

Use of Tc-99m Glucoheptonate in Surgical Complications of Renal Transplant

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We have evaluated Tc-99m glucoheptonate for use in renal transplants. We find it detects such surgical complications as urinary extravasation, lymphocele, and postrenal obstruction. The scintigrams were of excellent quality. Functional evaluation of nonsurgical complications was not possible. Whenever both structural and functional information is desired, it may be wise to perform studies with both glucoheptonate and orthoiodohippurate.

The kidney graft may be subjected to a variety of complications after transplant, both early and late. Most of the derangements are principally *functional* in nature and do not require high resolution imaging (1-4). Some, however, such as urinary extravasation are principally *structural* in nature and require as high resolution as possible (5-7).

In the management of such patients in our institution, we routinely use a computer-assisted comprehensive renal function study (CRFS), using I-131 orthoiodohippurate (OIH). It differentiates with high precision and sensitivity the type and degree of functional impairment (8,9) and to a slightly lesser extent structural information.

When high resolution anatomic or structural information is desired, we have used Tc-99m glucoheptonate (GH), a radiopharmaceutical widely used for cortical imaging. While it provides some functional information, exactly how much has been conjectural. The purpose of this article is to analyze the functional component provided by GH in selected patients with surgical complications in the post-transplant period; these patients have also been studied with OIH.

Materials and Methods

Patients: 20 consecutive patients in various stages af-

ter transplant were studied by both CRFS and GH, usually on the same day or within one day. Later, 30 selected patients had GH studies when an infarction, a lymphocele, urinary extravasation or postrenal obstruction by clot, stone, ureteral stricture, or edema was suspected.

Imaging: 150 μ Ci of OIH (less than 1.5% of free iodide) was injected in a normally hydrated patient under the LFOV Ohio Nuclear camera. Data were collected on computer-compatible magnetic tape for further processing (Informatek SIMIS 3). At 30 min an image (1-min acquisition) of the bladder was obtained and the procedure was repeated after urine collection. The injection site was routinely imaged. A 44-min blood sample was drawn for effective renal plasma flow (ERPF) calculation. The ERPF, fraction of the activity excreted at 35 min, bladder residual urine, and excretory index (EI) were then calculated by the computer as reported previously (10,11).

Five mCi of Tc-99m glucoheptonate (Glucoscan, NEN) was carefully calibrated and injected into the patient under the camera. Images were displayed in 3-min frames using the Ohio Nuclear Ultimat from 0 to 30 min. The computer acquisition and urine collection were identical to the CRFS. Creatinine and BUN serum levels were obtained.

Results

Results from the first 20 patients are presented in Table 1.

While urinary excretion of OIH at 35 min well reflects the function of the graft if obstruction is not present, this is not true with GH. The fraction retained in the kidney was not proportional to plasma flow, and the amount of Tc-99m GH excreted in the urine at 35 min varied widely in the group of normal subjects (8-28%), not allowing us to identify the patients with rejection (5-11%).

The sequential scintigraphic images were, however, of excellent quality with impressive definition of the kidney parenchyma and collecting system.

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TABLE 1. Results of CRFS in 20 Patients.

No.	Age/Sex	Diagnosis	ERPF ml/min	OIH % excreted	GH % excreted	Serum Creatinine mg %
1	35 M	Acute rejection	297	36	5	3.5
2	21 M	Normal	330	63	28	0.8
3	55 M	Normal	247	63	16	1.2
4	37 M	Acute rejection	212	26	11	2.8
5	41 M	Normal	251	58	16	1.1
6	36 F	Normal	384	56	8	1.1
7	30 M	Normal	325	62	25	1.4
8	26 M	Normal	284	58	14	1.3
9	29 M	Normal	348	60	-	1.1
10	17 M	Normal	425	69	18	1.6
11	29 M	Chronic rejection	161	50	9	2.1
12	32 M	Chronic rejection	136	41	10	6.5
13	39 M	Normal	281	-	-	2.0
14	35 M	Normal	342	63	23	1.2
15	32 M	Normal	-	-	11	1.1
16	35 M	Normal	403	75	8	1.2
17	36 M	Normal	322	76	19	1.2
18	24 M	Normal	405	72	14	1.3
19	53 F	Chronic rejection	160	44	11	1.2
20	41 M	Normal	262	64	16	1.4

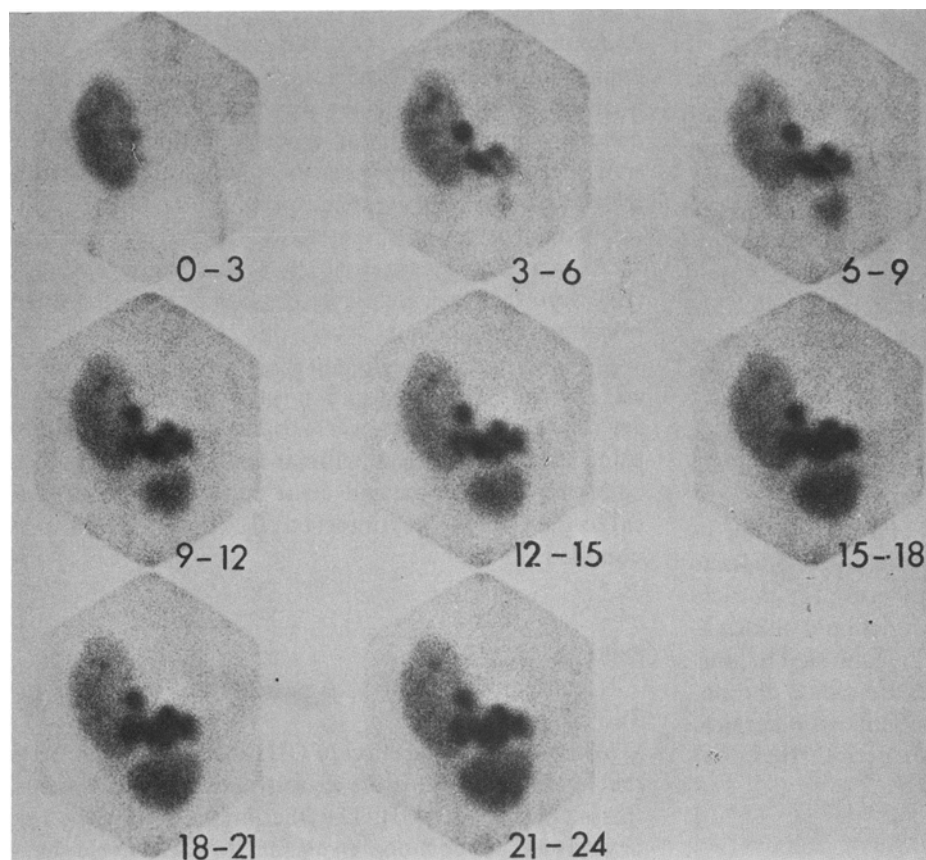


FIG. 1. Sequential scintigrams show urinoma localized between pelvis and urinary bladder. Postvoid scintigram (not shown here) demonstrates emptying of bladder and retention of activity in urinoma.

Functional data were obtained by CRFS; additional studies with GH were performed only if anatomic detail of the graft and collecting system was required to improve the diagnostic conclusion.

We present some specific cases to demonstrate the ad-

vantages of using GH. For example, patient 1 is a 36-year-old man who had been treated for 13 years for high blood pressure. He required dialysis for the past three years because of renal function deterioration. In February 1978, he underwent bilateral nephrectomy for

malignant hypertension and on March 22, 1978, received a living related donor (LRD) kidney found identical by histocompatibility typing. His postsurgical course was complicated by mild acute tubular necrosis (ATN) with rapid improvement in function. On March 31, 1978, he started to complain of pain in the bladder region. The excretory urogram (EXU) was negative. The CRFS performed on April 3, 1978, was suggestive of a pattern of obstruction. This was even more prominent three days later (ERPF: 197 ml/min, EI: 0.43, peak activity: 9 min). The Tc-99m GH scintigram obtained on April 10, 1978, was consistent with extravasation of urine (Fig. 1). The EXU performed the next day was consistent with this finding (Fig. 2). Surgery (on April 12) revealed a necrotic distal ureter with urine extravasation.

Patient 2, a 31-year-old woman, was on dialysis since September 1979 for end stage renal disease. February 20, 1978, she received a LRD kidney (3 antigen match). She had one acute rejection episode and was discharged on April 19, 1980, with a serum creatinine of 1.3 mg%. On May 27, 1980, she was seen by a nephrologist who found her blood pressure to be 220/129 mmHg and serum creatinine 1.8 mg%. The EXU, on admission, showed slight narrowing of the distal ureter and the CRFS revealed markedly decreased function (ERPF: 73 ml/min,

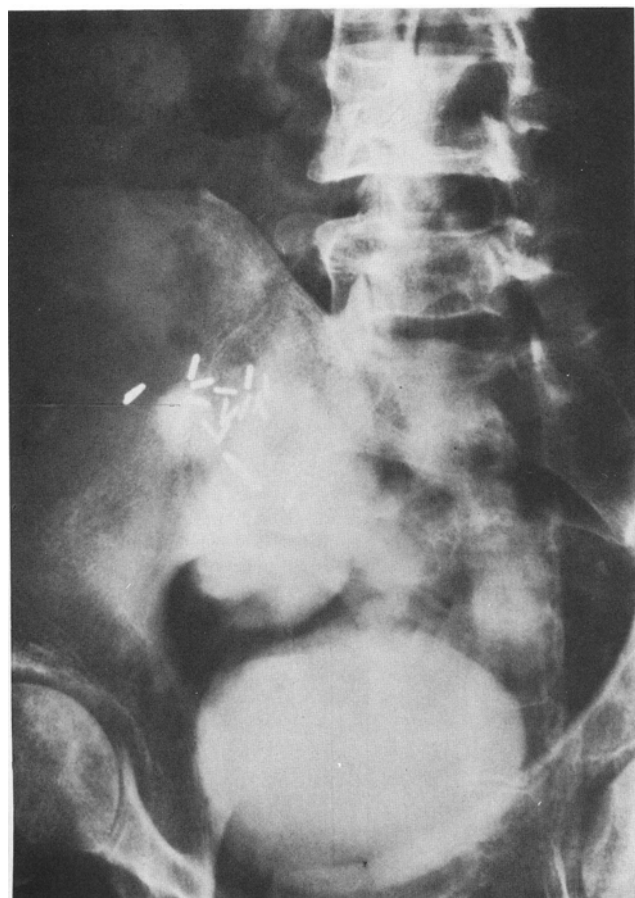


FIG. 2. Excretory urogram confirming diagnosis of urinoma.

EI: 0.26, peak activity time: 15 min) consistent with acute rejection and suggestive of obstruction (3). Renal biopsy was at this point compatible with acute, cell-mediated rejection. The Tc-99m GH scintigram showed an abnormal pattern of radiohippurate drainage around a space-occupying defect (Fig. 3). Ultrasound study confirmed the diagnosis. A lymphocele (10 × 10 cm with 400 ml of fluid) localized behind the bladder was drained on June 9, 1980.

Patient 3 is a 22-year-old man being treated for Wegener's granulomatosis with severe end stage renal disease. On February 9, 1979, he received a LRD kidney (3 antigen match). The postsurgical course was uncomplicated and renal function was stable. On February 21, 1979, the CRFS revealed an obstructive pattern (ERPF: 338 ml/min, EI: 0.25, peak activity time: 21 min) with good function. The Tc-99m GH scintigram localized the obstruction to the uretero-vesicle junction (Fig. 4). The EXU confirmed partial obstruction and at surgery the ureter was reimplanted into the bladder.

Patient 4 is a 30-year-old man being treated for end stage renal disease, nephrosclerosis, and hypertension with serum creatinine around 8 mg%. He received a cadaver kidney graft on January 29, 1979. The postsurgical course was uncomplicated. The CRFS performed on February 8, 1979, revealed a normal function (ERPF 395 ml/min, EI: 0.84, peak activity: 4 min) with mild dilation of the ureter. The Tc-99m GH scintigram revealed slight narrowing of the ureter at the bladder junction with no pelvic and calyceal dilatation (Fig. 5). This was felt to represent edema around the implanted ureter. The

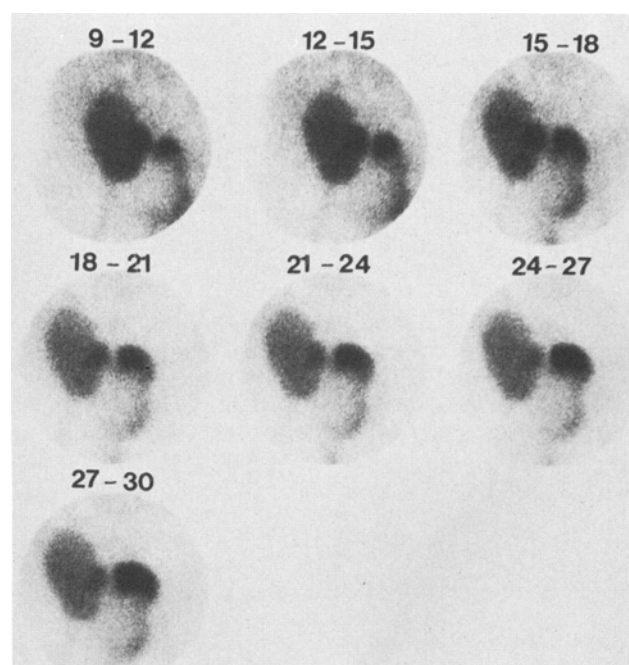


FIG. 3. Lymphocele displacing ureter to right and bladder to left. Post-void scintigram (not shown here) demonstrates emptying of activity from distorted bladder.

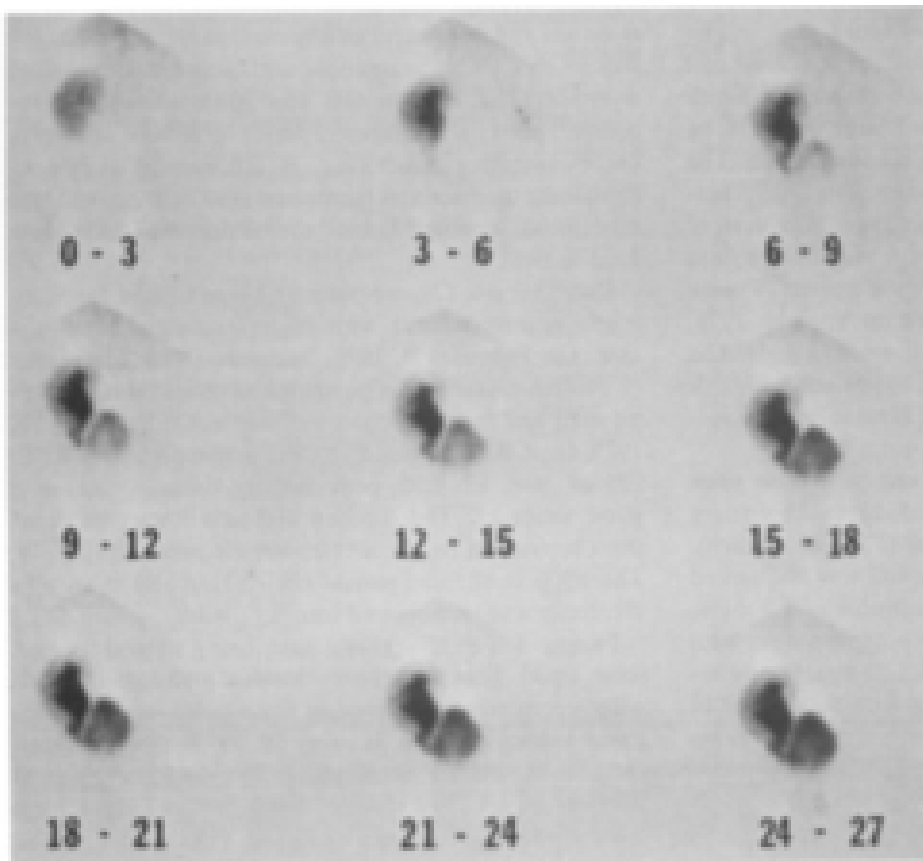


FIG. 4. Incomplete obstruction at ureteroblaster junction causing dilatation of ureter and pelvis.

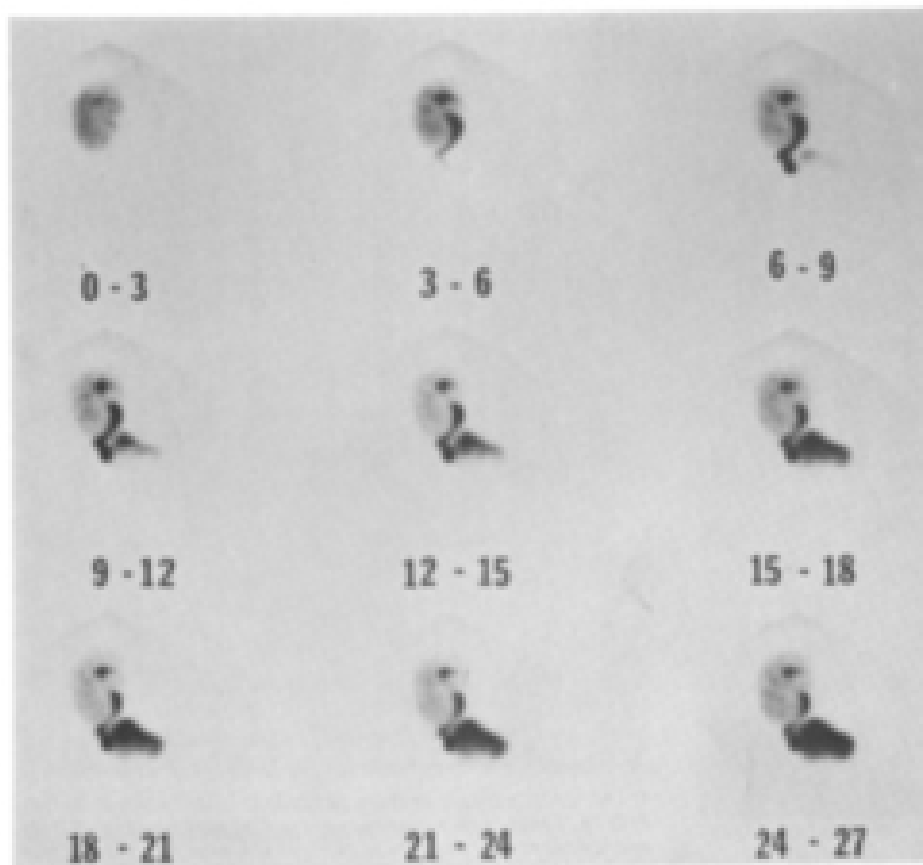


FIG. 5. Edema at ureteroblaster junction, often seen in early post-transplant period, causes slower transit of activity from ureter into bladder; however, no dilatation of collecting system is present.

following study was within normal limits.

In all these cases, the OIH image was positive, but the GH was more revealing. Functional information content from the GH images was minimal, that from OIH much more revealing.

Discussion

Technetium-99m glucoheptonate has been used for renal imaging for years (12). It is loosely bound to plasma proteins and excreted by both glomeruli and tubules. Since it partially (5–10% of dose) remains fixed to the renal cortex, it therefore does not reflect any single parameter of renal function. Due to the cortical fixation and to the excretion it is possible to visualize abnormalities of the collecting system as well as the renal parenchyma. In renal transplant, kidney function is best evaluated by quantitative measurement of ERPF combined with scintigraphy. The OIH scintigrams in every case of surgical complications were abnormal and suggestive of the problem but the resolution was suboptimal. The radiological evaluation (excretory urogram) is sometimes complicated by the position of the graft in the pelvis, poor preparation of the patient, presence of surgical clips; it is often complicated by low contrast concentration in kidneys with ATN or rejection. Ultrasound and computerized tomography are helpful; however, they are not always readily available. Sequential imaging with Tc-99m GH is rapid, inexpensive, and does not require patient preparation. It helps to localize obstruction and to differentiate extravasation, urinoma, and lymphocele with respect to normal structures in the pelvis.

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