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A retrospective study of Nosocomial Infection in Burn unit in Baquba Teaching Hospital

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Abstract

Introduction
Burn injury is a major public health problem in many countries of the world. The burn wound represents a susceptible site for opportunistic colonization by organisms of endogenous and exogenous origin. Patient factors such as age, extent of injury, and depth of burn in combination with microbial factors determine the likelihood of invasive burn wound infection. Septicaemia is a serious, rapidly progressing, life-threatening infection that can arise from infections throughout the body, including the lungs, abdomen, and the urinary tract. 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 the initial injury, and unless topical antimicrobial agents are used, these bacteria heavily colonize the wounds within the first 48 hours after injury. The topical agents reduce the microbial overgrowth, but they seldom prevent further colonization with other potentially invasive bacteria and fungi. These are mainly derived from the patient's gastrointestinal and upper respiratory tracts as well as from the hospital environment. Following colonization, the organisms on the surface start to penetrate the burn eschar to a variable extent, depending on their invasive capacity, local wound factors, and the degree of the patient's immunosuppression. If viable sub-eschar tissue becomes invaded, disseminated infection is likely to occur.

Aim of the study
To assess the sterility of the burn unit and to determine the commonest microorganisms responsible for the nosocomial infection between burned patients

Patients and method
This is a retrospective study done in Baquba teaching hospital concerned with the sterility of the burn unit. The study done over a period of one year from January 2012-January 2013.
The data collected from the microbiological unit in the hospital where the results of the cultures are kept. All the patients received immediate care and resuscitation therapy. Silver sulphadiazine was used topically and the dressings were changed daily. Ampiclox administered (single dose) as prophylactic antibiotics during debridement or early excision of the burn eschar and grafting. The wound was inspected daily during the dressing changes.
Culture swabs taken from the following places:

- Wound
- Bed of the patient
- Treatment rails
- Walls
- Gauze
- Wound dressing rails
- Path

These swabs are sent twice weekly for culture for gram stain and its species for a total number of 103 times over one year (January 2012-January 2013).

Results

The most common microorganism obtained was *Staphylococcus epidermidis* followed by the bacillus species followed by the E.oli then the Pseudomonas species. Less common microorganisms were the Klebsiella, Streptococcus species and the lesser microorganisms encountered was Proteus species. Also we can see that no site in the burn unit immuned against colonization of the microorganisms even the treatment rail and the gauze.

Discussion

Poor compliance with hygiene rules and inadequate disinfection or sterilization of mattresses, bed sheets, dressing materials, and other equipment used for patient care, prolonged catheterization, central or peripheral lines, inefficient isolation of infected patients, overcrowding, decreased host resistance, and inappropriate antibiotic use are the most important causes for nosocomial infections in burn units.

Conclusion and recommendations

Wound infections are common problems in burn units, mostly originating from nosocomial contamination. The development of infections in burn cases is serious because of their effects on the course of the disease and patient outcomes. Many burn patients die as a result of infection during their hospital courses. The rate of infection in burn cases is extremely high in developing countries. This may be due to the prevalence of low-level socioeconomic groups of patients in whom poor hygienic conditions prevail; malnutrition may also play a role in the earlier establishment of the infection. Families and hospital personnel frequently touch hospitalized patients. Infection is easily spread by means of this close contact. Inadequate measures to prevent cross-infection by burn unit workers and visitors may also be implicated.

Keywords: Burn unit, nosocomial infection.

Introduction

Burn injury is a major public health problem in many countries of the world. The burn wound represents a susceptible site for opportunistic colonization by organisms of endogenous and exogenous origin. Patient factors such as age, extent of injury, and depth of burn in combination with microbial factors determine the likelihood of invasive burn wound infection.**1, 2**

Septicaemia is a serious, rapidly progressing, life-threatening infection that can arise from infections throughout the body, including the lungs, abdomen, and the urinary tract.**3**

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 the initial injury, and unless topical antimicrobial agents are used, these bacteria heavily colonize the wounds within the first 48 hours after injury.**4,5** The topical agents reduce the microbial overgrowth, but they seldom prevent further colonization with other potentially invasive bacteria and fungi. These are mainly derived from the patient's gastrointestinal and upper respiratory tracts as well as from the hospital environment.**6**Following colonization, the organisms on the surface start to penetrate the burn eschar to a variable extent, depending on their invasive capacity, local wound factors, and the degree of the patient's immunosuppression. If viable sub-eschar tissue becomes invaded, disseminated infection is likely to occur.**7** It is common knowledge that the spectrum of infective agents varies from time to time and from place to place. It is therefore desirable to carry out periodic reviews of the bacterial flora of burn wounds in order to modify preventive strategies as necessary.

Epidemiology of infection

The development of infection depends on the presence of three conditions, a source of organisms; a mode of transmission; and the susceptibility of the patient.

Sources of organisms

Sources of organisms are found in the patient's own endogenous (normal) flora, from exogenous sources in the environment, and from healthcare personnel. Exogenous organisms from the hospital environment are generally more resistant to antimicrobial agents than endogenous organisms**.** Organisms associated with infection in burn patients include gram-positive, gram-negative, and yeast/fungal organisms. The distribution of organisms changes overtime in the individual patient and such changes can be ameliorated with appropriate management of the burn wound and patient.

The typical burn wound is initially colonized predominantly with gram-positive organisms, which are fairly quickly replaced by antibiotic-susceptible gram-negative organisms, usually within a week of the burn injury. If wound closure is delayed and the patient becomes infected, requiring treatment with broad-spectrum antibiotics, these flora may be replaced by yeasts, fungi, andantibiotic-resistant bacteria. Gram-positive organisms of particular concern include methicillin-resistant *S. aureus* (MRSA), enterococci, group A beta-hemolytic Streptococcus and coagulase negative Staphylococcus.**8**

Mode of transmission

Modes of transmission include contact, droplet and airborne spread. In burn patients the primary mode is director indirect contact, either via the hands of the personnel caring for the patient or from contact with inappropriately decontaminated equipment. Burn patients are unique in their susceptibility to colonization from organisms in the environment as well as in their propensity to disperse organisms into the surrounding environment. In general, the larger the burn injury, the greater the volume of organisms that will be dispersed into the environment from the patient.**11**

Patient susceptibility

The patient has three principal defenses against infection: physical defenses, nonspecific immune responses, and specific immune responses. Changes in these defenses determine the patient's susceptibility to infection. Physical defenses against infection are listed in **Table 1** along with changes induced by burn injury. Invasive devices, such as endotracheal tubes, intravascular catheters and urinary catheters, bypass the body's normal defense mechanisms. In general, pediatric patients have fewer problems with pneumonia than do adults because they are less likely to have pre-existing lung damage. Infection from intravascular catheters is of particular concern in burn patients, as often these lines must be placed directly through or near burn injured tissue. Catheter associated bloodstream infection (BSI) is caused by organisms which migrate along the catheter from the insertion site and colonize the catheter tip. **12**

Table 1 Physical defenses and their alteration by burn injury

Organ	Defense mechanism	Effect of burn injury
Intact skin	Physical barrier; normal flora; low pH maintained by fatty acids; dryness,desication, desquamation	Loss of epidermis and all or part of dermis, depending on depth of injury; colonization of wound by opportunistic and pathogenic organisms; moist wound bed with necrotic tissue, eschar
Respiratory tract	Mucociliary lining of tract; cough and sneeze reflex; lysosomes in nasal secretions; alveolar macrophages	Smoke inhalation injury with direct damage to lining of respiratory tract; endotracheal intubation; immobility
Gastrointestinal tract	Peristalsis; hydrochloric acid; mucous gel on epithelial surfaces; normal flora Secretory IgA; bile acids and enzymes; fatty acids; bacteriocin	Adynamic illeus in burn shock period immediately after injury; altered gut permeability with large injury; elevated pH for stress ulcer prophylaxis; altered flora after administration of antibiotics; nasogastric tubes and feeding tubes
Urogenital tract	Flushing action and bacteriostatic pH of urine; normal flora (lactobacilli)	Burns in genital area; urinary catheter drainage
External ear and conjunctiva	Flushing action of tears; lysosomes; sebum and ciliary action of ear canals	Inability to close burned eyelids; accumulation of wound exudates and debris in ear canal

Catheter tips are also susceptible to colonization from hematogenous seeding of organisms from the colonized burn wound.

The other principal modes of transmission in burn units are via the hands of the personnel and contact within adequately decontaminated equipment or surfaces. The two areas most likely to become contaminated when caring for the burn patient are the hands and apron area of the person, as the surfaces (e.g., beds, side rails, tables, equipment) are often heavily contaminated with organisms from the patient. Likewise all equipment used on the patient(e.g., blood pressure cuffs, thermometers, wheelchairs, IV pumps) are also heavily contaminated and may be transmitted to other patients if strict barriers are not maintained and appropriate decontamination carried out. Infact, a single cause is uncommon in a burn unit outbreak; in almost all instances, multiple factors contribute to its occurrence and perpetuation.

Culturing and surveillance

Culturing and surveillance guidelines are more stringent for the burn patient, particularly the patient with larger injuries, because of the increased propensity for transmission and infection in this population. Burn wound flora and antibiotic susceptibility patterns change during the course of the patient's hospitalization so that the purposes of obtaining routine surveillance cultures are:

_ To provide early identification of organisms colonizing the
wound;
_ To monitor the effectiveness of current wound treatment;
_ To guide perioperative or empiric antibiotic therapy;
_ To detect any cross-colonizations which occur quickly so that further transmission can be prevented.

Routine surveillance wound cultures should be obtained when the patient is admitted and at least weekly until the wound is closed. Many burn centers recommend obtaining wound cultures two or three time a week for patients with large burn injuries. Admission cultures are particularly important for patients transferred from other facilities, as they may be colonized with multiply resistant organisms and serve as an unsuspected reservoir for cross-transmission to other patients on the unit. For pediatric patients, admission throat cultures are also recommended as about 5% of the population will be colonized with Group A beta-hemolytic Streptococcus (S. pyogenes) which can have serious consequences if it is transmitted to the burn wound.

Methods of burn wound culturing include obtaining a semi-quantitative swab culture or a quantitative biopsy specimen. Semi-quantitative swab cultures provide information on the type of organisms present on the burn wound, as well as the approximate amount and antimicrobial susceptibility.

A general rule is to obtain a swab culture for each10% of open burn to identify organisms of significance on the wound. Quantitative cultures are used to define invasive infection based on bacterial count of 100,000 colonies or more per gram of tissue. However, further study has revealed that this technique is not precise, as 50% of patients with quantitative counts of greater than 100,000 organisms do not have histologic evidence of invasive infection **[10].**

Furthermore, quantitative culturing is more costly and labor-intensive than swab cultures, and their routine use to identify colonizing organisms on appropriately debrided wounds is rarely indicated. Accurate diagnosis of invasive burn wound infection is best determined by clinical criteria, supported when possible by histopathologic examination ifthe patient's condition is suspicious for this infection [9].

Surveillance of infection has been shown to diminish the rate of nosocomial infection **[11,12]**as well as reduce cost**[13,14].** Surveillance of infection in burn patients should be done to monitor incidence and rates which have been appropriately risk adjusted by size of burn injury and invasive device use. At a minimum, surveillance should include collection of data on burn wound infection, urinary tract infection, pneumonia, and bloodstream infection.

Systematic collection of data allows the burn unit to monitor changes in infection rates over time, identify trends, and evaluate current treatment methods.

Isolation guidelines

Standard precautions should be followed when caring for all patients with burn injury. The effectiveness of simple protective barrier precautions in reducing nosocomial colonization and infection was shown in a study by Klein et al. [15] in a pediatric ICU. Most burn units also supported the concept of barrier

techniques and isolation; although there was variation in which types were felt to be appropriate**[16].** The open burn wound increases the environmental contamination present around the patient, which is the major difference in burn versus non-burn patients. The degree or amount of contamination is roughly proportional to the size of the open wound and amount of colonization present and is inversely proportional to the distance from the patient. For this reason, appropriate barrier garb is recommended for any patient contact unless wounds are minimal and can be occlusively wrapped. The decision to use clean gowns versus plastic aprons should be evaluated for adequacy of protection, ease of use, comfort, and cost. Other requirements of standard precautions include appropriate hand washing, removal of garb immediately upon leaving the room, changing gloves that become contaminated with patient secretions or excretions before contact with another site, and addition of sterile gloves, hats and masks when caring for an open burn wound or other sterile procedures. Equipment and surfaces are considered contaminated following use and should be appropriately decontaminated before storage or use on other patients. Appropriate garb should also be worn when decontaminating this equipment.

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Results

The results of the different swab cultures were as shown in the table below

Table 1 The results of the different swab cultures in percentage

Site	Type of microorganisms							
	Staphylococcus epidermidis	**Bacillus species**	***E.coli***	**Enterobacter species**	**Pseudomonous species**	**Klebsiella species**	**Streptococcus species**	**Proteus species**
Wound	89%	73%	41%	12%	21%	9%	3%	4%
Walls and floors	87%	71%	46%	14%	24%	7%	4%	4%
Bed	77%	63%	39%	18%	19%	7%	3%	2%
Gauze	3%	2%	2%	16%	2%	_	_	_
Treatment rail	19%	16%	32%	9%	17%	2%	_	_
Bathing room	64%	62%	37%	17%	21%	6%	5%	2%

As we see the most common microorganism obtained was *Staphylococcus epidermidis* followed by the bacillus species followed by the E.oli then the Pseudomonas species.

Less common microorganisms were the Klebsiella, Streptococcus species and the lesser microorganisms encountered was Proteus species.

Also we can see that no site in the burn unit immuned against colonization of the microorganisms even the treatment rail and the gauze.

Discussion

Poor compliance with hygiene rules and inadequate disinfection or sterilization of mattresses, bed sheets, dressing materials, and other equipment used for patient care, prolonged catheterization, central or peripheral lines, inefficient isolation of infected patients, overcrowding, decreased host resistance, and inappropriate antibiotic use are the most important causes for nosocomial infections in burn units. **(10-13)**

In our study, the most frequent micro-organisms from burn wound infections and other sites in the word (as mentioned in the patient and method) were found to be *Staphylococcus epidermidis* followed by the bacillus species followed by the E.oli then the Pseudomonas species.

Less common microorganisms were the Klebsiella, Streptococcus species and the lesser microorganisms encountered was Proteus species.

Pseudomonas aeruginosa has emerged as an important pathogen during the past two decades. It causes between 10 and 20% of infections in most hospitals. Pseudomonas infection is especially prevalent among patients with burn wounds. Successful infection control measures depend on a burn unit being built with exacting specifications, well-trained burn unit workers, surveillance of the bacteria prevalent in the burn unit and their antimicrobial resistance patterns, and an efficient hospital infection control programme. To control infection in the burn unit, overcrowding must be avoided, and strict hand washing both before and after handling patients must be implemented, as well as restriction of movement within the burn unit. (**17)**

The pattern of bacterial resistance is important for epidemiologic surveillance and treatment options in patients with burns. The antimicrobial treatment closely depends on the bacterial resistance pattern. The antimicrobial resistance patterns seen in this study give serious cause for concern because the predominant bacterial isolates were highly resistant to the commonly available antimicrobial agents in many burn units. An effective infection control programme should be established in all burn units. The prevention of nosocomial burn wound infections can be minimized with fastidious wound care. It is important that the burn unit staff and infection control units work together to control infections. Team effort can help avoid infections and solve problems. The training of the burn unit staff and the establishment of a follow-up programme are important for the prevention of nosocomial infections. **(18)**

Conclusion and Recommendations

Wound infections are common problems in burn units, mostly originating from nosocomial contamination. The development of infections in burn cases is serious because of their effects on the course of the disease and patient outcomes. Many burn patients die as a result of infection during their hospital courses. The rate of infection in burn cases is extremely high in developing countries. This may be due to the prevalence of low-level socioeconomic groups of patients in whom poor hygienic conditions prevail; malnutrition may also play a role in the earlier establishment of the infection. Families and hospital personnel frequently touch hospitalized patients. Infection is easily spread by means of this close contact. Inadequate measures to prevent cross-infection by burn unit workers and visitors may also be implicated.

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