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The early diagnosis of tumors of the kidney presents the physician with one of the most difficult problems with which he has to cope. Prior to the advent of the cystoscope and the x-ray, renal tumors were usually missed. According to the early historical documents, renal growths in both adults and children have long been known.

Owing largely to the development and the skilled interpretation of the cystographic and pyelographic examination, renal tumors can be diagnosed clinically without great difficulty. The lesions which affect the outline of the pelvis of the kidney are neoplasms, hydronephrosis, cysts and renal calculi.

In my discussion I am limiting myself for the most part to the primary neoplasms.

Benign tumors of the renal parenchyma can be dismissed in a few words. They are usually found in post mortem examination and rarely give rise to any clinical symptoms. Adenomata are small round nodules, generally found in a kidney affected with interstitial nephritis, and are of some interest in that they may form a focus in which carcinoma is likely to develop. Small fibromata and lipomata have been found in the

kidney and may give rise to such profuse hematuria that nephrectomy is necessary.

Broasch (3) classifies the tumors of the kidney into two groups; those originating in the renal cortex, and those originating in the renal pelvis. The most common cortical tumors are hypernephroma (papillary adenocarcinoma), carcinoma (alveolar carcinoma) sarcoma, papillary cystadenoma, adenoma, and lipoma. Among the tumors arising in the renal pelvis are epithelioma, papilloma and leukoplakia. Such tumors may present recognizable clinical and pyelographic data which facilitate clinical differentiation.

The tumors most frequently found are cortical tumors, the so-called hypernephromas. Many authorities have advanced the theory that this group of tumors (hypernephromas) do not arise in kidney tissue, but arise in the adrenal bodies and in a short time invade the kidney tissue.

In a study of 283 cases of renal tumor made by Broasch (1) from January, 1901 to January 1, 1923, inclusive, 243 were found to be carcinomas. After careful histological study he found 199 of the 243 or 90 per cent carcinomas, to be hypernephromas. At Mt. Siani Hospital in New York City, Meyers (31) studied 38 kidney tumors and found 36 of them, or almost 95 per cent, were hypernephromas. Hynman(24) studied 70 cases of renal tumor at Mt. Siani and Lebanon Hospitals in New York City in which he classified 52 as

carcinomas, 44 as hypernephroma. Neff (34) analyzed 25 cases of renal tumor at the University of Virginia Hospital over a period of 19 years. He found 14 to be carcinoma and 11 were hypernephroma. Eastman (25) at the Mayo Clinic studied 56 cases of renal tumor between 1901 and 1911. In his analysis he found 36 or 71 per cent of the tumors to be hypernephroma. His data reveals a lower percentage because he has obtained his percentage of hypernephromas from all renal tumors studied and not limited himself simply to the carcinomas. Judd and Hand (25) studied 367 cases of carcinoma of the kidney at the Mayo Clinic between January 1, 1901 and January 1, 1928 inclusive. 85 per cent of those studied in this series were hypernephroma and about 80 per cent of all kidney tumors studied over the 27 years were hypernephroma.

From the percentages of hypernephromas found in these series we may conclude that the hypernephroma is the most common neoplastic lesion found in the kidney. If 80 per cent of all renal tumors are hypernephromas, 20 per cent of the growths are yet unaccounted for.

Neff (34) classified his series of patients studied as follows:

	Adult	Children	Total
Hypernephroma	10	1	11
Sarcoma	3	5	8
Carcinoma	1	0	1
Carcinoma (pelvis)	2	1	3
Solitary cysts	2	0	2

The final diagnoses were verified either at operations or at autopsies.

Hynman (24) gives the following classification of pathology in his series of seventy adult cases:

Hypernephroma	44
Carcinoma	7
Granuloma	5
Papillary carcinoma of pelvis	5
Sarcoma	1
Mixed tumors	2
Angioma	1

Broasch (3) lists 56 adult cases at the Mayo Clinic as follows:

Hypernephroma	36
Carcinoma	7
Sarcoma	4
Not classified	9

From the foregoing varied classifications we are forced to make some conjectures regarding the classification of the pathology of kidney tumors.

Until the cause of renal tumor formation and growth is revealed, no satisfactory permanent classification of them will be evolved. We might make a broad clinical division of kidney tumors into the innocent and the malignant tumors. Since it is known that benign renal tumors seldom produce clinical symptoms and also that they all possess the possibility of becoming malignant, the margin between innocent and malignant tumors is decidely narrowed.

At present much controversy arises over the origination and classification of renal tumors. Many

believe that the kidney singularly is incapable of producing its own tumors, and that nearly all, if not all, are new growths originating in extraneous tissue, as a result of displacement or of local arrest of development. It is their opinion also that the growths invade the renal tissue at an early stage.

Wade (48) gives the following classification as a generally accepted one.

I. Primary Renal Tumors.

1. of epithelial type.

1. Papilloma of pelvis.
2. Papillary carcinoma of pelvis.
3. Epidermoid carcinoma of pelvis.
4. Adenoma.
5. Papillary adeno-carcinoma.
   (a) with clear cells.
   (b) with granular cells.
6. Alveolar adeno-carcinoma.

2. of connective tissue origin.

1. Fibroma.
2. Lipoma.
3. Myxoma.
4. Angioma.
5. Sarcoma.

3. Tumors due to developmental abnormalities.

1. Mixed tumors (embryonal adenomyo-sarcoma).
2. Hypernephroma (Tumor of the adrenal tissue).

4. Tumors of perinephric fat and connective tissue origin.

1. Lipoma.
2. Fibroma.
3. Sarcoma.

II. Secondary Tumors.

1. Melano-sarcoma.

II. Secondary Tumors (cont.)

2. Squamous cell carcinoma.

3. Granular carcinoma.

4. Sarcoma.

Many of the tumors given by Wade in the foregoing classification are of rare occurrence, and many are not seen clinically and are met with only in the autopsy study. Wade classifies the hypernephroma as a growth originating without exception from the adrenal bodies. In this study the interest is centered in those tumors with which the clinician must deal. The following are such tumors:

1. Papilloma of renal pelvis.
2. Papillary carcinoma of the renal pelvis.
3. Epidermoid adenocarcinoma of the pelvis.
4. Papillary adenocarcinoma. Those with clear cells may be classified as hypernephroma.
5. Papillary carcinoma with granular cells.
6. Alveolar adenocarcinoma.
7. Angioma.
8. Mixed tumors.
9. Hypernephroma.
10. Sarcoma.

Many common characteristics are evident in these ten types of tumors. All will produce palpable masses; all may produce pain and all of them may cause

blood to appear in the urine. On the other hand, each type has distinctive features which, if recognized, enable them to be identified clinically. The following means of identification of the clinically important tumors have been found.

Papilloma of the renal pelvis is a benign tumor which affects any portion of the renal pelvis and ureter and readily grafts into the ureter and bladder. Hence when a papilloma of the bladder is encountered, it must be kept in mind that it may be a secondary manifestation of a renal growth. This tumor will invade the renal parenchyma since it is non-malignant. They will not distort the contour of the kidney pelvis; but since the density of the villi is less than that of the pyelographic media, their presence might be discerned. Since the parenchyma is normal, no positive findings can be had by excretion urography.

Malignant papillomas are tumors that form sessile growths of greater density. They occupy a portion of the renal pelvis, and on pyelographic examination reveal a filling defect of the cavity. The growth will also invade the parenchyma of the kidney and these local areas will show decrease or obliteration of the kidney function.

Epidermoid carcinomas are tumors frequently associated with renal calculi and leukoplakia. It is thought these tumors are closely related to some form

of chronic irritation. They will give slight alteration in pelvic contour, and obliteration of the kidney drainage system. The calices adjacent to the pathology may not be distorted, but appear perfectly normal when studied by infusion urography. Where studied by excretion urography, the renal functional activity is very poor and only a faint shadow may be observed.

Papillary adenocarcinoma is the growth most commonly met in the kidney and most American writers speak of it as the hypernephroma. Clinically it shows with the other renal growths in the occurrence of intermittent hematuria, with attacks of mild colic as blood clots pass down the ureter. They may show rod-shaped clots voided in the urine; and there will be, if diagnosis is late, the palpable tumor mass. These tumors invade the renal parenchyma at an early stage and destroy it. They frequently invade the venous system and thrombus will form in the renal veins. The hypernephroma is a highly vascular tumor which bleeds freely. These tumors distort the adjacent calices. The pyelograms will show a clearly defined area of pathology. If a catheter is passed up into the renal pelvis, bright red blood will be obtained which will soon clot. In tumors presenting such a picture hypernephroma can be suspected. The involved renal parenchyma will show good functional activity by excretion urography.

Papillary adenocarcinoma with clear cells resemble tumors of adrenal rests, and a differential diagnosis without histological study is practically impossible.

Alveolar adenocarcinoma originate from renal tissue, and are not uncommon in the adult. They are highly malignant and are non-encapsulated. They are not subject to hemorrhage or necrosis. They infiltrate the kidney diffusely, and invade the renal veins freely. They may involve the lymphatics, and they have a wide range of metastasis. Hematuria is not a true characteristic of these tumors. They will show little deformity on the pyelogram, but by excretion urography there will be almost a complete absence of function.

Mixed tumors or embryonal adeno-sarcomas of infants are rather characteristic tumors of the kidney, and are frequently found in children. Growth is rapid and they will grow to a great size, ultimately proving fatal. They are solid flesh-like in consistency. On section they are glandular, fibrous, muscular and highly cellular, and may contain bone and cartilage. Pyelographic study will show a distorted renal pelvis with obliteration of certain of the calices and elongation of others. The history and clinical indications of these tumors provide in themselves a diagnosis that is usually conclusive.

Frequency of Renal Tumors

How often are renal tumors encountered in the practice of clinical medicine?

Gult (31) in 1880 reviewed 14,160 admitted patients in Vienna Hospital, and he found only 16 cases of clinically recognized renal tumors. This gave a ratio of 1 to 914. This ratio was lower than most later reports and probably was due in a large part to the failure to make a diagnosis. It must be remembered that the pyelographic study of renal tumors was discovered many years later by Fenwick (13) in 1905, and has proved to be the greatest single aid to diagnosis. Meyers (31) stated, "The relative frequency of kidney tumors in relation to all tumors is 0.5 per cent which gives a ratio of 1 to 200. In children it is much higher, 20.4 per cent." He gave the frequency of renal tumors in adults about 0.25 per cent or 1 to 400, while in children it is much less, 0.06 per cent or about 1 to 1600. Mixter (32) analyzed 22,000 patients admitted to the surgical words of the Children's Hospital of Boston, between 1907 and 1932. Of 22,000 cases only 41 diagnoses of renal neoplasm were made.

Rolnick (40) analyzed thepatients admitted between the years 1929 and 1932 at Cook County Hospital, Chicago, and he was able to find 54 patients diagnosed as renal tumors.

Hinman and Kutzman (19) studied the cases from the urological department of the University of California Medical College. They reported, "The incidence of malignant disease of the kidney in adults is between 0.25 per cent and 1.0 per cent and between .06 per cent and .1 per cent in children." Clinically all tumors of the kidney should be considered malignant because of the great rarity of the benign type.

Between the periods of 1906 to 1923 there were 46,800 patients admitted to the wards of the University of California Hospital and only 29 cases of renal tumor were found. This indicates a rather low figure since it includes adults. The report may include many cases that were not studied thoroughly and many patients of short hospitalization.

Kirk (27) studied the cases admitted to the University of Nebraska Hospital for the past 11 years and found 19 cases of renal tumor diagnosed. In other words, fewer than two tumors a year were found in a hospital admitting approximately 3000 patients annually.

Further investigation of the situation reveals the fact that there is considerable chance for error in arriving at this low frequency from this analysis. From the large series of cases reported in the famous clinics of America the conclusion might be made that

that they have drawn more than there share of renal tumors from the country. This situation is probably proof of the extreme difficulty in making a diagnosis.

Age Incidence of Renal Neoplasms

Kirk (27) in the 19 cases studied at the University of Nebraska Hospital found the average age to be 4½ years. The ages varied from 18 months to 72 years. Walker (49) in 138 cases of renal tumors in the children at Johns Hopkins University Hospital found the following incidence:

Age	Patients	Percentage
7 to 8 months embryonic life	3	2.7
At birth	9	6.5
Under six months	7	5.0
Six months to one year	18	13.0
One to two years	27	19.5
Two to three years	19	13.7
Three to four years	20	14.4
Four to five years	13	9.4
Five to six years	10	7.2
Six to seven years	6	4.3
Seven to eight years	3	2.1
Eight to nine years	0	0
Nine to ten years	1	0.72
Ten to twelve years	0	0
Twelve to fourteen years	2	1.44

Approximately 50 per cent of the cases fall between the ages of six months and three years.

At Mt. Siani and Lebanon Hospitals in New York, Hynman (23) analyzed the age incidence of 60 adult patients and found the following data:

Age	No. of patients
10 to 20 years	0
20 to 30 years	2
30 to 40 years	10
40 to 50 years	16
50 to 60 years	20
60 to 70 years	11
70 to 80 years	1

Approximately 57 per cent of his series of adult patients fall between the ages of 30 to 60 years.

Swan (46) studied the records of all adult cases of renal tumors at the Cancer Hospital and St. Paul's Hospital in London. He found the following correlation of the growths to the different decades of life:

Age	Percentage of cases
10 to 30 years	1.9
31 to 41 years	3.9
41 to 51 years	25.4
51 to 61 years	37.7
61 to 71 years	21.0
71 to 81 years	9.0

According to his series 63 per cent of the cases fell between the ages of 41 and 61 with the majority of the remaining cases in the years past 60.

Hennessey (16) in his series of cases found the average age at which renal tumor occurs to be 50 years.

In conclusion, age incidence of renal tumors is indicated at two peaks. In children the majority of renal growths is found between 2 and 3½ years of life while in adults the majority appear between the fourth and sixth decade of life.

Diagnosis

The diagnosis of renal tumors is an extremely interesting problem. If the diagnosis is to be made early, it is generally very difficult.

Because symptomatology depends upon the invasion and destruction of tissue in a remote anatomical region, it is necessarily meager and usually vague, making diagnosis difficult at a time when it would be of most value to the patient. Fortunate is the patient as well as the physician to have the symptoms focus attention to some disorder in the urogenital tract.

Tumors of the kidney are usually unilateral. Men are more prone to have them than women by a ratio

of about 3 to 1 according to Green (15), but women are found more frequently with inoperable tumors than men. This is probably due to the lax abdominal wall which will allow large growths without causing discomfort.

The diagnosis of renal tumors might be conveniently divided into three parts. First, a carefully worked-out history and clinical symptoms and signs. Second, the urological x-ray examination, and third, the correlation of the clinical and urological findings.

In the diagnosis three cardinal symptoms are present; hematuria, pain and a palpable tumor mass. However, one cannot depend solely on cardinal symptoms particularly if the desired early diagnosis is to be made. Other symptoms that might be associated with kidney tumors are weakness; cachexia; varicocele, particularly those that do not diminish in size when the patient is placed in the incumbent position; swelling of the legs; vomiting; dilitation of the veins of the caput medusa; loss of weight; and gastro-intestinal disturbances.

Pugh (38) found, in analyzing 100 consecutive cases of renal tumors in four New York Hospitals, the following early symptoms: dribbling, dysuria, frequency, headache, incontinence, nausea, renal colic,

scanty urine, tenesmus, and urgency. As a rule two or more of these symptoms were present at the same time. Generally such symptoms will not result in a definite diagnosis of these tumors, but they serve to focus attention to the urinary tract and should lead to an extensive urological examination. Failure to heed such warnings may allow the patient to slip along to an inoperable and fatal termination.

Neff (34) analyzed the symptomatology of 25 cases at the University of Virginia and found the symptoms present in the following ratio:

Adult Patients

Symptoms	Initial	Late
Hematuria	5	11
Pain and Hematuria	4	0
Palpable mass	3	7
Pain	3	10
Gastro-intestinal signs	2	4
Weakness	1	0
Children		
Mass	5	6
Weakness	1	0
Gastro-intestinal signs	1	3
Pain	0	2
Hematuria	0	1

These data show that hematuria was present as the initial symptom in 55 per cent of his adult

cases and was present in 70 per cent of the patients at the time they entered the hospital. The hemorrhages, as a rule, were quite sharp, lasting a few days to a few weeks, and were intermittent in character. There were intervening periods extending as long as a year in some cases when the urine showed no gross blood. In three of his cases blood clotting was sufficient to cause retention of urine. With one exception, severe pain did not occur unless in association with hematuria. Five adults had renal colic as an accompaniment of hemorrhage. The pain associated with these cases was usually described as a dull dragging or drawing discomfort. The first thing to attract attention in three of his adult cases and in five children was the accidental palpation of an abdominal mass. Before admission in his 25 cases the patients, relatives, or physicians had felt a mass in 13 of them. In two adults a more or less constant nausea and loss of appetite were the only symptoms.

Mixter (32), in his cases of renal tumor in the Children's Hospital in Boston between the years 1907 and 1932, found the following initial symptoms:

Palpable tumors	17 cases
Pain	8
Malaise and weakness	3
Hematuria	1
Digestive disturbances	1

Mixter was able to palpate a mass in every case, without exception. Swan (46) in two London Hospitals found the following ratio of symptomatology in adult patients. Hematuria was present in 90 per cent of the cases and the initial symptoms in 70 per cent of the cases. Pain was present in the majority of cases. Tumor was palpable in a variable number of cases depending on the advancement of the disease, but in children it was usually the initial symptom.

Broasch (1), in 1913, reported 83 cases of renal tumor at the Mayo Clinic. He found the following symptoms and signs in his study. Hematuria was the initial symptom in 36 cases and the only symptom in 12 cases, but was observed in 64 of the cases. Palpable tumor was the initial symptom in 15 cases and was observed in 34 cases. Pain was the only symptom in 6 cases. Cachexia as the initial symptom was not detected in any case. Neither were the combined symptoms of hematuria, pain and palpable tumor present in any case. Pain and tumor were associated together in 38 late cases. Hematuria and pain in 33 cases were present together.

Barney (17) studied 74 cases of kidney tumor. He found hematuria present as the initial symptom in 24 cases. It was the only symptom in 4 cases, and was observed in 52 cases. Tumor was present as the initial

symptom in 20 cases and it was the only symptom in 6 cases.

Kirk (27) found, as initial symptoms in 19 cases at the University of Nebraska Hospital, mass in 5 cases, pain in 5 cases, hematuria in 3 cases, pain and hematuria in 3 cases, and hematuria and mass in 1 case.

Hennessey (16) found, as initial symptoms in his series of adult cases studied, 65 per cent hematuria, 35 per cent pain, and 6 per cent palpable mass.

Hynman (23) studied 60 adult cases at the Mt. Siani and Lebanon Hospitals in New York City and found the following facts:

Initial Symptoms	Cases	Percentage
Hematuria	21	36
Pain	18	30
Hematuria and pain	4	10
Loss of weight	5	8
Increase in size of abdomen	2	3
Urinary difficulty	2	3
Gastro-intestinal disorders	3	4
Symptoms from metastasis	2	3

Further study of the symptoms in his cases revealed that sometimes during the course of the disease the following ratio of symptoms occurred:

	Cases	Percentage
Hematuria	48	80
Tumor	45	75
Pain	40	66
Loss of weight	20	33
Cachexia	15	25
Metastasis	12	20
Fever	8	13

E. S. Judd and J. H. Hand (25) analyzed 376 cases of renal tumor found in adult patients at the Mayo Clinic. They found the initial symptoms as follows:

	Percentage
Hematuria	43.6
Pain	37.0
Tumor	13.0
Weakness	3.2

From the foregoing groups of figures it is quite obvious that one of the symptoms of hematuria, pain or tumor is present in most of the cases and that it is the initial symptom in the majority of cases of renal neoplasms.

The length of time the patient has had the symptoms unfortunately means nothing and gives us no clue to the diagnosis. Symptoms may exist from weeks to years. Only too frequently the symptoms appear and then suddenly disappear for a long period of time,

with both patient and physician lulled into a false sense of security, only to have the patient return at some later date with a far advanced inoperable neoplasm.

Neff (34), in 25 cases, found the duration of symptoms before admission to the hospital to be:

Length of Time	Cases
Adults	
12 to 30 months	6
6 to 10 months	6
5 to 1 months	6
Children	
10 to 24 weeks	3
2 to 8 weeks	4

Hynman (23) found the following periods of duration for hematuria and pain prior to operation in 70 adult cases:

Pain		Hematuria	
Days	No. of Patients	Days	No. of Patients
1	1	3	1
2	3		
5	2		
6	2		
7	1		

Pain		Hematuria	
Weeks	No. of Patients	Weeks	No. of Patients
2	1	1	1
3	3	2	1
5	2		
6	1		
Months	No. of Patients	Months	No. of Patients
7	3	2	2
8	1	3	1
9	1		
10	1		
Years	No. of Patients	Years	No. of Patients
1	6	1	2
1½	1	1¼	1
2	2	2	1
3	2	3	1
		5	1

Kirk (27) in a study of 19 cases at the University of Nebraska, found the duration of symptoms to be from 14 years to one week with an average duration of symptoms of 4½ years. Three cases had symptoms of unknown duration.

From these studies we can conclude that the duration of symptoms may be from a few days to many years before the patient sees his physician to be diagnosed and treated.

When the physician has finally had his attention drawn to the urinary tract of the patient by some of the symptoms he should strive to determine definitely where the pathology rests; one of the most valuable means of determining if the pathology is in the kidney is by careful and complete x-ray study. The patient should have both retrograde and pyelographic studies made. It is not only necessary that the radiographic plates be made, but that the views be interpreted accurately. If there is any doubt as to just what is shown in the radiograms, the study should be repeated at an early date. If the pelvis is spastic and a good picture is not obtained, the patient should be given belladonna until the mild physiological effects of the drug are manifested and the x-ray studies repeated during its influence.

The roentgen-ray diagnosis of tumors of the kidney require the best skill of the roentgenologist, both as to technique in the study and to the interpretation of the roentgenograms. Then very often the roentgenologist leans heavily on other laboratory findings and the help of the clinical views of the physician.

One must be certain that the opaque solution has free access to the renal pelvis and calices during the filling process. If there is even a suggestion of deformity, then one should determine if the

solution will run by the catheter back into the bladder. If it does this, there is little danger of over distention with a moderate amount of pressure on the solution. If there is no reflux, the injection must be made very slowly and carefully in order not to produce pain and spasm of the pelvis and calices.

A diagnosis of renal tumors by x-ray depends on some degree of deformity in the pelvis or calices as shown by the opaque solution. Several types of deformities are rather characteristic. The first and most commonly found deformity is an elongation of one or more calices. Probably the second most common deformity is the complete obliteration of one or more calyx with the defects having a smooth outline. The third in frequency is the dilation of the a calyx through pressure obstruction from some defect at a proximal point. A fourth deformity to be found is that in which the tumor invades all the pelvis and the calices so that natural shape of the pelvis is distorted and the opaque solution seems to take on a waxy appearance throughout a considerable part.

In the study of renal tumors by x-ray examination, it is essential that the gastro-intestinal tract be as free from gas and fecal concretions as possible. If this is not done, it may lead to confusion in interpretation and difficulty in introducing the opaque solution.

Blood clots and stones in the pelvis or calices may give a distorted contour in the picture and every effort should be made to check their presence. One must bear in mind that malignant growths in the kidney are not infrequently associated with kidney stones and the clinician should not be too willing to accept the presence of a stone as the basis of all symptoms.

Coryell (9) made a study of 145 consecutive cases of renal stone and renal neoplasms at the Mayo Clinic from January 1, 1905, to January 1, 1914. In this series, 131 were cases of stone only, 5 were cases of cancer only and 9 were cases of neoplastic disease associated with stone. In every case tissue was removed for examination.

A great deal might be said on the relation between chronic irritation and the formation of cancer. That the two processes are frequently associated cannot be questioned. Whether cancer is the direct result of chronic irritation, or whether the latter plays the part of an extraneous exciting agent and determines the location of the former in an organism which contains some sort of a chemical sensitization substance or is influenced by some hereditary factors is still a debatable question.

It is possible to differentiate these tumors arising from the cortex from those arising from the

renal pelvis.

The most frequently found cortical tumor is the so-called adenocarcinoma or hypernephroma. These tumors grow slowly and cause few, if any, symptoms early in the development. Hematuria does not usually appear until in the late stages and usually when the tumor is palpable. Alveolar carcinoma differs from hypernephroma in that it grows much more rapidly and the symptoms of hematuria and pain are seldom of more than one or two years duration, unless the lesion is associated with or is secondary to renal lithiasis. The carcinoma soon involves the pelvis with a tendency to extend beyond the capsule. Pain in cortical tumors is usually caused by involvement of the surrounding tissue, and when present adds to the gravity of the prognosis.

Considerable difference in tumors of the renal pelvis are evident. Since these tumors develop in the lumen of the pelvis, the pain, if present, is usually caused by urinary obstruction. As the tumor grows it may occlude the pelvic lumen to a greater or less extent and cause intermittent and variable hydronephrosis. These tumors are not usually palpable until such secondary hydronephrosis has developed. Hematuria is usually profuse and occurs early. In every case of hematonephrosis the possibility of tumor of pelvic origin must be excluded.

The characteristics of each type of tumor may be summarized thus:

Cortical Tumors	Pelvic Tumors
1. Definite, firm irregular mass.	1. Mass cystic and soft.
2. Renal area made out by palpation.	2. Difficult to palpate.
3. Hematuria late.	3. Hematuria early.
4. Pain due to extension into surrounding tissue.	4. Pain due to secondary obstruction.
5. Pain calls for grave prognosis.	5. Secondary hydronephrosis.
6. Most common tumors are hypernephroma and alveolar carcinoma.	6. Pain has no direct bearing on prognosis.
7. Pyelograms show elongation of calices. Major calices may be constricted and flattened. Minor calices may be tapering usually one or two calices involved.	7. Pyelograms show distorted pelvis and waxy appearance.

One of the most difficult differentiations to make by x-ray is that between adenocarcinoma (hypernephroma) and polycystic kidney. Although the elongation of the calices in both may be very similar in degree, in the neoplasm there is a tendency in the case of the neoplasm to narrowing and tapering of thin ends which is not usually seen in the polycystic disease in which the calices are broadened throughout. Both kid-

neys should be studied. The pyelogram will show pelvic deformities bilaterally in the polycystic disease while in the neoplasm it will usually be unilateral. Finally the general symptomatology associated with the polycystic kidneys is usually that of nephrosis and include variable degrees of diminished renal function.

By some physicians the intravenous urography has been recommended as a substitute for infusion urography, and some who are incapable of, or who do not have facilities for the pyelogram, are prone to use only the intravenous method. The excretion urography is not a substitute for infusion urography, but is a most valuable complement to it, with its own independent sphere of utility. By infusion urography an ocular demonstration is obtained of the morbid anatomy of the organ examined. It delineates function in the kidney. Excretion urography is physiological, the exact efficiency of the kidney being controlled and estimated by the amount of the drug excreted. Its value when used alone as a diagnostic aid in detection of renal tumor is negligible, but when used in conjunction with infusion urography, it is of great value in enabling a more accurate differential diagnosis.

Within the last ten years pneumopyelography has developed as another method of examining the kidney for diagnosis. This is the injection of gas into

the renal pelvis for roentgenological purposes. The technique is comparatively simple and the advantages are marked. The injection of oxygen into the ureter and renal pelvis causes no shadow at all, but creates a space which appears black on the radiogram, and brings into relief not only the pelvis and calices, but also the kidney tissue because it does not obscure the shadows caused by tissue either in front or behind the injected gas. This method of diagnosis is enthusiastically supported by some, yet it is certainly much less valuable in diagnosis than the radiograms where the opaque solutions are used.

In a series of 413 cases of malignant tumors of the kidney studied by Meyers (31) pyelographic x-ray studies with opaque solution were found to be positive in almost every case.

After we have made a diagnosis of renal tumor, what do we have to offer the patient in the way of treatment, and what are the chances for recovery?

The prognosis in renal tumors is notoriously bad. There, cancers do not offer precancerous signs. They are deep-seated and do not attract attention like the superficial growths. They metastasize early, as a rule, by blood stream and symptoms from metastasis may be the first symptoms the patient has.

About the only thing to offer the patient for treatment is surgery, providing the diagnosis has been made before there is too much extension. Neither deep x-ray or radium therapy offer much in the way of a cure; but may be of considerable value as preoperative treatment, particularly in the large mixed tumors seen in children, and in giving palliative treatment to inoperable cases. Under x-ray therapy, there is considerable shrinkage of the tumor, which is only temporary in nature. When this is accomplished, nephrectomy is indicated. Single metastasis or pulmonary metastasis do not necessarily contraindicate nephrectomy.

As a rule the lumbar route is preferable except in very large tumors where the transperitoneal nephrectomy is the preferable procedure.

In 135 nephrectomies for renal neoplasms studied by Hynman (23) the operative mortality is 9 per cent, and 20 per cent of his patients were alive 5 years after operation.

Mixter (32) in his series of 22 nephrectomies for renal tumor had a 4 year cure of 18 per cent.

Walker (49) analyzed cases from 1876 to 1906 at Johns Hopkins Hospital. There were 73 nephrectomies over this period. He summarized his operative mortality as follows:

Year	Cases	Mortality	Year	Cases	Mortality
1876	1	100	1887	3	66 2/3
1877	1	0	1888	6	33 1/3
1880	1	100	1889	5	80
1881	1	0	1900	5	0
1882	5	100	1901	3	33 1/2
1883	4	25	1902	6	16 1/3
1884	4	75	1903	8	12 1/2
1885	4	0	1904	5	0
1886	2	100	1905	5	40
			1906	4	25

In this series there were 27 operative deaths, or approximately 40 per cent. This seems high in comparison to some of the later reports, but when one considers the fact that he did not have the advantages of the x-ray for making early diagnosis, nor were operative asepsis and technique as advanced as that used in the later series, it justifies his high mortality. Twenty-eight of his series died of metastases within 2 years; 14 were not traced. Only three of his 73 cases were alive after $3\frac{1}{2}$ years. He estimated his 5-year cures as 5 per cent.

Hynman (24) found, in his study of 42 cases of nephrectomies, that three died in operation. The ultimate results of his operated cases were as follows:

Death	No. of Cases
1st year	18
2nd year	2
3rd year	1
4th year	2
Alive	
6 to 10 months	4
1 year	1
1½ years	2
2 years	2
2½ years	2
4 years	4
5 years	1
7 years	1

Approximate 3-year cures - 26 per cent

Approximate 4-year cures - 20 per cent

Approximate 5-year cures - 9 per cent

Swan (46) in 39 nephrectomies found 7 growths too large to remove; 5 of the remaining 32 died of operation; 3 died of post-operative complications; 2 died within 1 month following operation; 10 died from recurrences between 4 months and 2 years; and the fate of 4 cases was unknown.

This series shows a 7-year cure of 30 per cent. Foulds (14) in a series of 283 nephrectomies at the

Mayo Clinic between 1901 and 1928, found 13 or 8.5 per cent died of operation; 33 could not be traced; 57 of the remaining or 25 per cent were living and well on an average of 6 years post-operative. In his series he included 9 children, seven of whom he was able to trace. After 2 years 6 were dead.

In view of these findings the following summary might be made:

1. Renal growths occur in both adults and children.

2. Benign growths of the kidney are generally undiagnosed and symptomless, and most frequently found in autopsy examination.

3. Benign growths have the potentiality of becoming malignant.

4. There is considerable variation in classification of renal growths.

5. Most common tumor of the kidney in the adult is the hypernephroma. In children the most common tumor is the adeno-sarcoma.

6. Incidence of kidney tumor is approximately 0.25 per cent in the adult and 0.06 per cent in children.

7. Kidney tumors are more frequent in males than in females in a ratio of 1 to 3.

8. Age incidence of renal tumor is from child-

hood to old age with two high peaks. The majority of tumors of childhood fall between 2 and 4 years of age. In the adult the majority fall between 40 and 60 years.

9. Symptoms have wide variation, but most important of the symptoms are hematuria, pain, palpable mass.

10. Hematuria is most common early symptom in the adult, is intermittent in character, and may have long periods of remission. Tumor mass is the most common early symptom in children.

11. Symptoms may be present for days to years before patient sees his physician or before diagnosis is made.

12. Blood in the urine is a grave symptom and every effort should be made to explain its presence.

13. The presence of renal calculi should not be accepted as an explanation for all symptoms for not infrequently calculi are associated with neoplasm.

14. Infusion pyelography with an opaque solution is probably the greatest single aid to diagnosis.

15. Intravenous urography is in no way a substitute for infusion urography, but is a valuable complemental study; it gives an ocular view of kidney function.

16. Diagnosis is generally made late due to the unimpressive characteristics of the early symptoms.

17. Most renal neoplasms metastasize early, and generally by the blood stream route.

18. Treatment is nephrectomy, with deep x-ray and radium therapy of vlue in the pre-operative shrinking of large tumors and giving palliative treatment to inoperable cases.

19. Prognosis in renal tumors is bad, and warrants guarding.

20. In good hands, 5-year cures are generally slightly less than 20 per cent.

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