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Brief Correspondence

Fungal Urinary Tract Infection: A Brief Manual for Diagnosis and Treatment for Urologists

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Abstract

The detection of fungi in urine is common, particularly in nosocomial settings. Nevertheless, diagnostic and treatment approaches are often associated with uncertainty. Accordingly, this review aimed to give a concise overview of fungal urinary tract infection (UTI) as a supplement to the more comprehensive update of the European Association of Urology 2026 Guidelines on Urological Infections.

Only 2–11% of fungal isolates in urine are associated with symptoms, and a fungal UTI should only be assumed in such cases. *Candida albicans* is the most frequently identified pathogen. Diagnosis should include a urine culture with susceptibility testing, especially in non-albicans *Candida* UTI. Nonantimicrobial measures such as catheter replacement should always be part of the treatment. First-line antimicrobial treatment is fluconazole. In cases of localized bladder infections, intravesical amphotericin B may be considered. Asymptomatic funguria should only be treated in exceptional cases. Urologists should play a key role in treatment decision-making for patients with fungal UTIs.

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ADVANCING PRACTICE

What does this study add?
This editorial provides a concise, practice-oriented overview of fungal urinary tract infections (UTIs) aligned with the 2026 European Association of Urology Guidelines on Urological Infections. It clarifies key diagnostic and therapeutic principles, including the limited clinical significance of asymptomatic funguria, the importance of urine culture with susceptibility testing, and the central role of nonantimicrobial measures such as catheter replacement. The article also highlights the pivotal role of urologists in individualized treatment decision-making and antimicrobial stewardship in patients with fungal UTIs.

Clinical Relevance
Distinguishing asymptomatic funguria from true infection remains a common clinical challenge. This review provides practical guidance on when further investigation and treatment are warranted, emphasizing appropriate antifungal use and correction of modifiable factors such as indwelling devices and urinary tract obstruction. Associate Editor: Silvia Proietti.

Patient Summary
We reviewed the available evidence on the occurrence, diagnosis, and treatment of fungal urinary tract infections (UTIs). Our aim is to provide guidance for urologists on diagnostic and treatment decision-making, given that fungi are found in urine quite frequently, particularly in hospital-associated settings, but require treatment only in cases of symptomatic fungal UTI.

The isolation of fungi in urine is common in the nosocomial setting and also occurs in outpatient settings. However, the absence of clear evidence-based recommendations regarding diagnostic criteria, treatment indications, and therapeutic strategies contributes to considerable uncertainty in clinical decision-making.

This mini-review aimed to give urologists an up-to-date guideline on fungal urinary tract infection (UTI). The review was undertaken as part of the European Association of Urology (EAU) Urological Infections Guidelines 2026 update. A structured literature search on fungal UTI was performed for relevant articles published until July 2025. Databases searched included MEDLINE, Embase, and the Cochrane Library. A total of 1043 unique records were identified, retrieved, and screened for relevance [1].

Rates of funguria range from 1% in outpatients to 5–10% of positive urine cultures in hospitalized patients [2,3]. Only 2–11% of the patients with funguria present with symptoms of a UTI [4,5]. The incidence of funguria and fungal UTI is particularly high among intensive care unit patients (~15% and ~7%, respectively) but is subject to regional variations.

Candida albicans is the leading cause of fungal UTIs (50–70% of the isolates), followed by *C. glabrata* and *C. tropicalis* (10–35%), whereas *C. parapsilosis* and *C. krusei* are less common. Although multidrug-resistant *C. auris* has emerged as a global health threat, UTIs caused by *C. auris* remain rare [1]. Non-*Candida* fungi are rare causes of UTI. Similar to bacterial pathogens, *Candida* species have exhibited a marked increase in antifungal resistance over the past decade.

Key risk factors for fungal UTI include female sex, advanced age, diabetes, urinary tract abnormalities, chronic diseases, immunosuppression, and malnutrition [6]. Urinary instrumentation, indwelling devices, and previous antibiotic therapy significantly increase UTI risk [1], with *Candida* species being frequent postoperative pathogens after radical cystectomy [7].

The detection of fungi in urine can reflect a range of conditions from benign colonization to invasive systemic infection. Most cases of fungal UTI manifest locally as cystitis. Given that *Candida* species exhibit limited adherence to the bladder urothelium, the development of cystitis generally depends on predisposing factors such as urinary tract obstruction, immunosuppression, or biofilm formation on indwelling devices.

The diagnosis of fungal UTI should be reserved for patients with clear symptoms. Nevertheless, symptom assessment can be challenging in patients who are critically ill, long-term care residents, and individuals with indwelling urinary catheters, in whom reliable evaluation of lower urinary tract symptoms is often limited [8]. In these settings, particular attention should be paid to systemic signs of infection, such as fever, as well as less specific manifestations including worsening rigors, altered mental status, and the absence of an alternative infectious focus. However, it is important to recognize that fungal colonization of the urinary tract is common among patients with indwelling urinary catheters, which may further complicate the distinction between colonization and true infection (Fig. 1).

Repeating cultures using a freshly catheterized specimen or after device removal can help to distinguish contamination from funguria, whereas the presence of symptoms confirms infection (Fig. 1).

Antifungal susceptibility testing is recommended, particularly for non-albicans *Candida* species. Certain species, such as *C. glabrata*, may exhibit poor growth on standard media or require extended incubation, warranting additional diagnostic approaches when clinical suspicion persists despite negative cultures. Imaging with ultrasound or computed tomography (CT) urography is indicated in symp-

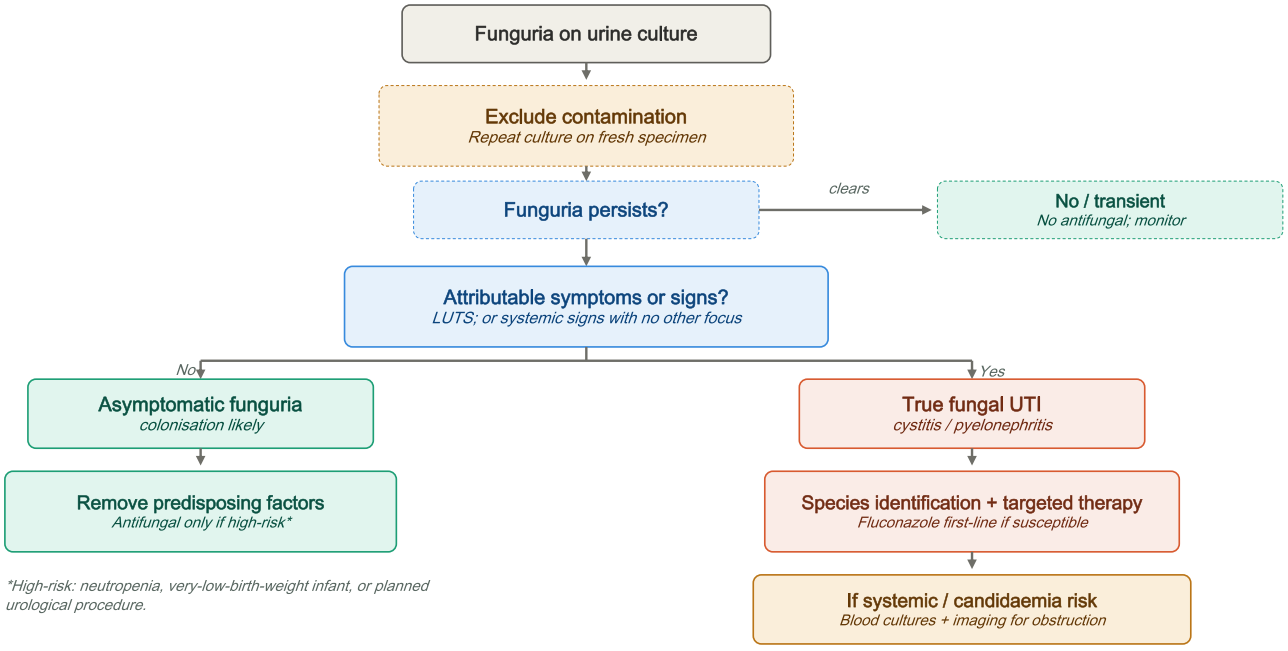

Fig. 1 – Diagnostic algorithm for distinguishing asymptomatic funguria from fungal UTI. LUTS = lower urinary tract symptoms; UTI = urinary tract infection.

tomatic patients to localize infection and detect complications. As with bacterial UTIs, ultrasound should be performed in patients with suspected *Candida* UTI to exclude urinary tract obstruction. Further imaging such as CT urography should be considered if fever persists despite 72 h of appropriate antifungal therapy or earlier in case of clinical deterioration.

Asymptomatic funguria typically does not require antifungal therapy, except in specific high-risk cases, such as patients with neutropenia or infants with low birth weight (<1500 g), or before urological procedures that disrupt the mucosa [9,10].

In symptomatic fungal UTIs, nonpharmacological interventions such as catheter replacement should be considered. In the presence of urinary tract obstruction (eg, caused by fungal bezoars), prompt decompression through ureteral stent placement or percutaneous nephrostomy is essential.

Antifungal therapy should be guided by the identified species and its susceptibility profile. Commonly recommended agents include fluconazole, amphotericin B deoxycholate, and oral flucytosine, with weight-based dosing crucial for achieving therapeutic efficacy.

Species-specific resistance patterns must be considered. *C. krusei* and *C. glabrata* exhibit intrinsic or high-level resistance to fluconazole (>90%), and treatment should be adjusted accordingly. *C. glabrata* UTIs may be treated with fluconazole only if susceptibility is confirmed, given that resistance rates vary considerably by region and patient population [11].

The pharmacological properties of antifungal agents should be carefully considered when selecting therapy. Evidence supporting the use of echinocandins (eg, caspofungin) for UTIs remains limited. Owing to their poor urinary excretion, echinocandins are generally unsuitable for the treatment of fungal cystitis. However, they achieve high renal tissue concentrations, making them a potential option for pyelonephritis or systemic fungal infections involving the urinary tract. Notably, micafungin may reach therapeutic concentrations in bladder tissue despite its low urinary penetration. Overall, echinocandins should be reserved for exceptional cases, particularly in infections caused by fluconazole-resistant species such as *C. glabrata*, *C. krusei*, or *C. auris* when other therapeutic options are unavailable or contraindicated.

Empirical treatment generally consists of a 2-wk course of oral fluconazole, initiated with a one-time double-loading dose on day 1, followed by daily maintenance dosing. A retrospective study of hospitalized adults with fungal UTI (n = 103) showed similar clinical success rates for 14-d (93.3%) and shorter (<14 d) fluconazole regimens (93.1%), suggesting that shorter treatment courses may suffice in localized disease, although differentiation between localized and systemic infection was not assessed [12]. Given that the available evidence is limited to a small retrospective study, current recommendations continue to support a 2-wk treatment course, even for localized *Candida* infections.

Bladder irrigation with amphotericin B deoxycholate is described as an alternative for localized fungal cystitis. A 2009 meta-analysis reported 80–90% fungal clearance within 24 h and superiority to fluconazole (odds ratio 0.57, 95% confidence interval = 0.32–1.00), although data were limited to asymptomatic funguria [13]. In a study of 95 patients, amphotericin B deoxycholate instillations (25 mg in 500 ml dextrose in water at 42 ml/h) for a median of 5 d achieved 80% eradication of fungi [14]. In a randomized controlled trial, early clearance occurred in 96% of the patients receiving amphotericin B bladder instillation versus 73% with fluconazole; however, 1-mo mortality was higher in the amphotericin group (41% vs 22%), indicating that local therapy

may be associated with poorer outcomes [14]. Importantly, the primary end point of most studies is fungal clearance and not the resolution of the UTI itself. Continuous bladder irrigation with amphotericin B deoxycholate (50 mg/l for 5 d) may be considered for fluconazole-resistant localized infections, provided that upper tract or systemic involvement is excluded beforehand (Table 1). In addition, antifungal therapies often necessitate specific clinical and laboratory monitoring that extends beyond routine urological practice (Table 2).

Table 1 – Treatment regimens for localized and systemic fungal UTIs

Localized fungal UTI			
Pathogens	Antimicrobial	Dose and duration of therapy	Renal function correction
Fluconazole-susceptible species	Fluconazole	• 200 mg/d p.o. for 2 wk • 800 mg/d p.o. for 2 wk for susceptible *Candida glabrata*	• CrCl <50 ml/min: reduce dose by 50% • Patients undergoing dialysis: administer full dose three times weekly after dialysis
Fluconazole-resistant species	Amphotericin B deoxycholate	• Bladder instillations: 200 ml/l in a 100 ml infusion bag of 5% glucose, three times daily for 7 d • 0.3–0.6 mg/kg/d IV for 1–7 d • Used with or without flucytosine for *C. glabrata*	• No dosage adjustment required
	Flucytosine	• 25 mg/kg p.o. or IV four times daily for 2 wk • Can be used as monotherapy for *C. glabrata*	• CrCl 21–40 ml/min: 25 mg/kg BID • CrCl 10–20 ml/min: 25 mg/kg daily • CrCl <10 ml/min: 25 mg/kg every 48 h • Dialysis patients: 25–50 mg/kg/dose every 48–72 h after dialysis
	Caspofungin	• 70 mg IV d 1, then 50 mg daily for 2–3 wk • Not recommended as cystitis treatment; recommended in pyelonephritis in highly selected patients	No dosage adjustment required
Systemic fungal UTI			
Pathogens	Antimicrobial	Dose and duration of therapy	Renal function correction
Fluconazole-susceptible species	Fluconazole	• 200–400 mg/d p.o. for 2 wk • 800 mg/d p.o. for 2 wk for susceptible *C. glabrata* • Severe infections: consider a loading dose of 400/800 mg on the first day	• CrCl <50 ml/min: reduce dose by 50% • Patients undergoing dialysis: administer full dose three times weekly after dialysis
Fluconazole-resistant species	Amphotericin B deoxycholate	• 0.3–0.6 mg/kg/d IV for 1–7 d • Used with or without flucytosine for *C. glabrata*	• No dosage adjustment required
	Flucytosine	• 25 mg/kg p.o. or IV four times daily for 2 wk • Generally used in combination with Amphotericin B	• CrCl 21–40 ml/min: 25 mg/kg BID • CrCl 10–20 ml/min: 25 mg/kg daily • CrCl <10 ml/min: 25 mg/kg every 48 h • Patients undergoing dialysis: 25–50 mg/kg/dose every 48–72 h after dialysis
	Caspofungin	• 70 mg IV day 1, then 50 mg daily for 2–3 wk	• No dosage adjustment required

BID = twice a day; CrCl = creatinine clearance; IV = intravenous; p.o. = per os; UTI = urinary tract infection.

Table 2 – Clinical monitoring matrix for antifungal treatments

Medication	Primary focus	Laboratory monitoring	When (frequency)	How (clinical execution and action)
Amphotericin B	Kidneys and electrolytes	• Serum creatinine, blood urea nitrogen, and eGFR • Potassium and magnesium (close tracking) • Complete blood count (nephrogenic anemia)	• Daily at treatment initiation • Two to three times weekly once stable • Continuous vital sign tracking during infusion	• Check eGFR/creatinine before each dose • Proactively substitute electrolytes IV/p.o. • Pre- and posthydrate routinely (eg, 500 ml saline 0.9%) to mitigate nephrotoxicity • Monitor for infusion reactions (fever and chills)
Flucytosine	Bone marrow and liver	• Complete blood count (leukocytes and platelets) • Transaminases (ALT and AST) • Serum creatinine (tracks accumulation)	• Two to three times weekly initially • Weekly when stable • Daily if renal impairment is present • First therapeutic drug monitoring at steady state (days 3–5)	• Therapeutic drug monitoring: draw blood for peak level exactly 2 h after oral dose (or 30 min after IV) • Strictly maintain peak level <100 mg/l • Hold/reduce dose immediately if exceeded to avoid bone marrow aplasia
Fluconazole	Liver and kidneys	• Transaminases (ALT and AST), bilirubin • Serum creatinine and eGFR	• Baseline laboratory panel • Weekly during therapy • Initial ECG; repeat at 48–72 h for high-risk patients	• Calculate CrCl/eGFR at baseline and ongoing • Reduce dose by 50% if GFR <50 ml/min • Measure QTc interval on ECG; discontinue if QTc >500 ms or increases by >60 ms • Screen for CYP2C9/CYP3A4 drug interactions
Caspofungin	Liver	• Transaminases (ALT and AST), alkaline phosphatase	• One to two times weekly for liver panel • Clinical observation during the first 30 min of infusion	• Assess Child-Pugh score at baseline • Reduce dose to 35 mg daily for moderate hepatic impairment (Child-Pugh score 7–9) • Monitor closely if combined with cyclosporine • Observe visually for histamine-mediated flush, pruritus, or rash

ALT = alanine aminotransferase; AST = aspartate aminotransferase; CrCL = XXX; CYP2C9 = XXX; CYP3A4 = XXX; ECG = electrocardiogram; eGFR = estimated glomerular filtration rate; GFR = XXX; IV = intravenous; p.o. = per os; QTc = corrected QT.

In view of the increasing complexity of fungal UTIs, a multidisciplinary approach involving urologists, infectious disease specialists, microbiologists, and intensivists is essential to ensure accurate diagnosis, individualized treatment, and optimal patient outcomes.

This brief correspondence provides a concise summary for urologists to diagnose and treat fungal UTIs. For a comprehensive overview, readers are referred to the full chapter in the EAU 2026 Urological Infections Guidelines [1].

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Study concept and design: Bausch, Smith, Bonkat, Kranz.
Acquisition of data: Bausch, Devlies, Stangl.
Analysis and interpretation of data: None.
Drafting of the manuscript: Bausch.
Critical revision of the manuscript for important intellectual content: Cai, Geerlings, Köves, Lambregts, Leitner, Mantica, Polo, Pilatz, Schneidewind, Schubert, Stangl, Veeratterapillay, Vallée, Wagenlehner, Bonkat, Kranz.
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References

[1] EAU Guidelines. Edn. presented at the EAU Annual Congress London, United Kingdom 2026, EAU Guidelines Office, Arnhem, the Netherlands. http://uroweb.org/guidelines/compilations-of-all-guidelines/.
[2] Fisher JF. Candida urinary tract infections—epidemiology, pathogenesis, diagnosis, and treatment: executive summary. Clin Infect Dis 2011;52:S429–32.
[3] Konje ET, Kizenga O, Charco NJ, et al. Five-year cross-sectional study to determine the burden of Candida spp. infections of the urinary tract system among patients attending tertiary hospital in Northwestern Tanzania. BMJ Open 2023;13:e074833.
[4] Kauffman CA, Vazquez JA, Sobel JD, et al. Prospective multicenter surveillance study of funguria in hospitalized patients. The National Institute for Allergy and Infectious Diseases (NIAID) Mycoses Study Group. Clin Infect Dis 2000;30:14–8.
[5] Ahmadikia K, Kordbacheh P, Shadpour P, et al. Increased urine interleukin-17 and interleukin-22 levels in patients with candidal urinary tract infection. Iran J Kidney Dis 2018;12:33–9.
[6] Krcmery S, Dubrava M, Krcmery Jr V. Fungal urinary tract infections in patients at risk. Int J Antimicrob Agents 1999;11:289–91.
[7] Clifford TG, Katebian B, Van Horn CM, et al. Urinary tract infections following radical cystectomy and urinary diversion: a review of 1133 patients. World J Urol 2018;36:775–81.
[8] Alvarez-Lerma F, Palomar M, León C, et al. Fungal colonization and/or infection in intensive care units. Multicenter study of 1,562 patients. Med Clin (Barc) 2003;121:161–6.
[9] Pappas PG, Kauffman CA, Andes DR, et al. Clinical practice guideline for the management of candidiasis: 2016 update by the Infectious Diseases Society of America. Clin Infect Dis 2016;62:e1–e50.
[10] Sobel JD, Kauffman CA, McKinsey D, et al. Candiduria: a randomized, double-blind study of treatment with fluconazole and placebo. The National Institute of Allergy and Infectious Diseases (NIAID) Mycoses Study Group. Clin Infect Dis 2000;30:19–24.
[11] Fan X, Tsui CKM, Chen X, Wang P, Liu ZJ, Yang CX. High prevalence of fluconazole resistant Candida tropicalis among candiduria samples in China: an ignored matter of concern. Front Microbiol 2023;14:1125241.
[12] Govel JC, Seabury RW, Asiago-Reddy EA, Gutierrez RL, Parsels KA, Kufel WD. Evaluation of shorter versus longer antifungal treatment durations for Candida spp. urinary tract infections among hospitalized adults. Antimicrob Agents Chemother 2025;69:e0192024.
[13] Tuon FF, Amato VS, Penteado Filho SR. Bladder irrigation with amphotericin B and fungal urinary tract infection—systematic review with meta-analysis. Int J Infect Dis 2009;13:701–6.
[14] Jacobs LG, Skidmore EA, Freeman K, Lipschultz D, Fox N. Oral fluconazole compared with bladder irrigation with amphotericin B for treatment of fungal urinary tract infections in elderly patients. Clin Infect Dis 1996;22:30–5.