DOI: 10.7860/JCDR/2016/20336.8445

Original Article

Surgery Section

Fungal Infection in Thermal Burns: A Prospective Study in a Tertiary Care Centre

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ABSTRACT

Introduction: Burn Wound Infection (BWI) is primarily caused by aerobic bacteria followed by fungi, anaerobes and viruses. There has been a worldwide decrease in incidence of bacterial infections in burns due to better patient care and availability of effective antibiotics. Consequently, the fungal burn wound infection has shown an increasing trend.

Aim: The aim of study was to assess the frequency of fungal infections in thermal burn wounds with respect to age of wounds, total body surface involved, depth of burns and to assess common fungal pathogens.

Materials and Methods: The study was conducted on 50 patients admitted with thermal burn wounds having 20-60% burns in the surgical unit. Pus swab and scrapings were taken under local anaesthesia from each burn patient. Scrapings were put in a sterile container and sent to Mycology section of Microbiology department and were examined by direct microscopy and culture studies on Sabouraud's Dextrose Agar medium in the Mycology section of Microbiology department.

Results: In our study, the incidence of fungal infection in burn wound patients came out to be 26%. The incidence of fungal infection increased with increase in Total Body Surface Area, (TBSA) increase in depth and age of burn. In our study, the maximum positive fungal cultures were seen in the third week of post-burn period. No positive culture was seen in the first week and 30.76% positive fugal cultures were seen in second post-burn week. *Candida albicans* was found to be the most common organism followed by Non-albicans *Candida* and *Aspergillus*.

Conclusion: It was concluded from the study that incidence of fungal infections in thermal burns increased with increase in post-burn period and with increasing depth and TBSA of burns. *Candida albicans* was found to be the most common fungus.

Keywords: Burn wound infection, Fungal culture, Mycoses

INTRODUCTION

Burns are damage to the skin caused by non-mechanical sources like heat, electricity, chemicals and nuclear radiations. Burn Wound Infection (BWI) is a major public health problem and one of the most devastating traumas [1]. Consequent to the development of effective antimicrobial agents and barrier nursing, near eradication of bacterial BWI was witnessed. Subsequently, fungal infections in burn wound patients have increased dramatically [2]. The burn patients are at high risk of developing infections in comparison to other hospitalised patients [3]. This is because of thermal destruction of the skin barrier and concomitant depression of local and systemic host cellular and humoral immune responses which are important factors contributing to infectious complications in patients with severe burns [4].

Thermal injury to the skin impairs the ability of the organ to maintain and regulate body temperature. There are many environment-related, patient-related and treatment-related risk factors for the development of fungal infections. Uncontrolled temperature and humidity promotes fungal infections. Similarly old age, more percentage of Total Body Surface Area (TBSA) of burn wound and inhalation injury also promote fungal infections [5-7]. Neutropenia and immune-compromised states like diabetes mellitus favour development of fungal infections of burn wounds [8,9].

Fungal invasion of burn wound can be either Fungal Wound Infection (FWI) which is the fungal invasion of the viable tissue and Fungal colonisation which is invasion of fungal elements in non-viable burnt skin. Further, fungal status category depends upon the deepest histological level of invasion [10]. Most of the infections are misdiagnosed due to lack of clinical awareness and similarity to bacterial infections as well as scarcity of mycology laboratories. The incidence of fungal infection as documented in literature is from 6.3 to 44% in reports from various burn centres around the world [11]. In India, there is scarcity of clinical data regarding fungal BWI probably due to lack of surveillance laboratories and well-equipped burn centres.

Candidial wound infection has become a major cause of morbidity and mortality in burn patients with the prevalence rate of 13 to 31.8%. But, epidemiology of fungi is exhibiting changing trends with isolation of Non-albicans *Candida* species, *Aspergillus*, *Fusarium* spp and Zygomycetes which are more aggressive and invasive as well as resistant against common anti-mycotics [12-14].

AIM

The aim of study was to assess the frequency of fungal infections in thermal burn wounds with respect to age of wounds, total body surface involved and depth of burns and to assess common fungal pathogens. The study was needed to elucidate the causes of mortality and morbidity despite initial improvement in burn patient.

MATERIALS AND METHODS

The prospective study was conducted on 50 patients admitted with thermal burn wounds having 20-60% involved surface in surgical unit during January 2013 to July 2014. Informed consent was taken from each patient. The age ranged from 18-60 years and patients admitted within 7 days of injury were included in the study. Pregnant and lactating mothers and women in post-partum period up to 6 weeks were excluded along with patients of pre-existing immune disorders, diabetes and patients already on anti-fungal drugs were excluded from the study. All these patients were examined clinically in the natural day light and local examination

of the wound was recorded. Burn wound in every patient was cleaned with normal saline and betadine, followed by a sterile gauze dressing. Patients were given broad spectrum antibiotics and high caloric and protein diet. Blood transfusion and intravenous fluids was given as per indication. Routine examination of blood and urine was done. Pus swab and scrapings under local anaesthesia were taken at the end of first, second and third post-burn week. Scrapings were put in a sterile container and sent to Mycology section of the Microbiology department and were examined by direct microscopy and culture studies on Sabouraud's Dextrose Agar medium.

In direct microscopy, the scrapings were put on a sterile glass slide in a drop of freshly prepared 10% KOH solution dissolved in 40% aqueous dimethyl sulphoxide. After passing the slide over a flame for 2-3 seconds, it was kept for half an hour in a labelled petri-dish containing wet cotton swab on its surface. Then, the glass slide was taken out of the petri-dish and a clean cover slip was put over the sample material and pressed gently. After that, it was examined under low power and then under high power of microscope for the presence of hyphae and spores.

In culture studies on Sabouraud Dextrose Agar medium, the scrapings were collected on a sterile piece of filter paper and labelled. After taking all the sterile precautions, the material was reduced in size to about 1mm across. Then, it was inoculated on Sabouraud's Dextrose agar slant in a test tube containing Chloramphenicol 0.05mg/ml and Cycloheximide 0.05mg/ml. Four such inoculum were gently implanted at well placed intervals. The test tube was inoculated at 28°C and observed on alternate day upto 3 weeks for fungal growth. This was followed by identification and sub culture. Statistical analysis was done using Chi-square test.

RESULTS

Total No. of Patients	Positive on Direct Microscopy	Positive On Fungal Culture
50	6	13

[Table/Fig-1]: Incidence of fungal infection in burn wound patients.

[Table/Fig-1] shows that among the 50 burn patients studied, 13 (26%) patients were positive for fungal culture out of which six patients were positive on direct microscopy also. The incidence of fungal infection came out to be 26%.

% of Burn	No. of Patients	Positive on Direct Microscopy	Positive on Fungal Culture
20-30	20	0(0%)	0(0%)
31-40	09	0(0%)	2(22.2%)
41-50	10	1(10%)	4(40%)
51-60	11	5(45%)	7(63.63%)

[Table/Fig-2]: Relation of total body surface area (tbsa) of burn wound with direct microscopy and fungal culture positivity.

[Table/Fig-2] shows increase in the incidence of fungal infections with increase in TBSA of burns with nil in 20-30% burns area to 2(22.2%) in 31-40% burns area to 4(40%) in 41-50% burns area to maximum 7(63.63%) in 51-60 % burns area.

Degree of Burn	No. of Patients	Positive on Direct Microscopy	Positive on Fungal Culture
First Degree	18	0	0
Second degree	16	1	4
Third Degree	16	5	9
Total	50	6 (12%)	13 (26%)
p-value		0.014 (S)	0.016 (S)

[Table/Fig-3]: Relation of degree of burn wound with direct microscopy and fungal culture positivity.

[Table/Fig-3] shows that the incidence of fungal infections is more in patients with third degree burns. Five patients of third degree burns were positive on direct microscopy and nine patients were positive on fungal cultures which was statistically significant ($p<0.05$). So it is concluded that as the depth of burn increases, the chances of fungal infection increases.

Post-Burn Week	No. of Fungal Positive Cases
First	0
Second	4(8%)
Third	9(18%)
Total	13
p-value	0.014 (S)

[Table/Fig-4]: Relationship of post burn week and incidence of fungal infection.

[Table/Fig-4] shows that as the post-burn time increases, the incidence of fungal infection increases. The maximum (18%) positive fungal cultures were seen in the third week of post burn period which was statistically significant ($p=0.014$). No positive culture was seen in the first week and 8% positive fungal cultures were seen in the second post-burn week.

Fungus Identified	No. of Cases
Candida albicans	6(12%)
Aspergillus flavus	3(6%)
Non-albicans *Candida*	4(8%)
TOTAL	13

[Table/Fig-5]: Showing culture data of fungal organisms identified.

[Table/Fig-5] shows the distribution of fungal organisms involved in fungal BWI. *Candida albicans* was found to be the most common organism (12%). The incidence of non-albicans *Candida* was 8% followed by *Aspergillus* flavus (6%).

DISCUSSION

Infections remain the major cause of mortality in patients hospitalized with burn injuries. In major burns, although underestimated, fungal infections are important emerging causes of late-onset morbidity and mortality. In our study the incidence of fungal infection in burn wound patients came out to be 26%. Mousa et al., reported similar results in a study conducted to investigate fungal infection in 130 burn patients in which 30 fungal isolates were recorded from 26 patients with an incidence of 20% [13]. In a multicentre trial, the American Burn Association reviewed 6918 patients, of whom 435 (6.3%) had positive fungal cultures [5]. Relatively high incidence of fungal infections in our study may be attributed to nosocomial and endemic factors.

In our study, the incidence of fungal infection gradually increased with increase in TBSA with fungal culture positivity in 63.63% of the burn patients having 51-60% TBSA involvement. None of the patients of 20-30% body surface area involvement suffered from fungal infection. A 43.33% patients having 31-60% body surface area involvement suffered from fungal infections. In the review of American Burn Association, 435 patients out of 6918 patients developed fungal BWI had burn size of 34.8± 22.7% TBSA [5]. This is in accordance with the study of Bruck et al., who observed the maximum number of positive fungal cultures (46.9%) in patients with 30-59% of body surface area [15]. This interaction of fungal infections with increase in body surface area suggests aggressive prevention and empiric treatment of fungal invasions.

In our study, maximum incidence (56.25%) of fungal infections was observed in patients of third degree burns. In second degree burns, the incidence was 25% on fungal cultures. This is in accordance with a study done by Bruck et al., who found the incidence of fungal to be 16.7% in second degree burns and 58.8% in third degree burns [15].

In our study, the maximum 69.23% positive fungal cultures were seen in the third week of post-burn period. No positive culture was seen in the first week and 30.76% positive fugal cultures were seen in second post-burn week. This was in accordance with study conducted by Bruck et al., which showed colonisation of burn wound with fungi and yeast increased after first post-burn week with peak incidence during third and fourth port-burn week [15].

Similar results have been reported by Ibrahim et al., on 66 patients who found fungi to cause burn wound invasion late during the second post-burn week, with the highest incidence during the fourth week, reaching 36% by the end of 4th week of admission [5]. Several studies point to a dominance of *Candida albicans* in fungal wound infection of burns [16-18].

LIMITATION

The limitations of our study were a single centre study and hence a small sample size.

CONCLUSION

The incidence of fungal infection in thermal burns increased with increase in post burn period and with increasing depth and TBSA of burns. *Candida albicans* was found to be the most common fungus. Further studies are required to form guidelines regarding empiric treatment of fungal invasions in patients of deep and burns of large body surface area.

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FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Mar 26, 2016**
Date of Peer Review: **May 04, 2016**
Date of Acceptance: **Jun 17, 2016**
Date of Publishing: **Sep 01, 2016**