

Full Length Research Paper

Evaluation of *Candida* isolation from vaginal mucosa of mothers and oral mucosa of neonates on the basis of delivery type

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Candida spp. is one of the most important fungal pathogens in the intensive neonatal care units associated with increased health care costs. This study was performed on 164 pregnant women (82 vaginal-routes and 82 cesarean-routes) and their infants. The vaginal samples were obtained using swabs from mothers prior to delivery. Swabs were taken from oral mucosa of all infants immediately after birth as well. Samples were inoculated onto Sabouraud dextrose agar and isolated species were obtained. Antifungal sensitivity was also evaluated against 3 different agents by disk diffusion method. The data were analyzed with Chi-square and Student t-test. *Candida albicans* and *Candida krusei* were the most common isolated species from mothers in vaginal and cesarean-route groups, respectively. Furthermore, *C. albicans* was the most common species in both neonate groups. There was significant difference in occurrence of *Candida* spp. on the oral mucosa between vaginally-born and cesarean-born infants whereas; there was no significant difference in occurrence of *Candida* spp. on the vaginal mucosa between mothers in vaginally and cesarean-route groups. Ketoconazole had higher antifungal activity in all studied groups. The type of delivery should be considered as a risk factor in neonatal candidiasis.

Key words: Candidiasis, neonates, cesarean and vaginal.

INTRODUCTION

Fungal infection with *Candida* spp. has become an increasingly important problem in the Neonatal Intensive Care Units (NICUs). Colonization of *Candida* in neonates results in significant morbidity and mortality and associated with increased health care costs (Mohan et al., 2007). Saiman et al. (2000) and Roilides et al. (2004) showed an incidence of 1.2% of neonatal candidiasis in

the NICUs. *Candida albicans* was the most common isolated species in infected or colonized infants, although in the past decade the frequency of *Candida parapsilosis* colonization increased as well (Mendiratta et al., 2006; Borderon et al., 2003). Other isolated species are *Candida tropicalis*, *Candida Krusei*, *Candida glabrata*, *Candida lusitanae* and *Candida guilliermondii* (Borderon et al., 2003).

Candida is transmitted by direct or indirect contact. Vertical transmission (mother or neonate) was controversially discussed (Borderon et al., 2003; Caramalac et al., 2007). It is noted that the vaginal candidiasis of the

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Table 1. Distribution of *Candida* spp. isolated from pregnant women.

Groups	<i>Candida</i> spp n: (%)	<i>C. albicans</i> n: (%)	<i>C. guilliermondii</i> n: (%)	<i>C. krusei</i> n: (%)
Vaginal-route	27: (32.9)	15: (55.6)	9: (33.3)	3: (11.1)
Cesarean-route	28: (34.1)	8: (28.6)	9: (32.1)	11: (39.3)
Total	55: (33.5)	23: (41.8)	18: (32.7)	14: (25.5)

Table 2. Antifungal sensitivity percentage of *Candida* spp. isolated from pregnant women.

Groups	Amphotericin B n: (%)	Nystatin n: (%)	Ketokonazole n: (%)
Vaginal-route	26: (96.2)	24: (88.8)	26: (96.2)
Cesarean-route	26: (92.8)	24: (85.7)	28: (100)
Total	52: (94.5)	48: (87.3)	54: (98.2)

mother, if not treated, may be a cause of neonatal candidiasis (Borderon et al., 2003).

Furthermore, Mendiratta et al. (2006) and Sharp et al. (1992) demonstrated that the colonization of newborn with *Candida* spp. occurs in the first few hours of life and oral colonization was the earliest and commonest among studied cases.

The aim of this study was to investigate and compare the occurrence of *Candida* spp. on the vaginal mucosa of pregnant women at the time of birth and on the oral mucosa of their neonates according to their delivery types (vaginally or cesarean).

MATERIALS AND METHODS

This study investigated the occurrence of *Candida* spp. on the vaginal mucosa of mothers at the time of birth and on the oral mucosa of their infants. Therefore 164 pregnant women (mean age 24.88 ± 5.5 years) were admitted in NICUs of Mahdiah Hospital, Tehran, Iran.

All mothers were informed about purpose of the study and written consent was obtained from participants. They had comprehensive files, included demographic information, number of delivery, duration of previous pregnancy, type of previous delivery, etc. Then, pregnant women were divided into two subgroups according to their delivery type.

Vaginal-route group (82 cases) and cesarean-route group (82 cases), the participants with different type of delivery were matched according to the age, number of previous delivery and duration of pregnancy. Species were collected by swabs from vaginal mucosa of both groups prior to delivery by the gynecologist and transported to the laboratory within 30 min of collection.

Furthermore, swabs were taken from oral mucosa (cheeks, lip, ventral and dorsal surface of tongues) of neonates (vaginally-born group and cesarean-born group) in each subgroups within first few hours of birth.

They were inoculated onto Sabouraud dextrose agar with chloramphenicol (5 mg/dL) and gentamicin (2 mg/dL) and incubated at 37°C for seven days. Then, yeast colonies were isolated. *C. albicans* was identified by light microscopic examination after gram staining.

Other subtypes of *Candida* were determined according to Chen

et al. (1985) by assimilation test and recorded in a data form (Mendiratta et al., 2006; Jha et al., 2006; Chen et al., 1985). Antifungal sensitivity testing of all isolated samples was done according to the method of Chakrabarti et al. against amphotericin B, ketoconazole and nystatin. (Chakrabarti et al., 1995).

Finally, the data were analyzed using chi-square and t-test. The significance level was considered as P-value less than 0.05.

RESULTS

Fifty five cases (33.5%) were yeast positive out of 164 delivering mothers. *Candida* species were isolated from 32.9 and 34.1% of vaginal and cesarean-route groups, respectively. *C. albicans* was observed in 15 of 27 (55.6%) pregnant women in vaginal-route group and 8 of 28 (28.6%) pregnant women in cesarean-route group. *C. albicans* was the most common isolated species from all mothers, followed by *C. guilliermondii* (32.7%) and *C. krusei* (25.5%).

C. krusei was the most common isolated species from mothers in cesarean-route group whereas in vaginal group *C. albicans* was dominant. (Table 1) There was no significant difference in vaginal candidiasis between vaginal and cesarean-route groups. ($P = 0.86$)

The results of antifungal sensitivity of *Candida* spp. isolated from vaginal mucosa of all mothers were summarized in Table 2.

Candida spp. was also isolated from oral mucosa of 15 (9.1%) (14 vaginally-born and 1 cesarean-born) neonates.

C. albicans was identified in 7 of 14 cases (50%) and 1 of 1 case (100%) of vaginally-born and cesarean-born infants, respectively. Other types of *Candida* were not found in cesarean-born neonates. However, *C. guilliermondii* and *C. krusei* were isolated from oral mucosa of vaginally-born neonates (Table 3).

There was a significant difference in presence of *Candida* spp. on the oral mucosa of neonates between vaginally and cesarean-born groups ($P = 0.001$).

Table 3. Distribution of *Candida* spp. Isolated from neonates.

Groups	<i>Candida</i> spp n: (%)	<i>C. albicans</i> n: (%)	<i>C. guilliermondii</i> n: (%)	<i>C. krusei</i> n: (%)
Vaginally-born	14: (17.7)	7: (50)	5: (33.72)	2: (14.28)
Cesarean-born	1: (1.2)	1: (100)	0	0
Total	15: (9.1)	8: (53.33)	5: (33.33)	2: (14.34)

Table 4. Antifungal sensitivity percentage of *Candida* spp. isolated from neonates.

Groups	Amphotericin B n: (%)	Nystatin n: (%)	Ketokonazole n: (%)
Vaginally-born	14: (100)	12: (85.7)	12: (85.7)
Cesarean-born	1: (100)	1: (100)	1: (100)
Total	15: (100)	13: (86.7)	13: (86.7)

Antifungal sensitivity of *Candida* spp. isolated from neonates has been shown in Table 4.

DISCUSSION

Candida spp. is important fungal pathogens in NICUs. Mother/newborn transmission of *Candida* spp. was controversially discussed in previous reports. The role of vaginal candidiasis as a source of neonatal candidiasis was suggested by Harms et al. (1992); Laskus et al. (1998); Hoppe (1997). It was rare for Reef et al. (1998); Borderon (1989); Rotimi et al. (1985). Waggoner-Fountain et al. (1996) in evaluation of vertical and horizontal transmission of *Candida* species to premature newborns showed, contamination was nosocomial, not peripartum (Waggoner-Fountain et al., 1996). In addition, Caramalac et al. (2007) pointed out that the vaginal mucosa is not the main source of *Candida*. However, genital candidiasis is a common problem for women and it is estimated from 17% in Turkey to 30% in U.S (Pirota and Garland, 2006).

In this study, *Candida* spp. was isolated from the vaginal mucosa of 32.9 and 34.1% of mothers in vaginal – route and cesarean – route groups, respectively. These rates were reported by Caramalac et al. (2007) as 47.2 and 46.4%, respectively. Review of literature showed that the rate of vaginal yeast colonization in pregnant women vary from 5.6 to 69.2%. These differences may be related to the sample size, time of sample collection, and methods of *Candida* identification (Mohan et al., 2007). For example, Giraldo et al. (2000) demonstrated that polymerase chain reaction (PCR), culture and wet mount or gram stain had different sensitivity for detection of *Candida* spp.

Generally, *Candida* spp. was detected from 33.5% of all mothers in our study and also there was no statistically significant difference in isolated *Candida* spp. from

vaginal mucosa between cesarean and vaginally-route groups ($P > 0.05$).

In this present report, *C. albicans* (55.6%) and *C. krusei* (39.3%) were the most common species isolated from vaginal mucosa of mothers in vaginal and cesarean-route groups, respectively. Also *C. krusei* (11.1%) and *C. albicans* (28.6%) were the less common isolated species from vaginal mucosa of mothers in vaginal and cesarean - route groups, respectively (Table 1).

Generally, *C. albicans* was the most common isolated species from vaginal mucosa of all mothers in our study. Caramalac et al. (2007) showed that the predominant species was *C. albicans*, isolated in 59 and 69% of mothers delivering by vaginal and cesarean birth, respectively. Also, *C. guilliermondii* and *Rhodotorula rubra* were the second most frequent in mothers by vaginal and cesarean birth, respectively.

According to Blasschke-Hellmessem (1998), *C. albicans* is observed in vaginal secretions in 25 to 30% of pregnant women, and about 70 to 85% of them contaminate their newborns with yeasts.

Furthermore, *C. glabrata*, *C. parapsilosis* and *Candida famata* were cultured from vaginal mucosa (Pirota and Garland, 2006). In our study, *C. albicans* (41.8%) was followed by *C. guilliermondii* (32.7%) and *C. krusei* (25.5%). This finding was similar to Caramalac et al. (2007).

In this present report, *Candida* spp. was isolated from oral mucosa of 17.7% of vaginally-born and 1.2% of cesarean-born neonates, respectively. These rates were close to that reported by Caramalac et al. (2007) (25% of vaginally-born and 3.6% of cesarean-born infants).

On the other hand, Aldana-Valenzuela et al. (2005) and Kozinn et al. (1958), reported congenital candidiasis in three cesarean-born infants.

According to our results, *Candida* spp. was collected from 9.1% of all neonates. This finding is in agreement with Koniz et al. (1958) and Mendiratta et al. (2006).

In our study *C. albicans* (53.32%) was the most common type of *Candida* spp. which isolated from oral mucosa of neonates in both groups (vaginally-born and cesarean-born neonates). This finding is similar to Farmaki et al. (2007).

Also, *C. guilliermondii* and *C. krusei* were not found in cesarean -born neonates. This finding is in agreement with Caramalac et al. (2007).

There was statistically significant difference in isolated *Candida* spp. from oral mucosa between vaginally and cesarean-born neonates ($P < 0.05$). This finding is in agreement with Harms et al. (1992) and Laskus et al. (1998). Also, it is in disagreement with Waggoner–Fountain et al. (1996). These differences may be related to the time of sample collection from neonates and *Candida* detection methods.

It is noted that *Candida* usually occurs in the first few hours of life; meanwhile, Farmaki et al. (2007) demonstrated that vaginally-born infants were at higher risk for early colonization than those delivered via cesarean.

In this present study, ketoconazole had higher activity against *Candida* spp. isolated from all mothers. None of the isolates were resistant to ketoconazole in cesarean – route group. Nystatin was not as effective as ketoconazole against *Candida* spp. in both vaginally and cesarean- route groups.

There were no resistant to amphotericin B in both groups of neonates (vaginally and cesarean-born infants). In vaginally – born neonates, nystatin and ketoconazole had similar effect on *Candida* spp. isolated species. These findings are close to that reported by Mendiratta et al. (2006).

Generally, ketoconazole and amphotericin B had higher effect on isolated species from vaginal mucosa of mothers and oral mucosa of their neonates, respectively.

Conclusion

There was a higher rate of candidiasis in vaginally-born neonates than those delivered via cesarean section. Screening and treatment of colonized infants have been suggested as a prophylactic measure of colonization and infection.

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