

Original Article

A STUDY OF WOUND INFECTIONS IN TWO HEALTH INSTITUTIONS IN ILE-IFE, NIGERIA.

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The microbiological analysis of wound infection in 102 patients was undertaken in the outpatient departments of the University Teaching Hospital and the Health Centre in Ile-Ife, Nigeria. The location and type of wound was considered and identification of bacterial isolates was determined by standard microbiological techniques. Forty per cent of wound types was attributed to trauma and in most cases, were located at the extremities. A total of one hundred and sixty two bacterial isolates were obtained from wound cultures. In 39 cases, cultures were monomicrobial, 55 cultures were polymicrobial but no bacterial isolate was obtained in eight cases. Staphylococcus aureus was the predominant microorganism (25%) followed by Escherichia coli (12%), Pseudomonas aeruginosa (9%) and Staphylococcus epidermidis (9%). The diversity of microorganisms and the high incidence of polymicrobial flora in this study give credence to the value of identifying one or more bacterial pathogens from wound cultures. Continuous dialogue between the microbiology department and wound care practitioners and education of patients on personal hygiene is strongly advised.

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INTRODUCTION

A wound is a breach in the skin and the exposure of subcutaneous tissue following loss of skin integrity provides a moist, warm, and nutritive environment that is conducive to microbial colonization and proliferation. (Bowler *et al*, 2001). Infection in a wound delays healing and may cause wound breakdown, herniation of the wound and complete wound dehiscence. (Alexander, 1994). In spite of technological advances that have been made in surgery and wound management, wound infection has been regarded as the most common nosocomial infection especially in patients undergoing surgery (Dionigi *et al*, 2001). It is an important cause of illness resulting in a prolongation of hospital stay, increased trauma care, treatment costs, and general wound management practices become more resource demanding (Bowler *et al*, 2001).

The severity of the complications depends largely on the infecting pathogen and on the site of infection

(Terry, 1985; Garner *et al*, 1988) and in general, a wound can be considered infected if purulent material is observed without the confirmation of a positive culture. The control of wound infections has become more challenging due to widespread bacterial resistance to antibiotics and to a greater incidence of infections caused by methicillin-resistant *Staphylococcus aureus*, polymicrobial flora and by fungi. The knowledge of the causative agents of wound infection has therefore proved to be helpful in the selection of empiric antimicrobial therapy and on infection control measures in health institutions.

This study investigated the bacteriology of patient's infected wounds in two health institutions in Ile-Ife, Nigeria.

MATERIAL AND METHODS

Sample population: One hundred and two patients participated in the study.

They were made up of 70males and 32 females between the ages of 2 and 72 years. The patients presented for wound dressing in the outpatient departments of the Obafemi Awolowo University Teaching Hospitals Complex (O.A.U.T.H.C) and the Health Centre, Ile-Ife. The wound types include boils, whitlow, abscesses, perimicitis, trauma wounds, burns, systemic ulcers, insect bites and swelling of no specific etiology. Wound sites were categorised as head and neck; back and abdomen; breast; armpit; arm; hand; thigh and groin; leg and foot regions.

Collection of samples: All the wounds were judged as infected by the presence of purulent material. Before wound cleansing and dressing conducted by a nurse, the exudate from each wound site was carefully taken using sterile cotton-tipped applicators (Sterilin, U.K) and transferred to the research laboratory. It was immediately applied to freshly prepared blood agar plates (Oxoid, U.K), streaked and incubated aerobically at 37oC for 24 hours. Bacterial colonies on blood agar plates were later Gram stained. Characterization of bacterial isolates was based on standard microbiological methods.6 They include Gram stain, morphological and cultural characteristics on nutrient agar, spore stain, motility and carbohydrate fermentation tests, nitrate reduction, catalase, hydrogen sulphide production and indole production. Other tests include citrate utilization, gelatin liquefaction, Methyl Red-Voges Proskauer test, coagulase, haemolysis on blood agar, morphological and cultural characteristics on mannitol salt and eosin-methylene blue agar.

RESULTS

Isolation of bacterial species: One hundred and sixty two bacterial isolates were recovered from various infected wounds averaging 1.6 bacteria per specimen. Positive growth was observed in 95% of wound cultures. One microorganism was present in 39 wound cultures, several microorganisms in 55

cultures, and in eight cultures, no bacterial isolate was obtained from the cultured material. Eleven bacterial genera and seventeen species were identified (Table I).

Staphylococcus aureus was the most frequently isolated microorganism (25%) followed by *Escherichia coli*, (12%) *Pseudomonas aeruginosa* (9%) and *Staphylococcus epidermidis* (9%). The staphylococci were the predominant Gram positive organism (41%) and the family Enterobacteriaceae constituted 37% of the total number of isolates. Bacterial isolates identified as *Klebsiella pneumoniae*, *Enterobacter cloacae*, *Proteus spp* and *Pseudomonas spp* accounted for less than seven percent of the total number of isolates. A total of forty per cent of wounds was attributed to trauma and forty-two percent of isolates were recovered from this wound type (Table II).

Table I
Bacterial Isolates Recovered From Patient's Wounds

ORGANISM	N (%)	%
<i>Staphylococcus aureus</i>	41(25.3)	
<i>Staphylococcus epidermidis</i>	15(9.3)	41.4
<i>Staphylococcus sp</i>	11(6.8)	
<i>Bacillus sp</i>	13(8.0)	8.0
<i>Streptococcus sp</i>	2(1.2)	1.2
<i>Diplococcus sp</i>	1(0.6)	
<i>Aerococcus sp</i>	1(0.6)	1.2
<i>Escherichia coli</i>	20(12.3)	
<i>Enterobacter cloacae</i>	2(1.2)	
<i>Enterobacter aerogenes</i>	7(4.3)	
<i>Klebsiella pneumoniae</i>	3(1.9)	37.7
<i>Proteus vulgaris</i>	11(6.8)	
<i>Proteus mirabilis</i>	10(6.2)	
<i>Proteus sp</i>	3(1.9)	
<i>Serratia marcescens</i>	5(3.1)	
<i>Pseudomonas aeruginosa</i>	15(9.3)	
<i>Pseudomonas sp</i>	2(1.2)	10.5
TOTAL	162(100)	

Fifteen bacterial species were identified from trauma wounds followed by boils (10) and abscess (9) respectively.

Table 2: The distribution of bacterial isolates in relation to location and types of wound infection

Body Regions	Wound type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Head&Neck; n=4	Boil (1)	1															1		
	Trauma (2)	1			1														1
	Postoperative (1)				1														
Back&Abdomen; n=3	Boil (2)	2							1										
	Postoperative (1)											1							
Breast; n=3	Boil (2)	1											1	1			1		
	Abscess (1)	1							1	1									
Armpit; n=2	Boil (2)	1		1										1					
Arm; n=2	Postoperative (1)										1								
	Trauma (1)										1								
Hand; n=27	Boil (1)				1									1					
	Trauma (7)	3			1	1					1			1	1				1
	Postoperative (3)	1											1						1
	Insect bite (1)																1		
	Whitlow (12)	6	7						2								1		1
	Abscess (2)	1	1														1		
	Inflammation (1)	1	1																
Thigh & Groin; n=15	Boil (2)	1			1									1		1			
	Trauma (1)				1					1									
	Postoperative (1)	1												1					
	Abscess (6)	4							2		1			1	1			1	
	Pericinitis (2)		1		1				1				1				1		
	Burns (1)			1					1										
	Ulcers (1)	1											1						
	Inflammation (1)																		1
	Leg; n=27	Boil (6)	2			1				1					1				1
Trauma (16)		4	3	3			1		3		1		4	1		2	6		
Postoperative (1)									1										
Insect bite (2)		1		2					1										
Ulcers (2)		1	1						2				1				1		
Foot; n=19	Boils (2)								1								1		
	Trauma (14)	6		2	5				4	1	2	1	3		1	2	1		
	Postoperative (1)																		1
	Insect bite (1)			1		1													
	Inflammation (1)	1	1																
Total	41	15	11	13	2	1	1	20	2	7	3	11	10	3	5	15	2	8	

1 – *Staphylococcus aureus*; 2 – *Staphylococcus epidermidis*; 3 – *Staphylococcus spp*; 4 – *Bacillus spp*; 5 – *Streptococcus spp*; 6 – *Diplococcus spp*; 7 - *Aerococcus spp*; 8 – *Escherichia coli*; 9 – *Enterobacter cloacae*; 10 – *Enterobacter aerogenes*; 11 – *Klebsiella pneumoniae*; 12 – *Proteus vulgaris*; 13 – *Proteus mirabilis*; 14 – *Proteus spp*; 15 – *Serratia marcescens*; 16 – *Pseudomonas aeruginosa*; 17 – *Pseudomonas spp*; 18 – No growth

A total of sixty-three isolates (39%) were obtained from wound types that required incision and drainage (I & D) to remove the exudate and clean the underlying tissue (incised boils, whitlows, abscesses and permicitis). *S. aureus* was the predominant microorganism constituting 31% of the total number of isolates recovered from these wound types.

The analysis of polymicrobial infections showed that 31 (56.3%) out of the 55 polymicrobial cultures was attributed to *S. aureus* with other microorganisms. They include ten cases of *S. aureus* with Gram positive organisms, nineteen cases of *S. aureus* with Gram negative organisms and two cases involving *S. aureus*, *Staphylococcus* spp and a Gram negative organism. Nine cases of polymicrobial infections involving *Bacillus* spp and Gram negative organisms were recorded from a variety of wound types.

The location of wounds in relation to wound types and organisms isolated from each wound site is shown in Table II. Trauma wounds were mainly located at the leg and foot regions. Wound infection at the extremities was observed in 27 cases at the hand and leg regions respectively followed by 19 cases at the foot and 15 cases at the thigh and groin regions of the body. *S. aureus* was recovered from all the wound sites except the arm and it was the most frequently isolated microorganism in wounds occurring in all the regions of the body excluding the hand and leg.

DISCUSSION

Wound infection has been a major concern among health care practitioners not only in terms of increased trauma to the patient but also in view of its burden on financial resources and the increasing requirement for cost-effective management within the health care system¹. The microbiological analysis reveals that *S. aureus* is the leading etiologic agent of wound infection in these health institutions. This is similar to reports in Nigeria, India, Thailand and Japan (Emele *et al*, 1999; Basak *et al*, 1992) Tranet *et al*, 1998; Mashita *et al*,

2000). *S. aureus* was the most frequently isolated microorganism from wounds caused by incision to reach pus or fluid collection under the skin surface and from wound types observed in this study.

Microbiological investigations have noted that this organism is the single causative bacterium in approximately 25 to 69% of cutaneous abscess (Meislin *et al*, 1977; Brook *et al*, 1981; Mahdi *et al*, 2000). The same microorganism has also been recognized as the most frequent isolate in superficial infections seen in Hospital Accident and Emergency Departments.

Nasal carriage of *S. aureus* has been identified as an important risk factor for the acquisition of *S. aureus* infection, although this may depend on an array of factors that may either be environmental or patient-related (Mahdi *et al*, 2000). The postulated sequence of events which leads to infection is initiated with *S. aureus* nasal carriage which is then disseminated via hand carriage to other body sites where infection can occur with breaks in the dermal surfaces. The emergence of methicillin-resistant *S. aureus* in wound infections has led to higher treatment costs and prolongation of hospital stay with serious consequences in infection control especially in developing countries. The number of trauma wound infection observed in this study was high (40%).

The wounding agent range from nail pricks on farm sites to door slams on fingers and motorcycle accidents. Trauma is often associated with the development of local or systemic infection and the situation in which injury or trauma occur as well as the location of the injury may be predictive of the number and types of pathogens found in the wound. Infecting microorganisms may be derived either from an exogenous source (i.e. water-borne from water-related injury or microorganisms from soil in a soil-contaminated injury) or the endogenous microflora of the patient (File, 1995).

Fifteen bacterial species were identified and forty two percent of the total number of isolates was recovered from trauma wound infection. A high

number of traumatic wound infections were located on the leg and foot regions of the body i.e. the extremities. Traumatic wound infection of the extremities is a common clinical problem and the high frequency and variety of microorganisms confirms the view that microbiological evaluation before treatment should be strictly observed (Holzapfel *et al*, 1999).

Most of the wound infection in these health institutions were polymicrobial in nature and in most cases, associated with *S. aureus* and other microorganisms. The variety of organisms observed in this study support the need to obtain culture specimens from infected wounds for microbiological evaluation and antibiotic susceptibility determination, so that adapted chemotherapy can be prescribed. We believe that it will not only facilitate successful wound management but also assist in the control of antibiotic usage and hence stem the spread of antibiotic-resistant bacteria. The fact that anatomically incorrect type of surgical incisions and wound debridement may delay wound healing brings to focus that information regarding site, type of wound infection and clinical symptoms should be considered along with the value of identifying one or more bacterial pathogens. Continuous dialogue between the microbiology department and wound care practitioners is strongly advised.

We did not investigate the impact of hygiene in the development of wound infection but we suggest that education of patients on personal hygiene will be helpful in enhancing wound healing and management of patients. This is with a view to saving cost, time and providing prompt and appropriate treatment for the patient.

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