Functional Oncocytoma of the Kidney: Evaluation by Dual Tracer Scintigraphy

Victor W. Lee, Jeffrey Allard, John Foster, Kieran Sheahan, and Peter Franklin

Departments of Radiology & Pathology, Boston City Hospital, Boston University School of Medicine, Boston, Massachusetts

We report a case of renal oncocytoma with a unique scintigraphic pattern. The tumor showed strong avidity for [^{123}I]iodohippurate, but no affinity for [^{99m}Tc] glucoheptonate. We offer an explanation for such exceptional scintigraphic finding, which may potentially enable us to make a pre-operative diagnosis of renal oncocytoma in the future.

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Various radiotracers are known to concentrate in normal renal parenchyma, such as technetium-99m glucoheptonate ([^{99m}Tc]GH), [^{99m}Tc]dimercaptosuccinic acid (DMSA), and iodine-123 (^{123}I) orthoiodohippurate (OIH), and have been used for evaluation of renal function as well as of renal mass lesions. Both benign and malignant neoplasms are almost invariably shown to be nonfunctional (cold) in the delayed static scans using these renal radiotracers, while dynamic scintigrams (tracer angiograms) may demonstrate hypervascularity. A benign neoplasm such as oncocytoma, therefore, could not be differentiated from malignant carcinoma by scintigraphy in the past (*1,2*).

The only renal tumor that concentrates [^{99m}Tc]GH consistently is nephroblastic nephromas in neonates (*3*). Among adults, there are only two cases of renal neoplasms (adenoma and carcinoma) reported in the literature, showing avidity of [^{99m}Tc]DMSA and [^{99m}Tc] GH (*4*). Recently, we encountered a patient with a renal mass lesion, which was functional on [^{123}I]OIH scintigram, but it was nonfunctional on [^{99m}Tc]GH scans. It was later proven to be an oncocytoma. This observation has not been previously reported (*5–7*). If this finding is confirmed by a larger series in the future, [^{123}I] OIH scintigram may be useful pre-operatively for differentiating oncocytoma from other malignant renal tumors, leading to better surgical planning and management.

CASE REPORT

The patient was a 58-yr-old black woman, who was in the hospital because of recurrent abdominal infections. She had a history of chronic renal failure that became worse while she was in the hospital. Renal ultrasound was first performed to rule out the possibility of obstructive uropathy as the cause of deteriorating renal function. The sonograms demonstrated two lesions; one was a simple cyst and the other was an echogenic mass in the right kidney. The possibility of hemorrhagic cyst was considered as a likely cause of the echogenic lesion. Computerized tomography (CT) demonstrated a well-defined, slightly hyperdense mass, protruding from the cortex of the right kidney (Fig. 1). A malignant tumor of the kidney was suspected and renal surgery was planned.

An [^{123}I] OIH scan was performed to evaluate renal function before surgery (Fig. 2). The solid renal mass was shown to be functional (hot), concentrating [^{123}I] OIH both in the early (5-min) and the delayed (20-min) scans. Since functional renal tumors (benign or malignant) are unusual, a [^{99m}Tc] GH scan was performed (Figs. 3 and 4). The mass lesion was shown to

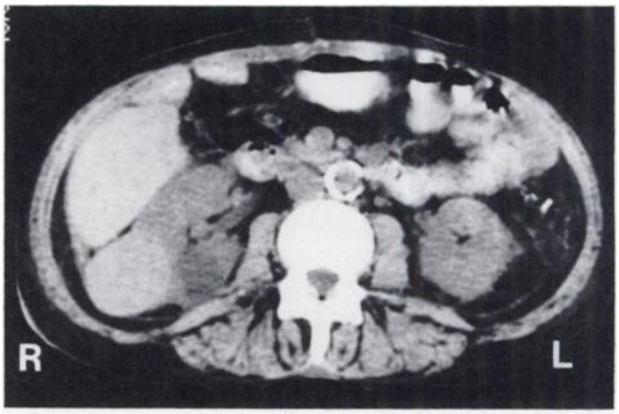

FIGURE 1
Noncontrast Ct scan revealed an exophytic mass in the right kidney slightly hyperdense compared with renal parenchyma. A second lesion in the right kidney was hypodense and proved to be a simple cyst.

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For reprints contact: V.W. Lee, 10 Mohawk Dr., Framingham, MA 01701.

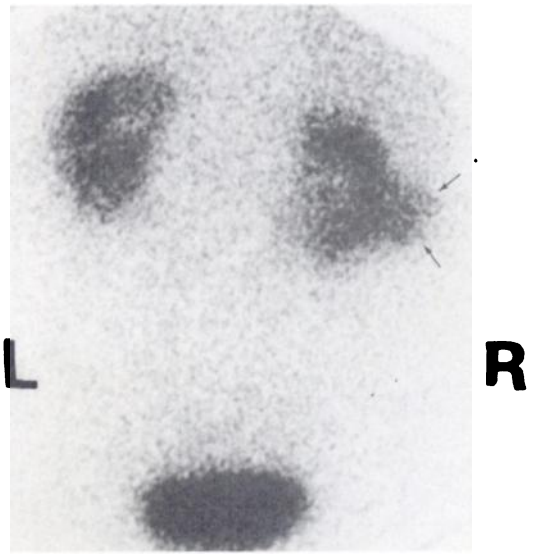

FIGURE 2
Static [^{123}I] OIH scans were performed after intravenous injection of 0.9 mCi of tracer. The scans were performed 5 min and 20 min and they demonstrated marked uptake of [^{123}I] OIH by the exophytic renal mass (arrows).

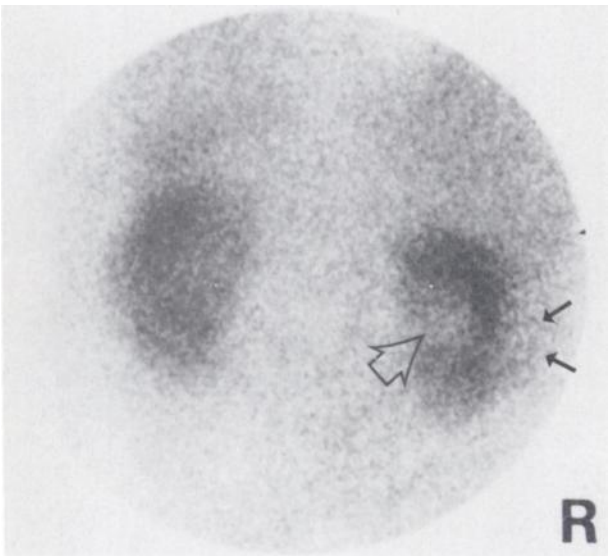

FIGURE 4
The static [^{99m}Tc]GH scans performed 3 hr after injection revealed that the exophytic renal mass was nonfunctional (cold) (thin arrows). A second "cold" lesion later proved to be a cyst (open arrow).

be hypervascular by tracer angiogram and was nonfunctional (cold) in the delayed (3-hr) scan. The findings of the [^{99m}Tc] GH scans were entirely consistent with the clinical diagnosis of renal neoplasm.

Right nephrectomy was later performed. Pathologic section demonstrated a 3.5 cm × 3 cm, well-defined, round tumor located in the renal cortex (Fig. 5). A tentative diagnosis of carcinoma of the kidney was considered because of the morphology revealed by light microscopy. However, in view of the unusual preoperative scintigraphic finding showing that the tumor was functional on [^{123}I]OIH, further examination by electron microscopy was performed, leading to a revised diagnosis of oncocytoma (Fig. 6).

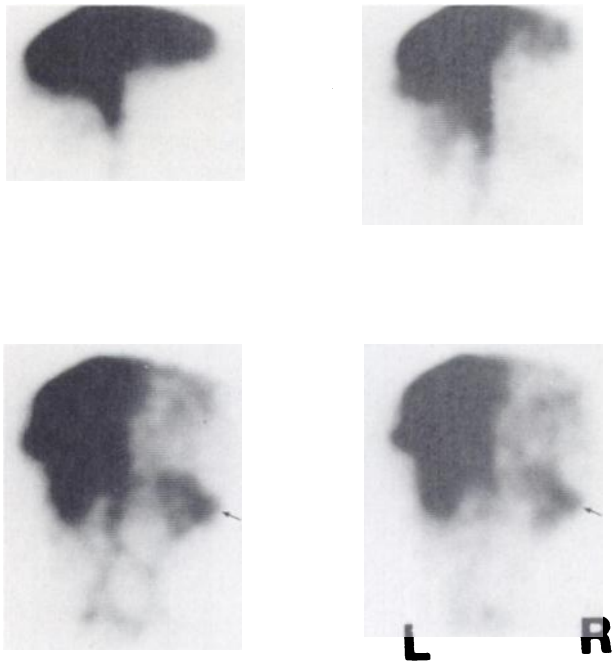

FIGURE 3
Dynamic scans (tracer angiograms) were performed after intravenous injection of 15 mCi of [^{99m}Tc] GH. The exophytic renal mass of the right kidney was hypervascular (arrows).

DISCUSSION

Most people believe that renal oncocytoma is a benign tumor, arising from the proximal renal tubules. It affects mostly patients in their sixth to seventh decade without any sex preponderance (*5–7*). The pre-operative diagnosis is extremely difficult since it shares many features of malignant renal cell carcinoma, as demonstrated by various imaging modalities. Typical findings include echogenic mass on sonogram, contrast-enhancing mass on CT with variable densities on noncontrast scans, and nonfunctional (cold) nature in [^{99m}Tc]GH scintigrams. Hypervascularity is usually demonstrable on tracer angiogram. Contrast angiogram is usually most helpful in the diagnosis of oncocytoma, demonstrating a "spoke-wheel" pattern, rim vessels, and a homogeneous blush (*5–7*). This angiographic pattern is not entirely specific, because one-third to one-half of the renal masses showing this pattern turn out to be renal cell carcinomas (*6–7*). Therefore, the pre-operative diagnosis of oncocytoma is often impossible, even though its importance for proper patient management is self-evident.

Since oncocytoma was thought to arise from the

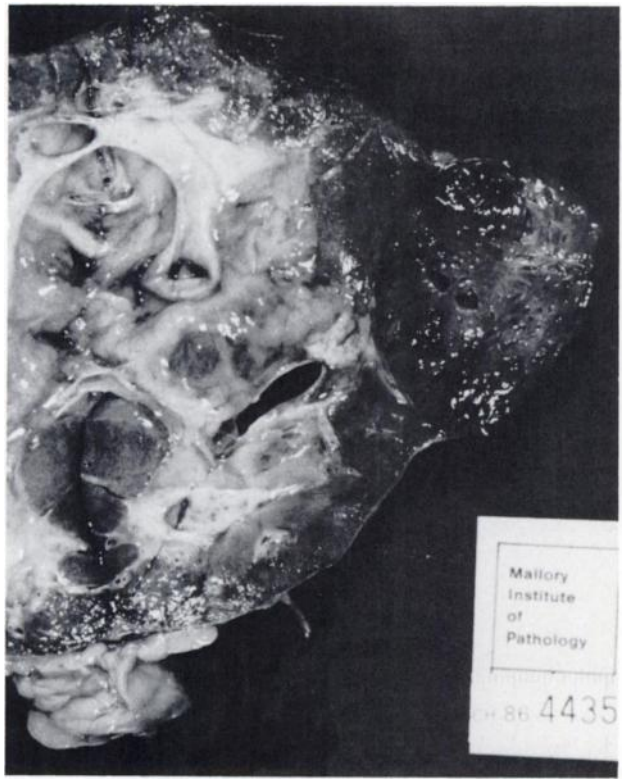

FIGURE 5
Gross specimen of the right kidney after nephrectomy demonstrated a 3.5 cm × 3 cm × 1 cm exophytic, well circumscribed cortical tumor. It was tannish brown in color.

proximal tubules, usually showing good histologic cell differentiation, Lautin et al. attempted to use [^{99m}Tc] GH to demonstrate the functional capability of oncocytoma (*5*). However, all four of his cases of oncocytoma failed to concentrate [^{99m}Tc] GH, being nonfunctional (cold) on the delayed scans, exactly as in our case report (Figs. 3 and 4).

The results were rather unexpected by Lautin, because [^{99m}Tc] GH was known to be bound to cells of the proximal tubules (*5*). Even though the exact biologic characteristics of [^{99m}Tc]GH are only partly known and are still controversial, perhaps, in retrospect, we may attempt to explain our observation. Technetium-99m GH is predominately excreted by nephrons through glomerular filtration, entering into the lumen of renal tubules. Only a small portion (5% to 10%) of the tracer is then extracted from the lumen and then bound to cells of proximal tubules (*1,2,8,9*). Since oncocytoma is composed of mainly tubular cells without glomerular elements, [^{99m}Tc]GH tracer is unable to reach the tubular cells (*1,5*).

On the other hand, only 20% of [^{123}I] OIH is excreted by normal renal tissue through glomerular filtration, while 80% is actively secreted through the proximal tubules via the direct blood supply from the efferent vessels (*1,2*). Therefore, the concentration of [^{123}I]OIH is not precluded by the absence of glomeruli in oncocytoma. Once secreted in the tumor, [^{123}I]OIH is retained since there is no direct communication between the neoplastic tubules and the collecting tubules, unlike the normal renal parenchyma (Fig. 2). Lautin et al. had one case of oncocytoma that failed to show any definite uptake of [^{131}I]OIH. This may have occurred as they explained themselves, because the scan was technically suboptimal based on the physical limitation and poor quality of scintigrams using ^{131}I tracers. The scintigrams in our case report was performed with [^{123}I] OIH giving us much superior spatial resolution and imaging quality, since [^{123}I] has much more desirable physical properties (gamma emitter of 159 keV photon energy without beta emission).

We emphasize the importance of using [^{99m}Tc]GH scintigrams in addition to [^{123}I]OIH. The nonfunctional nature of a renal mass on [^{99m}Tc]GH will exclude the

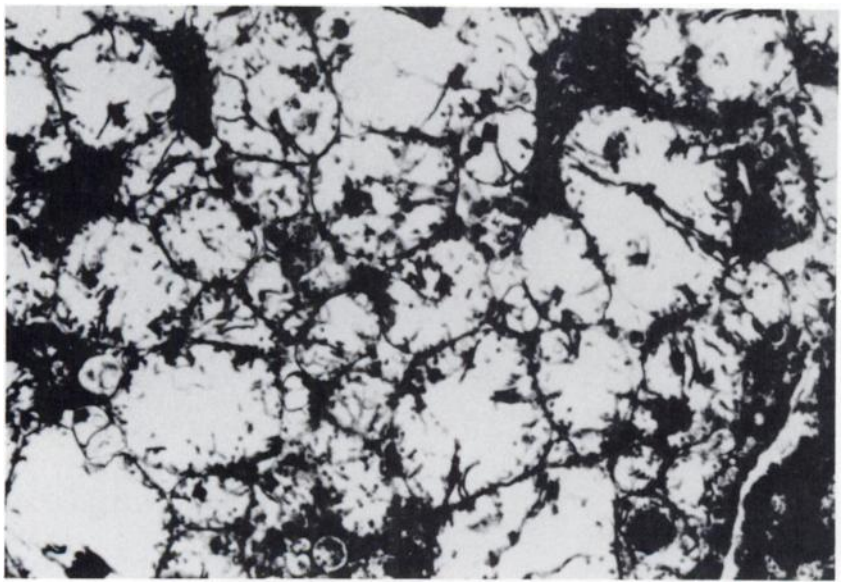

FIGURE 6
Electron microscopy demonstrated the tumor cells were packed with mitochondria. This abnormal pattern is characteristic of oncocytoma.

differential diagnosis of pseudomasses (hypertrophied column of Bertin and dromedary humps). In short, our observation of the functioning capability of oncocytoma appears to have a logical and physiologic basis. It is probably more than just a fortuitous exception to the rule. Needless to say, this hypothesis has to be tested vigorously by examining a larger series of oncocytoma in the future. If this turns out to be correct, this will lead to much better pre-operative diagnosis and better management of patients affected by oncocytoma.

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