# RAPID SEQUENTIAL KIDNEY SCANNING WITH $^{131}$I-HIPPURAN

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To visualize the dynamics of the concentration and excretion of intravenously injected orthoiodohippurate ($^{131}$I-hippuran) by the kidneys, one can do rapid sequential scanning of the kidneys with a conventional scanner.

The renogram is valuable for the simultaneous differential evaluation of the vascularization, concentrating capacity and patency of the urinary tract of each kidney (*1–5*). Through experience with this technique (*6*) and its pitfalls we have found it necessary in certain cases to obtain additional information by also performing rapid sequential scanning, which not only allows more accurate interpretation of the renogram but also often adds vital information.

## METHOD

With the patient in a supine position, 80 $\mu$Ci of $^{131}$I-hippuran* are injected intravenously. The scan is started 2 min after injection. We use the Picker Magnascanner with a 5-in. crystal and a 31-hole collimator with a 3-in. focus. The scanner is preset before injection, and the following setup has proved adequate even though rapidly changing conditions are being recorded: Counting rate—6,000 cpm; range differential—40%; speed—80 cm/min; time constant—0.04 sec; spacing—0.45 cm; dot factor —8; color—10. The first scan is finished in about 10 min when the lower pole of the kidney is reached. The scan is then repeated with the same setup for the next 30–60 min according to the case. By using color scanning together with the photoscan one gets an almost quantitative comparison between the simultaneous activity in both kidneys and the sequential dynamics of each kidney separately.

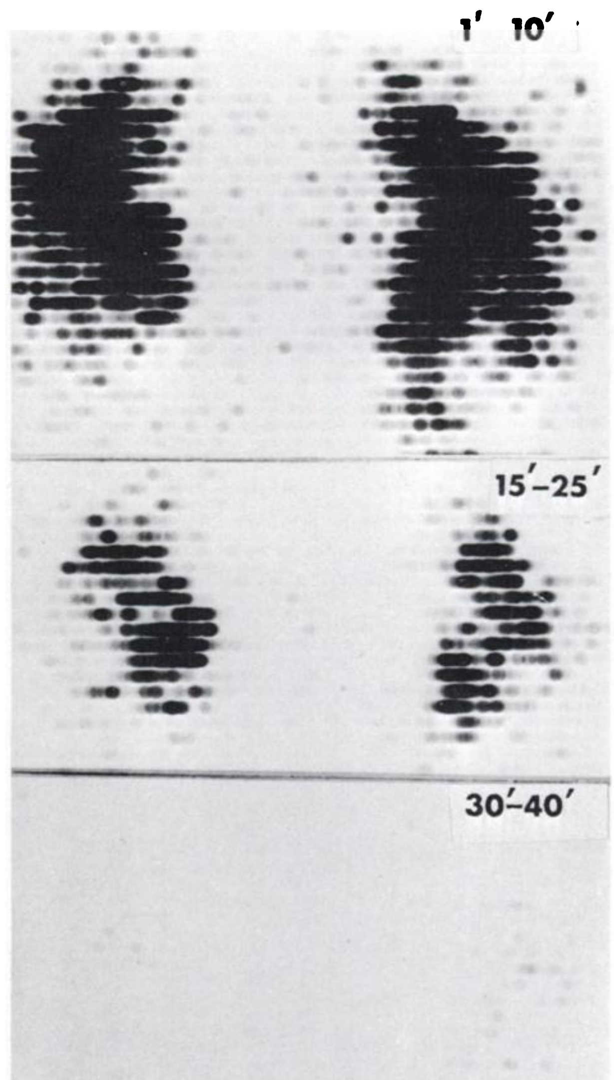


**FIG. 1.** Posterior-anterior scans of normal kidneys. Changing hippuran distribution with time is visualized.

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FIG. 2. Posterior-anterior renal scans of well-functioning kidney showing delayed clearance of radioactive material in right acute uretheral obstruction.

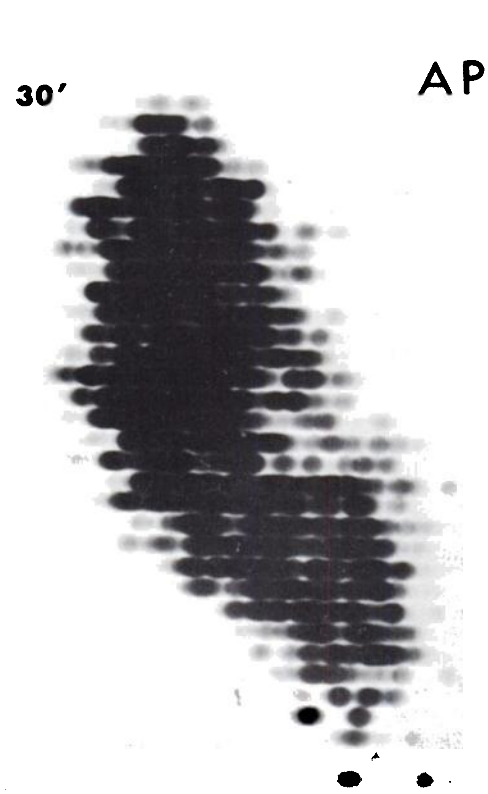


FIG. 3. Scan obtained during anuria in transplanted kidney in period of rejection. Hippuran is homogeneously distributed throughout renal parenchyma with no concentration in renal pelvis.

In cases of oliguria or anuria, a renogram is performed at the time of injection, and the scan is started 15–30 min later.

## CLINICAL RESULTS

The scan of a normal case is seen in Fig. 1. It shows that complete symmetry between both kidneys was maintained during the whole examination, which means that the rates of concentration and excretion are identical in both kidneys. The scan performed at 1–10 min shows the activity of the hippuran mainly in the cortical and medullary portions of the kidneys. From 10 to 20 min this activity decreases and shifts towards the renal pelvis. The scan performed at 20–30 min shows only a little hippuran left. In dehydrated patients the excretion is slower.

An example of urinary tract obstruction in a well-functioning kidney is shown in Fig. 2. The obstructed kidney retains the entire radioactive material at 30 min while the other kidney has already excreted almost all the hippuran it had previously concentrated.

This method has proven especially valuable in evaluating transplanted kidneys, under the following circumstances (*7–9*):

1. In cases of anuria following transplantation whenever doubt arises as to the patency of the arterial anastomosis, clear visualization of the trans-

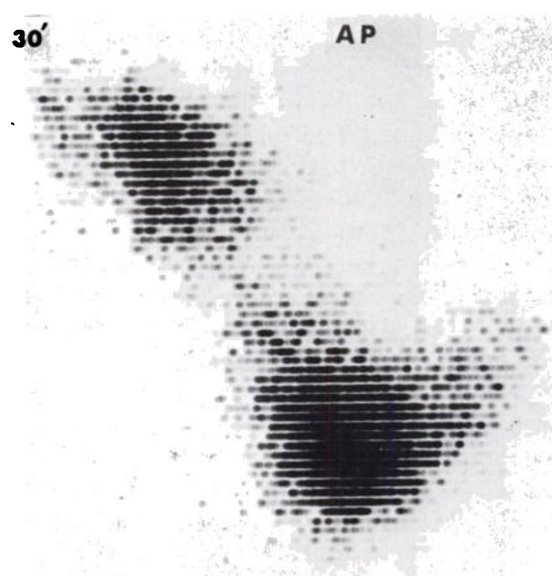


FIG. 4. Intra-abdominal urinary fistula. Hippuran is recognized in cellular spaces surrounding kidney and urinary bladder.

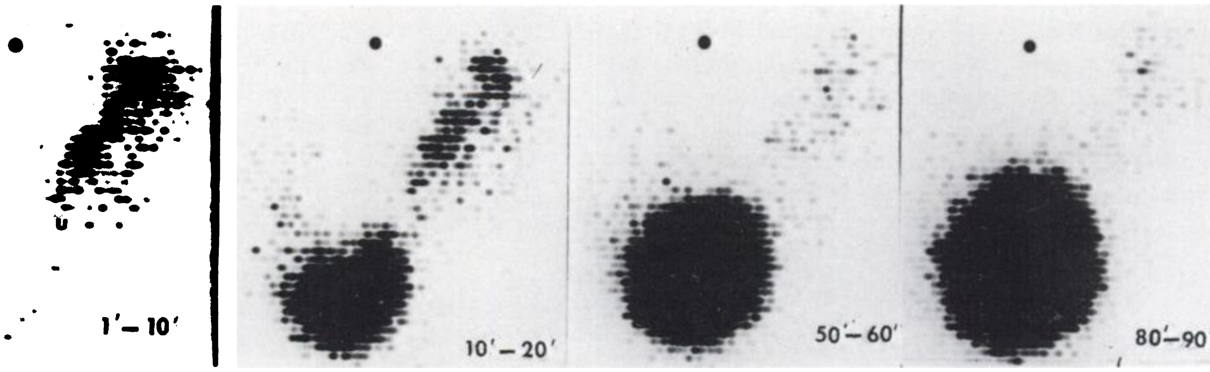


**FIG. 5.** Sequential scanning in case of double transplant. Anterior-posterior view. After rejection of first transplanted kidney in right side transplantation on left was made. Scan shows relative functional capacity. Right kidney is only scantily visualized.

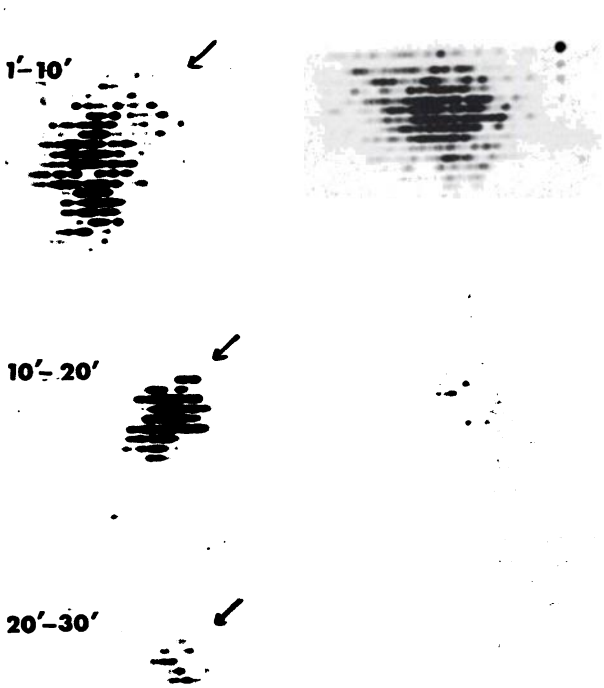


**FIG. 6.** Hypertension with regional ischemia of upper pole of left kidney. Scanning (P-A view) shows prolonged transit time of ischemic region with peak concentration at 10–20 min.

planted kidney implies a good blood supply. The homogeneous concentration of the radioactive material throughout the kidney with no increased concentration in the renal pelvis region suggests an intrarenal abnormality in the transport of hippuran which is suggestive of rejection (Fig. 3).

2. When it is necessary to irradiate the rejected kidney, it is extremely important to locate it exactly, because the transplanted kidney may change its original position, shifting towards the midline. Aiming the radiation field at the scar without previously locating the organ precisely can result in missing part or all of the kidney which therefore does not receive the radiation dose intended.

3. The renogram can give erroneous information about the patency of the urinary tract of the transplanted kidney. Because of the short ureter in transplants, the kidney and bladder are very closely located. This makes positioning of the renogram detector extremely critical in order to avoid contaminated information. Scanning easily overcomes this difficulty, and the consecutive visualization of kidney and bladder gives a correct idea of the actual situation, therefore letting one correctly interpret the renogram.

4. A similar problem arises when one is confronted with an intra-abdominal urinary fistula. In these cases, the $^{131}$I-hippuran-contaminated urine leaks around the kidney and this may be misinterpreted in the renogram as delayed excretion. An example of this is shown in Fig. 4 where the fistula was clearly recognized in early scans. This is of great importance for deciding whether urgent corrective surgery is necessary.

5. In cases of double transplants, the hippuran scanning has proved helpful for evaluating the relative function of both kidneys (Fig. 5).

In hypertension due to unilateral renal artery stenosis, sequential scanning visualizes the difference in transit time between both kidneys. The scan of maximal concentration appears late in the ischemic kidney compared with the normal one. Although similar information can also be obtained from the renogram, the scan may yield added information by depicting regional ischemia in the renal parenchyma. As can be seen in Fig. 6, there is clear delay in the peak of the concentration, and excretion is slow mainly in the upper pole of the left kidney. Such a finding is most valuable in planning corrective treatment.

Using expensive pieces of equipment Sigman, Bender and Blau (*10*), Anger (*11*) and Burke and Halko (*12*) have obtained information similar to that which we have presented. Our experience shows that a conventional scanner can provide equally valuable data about the kidneys because the dynamics studied are sufficiently slow.

## SUMMARY

The dynamics of hippuran in the kidneys have been studied by rapid sequential scanning performed with a conventional scanner.

This method has proved especially useful in:

1. the interpretation of the causes of anuria in transplanted kidneys,
2. the early recognition of intra-abdominal urinary fistula and
3. the recognition of localized partial ischemia of the kidneys.

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