INTRODUCTION

Superficial fungal infections (SFIs) are caused by heterogeneous group of fungi. As they involve stratum corneum, outermost layer of the skin, they are called superficial fungal infections. They can be classified as dermatophytic and non dermatophytic. Dermatophytic superficial fungal infections affect keratinized tissues and are also known as tinea. The non dermatophytic superficial fungal infections include tinea versicolor, tinea nigra, piedra and candidiasis ***(Lakhani et al., 2016).***

The fungal infections of the skin and its appendages are more common in tropical countries like India due to environmental factors like heat and humidity. The risk factors include socio-economic conditions like overcrowding, poverty and poor personal hygiene ***(Narasimhalu et al., 2016)***.

According to World Health Organization (WHO), the prevalence rate of superficial mycotic infection worldwide has been found to be 20-25% ***(WHO, 2005).***

The disease can have certain negative consequences for patients, such as itching or pain, and can potentially undermine work and social lives ***(El-Sharif and El-Taher, 2007).***

Superficial fungal infections include some of the most common infectious conditions. It may be caused by dermatophytes, yeasts, and molds. Dermatophytes are the most

frequently encountered causative agents of SFIs, leading to tinea infections, which are generally classified according to the body site affected. The dermatophytes are by far the most significant cutaneous fungi because of their widespread involvement of population at large and their worldwide prevalence ***(Cheesborough, 2000).***

The dermatophytes are molds that can invade the stratum corneum of the skin or other keratinized tissues derived from epidermis, such as hair and nails. They may cause infections (dermatophytoses) at most skin sites, although the feet, groin, scalp, and nails are most commonly affected ***(Bennett et al., 2008)***.

Superficial fungal infections affect millions of people worldwide, with an estimated lifetime risk of 10%–20% ***(Sahin et al., 2004)***.

The type and frequency of dermatophytoses may change with time, due to changes in living standards and application of preventive measures like personal hygiene ***(Djeridane et al., 2006).***

Superficial fungal infections also include changes in pigmentation of skin such as tinea nigra; formation of nodules along hair shaft as seen in white as well as black piedra. The yeasts are not essentially pathogenic to humans but when the host's defence mechanism, protective skin barriers or normal

flora are altered, colonization, infection and full-fledged disease may be established. Candida species being most significant of these organisms causes infections of skin and nails in addition to mucus membrane ***(Cheesborough, 2000).***

Superficial fungal infections are usually diagnosed clinically. The identification of the fungal species is epidemiologically important since the source of infection can be traced and its transmission halted ***(Gupta and Summerbell, 1998).***

Toukh is located in Qalyubia Governorate Egypt **37** kilometres away from Cairo. According to population estimates from 2015 the majority of residents in the governorate live in rural areas, with an urbanization rate of 44.7%. Out of an estimated 5,105,972 people residing in Qalyubia Governorate, 2,825,045 people live in rural areas as opposed to only 2,280,927 in urban areas**.** Toukh Population is **79800** persons ***(CAPMAS, 2015).***

AIM OF THE WORK

1. To determine the frequency of superficial cutaneous fungal infections in Toukh City.

2. To identify the risk factors underlying superficial cutaneous fungal infections.

Chapter 1

EPIDEMIOLOGY OF SUPERFICIAL FUNGAL INFECTIONS

Superficial Fungal Infections (SFIs) are infections caused by pathogenic fungi and limited to the human hair, nails, epidermis, and mucosa. Despite the fact that these infections are rarely dangerous or life threatening, they are important because of their worldwide distribution, frequency, person-to-person transmission, and morbidity ***(Kelly, 2012).***

The prevalence of SFIs has risen in the last decades that skin mycoses now affect more than 20–25% of the world population, making them one of the most frequent forms of infections ***(Blanka et al., 2008)***.

A study carried by ***Khairy in (2001)*** found that the prevalence of SFIs in rural Montazah, Alexandria was 20.5%. ***Abdel-Hafez et al. in (2003)*** found that the prevalence of SFIs in rural areas of Assiut Governorate was 16.17%.

Superficial fungal infections may be caused by dermatophytes or yeasts ***(Cheesborough, 2000).***

Epidemiology of Superficial Fungal Infections

Place: SFIs increase in tropical countries conditions such as climatic, economic (poor hygiene) and social (overcrowding) are known to adversely influence the course of the infections.

Geographical location and whether patient is from rural or urban area are also contributing factors. Although SFIS does not produce mortality, it does cause morbidity and poses a major public health problem, especially in tropical countries ***(Munir et al., 2014).***

Time: common in the summer than in the winter months ***(Gupta et al., 2002).***

Person: there are some persons at risk:

1. Elderly patients and obese patients are at increased risk **(*Al Hasan et al., 2004*)**.

2. Other risk factors may be related to the patient's family history, lifestyle or underlying physiology. In addition, patients with concomitant disease (e.g. peripheral vascular disease, diabetes) or patients who are immunosuppressed (e.g. those with human immunodeficiency virus (HIV) /acquired immunodeficiency syndrome (AIDS) or receiving immune-suppressive drugs) are more susceptible ***(Scher and Baran, 2004).***

3. Occupational factors as working in manual occupations exposes workers to a variety of challenges, including occlusive shoes, vigorous physical activity, and wet conditions. These challenges predispose workers to fungal infection ***(Pichardo-Geisinger et al., 2014).***

4. Local factors that may contribute to infection are trauma, excessive moisture, occlusive clothing, frequent uses of others fomite and frequent usage of public showers and pools ***(Al Hasan et al., 2004).***

5. Several factors can predispose to oral candidiasis such as impaired salivary gland function, and drugs such as inhaled steroids or broad spectrum antibiotics that alter the local oral flora creating a suitable environment for candida to proliferate ***(Singh et al., 2014).***

6. Cutaneous candidiasis is predisposed to by warm, moist conditions with abrasion, especially in the diaper rash of infancy ***(Richardson et al., 2017).***

Causative organisms:

They include dermatophytes and yeasts. They can be classified in different methods according to morphology ***(Taha, 2011)***.

A) Dermatophytes are a unique group of fungi that infect keratinous tissue and are able to invade the hair, skin, and nails of a living host. This closely related group of organisms can be categorized into one of three genera: Trichophyton, Microsporum, and Epidermophyton ***(Ghannoum and Isham, 2009).***

Dermatophytes are not endogenous pathogens. Transmission can occur directly from person to person (anthropophilic organisms), animal to person (zoophilic organisms), and soil to person (geophilic organisms) ***(Raugi and Nguyen, 2012).***

As with a number of fungi, dermatophytes may exhibit two phases in their life cycle: the anamorph state (imperfect or asexual phase) that is the state isolated in the laboratory, and the teleomorph state (perfect or sexual phase) ***(Ghannoum and Isham, 2009).***

Dermatophytes infection is initiated by adherence of arthroconidia to corneocytes, with rapid germination and production of germ tubes (within 4–6 hours), which grow through layers of keratin in both a horizontal and vertical direction. These pathogens are able to produce and secrete keratinases, lipases, proteases, and phosphatases, all of which aid the spread of the developing hyphae through the keratin layer ***(Smith and McGinnis, 2015).***

Dermatophytes do not cause invasive disease except in immune compromised hosts. The clinical disease attributable to dermatophytes varies by organism, site of infection, and host immunologic responses ***(Piggott and Friedlander, 2012)***.

B) Yeasts: are unicellular fungi which reproduce asexually by blastoconidia formation (budding or fission). The yeast may produce chains of attached buds (daughter cells) form pseudohyphae. Some of yeasts may produce true mycelia.They classified in two groups:

1- Ascomycetous e.g. candida, geotrichum, blastoschizomycetes and pneumocystes.

2- Basidiomycetous e.g. malassezi ***(Taha, 2011).***

1) Candida:

Candida is the shortened name used to describe a class of fungi that includes more than 150 species of yeast e.g.C. albicans, C. glabrata, C. guillermondii, C. krusei, C. parapsilosis, C. pseudotropicalis, C. stellatoidea and C. tropicalis. In healthy individuals, Candida exists harmlessly in mucus membranes such as ears, eyes, gastrointestinal tract, mouth, nose, reproductive organs, sinuses, skin, stool and vagina, etc. It is known as "beneficial flora" and has a useful purpose in the body ***(Singh et al., 2014).***

When an imbalance in the normal flora occurs, it causes an overgrowth of *Candida*. This is called *Candidiasis* or *Thrush* which is a fungal infection caused by any of the Candida species, of which *Candida albicans* is the most common ***(Fitzpatrick et al., 2006).***

Adhesion of candida to epithelial cell walls, an important step in initiation of infection, is promoted by certain fungal cell wall components such as mannose, C3d receptors, mannoprotein and saccharins. Other factors implicated are germ tube formation, presence of mycelia, endotoxins, induction of tumor necrosis factor (TNF) and proteinases ***(Singh et al., 2014).***

2- Malassezia:

Malassezia are lipid dependent basidiomycetous yeasts that inhabit the skin and mucosa of humans and other warm-blooded animals, and are a major component of the skin microbiome. They occur as skin commensals, but are also associated with various skin disorders and bloodstream infections. The genus currently comprises 17 species and has recently been assigned its own class, Malasseziomycetes ***(Theelen et al., 2018).***

Depending on the host immune condition, Malassezia yeasts can be a skin-related commensal or an opportunistic fungal pathogen. Malassezia is commonly found in seborrheic areas in up to 90% of adults and become pathogenic under certain circumstance such as warm and humid environment. Malassezia species (M. Furfur) are known as aetiological agents of skin diseases, such as pityriasis versicolor ***(Chaudhary et al., 2010).***

Chapter 2

CLINICAL TYPES OF SUPERFICIAL FUNGAL INFECTIONS

Based upon the affected site, SFIs have been classified clinically into:

1- Tinea capitis:

Tinea capitis is a dermatophytes infection of the scalp (scalp ringworm) seen predominantly but not exclusively in children ***(Elewski, 2000).***

The organisms adapted to this form of infection are belong to the genera Trichophyton and Microsporum. While all the causative organisms can affect other skin sites, the scalp hair is usually a focus of infection ***(Hogewoning et al., 2011).***

Invasion of the hair shaft is followed by the production of arthroconidia either inside the hair (endothrix) or its external surface (ectothrix) (Fig.1). Tinea capitis caused by T. schoenleinii adopts a different pattern of infection, known as favus, as their growth within the hair is not sustained and the course of hyphal invasion is marked by air-containing tunnels in the hair. These organisms produce large clusters of hyphae along with inflammatory debris, in the perifollicular keratin (scutula) ***(Hay and Ashbee, 2010).***

Figure (1): Optical examination of infected hair shaft. Tinea capitis ectotrix ***(Bennassar and Grimalt, 2010)***.

Clinical features:

Tinea capitis presents with different patterns depending on the degree of inflammation. Several subtypes of non-inflammatory scalp ringworm exist:

A- Scaly ring worm:

Trichophyton violaceum and Microsporum canis are the most causative organisms. It presents with one or multiple circular grey patches of hair loss with marked scaling (Fig. 2) ***(Patel and Schwartz, 2011).***

Figure (2): Scaly ring worm ***(Möhrenschlager et al., 2005).***

B- The blackdot type:

Trichophyton violaceum is the causative organism. It is characterized by areas of alopecia with hair shafts broken off at the surface of the skin and no signs of inflammation (Fig. 3) ***(Hogewoning et al., 2011).***

Figure (3): Blackdot ring worm ***(Hogewoning et al., 2011).***

C- Kerion:

Kerions are mainly caused by zoophilic fungi as trichophyton verrucosum and usually localized to one spot. Kerion is an indurated inflammatory, suppurative type of tinea capitis. It produces an inflammatory crusted mass that can be associated with purulent discharge (Fig.4). Regional lymph node not affected and good general condition differentiate it from pyogenic abscess because incision is contraindicated ***(Kradin, 2010).***

Figure (4): Kerion ***(Bennassar and Grimalt, 2010).***

D- Favus:

It is a special type of chronic and progressive inflammatory infection on the scalp most frequently caused by Trichophyton schoenleinii. This variant is seen in Asia, Africa, the Middle East, and South America. It is characterized by permanent hair loss and inflammation of the scalp, which becomes covered by matted hair with dense, yellow, follicular, cup-shaped crusts (scutula) that have an unpleasant odor **(**Fig. 5) ***(Andrea, 2017).***

Figure (5): Favus ***(Möhrenschlager et al., 2005).***

2- *Tinea Barbae:*

Tinea barbae is a dermatophytic infection that is limited to the coarse hair-bearing beard and mustache areas in men. Clinically, it ranges from mild and superficial to a severe inflammatory pustular folliculitis. In inflammatory cases, the zoophilic ectothrix dermatophytes Trichophyton verrucosum and Trichophyton mentagrophytes are most frequently responsible for the infection **(**Fig. 6) ***(Kradin, 2010).***

Figure (6): Tinea barbae ***(Kradin, 2010).***

3- *Tinea corporis (Ringworm of the Body, Tinea Circinata):*

This type affects the trunk and limbs. The causative organisms are Trichophyton mentagrophytes, Trichophyton rubrum and Microsporum gypseum. The site of the lesion is typically on exposed skin unless the infection represents on extension from a pre-existing infection. In such cases, infection may spread from the scalp, down to the neck and the upper trunk, or from the groin on to the buttocks and lower trunk ***(Hay and Moore, 2010)***.