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Aerobic Bacteria associated with Wound Infections among Sudanese Patients

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Abstract

Background: Wound infections are very serious conditions and they are widely prevalent in hospitals. Some are difficult to treat and sometimes need amputation. Investigations of wound infections require proper isolation, identification, and susceptibility testing.

Objective: To estimate the frequency of aerobic bacteria associated with wound infections among Sudanese patients.

Materials and methods: A cross-sectional study was carried out at Omdurman Military Teaching Hospital. 100 wound infection patients were investigated. The wounds were swabbed and the specimens were investigated using conventional standard bacteriological methods. Antibiotic susceptibility testing was carried out on all the isolates using Kirby-Bour disc diffusion technique and commonly prescribed antibiotics.

Results: Out of the 100 samples collected, 86 specimens (86%) revealed bacterial growth. The most frequent isolate was *Staphylococcus aureus* (48 / 46.6%) and the least frequent isolate was *Proteus mirabilis* (4 / 3.9%). Ciprofloxacin, norfloxacin, and ceftriaxone were the most effective agents against the organisms isolated.

Conclusion: *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *E. coli* were the major isolated organisms from wound infections; and the isolated organisms were highly sensitive to ciprofloxacin, norfloxacin, and ceftriaxone.

Key words: Aerobic bacteria, Wound infections, Sudanese patients

Introduction:

Infected wounds are wounds which result of a break in the skin surface and can occur as complications of surgery, trauma or bite¹.

Infected wounds are wounds in which bacteria or other microorganisms have colonized, causing either a delay in wound healing or deterioration of wound. Most wounds are typically contaminated by bacteria. However, infected wounds result when the body's immune defenses are overwhelmed or cannot cope with normal bacterial growth. Wounds can be broadly categorized as having either an acute or chronic etiology. Acute wounds are caused by external damage to intact skin and including surgical wounds, bites, burn, minor cuts, and more severe

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traumatic wounds such as gun-shot injuries. Chronic wounds are most frequently caused by endogenous mechanisms associated with predisposing factors that affect the integrity of dermal and epidermal tissue such as patho-physiological abnormalities that may predispose to formation of chronic wounds such as leg ulcer, foot ulcer, pressure sores, and metabolic diseases such as diabetes mellitus. The most causative agents are methicillin resistant *Staphylococcus aureus* and vancomycin resistant enterococci².

Diabetic foot infections are frequently associated with *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, *Enterococcus* species and coliform bacteria. Anaerobes also can be isolated in up to 95% of people with severe diabetic lower leg infections, most commonly peptostreptococci, *Bacteroides* and *Prevotella* species. Bite wounds: often contain more exotic flora, reflecting the source of the bite. They are commonly polymicrobial, with very high microbial loads. *Staphylococcus aureus*, *Peptostreptococcus* species and *Bacteroides* species are the most common microorganisms in wounds resulting from human or animal bites. Superficial burns do not usually become infected, unless other systemic factors are present. The most common microbes are *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli* and other coliforms³.

While all wounds are colonized by microorganisms, the presence of infection is recognized by finding an inflammation or purulent infection. The majority of skin wounds are colonized with aerobic and anaerobic microorganisms that originate predominantly from mucosal surfaces. Infections may cause considerable morbidity and mortality. They may also precipitate metabolic derangements, and conversely the metabolic derangements may facilitate infection. Wound infections are very serious conditions and it is widely distributed in hospitals, and some are difficult to be treated and sometimes need amputation of the infected site. Investigations of wound infections require good isolation, identification, and susceptibility testing.

This study was therefore proposed to study the frequency rate of aerobic microbial wound infections among patients attending Omdurman Military Teaching Hospital and to determine the susceptibility patterns of the isolated organisms. By so doing, improvement in management of these cases may occur.

Materials and methods

This study had a qualitative, prospective, hospital-based, analytical, descriptive and cross-sectional study. It was carried out during the period from June to July, 2014, including the literature review, samples collection, laboratory work, and data analysis. This study was conducted at Omdurman Military Teaching Hospital; and the population investigated was patients with infected wounds covering different age groups and gender. Inclusion criteria were all patients with infected wounds; and exclusion criteria were severely ill patients or those with clean wounds not containing pus. Confidentiality of information collected from all patients investigated was maintained; and a valid consent of the patients under the study was obtained. Laboratory results of specimens collected were handed over to all patients included in the study or dispatched to physicians treating those patients. Permission to collect the specimens was granted by the Director of Omdurman Military Teaching Hospital. The software used for analysis of data was the Statistical Package for Social Sciences (SPSS) program (version 14). Frequencies, percentages, tables and graphs were used for presentation of data. The sampling technique adopted was a non- probability, purposive sampling; and the sample

strategy was a convenience type where patients were chosen on the basis of accessibility. The Sample size was 100 wound swabs collected from the patients studied. Demographical data (name, age, gender) and clinical symptoms were collected from all patients using a direct interviewing questionnaire. Collection of specimens from infected wounds was done by swabbing. Each patient was given a concise explanation of the need for the microbiological investigation. Sterile cotton swabs were usually used. If the wound was moist, the swab could be used straight from the packaging. If the wound was dry, the swab tip was moistened with sterile saline to increase the chances of recovering organisms from the site. Ames transport media were used to enhance the survival of fastidious organisms. When collecting the specimen, special care was taken to avoid contaminating the specimen with commensal bacteria from the skin.

Specimens were examined directly by Gram stain. All specimens were directly cultured on standard media such as blood agar and Mac Conkey agar. Plates were incubated aerobically at 37°C for 24 hours. The isolates were identified using different biochemical reactions such as oxidase test, Kligler iron agar test, citrate utilization test, urease test, motility, and indole test for identification of Gram negative bacilli. While catalase test, DNase test, coagulase test, and novobiocin sensitivity test were used for identification of Gram positive organisms.

Antimicrobial susceptibility testing was performed Kirby-Bour agar disc diffusion method. Isolates were swabbed uniformly across a Muller-Hinton agar plate. Inoculum was adjusted as per Mc Farland turbidity standard. Filter-paper disks were placed on the surface of the agar and incubated at 37°C overnight. The antimicrobial drugs used were ciprofloxacin, trimethoprim, norfloxacin, ceftriaxone, cefixime, and ceftazidime.

Results

This study was done to identify bacterial species associated with wound infections and to determine the sensitivity pattern towards the commonly used antibiotics. The study included 100 patients with wound infections at Omdurman Military Teaching Hospital.

The majority of the population investigated was males (62/62%), and females (38/38%).

The age incidence of the patients investigated ranged from less than 10 years to 70 years with a mean age of 34±15 years. The largest number of patients studied (29/29%) was among patients in the age range 31-40 years, and the least number (5/5%) was among patients in the age range 51-60 years (Table I).

Table (I): Distribution of study population according to age range

Age range	Frequency	Percent
1-10 years	7	7%
11-20 years	9	9%
21-30 years	28	28%
31-40 years	29	29%
41-50 years	16	16%
51-60 years	5	5%
61-70 years	6	6%
Total	100	100%

The majority of the population investigated (73/73%) suffered from a recent wound infection; and (27/27%) suffered from chronic wound infection.

As shown in Table (II), out of the 100 specimens collected, 86 bacterial species (86%) were isolated. Gram positive organisms isolated were *Staphylococcus aureus* (48/55.8%) and coagulase-negative *Staphylococcus aureus* (4/4.7%). While Gram negative organisms isolated were *Pseudomonas aeruginosa* (15/17.4%), *Proteus mirabilis* (4/4.7%), *E. coli* (9/10.5%), and *Klebsiella pneumoniae* (6/6.9.0%). The overall most frequent isolate was *Staphylococcus aureus* (48/55.8%); and the least frequent isolate were *Proteus mirabilis* and coagulase-negative *Staphylococcus aureus* (4/4.7%).

Table (II): Frequency rate of isolated bacteria among the study population

Isolated organism	Frequency	Percent
<i>Staphylococcus aureus</i>	48	55.8%
<i>Pseudomonas aeruginosa</i>	15	17.4%
<i>Escherichia coli</i>	9	10.5%
<i>Klebsiella pneumoniae</i>	6	6.9.0%
Coagulase-negative <i>Staph. aureus</i>	4	4.7%
<i>Proteus mirabilis</i>	4	4.7%
Total	103	100%

The sensitivity pattern of the organisms isolated showed that ciprofloxacin, norfloxacin, and ceftriaxone were the most effective agents against both Gram-positive and Gram-negative organisms (Table III).

Table (III): Sensitivity pattern of the bacterial species isolated

Bacterial species	% of bacterial species sensitive to:					
	CIP %	T %	N %	CEF %	C %	CZ %
<i>Staph. aureus</i>	100%	53.6%	100%	56.1%	100%	56.1%
<i>Ps. aeruginosa</i>	100%	4.9%	100%	18.3%	100%	18.3%
<i>E. coli</i>	100%	11.0%	100%	2.4%	100%	2.4%
<i>K. pneumoniae</i>	100%	7.3%	100%	7.3%	100%	7.3%
<i>Prot. Mirabilis</i>	100%	4.9%	100%	3.7%	100%	3.7%
Total pathogenic organisms tested = 82						

CIP = Ciprofloxacin

T = Trimethoprim

N = Norfloxacin

CEF = Cefoxime

C = Ceftriaxone

CZ = Ceftazidime

Discussion:

The current study revealed the majority of participants fell in the age group 21 to 40 years and the minority fell in the age range 51 to 60 years. This study also showed that the male patients (62%) outnumbered the female participants. Furthermore, the majority of wound infections were of an acute nature.

These findings were similar to the findings of the study conducted by Christopher and his co-workers in Nigeria (2011) who investigated the microbiology of wound infections among 2061 patients of a tertiary care hospital. They found that the prevalence of wound infections was not significantly affected by gender but it was significantly affected by age incidence⁴.

Also in this study the most frequent isolated organism (48/55.8%) was *Staphylococcus aureus* followed by *Pseudomonas aeruginosa* (15/17.4%); and the least frequent organism (4/4.7%) was *Proteus mirabilis*. This finding also agrees with the study of Christopher and his co-workers in Nigeria (2011) who found that *Staphylococcus aureus* was the most prevalent etiological agent (21.5%)⁴.

On the other hand, in the current study the bacterial isolates were found highly sensitive (100%) to the antibiotics ciprofloxacin, norfloxacin and ceftriaxone and moderately sensitive (81.7%) to trimethoprim. The study of Verma and his colleagues conducted in India (2012) revealed the maximum susceptibility of *E. coli* was observed to ciprofloxacin (75.7%); and the isolated organisms were commonly susceptible to vancomycin, ciprofloxacin and gentamicin⁵. Raza and his co-workers in Nepal (2013) studied the antimicrobial resistance pattern of bacterial isolates of post-operative wound infections in a tertiary care hospital. They found that all *Staphylococcus aureus* isolates were sensitive to vancomycin; and all Gram negative organisms showed a high resistance against ceftriaxone⁶.

From this study we could recommend that ciprofloxacin, norfloxacin, and ceftriaxone to be considered as drugs of choice for treatment of wound infections. Emphasis should also be made on performing culture and sensitivity tests to wound infections patients in order to prescribe the proper antibiotic.

Conclusion: *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *E. coli* were the major isolated organisms from wound infections among Sudanese patients. The isolated organisms were highly sensitive to ciprofloxacin, norfloxacin, and ceftriaxone.

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