11 Collecting Duct Carcinoma

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11.1 Introduction

Renal cell carcinoma (RCC) accounts for roughly 2–3% of adult malignancies and constitutes approximately 85% of all primary malignant renal tumors. The male-to-female annual incidence ratio for RCC is 1.5:1. The incidence is equivalent between whites and blacks. Although RCC may occur at any age, including childhood, there is a progressive increase in frequency with age. Patients usually present between the ages of 50 and 70 years, with a median age at diagnosis of 57 years (Levine and King 2000). Rare types of RCC occurring in children have an appearance and behavior equivalent to those developing in adults.

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In 1976, Mancilla-Jimenez et al. reported that atypical hyperplastic changes of adjacent collecting ducts were present in 3 of 34 papillary RCC and suggested that some papillary RCC may originate from collecting duct epithelium (Singh and Nabi 2002). The term Bellini duct carcinoma, reflecting the presumed site of origin, was first defined by Cromie et al. (1979). It is also known by several synonyms: collecting duct carcinoma (CDC); medullary renal carcinoma; distal renal tubular carcinoma; and distal nephron carcinoma that arises from the cells of the distal nephron (Kuroda et al. 2002). The detailed morphologic studies of Thoenes et al. (1986) have delineated the major morphologic types of renal cell neoplasia and their histogenetic relationship to various segments of the renal tubular system, whereas chromophobe RCC and CDC have been categorized as distinct new entities in a new classification system of renal tumors (Srigley and Eble 1998). Fleming and Lewi (1986) defined the diagnostic criteria and established collecting duct carcinoma of the kidney as a separate histologic entity arising in the renal medulla (Natsume et al. 1997). The Heidelberg classification of renal tumors, introduced in 1997, identified five histologic types of renal cancer (conventional, papillary, chromophobe, collecting duct, and unclassifiable), according to their morphologic aspects and their chromosome alterations obtained by a cytogenetic analysis of the neoplastic karyotype (Antonelli et al. 2003). Since the First International Workshop on Renal Cell Carcinoma held by the World Health Organization, CDC has been also classified as an entity different from conventional (clear cell) renal carcinoma, papillary renal carcinoma, chromophobe renal carcinoma, and unclassified renal cell carcinoma. Each has distinct histomorphologic, ultrastructural, immunohistochemical, histochemical, and cytogenetic features. Conventional RCC is the most common cancer of the renal cortex, accounting for approximately 70% of cases. Most conventional RCCs contain clear cytoplasm, but some have eosinophilic or granular cytoplasm. Papillary RCC accounts for approximately

15% of RCC, including those previously referred to as chromophil RCC. Chromophobe RCC accounts for approximately 5% of cases of RCC. The cytoplasm contains numerous microvesicles that appear blue with Hale's colloidal iron stain. Unclassified RCC is reserved for cases that do not fulfill the criteria for the cancers described previously. These tumors are morphologically and genetically variable and are often high grade. Less than 2% of renal carcinomas are unclassified (Bostwick and Eble 1999).

The collecting duct is embryologically derived from the ureteric bud, whereas the remainder of the kidney develops from metanephric blastema. The ureteric bud also differentiates into ureter, renal pelvis, and calyces. The renal collecting ducts extend from the cortex to the tips of the renal papillae (Srigley and Eble 1998). Collecting duct carcinoma, or Bellini duct carcinoma, is a very rare, aggressive renal neoplasm that arises from the distal segment of the collecting ducts of Bellini in the renal medullary pyramids (Fig. 11.1), unlike the much more common variants of RCC which arise from the convoluted tubules (Sironi et al. 2003). Collecting duct carcinoma originates in the medullar collecting duct, which arises from the mesonephron. In contrast, the tubular structures of the kidney, which can be a point of origin for RCC, originate in the metanephric blastema (Auguet et al. 2000). Recognition of CDC remains somewhat controversial, and the tumor is typically described as containing irregular channels lined by highly atypical epithelium, often with a hobnail cell appearance (Bostwick and Eble 1999). Collecting duct carcinoma is almost invariably centered in the renal medulla with or without extension into the renal cortex, renal pelvis, or hilar soft tissue. Its hypothesized origin from the collecting duct epithelium is supported by the presence of the collecting duct epithelium dysplasia far from the main tumor and reactivity of tumor cells with antibodies to high molecular weight cytokeratin and *Ulex europaeus* agglutinin-I (UEA-I; Gong et al. 2003).

The most common neoplasms arising from the collecting ducts are renal oncocytoma and chromophobe RCC, which appear to arise in the cortex from the intercalated cells of the proximal connecting segment of the collecting ducts. Collecting duct carcinoma is a much less common neoplasm that displays a tubulopapillary architecture, arises in the renal medulla (and later invades the renal cortex), and demonstrates infiltrating tubules with an associated desmoplastic reaction (Milowski et al. 2002). The microscopic appearance of the tumor is variable; thus, diagnosis based on histologic criteria

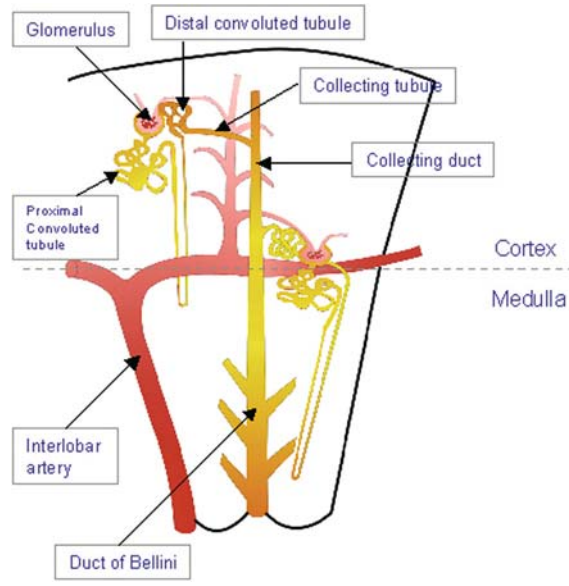

Fig. 11.1. Normal histologic anatomy of the kidney.

alone cannot be accurate, and immunohistochemical staining is needed to demonstrate the origin of the tumor (Kirkali et al. 1996). Because most CDC cases are published as case reports, it is difficult to characterize this entity.

In this chapter, we review the natural history, clinical course, pathologic and radiologic findings, treatment, and prognosis of typical CDCs.

11.2 Clinical Features

Collecting duct carcinoma is a rare variant of renal carcinoma associated with an aggressive course and an extremely poor prognosis. It is considered one of the most aggressive carcinomas of the renal tubular epithelium: 35–40% of patients with distant metastases and two-thirds of all patients are dead within 2 years of diagnosis (Gallob et al. 2001). Collecting duct carcinoma account for approximately 0.4–2.6% of all renal neoplasms. With regard to the incidence of CDC, Rumpelt et al. (1991) found six CDC (0.4%) among 1400 consecutive RCC. Most cases reported previously had a tendency to early dissemination and a fatal clinical course. Patients tend to be younger than those with classical RCC (median age at diagnosis of 43 years) and white (Milowski et al. 2002; Natsume et al. 1997). More men than women (ratio 2:1) are affected. There is no predominant laterality of the affected side. Patients with CDC usually have a

family history of associated malignancies, including colon, pancreas, lung, ovary, and uterus malignancies (Kuroda et al. 2002). Clinical manifestations of CDC, similar to those of RCC, are hematuria, flank pain, and palpable mass. Constitutional symptoms, such as fever, anorexia, and weight loss, are also common, but no particular paraneoplastic syndrome has been reported (Auguet et al. 2000; Pickhardt 1999).

The tumor typically follows an aggressive clinical course with most patients showing evidence of metastatic disease at presentation. The most common site of metastatic disease is the lymph nodes, including the cervical or supraclavicular lymph nodes and visceral metastases. Nodal involvement was reported in 77.8% and lung metastases in 44.4% of patients (Peyromaure et al. 2002). These findings are similar to those of Davis et al. (1995), who reported nodal involvement and lung metastasis rates of 78 and 27%, respectively. In their study tumors were also metastatic to the adrenal gland in 24% of cases and to the liver in 18%. In contrast to RCC, blastic bone metastases occur more frequently than lytic bone metastases in CDC. This rapid metastatic spread may be due to the tumor's central location, close to the renal hilus (Milowski et al. 2002; Peyromaure et al. 2002). The growth pattern of CDC seems to be quite rapid, which would explain why it is almost always detected clinically (90% of our patients), especially when tumors are large (mean 94 mm). This is unlike other renal malignancies, which are increasingly more frequently discovered fortuitously (Mejean et al. 2003).

The association of CDC with sickle cell trait (SCT) has been noted by others. In one study 44.4% of patients were black and 55.6% had SCT. All black patients had SCT. In the series of Davis et al. (1995), which included 33 patients with CDC, all except 1 were black and had SCT (Peyromaure et al. 2002).

11.3 Pathology

There are five distinct subtypes of RCC: conventional (clear cell); papillary; chromophobe; collecting duct subtypes; and unclassified RCC. Each subtype has distinct histomorphologic, ultrastructural, immunohistochemical, histochemical, and cytogenetic features (Gong et al. 2003). A modern classification of renal epithelial neoplasms has been proposed that takes into account both the morphologic and genetic findings.

Collecting duct carcinoma is an adenocarcinoma consisting of two components. The first component is the main tumor mass, which is papillary with a fibrovascular core, whereas the second, invasive part is composed of glandular elements associated with marked desmoplastic reaction. The tumor cells are columnar, and show variable degrees of pleomorphism (Nguyen and Schumann 1997).

Several pathologic criteria define CDC. It has tubulopapillary architecture, arises in the renal medulla, and contains atypical hyperplastic changes in adjacent collecting tubules. Staining for high molecular weight cytokeratins and UEA-I lectin provides strong support for an origin in the collecting duct of the distal nephron. Some cytogenetic abnormalities have been identified, including loss of heterozygosity of 8p and 13q, which suggests that tumor suppressor genes on 8p and 13q may be involved in the pathogenesis of this variety of cancer (Peyromaure et al. 2002). The tumor can also have prominent papillary or sarcomatoid features, may contain mucin, and can resemble urothelial carcinoma with glandular differentiation or adenocarcinoma arising from the urothelium of the renal pelvis (Gallob et al. 2001). The collecting duct is embryologically derived from the ureteric bud, which explains the urothelial features of some cases of CDC. The pathologic and immunohistochemical description as well as the cytogenetic abnormalities support the belief that CDC is more similar to urothelial carcinoma than to clear cell RCC (Milowski et al. 2002).

Two other neoplasms considered to originate from the collecting ducts, renal medullary carcinoma (Davis et al. 1995) and low-grade CDC (MacLennan et al. 1997), have been described. Renal medullary carcinoma arises in young black patients with SCT, and has a reticular, yolk sac tumor-like, or adenoid cystic morphology. There is some overlap in histologic appearance between typical CDC and renal medullary carcinoma, with the latter seeming to form the aggressive end of the CDC spectrum (Srigley and Eble 1998). All patients with this tumor died of the disease; mean duration post-surgery was 15 months. Low-grade CDC presents a grossly solid or cystic, well-circumscribed, macroscopic appearance and is characterized by tubular formation of tumor cells with a hobnail cell appearance and low nuclear grade. This tumor seems to have a better prognosis than classic CDC (Fukunaga 1999). Collecting duct carcinoma appears to belong to a broad spectrum of distal CDC tumors with different morphologic traits and prognoses, which emphasizes the difficulty of diagnosing this condition.

11.3.1 Gross Morphology

Collecting duct carcinoma is usually located in the central region of the kidney and is poorly defined, with firm, gray-white, infiltrating tumors that develop from the medulla toward the cortex (Fig. 11.2). Of the tumors 87.5% are centered around the renal medulla and have irregular borders; however, not every renal tumor in the central location originates in the collecting ducts of the renal medulla (Fig. 11.3). The renal cortex was involved in 66.7% of the cases and the pelvocalyceal system in 44.4% of cases. Most common RCC is well delineated and centered on the cortex. Grossly, the tumor tends to be large at the time of diagnosis and may contain areas of necrosis. In large tumors, origin in the medulla is impossible to establish. In addition, although CDC demonstrates an infiltrative growth pattern initially, an expansile appearance may predominate as the tumor enlarges and extends beyond the renal capsule. The presence of a central, infiltrative component in such cases may be a useful finding. Collecting duct carcinoma ranges widely in size from 2.5 to 12 cm (mean 5 cm). Yellow areas of necrosis may be present. Some tumors have grown into the renal pelvis. Local extension may be grossly obvious with invasion of perirenal and renal sinus fat, and metastases to regional lymph nodes or the adrenal gland. Sometimes, gross renal vein invasion may be seen (Antonelli et al. 2003; Pickhardt 1999). The unaffected outer configuration of the kidney is explained by infiltrative interstitial, intratubular, and intravenous spreading (Fukuya et al. 1996). A multicystic appearance secondary to dilated tubular structures is common.

11.3.2 Microscopic Findings

Typical CDC has a variety of growth patterns, including tubular (Fig. 11.4), papillary, tubulopapillary (Fig. 11.5), microcystic–papillary, pseudopapillary, cribriform, and solid patterns. Irregular angulated tubules infiltrate a desmoplastic stroma (Fig. 11.6). Microcystic change may be seen with the cysts irregular in contour and with small papillary infoldings (Fig. 11.7). Rumpelt et al. (1991) emphasized that the microcystic papillary pattern is diagnostically most important. The tubular architecture is markedly irregular, and anastomosing glands are often observed. Nuclear atypia are prominent, and significant atypical mitotic figures are also present. In addition to a desmoplastic stroma, there is commonly a brisk inflammatory infiltrate within and around the tumor. Extensive destruction of renal medullary and cortical tissue is often present. Marked vascular and lymphatic space invasion is common, and there is often permeation of hilar

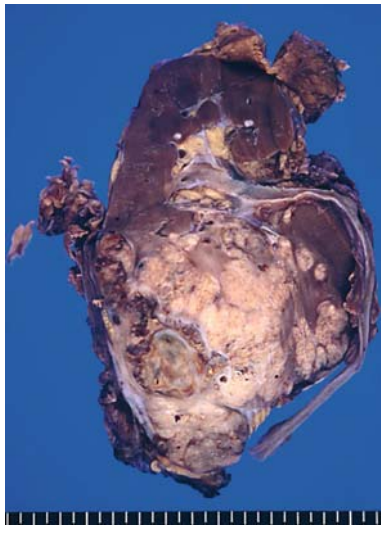

Fig. 11.2. Collecting duct carcinoma in a 45-year-old man. Gross specimen shows a poorly defined, grayish-white, multinodular protruding mass at the lower renal pole.

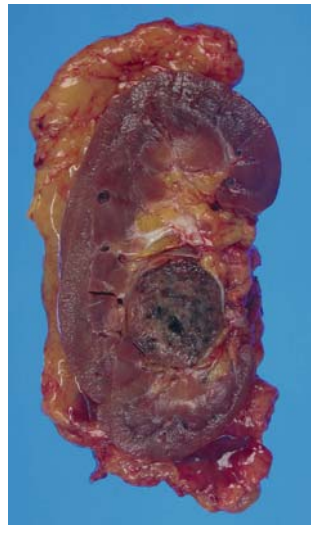

Fig. 11.3. Renal tumor in a central location in a 39-year-old woman. Gross specimen shows a well-marginated mass in the kidney. Chromophobe renal cell carcinoma was confirmed at histology. Central location does not always mean a collecting duct carcinoma.

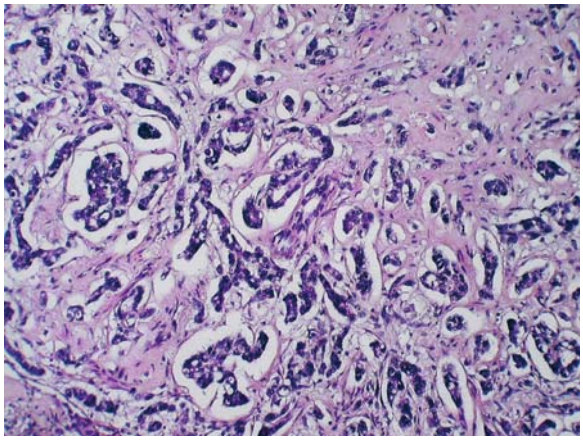

Fig. 11.4 Collecting duct carcinoma in a 45-year-old man. Photomicrograph shows a tubular growth pattern (hematoxylin and eosin stain; original magnification, ×200).

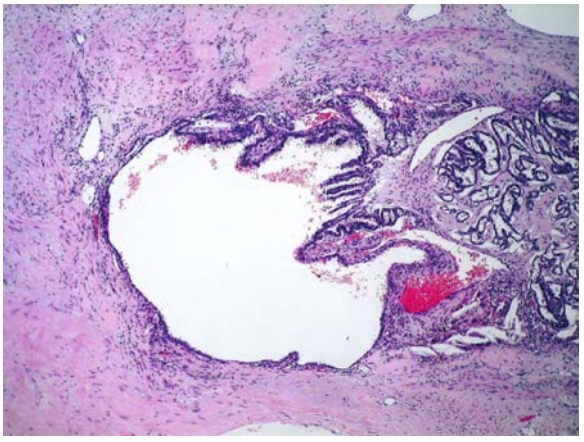

Fig. 11.5. Collecting duct carcinoma in a 45-year-old man. Photomicrograph shows tubulopapillary growth pattern (hematoxylin and eosin stain; original magnification, ×40).

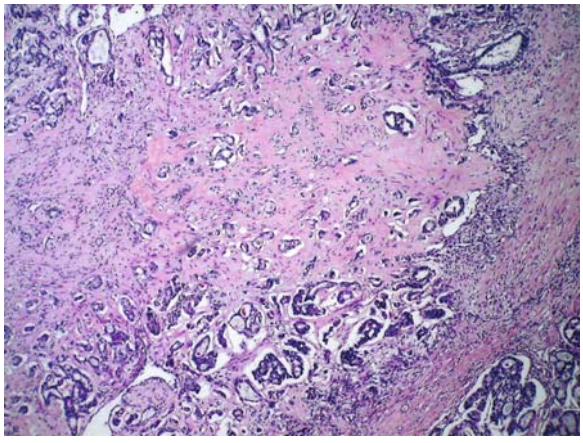

Fig. 11.6. Collecting duct carcinoma in a 45-year-old man. Photomicrograph shows an infiltrative growth with prominent desmoplastic reaction (hematoxylin and eosin stain; original magnification, ×100).

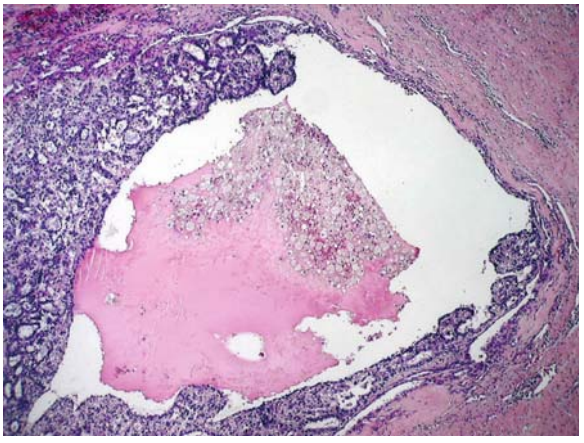

Fig. 11.7. Collecting duct carcinoma in a 45-year-old man. Photomicrograph of the collecting duct carcinoma depicts an intratumoral cystic area (hematoxylin and eosin stain; original magnification, ×40).

fat. The tumor biologic behavior is mostly aggressive with a high rate of local, lymphatic, and hematogenous spreading at diagnosis and a poor long-term prognosis. The tumor consists of an intermingling of clear, eosinophilic, or basophilic cells and polymorphic nuclei, often of hobnail appearance (Fig. 11.8); these are diagnostically helpful because hobnail cells are not seen in clear cell, papillary, or chromophobe RCC (Srigley and Eble 1998). Most CDCs have high-grade nuclear features. The plasma is lesser in amount and lacks the characteristic clear, granular and spindle cell types seen with RCC in which the nuclei are vesicular and firm and differentiation from metastatic lesions might be difficult, especially from ovarian and pancreatic origin tumors. The presence of dysplastic features in the epithelium of collecting ducts near a tumor has been taken as evidence the tumor originated in the epithelium of the collecting ducts (Fig. 11.9; Antonelli et al. 2003; Singh and Nabi 2002). Collecting duct carcinoma with sarcomatoid transformation has been noted (Aita et al. 2003; Kuroda et al. 2002).

11.3.3 Immunohistochemistry

Histopathologic differentiation of CDC from RCC is possible only by immunohistochemistry. In lectin histochemistry, *Ulex europaeus* agglutinin-I is commonly reactive. Peanut lectin is also often positive.

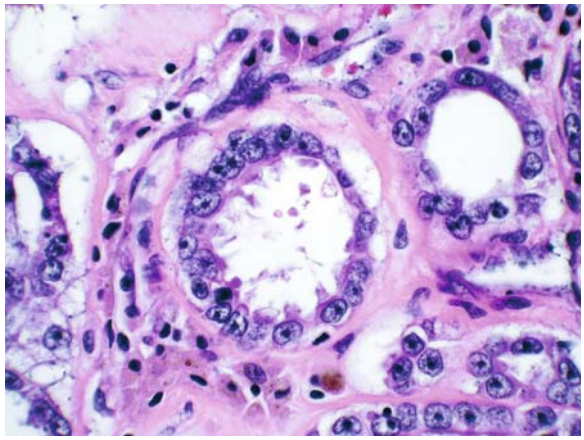

Fig. 11.8. Collecting duct carcinoma in a 62-year-old man. Photomicrograph reveals renal tubules lined by hobnail cells with high-grade nuclear atypism (hematoxylin and eosin stain; original magnification, ×400).

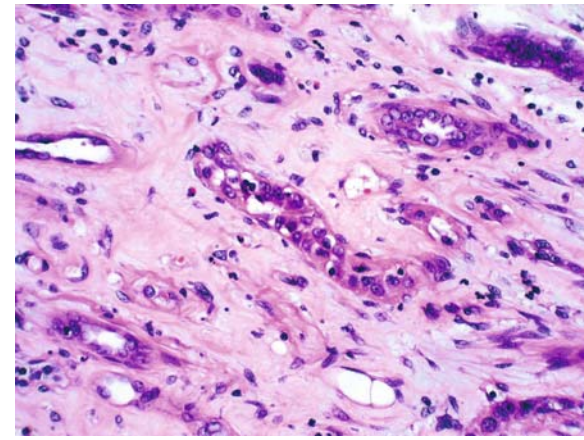

Fig. 11.9. Collecting duct carcinoma in a 62-year-old man. Photomicrograph shows a dysplastic epithelium of the collecting duct in the renal medulla (hematoxylin and eosin stain; original magnification, ×200).

High molecular weight keratin is commonly immunoreactive, and vimentin may also be reactive and negative staining with a proximal tubule marker (Leu-M1). Staining specifically for high molecular weight cytokeratins can provide further evidence for a collecting duct origin. The presence of mucin is confirmed by periodic acid–Schiff (PAS), Alcian blue, or mucicarmine staining in some cases. Such intracellular mucicarminophilic material is not seen with RCC; hence, staining with mucicarmine and PAS is useful in distinguishing CDC from RCC (Milowski et al. 2002; Singh and Nabi 2002).

11.3.4 Cytogenetics

Cytogenetically, CDC is characterized by a hypodiploid stem line, a high number of numerical and structural chromosome aberrations, and commonly, involvement of chromosome 1 and the autosomes (Antonelli et al. 2003).

11.3.5 Pathologic Criteria

Srigley and Eble (1998) described the typical CDC as a tubular or tubulopapillary tumor with desmoplastic stroma with inflammatory infiltrate and high nuclear grade. They proposed five major and four minor diagnostic criteria (Table 11.1).

Distinguishing CDC from papillary RCC is most important, because both tumors share some pathologic features, including a papillary architecture and positive reaction for distal nephron markers (Kuroda et al. 2002). Papillary RCC, medullary carcinoma, conventional RCC, transitional cell carcinoma, juxtaglomerular cell tumor, and metastatic carcinoma originating from other sites should be carefully considered and excluded when diagnosing CDC.

11.4 Radiologic Findings

Collecting duct carcinoma is usually centrally located and extensive with poorly defined borders. It frequently invades renal or hilar fat and vessels. These characteristics differ strongly from other types of RCC. For example, clear cell, chromophobe, and papillary carcinomas are usually located in the cortex and are well circumscribed with a distinctive cut surface appearance and color (Mejean et al. 2003). At diagnosis, CDC is frequently too large to allow a sharp definition of its location, but on image analysis, compared with RCC, it displays a very hypovascular and hypointense appearance.

Due to the rarity of CDC, radiographic findings have not been well established. Pickhardt et al. (2001) described the largest radiologic series in the literature. Imaging findings that support the diagnosis of CDC include a medullary location and an infiltrative appearance on CT, hyperechogenicity on ultrasound, hypointensity on T2-weighted MR images, distortion of the renal collecting system on urography, and hypovascularity on angiography. These tumors,

Table 11.1. Diagnostic criteria for collecting duct carcinoma

Major criteria	Minor criteria
Location in a medullary pyramid (small tumors)	Central location (large tumors)
Typical histology with irregular tubular architecture, desmoplasia, and high grade	Papillary architecture with wide, fibrous stalks, and desmoplastic stroma
Reactive with antibodies to high-molecular weight cytokeratin	Inflammatory stroma with numerous granulocytes
Reactive with *Ulex europaeus* lectin	Extensive renal, extrarenal, and vascular infiltration
Absence of urothelial carcinoma	

however, are often large at presentation and also have an expansile appearance and exophytic component that cannot be reliably distinguished from the more common cortical RCC. It cannot always be determined from radiologic images whether a renal tumor in a central location originated in the collecting ducts of the renal medulla.

Radionuclide studies seem to show uptake of Ga-67 in CDC, indicating that Ga-67 scintigraphy may be helpful for identifying this type of cancer preoperatively (Peyromaure et al. 2002).

11.4.1 Excretory Urography

Distortion of the intrarenal collecting system, with calyceal displacement and associated filling defects is observed. Medial displacement of the ureter can be seen. Focally prolonged cortical retention of contrast material may be seen on delayed film in the region that supports the medullary portion involved by tumor.

11.4.2 Ultrasound

Collecting duct carcinoma appears as a solid tumor with variable echogenicity compared with normal renal parenchyma, although most lesions are reported to be hyperechoic (Fig. 11.10). A hypoechoic rim is not identified at the tumor–parenchyma interface, indicating the absence of a pseudocapsule with this infiltrative neoplasm. Anechoic cystic areas are noted, representing either intratumoral cysts or cystic necrosis.

11.4.3 Computed Tomography

Collecting duct carcinoma generally shows a heterogeneous solid renal mass arising from the central kidney region with extension to the renal sinus. The mean size of the tumors is 7.7 cm (range 1.5–19 cm). Most tumors exhibit involvement of the renal medulla (Fig. 11.11). Recognition of a medullary origin can be difficult in larger tumors. Replacement of the renal sinus fat or protrusion into the renal pelvis is present in many cases (Fig. 11.12). Occasionally, CDC reveals an exophytic appearance without involvement of the renal sinus (Fig. 11.13).

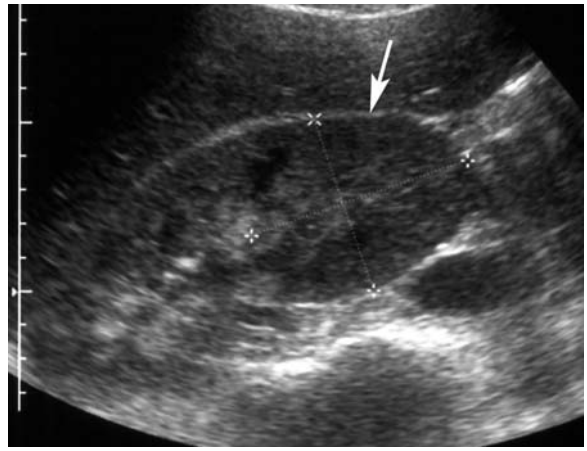

Fig. 11.10. Collecting duct carcinoma in a 45-year-old man. Longitudinal US image shows a poorly defined, hypoechoic mass (*arrow*) at the lower pole of the right kidney.

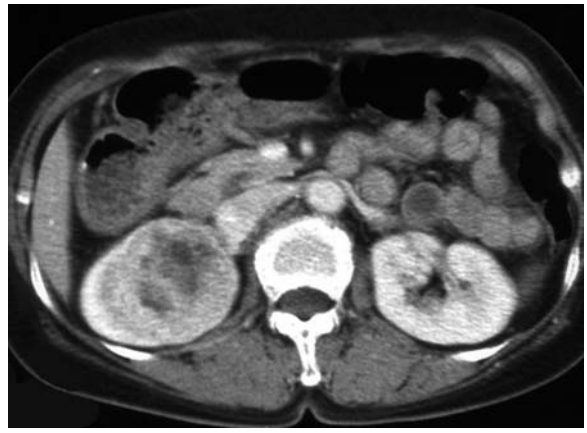

Fig. 11.11. Collecting duct carcinoma in a 55-year-old woman. Axial contrast-enhanced CT scan shows a poorly marginated enhancing mass in the renal medulla of the right kidney.

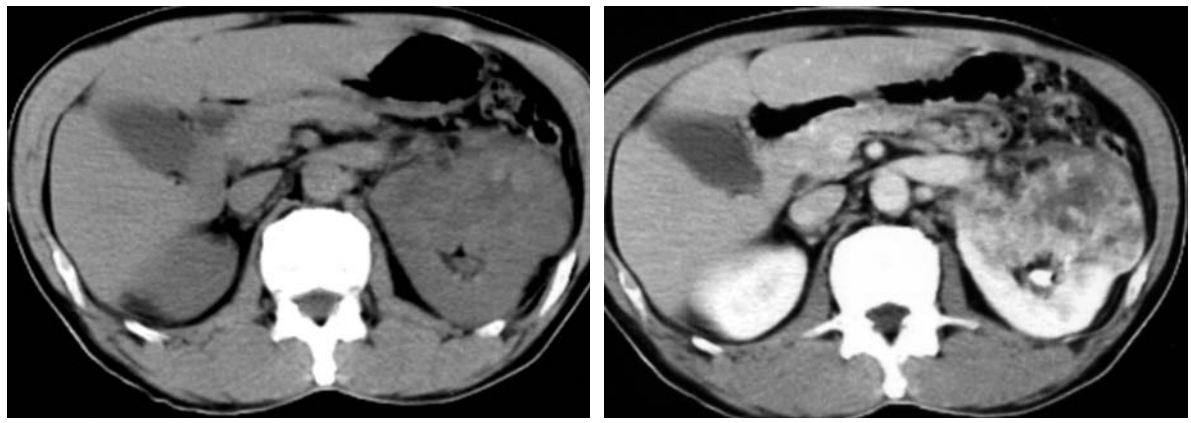

Fig. 11.12a,b. Collecting duct carcinoma in a 65-year-old man. **a** Axial unenhanced CT scan shows an ill-defined, inhomogeneous hypodense mass in the left kidney. **b** Axial contrast-enhanced CT scan shows a heterogeneous enhancing mass with protrusion into the left renal pelvis.

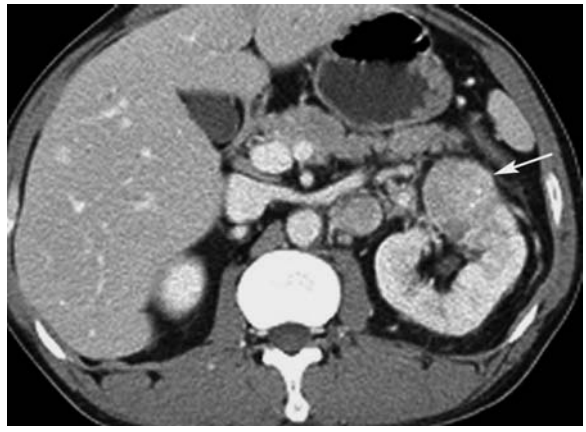

Fig. 11.13. Collecting duct carcinoma in a 38-year-old woman. Axial contrast-enhanced CT scan shows the left kidney presenting an exophytic mass (*arrow*) without involvement of the renal sinus.

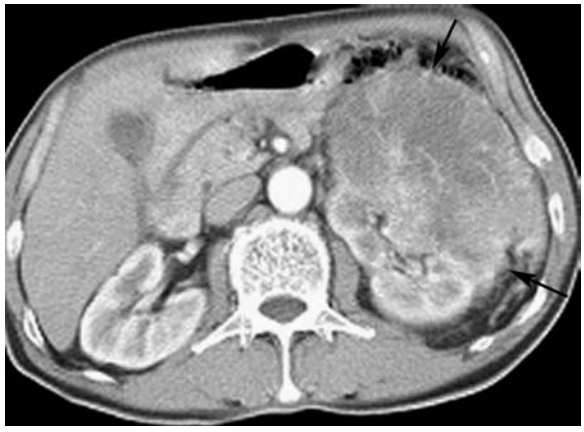

Fig. 11.14. Collecting duct carcinoma in a 68-year-old man. Axial contrast-enhanced CT scan shows a cortical location and exophytic appearance of the left kidney mass (*arrows*).

In a few cases, however, the main location or center of the tumor is cortical or exophytic (Fig. 11.14).

Collecting duct carcinoma is classified into three types according to the predominate region of involvement and the pattern of the tumor growth: medullary location only; medullary location with cortical extension; and medullary location with renal sinus extension (Fig. 11.15). Smaller tumors are usually medullary only; however, in larger tumors, CDC is likely to extend into the renal cortex or renal sinus. The origin and growth patterns of CDC could explain CT findings that distinguish it from ordinary RCC, 94% of which show predominantly exophytic growth with distortion of the renal contour regardless of the size of the tumor (Fukuya et al. 1996).

Tumor margins are poorly circumscribed in most cases. An irregular, serrated tumor margin along the interface with the medullary portion of the kidney suggests infiltrative growth (Fig. 11.16). Sometimes, the tumor has several satellite cortical nodules (Mejean et al. 2003). Infiltrative growth is a much less common pattern in which tumor cells spread using the normal architecture as scaffolding for interstitial growth. In addition to infiltrative growth, expansile growth can be seen (Fig. 11.17). Most renal tumors other than CDC grow by radial expansion with displacement of the normal parenchyma, focal bulging of the renal contour, and pseudocapsule formation (Pickhardt et al. 2001). In many cases, the affected kidneys maintain a normal outer contour (Fig. 11.18). As the size of the tumor increases, an exophytic appearance may be seen (Fig. 11.19). Unlike the more common conventional RCC, contrast-enhanced CT scans of the CDC usually demonstrate a heterogeneous mass with min-

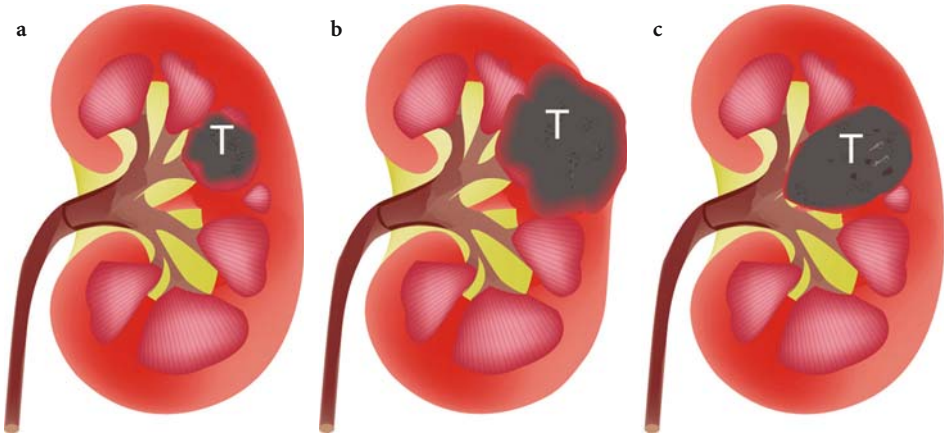

Fig. 11.15a-c. Collecting duct carcinomas are classified into three types according to the main location and the pattern of tumor growth (*T* tumor). **a** Medullary involvement only. **b** Medullary involvement with cortical extension. **c** Medullary involvement with renal sinus extension.

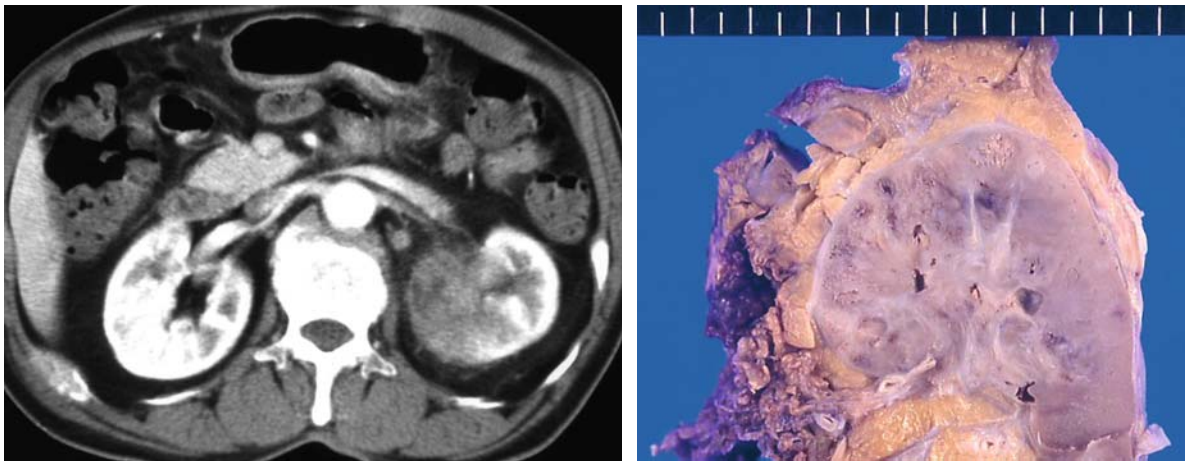

Fig. 11.16a,b. Collecting duct carcinoma in a 62-year-old man. **a** Axial contrast-enhanced CT scan shows left kidney ill-defined tumor with infiltrative growth pattern. **b** Gross specimen shows an infiltrative growth with poor demarcation in the renal medulla.

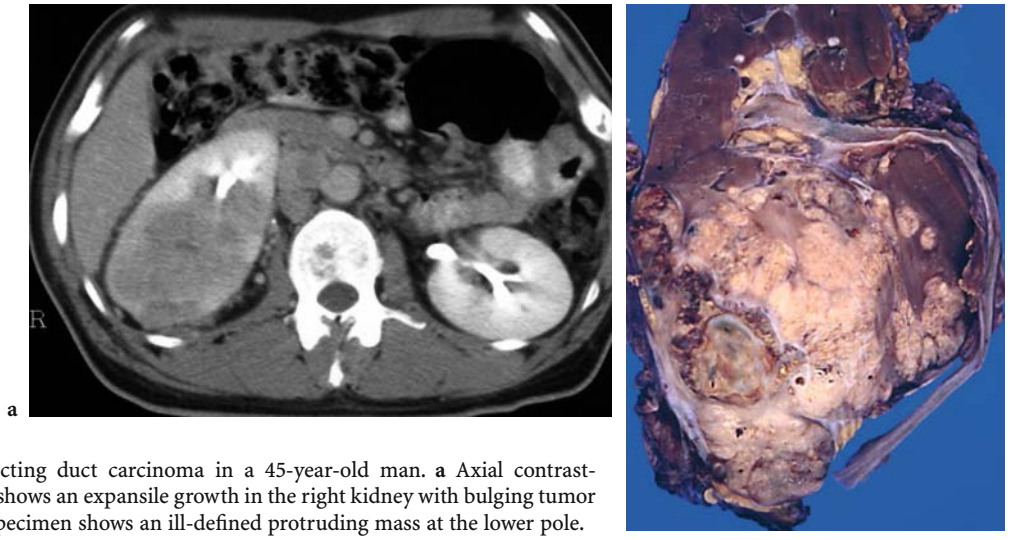

Fig. 11.17a,b. Collecting duct carcinoma in a 45-year-old man. **a** Axial contrast-enhanced CT scan shows an expansile growth in the right kidney with bulging tumor margins. **b** Gross specimen shows an ill-defined protruding mass at the lower pole.

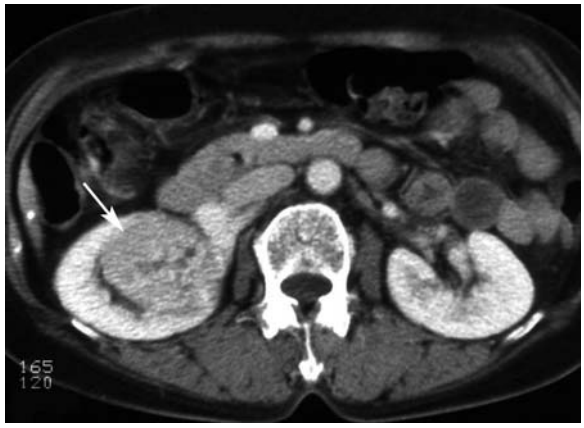

Fig. 11.18. Collecting duct carcinoma in a 62-year-old woman. Axial contrast-enhanced CT scan reveals a heterogeneous mass in the right kidney (*arrow*) with preservation of the renal outer contour.

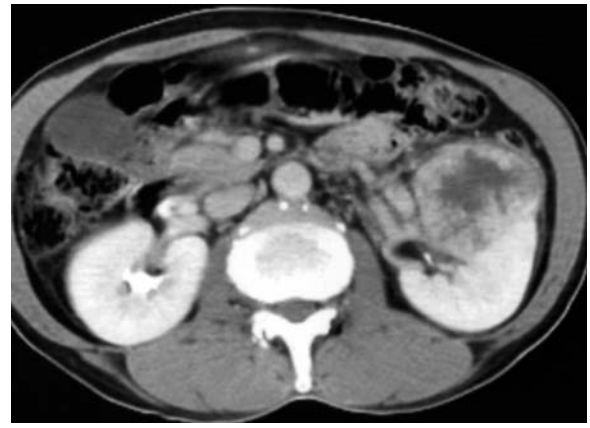

Fig. 11.19. Collecting duct carcinoma in a 65-year-old man. Axial contrast-enhanced CT scan shows the left kidney tumor appears exophytic as collecting duct carcinoma enlarges.

imal or moderate enhancement (Figs. 11.20, 11.21). Gross extension to perinephric fat and vascular invasion are sometimes present (Fig. 11.22). Calcification is rare, unlike in conventional RCC (Fig. 11.23). A cystic component that resembles the more conventional cortical RCC, suggesting either intratumoral cyst or cystic necrosis, is frequently noted within the tumors (Fig. 11.24).

Many patients with CDC already have invasion into other sites, lymphadenopathy, or metastasis, when diagnosis is established. About 35-40% of patients have metastases at presentation. Regional lymph nodes (60–80%) (Fig. 11.25), lung (Fig. 11.26) or adrenal glands (25%), bone, and liver are common metastatic sites. Lymph node metastasis and inferior vena caval thrombosis are also present. Metastases to bone appear osteolytic or osteoblastic appearance (Fig. 11.27; Kuroda et al. 2002).

In summary, medullary location, involvement of the renal sinus, infiltrative growth, preservation of renal contour, and weak enhancement are CT findings most commonly seen in patients with CDC of the kidney.

11.4.4 Magnetic Resonance Imaging

Collecting duct carcinoma appears isointense to normal renal parenchyma on T1-weighted spin-echo images and hypointense to normal renal parenchyma on T2-weighted spin-echo images. As with CT, weak enhancement is noted on contrast-enhanced T1-weighted image (Fig. 11.28). The lack of a visible marginal hypointense rim indicates that there is no pseudocapsule. In general, RCC appears

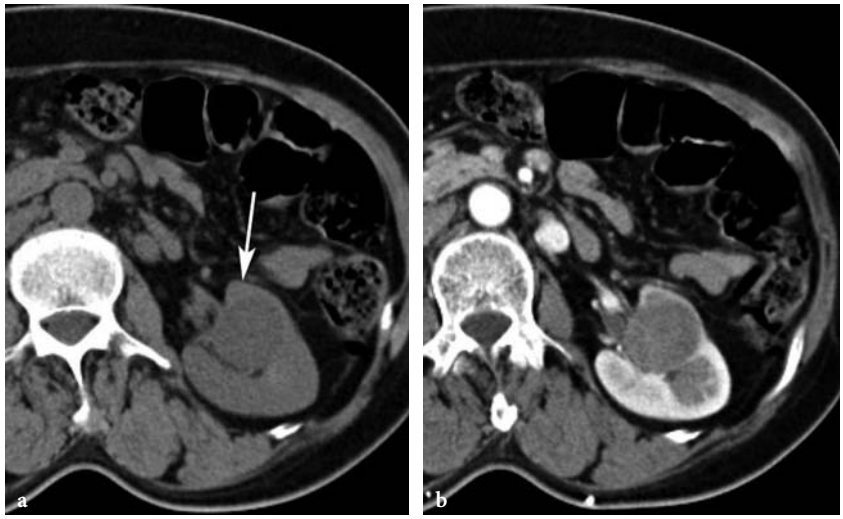

Fig. 11.20a,b. Collecting duct carcinoma in a 49-year-old man. **a** Axial unenhanced CT scan shows a hypodense mass (*arrow*) at the left renal medulla. **b** Axial contrast-enhanced CT scan shows minimal enhancement of the tumor.

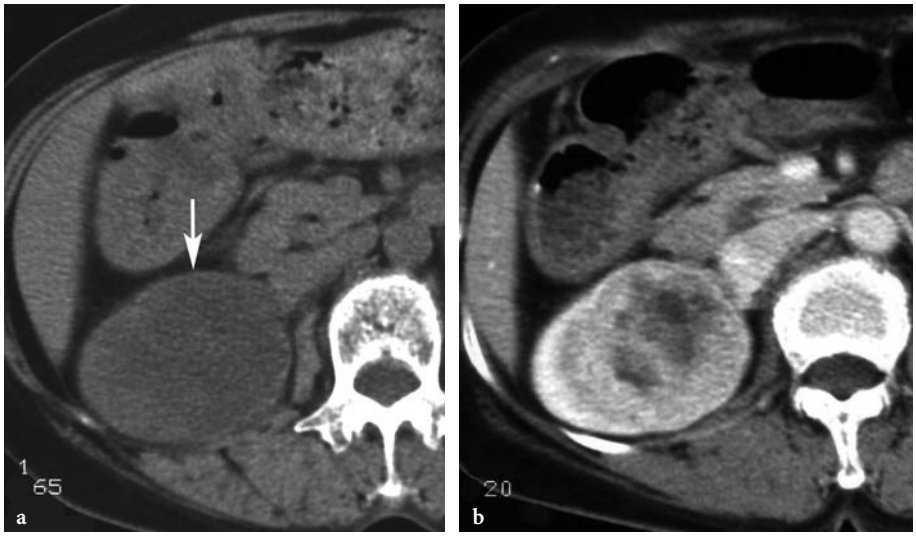

Fig. 11.21a,b. Collecting duct carcinoma in a 64-year-old woman. **a** Axial unenhanced CT scan shows a hypodense mass (*arrow*) with preservation of the right renal contour. **b** Axial contrast-enhanced CT scan shows moderate, heterogeneous enhancement of the tumor.

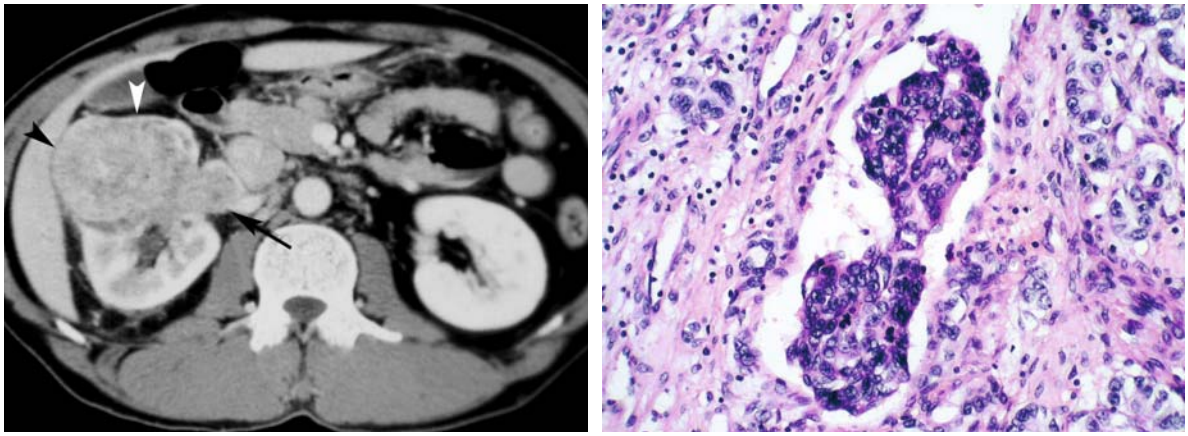

Fig. 11.22a,b. Collecting duct carcinoma in a 55-year-old man. **a** Axial contrast-enhanced CT scan shows an anterior exophytic mass in the right kidney (*arrowheads*) and hypodense thrombus (*arrow*) in the right renal vein. **b** Photomicrograph demonstrates tumor emboli and vascular invasion (hematoxylin and eosin stain; original magnification, ×200).

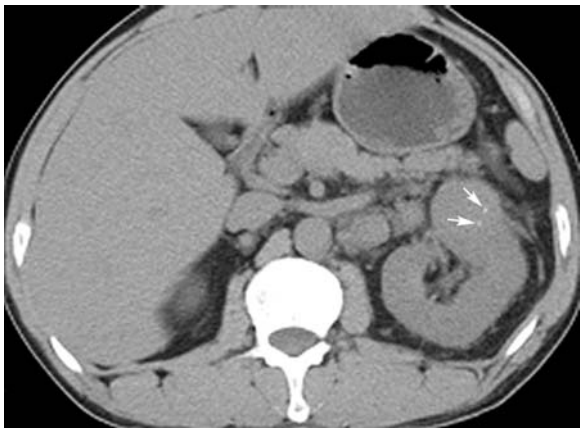

Fig. 11.23. Collecting duct carcinoma in a 38-year-old woman. Axial unenhanced CT scan reveals multiple tiny calcifications (*arrows*) within the exophytic tumor in the left kidney.

slightly hypointense to normal renal parenchyma on T1-weighted images and slightly hyperintense on T2-weighted images. Hypointensity on T2-weighted images appears to favor CDC, especially with a centrally located tumor (Pickhardt et al. 2001).

11.4.5 Angiography

Selective renal angiography shows the tumors to be hypovascular compared with normal renal parenchyma; however, with CT it remains difficult to differentiate CDC from other infiltrating tumors of the kidney such as lymphoma, metastasis, sarcomatoid carcinoma, and calyceal urothelial tumors with renal spread, and from xanthogranulomatous pyelo-

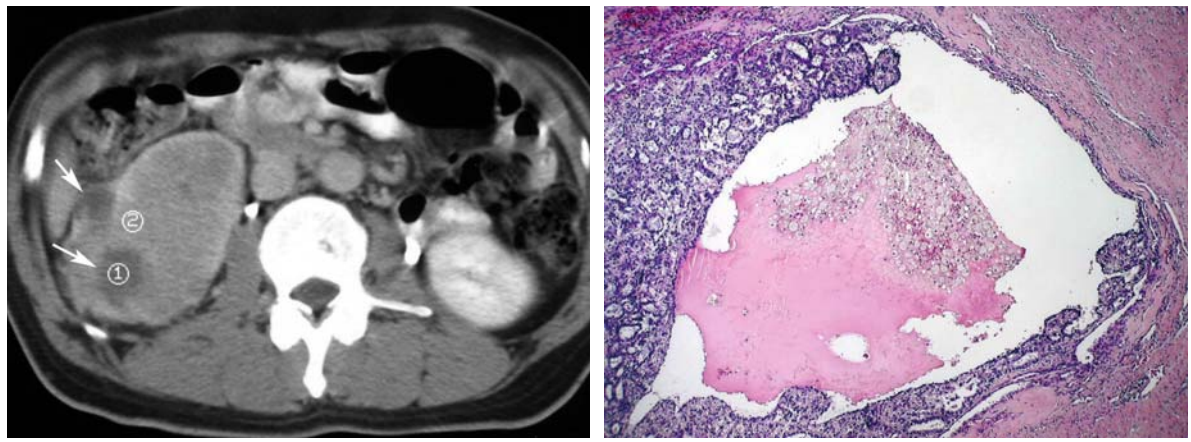

Fig. 11.24a,b. Collecting duct carcinoma in a 45-year-old man. **a** Axial contrast-enhanced CT scan shows multiple cystic lesions (*arrows*) within the poorly defined tumor in the right kidney. **b** Photomicrograph depicts an intratumoral cystic area (hematoxylin and eosin stain; original magnification, ×40).

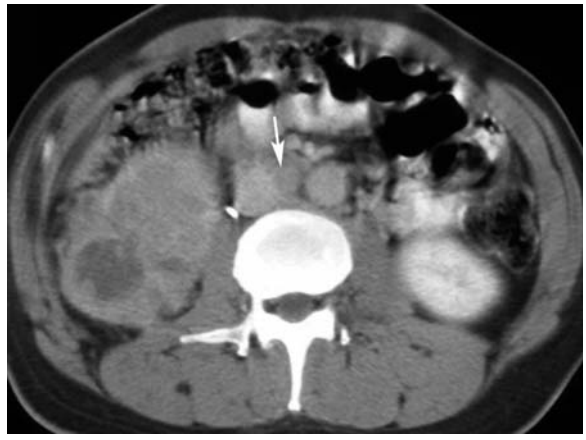

Fig. 11.25. Collecting duct carcinoma in a 45-year-old man. Axial contrast-enhanced CT scan shows a heterogeneous mass in the right kidney and mildly enhancing interaorticocaval lymphadenopathy (*arrow*).

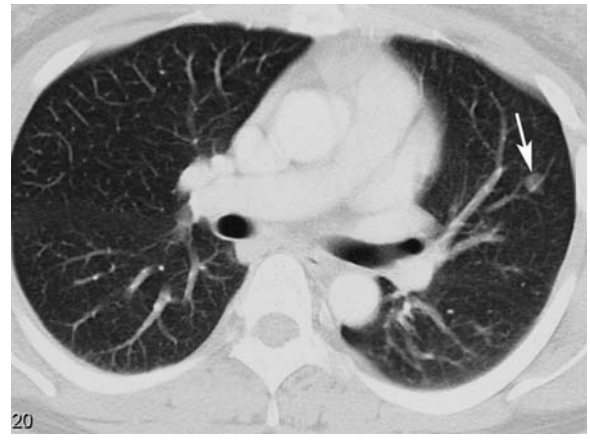

Fig. 11.26. Collecting duct carcinoma in a 55-year-old woman. Axial chest CT scan at lung window shows a small hematogenous metastatic left pulmonary nodule (*arrow*).

nephritis. A single infiltrating renal tumor should suggest the diagnosis of CDC (Mejean et al. 2003).

11.4.6 Differential Diagnosis

Differential diagnoses for centrally located renal lesions with infiltrative features include invasive transitional cell or squamous cell carcinoma of the renal collecting system, renal lymphoma, renal metastases, invasive RCC involving the columns of Bertin, mesoblastic nephroma, renal medullary carcinoma, and bacterial pyelonephritis (Pickhardt 1999). Although only about 6% of cortical RCC is truly infiltrative, RCC nonetheless represents a sig-

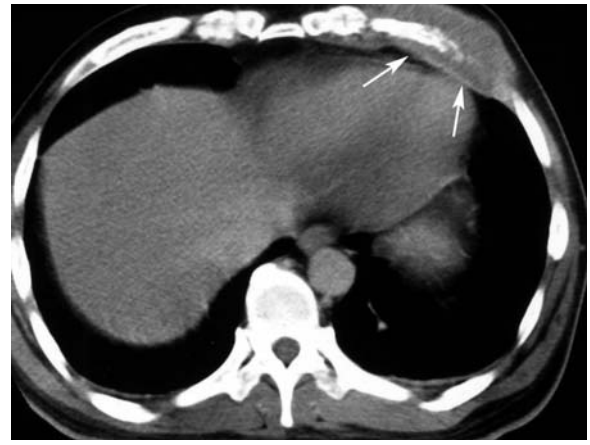

Fig. 11.27. Collecting duct carcinoma in a 45-year-old man. Axial CT scan shows rib destruction with metastatic soft tissue mass (*arrows*).

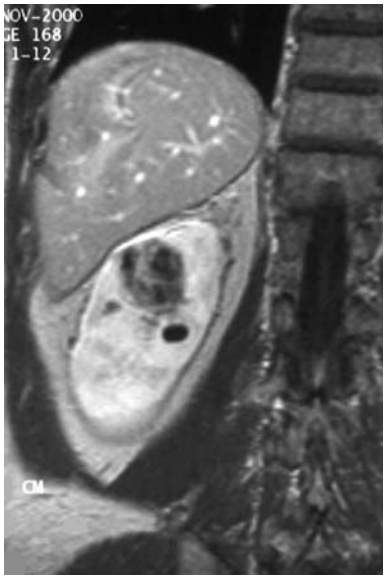

Fig. 11.28. Collecting duct carcinoma in a 69-year-old man. Coronal contrast-enhanced T1-weighted MR image reveals a poorly enhancing tumor with internal enhancing areas in the right kidney.

nificant proportion of infiltrative tumors given its overall abundance. Distinguishing between cortical RCC and collecting duct carcinoma on preoperative imaging studies has prognostic significance.

It is important to keep in mind that a central location in the kidney does not mean that a tumor originates in the collecting ducts of the renal medulla.

11.5 Treatment

The standard treatment for CDC of the kidney is radical nephrectomy; however, it is not clear if such a radical operation is needed for small CDC (Matsumoto et al. 2001). Collecting duct carcinoma shows aggressive behavior and advanced stage at the time of presentation, causing death in two-thirds of the patients within 2 years of surgery, so that a systemic multidrug therapy is necessary in the majority of patients (Sironi et al. 2003).

11.6 Prognosis

The overall prognosis of CDC is generally poor. About two-thirds of patients with CDC die of carcinoma within 2 years of diagnosis. Many patients with CDC already have invasion into other sites or metastases when the diagnosis is established. Approximately 35–40% of patients have metastases at presentation. Common metastatic sites include regional lymph nodes, adrenal glands, bone, lung, and liver. Lymph node metastasis and inferior vena caval thrombosis are also known to occur, as in RCC. Metastases to bone often appear osteoblastic radiographically. The rapid metastatic spread and aggressiveness of CDC may be due to its central or perihilar location (Kuroda et al. 2002; Singh and Nabi 2002).

Patients usually present at an advanced clinical stage and have a poor prognosis. There is no standard treatment regimen for patients who present with metastatic disease (Kirkali et al. 1996). Treatment for CDC based on surgical excision alone does not appear to improve the prognosis and can be a source of perioperative and early postoperative complications, which are rare in the context of RCC (Mejean et al. 2003). Patients treated with radical nephrectomy, radiation, chemotherapy, or immunotherapy have shown mixed results, but the number of patients is too small to draw any useful conclusion and the prognosis is generally worse than with other types of RCC (Kuroda et al. 2002). Close follow-up is recommended regardless of the stage; however, McLennan et al. (1997) have described a series of unusual low-grade tubulocystic renal cancers with a good prognosis (Fig. 11.29).

11.7 Conclusion

Collecting duct carcinoma is an aggressive subtype of RCC derived from the renal medulla. The tumor occurs in a wide age range, predominately in men. The usual histologic pattern is that of a tubular or tubulopapillary carcinoma with a desmoplastic stroma. Imaging features suggestive of this diagnosis include a medullary origin and an infiltrative growth pattern. This type of cancer is associated with an extremely poor prognosis. At presentation CDC is metastatic to regional lymph nodes. The characteristic location, typical histologic and radiologic appearance, and reportedly poor prognosis differentiate CDC from the more common RCC. Death usually occurs within 2 years. Various treatments have been proposed but with disappointing results, including radiation therapy, immunotherapy and some combinations of chemotherapy.

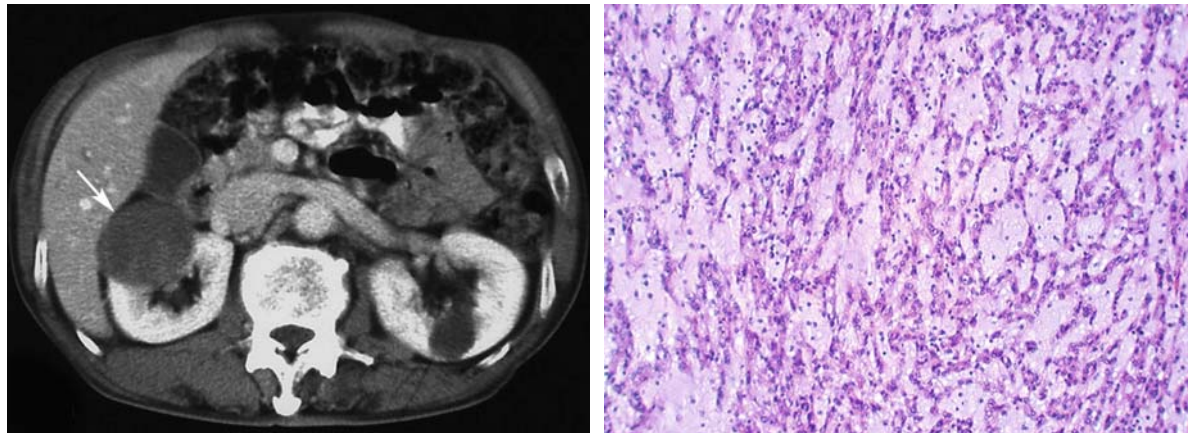

Fig. 11.29a,b. Collecting duct carcinoma in a 60-year-old man. **a** Axial contrast-enhanced CT scan shows a hypodense tumor with poor enhancement in the right kidney. **b** Photomicrograph shows mucin-containing tumor cells with tubulopapillary growth (hematoxylin and eosin stain; original magnification, ×100). Low-grade, tubular, mucinous renal carcinoma of possible collecting duct origin was confirmed by radical nephrectomy.

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