Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i7.7237

CLINICAL AND MYCOLOGICAL STUDY OF MUCOCUTANEOUS CANDIDIASIS

Dr. Bismi Sherief[1], Dr. Lilakumari Subramoniam[2*]

[1] Consultant, Department of Dermatology, Dr. Yogiraj Centre for Dermatology and Cosmetology, Trivandrum, Kerala, India.
[2*] Associate Professor, Department of Dermatology, Government Medical College, Kollam, Kerala, India.

***Corresponding Author:** Dr. Lilakumari Subramoniam
*****Associate Professor, Department of Dermatology, Government Medical College, Kollam, Kerala, India.

ABSTRACT

BACKGROUND: This study was conducted to evaluate the clinico-morphological pattern of mucocutaneous candidiasis, and to identify the species of Candida by culture, sugar fermentation and sugar assimilation tests.

METHODS: This was a hospital-based descriptive-case series that was carried out over the course of a year, among 64 patients who had been clinically diagnosed with mucocutaneous candidiasis. The study was approved by the institutional ethics committee, and the participants provided written informed consent.

RESULTS: Sixty-four patients with clinical diagnosis of mucocutaneous candidiasis excluding children below 5 years of age and patients with onychomycosis and paronychia were studied during a period of one year. Both the clinico-morphological and mycological aspects were studied. The age of patients ranged from 20 years to 78 years with a mean age of 45.89 years. The male to female ratio was 1:1.9 indicating a female preponderance. Diabetes mellitus was the most common co-morbid condition noted. Majority of the patients had several known predisposing factors. In this study, the most common clinical type of mucocutaneous candidiasis was intertrigo (42.2%) followed by oral candidiasis (32.8%). Among males, the most common clinical type was oral candidiasis (54%), whereas intertrigo (48%) was the predominant presentation among females. Genital candidiasis was twice more common in females than in males. Acute pseudo-membranous candidiasis accounted for 80.9% of oral candidiasis cases. Out of all the cases, direct microscopy by KOH mount was positive in 31.2% cases and correlation with culture showed significant level of agreement. Oral candidiasis had the highest rate of positive direct microscopy (38.10 %) while balanoposthitis had the lowest rate (0%). Fungal culture yielded Candida in 57.8% of the study population. The most common isolate was *C.tropicalis* (56.8%). Positive Candida culture was highest for oral candidiasis and balanoposthitis (66.7% each) and lowest for vulvovaginitis (46.2%). *C.tropicalis* (42.7%) was the most common species isolated in oral candidiasis followed by C.albicans (21.3%). The rest of the isolates were made up by *C.parapsilosis* (14.4%), *C.glabrata* and *C.stellatoidea* (7.2% each). In intertrigo, *C.tropicalis* accounted for 73.2% of the isolates, far outnumbering *C.albicans*, *C.stellatoidea*, *C.parapsilosis* and *C.kefyr* (6.7% each). *C.tropicalis* and *C.stellatidea* (33.3% each)

together made up the majority in vulvovaginitis. The other isolates were *C.albicans* and *C.glabrata* (16.7% each). The two isolates obtained from balanoposthitis were identified as *C.tropicalis*.

CONCLUSION: The results of the study showed a significant change in the relative prevalence of the different species of Candida, with non-albicans Candida being the predominant isolate and *C.tropicalis* emerging as the most common species. Further research on Mucocutaneous Candidiasis is needed to determine whether this finding is unique or if it is the beginning of an emerging trend as seen in nosocomial candidaemia.

KEYWORDS : Clinical, Mycological, Mucocutaneous Candidiasis.

INTRODUCTION

Fungi constitute an extremely diverse group of organisms and are generally classified as either moulds or yeasts. Some have been recognized as classic pathogens whereas others are recognized only as environmental saprobes. Fungi can cause mild infections, trigger allergic reactions including asthma, and produce serious life-threatening diseases. With the advent of chemotherapy, radiation therapy and diseases such as AIDS that affect the immune system, the line between pathogen and saprobe has been blurred.[1]

Candidiasis refers to a diverse group of infections caused by the yeast *Candida albicans* or by other members of the genus Candida. They typically infect the skin, nail, mucous membranes and gastro-intestinal tract but may also cause systemic disease.[2] Candida species are normal inhabitant of the skin and mucosa. Since candidiasis is an opportunistic endogenous infection, several factors that alter the host defenses can predispose to candidiasis.[3,4]

C.albicans is responsible for a wide range of infections in both immune competent and immune compromised individuals. It is the most frequent fungal species involved in recurrent infections, outbreaks and nosocomial infections.[5] In addition to the overall increase of Candida infection, epidemiological shift in the relative prevalence of the different Candida species and emergence of new pathogens has occurred. Several studies show an increased incidence of systemic infections due to non-albicans Candida such as *C.tropicalis*, *C.glabrata*, *C.krusei* and *C.parapsilosis*, some of which are often resistant to most of the antifungals currently available. Among the possible factors contributing to these shifts, an important role has been attributed to antifungal drugs. It is believed that the introduction of various antimycotic agents into extensive use has resulted in the selection of specific species that are inherently less susceptible to the specific drug.[6-30] *C.tropicals* has been identified as the most prevalent pathogenic yeast species of the non-albicans Candida group. In India, *C.tropicalis* is the most common cause of nosocomial candidiasis.[13]

In oropharyngeal and vaginal candidiasis also a trend towards an increase in the incidence of non-albicans Candida has been reported, especially *C.dubliniensis* and *C.glabrata*.[12,14,15,19-34] *C.albicans* responds to antifungal treatment uniformly well, but the non-albicans Candida have variable responses to conventional azole treatment. With the rise in non-albicans Candida, there are groups of patients who will not achieve clinical cure despite treatment with multiple conventional agents, and alternative treatments have to be considered.[34]

Several studies have been done worldwide on the epidemiology of candidaemia in both immunocompromised and immunocompetent hosts. However, studies on mucocutaneous candidiasis are limited.[23-35] Hence, in view of the changing scenario of candidal infections, this study was undertaken to analyse the clinico-morphological and mycological features of mucocutaneous candidiasis.

Aims and Objectives

- To study the clinico-morphological pattern of mucocutaneous candidiasis.
- To identify the Candida species by culture, sugar fermentation and assimilation tests.

METHODS

This hospital based descriptive study was conducted among patients attending the outpatient wing of the Department of Dermatology and Venereology, Govt. Medical College, Thiruvananthapuram, a tertiary care referral and treating institution in south Kerala, India.

Specific mycological investigations were done as part of the study in the Department of Microbiology, Govt. Medical College, Thiruvananthapuram. The study was done in patients who fulfilled the eligibility criteria.

Exclusion Criteria

- Patients having onychomycosis.
- Patients below 5 years of age.
- Patients not willing to take part in the study.

The cumulative sample size was 64. A structured proforma was used to collect the data. The study was approved by the Institutional Ethics Committee and the participants gave written informed consent.

Detailed evaluation of the clinical profile was done and the predisposing factors were noted. KOH mount, gram staining and fungal culture were done in all patients. In culture positive cases, germ tube test and biochemical characterisation were also done. Confirmation of the species was done by culturing the organism in corn meal agar supplemented with Tween 80.

Data was analysed using the computer software SPSS version 19.

RESULTS

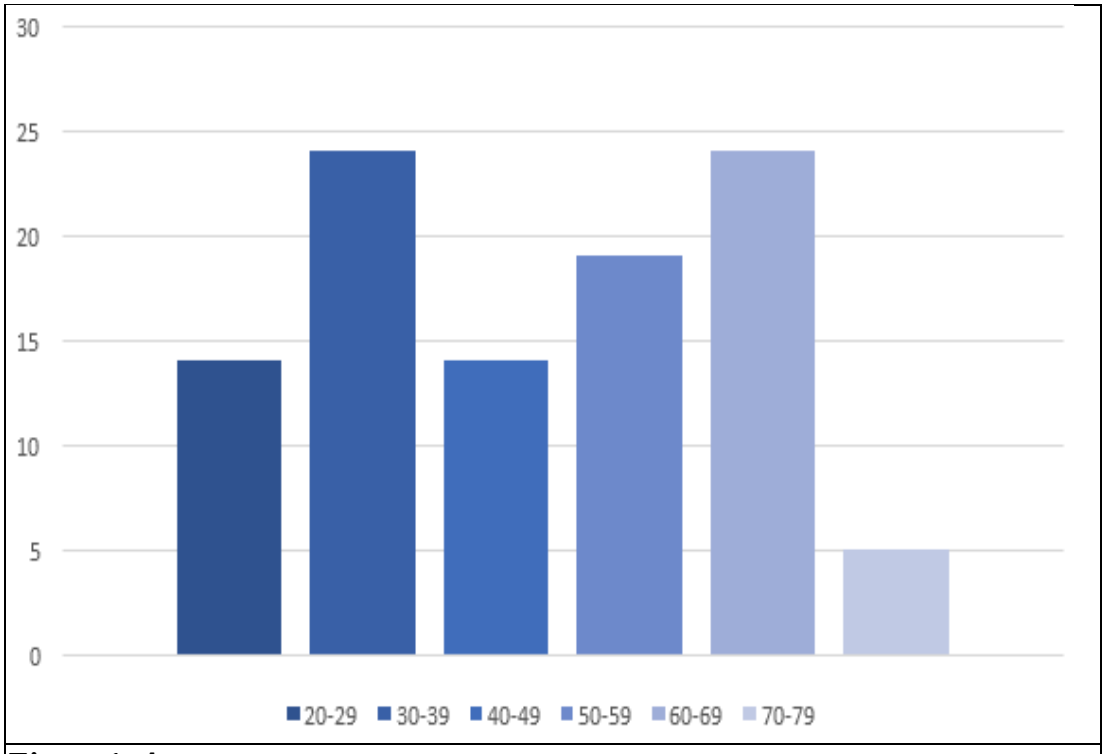

Figure 1: Age

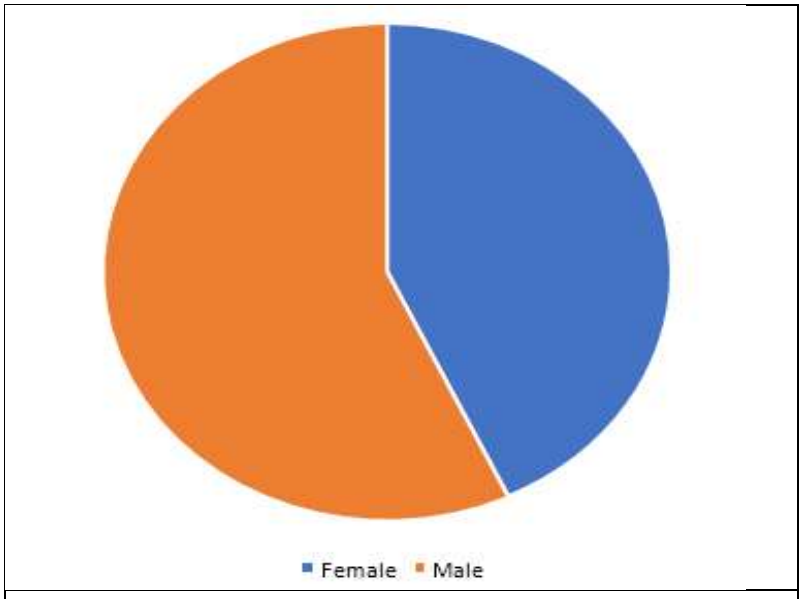

Figure 1: Gender

Site of Lesion	Frequency	Percentage
Oral cavity	21	32.8
Skin	27	42.2
Genitalia	16	25.0
Total	64	100.0

Table 1: Site of Lesion

Disease	Frequency	Percentage
Diabetes mellitus	14	21.9
HIV	2	3.1
STI	5	7.8
Pemphigus vulgaris	5	7.8
SLE	1	1.6
SJS/TEN	3	4.7
Herpetic gingivostomatitis	1	1.6
Others	23	35.9
No associated diseases	14	21.9

Table 2: Associated Diseases

Clinical Diagnosis	Frequency	Percentage
Oral Candidiasis	21	32.8
Intertrigo	27	42.2
Vulvovaginitis	13	20.3
Balanoposthitis	3	4.7
Total	64	100.0

Table 3: Clinical Diagnosis

Oral Candidiasis	Frequency	Percentage
Acute pseudomembranous	17	80.9
Acute pseudomembranous + cheilitis	1	4.8
Median rhomboid glossitis	1	4.8
Chronic hyperplastic	2	9.5
Total	21	100.0

Table 4: Type of Oral Candidiasis

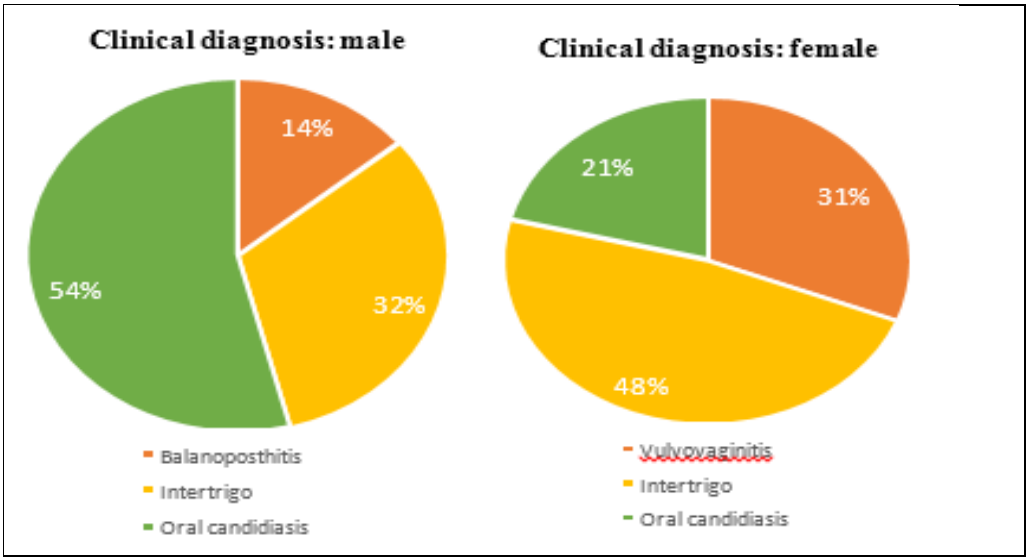

Figure 2: Clinical diagnosis in males and females

	Positive		Negative	
Investigation	**Frequency**	**Percentage**	**Frequency**	**Percentage**
KOH mount	20	31.2	44	68.8
Gram stain	16	25.0	48	75.0
Culture	37	57.8	27	42.2

Table 5: Mycological Investigations

		Culture	
		Positive	**Negative**
KOH	Positive	20	0
	Negative	17	27
Total		37	27

Table 6: Correlation between KOH Mount and Culture

		Culture	
		Positive	**Negative**
Gram stain	Positive	16	0
	Negative	21	27
Total		37	27

Table 7: Correlation between Gram Stain and Culture

Candida Species Isolated	**Frequency**	**Percentage**
C.albicans	5	13.5
C.tropicalis	21	56.8
C.glabrata	2	5.4
C.stellatoidea	4	10.8
C.parapsilosis	3	8.1
C.kefyr	1	2.7
Not identified	1	2.7

Table 8: Isolates

Candida Species Isolated	**Frequency**	**Percentage**
C.albicans	3	21.3
C.tropicalis	6	42.7
C.glabrata	1	7.2
C.stellatoidea	1	7.2

C.parapsilosis	2	14.4
C.kefyr	0	0
Not identified	1	7.2
Total	14	100

Table 9: Oral Candidiasis Isolates

Candida Species Isolated	Frequency	Percentage
C.albicans	1	6.7
C.tropicalis	11	73.2
C.glabrata	0	0
C.stellatoidea	1	6.7
C.parapsilosis	1	6.7
C.kefyr	1	6.7
Total	15	100

Table 10: Intertrigo Isolates

Candida Species Isolated	Frequency	Percentage
C.albicans	1	16.7
C.tropicalis	2	33.3
C.glabrata	1	16.7
C.stellatoidea	2	33.3
C.parapsilosis	0	0
C.kefyr	0	0
Total	6	100

Table 11: Vulvovaginitis Isolates

Candida Species Isolated	Frequency	Percentage
C.albicans	0	0
C.tropicalis	2	100
C.glabrata	0	0
C.stellatoidea	0	0
C.parapsilosis	0	0
C.kefyr	0	0
Total	2	100

Table 12: Balanoposthitis Isolates

DISCUSSION

Age

The age of the patients ranged from 20 years to 78 years, with a mean age of 45.89 years. The largest number of patients were in the age group of 30 to 39 years (24%) whereas those in the age group 70 to 79 years had the least number of patients (6%). The distribution did not show much variation among the other age groups.

Different clinical forms of candidiasis are associated with different age groups. While oral candidiasis tends to affect people at extremes of age, Candida vulvovaginitis is more common in sexually active age groups.[36,37] Since candidiasis is an opportunistic infection, there is also an interplay of several host factors, age being one among them. Hence, frequency distribution according to age may not show wide variation, and this is reflected in our study.

Gender

In our study population, females made up 65.62% of the total, and the male-to-female ratio was 1:1.9. In their investigation, Shroff PS et al. reported an identical sex ratio; however, Kim SN et al. reported a ratio of 1:1.7.[25,26]

Site of Lesion
Skin lesions were present in 42.2% while 32.8% had oral lesions. Only 25% had genital lesions.

Associated Diseases
Mucocutaneous candidiasis is associated with several predisposing factors, including immunosuppression brought on by illnesses and medications as well as antibiotic-induced changes to the natural flora.[2] Diabetes mellitus as a comorbidity was the most common related disease in the study population (21.9%). A comparable rate of diabetes (20.4%) was reported in a study by Kandhari KC et al., whereas in a study by Shroff PS et al., only 14.7% of the patients had diabetes.[24,26] Seven patients had sexually transmitted infection (11%), while no associated disease was seen in 21.9%.

Clinical Diagnosis
In our study, the most common clinical type of mucocutaneous candidiasis was intertrigo (42.2%), followed by oral candidiasis (32.8%). Candidal intertrigo as the commonest presentation was also reported by Kim SN et al. and Shroff PS et al.[25,26] In contrast, in a study on the clinical patterns of Candida infections in Bombay, vulvovaginitis was the commonest presentation, followed by intertrigo.[23] Genital candidiasis constituted the remaining 25% cases in our study.

Type of Oral Candidiasis
Out of the twenty-one patients diagnosed with oral candidiasis, the majority (80.9%) had acute pseudomembranous candidiasis, whereas in one patient (4.8%), both acute pseudomembranous candidiasis and angular cheilitis were seen together. Two patients (9.5%) had chronic hyperplastic candidiasis and one patient (4.8%) had median rhomboid glossitis. These results show a strong correlation with those reported in the literature.[2,30,38]

Clinical Diagnosis in Males and Females
Oral candidiasis was the most common clinical type in males (54%) whereas intertrigo was the predominant presentation among females (48%). This could be due to the fact that majority of females were homemakers performing domestic chores which involves frequent wetting of skin. Thus, a good proportion of the female patients are predisposed to developing candidal intertrigo.[39] A similar finding was reported in a study by Mishra M et al.[28]
Intertrigo (32%) was the second most common clinical type in males while the counterpart in females was vulvovaginitis (31%). Only 21% of females had oral candidiasis whereas the least common clinical pattern among males was balanoposthitis (14%). In the present study, genital candidiasis was twice more common in females than in males. This is in accordance with the study by Shroff PS et al. and in contrast to reports by Mishra M et al.[26,28]

Mycological Investigations
Mycological investigations done in all patients included examination of wet mount in 10% KOH, examination of fixed smear stained by Gram stain and Candida culture. Out of the 64 patients, KOH mount was positive in 31.2% cases compared to 25% positive cases on Gramstained smear. However, fungal culture yielded Candida species in the majority (57.8%) of the study population. The rate of positivity of KOH mount and fungal culture was less when compared to the study by Kim SN et al.[25] Correlation between KOH mount and culture showed that the measure of agreement kappa value was 0.498, which means that there is 49.8% agreement between these two tests. The p value of 0.000 indicates that this agreement is significant. In the case of direct microscopy by Gramstained smear, the measure of agreement kappa value was lower (0.391), but the p value indicated that there was significant agreement between Gram-stained smear examination and culture.

Isolates
Out of the 64 patients, 37 yielded Candida species on culture. *C.tropicalis* was isolated from 21 cases. It accounted for 56.8% of all isolates in the study. *C.albicans* was the second most frequent isolate

(13.5%). The remaining isolates included *C.kefyr* (2.7%), *C.parapsilosis* (8.1%), *C.glabrata* (5.4%), and *C.stellatoidea* (10.8%). Since pure culture was not obtained, one Candida isolate could not be identified. These findings stand in contrast to studies by Kim SN et al., Shroff PS et al., and Kandhari KC et al. where the most common Candida species isolated from mucocutaneous lesions was *C. albicans*. The predominant non-albicans Candida in these studies was *C.tropicalis*.[24,26]

In our study, there was a market decline the number of *C.albicans*, which is considered as the most common cause of mucocutaneous candidiasis. Another significant finding is the remarkable increase in the *C.tropicalis* isolates, which emerged as the single most common species. *C.dubliniensis*, which is an emerging cause of oral candidiasis among HIV positive individuals was not isolated in our study. [21] Also, the study did not show a predominance of *C.glabrata* among the non-albicans Candida group in patients with vulvovaginitis.[33,34]

Considering the fact that *C.tropicalis* has replaced *C.albicans* as the most common cause of nosocomial candidemia in India, the findings in our study point towards the possibility of a similar development in the case of mucocutaneous candidiasis also.[9,13]

C.tropicalis isolates accounted for 73.2% of intertrigo cases, which is noteworthy. Since intertrigo has a chronic course and prolonged treatment with topical antifungals are needed, it is possible that the Candida species which are relatively resistant to the commonly used antifungals have gained an upper hand compared to the more susceptible ones. It is reported that resistance to fluconazole in clinical isolates of *C.tropicalis* has increased.[13]

A study of the distribution and antifungal susceptibility of Candida species isolated from candidaemia cases in India detected an emergence in resistance to amphotericin B and ketoconazole among the isolates, including *C.tropicalis*.[9]

Oral Candidiasis

Among the 14 culture positive patients with oral candidiasis, six isolates were *C.tropicalis* (42.7%), three were *C.albicans* (21.3%) and two were *C.parapsilosis* (14.4%). One isolate each (7.2%) was *C.galgrata* and *C.stellatoidea*. One isolate could not be identified. However, in the study by Baradkar VP et al., *C.albicans* was the most common isolate (70%), followed by *C.parapsilosis* (15%), *C.glabrata* (7.5%), *C.tropicalis* (5%) and *C.dubliniensis* (2.5%).[30] In the study by Lattif AA et al., the proportion of isolates identified as *C.albicans* was higher (86%), and the other species isolated were *C.parapsilosis* (8%), *C.glagrata* and *C.krusei* (3% each).[40] *C.tropiocalis* and *C.dubliniensis* were not isolated in this study.

Intertrigo

Out of the 15 Candida isolates from intertrigo lesions, the majority (73.2%) were *C.tropicalis*. One isolate each (6.7%) was *C.albicans*, *C.glabrata*, *C.stellatoidea*, *C.parapsilosis* and *C.kefyr*. As in the case of oral candidiasis, here also non-albicans Candida predominated, with *C.tropicalis* emerging as the most common species.

Even though *C.albicans* and *C.tropicalis* account for more than 80% of the isolates from skin lesions, *C.albicans* is the most commonly isolated species.[38,41] However, in our study, *C.tropicalis* constituted a strikingly large proportion (73.2%) of isolates, whereas *C.albicans* was drastically reduced to 6.7%. Since majority of our patients had a prolonged duration of symptoms and gave history of prior treatment, it is possible that they represented treatment failure cases, which could be due to infection by the relatively resistant non-albicans Candida. Hence, our population may have constituted an inadvertently selected group of rather uncommon pathogens, and not represented the true picture in the community. On the other hand, it is also possible that skin infections due to *C.tropicalis* is truly on the rise. This can be considered in the context of the dramatic increase in the number of *C.tropicalis* isolated from nosocomial candidaemia. In such a case also, drug resistance is to be suspected as the prime reason for a change in the relative prevalence of the different Candida species. According to several reports, resistance to fluconazole in clinical isolates of *C.tropicalis* has increased. [13] The antifungal activity of ketoconazole, which is commonly used as a topical agent for candidiasis is

found to be comparatively low. [42] Further studies on the sensitivity of Candida species to the other commonly used topical azoles will throw light into this aspect.

Vulvovaginitis

Out of the six culture positive cases, two each (33.3%) were *C.tropicalis* and *C.stellatoidea*. One isolate (16.7%) was identified as *C.albicans* whereas the other was *C.glabrata*. In other studies on vulvovaginal candidiasis, the most common isolate was *C.albicans*, whereas the predominant non-albicans species isolated was *C.albicans*, whereas the predominant nonalbicans species isolated was *C.glabrata*.[31-34]

So, our study showed a predominance of non-albicans Candida species, along with the identification of *C.stellatoidea*, which was not reported from the other studies. This species, along with *C.tropicalis*, accounted for the majority (66.6%) of the isolates. However, a study of vaginal flora in antenatal cases in the department of Gynaecology and Obstetrics in our institution reveals that these two species are not uncommon among our population.[43] In this study done among antenatal women, several of whom with symptoms suggestive of vulvovaginitis, the major Candida isolate was *C.albicans* (57.10%), while *C.tropicalis* and *C.stellatoidea* accounted for 22.44% and 2.04% cases respectively.

Balanoposthitis

Two patients (66.7%) were culture positive, and both the isolates were *C.tropicalis***.**

CONCLUSION

In conclusion, mucocutaneous candidiasis encompasses several different clinical types with distinct characteristics. In general, females are more commonly affected, and specific predisposing factors are important in the development of mucocutaneous lesions. Direct microscopy helps in detecting Candida in the tissue, while culture and biochemical tests aid in identifying the species. This study revealed a radical shift in the relative prevalence of the various Candida species, with non-albicans Candida being the predominant isolate, and *C.tropicalis* emerging as the most common species. Whether this finding is an isolated one, or is the unravelling of an emerging trend as seen in nosocomial candidaemia, can only be proved by further studies on mucocutaneous candidiasis.

REFERENCES

1. Fothergill AW. Medically Significant Fungi. In: Mahon CR, Lehman DC, Manuselis G, eds. Textbook of Diagnostic Microbiology. 3rd edn. St. Louis: Elsevier 2007:719-59.
2. Janik MP, Heffernan MP. Yeast infections: candidiasis and Tinea (Pityriasis) versicolor. In: Wolff K, Goldsmith LA, Katz SI, Gilchrest BA, Paller AS, Leffell DJ, eds. Fitzpatrick's Dermatology in General Medicine. 7th edn. Vol. 2. New York: McGraw-Hill Medical 2008:1822-30.
3. Ananthanarayan R, Paniker CJ. Ananthanarayan and Paniker's Textbook of Microbiology. 8th edn. Medical mycology. Chap- 65. Hyderabad: Universities Press 2009:600-8.
4. Vartivarian S, Smith CB. Pathogenesis, Host Reisstance, and predisposing factors. In: Bodey GP, ed. Candidiasis: pathogenesis, diagnosis and treatment. 2nd edn. New York: Raven Press 1993:59-75.
5. Garcia-Hermoso D, MacCallum DM, Lott TJ, Sampaio P, Serna MJ, Grenouillet F, et al. Multicenter collaborative study for standardization of Candida albicans genotyping using a polymorphic microsatellite marker. J Clin Microbiol 2010;48(7):2578-81.
6. Pfaller MA, Diekema D. Epidemiology of invasive candidiasis: a persistent public health problem. Clin Microbiol Rev 2007;20(1):133-63.
7. Pfaller M, Wenzel R. Impact of the changing epidemiology of fungal infections in the 1990s. Eur J Clin Microbiol Infect Dis 1992;11:287-91.
8. Trick WE, Fridkin SK, Edwards JR, Hajjeh RA, Gaynes RP, National Nosocomial Infections Surveillance System Hospitals. Secular trend of hospital-acquired candidemia among intensive care unit patients in the United States during 1989–1999. Clin Infect Dis 2002;35(5):627-30.

9. Chakrabarti A, Mohan B, Shrivastava SK, Marak RS. Change in distribution & antifungal susceptibility of Candida species isolated from candidaemia cases in a tertiary care centre during 1996-2000. Indian J Med Res 2002;116:5-12.
10. Shivaprakasha S, Radhakrishnan K, Karim PM. Candida spp. other than Candida albicans: a major cause of fungaemia in a tertiary care centre. Indian J Med Microbiol 2007;25(4):405-7.
11. Nguyen MH, Peacock Jr JE, Morris AJ, Tanner DC, Nguyen ML, Snydman DR, Wagener MM, Rinaldi MG, Victor LY. The changing face of candidemia: emergence of non Candida albicans species and antifungal resistance. Am J Med 1996;100(6):617-23.
12. Vazquez JA, Sobel JD, Peng G, Steele-Moore L, Schuman P, Holloway W, et al. Evolution of vaginal Candida species recovered from human immunodeficiency virus infected women receiving fluconazole prophylaxis: the emergence of Candida glabrata? Clin Infect Dis 1999;28(5):1025-31
13. Kothavade RJ, Kura MM, Valand AG, Panthaki MH. Candida tropicalis: its prevalence, pathogenicity and increasing resistance to fluconazole. J Med Microbiol 2010;59(8):873-80.
14. Martinez M, López-Ribot JL, Kirkpatrick WR, Coco BJ, Bachmann SP, Patterson TF. Replacement of Candida albicans with C. dubliniensis in human immunodeficiency virus infected patients with oropharyngeal candidiasis treated with fluconazole. J Clin Microbiol 2002;40(9):3135-9.
15. Coleman DC, Sullivan DJ, Bennett DE, Moran GP, Barry HJ, Shanley DB. Candidiasis: the emergence of a novel species, Candida dubliniensis. AIDS 1997;11(5):557-67.
16. Samaranayake YH, Samaranayake LP. Candida krusei: biology, epidemiology, pathogenicity and clinical manifestations of an emerging pathogen. J Med Microbiol 1994;41(5):295-310.
17. Trofa D, Gácser A, Nosanchuk JD. Candida parapsilosis, an emerging fungal pathogen. Clin Microbiol Rev 2008;21(4):606-25.
18. Wingard JR, Merz WG, Rinaldi MG, Johnson TR, Karp JE, Saral R. Increase in Candida krusei infection among patients with bone marrow transplantation and neutropenia treated prophylactically with fluconazole. N Engl J Med 1991;325(18):1274-7.
19. Chunchanur SK, Nadgir SD, Halesh LH, Patil BS, Kausar Y, Chandrasekhar MR. Detection and antifungal susceptibility testing of oral Candida dubliniensis from human immunodeficiency virus-infected patients. Indian J Pathol Microbiol 2009;52(4):501-4.
20. Sullivan D, Haynes K, Bille J, Boerlin P, Rodero L, Lloyd S, et al. Widespread geographic distribution of oral Candida dubliniensis strains in human immunodeficiency virus infected individuals. J Clin Microbiol 1997;35(4):960-4.
21. Polacheck I, Strahilevitz J, Sullivan D, Donnelly S, Salkin IF, Coleman DC. Recovery of Candida dubliniensis from non-human immunodeficiency virus-infected patients in Israel. J Clin Microbiol 2000;38(1):170-4.
22. Phillips AJ. Treatment of non-albicans Candida vaginitis with amphotericin B vaginal suppositories. Am J Obstet Gynecol 2005;192(6):2009-13.
23. Pratiba DJ, Kelkar SS. Clinical Patterns of Candida Infections in Bombay. Indian J Dermatol Venereol Leprol. 1980; 46: 31-2.
24. Kandhari KC, Rao RK. Clinical and laboratory studies on cutaneous candidiasis. Indian J Dermatol Venereol Leprol 1969;35:102-7.
25. Kim SN, Ihm SK. A clinical and mycological study of cutaneous candidiasis. Korean J Dermatol 1985;23:314-20.
26. Shroff PS, Parikh DA, Fernandez RJ, Wagle UD. Clinical and mycological spectrum of cutaneous candidiasis in Bombay. J Postgrad Med 1990;36(2):83-6.
27. Sharma RC, Mendiratta V. Clinical profile of cutaneous infections and infestations in the paediatic age group. Indian J Dermatol 1999;44(4):174-8.
28. Mishra M, Mishra S, Singh PC, Mishra BC. Clinico-mycological profile of superficial mycoses. Indian J Dermatol Venereol Leprol 1998;64(6):283-5.
29. Barbhuiya JN, Das SK, Ghosh A, Dey SK, Lahiri A. Clinico-mycological study of superficial fungal infection in children in an Urban clinic in Kolkata. Indian J Dermatol 2002;47(4):221-3.

30. Baradkar VP, Kumar S. Species identification of Candida isolates obtained from oral lesions of HIV infected patients. Indian J Dermatol 2009;54(4):385-6.
31. Richter SS, Galask RP, Messer SA, Hollis RJ, Diekema DJ, Pfaller MA. Antifungal susceptibilities of Candida species causing vulvovaginitis and epidemiology of recurrent cases. J Clin Microbiol 2005;43(5):2155-62.
32. Spinillo A, Capuzzo E, Gulminetti R, Marone P, Colonna L, Piazzi G. Prevalence of and risk factors for fungal vaginitis caused by non-albicans species. Am J Obstet Gynecol 1997;176(1):138-141.
33. Neerja J, Aruna A, Paramjeet G. Significance of Candida culture in women with vulvovaginal symptoms. J Obstet Gynecol India 2006;56(2):139-41.
34. Nyirjesy P, Seeney SM, Grody MH, Jordan CA, Buckley HR. Chronic fungal vaginitis: the value of cultures. Am J Obstet Gynecol 1995;173(3):820-3.
35. Dockerty WG, Sonnex C. Candidal balano-posthitis: a study of diagnostic methods. Genitourin Med 1995;71:407-9.
36. Hay RJ, Ashbee HR. Mycology. In: Burns T, Breathnach S, Cox N, Griffiths C, eds. Rook's Textbook of Dermatology. 8th edn. Vol. 2. West Sussex: Wiley-Blackwell 2010:36.1-69.
37. Nyirjesy P, Sobel JD. Vulvovaginal candidiasis. Obstet Gynecol Clin N Am 2003;30(4):671-84.
38. Segal E, Elad D. Candidiasis. In: Merz WG, Hay RJ, eds. Topley and Wilson's microbiology and microbial infections. 10th edn. Vol 1. Medical Mycology. London: Hodder Arnold 2005:579-613.
39. Rippon JW. Medical Mycology. Chap- 8. In: The Pathogenic Fungi and the Pathogenic Actinomycetes. Philadelphia: W.B Saunders Company. Candidosis 1974:175-204.
40. Lattif AA, Banerjee U, Prasad R, Biswas A, Wig N, Sharma N, et al. Susceptibility Pattern and molecular type of species-specific Candida in oropharyngeal lesions of Indian human immunodeficiency virus positive patients. J Clin Microbiol 2004;42:1260-2.
41. Hymes SR, Duvic M. Cutaneous Candidiasis. In: Bodey GP, ed. Candidiasis: Pathogenesis, Diagnosis and Treatment. 2nd edn. New York: Raven Press 1993:159-66.
42. Eggimann P, Garbino J, Pittet D. Management of Candida species infections in critically ill patients. Lancet Infect Dis 2003;3:772-85.
43. Sulekha B. A Study of Vaginal Flora in Antenatal Cases with Special Reference to Candida [master's thesis]. [Trivandrum]: University of Kerala 1984: p. 86.