*	*Creat.*	*U.V./24 Hrs.*	*Creat. Cl.*	*Urine Lymphocytes*
	4.6	11	0.6	1797	——	Negative
Group I	7.5	21	0.9	2143	——	Negative
	8.1	17	1.2	2000	——	Negative
	6.0	31	2.2	3130	——	Negative
Group II	18.0	51	2.8	1050	——	Negative
	Inf.	94	4.1	550	——	3-5
	Inf.	19	1.0	3279	——	Many WBC
Group III	14.7	25	1.3	——	——	Negative
	7.6	16	1.0	——	——	Negative
	Inf.	64	6.6	1337	8.2	Negative
Group IV	Inf.	33	1.5	2314	26.7	Negative
	Inf.	43	1.1	2557	25.7	Negative
Cortical Necrosis	Inf.	120	12.6	0	——	————
Ureteral Obstruction	Inf.	10	1.0	1488	——	Negative
Tubular Necrosis	Inf.	141	15.0	1150	——	————

Group III. Eleven patients had abnormal renograms which returned to normal

Group IV. Seven patients had abnormal renograms which remained abnormal

Comparison of T ½ with conventional data is shown in Table I.

DISCUSSION

While visual inspection of the renogram tracing quickly delineates the grossly abnormal curve from the normal in the transplant subject (4, 5), determination of the T ½ time on serial tracings is of value in the assessment of renal excretory function.

Comparison of the renogram with conventional data in Group I, patients showed that a normal T ½ immediately posttransplant was consistent with normal renal function as measured by BUN, creatinine and creatinine clearance. (Group I, Figs. 1, 2, and 3).

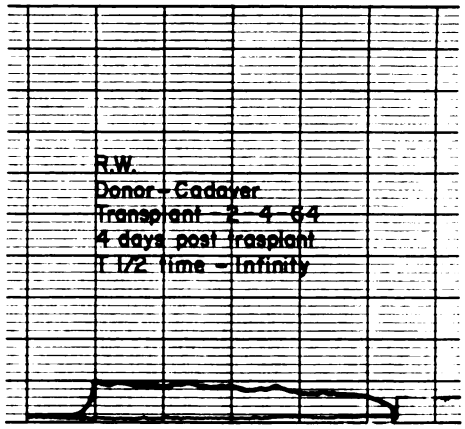
The classic rejection response was not seen in patients having a T ½ pattern which was initially normal and remained normal throughout the first week post transplant.

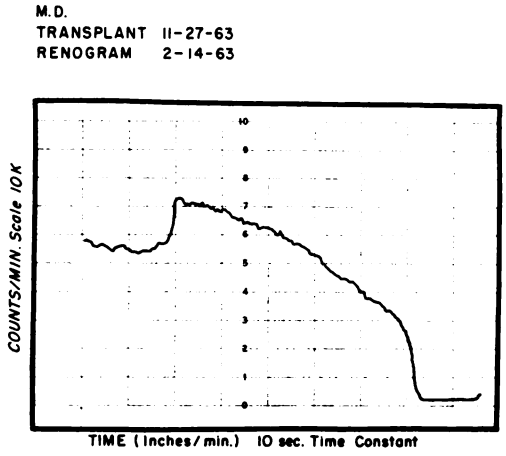
Patients in Group II had delay in T ½ that preceded the appearance of urinary lymphocytes and was ultimately followed by decrease in urinary output and subsequent rise in BUN and creatinine with development of the histologic picture of homograft rejection. (Group II, Figs. 1 - 3).

Renal handling of ortho-iodo-hippurate may be impaired early posttransplant in spite of a good urinary output as seen in patient, C. N., (Group III., Fig. 1) who had T ½ of infinity with urinary output of 3279 cc/24 hours. Subsequent return of T ½ to normal (Group III., Figs. 2, 3) occurred without rejection at subsequent followup.

Renal handling of ortho-iodo-hippurate again was impaired (Group IV., Figs. 1, 2, and 3) despite urinary output which ranged from 1.3-to-2.5 liters daily.

In addition to its being of value in predicting the need for increased immunosuppressive therapy which was employed in each patient, the renogram was useful in assessing renal function in cases of cortical necrosis, ureteral obstruction and tubular necrosis. Initial tracings obtained in cortical necrosis (Fig. 1), tubular necrosis (Fig. 2) and ureteral obstruction (Fig. 3) are clearly abnormal. Figure 1 shows a renogram obtained four days posttransplant in a patient with proven cortical necrosis and is characterized by complete absence of the vascular background and secretory segment, and it shows no excretion of the ^{131}I Hippuran during the twenty-minute period of inscription. This pattern is totally different from that obtained in the patients with tubular necrosis and ureteral obstruction. Figure 2 demonstrates the renogram from a patient with tubular necrosis and is characterized by the presence of the vascular background segment; however, the secretory segment is not delineated and there is a continuous rise of radioactivity. Figure 3 demonstrates a renogram, one day posttransplant, in a patient with ureteral obstruction. This renogram is characterized by the presence of the vascular background segment and shows a continuous rise following inscription of the





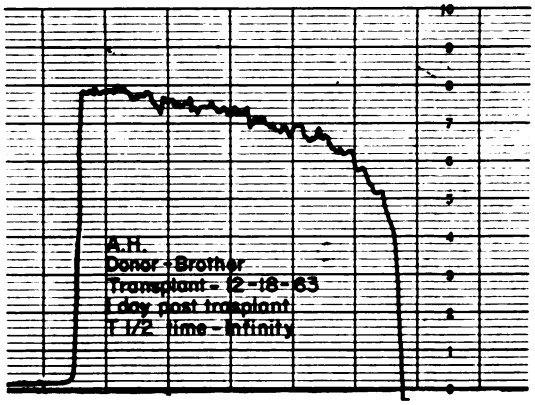
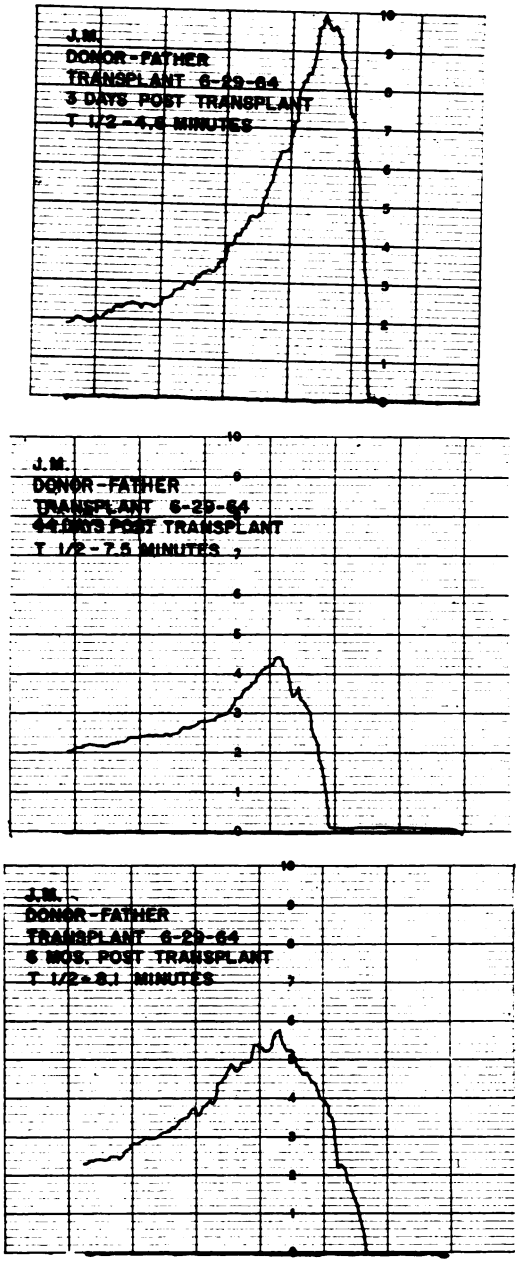


Fig. 1. *Top:* Cortical Necrosis. BUN 120. Creatinine 12.6. Urine Volume 0 cc/24 hours. Four days posttransplant.

Fig. 2. *Middle:* Ureteral Obstruction. BUN 10. Creatinine 1.0. Urine Volume 1150 cc/24 hours. Seventy-nine days posttransplant.

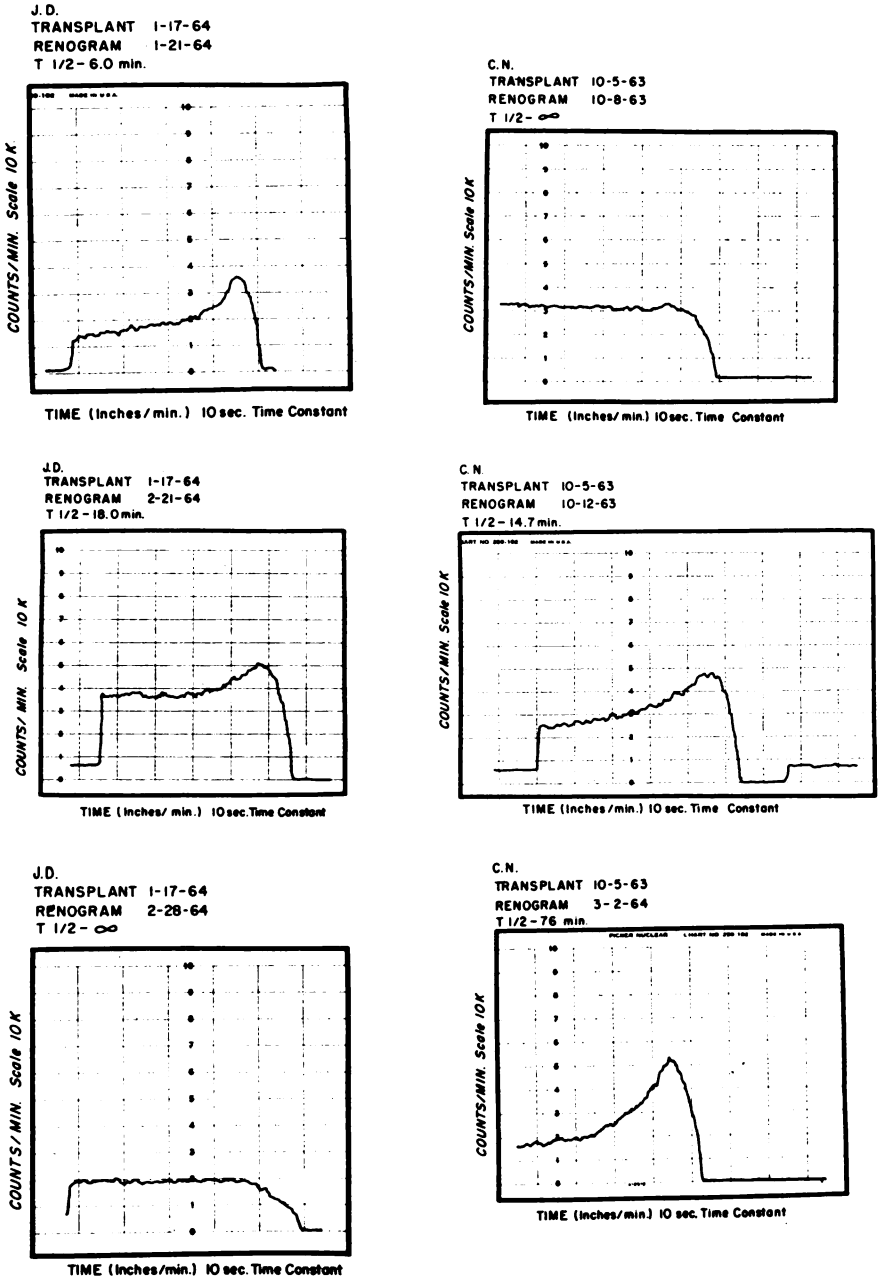
Fig. 3. *Bottom:* Tubular Necrosis. BUN 141. Creatinine 15. Urine Volume 1788 cc/24 hours. One day posttransplant.



BUN 11. *Top:* Creatinine 0.6. Urine Volume 1797 cc/24 hours. Urine negative for lymphocytes. Three days posttransplant.

BUN 21. *Middle:* Creatinine 0.9. Urine Volume 2143 cc/24 hours. Urine negative for lymphocytes. Forty-four days posttransplant.

BUN 17. Bottom: Creatinine 1.2. Urine Volume 2200 cc/24 hours. Urine negative for lymphocytes. Six months posttransplant.



BUN 31. ***Upper-Lt:*** **Creatinine 2.2. Urine Volume 3130 cc/24 hours. Urine negative for lymphocytes. Four days posttransplant.**

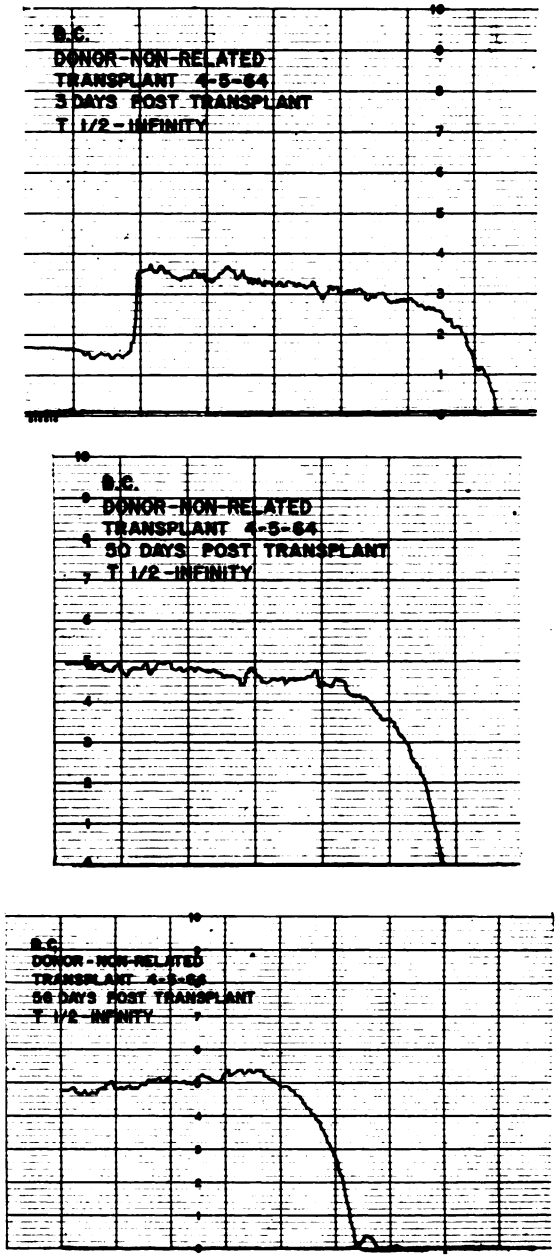
BUN 51. ***Middle-Lt:*** **Creatinine 2.8. Urine Volume 1050 cc/24 hours. Urine negative for lymphocytes. Thirty-five days posttransplant.**

BUN 94. ***Bottom-Lt:*** **Creatinine 4.1. Urine Volume 550 cc/24 hours. Three to five lymphocytes per high power field. Forty-two days posttransplant.**

BUN 19. ***Upper-Rt:*** **Creatinine 1.0. Urine Volume 3279 cc/24 hours. Many WBC in urine. Three days posttransplant.**

BUN 25. ***Middle-Rt:*** **Creatinine 1.3. Urine negative for lymphocytes. Seven days posttransplant.**

BUN 16. ***Bottom-Rt:*** **Creatinine 1.0. Urine negative for lymphocytes. 148 days posttransplant.**



BUN 64. *Top:* Creatinine 6.6. Urine Volume 1337 cc/24 hours. Creatinine clearance 8.2. Urine negative for lymphocytes. Three days posttransplant.

BUN 33. *Middle:* Creatinine 1.5. Urine Volume 2314/24 hours. Creatinine clearance 26.7. Urine negative for lymphocytes. Fifty days posttransplant.

BUN 43. *Bottom:* Creatinine 1.1. Urine Volume 2557 cc/24 hours. Creatinine clearance 25.7. Urine negative for lymphocytes. Fifty-six days posttransplant.

secretary segment with no excretion during the twenty-minute period. It is not felt that clear separation of the latter two conditions is readily apparent from the renogram although the initial rise in radioactivity was higher and more distinct in ureteral obstruction with some delineation of the secretory segment whereas this was absent in acute tubular necrosis. Placement of the second probe over the bladder in ureteral obstruction, since this was not complete, would perhaps aid in differentiating these two conditions as one would expect to see the appearance of radioactivity entering the bladder in incomplete ureteral obstruction sooner than in acute tubular necrosis. Comparison of the renogram tracings of the above three conditions with those seen in rejection reveal distinctly different patterns, however. Sequential tracings early in rejection are characterized by normal vascular background and secretory segment and show only a delay in the excretory segment with a prolonged T ½.

SUMMARY

Four hundred and eighty-four serial renograms have been performed in 39 patients following renal transplantation.

Four distinctive renogram patterns have evolved from this study. Normal patterns immediately posttransplant were obtained in grafts from related donors and persistence of this pattern has been observed up to twenty-four months.

Determination of T ½ time in serial renogram tracings showing improvement or degeneration correlated well with conventional renal function studies.

Renograms showing continued prolongation of the T ½ time were characteristic of ultimate rejection.

Patterns suggestive of acute tubular necrosis, ureteral obstruction and arterial occlusion were of aid in the management of patients.

A delay in the T ½ time while not characteristic of rejection occurs early in the rejection phase, frequently precedes change in conventional renal studies, and is of value in predicting the need for additional immunosuppressive therapy.

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