PATTERN OF BACTERIAL INVASION IN BURN PATIENTS AT THE PAKISTAN INSTITUTE OF MEDICAL SCIENCES, ISLAMABAD

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SUMMARY. A prospective study was carried out in the Department of Plastic Surgery, Pakistan Institute of Medical Sciences, Islamabad, from January 2002 to December 2003. A total number of 142 patients were included in the study. The patients' mean age was 32.2 yr for males and 24.4 yr for females. The male/female ratio was 1.18:1.0. Micro-organisms from 86 patients were cultured for the first five days and in 77 patients from day 6 onwards. *Staphylococcus aureus* was found in 24.4%, which decreased to 18.2% after the first week. *Pseudomonas aeruginosa* was found in 27.3% of patients. Methicillin-resistant *Staphylococcus aureus* was observed in 11.7% of cases. No case of methicillin-sensitive *Staphylococcus aureus* was found. Seven patients, after admission day 6, showed no growth. Eighteen per cent of males and 16% of females died during their stay in hospital. This study highlights the predominant bacterial pathogens among the infected burn wounds treated in our centre.

Introduction

Burn injury is a major problem in many areas of the world. Thermal injury destroys the physical skin barrier that normally prevents the invasion of micro-organisms. This provides novel sites of bacterial colonization, infection, and clinical sepsis in burn patients.[1] It has been estimated that 75% of all deaths following thermal injuries are related to infection. Initially the burned area is considered free of major microbial contamination. However, Gram-positive bacteria in the depths of sweat glands and hair follicles may survive the heat of initial injury and unless topical antimicrobial agents are applied, these bacteria heavily colonize the wounds within the first 48 h post-injury.[2]

The organisms that predominate as causative agents of burn wound infection in any burn treatment facility change over time. Gram-positive organisms are initially prevalent, and are then gradually superseded by Gram-negative opportunists.[3] Individual organisms are brought into the burn ward in the wounds of new patients. Measures to prevent and treat infection are essential for the survival of patients with extensive burns. Many studies correlate infection to mortality.[4]

The purpose of this study was to analyse the pattern of burn wound microbial colonization in order to determine which organisms were most prevalent in our burn patients.

Materials and methods

Setting

This study was carried out in the burn patients admitted to the Department of Plastic Surgery, Pakistan Institute of Medical Sciences, Islamabad, from January 2002 to December 2003. The patients were followed to discharge or death. For estimation of burned areas, the Lund and Bowder total body surface area (TBSA) scale was used. Only adult patients above 12 years of age were included as patients. Children below 12 were treated at the Children's Hospital. Similarly, patients receiving out-patient department treatment were also excluded, as also patients with TBSA > 70%.

Burn wound management

The burn wounds of all patients were washed and debrided at least daily. Two per cent silver sulphadiazine was used as a topical antimicrobial. Patients were also given enteral feeding (pump feeding with Flexiflo® and Osmolite®). Pain relief and ventilatory support was also given when needed. Gentle removal of burn eschar was started 7-10 days after injury and repeated every second or third day, allowing granulation tissue to form. Patients were encouraged to be mobilized and take frequent oral diet. Wounds were later covered using autografts.

Antibiotics

Systemic antibiotics (ampicillin or cephalosporin) were

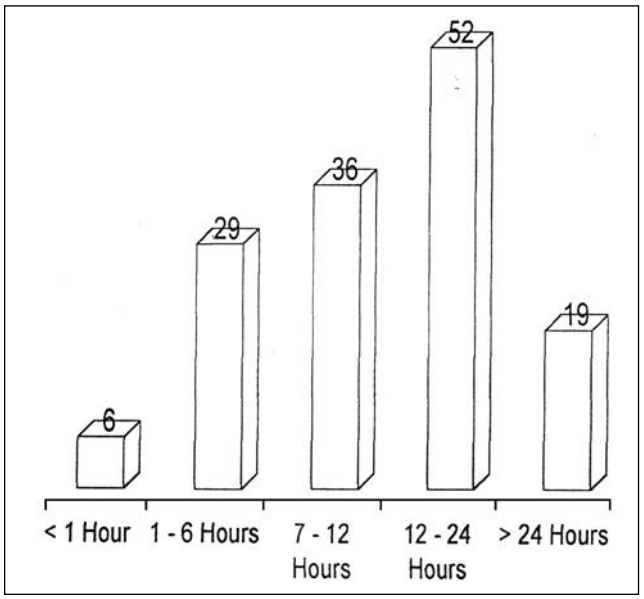

Fig. 1 - Time interval between injury and admission

given initially to all patients admitted. Later, antibiotics were administered according to culture and sensitivity reports.

Burn wound sampling

The sampling included swabs taken from clinically deep areas of burn wounds prior to any cleansing. Later, swabs were taken on debridement or excision and grafting. The swabs were taken immediately (within 2 or 3 h) to the laboratory. Various culture media were used, e.g. McConkey, blood agar, etc. After incubation for 18-48 h, sensitivity tests were performed.

Results

Demographic data

A total number of 142 patients (77 males and 65 females) were included in this study. The majority of the patients were in the 20-40 years old age group. The mean age was 32.2 yr (males) and 24.4 yr (females). The male/female ratio was 1.18:1.0. Nearly all the patients presented within 12 h of injury (*Fig. 1*). The average TBSA was 27.4% in males and 39.5% in females. The average hospital stay was 40 days (range, 6 h to 5 months). Eighteen per cent of the males and 16% of the females died in hospital.

Pattern of burn wound colonization

First five days: during the first five days after admission, swabs were taken from a clinically deep area of the burn wound. The micro-organisms isolated are listed in *Table I*. *Staphylococcus aureus* was the commonest micro-organism (24.4%); multi-resistant *Staphylococcus aureus* (MRSA) was found in 12.8% of cases.

Table I - Micro-organisms isolated during first five days (n = 86)

Microbe	Patients	Percentage
Staphylococcus aureus	21	24.4
Pseudomonas aeruginosa	16	18.6
Klebsiella species	12	13.9
E. coli	10	11.6
Enterobacter species	10	11.6
Streptococcus pyogenes	8	9.3
Streptococcus faecalis	6	6.9
MRSA	11	12.8
Candida albicans	1	1.2
No growth	12	13.9

Table II - Micro-organisms isolated from day 6 onwards (n = 77)

Microbe	Patients	Percentage
Staphylococcus aureus	14	18.2
Pseudomonas aeruginosa	21	27.3
Klebsiella species	18	23.4
E. coli	13	16.9
Enterobacter species	12	15.6
Streptococcus pyogenes	7	9.1
Streptococcus faecalis	4	5.2
MRSA	9	11.7
Candida albicans	1	1.3
No growth	7	9.1

Day 6 onwards: *Pseudomonas aeruginosa* (27.3%) was the most frequently cultured micro-organism. Other microbes isolated are listed in *Table II*; MRSA was found in 11.7% of cases.

Discussion

Thermal injury impairs the skin's normal barrier function, thus allowing microbial colonization of burn wounds so that contamination is almost unavoidable. The type and amount of micro-organisms colonizing the burn wound influence the frequency of invasive burn wound infections and the clinical characteristics of such infections.[5] Burn wound infection is one of the frequent and severe complications in patients who have sustained burns.[6] Because of the variability of both local and systemic clinical manifestations of invasive burn wound infection, great emphasis is placed on the proper identification of burn wound microbial flora by clinicians treating burn wound sepsis.[7]

In this study, we evaluated the pattern of burn wound microbial colonization, as well as the time related to changes in the predominant flora during the patients' hospital stay. The number of patients is larger than in some other studies. Our patients were adults. The mean burn size was 27.4% in males and 39.5% in females. The total per-

centage of wound infection was 49.3%, which is fairly high even if a similar high percentage is also noted in other studies.[8] Mortality in our burn patients was higher than in other studies.[2,9] Large burns, late primary excisions, old age, and polymicrobial bacteraemias are well recognized risk factors for mortality in burn patients.[10,11] Inhalation injury was noted in 23% of the cases, in most of which severe burns contributed to the higher mortality.

In all patients we registered that infections were not present on admission. Infected patients had larger burns, longer hospital stay, more operations, and higher mortality. Prospective studies of infection in burn patients are few, and comparisons between units are problematic. In a six-month study Wurtz et al.[12] registered only signs and symptoms of infection starting 72 h or more after admission to the burn unit; however, burn injury severity was not considered. Taylor,[13] in a one-year study, used the Center for Disease Control, Atlanta, USA, criteria and started to register from the time of admission. Average burn size was not however given. The main infecting micro-organisms were staphylococci. We excluded patients with 80% TBSA or more because prognosis in such patients is very poor, even in well-established burn centres.

Our findings regarding the high frequency of *Pseudomonas aeruginosa* (18.6%) are largely consistent with many previous reports, in which this organism was held responsible for the majority of cases of invasive burn wound infection.[14-16] This figure of 18.6% increased to 27.3% within a week. The reason may be that there was no special burn unit in our hospital and these patients, although separated from other patients, were managed in the same ward. Another reason may be the fact that our unit shared beds with general surgery and urology, and cross-infection was definitely beyond control, even if measures were taken to reduce it.

Klebsiella species was the second most frequently identified organism (increasing from 13.9 to 23.4%). A similar high frequency was noted in a specialized burns centre.[2] *Staphylococcus aureus* increased from 18.2 to 24.4%. More importantly, methicillin-resistant *Staphylococcus aureus* (MRSA) was noted to decrease from 12.8 to 11.7% of patients. We did not encounter any case of methicillin-sensitive *Staphylococcus aureus*. This frequency of MRSA was lower than that observed in other studies in which MRSA became a significant problem.[15,17,18]

Antimicrobial therapy can cause severe problems as regards resistance, mainly against cephalosporins and other beta-lactams, as well as quinolones, in intensive care units.[19] A strict antibiotic policy is important in the control of antibiotic resistance.[20] In particular, broad-spectrum beta-lactam antibiotics have been shown to cause Gram-negative problems in hospital areas with a high number of courses of empirical treatment. Antibiotic prophylaxis has been shown to be of little use.[21] It is possible to reserve antibiotics for proven infection and to limit the use of broad-spectrum drugs without increasing mortality and other complication rates.[9]

Infection rates in burns units have been reported to be high compared with other intensive care units.[22] Burn patients are infection-prone and very contagious when infected.[23] Isolation care in general is important in the prevention of nosocomial transmission of infection and detailed guidelines are available.[17] Cross-contamination of multi-resistant micro-organisms is common in intensive care units.[19] If transmission occurs, this is an indicator of poor-quality nursing care - nursing overload and patient crowding are the most important factors.[24,25] Simple barrier nursing using gloves and gowns during patient contact is more effective than elaborate isolation care with gowning, sterile gloves, caps, etc. on every patient.[26] Since the micro-organisms that predominate in a particular burns ward often change in relation to newly admitted patients and altered therapy protocols, knowledge of micro-organisms that are generally a problem in burns practice may result in the wrong selection of empirical systemic antibiotics.[27]

It is essential for every burn institution to determine its specific pattern of burn wound microbial colonization, time-related changes in predominant flora, and antimicrobial resistance profiles. This permits early management of septic episodes with proper empirical systemic antibiotics before the results of microbiological cultures become available, thus improving overall infection-related morbidity and mortality.

Conclusion

Careful surveillance of infection, good isolation techniques and procedures, and restrictive antimicrobial policy can keep rates of antimicrobial resistance and infection low in infection-prone burn patients.

The establishment of a separate burns unit in our centre is expected to reduce the morbidity and mortality of such patients because cross-infection, which is a hallmark of open/general wards, will be reduced to the barest minimum, thus reducing the burn wound infection rate.

RÉSUMÉ. Les Auteurs ont effectué une étude prospective au Département de Chirurgie Plastique, Institut Pakistanais des Sciences Médicales, Islamabad, de janvier 2002 à décembre 2003, avec un numéro total de 142 patients. L'âge moyen des patients était 32,2 ans (hommes) et 24,4 ans (femmes). Le rapport hommes/femmes était 1,18:1,0. Les microorganismes de 86 patients ont été cultivés pendant les cinq premiers jours et de 77 patients du jour 6 en avant. Le *Staphylococcus aureus* a été trouvé en 24,4% des cas, avec un incrément jusqu'à 18,2% après la première semaine. Le *Pseudomonas aeruginosa* a été trouvé en 27,3% des patients. Le *Staphylococcus aureus* résistant à la méticilline a été observé en 11,7% des cas. Aucun cas de *Staphylococcus aureus* sensible à la méticilline n'a été trouvé. Sept patients, après le jour 6 d'hospitalisation, n'ont présenté aucun signe de croissance. Dix-huit pour cent des hommes et 16% des femmes sont morts au cours de l'hospitalisation. Cette étude met en lumière les principaux pathogènes bactériens dans les lésions infectées que les Auteurs ont observées dans leur centre.

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