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Epidemiology of filamentous fungal infections in burned patients: A French retrospective study

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ABSTRACT

Introduction: Filamentous fungal infections (FFI) seem to become more frequent in burn patients, in whom they are usually accepted to cause severe. However published data regarding their incidence and consequences in that context remain scarce. The aim of this study was to evaluate the incidence of mould infections in our burn centre, and to review characteristics and outcomes of patients with such infections.

Methods: This retrospective single-centre study reviews all patients admitted in our centre with acute burns (2000–2011) and positive culture for moulds. Wound infections were defined as follows: fungal wound colonisations (FWC) for positive mycological cultures without signs of wound infection; fungal wound infections (FWI) for positive mycological cultures with local signs of wound infection; disseminated infection (DI) for FWI with a positive blood culture or a positive galactomannan (for aspergillosis) or severe sepsis or secondary organ localisation(s).

Results: Among 1849 patients, 31 patients presented a FFI. For 29 patients (93%), positive fungal samples were cutaneous: 20 Aspergillosis ASP (5 FWC, 8 FWI and 7 DI), 9 mucormycosis MMC (3 FWC and 6 FWI) and 3 fusariosis FUS (3 FWI). Two patients presented a catheter colonisation or a pulmonary colonisation (*Aspergillus fumigatus*). Incidence of FFI was 1.7%. Total body surface area burned, full-thickness burn surface area, Unit Burn Standard, Tobiasen score and SAPS2 (respectively 55% [40–73], 45% [30–63], 180 [129–259], 11 [8–12] and 50 [40–62]) were markedly higher than in burned patients without FFI hospitalised during the same time period. 30% of the patients with burn wound ASP (6/22) died. Mean length of stay was 111 ± 67 days.

Conclusion: FFI are essentially cutaneous, infrequent and occur in the most severe burned patients. ASP seems to be more serious than other FFI.

1. Introduction

Early surgical excision with extensive debridement of necrotic tissue and skin grafting of cover with skin substitutes have decreased mortality rates associated with extensive burns. Advances in patient care also include use of broad-spectrum antibiotics, surgical techniques for skin coverage, enteral and parenteral nutrition, and critical care support for organ dysfunctions [1,2]. Moreover, host defences of burned patients

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are severely impaired, with a high decrease in both innate and adaptive immune system responses [3,4]. As a result, burned patients are at high risk of developing life-threatening opportunistic infections during their stay in a burn unit. In patients with severe burns, almost 70% of all deaths are currently related to sepsis from local and systemic infections. Bacterial infections remain the main causes of sepsis in the burn units [4–6].

Incidence of fungal infections in burned patients has increased since the implementation of topical antimicrobial agents used to control bacterial colonisation [7]. *Candida* species remain the predominant cause of invasive fungal infections of burn wounds. *Candida* infections have been well described in burned patients. They represent a serious problem and are associated with increased mortality, morbidity, length of hospital stay and costs [8].

Filamentous fungi (also known as moulds) are not common, but are known to cause severe diseases and invasive wound infections in patients with extensive burns [4,9,10]. Filamentous fungi are made up of fine threads called hyphae. Hyphae grow at the tip and divide repeatedly along their length creating long and branching chains [11]. Hyphae keep growing until they form a network of threads called a mycelium. Some of the hyphal branches form a specialised structure called thallus that can produce spores or conidia. Spores enable the fungus to reproduce. Wind, rain, insects, ventilation systems or hand carriage can spread spores. They eventually land in new habitats to grow and produce new hyphae if conditions are right, and burn wounds provide such conditions. Diagnosis and treatment of invasive mould infections are a challenge because filamentous fungi have a much greater invasive potential than yeasts [12]. However data are scarce in the literature about incidence and consequences of filamentous infection in burns. The main objective of this study was to evaluate the incidence of filamentous infections in our burn centre. Secondary objectives were to review characteristics, treatments and outcomes of patients with such infections.

2. Patients and methods

2.1. Study design and setting

In this retrospective single centre study, medical records and charts of patients from the burn centre at Percy military teaching hospital were systematically reviewed. This department is the main French military burn centre. It features 16 acute care beds (10 ICU and 6 step down beds), two dedicated operating rooms, and two initial resuscitation rooms. The full time staff consists of physicians specialised in critical care and anaesthesiology and trained in burn care, assisted by dedicated nurses and nurse assistants. Surgeons from the plastic surgery department also perform surgical procedures.

2.2. Patients

All patients with burns admitted to our centre between January 1st 2000 and October 31st 2011 and with a microbiological sample with a positive filamentous culture (confirmed by a second isolate) were included. Non-burned patients such as dermatological disorders (Lyell syndrome, purpura fulminans, traumatic wound, graft-versus-host disease, Morel-Lavallée syndrome, or frostbites) were excluded.

2.3. Definition of fungal infections

The 2008 European Organization for Research and Treatment of Cancer/Mycoses Study Group (EORTC/MSG) criteria are usually used to define fungal infections [13]. However, these criteria are not applicable for diagnosis of cutaneous, wound or burn infections. In our unit, these infections have been classified according to microbiological and clinical criteria. First, fungal wound colonisations (FWC) are defined by positive cultures (for moulds) on one single full thickness skin or wound biopsy, or on at least 2 wound swabs (Table 1). Second, fungal wound infections (FWI) are defined by similar microbiological results yet associated with local signs of wound infection (Table 1). Third, a disseminated infection (DI) is a FWI associated with positive blood culture or presence of galactomannan (for disseminated aspergillosis) or secondary organ localisation (including other cutaneous localisation).

2.4. Microbiological methods

Wound swabs were regularly performed in order to detect the presence of microorganisms as part of our standard of care. In cases of clinically suspected wound infection, culture of full thickness skin biopsy was performed either directly on full thickness burns before excision, or after a swab culture positive for moulds on other sites.

Tissue biopsy and other relevant samples were processed by standard microbiological procedures using direct microscopy

Table 1 – Clinical description of filamentous burn wound infection.

Localisation	Clinical description
Unexcised burn wound	• Moderate to severe changes in appearance of burn wound (>48th hour) • Unexplained conversion of partial-thickness to full-thickness lesions • Haemorrhagic or necrotic discoloration of subeschar tissues • Unexpectedly fast separation of eschar
Excised burn wound	• Formation of neoeschar or focal necrosis on wound surface (or both) • Failure to heal
Grafted wound	• Partial or total lysis of graft areas • Haemorrhagic or necrotic discoloration of tissues under the graft • Failure to heal
Donor site	• Formation of neoeschar or focal necrosis • Failure to heal
Healed burn	• Lysis of healed burn
All sites	• Changes at wound surface suspicious for mould colonies • Wound colour change: focal dark red, brown, or black eschar discoloration • Necrotic lesions