

Macroscopic assessment, dissection protocols and histologic sampling strategy for renal cell carcinomas

Stephen M Bonsib

Abstract

There are substantial data identifying pathologic stage as the single most important prognostic feature predictive of patient outcome for renal cell carcinoma. The pathologist, therefore, must be familiar with the nuances of staging so that dissection protocols and histologic sampling strategies can be designed to achieve an accurate pathologic stage. The most critical staging issue is identification of renal-limited disease versus extension beyond the kidney. Since the latter occurs either by venous involvement or perinephric fat extension, it is important to understand the gross anatomy of the two perinephric compartments, and the complex renal venous system and its interconnections. This article will, therefore, review the gross anatomy of the normal kidney pertinent to handling tumor resections, offer several dissection approaches (each capable of providing accurate staging information) and provide recommendations for histologic sampling.

Keywords renal cell carcinoma; renal sinus; renal vein; TNM stage

Introduction

There has been explosive growth in our understanding of renal cell carcinomas (RCCs) in recent years. New histologic types, unique tumor-specific cytogenetic abnormalities and powerful prognostic parameters have been identified.¹⁻⁷ Although surgical therapy is the mainstay of treatment for RCCs, several adjuvant therapies are beginning to show promise. Thus, identification of patients at risk for progression has assumed great importance.

Pathologic stage is the most important prognostic parameter.³⁻⁷ Pathologists must, therefore, be familiar with the nuances of the most current staging system so that dissection protocols and histologic sampling strategies can be designed to achieve an accurate pathologic stage. For most oncology programs this means the American Joint Commission on Cancer/International Union Against Cancer (AJCC/UICC) TNM staging system.⁸ This is a dynamic system with revisions published on a regular basis. The most recent formulation appeared in 2002 (Table 1) and accommodated recent advances in understanding of invasive pathways, specifically the importance of renal sinus involvement.⁹⁻¹³

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TNM classification of renal cell carcinoma⁸

T – Primary tumor

TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
T1	Tumor 7 cm or less in greatest dimension, limited to the kidney
T1a	Tumor 4 cm or less
T1b	Tumor more than 4 cm but not more than 7 cm
T2	Tumor more than 7 cm in greatest dimension, limited to the kidney
T3	Tumor extends into major veins or directly invades adrenal gland or perinephric tissues but not beyond Gerota's fascia
T3a	Tumor directly invades adrenal gland or perinephric tissues ^a but not beyond Gerota's fascia
T3b	Tumor grossly extends into renal vein(s) ^b or vena cava or its wall below diaphragm
T3c	Tumor grossly extends into vena cava or its wall above diaphragm
T4	Tumor directly invades beyond Gerota's fascia

N – Regional lymph nodes

NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Metastasis in a single regional lymph node
N2	Metastasis in more than one regional lymph node

M – Distant metastasis

MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis

^aIncludes renal sinus (peripelvic) fat.

^bIncludes segmental (muscle-containing) branches.

Table 1

This article will review the gross features of the two perinephric fat compartments and the complex renal venous systems, and offer several specimen dissections strategies followed by recommendations for tumor sampling. The observations and recommendations derive from the author's experimentation with dissection strategies and experience accrued from the examination of over 300 nephrectomy specimens with attention focused on invasive pathways.

Gross anatomy of the kidney and related structures

Perinephric fat

The perinephric fat includes two compartments, the peripheral perinephric fat located external to the renal capsule and within the confines of Gerota's fascia and the central perinephric fat that consists of the internally located renal sinus fat. The peripheral perinephric fat contains the adrenal gland; its quantity of fat varies substantially in nephrectomy specimens. The renal sinus fat is the fatty compartment located between the pelvi-calyceal system and the renal parenchyma (Figure 1). It contains the major lymphovascular endowment of the kidney and is visible only

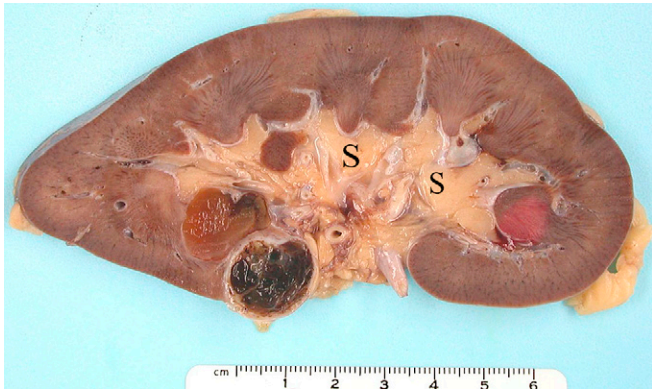


Figure 1 This kidney is sectioned in a plane anterior to the collecting system. The peripheral perinephric fat has been removed. The sinus fat (S) is centrally located entirely within the confines of the kidney. It contains numerous arteries and veins.

upon sectioning the kidney. The renal sinus has been an important compartment in staging of nephroblastoma for decades, but its importance in RCC is a more recent advance, first codified in the 2002 TNM formulation.⁹⁻¹⁵

Renal arteries and veins

Although there are countless variations in the architecture of the renal arteries and veins, there are a few generalizations to consider when examining a nephrectomy specimen. The most common arterial arrangement is for the main renal artery to give rise to five segmental arteries. One each supplies the anterior and posterior surfaces of the upper and lower poles, two supply the mid anterior surfaces, and one supplies the mid posterior surface. These five segmental branches often intertwine with the major tributaries of the main renal vein at the renal hilum (Figure 2).

The left and right main renal venous systems differ substantially.¹¹ The left renal vein is longer than the right and is often single. The right renal vein is shorter and will often have two or

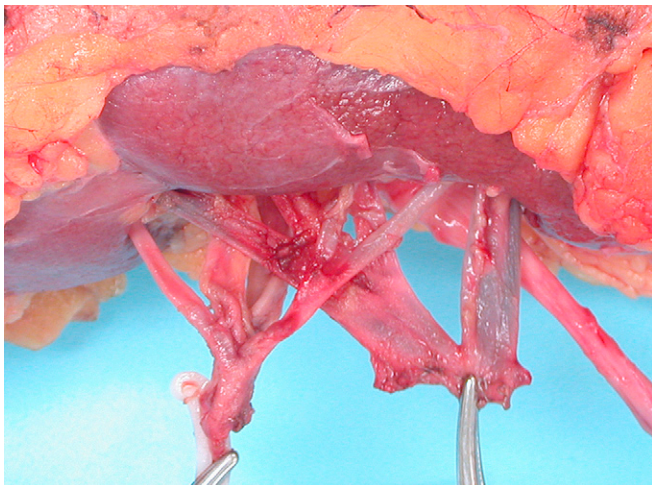


Figure 2 This left nephrectomy demonstrates that the arteries (left clamp) and veins (right clamp) intertwine and are anterior to the renal pelvis. Notice that the main renal vein has two primary tributaries and the superior primary tributary has three secondary tributaries – all external to the kidney. The lower pole and ureter are to the far right.

three major connections to the vena cava. Even with a single renal vein, venous branching may occur one or more centimeters outside of the hilum. Therefore, one or more main renal veins or primary tributaries may require evaluation for tumor involvement. The left renal vein receives extrarenal tributaries that may include the adrenal, capsular, periureteral, gonadal, and posterior lumbar veins that join the main renal vein after it exits the renal sinus. On the right side the adrenal, gonadal, and posterior lumbar veins usually join directly to the vena cava. Some of these complex venous interconnections are demonstrated in a left nephrectomy with renal and adrenal vein involvement in Figure 3.

The proximal tributaries of the main renal vein within the renal sinus are sizable veins that range from several millimeters to 2 cm in diameter. They receive drainage from intralobar veins that exit the anterior and posterior renal parenchyma. Multiple^{2,3} venous divisions converge anterior to the renal pelvis to eventually form the main renal vein(s). Therefore, awareness of specimen orientation facilitates location of the veins, which are invariably anterior to the renal pelvis (Figure 2).

Nephrectomy for RCC

Initial gross observations

Determine the type of surgical resection, the specimen components, and intactness of the resection. These observations influence your strategy for subsequent dissection. A radical nephrectomy includes Gerota's fascia, peri-renal fat, and usually the adrenal gland. In addition, lymph nodes and a portion of peritoneum on the anterior surface (recognizable by its shiny smooth surface) may be present. In large locally invasive tumors, there also may be inclusion of adjacent organs such as segments of the gastrointestinal tract or liver.

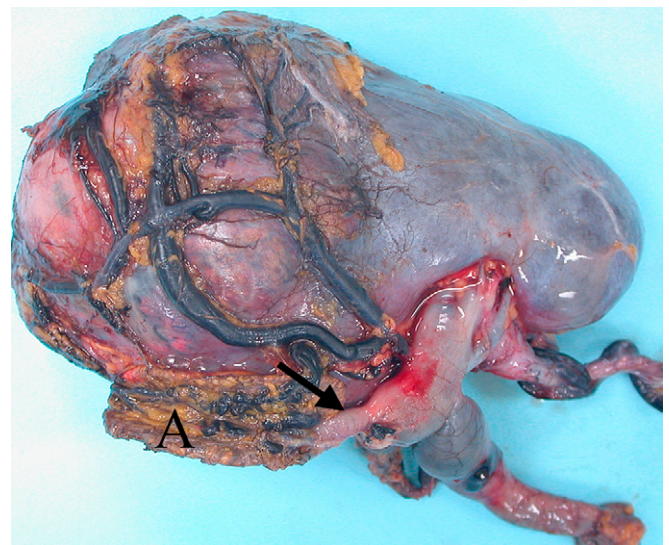


Figure 3 The perinephric fat has been removed from this left radical nephrectomy. The tumor has not breached the capsule, which retains its smooth shiny appearance. Notice that the main renal vein is involved and there is retrograde adrenal (A) vein involvement (arrow). Also notice the additional venous connections to the main renal vein that include capsular and periureteral veins. They are thrombosed but do not contain tumor.

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