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The ROENTGENOGRAPHIC DIAGNOSIS of RENAL MASS LESIONS

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By

ERICH K. LANG, M.D.

Professor and Chairman
Department of Radiology
Louisiana State University Medical Center
School of Medicine in Shreveport
Shreveport, Louisiana

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The
ROENTGENOGRAPHIC DIAGNOSIS
of
RENAL MASS LESIONS

A Monograph in

MODERN CONCEPTS OF RADIOLOGY
NUCLEAR MEDICINE AND ULTRASOUND

Series Editor

LEWIS E. ETTER, M.D., F.A.C.R.
Professor of Radiology
Western Psychiatric Institute
and Falk Clinic
Presbyterian-University Hospital
School of Medicine
University of Pittsburgh
Pittsburgh, Pennsylvania

FOREWORD

ROENTGEN DIAGNOSIS IN ALL FIELDS, but particularly in urology, has been undergoing an unheralded but nonetheless extremely significant metamorphosis. Hitherto, the scope of roentgen diagnostic evaluation of the urinary excretory system was limited to the investigation of normal and morbid anatomy. In the recent past, however, the demand for a final and definitive diagnosis has been established for both clinical and laboratory diagnostic examinations. This change of diagnostic goal and concept has prompted diagnostic radiology to acquire a new dimension.

The mere roentgen diagnosis of "space-occupying lesions of the kidney" is no longer acceptable and a differentiation of inflammatory, benign and malignant neoplastic lesions involving the kidneys is expected from the radiologist today.

With this demand in mind, diagnostic radiology has been expanded by innumerable special roentgenographic techniques and the data presentation has been advanced by the introduction of technically advanced equipment.

It is hoped that this monograph will bring together the vast amount of previously scattered information on newer and special roentgenographic techniques designed for assessment and differentiation of renal mass lesions and that it will meet the need for a comprehensive and authoritative survey on these diagnostic roentgenographic examinations. The presentation will not only attempt to establish a rationale for proper sequence in which a special examination modality should be deployed but also acquaint the reader with the diagnostic accuracy which can be expected each and every one of these examinations.

No book ever reaches fruition as a result of the author's efforts

alone. The efforts of my secretary, Mrs. Kathryn Wendt, and Mr. Gordon Maxcy of the Art and Photography Department at Confederate Memorial Medical Center are acknowledged with sincere thanks.

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CHAPTER I

INTRODUCTION

THE LAST DECADE has witnessed a change in the diagnostic goal of the assessment of renal mass lesions (21, 101). In the past, the obligation of the diagnostician ceased after establishing the diagnosis of a space-occupying lesion in the kidney. Today, differentiation of the various types of space-occupying lesions is considered mandatory (75, 76, 121, 123). The need for the development of various diagnostic tests capable of differentiating and assessing renal cysts and tumors was established by a change of the predominant age group in whom asymptomatic space-occupying lesions were first recognized and by the demand to establish a definitive diagnosis to obviate surgical exploration (144).

The change in statistical occurrence of cyst and tumor is, undoubtedly, related to the marked increase in the use of intravenous urography as a routine screening examination in a urologic patient group which shows a rapid preponderance of patients past the fifth decade. Prior to 1926, not a single case of renal cyst was found among 12,500 admissions to the Brady Urologic Institute, Johns Hopkins Hospital. In the 1940's, the incidence rate of cysts was considered one-half that of carcinoma. Today, however, the incidence rate of cysts presenting as symptomatic and asymptomatic space-occupying lesions exceeds, by far, that of tumors. This, undoubtedly, reflects our increased ability to recognize space-occupying lesions and the expanded use of screening intravenous urography in a urologic patient population that has substantially increased in average age. Renal carcinoma is not a common malignancy; it constitutes no more than 1 to 2 percent of all cancers (242). Renal cysts, however, are found in 3 to 5 percent of all routine autopsies (41). Our ability to recognize such space-occupying lesions is best denoted by reports in the recent literature

claiming a 2 percent incidence of renal mass deformity seen on the routine intravenous urograms performed on patients requiring prostatectomy (33).

Our recently gained ability to recognize many asymptomatic space-occupying lesions that evaded detection in the past necessitates a reevaluation of our concepts of management of such lesions (101, 145). In the past, the demonstration of a space-occupying lesion in the kidney almost certainly indicated the presence of a neoplasm. Hence, surgical exploration was the method of choice. Today, the diagnosis of an asymptomatic space-occupying lesion in the kidney would more often indicate the presence of a cyst than a tumor. In the past, many authorities have advocated exploration of all asymptomatic space-occupying lesions in all patients without medical contraindication to surgery. This concept must be reevaluated in the light of the statistical data of curability of a given mass lesion against the incidence of surgical mortality and morbidity for the patient (114, 144, 146, 223, 236, 237).

The incidence of surgical mortality and morbidity accelerates sharply with rising age and casts considerable doubt on the efficacy of exploration as a diagnostic procedure (144). Lassen analyzed the progressive increase of operative mortality rate in all elective procedures for various age groups (168.) An operative mortality rate of 2 percent was established for the 40-year age group. For the 65-year age group this rose to almost 10 percent and for the 80-year age group, the unacceptable figure of over 25 percent had been reached. The increased mortality or permanent disability in this older age group was confirmed by Plaine, *et al.,* who reported a mortality-morbidity incidence rate of 2.4 percent in their patients operated for serous cysts (223). Moreover, 11 percent of unnecessary nephrectomies resulted from exploration of space-occupying lesions either because the benign nature of the lesion could not be determined at operation or because hemorrhage had been impossible to control otherwise. Apart from the significant risk of surgical exploration, this procedure is not infallible in the detection of cancer and cases of surgically missed neoplasms have been reported (101, 116).

In order to ascertain the statistical significance of these delib-

erations, Plaine established the formula "chance of missing carcinoma = incidence of cancer × percent inaccuracy of tests" (Table I). The diagnostic accuracy, therefore, depends on appropriate assignment of the patient to a group with an established

TABLE I*
CHANCE OF MISSING CANCER = INCIDENCE OF CANCER × ACCURACY OF TEST

Groups with Known Incidence of Carcinoma	*Chance of Missing Carcinoma by Arteriography or Nephrotomography (90% Accuracy)*
All carcinoma	10%
50% of all carcinoma (symptomatic and/or with stigmata of malignancy)	5%
5% of all carcinoma (asymptomatic without stigmata of malignancy)	0.5%

*Adapted from: Plaine, L. I., and Hinman, Frank, Jr.: Malignancy in asymptomatic renal masses. J Urol 94:342-347, 1965.

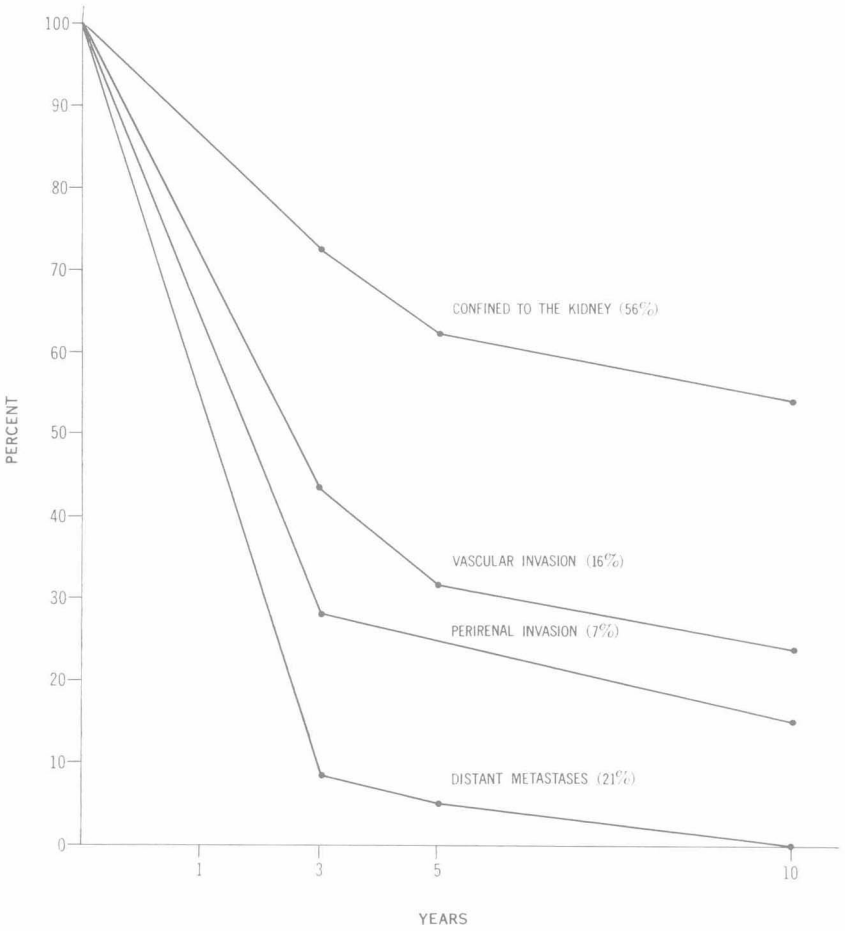
statistical incidence of cancer and on available statistical data on the percentage accuracy of the composite tests deployed for ascertaining this diagnosis (223). After eliminating all patients with symptoms or other stigmata of renal malignancy, a group of only 79 patients out of 387 remained in Plaine's series of renal mass lesions (223). Of these remaining 79 patients, only 4 were found to have a malignancy. Plaine argues, on the basis of statistical deliberations, that only 1 carcinoma in 220 patients with renal mass lesions would be missed in the subgroup without symptoms or stigmata of malignancy and without nephrotomographically or angiographically identifiable neoplasm. The incidence rate of death or permanent disability resulting from exploratory surgery in this group of patients, however, approximates 2.4 percent. He, therefore, advocates reliance on laboratory and x-ray evaluation of malignancy since the actual probability of finding a carcinoma and curing it is only 0.25 percent whereas the chance of death or permanent disability from an operative intervention is 2.4 percent (223).

The paramount importance of early diagnosis of renal cell carcinoma and the use of radical procedures adapted to the stage of

the neoplasm have been emphasized in the recent surgical literature (145, 146, 233, 236, 237). The significance of the clinical stage of a renal carcinoma in respect to the curability of the lesion was first pointed out by Kaufman and Mims (146) (Table II).

TABLE II*

SURVIVAL CURVES ACCORDING TO DEGREE OF INVASION AND BASED ON 100 OF OUR CASES. (FROM KAUFMAN AND MIMS)



*ADAPTED FROM: KAUFMAN, JOSEPH J., M.D.: REASONS FOR NEPHRECTOMY. PALLIATIVE AND CURATIVE. JAMA 204: 145-146, 1968.

In their series of 100 patients, a greater than 50 percent 10-year survival rate is noted in those with lesions confined to the kidney, accounting for 56 percent of the total group. In patients demonstrating renal vein invasion, 16 percent of the total series, the 10-year survival drops to 25 percent. In the presence of perirenal extension of disease, the 10-year survival is reduced to less than 20 percent. However, if distant metastases were present at the time of diagnosis, a finding occurring in 21 percent of the total series, there were no 10-year survivors (Table II).

The importance of early diagnosis of renal cell carcinoma to guarantee early and adequate surgical treatment is self-evident from this tabulation (Tables II and III). The pathologic grade of

TABLE III*

5 YEAR SURVIVAL OF PATIENTS WITH HYPERNEPHROMA OF VARIOUS STAGE IRREGARDLESS OF TREATMENT

Arteriographic Stage	*Total No.*	*5 Year Survival*	*% 5 yr. Survival*	*Lost for Follow up*
I	15	9	60%	2
II-a	12	6	50%	2
b	4	1	25%	1
c	9	1	11%	2
III-a	9	1	11%	2
b	2	0	0	1
c	1	0	0	0
d	8	1	12.5%	2
	60	19	31.6	12

*Courtesy, Lang, E.K.—Radiology.

the tumor and cell type, likewise, influence the survival figures by the propensity of undifferentiated lesions to cause early local invasion and early distant metastases (12, 145). Radical nephrectomy with retroperitoneal lymph adenectomy appears to offer a better prognosis than a conservative surgical approach particularly in patients with renal vein involvement, perirenal extension, or local lymphatic involvement (24). Robson reported a 10 year survival rate of 63.3 percent in patients subjected to a radical nephrectomy versus 22 percent in a large collected series treated by simple nephrectomy (237). The value of renal arteriography for assessment of extension of the tumor into the perirenal area, involvement of the renal vein, and demonstration of distal meta-

static implants has been emphasized by many authors (1, 3, 5, 7, 18, 23, 38, 75, 78, 80, 141, 142, 143, 144, 161, 162, 163, 165, 184, 193, 205, 210, 228, 234, 237, 248, 276).

The last but probably most important single factor influencing diagnostic goals is the sum total accuracy of diagnostic procedures deployed for definitive assessment of such lesions.

Differentiation of cyst from tumor on basis of clinical criteria is difficult if not impossible (16, 96). It has been emphasized that painless hematuria is highly suggestive of renal cell carcinoma. However, in most series hematuria is found in only 50 to 60 percent of the patients with renal cell carcinoma (133, 211). Gregg, in his series, found hematuria in 50 percent of the patients with renal cell carcinoma and in 33 percent of those with cysts (115). Pain was as common in his patients with cysts as in those with tumor. A palpable mass, however, was more frequent in cysts. Hypertension, again, was present with the same frequency in both conditions (133, 153). The classical triad of renal mass, pain, and hematuria is usually found in less than 25 percent of the cases (122).

Anemia and an elevated erythrocyte sedimentation rate are definitely more frequent in tumors, nevertheless, intercurrent disease entities may occasion a similar pattern in patients with renal cysts (114). Elevated urinary beta glucuronidase levels, likewise, favor the diagnosis of a hypernephroma (246). However, similar elevation of enzyme levels may be caused by active pyelonephritis. Elevation of C-reactive protein is a finding of such nonspecific nature that one should caution against utilizing this data for differentiation of renal tumors and cysts.

The relative infrequency of calcifications in tumors demonstrable on plain roentgenograms mitigates against successful use of this criterion. Moreover, the presence of calcifications in proven renal cell carcinoma has been reported as lower than 2 percent and as high as 35 percent whereas that of renal cysts is generally considered to be in the 3 percent range; findings which emphasize the definite overlap of this criterion in a substantial percentage of cysts and tumors (122, 165, 248) (Table IV). Even the demonstration of crescent-shaped calcifications carries no particular diag-