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ORIGINAL ARTICLE/ARTICLE ORIGINAL

Prevalence of oral *Candida* colonization in patients with diabetes mellitus

La prévalence de la colonisation orale de Candida *chez les patients diabétiques*

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KEYWORDS
Diabetes mellitus;
Candidiasis;
Candida species;
HbA_{1c}

Summary
Objectives of the study. — We aimed to assess the prevalence of oral *Candida* colonization in patients with diabetes and its relationship with factors such as *Candida* species, serum glucose level, and the susceptibility rate of isolated yeasts to antifungals.
Patients. — Random samples were obtained from 113 patients with type 2 diabetes, 24 patients with type 1 diabetes, and 105 healthy controls.
Materials and methods. — The samples were taken by swabbing the oral mucosa of patients with diabetes mellitus and healthy individuals. Afterwards the samples were inoculated onto CHROMagar-*Candida*. The growing colonies were counted, and the isolated yeasts were identified by PCR-RFLP and RapID methods. Various isolated species of *Candida* were also subjected to susceptibility testing of antibiotic drugs. Blood samples were taken to evaluate glycosylated hemoglobin (HbA_{1c}).

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Results. — Although the *Candida* carriage rate and density were statistically higher in diabetics than healthy individuals, no direct association was found between having high *Candida*-burden and glycosylated hemoglobin. The most commonly isolated species in both diabetics and controls was *Candida albicans*. Of the tested antifungal drugs, the highest rate of resistance was found against itraconazole, followed in frequency by ketoconazole and fluconazole.
Conclusions. — This study identified a significant association between the poor glycemic control and the higher prevalence rates of *Candida* carriage and density in diabetic patients. In addition, a high prevalence of *C. dubliniensis* in diabetic patients was found, which might be misdiagnosed with its morphologically related species, *C. albicans*.

MOTS CLÉS
Diabète sucré ;
La candidose ;
Les espèces de *Candida* ;
HbA_{1c}

Résumé
Objectif de l'étude. — Évaluer la prévalence de la colonisation orale de *Candida* chez les diabétiques et sa relation avec des facteurs tels que les espèces de *Candida*, le niveau de glycémie et le taux de la sensibilité des levures isolées aux antifongiques.
Patients. — Cette étude a été réalisée auprès d'un échantillonnage tiré au hasard et composé de 114 patients atteints de diabète de type 2, 24 patients diabétiques de type 1 et 105 sujets témoins.
Matériel et méthodes. — Les échantillons ont été prélevés par écouvillonnage de la muqueuse buccale des patients atteints de diabète sucré et individus sains et ont été inoculés sur CHROMagar-*Candida*. Les colonies en croissance ont été comptées et les levures isolées ont été identifiées par des méthodes PCR-RFLP et RapID. Diverses espèces de *Candida* isolées ont également été soumises aux tests de sensibilité aux antibiotiques. Des échantillons de sang ont été prélevés pour évaluer l'hémoglobine glycosylée (HbA_{1c}).
Résultats. — Malgré le fait que le taux et la densité de colonisation de *Candida* étaient statistiquement plus élevés chez les diabétiques que chez les témoins, aucune association directe n'existe entre la présence élevée de *Candida* et l'hémoglobine glycosylée. Les espèces les plus couramment isolées chez les diabétiques et les témoins étaient *Candida albicans*. Parmi les médicaments antifongiques testés, le taux le plus élevé de la résistance a été trouvé contre itraconazole, suivi en fréquence par le kétoconazole et le fluconazole.
Conclusions. — Cette étude a identifié une association significative entre le contrôle glycémique faible et le taux de prévalence plus élevé de portage de *Candida* et la densité chez les patients diabétiques. En outre, une forte prévalence de *C. dubliniensis* chez les patients diabétiques a été trouvée qui pourrait être mal diagnostiquée avec l'espèce morphologiquement voisine, *C. albicans*.

Introduction

Diabetes mellitus (DM) is one of the most common endocrine disorders, affecting the immune system. More than 6% of the world's population is affected by DM [31]. In Iran, a prevalence of 3.1—5.1% has been reported for DM [3]. Owing to elevated serum glucose levels and decreased function of the cellular immune system in patients with DM, these patients are susceptible to opportunistic infections.

Candida yeasts comprise the oral flora of about 20—60% of healthy individuals without any specific signs or symptoms [44,32]. Candidiasis is one of the most common oral fungal infections in healthy individuals or immunocompromised patients such as those with DM. Salivary hyper glaycemic is one of the main risk factors for oral candidasis in patients with DM, more that 77% of whom suffer from oral candidiasis [40]. This infection can manifest itself in various forms such as erythematous, atrophic, hyperplastic candidiasis, osteomatosis, thrush, and angular cheilitis [14].

Although *C. albicans* is the most common species of *Candida* in healthy individuals and patients with DM, the non-*albicans* species are more colonized in patients with DM [21]. In recent years, resistance to common azole compounds has been reported in different *Candida* species [41]. Moreover, it has been observed that strains isolated from patients with DM have higher resistance to antifungals compared to strains isolated from healthy individuals [2]. On the other hand, *C. dubliniensis*, as a distinct species of *C. albicans*, has been isolated frequently from oral infections in immune-compromised individuals in particular HIV-positive patients [8,35]. Recently this species has been isolated from oral cavity of denture wearers and healthy individual with frequency ranging from 0 to 18% [43,23,1]. Considering the limited number of studies on different species of *Candida*, especially *C. dubliniensis* in patients with DM, the prevalence of *Candida* colonization in patients with DM was assessed compared to healthy individuals; and its relationship with factors such as species of *Candida* and susceptibility of isolated yeasts to common antifungal drugs were