

## The Spectrum of Angiographic Findings in Transitional Cell Carcinoma of the Kidney

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### PATIENT MATERIALS

Renal angiography was performed in 20 patients with histologically proven transitional cell carcinomas of the kidney at Wayne County General Hospital, The University of Michigan Medical Center, and Ann Arbor St. Joseph Mercy Hospital between 1967 and 1975. In addition to conventional angiograms, six patients had pharmacoangiographic studies, four with epinephrine and two with Priscoline. There were 16 men and four women, with an average age of 59 years (range 21 to 89 years). All twenty patients had intravenous urograms; a diagnosis of transitional cell carcinoma could be made with a high level of confidence in ten. In an additional six patients the intravenous urogram revealed a nonfunctioning kidney. In the patients with nonfunctioning kidneys, retrograde urograms gave the diagnosis in the four patients in whom it was done.

### ANGIOGRAPHIC FINDINGS

The angiographic abnormalities are summarized in Table 1. In five of the 20 patients (25%) the diagnosis could be made neither in prospect nor retrospect. One of these patients had a large tumour mass occluding the main renal artery and the other four showed no angiographic abnormalities. The size of the tumours in the patients with normal angiograms ranged from 0.4 cm to 2.0 cm (1.1 cm average). Moreover, an angiogram done on the resected kidney in one of these patients failed to reveal any abnormality in spite of definite polypoid defects which has been demonstrated on the urogram. In four of the patients in whom the diagnosis was missed by angiography, the tumour involved primarily the calices and was situated within the renal parenchyma, while in one the lesion was found in the renal pelvis (Figure 1).

In the remaining 15 patients, a prospective diagnosis of transitional cell carcinoma was made because of a combination of the following angiographic findings:

- 1) Tumour vessels (Figure 2). All 15 patients

had fine neovascularity, frequently arising from prominent pelviureteric arteries or from proximal renal artery branches in the region of the pelvis or calices. The number of tumour vessels present correlated roughly with the size of the lesion. A high quality angiogram with magnification technique, therefore, is an aid to correct diagnosis.



FIGURE 1A

FIGURE 1.—Urography and angiography in a 23 year old woman with gross hematuria. A 1.5 cm transitional cell carcinoma was found in the renal pelvis at operation. A. An intravenous urogram shows polypoid filling defects in the pelvis (arrow).

B. A renal angiogram demonstrates no abnormality.

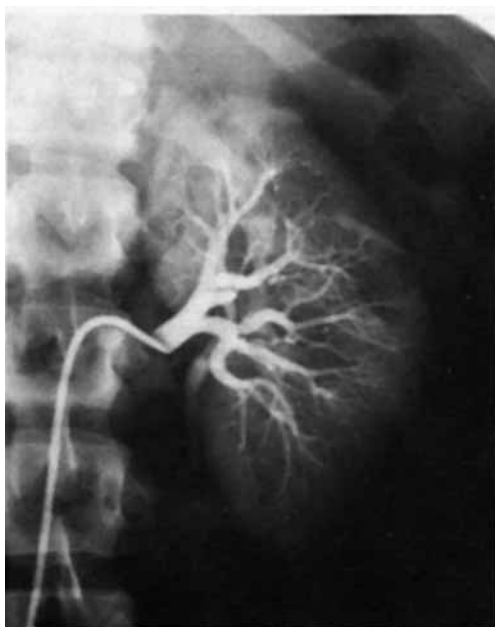


FIGURE 1B

2) Tumour stain (Figure 3). A faint, relatively homogenous increase in contrast accumulation was present through the tumour in 11 of the patients. This was best seen in the region of the renal pelvis during the capillary or venous phases. No vascular lakes nor arteriovenous shunts were observed in any patient.

3) Prominent pelviureteric arteries (Figure 3). The pelviureteric arteries were prominent in 13 patients. This finding alone, however, is non-specific and may be seen in inflammatory disease of the renal pelvis or ureter.

4) Arterial encasement (Figures 2, 4). Renal and renal pelvic arteries were encased in ten patients. The encasement was the type caused by most carcinomas, characterized by abrupt changes in the course and caliber of arteries. This finding was most easily discerned in renal pelvic branches, but could also be found in those tumours which encased intrarenal arteries.

5) "Pruned tree" appearance of intrarenal arteries associated with an ill-defined defect in the nephrogram phase (Figure 4). This combination of findings was observed in only four patients and is caused by invasion of the renal parenchyma by the poorly vascularised transitional cell tumour.

6) Hydronephrosis (Figures 2, 3). Five of the



FIGURE 2A

FIGURE 2.—Renal angiogram in a 21 year old woman with an exophytic, slightly papillary, transitional cell carcinoma of the kidney.

A. Mid-arterial phase. Numerous, fine tumour vessels are associated with hydronephrosis.

B. Angiogram after intra-arterial administration of epinephrine. Note the relative lack of constriction of the tumour vessels to epinephrine. The encased arteries, with changing calibre and angulation, do not respond to epinephrine (arrow).

patients had angiographic findings of hydronephrosis, caused by tumour obstruction of the renal pelvis or the infundibulae.

7) Venous invasion (Figure 5). The overall incidence of venous invasion could not be evaluated in this series since only three patients showed either invasion or displacement of the veins. In one additional patient an occlusion of the main renal vein was shown in the venous phase of the renal angiogram.

As can be seen from Table 1, a combination of several of the above angiographic findings were present in the 15 patients in whom the diagnosis was made. These lesions were all larger than 2 cm in diameter and most were in the extrarenal portion of the renal pelvis.

## ANGIOGRAPHY OF RENAL TRANSITIONAL CELL CARCINOMA



FIGURE 2B



FIGURE 3A

In the four patients in whom epinephrine was given prior to angiography, the tumour vessels failed to constrict following epinephrine. In three patients fine tumour vessels were much better seen following epinephrine because of the marked vaso-constriction of the adjacent normal renal vessels (Figure 3C). The tumours were also better seen on angiograms following the administration of Prisolone, probably because of an increased amount of contrast accumulation in the tumour during the capillary phase.

### DISCUSSION

The differential diagnosis of transitional cell carcinoma of the kidney at angiography includes hypernephroma, metastatic carcinoma, nonopaque calculi, and several types of inflammatory disease. Hypernephromas are rarely a problem because they are generally hypervascular and occur in the renal parenchyma. They usually have vascular lakes within the tumour and some arteriovenous shunting; they are rarely supplied by pelviureteric arteries<sup>9</sup>. However, a poorly vascularized hypernephroma of the papillary type may very rarely simulate an infiltrating transitional cell carcinoma,

particularly if it parasitizes blood flow from the areas that it infiltrates, including the renal pelvis and calyces. Metastatic carcinoma to the kidney is also frequently poorly vascularized<sup>2</sup> and may give an angiographic appearance similar to transitional cell carcinoma, particularly the "pruned tree" appearance of the arterial branches and an ill-defined defect in a nephrogram phase, as shown in Figure 4B. They should not, however, cause the development of prominent pelviureteric arteries.

Nonopaque renal calculi can be a differential problem at both intravenous urography and angiography. At urography they may appear as a fixed filling defect which may or may not cause obstruc-



FIGURE 3B

tion and hydronephrosis. At angiography they frequently stimulate the formation of localized inflammatory reaction and an accompanying increase in fine vascularity and some dilatation of the pelviureteric arteries. Tumour vessels and infiltrated arteries, however, should not be seen.

Renal inflammatory diseases which are associated with pyonephrosis, such as xantho-granulomatous pyelonephritis or tuberculosis, may produce appearances similar to a transitional cell carcinoma. However, subtle differences should be present. In most of these conditions, a fine increase in vascularity occurs in the infected areas, and in tuberculosis the pelviureteric arteries may become dilated<sup>4</sup>. However, tumour neovascularity and encased arteries have not been observed in inflammatory disease. Gammil *et al.*<sup>3</sup>, analyzing 13 patients with xantho-granulomatous pyelonephritis found no neovascularity.

The use of pharmacoangiography may aid in the differential diagnosis of transitional cell car-



FIGURE 3C

cinomas. In our patients the tumour vessels were apparent without epinephrine, but the use of epinephrine enhanced their visualization. Moreover, the abnormal vessels seen in inflammatory diseases may constrict following the administration of epinephrine<sup>3</sup> although the general experience with epinephrine in the differential diagnosis of inflammatory disease and tumours is inadequate to state this for certain. Priscoline has been used to enhance the demonstration of poorly vascularized hypernephromas and may also have some value in the demonstration of these generally poorly vascularized transitional cell tumours.

The results of this group of patients indicate that the accuracy of angiography is not appreciably greater than intravenous urography and retrograde urography. However, the methods tend to be complementary. Retrograde urography has a greater accuracy in those patients with polypoid tumours in the renal calices and the intrarenal portion of the renal pelvis while angiography is of greater value in patients with nonfunctioning kidneys, which generally have complete obstruction. Angiography is generally used to assess the extent of the tumour and to exclude extension of

## ANGIOGRAPHY OF RENAL TRANSITIONAL CELL CARCINOMA



FIGURE 4A



FIGURE 4B

FIGURE 4.—Renal angiogram in a 52 year old man with an infiltrating transitional cell carcinoma in the lower half of the left kidney.

A. Arterial phase. An interlobar branch is irregularly encased (arrow). The lower half of the kidney has a "pruned-tree" appearance.

B. Venous phase. An ill-defined defect is present in the lower half of the kidney during nephrogram phase.

TABLE 1  
*Angiographic Findings in 20 Patients with Transitional Cell Carcinoma of the Kidney*

Angiographic Findings	Number of Patients	Percent
A. Tumour Vessels	15	75
B. Tumour Stain	11	55
C. Prominent Pelviureteric Arteries	13	65
D. Arterial Encasement	10	50
E. Pruned-Tree Appearance	4	20
F. Defect in Nephrogram	4	20
G. Hydronephrosis	5	25
H. Venous Invasion or Displacement	4	20

the lesion into the renal veins and inferior vena cava even though the diagnosis has been made by urography.

### SUMMARY

The spectrum of angiographic findings in 20 patients with transitional cell carcinomas of the

kidney is described. In 15 of 20 patients (75%), prospective diagnosis of transitional cell carcinomas were made because of a combination of the angiographic findings; tumour vessels, tumour stain, prominent pelviureteric arteries and arterial encasement. In 4 patients with negative angiograms the lesions were relatively small in size and were situated within the renal parenchyma, primarily involving the calyces. The use of pharmacoangiographic agents such as epinephrine and priscoline improved the angiographic visualization of transitional cell carcinomas of the kidney.

For the past several years angiography has had a central role in the evaluation of patients with hematuria and renal masses<sup>1, 5, 6, 7, 8</sup>. Although the use of diagnostic ultrasound and renal puncture have eliminated angiography from the diagnosis of renal cysts, most renal masses which are solid or which have equivocal findings at ultrasound still undergo angiography. At the same time, the decreasing use of retrograde urography has resulted in more frequent angiography in patients with unilateral nonfunctioning kidneys. Transitional cell carcinomas of the renal pelvis are an important cause of both hematuria and non-functioning kidneys. We have therefore reviewed our material to reassess the angiographic abnormalities caused by the transitional cell carcinomas and the overall accuracy of the angiography in the diagnosis of these lesions.



FIGURE 5.—Renal venogram in a 65 year old man with a transitional cell carcinoma of the renal pelvis. Segmental veins are stretched and narrowed (arrows).

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