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Candiduria in Catheterized Intensive Care Unit Patients and Pregnant Female Patients at a Tertiary Care Hospital

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Abstract: ***Background: Candida is a naturally occurring component of the vaginal, gastrointestinal, and oral microbiota. Among its species, Candida is the most frequent cause of oral candidiasis, genitourinary candidiasis, and nosocomial urinary tract infections (UTIs), making it clinically significant. The presence of budding yeast cells in urine may indicate severe candidiasis, a urinary tract infection, or sample contamination. To differentiate between contamination, colonisation, and infection, a repeat urine examination for yeast cells is recommended. Multiple antifungal agents are available for treatment; however, antifungal resistance—particularly among non-albicans species—has increased over recent decades. Methods: A prospective study was conducted over 14 months (December 2023 to February 2025) in the Department of Microbiology, Government Medical College, Amritsar. All patients admitted to the obstetrics and gynecology department and the intensive care unit (ICU) with indwelling catheters for more than 48 hours were included. A total of 200 urine samples, collected aseptically, were processed. Results: Of the 200 patients, 26 (13%) tested positive for Candida species. Non-albicans Candida predominated among ICU patients, whereas Candida albicans was more common in obstetrics and gynecology patients. Conclusions: Regardless of the presence or absence of symptoms, candiduria should be carefully evaluated and managed with a logical, evidence-based approach rather than being ignored or treated hastily.***

Keywords: Candida, candiduria, antifungal resistance, intensive care unit, obstetrics and gynecology

1. Introduction

Candiduria, the presence of Candida species in the urine, represents a significant yet often overlooked healthcare concern among hospitalized patients—particularly those in intensive care units (ICUs) and pregnant women. While it is rare among healthy individuals with structurally normal urinary tracts, its frequency rises sharply in hospitalized and high-risk populations.[1, 2]

Catheter-associated candiduria is notably prevalent among critically ill patients. In ICUs, indwelling urinary catheters markedly elevate the risk of Candida colonization and candiduria development.[2, 3] The rate of infection correlates with the duration of catheterization—studies report that infection risk rises by approximately 10% each day, with nearly all long-term catheterized patients eventually developing candiduria. Other contributory factors include broad-spectrum antibiotic use, diabetes mellitus, extremes of age, prolonged hospitalization, and immunosuppressive states.[2,3]

Species distribution has shifted: non-albicans *Candida* (NAC) species now predominate over *C. albicans* in many ICU settings—e.g., NAC accounted for 66.7% to 71.4% of cases in some studies.[4, 5] A notable study from India's ICU found an incidence of candiduria at 29.6 per 1,000 admissions, with 80.6% of patients having indwelling catheters, along with high rates of antibiotic exposure and diabetes. Concomitant candidemia occurred in 19.4% of cases—and ICU mortality reached approximately 29%.[4] Another Indian investigation reported high mortality (61.4%) among ICU patients with candiduria, often linked to persistent colonization by difficult-to-treat NAC strains.[3]

Pregnancy predisposes women to urinary tract infections (UTIs), including candiduria, due to anatomical and physiological changes such as urinary stasis and hormonal modulation of immune defenses.[6, 7] Among pregnant women, asymptomatic bacteriuria can rise to symptomatic UTIs and may lead to adverse outcomes like prematurity, low birth weight, and pre-eclampsia.[6] Although bacterial pathogens (notably *E. coli*) are the most frequently isolated uropathogens, *Candida* species also contribute significantly. In one study, *Candida* comprised 20.6% of all uropathogens in pregnant women, with non-albicans species making up 59% of *Candida* isolates; emerging resistance to fluconazole was noted (31.8%).[6]

Urinary candidiasis is one of the most challenging forms of candidiasis because distinguishing between colonization and true infection is difficult. Candida albicans is the main species associated with the human infection, however there has been a significant increase in infections caused by non-albicans species in the past two decades.[8] Despite the clinical importance of candiduria—especially in ICU catheters and pregnancy contexts—there is a scarcity of data specifically comparing its prevalence and microbiological profile across these two high-risk cohorts at tertiary care centers, particularly in India. Differences in species distribution, risk factors, antifungal susceptibility, and clinical management strategies underscore the necessity for localized surveillance.

Aims

1) Quantify the prevalence of candiduria in both groups.
2) Characterize the distribution of *Candida* species (albicans vs. non-albicans).

3) Assess patterns of antifungal resistance

2. Material and Methods

A prospective study was conducted over a period of 14 months, from December 2023 to February 2025, in the Department of Microbiology, Government Medical College, Amritsar. The study included all patients admitted to the Obstetrics and Gynecology Department and the Intensive Care Unit who had an indwelling catheter for more than 48 hours. A total of 200 urine samples were aseptically collected from a needleless sampling port using a sterile syringe/cannula adapter after cleansing the port with a disinfectant. The samples were collected in disposable, clean, dry, leak-proof, and sterile containers with lids and were immediately transported to the microbiology laboratory for processing according to standard microbiological guidelines. Data analysis was performed using statistical methods with SPSS software, version 22.

Inclusion Criteria

1) A positive urine culture, defined as $\geq 10^5$ colony-forming units (cfu) of one or two microorganisms per milliliter of urine.
2) Patient fulfilling the clinical criteria that is having at least one of the following:
   - New onset or worsening of fever
   - After catheter removal: dysuria, frequency and urgency can be considered within 24 hrs
   - Altered mental status
   - Flank pain
   - Costovertebral angle tenderness
   - Rigors
   - Pelvic discomfort
   - New or worsening incontinence, malaise or lethargy

Exclusion Criteria

1) Patients hospitalized for less than 48 hours (not catheterized).
2) Samples showing mixed growth of microorganisms on culture.

Procedure

The urine samples were centrifuged, and the sediment was analyzed using microscopy, Gram staining, and culture. A wet mount examination of the urine sample was performed to look for pus cells, red blood cells, budding yeast cells, pseudo hyphae, casts, and crystals. Urine samples were cultured on cystine lactose electrolyte deficient (CLED) agar using a calibrated loop, as per the standard protocol of urine culture.[9] On the same day, samples showing yeast cells or pseudo hyphae on microscopy were cultured on Sabouraud's dextrose agar (SDA) with chloramphenicol (0.05 mg/ml). The inoculated culture plates were incubated at 37°C for 24–48 hours. [10,11]

Samples showing significant colony count and pure growth of yeast cells on culture were processed according to standard operating procedures.

The identification process involved:

1) Culture on Sabouraud's dextrose agar (SDA):

These isolates were inoculated on two SDA slants supplemented with chloramphenicol and gentamicin, one incubated at 37°C aerobically and the other at 22°C for 24–48 hours. The growth is suspected as *Candida* if it is smooth, cream-colored, white pasty colonies on SDA (Fig 01), and confirmation is done by Gram staining. On Gram staining, Gram-positive budding oval-shaped yeast cells with pseudohyphae were observed (Fig 02).[12, 13]

Figure 1: Candida growth on Sabouraud Dextrose agar

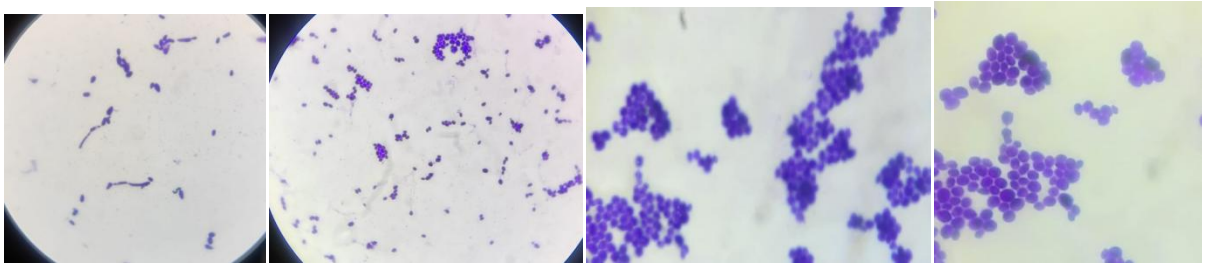

Figure 2: Gram staining of candida species.

2) Germ Tube

To speciate Candida isolates, a Germ tube test was done. It will differentiate C. albicans and Candida dublienenses from other Candida species. An isolated colony of Candida was passed in 0.5 mL of serum and incubated at 37°C for 2 h. A drop of this suspension was placed on clean microscopic slide, covered with coverslip, and examined under the microscope for the presence of Germ tube (Fig : 03).[14]

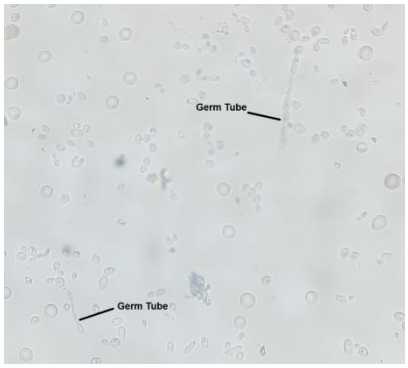

Figure 3: Germ tube

Corn Meal Agar (Dalmau Plate Culture Method)

The Dalmau plate culture method is widely used to observe **chlamydospore production in yeasts**, particularly *Candida albicans*. A heavy inoculum of yeast is streaked across a plate containing **corn meal agar** medium (Fig 04). A sterile coverslip is placed over the streak to create a slight anaerobic condition. The streak should extend beyond the coverslip to facilitate growth both under and outside of it.

The inoculated plates are incubated at **25–30°C for 24–48 hours** and then examined microscopically. Characteristic structures such as **chlamydospores, pseudohyphae, and true hyphae** can be observed under the coverslip (Fig 05).[15]

Figure 4: Inoculation on corn meal agar

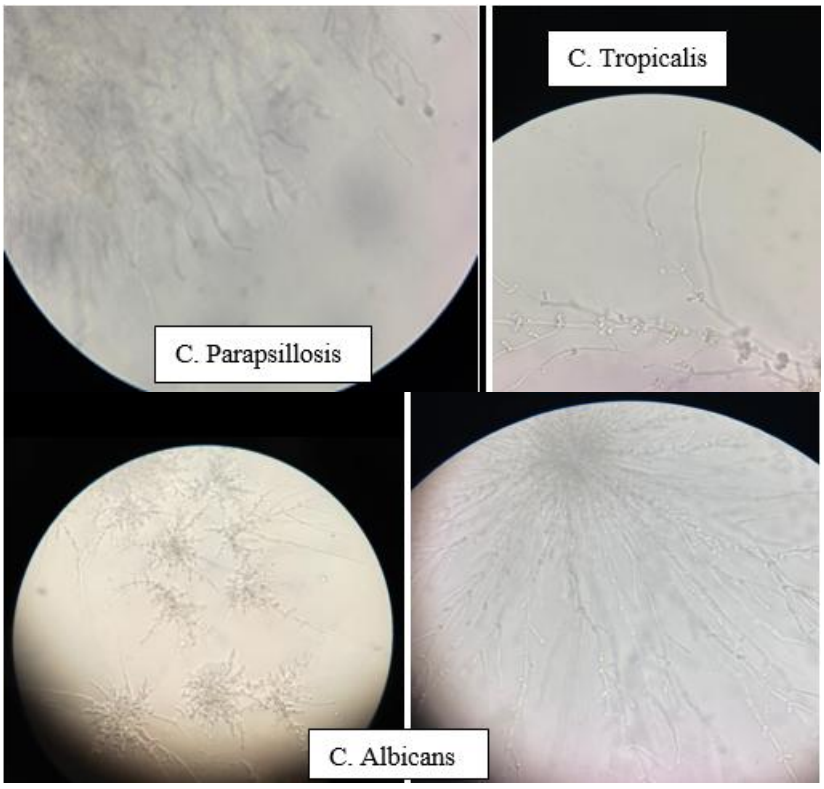

Figure 5: Chlamydospores of candida speices.

Sugar Assimilation Test

A 24–48 hours old culture was taken and a yeast suspension was prepared in 2 ml of yeast nitrogen base (YNB) by adding a heavy inoculum. About 18 ml of molten agar, cooled to 45 °C, was taken and the yeast suspension was added to it and mixed well. The molten agar, along with the yeast suspension, was poured into a 90 mm Petri plate and allowed to set at room temperature until the agar surface solidified.[16]

Sugar discs obtained commercially (HiMedia, Mumbai, India) were placed onto the surface of the agar plate. The sugar discs used were **glucose, galactose, xylose, sucrose, trehalose, and cellobiose** (Fig. 06). The plates were incubated at **37 °C for 3–4 days**. The presence of growth around the disc was considered as assimilation positive for that particular carbohydrate. Growth around the glucose disc was recorded first, which served as the **positive control (viability of yeast)**.[16]

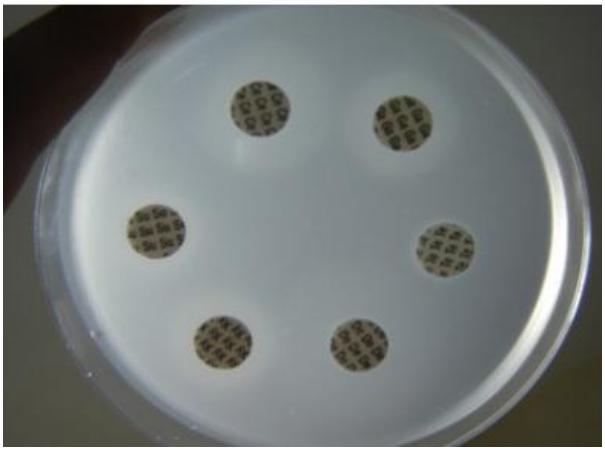

Figure 6: Sugar assimilation test of candida albicans

Tetrazolium Reduction Medium (TRM)

Tetrazolium reduction medium (TRM) was used to differentiate various species of *Candida* such as *C. albicans, C. tropicalis, C. parapsilosis, C. glabrata, C. krusei,* and *C. pseudotropicalis* (Fig. 07).[17]

Tetrazolium is reduced in different gradients by various species of *Candida* to produce distinct colours depending on the species. The yeast colonies were inoculated onto the tetrazolium reduction medium and incubated at **37 °C for 24–48 hours**, after which the colour produced by the isolates was recorded.[18]

S. No	Candida Species	Colour on TRM
1	C. Albicans	Cream
2	C. Tropicalis	Maroon red
3	C. Krusei	Pink
4	C. Glabrata	Pale pink
5	C. Parapsilosis	Rose pink

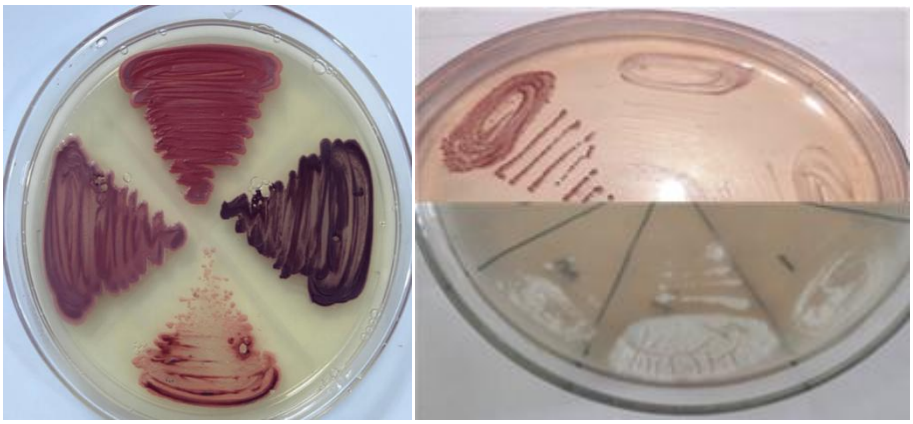

Figure 7: Candida Species on TRM

CHROMagar Candida Medium

CHROMagar Candida (Paris, France) is a selective and differential chromogenic medium used for the identification of various *Candida* species (Fig.08) This medium is based on the direct detection of specific enzymatic activities by incorporating multiple chromogenic substrates (fluorochromes) into the medium.[19]

Due to the chromogenic substrates present, colonies of different *Candida* species produce distinct colours on the isolation plate, thereby allowing their direct identification.

Colonies from the various *Candida* isolates were inoculated onto CHROMagar Candida medium and incubated at **37 °C for 48–72 hours**, after which the colours produced were recorded.[17]

S. No	Candida Species	Colour on CHROMagar
1	C. Albicans	Bluish green
2	C. Tropicalis	Blue
3	C. Krusei	Pink
4	C. Glabrata	Dark Pink
5	C. Parapsilosis	Pale Pink

Figure 8: Candida species on CHROMagar

Antifungal Susceptibility Test (AFST)

Candida isolates were subjected to AFST using the disc diffusion method on Mueller–Hinton agar containing 2% glucose and 0.5 µg/ml of methylene blue, according to CLSI standards (M44-A2). The plates were incubated aerobically at **37 °C for 24–48 hours**. The zone of inhibition was measured according to the standard protocol.[20]

The antifungal susceptibility test was performed using commercially available antifungal discs (HiMedia):

Fluconazole (25 µg), Itraconazole (10 µg), Caspofungin (5 µg), Amphotericin B (20 µg), Voriconazole (1 µg).

Quality Control:The sterility of each batch of media prepared was checked by incubating at **37 °C for 24 hours**. *Candida albicans* American Type Culture Collection (ATCC) **90028** was used as a quality control strain for the antifungal susceptibility testing.[20]

3. Results

Out of 200 patients included in the study, 150 were from the Obstetrics and Gynecology department and 50 were from the ICU.

Obstetrics and Gynecology Patients
Among the 150 patients, 39 (26%) had a positive urine culture. Of these, 28 (71.7%) were positive for bacteria, while 11 (28.2%) showed growth of *Candida* species.

- Majority of the isolates, 7 (63.6%), were identified as *Candida albicans*, while 4 (36.3%) were due to non-*albicans Candida* spp.

ICU Patients
Out of 50 ICU patients, 38 (76%) had a positive urine culture. Among them, 23 (60.5%) were positive for bacteria, and 15 (39.4%) were positive for *Candida* species.

- The majority, 11 (84.6%), were identified as non-*albicans Candida* spp., while 4 (23.07%) were *Candida albicans*.

Table 1: Species- wise distribution of candida isolates.

Candida Species	Obstetrics and Gynecology (150 patients)	ICU (50 Patients)
C. Albicans	7	4
C.Tropicalis	1	4
C. Krusei	1	2
C. Glabrata	1	3
C. Parapsilosis	1	2

Table 2: Age- wise distribution of candida isolates between male and female.

	Obstetrics and Gynecology	ICU	
Age groups (Years)	Female	Male	Female
18-30	8	1	2
31-45	2	1	2
46-55	1	1	3
>55	0	1	4

Table 3: Total of isolates of candida identified by 3 phenotypic tests

Phenotypic tests	C. Albicans	C.Tropicalis	C. Krusei	C. Glabrata	C. Parapsilosis
Tetrazolium reduction medium	11	5	3	4	3
CHROMagar	11	5	3	4	3
Sugar assimilation	11	4	3	-	3

Table 4: Antifungal susceptibility pattern

Antifungal	Obstetrics and Gynecology		ICU	
	C.albicans	Non albicans	C.albicans	Non albicans
Fluconazole	82.3	76.5	80.8	72.2
Itraconazole	58.5	62.6	55.9	68.2
Caspofungin	95.2	94.4	92.1	91.7
Amphotericin B	72.4	78.8	68.2	71.2
Voriconazole	92.4	92.1	90.3	91.4

4. Discussions

The present study investigated the prevalence, species distribution, and antifungal susceptibility of *Candida* species isolated from catheterized intensive care unit (ICU) patients and pregnant women admitted to a tertiary care hospital. Out of 200 patients studied, candiduria was detected in 26 cases (13%), with a significantly higher occurrence among ICU patients (30%) compared to obstetrics and gynecology patients (7.3%). These findings emphasize the differential epidemiology of candiduria across distinct high-risk populations, as reported in earlier studies where prevalence varied from 9% to 22% depending on patient cohorts and hospital settings.[2,3]

In the ICU cohort, non-*albicans Candida* (NAC) species predominated (73.3%), whereas *Candida albicans* remained the most frequent isolate among obstetrics and gynecology patients (63.6%). This distribution aligns with global trends showing an epidemiological shift towards NAC species in critically ill patients, particularly *C. tropicalis* and *C. glabrata*.[4,5] The higher proportion of NAC in ICUs has been attributed to prolonged catheterization, indiscriminate use of broad-spectrum antibiotics, and immunosuppressive conditions.[3,4] In contrast, the predominance of *C. albicans* among pregnant women in our study concurs with prior reports linking pregnancy-related hormonal changes, glycosuria, and altered vaginal flora to increased susceptibility to *C. albicans* colonization.[6,7]

The antifungal susceptibility profile observed in this study has important clinical implications. High susceptibility rates were seen with echinocandins (caspofungin >90%) and voriconazole (>90%) across both groups, whereas reduced susceptibility was noted for fluconazole and itraconazole, particularly among NAC isolates (72.2% and 68.2%, respectively, in ICU patients). These findings are consistent with global and Indian studies reporting emerging azole resistance, especially among NAC species such as *C. glabrata* and *C. krusei*.[3,6,8] Fluconazole resistance rates as high as 31.8% among pregnant women and ICU patients have been documented in recent Indian studies.[6,8] This poses a therapeutic challenge in low-resource settings where fluconazole remains the most widely prescribed antifungal due to its cost-effectiveness and oral formulation.

Pregnant women with candiduria, though often asymptomatic, represent a high-risk group where untreated

infections can have adverse outcomes including preterm labor, low birth weight, and pre-eclampsia.[6,7] In contrast, candiduria in ICU patients often reflects colonization rather than true infection; however, given the association with prolonged catheterization and reports of concomitant candidemia in 10–20% of ICU patients, it warrants careful evaluation.[4,5] Thus, distinguishing colonization from invasive infection remains a diagnostic and therapeutic challenge.

Taken together, our findings highlight the importance of routine surveillance, accurate species identification, and antifungal susceptibility testing to guide management. The increasing burden of NAC species and azole resistance underscores the need for antifungal stewardship and judicious use of broad-spectrum antibiotics in hospital settings.

5. Conclusions

In conclusion, candiduria remains an important nosocomial and obstetric concern. While *C. albicans* predominates in pregnant women, NAC species are increasingly common in ICU patients and are often associated with reduced azole susceptibility. Differentiating colonization from infection, coupled with targeted antifungal stewardship, is crucial for optimizing patient outcomes and reducing morbidity.

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