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Original Research Article

Uropathogenic *Candida*: Microbial profile and antifungal sensitivity patterns in a tertiary care hospital in Vadodara, Gujarat

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ABSTRACT

Introduction: Fungal urinary tract infections (UTIs) are commonly caused by *Candida* species, with *Candida* albicans historically recognized as the most frequently isolated species. Differentiating between mere colonization and true infection—identifying whether the *Candida* is a uropathogen or a commensal—is essential for appropriate clinical management. Antifungal sensitivity testing is critical in guiding effective treatment, particularly in the face of increasing resistance.

Objective: The objective of this study was to analyze the microbial profile of candiduria, distinguish between uropathogenic and commensal *Candida* isolates, and evaluate their Antifungal sensitivity patterns at a tertiary care hospital in Vadodara, Gujarat.

Materials and Methods: This retrospective study was conducted over a one-year period, from January 1, 2022, to December 31, 2022. A total of 9,227 urine samples from patients suspected of having UTIs were analyzed. Isolation and identification of *Candida* species were performed using established microbiological methods, including culture on selective media and biochemical testing. Antifungal sensitivity testing was conducted following the Clinical and Laboratory Standards Institute (CLSI) guidelines using the broth microdilution method. Patient clinical data were reviewed to differentiate uropathogenic isolates from commensals based on factors such as colony counts, presence of symptoms, and associated risk factors.

Results : Out of the 9,227 urine samples analyzed, 2,751 (29.82%) exhibited significant microbial growth, with *Candida* species isolated in 67 (2.43%) of these cases. Of the 67 *Candida* isolates, 45 (67.16%) were identified as uropathogens, while 22 (32.84%) were categorized as commensals. *Candida* albicans was identified in 24 (35.82%) of the isolates, while non-albicans species accounted for 43 (64.18%), including *C. tropicalis* (25.37%), *C. parapsilosis* (20.90%), *C. glabrata* (11.94%), and *C. krusei* (5.97%). Antifungal sensitivity testing showed high sensitivity to echinocandins (caspofungin and micafungin), with varying resistance patterns observed for azoles and amphotericin B among different species.

Conclusion: The study reveals a predominance of non-albicans *Candida* species in cases of candiduria and emphasizes the importance of accurate species identification and Antifungal sensitivity testing. Differentiating between uropathogenic and commensal isolates is vital for guiding appropriate treatment. Continuous monitoring is necessary to detect emerging resistance trends and to inform treatment strategies.

1. Introduction

The genus *Candida* comprises over 150 species, with approximately 20 known to cause infections in humans.[1]

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Candida albicans is traditionally recognized as the most common opportunistic fungal pathogen responsible for a variety of infections, including urinary tract infections (UTIs).[2] Candiduria, the presence of *Candida* species in urine, is frequently encountered in both hospital and community settings, with reported prevalence ranging from 1% to 10% among all urine samples processed in clinical microbiology laboratories.[3,4]

Differentiating between colonization and true infection is a significant clinical challenge. While candiduria may represent mere colonization or contamination, it can also indicate invasive disease, particularly in high-risk populations such as critically ill patients, those with indwelling urinary catheters, diabetics, and individuals receiving broad-spectrum antibiotics.[5,6] Accurate identification of *Candida* species and determination of their pathogenic role are essential for effective patient management.

In recent years, there has been a notable shift in the epidemiology of candiduria, with non-albicans *Candida* species emerging as significant pathogens.[7] These species often exhibit reduced susceptibility or inherent resistance to commonly used antifungal agents, particularly azoles, complicating treatment decisions.[8–12] Therefore, Antifungal sensitivity testing plays a critical role in guiding appropriate therapy and improving patient outcomes.

This study aims to elucidate the microbial profile of candiduria in a tertiary care hospital in Vadodara, Gujarat, distinguish between uropathogenic and commensal isolates based on clinical and microbiological criteria, and assess their Antifungal sensitivity patterns to inform effective treatment strategies.

2. Aim

To determine the microbial profile of candiduria, differentiate between uropathogenic and commensal isolates, and assess their antifungal sensitivity patterns in a tertiary care hospital in Vadodara, Gujarat.

3. Objectives

1. To identify and quantify the *Candida* species in urine specimen from patients with suspected UTIs.
2. To classify the *Candida* isolates as uropathogens or commensals based on clinical data, colony counts, and patient symptoms.
3. To evaluate the antifungal sensitivity of *Candida* by standard testing methods.

4. Materials and Methods

4.1. Study design and setting

This study employed a retrospective cross-sectional approach, spanning from January 1, 2022, to December 31, 2022, at a tertiary care facility located in Vadodara, Gujarat. The Institutional Ethics Committee approved the study.

4.2. Sample collection

We collected a total of 9,227 urine samples from patients of various ages and genders who presented with suspected urinary tract infections across different hospital departments, including both inpatient and outpatient settings.

4.3. Inclusion criteria

1. Patients exhibiting clinical symptoms indicative of a urinary tract infection (e.g., dysuria, frequent urination, urgency, suprapubic discomfort, fever).
2. Patients with identified risk factors such as indwelling urinary catheters, diabetes mellitus, immunosuppression, recent antibiotic usage, or extended hospital stays.

4.4. Exclusion criteria

1. Repeated samples from the same patient within a 7-day window.
2. Samples with insufficient volume or collected improperly.

4.5. Sample processing

4.5.1. Urine sample collection

1. Midstream clean-catch urine samples were gathered in sterile, leak-proof containers using standard aseptic methods.
2. For patients with catheters, samples were obtained aseptically from the catheter port with sterile syringes.

4.5.2. Microscopic examination

Uncentrifuged urine samples were analyzed under a microscope using wet mounts and Gram staining to identify yeast cells and pseudohyphae.

4.5.3. Culture techniques

1. Samples were plated onto Cysteine Lactose Electrolyte Deficient (CLED) agar and Sabouraud Dextrose Agar (SDA) using a calibrated loop to deliver 0.001 mL of urine.
2. The plates were incubated aerobically at 37°C for 24-48 hours.
3. Colony counts were assessed, with $\geq 10^4$ CFU/mL for catheterized patients and $\geq 10^5$ CFU/mL for non-catheterized patients considered significant.

4.6. Identification of candida species

4.6.1. Preliminary identification

Yeast colonies were examined for morphological traits on SDA and Chromogenic *Candida* Agar (HiCrome *Candida* Differential Agar, HiMedia, India), which allowed presumptive identification based on colony color:

1. *C. albicans*: Light to medium green
2. *C. tropicalis*: Metallic blue to purple
3. *C. glabrata*: Pink to purple
4. C. krusei: Light pink, dry, and rough

4.6.2. Germ tube test

Suspected yeast colonies were inoculated into human serum and incubated at 37°C for 2 hours to test for germ tube formation, indicating C. albicans or *C. dubliniensis*.

4.6.3. Cornmeal agar morphology

Chlamydospore formation was evaluated by culturing isolates on Cornmeal Agar with Tween 80 and incubating at 25°C for 48-72 hours.

4.6.4. Automated identification

Final species identification was verified using the VITEK 2 Compact System (BioMérieux, France) with the YST identification card, adhering to the manufacturer's guidelines.

Quality control was conducted using standard reference strains (*C. albicans* ATCC 90028, *C. tropicalis* ATCC 750, *C. glabrata* ATCC 2001, and *C. krusei* ATCC 6258).

4.7. Antifungal sensitivity Testing

4.7.1. Methodology

Antifungal sensitivity was assessed using the CLSI M27-A3 broth microdilution method.

The antifungal agents tested included:

1. Fluconazole
2. Voriconazole
3. Amphotericin B
4. Caspofungin
5. Micafungin
6. 5-Flucytosine

4.7.2. Procedure

Yeast suspensions were adjusted to match a 0.5 McFarland standard and diluted to 0.5 x 10^3 to 2.5 x 10^3 CFU/mL.

Antifungal agents were prepared in RPMI 1640 medium with MOPS buffer at the required concentrations.

Microdilution plates were incubated at 35°C and assessed visually after 24 and 48 hours.

Minimum Inhibitory Concentrations (MICs) were determined:

1. For azoles and 5-flucytosine: Lowest concentration showing ≥50% reduction in turbidity compared to the control.
2. For echinocandins and amphotericin B: Lowest concentration achieving 100% inhibition of visible growth.

4.7.3. Interpretation

1. MIC values were interpreted using CLSI M60 guidelines (2017).
2. Isolates were classified as Susceptible (S), Intermediate (I), or Resistant (R) based on the breakpoint criteria.
3. Quality control strains included *C. parapsilosis* ATCC 22019 and *C. krusei* ATCC 6258.

4.8. Differentiation between Uropathogenic and commensal candida isolates

4.8.1. Criteria for uropathogenicity

1. Significant colony counts ($\geq 10^5$ CFU/mL for non-catheterized and $\geq 10^4$ CFU/mL for catheterized patients).
2. Presence of urinary symptoms (e.g., dysuria, urgency, frequency, hematuria, suprapubic pain).
3. Risk factors for candiduria (e.g., indwelling urinary catheter, recent antibiotic use, diabetes mellitus, immunosuppression).

4.8.2. Criteria for commensalism

1. Low colony counts ($<10^5$ CFU/mL for non-catheterized and $<10^4$ CFU/mL for catheterized patients).
2. Absence of urinary symptoms and relevant risk factors.
3. Colonization in asymptomatic individuals without systemic signs of infection.

5. Results

5.1. Microbial profile of candiduria

We identified 67 *Candida* isolates from the 9,227 urine samples, representing a candiduria prevalence of 2.43%. Among these, *Candida* albicans was isolated in 24 cases (35.82%), while non-albicans species predominated, accounting for 43 cases (64.18%).

5.2. The distribution of non-albicans Candida species was as follows

1. *C. tropicalis*: 17 cases (25.37%)
2. *C. parapsilosis*: 14 cases (20.90%)
3. *C. glabrata*: 8 cases (11.94%)
4. *C. krusei*: 4 cases (5.97%)

Table 1: Antifungal Susceptibility Patterns of *Candida* Isolates

Candida Species	Fluconazole Susceptibility (%)	Caspofungin Susceptibility (%)	Micafungin Susceptibility (%)	Voriconazole Susceptibility (%)	Resistance Observed
C. albicans	95.83	100	-	-	None
C. tropicalis	70.59	94.12	100	-	None
C. parapsilosis	Variable (78.57)	85.71	-	78.57	Azoles
C. glabrata	Resistant	100	-	-	Fluconazole
C. krusei	Resistant	100	-	-	Fluconazole

Table 2: Criteria for differentiation between uropathogenic and commensal *Candida* Isolates

Criteria	Uropathogenic *Candida*	Commensal *Candida*
Colony Count	≥10^5 CFU/mL (non-catheterized) ≥10^4 CFU/mL (catheterized)	<10^5 CFU/mL (non-catheterized) <10^4 CFU/mL (catheterized)
Urinary Symptoms	Present (dysuria, urgency, frequency, hematuria, suprapubic pain)	Absent
Risk Factors	Indwelling urinary catheter, recent antibiotic use, diabetes mellitus, immunosuppression	None or minimal risk factors
Clinical Relevance	Indicative of possible infection	Likely colonization

5.3. Differentiation between uropathogenic and commensal isolates

Based on clinical and microbiological criteria, 45 isolates (67.16%) were classified as uropathogens, while 22 isolates (32.84%) were considered commensals. *C. albicans* was more frequently associated with uropathogenicity (16/24, 66.67%), whereas non-albicans species were more commonly isolated as commensals.

5.4. Antifungal sensitivity patterns

Antifungal sensitivity testing revealed the following patterns:

1. *C. albicans* isolates were highly susceptible to fluconazole (95.83%) and caspofungin (100%), with no resistance to amphotericin B observed.
2. Among non-albicans species, C. tropicalis showed 70.59% susceptibility to fluconazole and 94.12% susceptibility to caspofungin, while 100% of isolates were susceptible to micafungin.
3. *C. parapsilosis* isolates exhibited variable resistance to azoles, with 78.57% susceptible to voriconazole and 85.71% susceptible to caspofungin.
4. *C. glabrata* and *C. krusei* demonstrated inherent resistance to fluconazole and were fully susceptible to echinocandins.

6. Discussion

Candiduria, though often perceived as benign colonization, can represent invasive infection in certain patient populations.[13] The clinical significance of candiduria, therefore, depends on various factors, including colony counts, patient symptoms, and underlying risk factors.[14]

The present study demonstrates a predominance of non-albicans *Candida* species in candiduria cases, consistent with recent epidemiological trends worldwide.[15] The high isolation rate of *C. tropicalis* and *C. parapsilosis* highlights the shifting landscape of candiduria, with these species increasingly recognized as important Uropathogens.[16,17]

Antifungal sensitivity testing remains a critical tool in managing candiduria, particularly given the rising incidence of antifungal resistance.[18] In our study, echinocandins demonstrated the highest efficacy against *Candida* isolates, while azole resistance was notably higher among non-albicans species, particularly *C. glabrata* and *C. krusei*.[19,20]

The study underscores the importance of distinguishing between uropathogenic and commensal *Candida* isolates. Clinical and microbiological criteria, including colony counts and patient symptoms, are essential in guiding appropriate management decisions.[21] While echinocandins may offer a robust treatment option for invasive candiduria, the use of azoles should be guided by susceptibility results, particularly in the context of non-albicans species.

Continuous surveillance of antifungal resistance patterns in candiduria is imperative to inform empirical therapy and improve patient outcomes.

7. Conclusion

The study highlights a significant shift in the microbial profile of candiduria, with non-albicans *Candida* species emerging as predominant pathogens. Differentiating between uropathogenic and commensal isolates based on clinical and microbiological criteria is crucial for appropriate management. Antifungal sensitivity testing remains essential, particularly in the context of rising resistance to azoles. Ongoing surveillance and tailored treatment protocols are necessary to address the evolving

landscape of candiduria.

8. Ethical Approval

This study was conducted under approval of Sumandeep Vidhyapeeth stitutional Ethics Committee (SVIEC/ON/Medi/RP/Aug/24/1).

9. Conflict of Interest

None.

10. Source of funding

None.

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