Superficial fungal infections of the male genitalia: A review

Article in Critical Reviews in Microbiology · August 2011

CITATIONS
12

READS
624

3 authors:

Atilla Aridonog
Cukurova University
70 PUBLICATIONS 537 CITATIONS
SEE PROFILE

Volkan Izol
Cukurova University
31 PUBLICATIONS 98 CITATIONS
SEE PROFILE

Macit Ilkit
Cukurova University
99 PUBLICATIONS 700 CITATIONS
SEE PROFILE

Some of the authors of this publication are also working on these related projects:

Project
Virulence markers of opportunistic black yeasts in Exophiala View project

Project
I am working on Aspergillus and aspergillosis View project

All content following this page was uploaded by Macit Ilkit on 16 February 2015.

The user has requested enhancement of the downloaded file. All in-text references underlined in blue are added to the original document and are linked to publications on ResearchGate, letting you access and read them immediately.
Introduction

Diseases of the glans penis and/or prepuce are not uncommon in clinical practice and may involve the following: (1) localized pathological signs, (2) genital signs of dermatological disorders, and (3) balano-preputial signs of a disease originally developed in another organ (Fornasa et al., 1994). More specifically, mycotic infections of the penis can be divided into two pathogenic categories, superficial and disseminated. Superficial fungal infections of the penis, especially of the genus *Candida*, are much more commonly encountered than dermatophytic pathogens and *Malassezia* spp. (Mayser, 1999). Yeasts of the genera *Candida* and *Malassezia* are also part of the microflora of human male genitalia (Mayser et al., 2001; Aridogan et al., 2005a; Iskit et al., 2006).

In previous studies, the embryology and gross anatomy of the male genitalia were reviewed to provide a better understanding of the diseases affecting male genitalia (English et al., 1997; Cold and Taylor, 1999). In this review, PubMed (Medline) was searched for clinical and mycological studies published in English (up to September 2010) using the key words “*Candida* balanitis,” “pityriasis versicolor and penis,” and “dermatophyte and penis or scrotum.” The goal of this review is to provide an overview and update on the literature concerning superficial mycotic infections of the penis and/or scrotum for microbiologists and clinicians in the field. This review highlights clinical features, diagnosis and treatment of male genital superficial fungal infections, and their possible relationship to circumcision.

Candida colonization of the penis

The resident flora of the preputial space is complex and changing: the type and number of bacteria present depend on age, individual hygiene, and sexual activity (Schiefer, 1998). However, yeasts of the genus *Candida* are not necessarily pathogenic and are found in the preputial space of clinically normal men (Mayser et al., 2001; Aridogan et al., 2005a). Therefore, the mere positive laboratory finding of *Candida* spp. using culture methods does not allow for the diagnosis of clinical disease (Mayser, 1999). In earlier studies, it was generally believed that *Candida* spp. were sexually acquired, although carriage of yeast on the penis is common, with a prevalence rate of 14–18% (Rodin and Kolator, 1976; Davidson, 1977). David et al. (1997) reported *Candida* colonization in 74 (16%) of 462 men who visited to a sexually transmitted disease (STD) clinic in Coventry, UK. Of the 74 patients with penile colonization, 26 (37%) were symptomatic, and 20 (27%) had balanitis. In addition, Schaller et al.
Candida balanitis

A wide range of infections and neoplastic and inflammatory dermatoses can affect the glans penis and prepuce. Inflammation of the glans penis is termed balanitis, whereas inflammation of the prepuce is termed posthitis; balanoposthitis involves inflammation of both structures (Vohra and Badlani, 1992; English et al., 1997; Köhn et al., 1999).

Epidemiology

There is a wide variety of causes and predisposing factors for balanitis; however, infectious causes are the most commonly reported etiology (Edwards, 1992; English et al., 1997). Patients with clinical signs of balanoposthitis are a diverse group that has been colonized and/or infected with microbes (Alsterholm et al., 2008). In two elegant reviews, the most common causes of infectious balanitis were reported to be Candida spp., particularly C. albicans, followed by several bacteria (Streptococcus spp., Staphylococcus spp., Pseudomonas spp., Gardnerella vaginalis, anaerobes, Treponema pallidum, Chlamydia trachomatis, and Mycoplasma spp.) and, less commonly, viruses and parasites (Edwards, 1996; English et al., 1997).

The well-recognized condition Candida balanitis was first described by Engman (1920). Later, Brook (1980) reported a case of balanitis caused by a group B β-hemolytic streptococcus. Further studies investigating infectious balanitis have reported the predominance of Candida spp. and Streptococcus spp., with prevalence rates ranging from 8–60% and 4–27.5%, respectively (Bhargava and Thin, 1983; Fornasa et al., 1994). However, one recent study demonstrated that Staphylococcus aureus was significantly more prevalent in the balanoposthitis group than the control group (P < 0.05) (Alsterholm et al., 2008). Furthermore, no statistically significant difference was described in either group for group B streptococci, C. albicans, and Malassezia spp. (Alsterholm et al., 2008). Non-Candida yeasts, including Rhodotorula spp. and Trichosporon spp., have been identified in both asymptomatic men and men with balanitis (Lisboa et al., 2010a). As previously stated, Malassezia spp. have been suggested as possible pathogens in balanoposthitis; however, there were no significant differences in Malassezia spp. isolation between men with balanoposthitis and healthy controls (Alsterholm et al., 2008). In unselected men, the prevalence of Gardnerella vaginalis isolation was 7.2%, with a significantly higher isolation rate in men with balanoposthitis (P < 0.001) (Kinghorn et al., 1982). In addition, anaerobes have been found in uncircumcised men (76%) with balanoposthitis (Masfari et al., 1983). In one study, Bacteroides spp. were the predominant microorganisms in anaerobic balanitis (Cree et al., 1982).

Clinical Manifestations

Clinical presentation alone is of little value in predicting the etiological agent associated with balanoposthitis (Lisboa et al., 2009). Patients often complain of soreness or irritation of the glans penis; less commonly, they have suprapubic discharge (Working Group of BSMM, 1995). Typical symptoms of Candida balanitis are a mild glazed erythema, satellite-eroded pustules, moist curd-like accumulations, dysuria, bleeding, and, sometimes, ulceration of the glans penis. Symptoms also usually include mild burning and pruritis (Köhn et al., 1999; English et al., 1997). White plaques can be found upon retraction of the prepuce (Working Group of BSMM, 1995). Bacterial superinfection with streptococci or staphylococci is associated with increased pain. In men who have diabetes or are immunocompromised, an acute fulminating edematous or ulcerative variant may occur (English et al., 1997). Interestingly, in a patient with acute leukemia, invasive Candida balanitis and penile ulceration due to C. tropicalis was reported after a condom catheter was used due to urinary incontinence (Morrissey et al., 1985). Agrawal et al. (2005) reported a case of Mondor’s phlebitis of the penis following recurrent episodes of candidal balanitis, and the patient’s wife also had vulvovaginal candidosis (VVC). It was reported that an anatomical variation in the venous arcade was the basic defect and that both trauma and infectious agents were precipitating factors.

Recently, Lisboa et al. (2010a) analyzed the possible risk factors related to Candida balanitis. The authors reported that Candida balanitis was strongly associated with age above 40 years and diabetes mellitus. In addition, isolation of more than 10 Candida colonies is a demonstrated risk factor for symptomatic infection, at least for Candida balanitis when comparing symptomatic men with asymptomatic men with a positive Candida culture. Candida balanitis is more common among uncircumcised men, possibly as a result of poorer hygiene and aeration or because of irritation by smegma (Vohra and Badlani, 1992). Underlying medical conditions may cause more severe balanitis (Edwards, 1996). The pathogenicity of the organism also depends on host factors, diabetes mellitus being the most important. Balanitis may be a presenting symptom of diabetes, which should be investigated in cases of persistent balanitis. Thus, serum glucose should be determined, and a urinalysis should be performed to investigate glycosuria. In cases in which a family history of diabetes mellitus is present, further investigation, including a glucose tolerance test, is indicated (Vohra and Badlani, 1992). A cross-sectional study of a randomly selected group of 398 dermatology patients demonstrated that balanitis was present in 2.3%
of circumcised men and 12.5% of uncircumcised men. However, in patients with diabetes mellitus, the prevalence of balanitis was 34.8%, which is higher than that of the uncircumcised population (Fakjian et al., 1990). Interestingly, Tietz (2008) reported the combination of both balanitis and eczematous perigenital intertriginous candidosis due to C. albicans in a 29-year-old man who was successfully treated with an antifungal (isoconazole) and corticosteroid (diflucortolone) cream for 2 weeks.

Source of Infection

Li et al. (2008) found that isolates from 10 men with balanitis whose female partners presented with recurrent or severe VVC were C. albicans. The authors suggested that the genotypic identity or similarity between independent C. albicans strains causing infections in male and female individuals provided strong evidence for the possibility of sexual transmission of the infection. In contrast, Lisboa et al. (2011) investigated 64 sexually active couples in whom at least one partner had genital candidosis, and both yielded positive culture results. The same Candida species were found in both partners in 25% of the couples; however, only 17.2% of the species were genetically similar. The authors suggested that male genitalia did not represent a relevant reservoir for recurrent VVC. Thus, the relevance of sexual transmission is questionable.

In one review, it was reported that penile carriage and symptomatic balanitis were primarily associated with sexual partners with VVC (Mayser, 1999). Significantly more of the female partners of men carrying yeast were sexual partners with VVC (Mayser, 1999). Interestingly, Thin et al. (1977) stated that 39% of VVC and 29% of Candida balanitis cases were sexually acquired. The infectivity of Candida balanitis following intercourse is low and has been estimated to be 10% (Oriel et al., 1972). In contrast, one recent study found that 38.2% of the male partners of women suffering from VVC had Candida balanitis (Lisboa et al., 2011). It is believed that there is an over-diagnosis of Candida balanitis, resulting from a lack of laboratory confirmation, which leads to the inappropriate use of prescription and over-the-counter antifungal agents (Lisboa et al., 2010b). In conclusion, the presence of diabetes mellitus, a lack of circumcision, age above 40 years and penile-vaginal transmission stand out as predisposing factors for genital candidosis (Edwards, 1996; English et al., 1997; Mayser, 1999; Lisboa et al., 2010a).

Laboratory Diagnosis

The diagnosis of Candida balanitis should be based on both clinical and mycological data (Lisboa et al., 2010a). Clinical specimens for mycological investigation should be sampled from the coronal sulcus and the subpreputial sac (Working Group of BSMM, 1995). However, the method of collecting material is critical in confirming or dismissing a clinical diagnosis of Candida balanitis. The most common problem in collecting material is that the quantity obtained is often small, thus contributing to the incidence of a negative culture (Dockerty and Sonnex, 1995). Briefly, the laboratory diagnosis of Candida balanitis is performed by the recognition of pseudohyphae in a potassium hydroxide, saline or Gram's stain preparation (English et al., 1997). Diagnosis using direct microscopy has low sensitivity and varies with the method used for collecting material. The sensitivity of microscopy compared with culture was 12% and 65% for “plain slide” (i.e., material collected by pressing a microscope slide against the penis) and “adhesive tape” (i.e., material collected by using adhesive tape), respectively. In addition, a number of false-positive diagnoses have been made using microscopy. For example, the presence of material with a similar Gram stain appearance to hyphae or spores was suspected to be debris from the subpreputial space and epithelial cell fragments (Dockerty and Sonnex, 1995). In contrast, direct impression of the glans on the agar surface of solid culture media (i.e., CHROMagar Candida) resulted in the highest Candida spp. recovery rate (45%) compared with a swabbing procedure (28.5%) (Lisboa et al., 2010b).

Fungal Culture

Sabouraud agar is the standard for fungal culture; however, chromogenic medium, such as CHROMagar Candida, resulted in the highest yield of Candida spp. and could detect polyfungal populations (Lisboa et al., 2010a; 2010b; 2011). The swab method of sampling the genital area is the procedure currently used by most clinicians to perform microscopy or culture (Dockerty and Sonnex, 1995). A cut-off value of 10 Candida colonies cultured using direct impression has been correlated with the signs and symptoms of balanitis (Lisboa et al., 2010a; 2010b). However, the concentration of Candida organisms that should be considered pathological rather than representing the endogenous genital microbial population has not yet been established (Lisboa et al., 2010b). Although PCR assays are increasingly common in the laboratory, they are of limited use for the diagnosis of candidal infections because Candida comprises a portion of the male genital flora (Tabrizi et al., 2006). However, balanitis that persists and for which the cause remains unclear warrants a biopsy because it may indicate underlying malignancy (Edwards, 1996).

Treatment

The distressing symptoms and associated discomfort of balanitis require rapid and effective treatment (Stary et al., 1996). A number of topical (e.g., clotrimazole, miconazole, and nystatin) (Forster and Harris, 1986; Stary et al., 1996) and systemic (e.g., fluconazole and itraconazole) (Stary et al., 1996; Lisboa et al., 2009) antifungal drugs are available. All of the topical therapies require 1–2 weeks of application for effective cure; however, one day of therapy is generally adequate for systemic therapy (Forster and Harris, 1986; Stary et al., 1996; Lisboa et al., 2009). The primary therapeutic target in mild-to-moderate cases of balanoposthitis should
be to decrease inflammation with a mild corticosteroid cream containing an antifungal agent (Alsterholm et al., 2008), and external therapy is generally sufficient (Working Group of BSMM, 1995). For example, Stary et al. (1996) found similar clinical (92% vs. 91%) and mycological (78% vs. 83%) response rates to treatment with either a single 150-mg dose of fluconazole or a topical 1% clotrimazole cream administered twice daily for 7 days to patients with Candida balanitis.

Oral treatment is recommended when symptoms are more severe, in recalcitrant cases, or with concomitant diabetes (Lisboa et al., 2009). More severe inflammatory or erosive forms of balanitis initially require daily bathing of the penis or wet dressing with the prepuce retracted (Working Group of BSMM, 1995). In addition, sexual partners should be screened because they are likely to have a high rate of infection (Davidson, 1977). Men who fail to respond to treatment should be referred to a specialist (Working Group of BSMM, 1995).

**Malassezia Colonization of the Penis**

The genus *Malassezia* consists of lipophilic, dimorphic yeasts. Their natural habitat is the stratum corneum of the human skin (Tosti et al., 1977). *Malassezia* spp. are most often found in sebum-rich areas of the skin, such as the scalp, face, trunk, and upper back. The incidence of skin colonization increases from approximately 25% in children to almost 100% in adolescents and adults (Richardson and Warnock, 2003). It is thought that colonization with *Malassezia* spp. primarily occurs at the time at which the concentration of lipids on the skin increases (Richardson and Warnock, 2003). Mayser et al. (2001) stated that the preputial space was an intertriginous area, and the resident flora of this area depends on age, sexual activity, and individual hygiene. Because this area is a damp, warm and primarily anaerobic environment with a neutral to alkaline pH, there is a predisposition to bacterial and mycotic infections. In addition, the production of smegma, which consists of 26.6% fat and 13.3% protein by multilayer squamous epithelia makes this area a lipid-rich environment, contributing to the occurrence of lipophilic yeast of the genus *Malassezia* (Mayser et al., 2001).

Previous studies have reported *Malassezia* spp. colonization on the glans penis and prepuce of both circumcised and uncircumcised adults (Mayser et al., 2001; Aridogan et al., 2005a) and children (Iskit et al., 2006; Aridogan et al., 2009). Mayser et al. (2001) reported that *Malassezia* spp. were part of the microflora of the male genital region in 49.2% of the men studied, who were mostly uncircumcised. However, we observed that only 7% of circumcised men without genital dermatoses were colonized with *Malassezia* spp. in an outpatient urology clinic (Aridogan et al., 2005a). In a study by our group, we showed that yeast colonization, especially lipophilic species, was more frequently observed among uncircumcised children. While age was not found to be a factor ($P > 0.05$), circumcision was responsible for increasing the colonization rate 4.8 fold (95%CI: 1.6-14.5; $P < 0.01$) (Iskit et al., 2006). Recently, we investigated glans penis and prepuce colonization by yeast fungi in a pediatric population and found significant pre- and post-circumcision results. The frequency of yeast colonization was significantly decreased from 11.7% to 1.3% following circumcision ($P = 0.008$). Therefore, we suggested that circumcision, rather than age, played an important role in the reduction of yeast fungi in genitalia (Aridogan et al., 2009). In an adult population, *M. sympodialis* and *M. globosa* (Mayser et al., 2001) and *M. furfur* (Ardogan et al., 2005a) were the most common lipophilic species. In a pediatric population, *M. globosa* and *M. furfur* (Iskit et al., 2006) and *M. furfur* and *M. sympodialis* (Ardogan et al., 2009) were the most common species.

**Pityriasis Versicolor (PV) of the Penis**

PV is a superficial fungal infection of the skin caused by *Malassezia* spp., which are a part of the normal flora of the human skin (Richardson and Warnock, 2003). PV is a common disease and is more prevalent in tropical than temperate climates (Nia and Smith, 1979). PV of the penis has been reported in a limited number of studies (Blumenthal, 1971; Smith, 1978; Nia and Smith, 1979; Aljabre and Sheikh, 1994; Khaddar et al., 2008). This low reporting may be due to the lower pH (4.0–4.5) of the vagina and a lack of lipid sources, conditions that are not optimal for the growth of *Malassezia* (Mayser et al., 2001). In addition, changes in skin pH caused by circumcision may play a crucial role in glans penis colonization by yeast of the genus *Malassezia* (Ardogan et al., 2009). The surface of the glans is unaffected due to its different structure (Nia and Smith, 1979). Moreover, a preliminary study in 100 women aged 16–83 years failed to detect *Malassezia* yeasts in vaginal smears from the posterior fornix, suggesting that sexual transmission is not possible (Mayser et al., 2001).

Blumenthal (1971) first described PV of the penis in a 63-year-old African-American man who presented with hypopigmented lesions on the penis and the right cubital fossa. However, no other areas of involvement were found. Nia and Smith (1979) reported that 5 cases of PV of the penis in men aged 23–35 years had been diagnosed in 70 men from the United Arab Emirates who were of different geographical origins, i.e., two Sudanese, two Indians, and one Palestinian. In addition, after a 3-year history of PV involving the trunk, one circumcised man had circinate fine scaling patches of the glans and corona. The authors also noted that in hot climates, involvement of the skin was frequently extensive, but the genitals were less commonly affected because of the role of heat and moisture in the etiology of the condition (Nia and Smith, 1979). Interestingly, Khaddar et al. (2008) reported a 39-year-old Tunisian Muslim circumcised man with hypopigmented PV located on the trunk, limbs, and glans penis but not the preputial space. Aljabre and Sheikh (1994) observed widespread hypo- and hyperpigmented lesions on the
upper part of the body of a 23-year-old Saudi man with involvement of the shaft of the penis, which was hypopigmented. In all of the previously mentioned reports, neither culture nor molecular techniques were applied, and *Malassezia* species were not reported.

**Laboratory Diagnosis**
The skin appearance of PV is typical, with discrete, circinate, finely scaling and hypopigmented areas (Blumenthal, 1971; Smith, 1978; Aljabre and Sheikh, 1994; Khaddar et al., 2008). Confirmation of the clinical diagnosis may be performed using Wood’s light with yellow fluorescence, which is also useful in determining the extent of the skin affected (Smith, 1978; Nia and Smith, 1979; Aljabre and Sheikh, 1994). The fungus can be easily confirmed using direct microscopy of scales by its characteristic micromorphology (i.e., short, curved hyphae and clusters of thick-walled spores, “spaghetti and meatballs”) (Blumenthal, 1971; Smith, 1978; Aljabre and Sheikh, 1994; Khaddar et al., 2008). Fungal culture is of no value in clinical diagnosis because yeast belongs to the resident flora of the skin (Mayser, 1999). However, the definitive identification of the fungus helps in establishing epidemiological data. Therefore, impression preparations must be made and skin scales must be inoculated on lipid-containing media (e.g., modified Dixon and/or Leeming-Notman agars) (Mayser, 1999; Iskit et al., 2006; Arıdogan et al., 2009).

**Treatment**
As discussed in a recent systematic review by Hu and Bigby (2010), a number of treatment options, both topical and systemic, have been shown to be effective in targeting PV. Topical agents include selenium sulphide lotion or shampoo, sodium thiosulphate with salicylic acid, propylene glycol, zinc pyrithione shampoo, ciclopirox solution, clotrimazole, bifonazole, and ketoconazole. Systemic medications used to treat PV include ketoconazole, fluconazole, and itraconazole. In particular, penile PV lesions have successfully been treated with topical (e.g., miconazole or tolnaftate cream) (Blumenthal, 1971; Nia and Smith, 1979) or oral antifungals (e.g., ketoconazole) (Aljabre and Sheikh, 1994).

**Tinea genitalis**
Dermatophytes are a group of keratinophilic fungi that invade the skin, nails, and hair. Dermatophytic infections of the scrotum, glans penis, and penile sheath are relatively rare compared with those involving the groin (Mayser, 1999; Pielop and Rosen, 2001; Romano et al., 2005). This rarity may be due to decreased eccrine sweat secretions resulting in decreased skin hydration of the penile shaft (Pillai et al., 1975). Some reports have provided a relatively higher estimation of the incidence of penile and scrotal tinea, particularly from tropical countries, such as India (La Touche, 1967; Kumar et al., 1981; Mukhopadhyay, 2005; Das et al., 2009). Kumar et al. (1981) reported that of the 2200 Indian patients with various dermatophyte infections, approximately 1% had “clear-cut penile involvement.” In a study of 26 patients with penile shaft infections, all had widespread tinea lesions involving the thighs, lower abdomen, and/or buttocks (Kumar et al., 1981). In another study, penile involvement was seen in 19.5% of 261 patients with tinea cruris, aged 11 to 30 years (Pandey et al., 1981). Recently, Romano et al. (2005) reported 9 male cases of tinea genitalis, of which 5 were identified from 415 cases of tinea cruris (1.2%), whereas the remaining 4 cases were seeking advice for genital lesions. Therefore, it was concluded that tinea cruris was not necessary for the development of penile tinea (Pielop and Rosen, 2001; Romano et al., 2005; Das et al., 2009). Overall, tinea of the penile sheath is much more clearly defined than tinea of glans penis. However, the lack of uninvolvement of the penile shaft in patients with tinea cruris is difficult to explain.

**Scrotal dermatophytosis**
In one study, a low frequency of scrotal dermatophytosis was noted despite extensive infection of nearby sites, such as the groin and thighs. This result was attributed to capric acid, one of the fatty acids in the epidermal barrier that is particularly abundant in scrotal skin and is thought to act as an antifungal factor (Smith et al., 1961). Hopkins et al. (1947) reported that one-eighth to one-third of military recruits with tinea cruris had positive fungal cultures of the scrotum. La Touche (1967) analyzed 75 patients with tinea cruris and reported that 37 (49.3%) and 7 (9.3%) had clinical signs of scrotal and penile involvement, respectively. In a study by our group involving routine urology practices, 155 patients were examined, and only 3 (1.9%) cases of tinea cruris were detected, while no penile or scrotal dermatophytic infections were detected (Arıdogan et al., 2005b).
Clinical Presentations

Tinea of the penis and/or scrotum produces sharply demarcated, scaly, mildly erythematous, or pigmented areas, often with a slightly raised border on the groin (Hopkins et al., 1947; La Touche, 1967) (Figure 1). Dekio and Jidoi (1989) described an adult male with tinea of the glans penis but without any other skin lesions due to dermatophytic fungus on his entire body. In another study by Dekio et al. (1991), tinea of the glans penis was reported as a cluster of small flesh-colored papules, with slight scaling on the glans penis. Mukhopadhyay (2005) reported *T. rubrum* infection of the prepuce in an uncircumcised, otherwise healthy 29-year-old man. However, no lesion was detected on the glans or on the shaft of the penis, the scrotum, the intertriginous area, or elsewhere on the body. Interestingly, his wife had ringworm of the groin and anterior abdomen, suggesting the role of sexual exposure.

However, diverse clinical manifestations of scrotal dermatophytic infections have been reported, e.g., asymptomatic (Chakrabarti et al., 1992), favic (Bakos et al., 1996; Quiangqiang et al., 2002; Prochnau et al., 2005), pseudomembranous-like (Lu et al., 2009), lichenified plaques (Dekio et al. 1990), verrucous-type (Qiangqiang et al., 2001), and Majocchi’s granuloma (Cho et al., 2007).

Predisposing Factors

Lesions of the penis and scrotum are often preceded by dermatophytosis of other body sites, usually the groin and, rarely, the feet, toenails, hands, and beard (Pielop and Rosen, 2001; Romano et al., 2005). Local humidity and skin maceration are well-known predisposing factors (Romano et al., 2005). In addition, the long-term use of tight-fitting garments (i.e., the use of langota, a tight undergarment that occludes the areas between the penis and thighs) (Pielop and Rosen, 2001), nylon undergarments (Das et al., 2009), diabetes mellitus (Pielop and Rosen, 2001; Romano et al., 2005; Das et al., 2009), immunosuppression (Aly and Berger, 1996), or atopic dermatitis (Pillai et al., 1975, Pandey et al., 1981) may be necessary for penile infection. However, penile infection can sometimes happen in the absence of such factors (Das et al., 2009).

Etiological Agents

*Trichophyton rubrum* is the most frequently identified pathogen, followed by *T. mentagrophytes*, *Epidermophyton floccosum* (La Touche, 1967; Pillai et al., 1975; Kumar et al. 1981; Romano et al., 2005; Das et al., 2009), and *T. verrucosum* (La Touche, 1967). Interestingly, in some studies, cuticular infections of the scrotum caused by the geophilic *Microsporum gypseum* have been reported (Bakos et al., 1996; Quiangqiang et al., 2002; Prochnau et al., 2005).

Laboratory Diagnosis and Treatment

The clinical diagnosis is confirmed using direct microscopic examination with visualization of fungal elements (e.g., spores, septate hyphae, and arthrospores) and fungal culture on Sabouraud dextrose agar with cycloheximide. Treatment with topical imidazoles and/or systemic antymycotics (e.g., terbinafine and itraconazole) have led to complete resolution of tinea genitalis (Pielop and Rosen, 2001; Romano et al., 2005).

Circumcision

Male circumcision is one of the oldest surgical procedures known and is traditionally undertaken as a mark of cultural identity or religious importance. Circumcision was practiced among ancient Semitic peoples, including Egyptians and Jews, with the earliest records depicting the practice coming from Egyptian tomb work and wall paintings dating from approximately 2300 BC. In the Jewish religion, male infants are traditionally circumcised on the eighth day of life. The justification in the Jewish holy book (the Torah) is that a covenant was made between Abraham and God, the outward sign of which was circumcision for all Jewish males: “This is my covenant, which ye shall keep, between me and you and thy seed after thee: every male among you shall be circumcised” (Genesis 17:10). In addition, Islam is the largest religious group to practice male circumcision. As part of their Abrahamic faith, Muslims practice circumcision as a confirmation of their relationship with God (WHO and UNAIDS, 2007).

The Foreskin

The foreskin is a continuation of the skin from the shaft of the penis that covers the glans penis and the urethral meatus. The foreskin is attached to the glans by the frenulum, a highly vascularized tissue of the penis. Circumcision removes some or all of the foreskin from the penis. The word “circumcision” comes from the Latin *circumcidere* (meaning “to cut around”) (WHO and UNAIDS, 2007). The presence of foreskin has been found to predispose men to penile carcinoma and sexually transmitted infections (English et al., 1997; WHO and UNAIDS, 2007). Medically, circumcision is performed for phimosis and recurrent balanitis (Mallon et al., 2000). According to Mallon et al. (2000), cutaneous penile infections, including human papillomavirus (HPV), herpes simplex virus (HSV), molluscum contagiosum, and *Candida* balanitis, were more prevalent in uncircumcised male adults. Most cases of inflammatory dermatoses have been diagnosed in uncircumcised men, suggesting that circumcision protects against inflammatory dermatoses. The presence of the foreskin may promote inflammation by a Köebnerization phenomenon, or the presence of microorganisms, which are as yet unidentified, may induce inflammation.

Circumcision and the Epidemiology of Infections

The neonatal period is thought to be the most appropriate time for circumcision (American Academy of Paediatrics, 1999; Updegrave, 2001). Epidemiological studies have shown that circumcision influences the
type and frequency of genital dermatoses (Mallon et al., 2000; WHO and UNAIDS, 2007). The area under the foreskin is a warm, moist environment that may enable some pathogens to persist and replicate, especially when penile hygiene is poor (Cold and Taylor, 1999). For example, Wiswell et al. (1988) noted that uncircumcised infants were more likely to harbor a reservoir of uropathogenic organisms (e.g., *Escherichia coli*) in the urethral meatus and periurethral area (*P* < 0.01). The authors concluded that during the first 6 months of life, the presence of a prepuce was associated with a greater quantity of periurethral bacteria and a greater likelihood for the presence of high concentrations of uropathogens. Similarly, uropathogens have been reported to have a high affinity for the prepuce, and a 10- to 12-fold increase in urinary tract infections has been reported among uncircumcised compared to circumcised children (American Academy of Paediatrics, 1999; Updegrove, 2001).

**Conclusions**

Balanitis is a common condition among genitourinary medicine clinic attendees and covers a variety of unrelated conditions with similar clinical presentations. However, the treatment of balanoposthitis depends on the etiologic agent or disease identified. Although balanitis is not a reportable entity and the cause often remains undiagnosed, the etiology of balanitis includes several risk factors, such as, infections, chronic toxic/irritative eczema, poor personal hygiene, water loss and dry skin, xerosis, chemical irritants (e.g., soap and petroleum jelly), and obesity. Balanitis/balanoposthitis caused by yeast, in particular *C. albicans*, is the most frequent infection of the penis. In the literature, most cases of inflammatory dermatoses have been diagnosed in uncircumcised men, suggesting that circumcision protects against inflammatory dermatoses. Circumcision significantly decreases the action of yeast fungi in the glans penis and prepuce, leading to infrequent isolation of yeast fungi from both circumcised adults and children (e.g., *Candida* and *Malassezia*). It is thought that approximately one-third of the world’s male population is circumcised.

Although rare, tinea genitallis should be suspected in cases presenting with fine scaly lesions of the penis or scrotum. In addition, although not necessary, the available data suggest that penile lesions often occur from secondary spreading from groin lesions. The examination of a smear for *Candida* spp. has low sensitivity. However, epithelial scrapings from the penis provide information on both *Malassezia* spp. and dermatophytic pathogens. Fungal culture is a key component of diagnosing men with balanoposthitis and tinea genitalis. In conclusion, superficial fungal infections of the male genitalia, particularly *Candida* balanitis, are not uncommon and are on the rise. Therefore, the continuous medical education of general practitioners, collaboration between clinicians and microbiologists, and mycological examinations are essential for correct diagnoses.

**Acknowledgments**

This study is dedicated to one of the most distinguished microbiologists, a dear friend, a gifted teacher, a leader, and a gentleman, emeritus Professor Erol Akan, for his outstanding and inspiring contributions to the development of the field of Medical Microbiology for over 50 years in Turkey.

**Declaration of interest**

The authors report no conflicts of interest. The authors alone are responsible for the content and the writing of the paper.

**References**


© 2011 Informa Healthcare USA, Inc.
Engman MF. (1920). A peculiar fungus infection of the skin (soorpilze?). Arch Dermatol Syphilol, 1, 730.