

Diffusion-weighted MRI in the diagnosis and follow-up of renal abscess

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Section: Uroradiology & genital male imaging

Area of Interest: Kidney

Procedure: Diagnostic procedure

Imaging Technique: CT

Imaging Technique: Ultrasound

Imaging Technique: MR

Imaging Technique: MR-Diffusion/Perfusion

Special Focus: Abscess Case Type: Clinical Cases

Authors: Tonolini Massimo, MD.

Patient: 36 years, female

Clinical History:

Young adult woman with unremarkable medical history, presenting to the emergency department complaining of right flank pain, nausea and mild fever a few days earlier. Currently afebrile, without previous therapies. Emergency laboratory tests revealed leukocytosis (17.000 cells/mm³), mild anaemia (11.6 g/dl haemoglobin), normal C-reactive protein and urinalysis.

Imaging Findings:

Emergency noncontrast CT for acute renal colic (Fig. 1a) showed normal-sized, symmetric kidneys without calculi, hydronephrosis and perinephric fat stranding. The right kidney had a 3.5-cm centrally hypoattenuating mass, which showed thin peripheral enhancement on immediate contrast-enhanced study (Fig. 1b-e), without any other signs of acute pyelonephritis. Sonographically, the renal lesion showed heterogeneous hypoanechoic appearance. Upon hospitalisation, further investigation using unenhanced and post-gadolinium MRI (Fig. 3) confirmed normally functioning kidneys and right-sided lesion with internal moderately high T2-signal and frank restricted diffusion, thin T2-hypointense and strongly enhancing periphery, consistent with an abscess. After initial improvement on intensive antibiotics, early follow-up noncontrast MRI (Fig. 4) showed initial decrease in size of the renal abscess with unchanged signal and partial regression of diffusion restriction. At discharge, leukocyte count had normalised. Repeated noncontrast MRI at 1 month (Fig. 5) showed markedly decreased size, hypointense signal consistent with regression of necrotic-purulent content.

Discussion:

Renal abscesses (RA) may develop from either haematogenous septic dissemination or fusion of tiny suppurative foci in acute pyelonephritis, and may be detected sonographically as hypo-anechoic cavities or complex structures without internal colour Doppler signals. However, the vast majority of RA are currently encountered during CT studies requested to investigate suspected pyelonephritis, flank pain or unexplained fever. The well-known CT appearance of a RA is a variable-sized, round or geographic collection with central near-water hypoattenuation (corresponding to pus, liquefaction and debris), demarcated by a more or less thick (typically several millimetres) peripheral enhancing "rim", often surrounded by hypoenhancing (infected but non-necrotic) renal parenchyma [1-3]. Particularly in adolescents and young individuals, MRI is increasingly used to investigate abdominal disorders

without use of ionising radiation, including suspected pyelonephritis in women of childbearing age. Diffusion-weighted imaging (DWI) is now implemented in most MRI protocols as it provides information regarding cellular density, cytotoxic oedema and abscess formation, and increases conspicuity of both neoplastic and inflammatory lesions. As in this patient, RA appear as fluid-like heavily T2-hyperintense collections with lower-signal periphery which enhances after gadolinium contrast. High b-value DWI further confirms a diagnosis of RA by showing strong hyperintensity in the liquefied centre. The DWI-derived apparent diffusion coefficient (ADC) quantifies the degree of molecular water motion. Restricted diffusion is more pronounced in RA's fluid components compared to renal carcinomas, where diffusion is free in cystic/necrotic portions, thus resulting in high sensitivity and specificity for differential diagnosis [4-7].

Particularly in those patients without frank clinical and laboratory signs of renal infection, such as when lower urinary tract symptoms are absent and urinary cultures test negative after empiric antibiotics, the use of MRI is helpful to correctly diagnose RA which requires tailored therapy including prolonged antibiotics and percutaneous drainage of larger collections [8, 9].

If other cross-sectional signs of acute pyelonephritis (including perinephric fat inflammation and thickening of the retroperitoneal fasciae) are absent, the other key differential diagnosis is a complex cystic renal lesion, which requires careful MRI assessment of loculation, number and thickness of septa, mural thickness, nodularity and enhancement. Finally, the high diagnostic agreement between the restricted diffusion and the nonenhancing portion of RA enables reliable lesion follow-up without use of paramagnetic contrast, particularly in patients with contraindications such as impaired renal function, pregnancy and lactation. MRI may be repeated every 3 weeks and regression of treated RA may take up to 8-10 weeks [4-7].

Differential Diagnosis List: Solitary renal abscess, Uncomplicated acute pyelonephritis, Complex cystic renal mass, Renal haematoma, Necrotic renal tumour

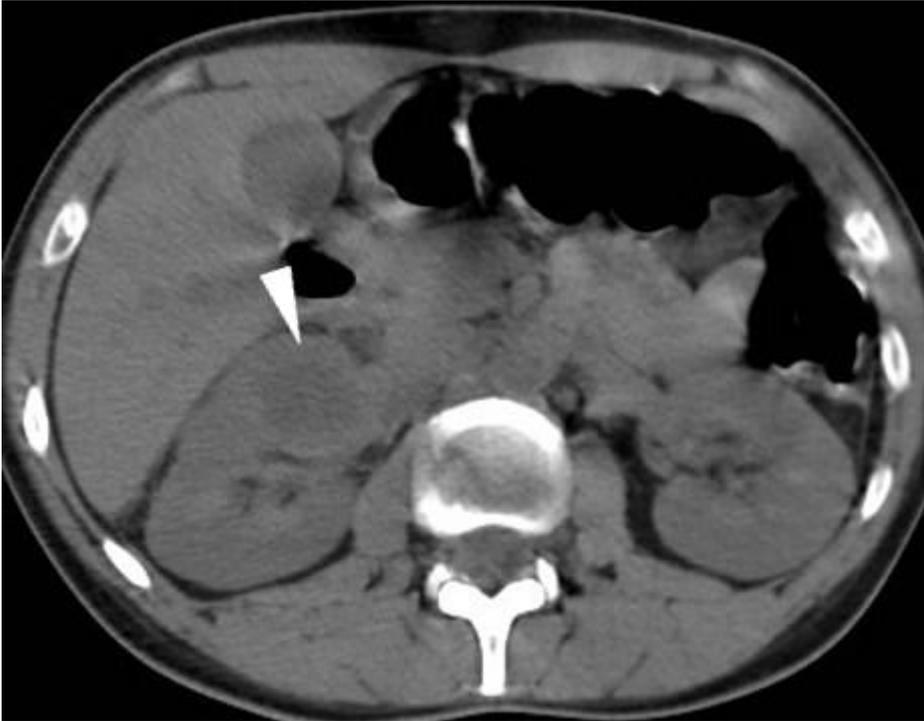
Final Diagnosis: Solitary renal abscess

References:

- Demertzis J, Menias CO (2007) State of the art: imaging of renal infections. *Emerg Radiol* 14:13-22. (PMID: [17318482](#))
- Stunell H, Buckley O, Feeney J, et al (2007) Imaging of acute pyelonephritis in the adult. *Eur Radiol* 17:1820-1828. (PMID: [16937102](#))
- Craig WD, Wagner BJ, Travis MD (2008) Pyelonephritis: radiologic-pathologic review. *Radiographics* 28:255-277 (PMID: [18203942](#))
- Martina MC, Campanino PP, Caraffo F, et al (2010) Dynamic magnetic resonance imaging in acute pyelonephritis. *Radiol Med* 115:287-300. (PMID: [19902327](#))
- De Pascale A, Piccoli GB, Priola SM, et al (2013) Diffusion-weighted magnetic resonance imaging: new perspectives in the diagnostic pathway of non-complicated acute pyelonephritis. *Eur Radiol* 23:3077-3086. (PMID: [23749224](#))
- Faletti R, Cassinis MC, Fonio P, et al (2013) Diffusion-weighted imaging and apparent diffusion coefficient values versus contrast-enhanced MR imaging in the identification and characterisation of acute pyelonephritis. *Eur Radiol* 23:3501-3508 (PMID: [23887662](#))
- Rathod SB, Kumbhar SS, Nanivadekar A, et al (2015) Role of diffusion-weighted MRI in acute pyelonephritis: a prospective study. *Acta Radiol* 56:244-249. (PMID: [24443116](#))
- Rollino C, Beltrame G, Ferro M, et al (2012) Acute pyelonephritis in adults: a case series of 223 patients. *Nephrol Dial Transplant* 27:3488-3493. (PMID: [22344777](#))
- Piccoli GB, Consiglio V, Deagostini MC, et al (2011) The clinical and imaging presentation of acute "non complicated" pyelonephritis: a new profile for an ancient disease. *BMC Nephrol* 12:68. (PMID: [22171968](#))

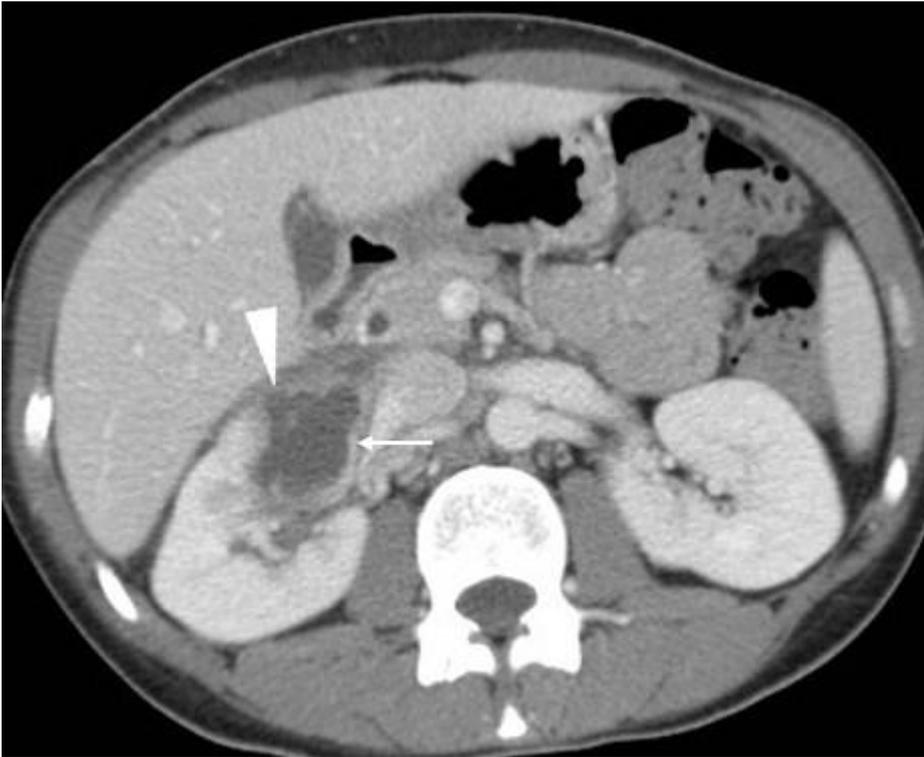
Figure 1

a



Description: Noncontrast CT (urolithiasis protocol) showed normal-sized, symmetric kidneys without perinephric fat stranding and hydronephrosis. A 3.5-cm mass (arrowhead) with central hypoattenuation was noted at the ventromedial aspect of the right kidney. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

b



Description: Suggested by attending radiologist, further investigation with intravenous contrast confirmed right renal mass (arrowhead) nonenhancing apart from thin periphery (thin arrows). Note synchronous, homogeneous nephrographic enhancement bilaterally. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

c



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d



Description: Delayed excretory phase confirmed internally nonenhancing 3.5-cm right renal mass (arrowhead). Note well-opacified urinary collecting systems. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

e

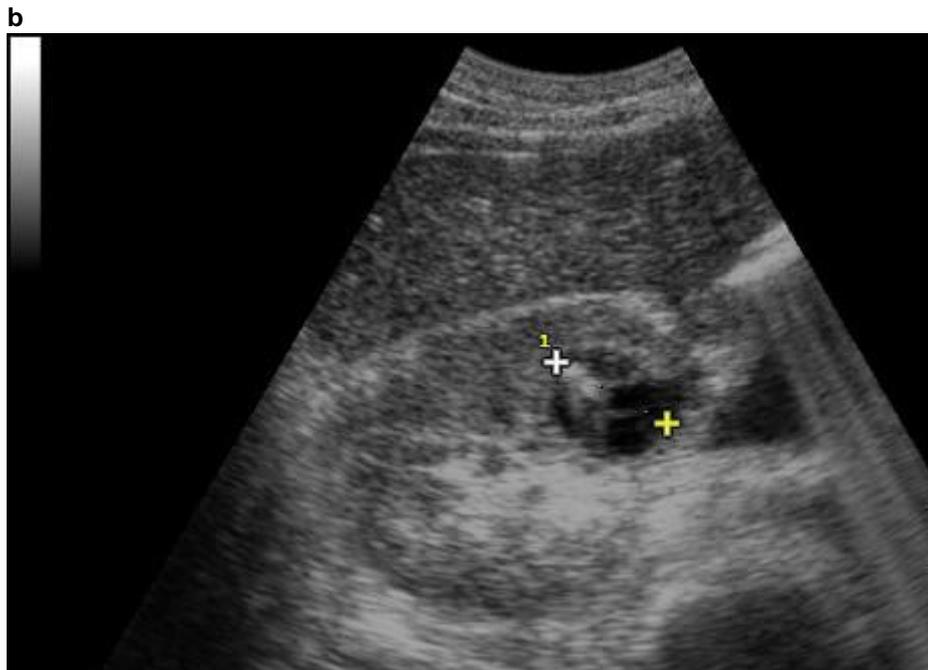


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Figure 2



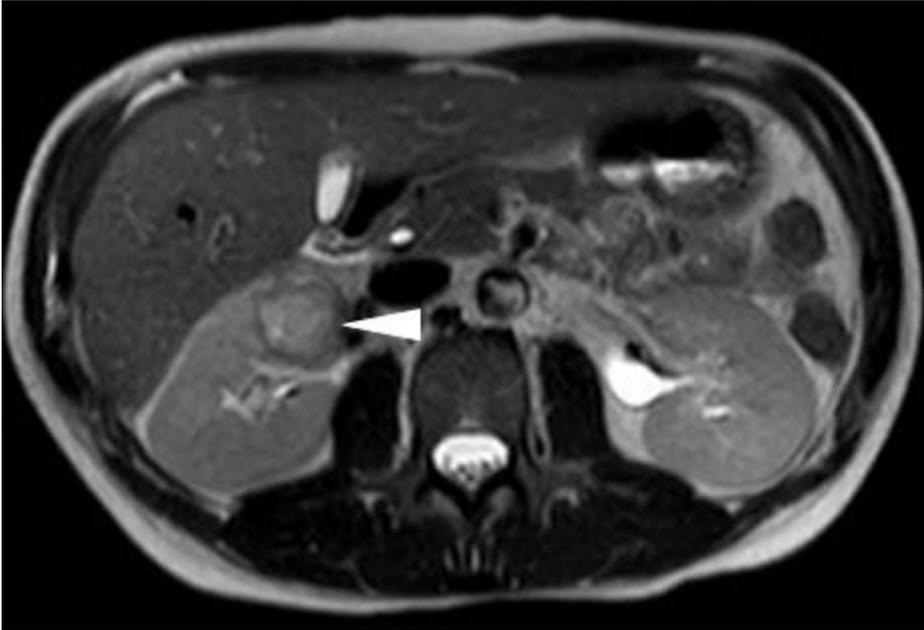
Description: On longitudinal (a) and transverse (b) sonographic images, the right renal mass found at CT (calipers) appeared well-demarcated with heterogeneous hypoanechoic appearance. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)



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Figure 3

a

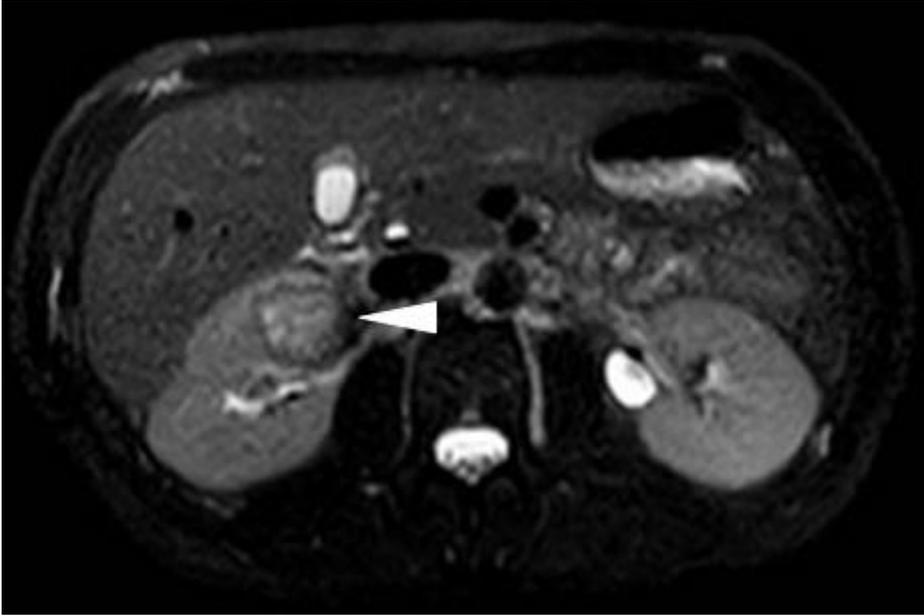


Description: On T2-weighted acquisitions (a...c) the right renal mass (arrowheads) showed moderately high internal signal intensity and uniform peripheral T2-hypointensity measuring a few millimetres thickness. No other abnormal findings in both kidneys. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)



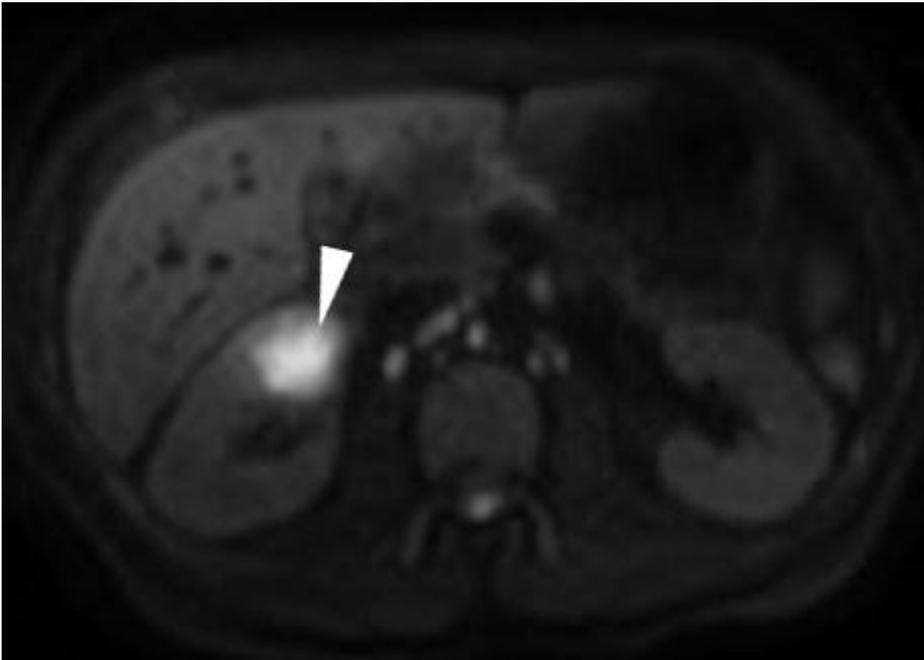
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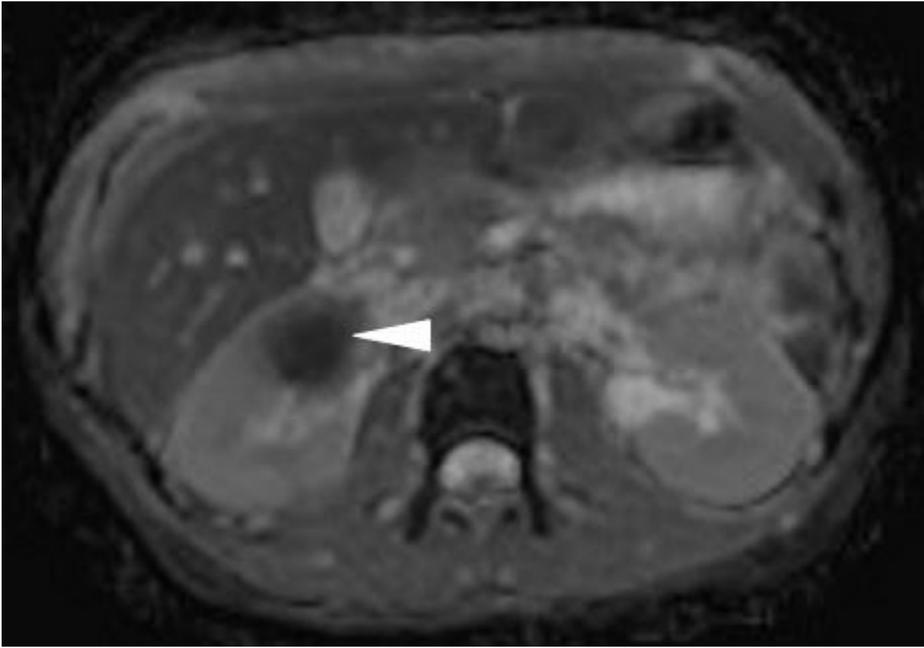
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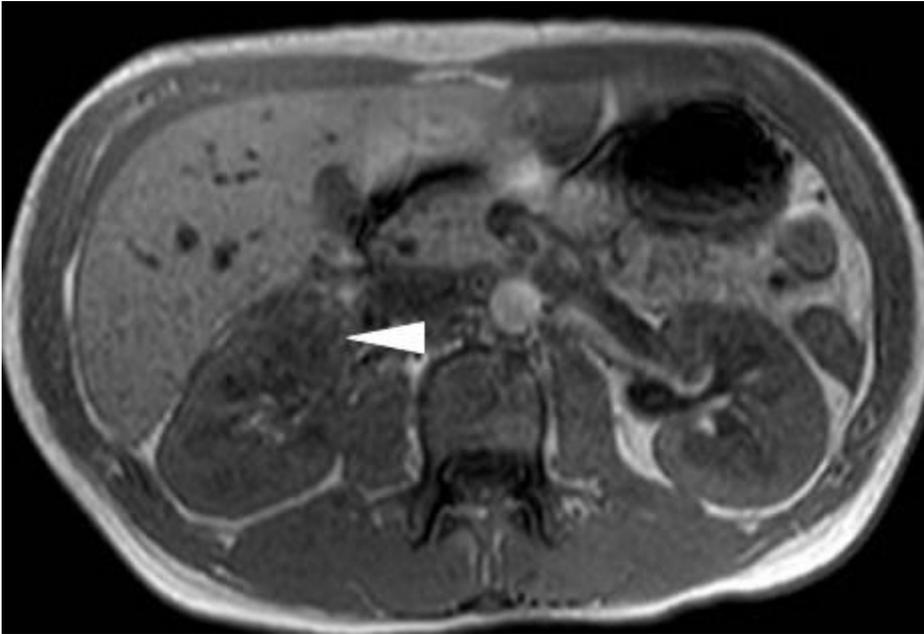
Description: On high (800) b-value diffusion-weighted images (d) the right renal mass (arrowheads) showed strong internal hypersignal, consistent with markedly restricted diffusion. Measured apparent diffusion coefficient (ADC) was approximately $0.7 \times 10^{-3} \text{ mm}^2/\text{sec}$ (e). **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

e



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f



Description: On precontrast T1-weighted acquisition, the right renal mass (arrowhead) showed heterogeneous appearance, with predominant intermediate signal intensity at the periphery. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

g



Description: Corticomedullary (g) and nephrographic (h) phases of contrast-enhanced study showed internally nonenhancing renal mass (arrowheads), thin peripheral enhancement (thin arrows) measuring a few millimetres thickness. Note synchronous, homogeneous renal enhancement. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

h



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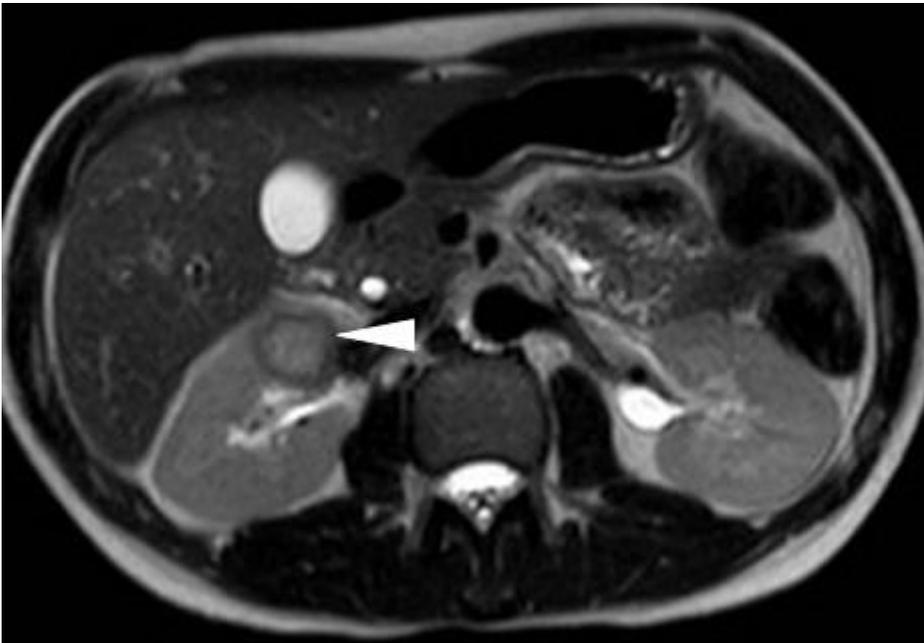
Figure 4

a



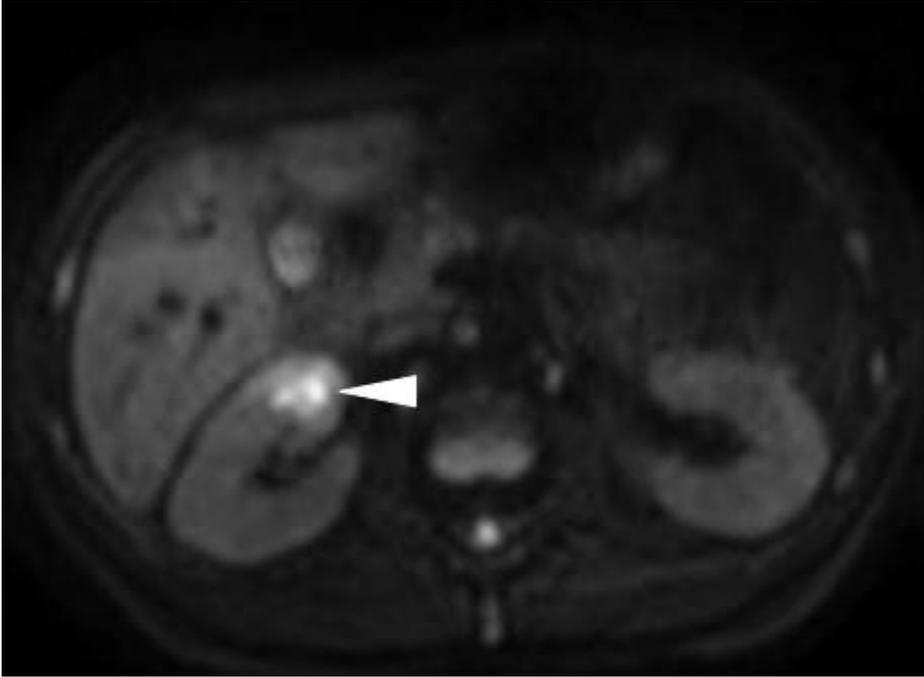
Description: T2-weighted images (a, b) showed initial decrease in size of the renal abscess (arrowheads) with unchanged signal features. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

b



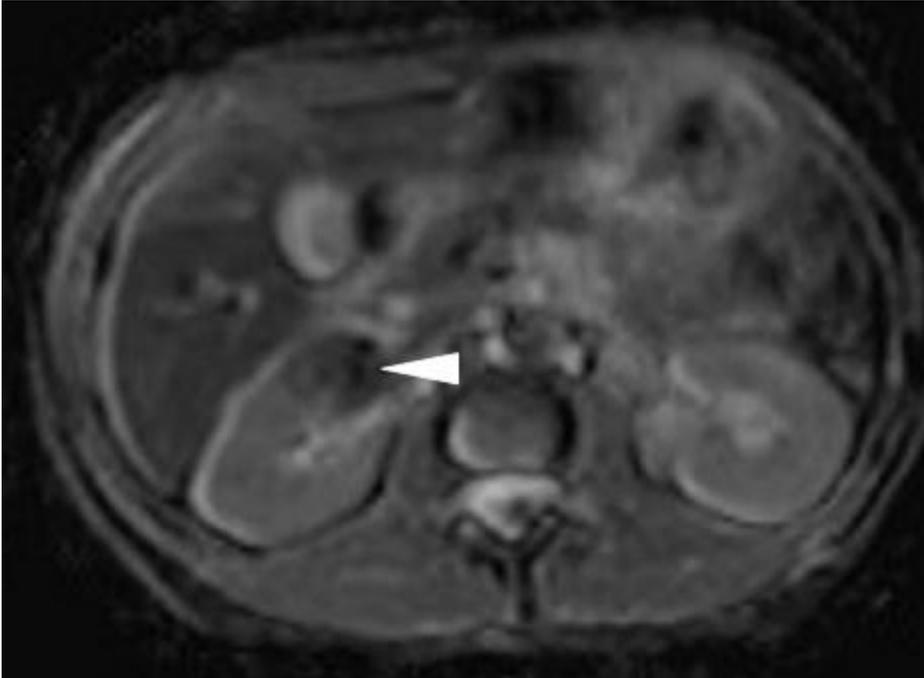
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c



Description: Diffusion-weighted (c) and ADC map (d) showed partial regression of diffusion restriction compared to Fig. 3, with measured ADC approximately 1×10^{-3} mm²/sec. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

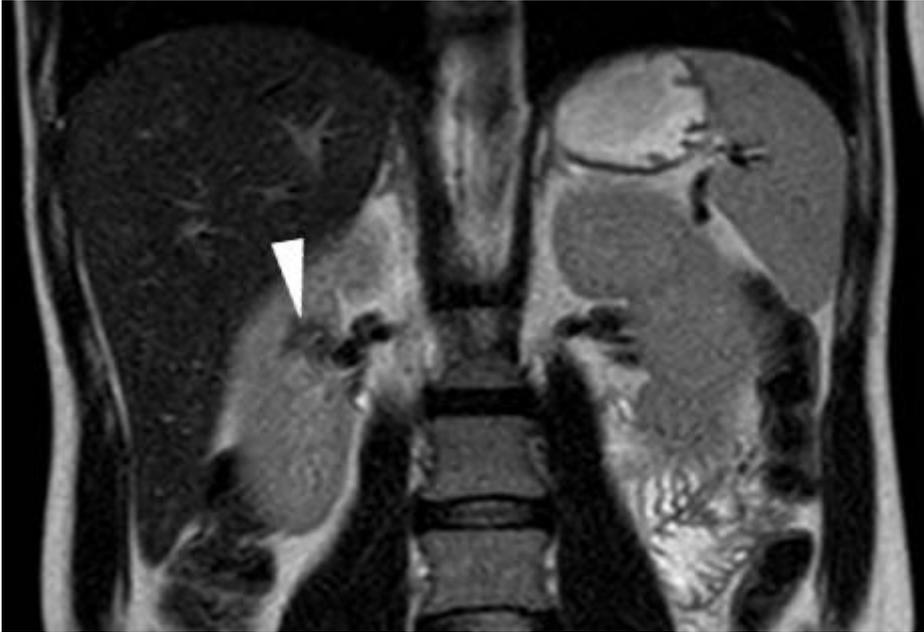
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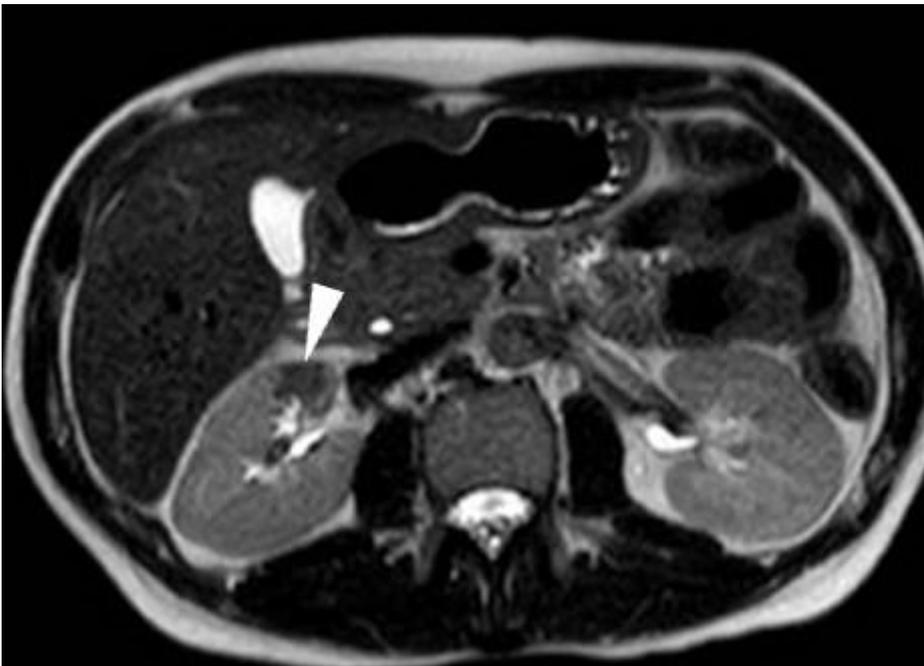
Figure 5

a



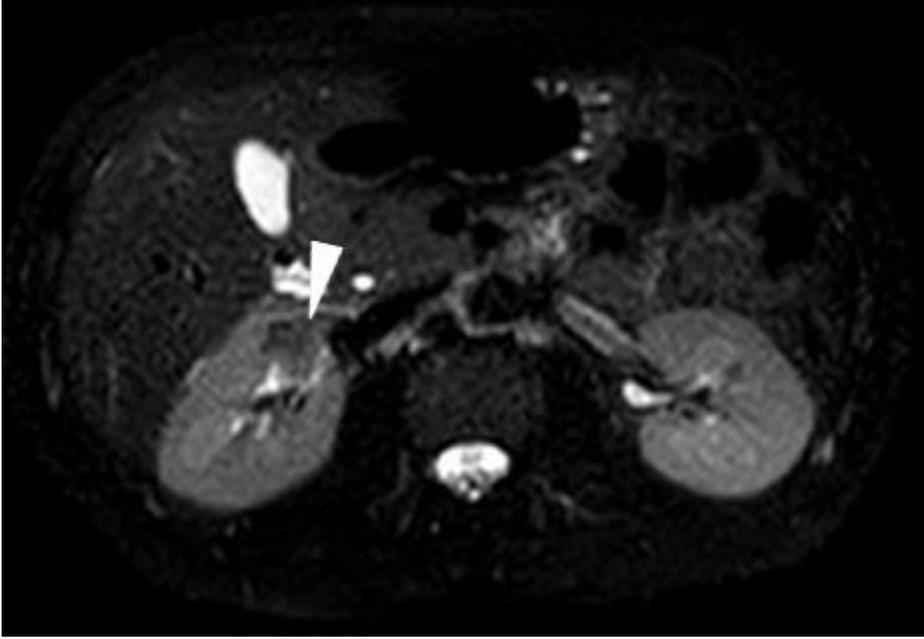
Description: The treated renal abscess (arrowheads) showed markedly decreased size and mostly hypointense signal consistent with regression of necrotic-purulent content. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

b



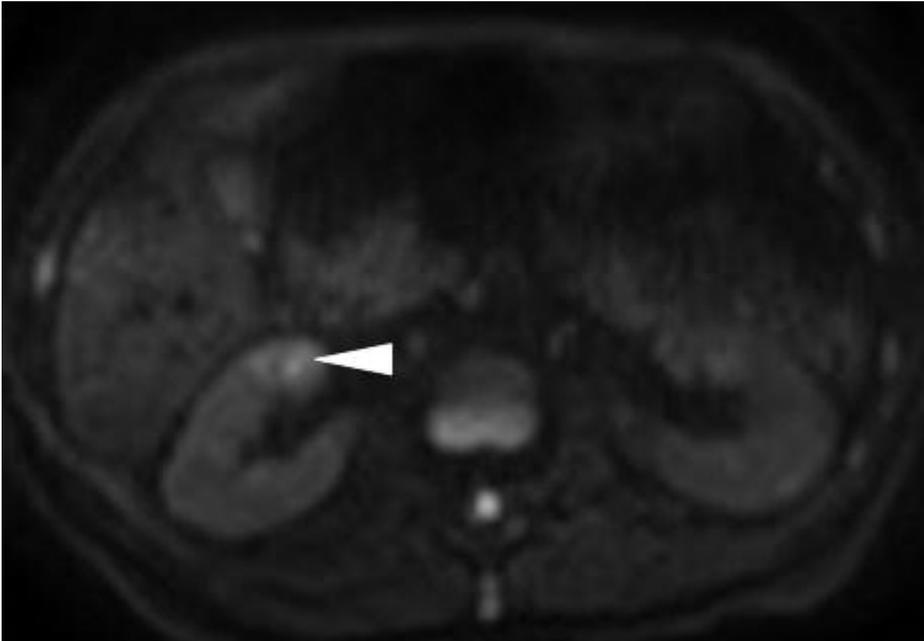
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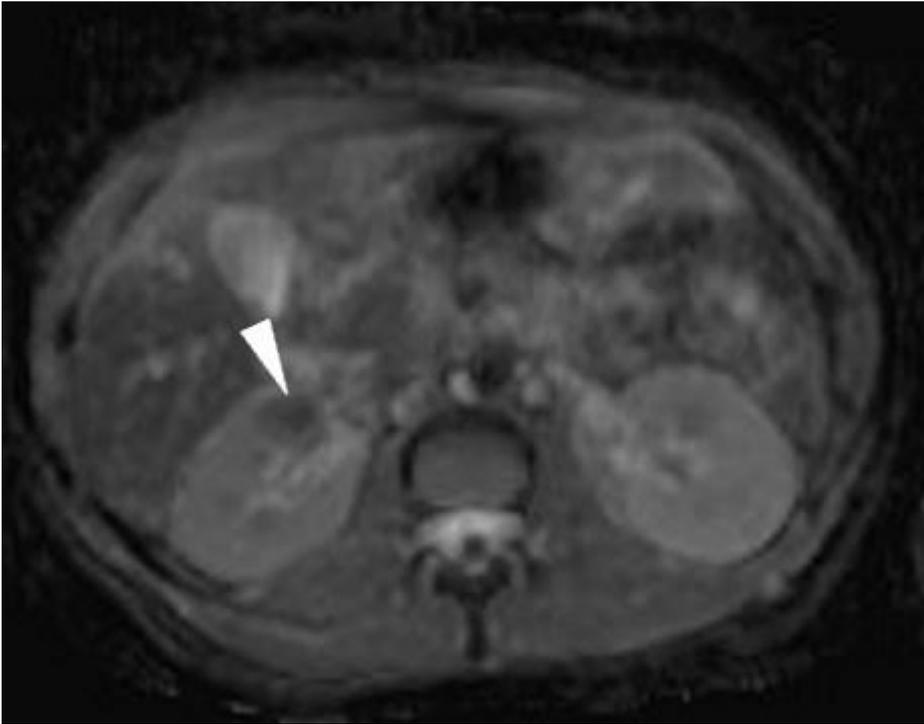
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d



Description: Diffusion-weighted (d) and ADC map (e) showed further regression of diffusion restriction compared to Fig. 4. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)

e



Description: Diffusion-weighted (d) and ADC map (e) showed further regression of diffusion restriction compared to Fig. 4. **Origin:** Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)