

INTRODUCTION

Renal cell carcinoma (RCC) accounts for 3% of adult solid tumors; with highest incidence between 50–70 years of age (*Kirkali and Öbek, 2003*).

During the last 20 years the incidence of renal cell carcinoma (RCC) has been steadily increasing (2-3%/ year) (*Pantuck et al., 2001*).

Currently, most of the renal masses are being detected incidentally up to 40% with smaller size due to widespread use of imaging modalities such as ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI). This leads to increased RCC incidence worldwide with an earlier stage which can be cured by surgery (*Kirkali, 2006*).

This leads to introduce concepts as “incidental” or “small renal masses” (SRMs). SRM could be defined as those renal masses lower than 4 cm in diameter (*Kunkle et al., 2008*), accounting for 48–66% of RCC diagnosis (*Volpe et al., 2004*). Actually, 79–84% of SRM are detected before genitourinary symptoms are present (*DeRoche et al., 2008*) (size is smaller than symptomatic cancer classifying it as local stage with a better prognosis) (*Patard et al., 2002*). Although mean tumor size has

decreased in the last years, several studies indicate that this variable is one of the most important prognostic factors for RCC, and it has also contributed to the last modifications of RCC staging and treatment (**Kunkle et al., 2007**).

Small renal masses include all solid or complex cystic lesions lower than 4 cm. Among them, different benign tumors are found in a 12.8 to 17.3% of cases (**Russo, 2008**) including oncocytoma in 53%, angiomyolipoma (AML) in 22%, atypical cyst in 10%, and different benign lesions as leiomyoma, xanthogranulomatous pyelonephritis, and focal infarction in 13% (**Pahernik et al., 2007**).

Incidental renal tumors have a mean size of 3.7 cm (median 3, range 0.8 to 12). Nevertheless, tumors greater than 4 cm could be incidental (**Schlomer et al., 2006**).

Incidental diagnosis is performed in the 82.4%, 78.9%, and 56.7% of the 1–4 cm, 4–6 cm and greater than 6 cm renal masses, respectively (**Volpe et al., 2004**).

If a cut-off should be made, most cases of RCC lower than 7 cm are incidentally discovered, while tumors greater than 7 cm are mainly symptomatic but, this cannot be taken as a rule (**Schlomer et al., 2006**).

The percentage of malignancies increases from 72.1% in masses lower than 2 cm to 93.7% in tumors greater than 7 cm (*Schlomer et al., 2006*).

Ninety percent of tumors lower than 1 cm were low-grade compared to only 37.9% of tumors ≥ 7 cm (*Frank et al., 2003*). Grade 3 was found in 7.1%, 9.0%, and 14.0% of the patients in the 2, 3, and 4 cm groups, respectively and just 10.6% of small RCC were grade 3 (*Pahernik et al., 2007*).

Tumor grade increase as tumor size increase from 2 to 4 cm. Grade 1 was 31.3% for 2 cm, 27.4% for 3 cm, and 18.1% for 4 cm tumors; and grade 3 was 7.1% for 2 cm, 9% for 3 cm, and 14% for 4 cm tumors (*Pahernik et al., 2007*).

Size is a significant factor in the decision to perform nephron sparing surgery (NSS): tumors sized 2 cm (81%), 3 cm (73%), and 4 cm (44%) could be treated by means of NSS. This treatment is technically easier in incidental than non incidental RCC (76% versus 24%) (*Dall'Oglio et al., 2007*).

Nephron-sparing surgery entails complete local resection of a renal tumor while leaving the largest possible amount of normal functioning parenchyma in the involved kidney (*Fergany et al., 2000*).

The first partial nephrectomy was performed in 1884 by Wells for the removal of a perirenal fibrolipoma (**Wells, 1984**).

Partial nephrectomy to treat renal malignancy was first described in 1890 by Czerny (**Czerny, 1890**). In 1950, Vermooten first suggested that localized RCC could successfully be excised while leaving a surrounding area of normal renal parenchyma (**Vermooten, 1950**).

Interest in nephron-sparing surgery for RCC has been stimulated by advances in renal imaging, experience with renal vascular surgery for other conditions, improved methods of preventing ischemic renal damage, growing numbers of incidentally discovered low-stage RCCs, and good long-term survival in patients undergoing this form of treatment (**Fergany et al., 2000**).

Indications for nephron-sparing surgery include situations in which radical nephrectomy would render the patient anephric with a subsequent immediate need for dialysis. This indication encompasses patients with bilateral RCC or RCC involving a solitary functioning kidney (**Ghavamian et al., 2002**).

In patients with bilateral synchronous RCC, the main aim is to attempt to preserve as much functioning renal tissue as possible. This entails performing bilateral

nephron-sparing operations when feasible (**UZZO *et al.*, 2001**).

These cases have created a controversy of whether nephron-sparing surgery is indicated when the patient has a normal functioning contralateral kidney.

Engen and Herr published the first successfully performed NSS for such an indication in 1981 (**Engen and Herr, 1981**). Since then, several studies have also demonstrated the successful use of NSS for this indication. Leading to, increase the use of nephron-sparing surgery for patients with unilateral RCC and a normal contralateral kidney (**Tsui *et al.*, 1999**).

Although radical nephrectomy remains the standard treatment for localized renal carcinoma in patients with an anatomically and functionally normal opposite kidney, a growing number of authors have reported excellent results with nephron-sparing surgery in this setting. Clearly, patient selection on the basis of small tumor size is a significant factor accounting for the favorable outcome after nephron-sparing surgery in these patients (**UZZO *et al.*, 2001**).

AIM OF THE WORK

To shed light on the nephron sparing surgery as a recent modality in the management of localized renal cell carcinomas. And discuss the surgical technique, indication and evaluation of the patient candidate for NSS.

Chapter (1)

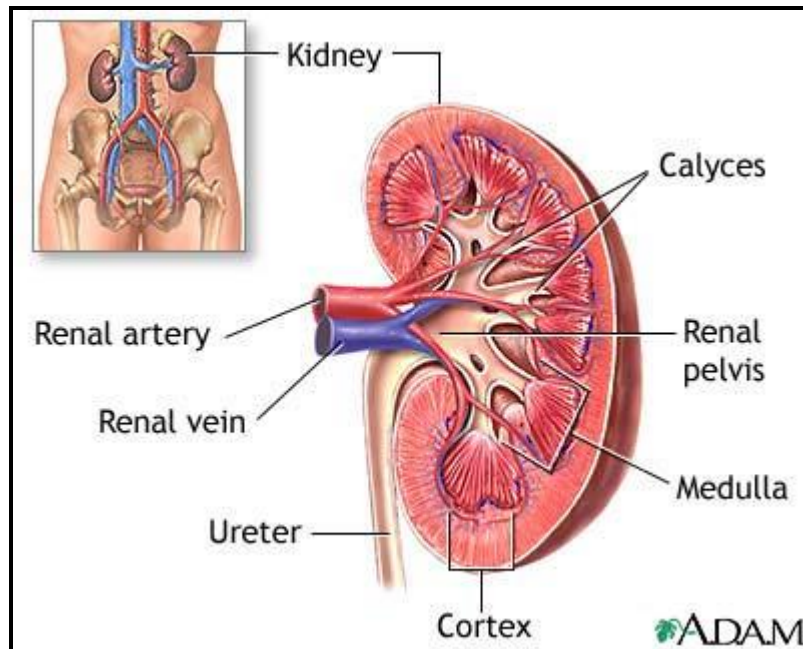
ANATOMY OF THE KIDNEY

Fig. (1): General renal structure

General renal structure (Fig. 1):

The kidney has a thin capsule, easily removed, and composed of collagen-rich tissue with some elastic and smooth muscle fibers. In renal disease it may become adherent. The kidney itself can be divided into an internal medulla and external cortex.

The renal medulla consists of pale, striated, conical renal pyramids, their bases peripheral, and their apices

converging to the renal sinus. At the renal sinus they project into calyces as papillae (*Standring et al., 2005*).

The renal cortex is subcapsular, arching over the bases of the pyramids and extending between them towards the renal sinus as renal columns. The peripheral regions are cortical arches and are traversed by radial, lighter-colored medullary rays, separated by darker tissue, the convoluted part.

The rays taper towards the renal capsule and they are peripheral prolongations from the bases of renal pyramids. The cortex is histologically divisible into outer and inner zones; the inner is demarcated from the medulla by tangential blood vessels (arcuate arteries and veins), which lie at the junction of the two, but a thin layer of cortical tissue (subcortex) appears on the medullary side of this zone. The cortex close to the medulla is sometimes termed juxtamedullary (*Standring et al., 2005*).

Renal calyces and pelvis:

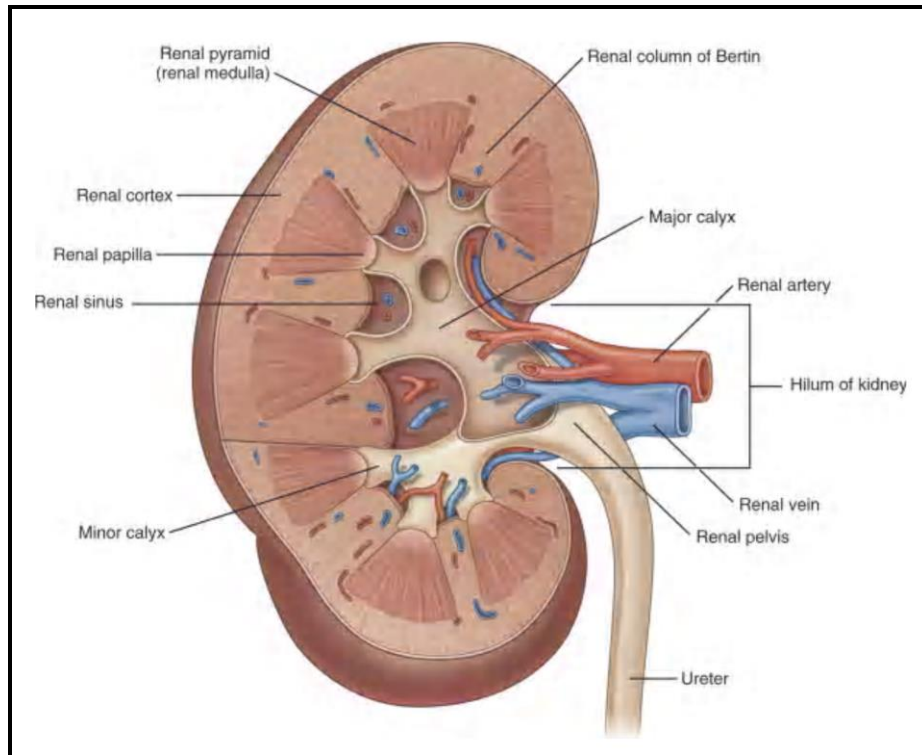


Fig. (2): Internal structure of the kidney. (From Drake RL, Vogl W, and Mitchell AWM: *Gray's Anatomy for Students*. Philadelphia, Elsevier, 2005, p 323.)

The hilum of the kidney leads into a central renal sinus, lined by the renal capsule and almost filled by the renal pelvis and vessels, the remaining space being filled by fat. Within the renal sinus, the collecting tubules of the nephrons of the kidney open onto the summits of the renal papillae to drain into minor calyces, funnel-shaped expansions of the upper urinary tract (**Standring et al., 2005**).

The renal capsule covers the external surface of the kidney and continues through the hilum to line the sinus and fuse with the adventitial coverings of the minor calyces. Each minor calyx surrounds either a single papilla or, more rarely, groups of two or three papillae.

The minor calyces unite with their neighbors to form two or possibly three larger chambers, the major calyces. The calyces of each kidney are usually arranged in seven pairs (seven ventral and seven dorsal) although there is wide variation (*Standring et al., 2005*).

The calyces drain into the infundibula. The renal pelvis is normally formed from the junction of two infundibula, one from the upper and one from the lower pole calyces, but there may be a third, draining the calyces in the mid-portion of the kidney.

The calyces are usually grouped so that three pairs drain into the upper pole infundibulum and four pairs into the lower pole infundibulum. If there is a middle infundibulum, the distribution is normally three pairs at the upper pole, two in the middle, and two at the lower pole (*Standring et al., 2005*).

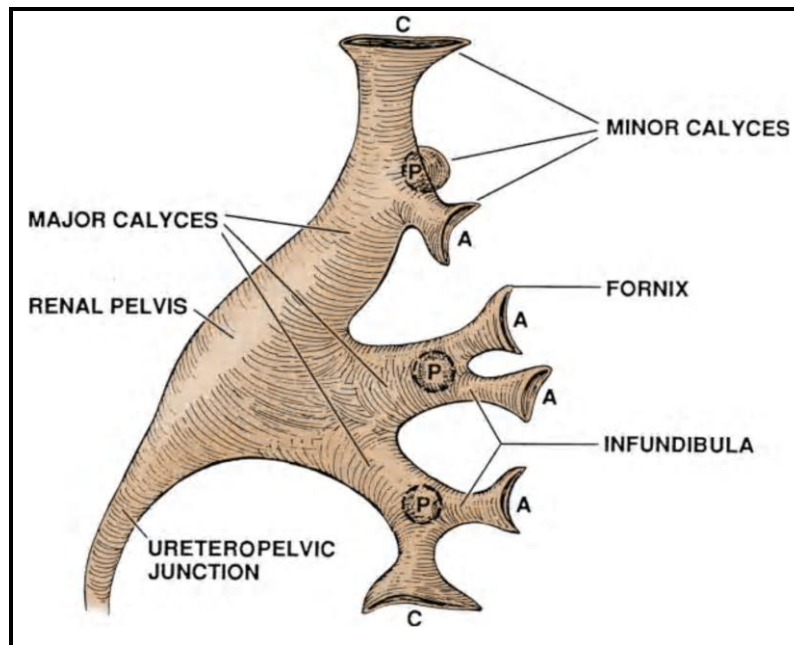


Fig. (3): The renal collecting system (left kidney) showing major divisions into minor calyces, major calyces, and renal pelvis. A, anterior minor calyces; C, compound calyces at the renal poles; P, posterior minor calyces.

There is considerable variation in the arrangement of the infundibula and in the extent to which the pelvis is intrarenal or extra renal. The funnel-shaped renal pelvis tapers as it passes inferomedially, traversing the renal hilum to become continuous with the ureter (*Standring et al., 2005*).

It is rarely possible to determine precisely where the renal pelvis ceases and the ureter begins, the region is usually extrahilar and normally lies adjacent to the lower part of the medial border of the kidney.

Rarely, the entire renal pelvis has been found to lie inside the sinus of the kidney so that the pelviureteric

region occurs either in the vicinity of the renal hilum or completely within the renal sinus (*Standring et al., 2005*).

Renal Vasculature:

The renal pedicle classically consists of a single artery and a single vein that enter the kidney via the renal hilum (see Fig. 4). These structures branch from the aorta and inferior vena cava just below the superior mesenteric artery at the level of the second lumbar vertebra. The vein is anterior to the artery. The renal pelvis and ureter are located further posterior to these vascular structures (*Standring et al., 2005*).

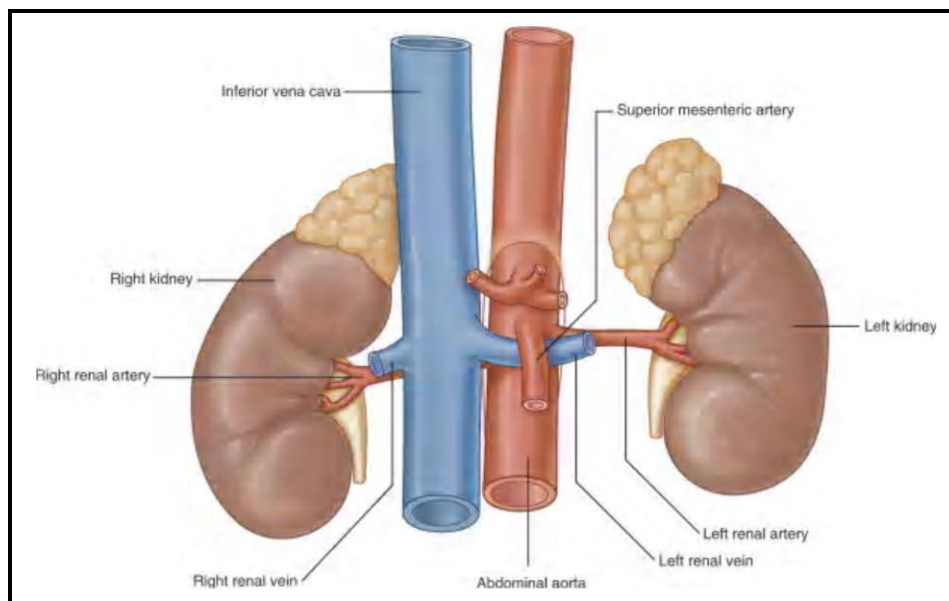


Fig. (4): Renal vasculature. Note path of left renal vein under the superior mesenteric artery. (*From Drake RL, Vogl W, Mitchell AWM: Gray's Anatomy for Students. Philadelphia, Elsevier, 2005, p 324.*)

Renal Artery:

The renal artery branches laterally from the aorta just below the origin of the superior mesenteric artery. Both cross the corresponding crus of the diaphragm at right angles to the aorta. The right renal artery is longer and often higher, passing posterior to the inferior vena cava, right renal vein, head of the pancreas and descending part of the duodenum (*Standring et al., 2005*).

The left renal artery is a little lower and passes behind the left renal vein, the body of the pancreas and splenic vein. It may be crossed anteriorly by the inferior mesenteric vein.

A single renal artery to each kidney is present in 70% of individuals. The arteries vary in their level of origin and in their calibre, obliquity and precise relations.

In its extrarenal course each renal artery gives off one or more inferior suprarenal arteries, a branch to the ureter and branches which supply perinephric tissue, the renal capsule and the pelvis (*Standring et al., 2005*).

Near the renal hilum, each artery divides into an anterior and a posterior division, and these divide into segmental arteries supplying the renal vascular segments. Accessory renal arteries are common (30% of individuals), and usually arise from the aorta above or below the main

renal artery and follow it to the renal hilum. They are regarded as persistent embryonic lateral splanchnic arteries (*Standring et al., 2005*).

Accessory vessels to the inferior pole cross anterior to the ureter and may, by obstructing the ureter, cause hydronephrosis. Rarely, accessory renal arteries arise from the coeliac or superior mesenteric arteries near the aortic bifurcation or from the common iliac arteries (*Standring et al., 2005*).

Segmental arteries:

Upon approaching the kidney, the renal artery splits into four or more branches, with five being the most common. These are the renal segmental arteries (Fig. 5). Each segmental artery supplies a distinct portion of the kidney with no collateral circulation between them (Fig. 6). Thus, occlusion or injury to a segmental branch will cause segmental renal infarction (**Anderson et al., 2007**).

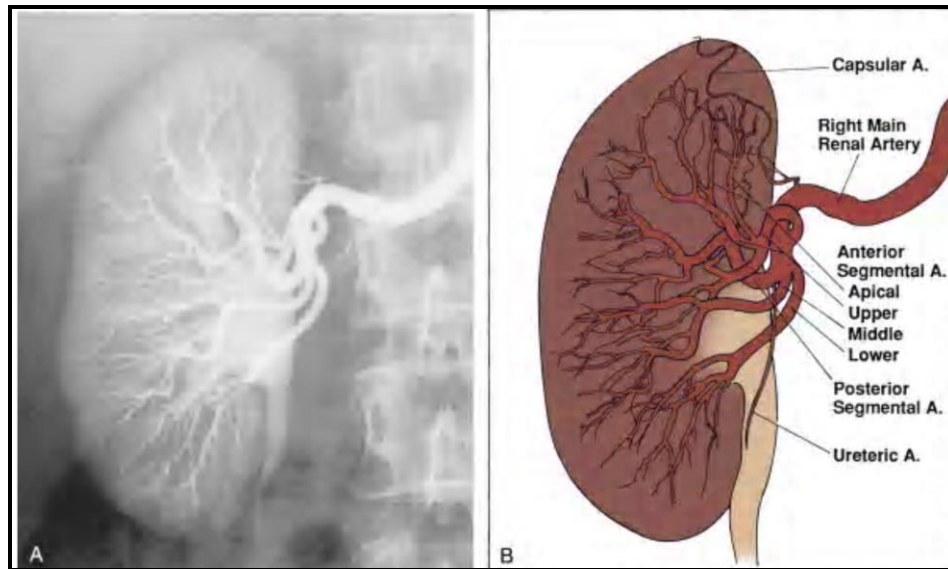


Fig. (5): A and B, Segmental branches of the right renal artery demonstrated by renal angiogram.

Generally, the first and most constant branch is the posterior segmental branch, which separates from the renal artery before it enters the renal hilum. There are typically four anterior branches, which from superior to inferior are apical, upper, middle, and lower (*Anderson et al., 2007*).

The relationship of these segmental arteries is important because the posterior segmental branch will pass posterior to the renal pelvis while the others pass anterior to the renal pelvis (*Anderson et al., 2007*).

Five arterial segments have been identified. The apical segment occupies the anteromedial region of the superior pole. The superior (anterior) segment includes the rest of the superior pole and the central anterosuperior