Cross-Sectional Imaging of Urosepsis

17

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17.1 Introduction

Although extremely common, urinary tract infections (UTI) encompass a wide range of conditions which range from asymptomatic bacteriuria and simple cystitis causing local symptoms to potentially life-threatening conditions. Generally, urinary sepsis or urosepsis is defined by the presence of bacteraemia with a urinary tract infectious focus [1].

The incidence of sepsis is reportedly increasing, in both community-acquired and healthcare-associated (nosocomial) UTIs. Patients with the RENUC risk factors (as listed in Table 1.1 in the introductory chapter of this book) are much more likely to develop urosepsis, such as diabetics, immunosuppressed and transplant recipients, those treated with corticosteroid or chemotherapy, those with urolithiasis, obstructed urinary tract, neurogenic bladder and congenital abnormalities, or following recent instrumentation. Although associated with a better prognosis compared to other systemic infections, urosepsis remains a critical situation, particularly in the elderly and immunocompromised. The associated mortality is estimated to fall in the range between 20 and 40% and is probably declining due to improvements in patient care. However, mortality remains considerable in severe sepsis (defined by the development of organ dysfunction) and in septic shock with persistent hypotension despite fluid resuscitation [1, 2].

17.2 Role of Imaging in Urosepsis

Suspected urosepsis requires early diagnosis and timely treatment, particularly in those patients with risk factors for complicated UTI. The role of imaging includes:

(a) To detect urological complications requiring directed treatment, such as abscess and pyonephrosis
(b) To document congenital, acquired or postsurgical anatomical situations which predispose to infection
(c) To confirm urological cause of sepsis while excluding other potential sources in the body

The ultimate aim is to prevent renal function deterioration and to decrease morbidity and mortality [1, 3].

As well known, first-line ultrasound readily allows detecting urinary obstruction and pyonephrosis requiring prompt drainage without use of ionizing radiation and intravenous contrast medium. However, as extensively discussed in other chapters of this book, multidetector CT (including intravenous contrast enhancement unless contraindicated) is superior to ultrasound in the detection of infection and abscesses and by

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far represents the ideal modality to comprehensively investigate severe UTI and possible complications [4–10].

Figures 17.1, 17.2, and 17.3 present three clinical examples of cross-sectional imaging investigation of urinary sepsis. In our experience, the use of CT is particularly useful in the postoperative setting after urological instrumentation and surgery [9, 11–13].

In a large study including 221 adult patients experiencing first-time urosepsis, the use of CT discovered major findings in almost one-third (32%) of patients, particularly hydro- or pyonephrosis (17%) and urolithiasis (7.6%). Other findings in descending order or frequency included tumours, renal abscesses, ureteral dilatation, calyceal dilatation, duplex kidney, ureteral structure, infected polycystic kidney, emphysematous pyelonephritis and displaced nephrostomy. Clinical predictors of major abnormalities include increased serum creatinine, type 2 diabetes, diabetic complications, known renal disease or urological abnormality. Interestingly, abnormal CT findings led to urological intervention in approximately one-half

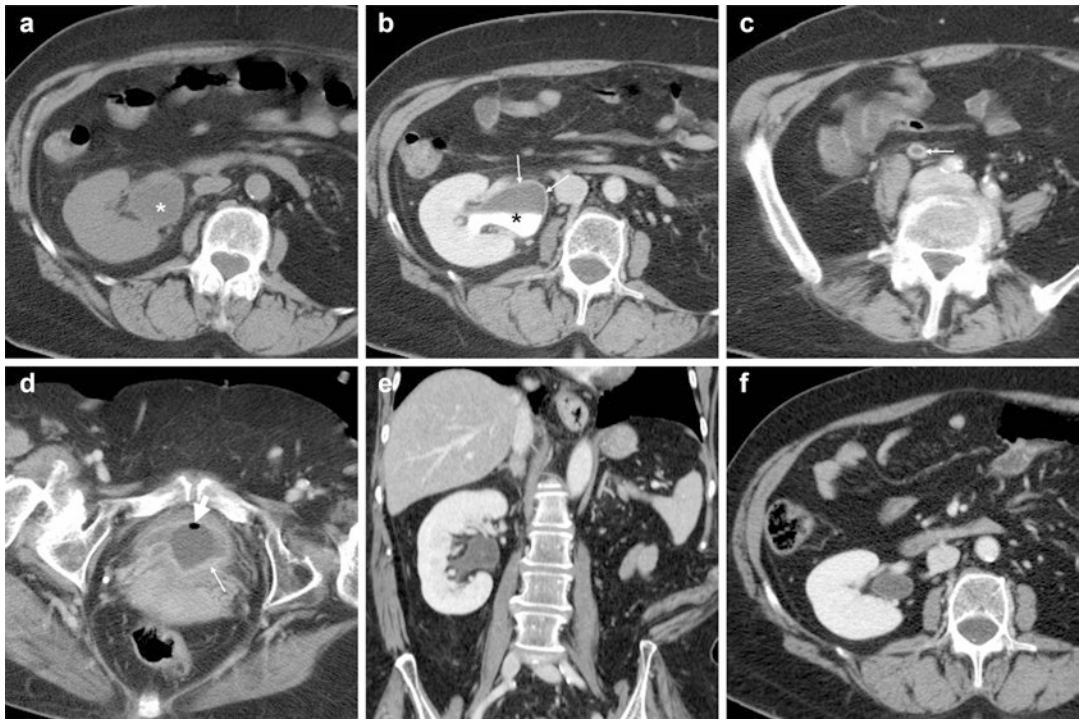

Fig. 17.1 A 71-year-old female with a congenital solitary kidney was hospitalized for voiding difficulty and high fever unresponsive to empirical antibiotics. Urgent unenhanced (**a**) and post-contrast (**b**–**d**) multidetector CT revealed mild hydronephrosis with preserved renal function. The dilated renal pelvis (*) showed minimal, enhancing mural thickening (thin arrows in **b**) which was even more pronounced along the ureter (thin arrow in **c**) and in the bladder (thin arrow in **d**; note Foley catheter indicated by thick arrow). Findings were consistent with diagnosis of urosepsis which required prolonged in-hospital treatment. Four months after discharge, repeated CT (**e**, **f**) showed decreased hydronephrosis, normalized mural thickening and disappearance of urothelial hyperenhancement. Note absent left kidney

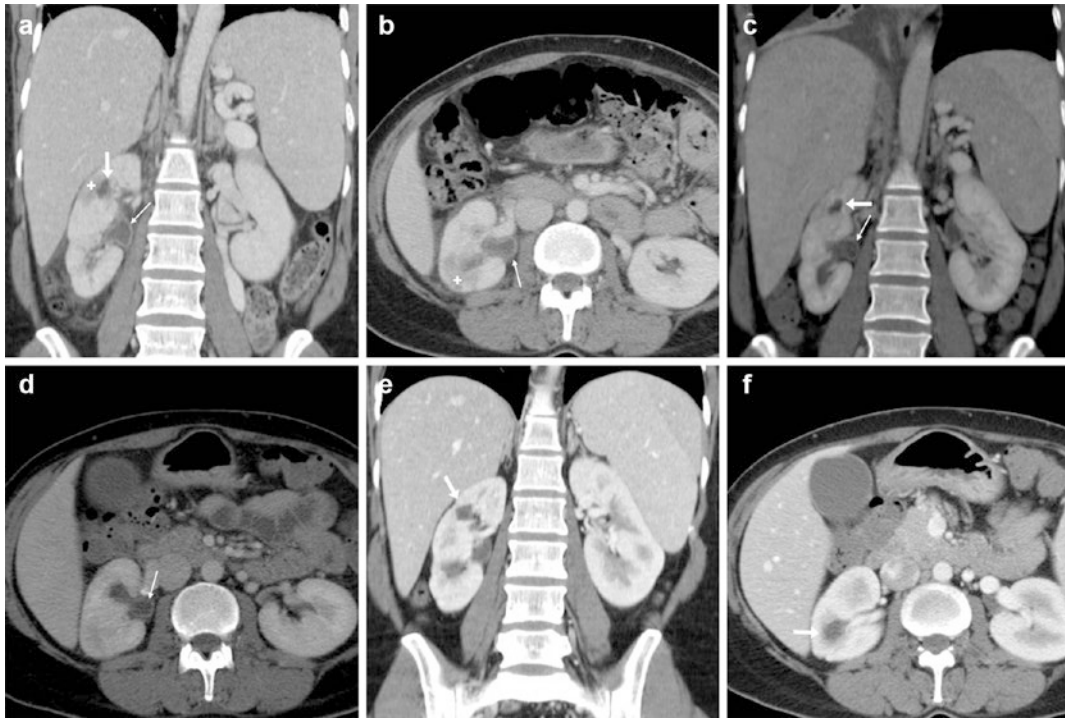

Fig. 17.2 A 41-year-old female immigrant from the Middle East had history of renal colic 2 years ago. Currently attended at emergency department for abdominal and right flank pain associated with shivers, high fever and dysuria. Laboratory tests revealed leukocytosis and increased acute phase reactants. Urgent contrast-enhanced CT (**a**, **b**) showed mild, hyperenhancing thickening of the renal pelvis (thin arrows), calyceal dilatation (arrow) at the upper renal third, two wedge-shaped hypoperfused parenchymal areas (*), consistent with right acute pyelitis and pyelonephritis. Transferred to intensive care unit, she progressively improved with medical therapy. Urine cultures diagnosed *Escherichia coli* infection. Before discharge, repeated CT (**c**, **d**) showed resolution of parenchymal changes and persistence of calyceal dilatation (arrow) and of pelvic urothelial enhancement (thin arrows). Distant follow-up CT (**e**, **f**) showed resolved hydronephrosis and urothelial enhancement and persistent upper calyceal dilatation (arrows) with focal thinning of the overlying parenchyma consistent with chronic "scarring"

of cases, such as positioning or replacement of nephrostomy or ureteral stent, sometimes cyst drainage, catheter replacement, stone removal and occasionally even nephrectomy [3].

Furthermore, multidetector CT provides panoramic body exploration, thus allowing to detect infectious changes resulting from haematogenous dissemination in other anatomical regions, which are most usually found in the lungs, the brain, the liver and spleen and the iliopsoas muscles [14]. Finally, as exemplified in Figs. 17.1, 17.2, and 17.3, cross-sectional CT imaging is highly valuable to provide consistent follow-up of severe or complicated UTIs during medical or interventional therapy, in order to document resolution of infectious changes or long-term sequelae [5–8].

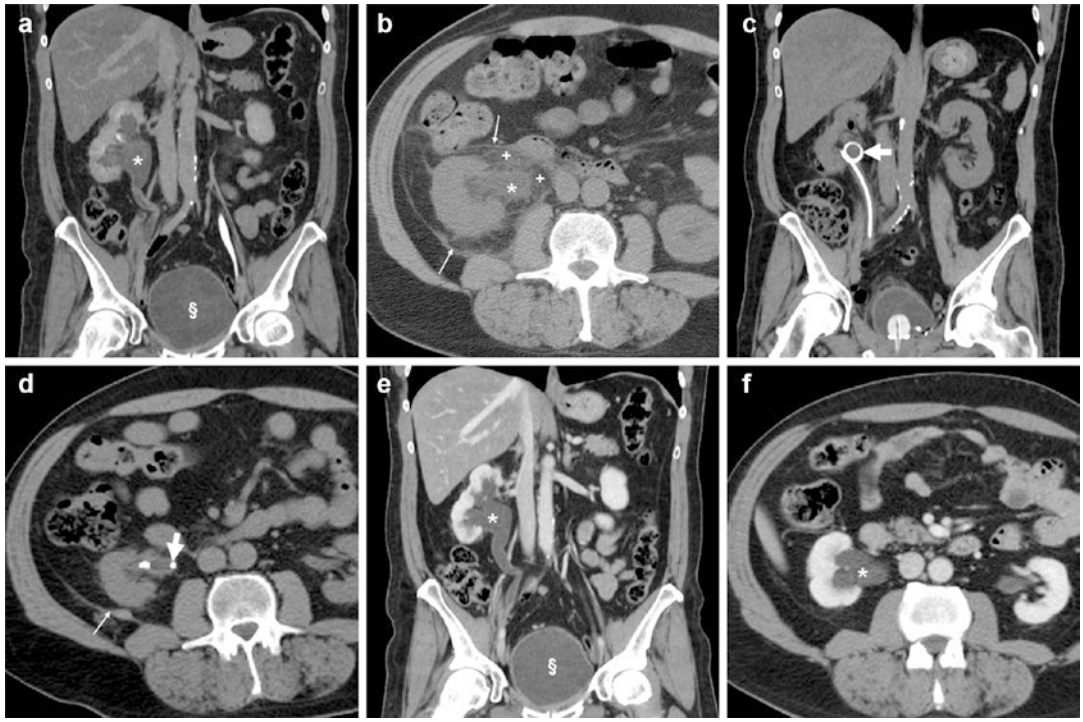

Fig. 17.3 A 61-year-old male with recent radical cystectomy for bladder carcinoma and orthotopic neobladder (§) reconstruction, as documented by postoperative multidetector CT urography. Note right-sided hydronephrosis (*) with delayed contrast excretion. A year later, he was hospitalized for sepsis and acute renal failure. Unenhanced CT (**b**) showed stable dilatation of the right renal pelvis (*) with appearance of peripelvic and perirenal "fat stranding" (+) and of ipsilateral fascial thickening (thin arrows). Pyonephrosis was relieved by ureteral stenting (thick arrows) as seen on repeated unenhanced CT (**c**, **d**) with resolution of perirenal inflammation and persistently thickened posterior renal fascia (thin arrow in **d**). With resolution of urosepsis and improved renal function, follow-up contrast-enhanced CT (**e**, **f**) showed resolution of infectious changes, preserved nephrographic effect, stable hydronephrosis (*) compared to (**a**) and well-distended neobladder (§)

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