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Bacteriological profile of burn wound isolates in a burns center of a tertiary hospital

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ABSTRACT

Objective: To determine the bacteriological profile and antimicrobial susceptibility patterns of burn wound isolates. **Methods:** Swabs were taken from burn wound of patients admitted to Ward D2C and Burns Intensive Care Unit (BICU) from December 2014 to November 2015. Samples were processed at the Microbiology Laboratory for identification and sensitivity. Bacteria isolated were identified using their morphological characteristics, Gram staining reaction and biochemical tests. The antimicrobial susceptibility testing was done using Kirby-Bauer disc diffusion method. Questionnaires were also administered to study participants to obtain information on demography, kind of first aid received, antibiotics received prior to culture and sensitivity. **Results:** A total of 86 patients comprising 45 patients from Ward D2C and 41 from BICU participated in the study. Males were 51(59.3%) and females 35 (40.7%). Age of participants ranged from 0–56^{+} years. *Pseudomonas aeruginosa* was the commonest pathogen isolated 26(30.2%), followed by *Pseudomonas* spp. 21(24.4%), *Escherichia coli* 17(19.8%), *Klebsiella* spp. 12(14.0%). Coagulase negative *Staphylococcus* accounted for 2(2.3%). Overall prevalence of infection in the study was 90.7%. **Conclusions:** Burn wound infection continues to be a major challenge in burn centers. Regular surveillance of commonly identified pathogens in the ward and their antimicrobial susceptibility will guide proper empiric selection of antibiotics for management of burn wounds.

1. Introduction

Burn wound infection continues to be a major issue of concern globally taking a greater toll on developing countries[1], where infection of wound sites is a major cause of post-operative illness and common cause of death in burn patients, accounting for quarter of nosocomial infections[2].

Infection is the invasion of proliferating bacteria not only on the surface of the wound but into deeper, healthy viable tissue on the periphery of the wound that elicits a host response[3]. About 50% of burn related infections are caused by gram negative bacteria[4]. When burns occur, the wounds are initially sterile; however, there is gradual colonization of the wound[5]. Following burns in general, there is wound formation and delay epidermal maturation, increasing the likelihood of sepsis in persons with infected wound[6]. About 73% of post burn deaths occurring within five days has been reported to be sepsis related[7]. With high prevalence of infection and changing bacteriological profile of isolates, it is necessary to assess bacteria pathogens in each burn centre. There are three main indications for antibiotic use: identified pathogen-directed, empirical and prophylactic[8]. In Ghana, based on the microbiology surveillance,empiric antibiotic may be commenced in

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clinically systemic infected patients until specific culture organisms are identified and sensitivity available for treatment. This approach to antibiotic treatment is confirmed in a study by Giaquinto-Cilliers *et al*[9]. Burns are a major public health issue globally, resulting in an estimated 265 000 deaths and 19 million disability-adjusted life years lost annually[10,11]. This burden falls disproportionately on Low and Middle- Income Countries (LMICs), which are least equipped to provide timely and comprehensive care[12].

2. Materials and methods

2.1. Study design

This cross sectional study was conducted at the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana, from December 2014 to November 2015.

2.2. Study setting

Komfo Anokye Teaching Hospital (KATH), named after the legendary priest Okomfo Anokye,was established in 1954 and is located in Kumasi, the second largest city of Ghana. It is the only tertiary hospital in the middle belt of the country and hence doubles as a referral centre for the Northern, Upper West and East and BrongAhafo, Central, Eastern regions and some parts of the Volta Region. The hospital has two burns units; the old Burns Intensive Care Unit (BICU) (currently referred to as Burns Ward D2C) established in 2001 and the new KATH Burns Intensive Care Unit (BICU) established in 2009. The BICU is located within the Accident and Emergency (A&E) Block and consists of 6 rooms fully equipped with sophisticated equipment to fully manage severe burn cases[13].

2.3. Burns management

A burns patient presented to the unit is critically examined and the required treatment is administered according to the KATH Burns Protocol[14,15]. Either wound dressing or surgery is done asrequired. Often, broad spectrum antibiotics are administered to the patients, predominantly, I.V. Ceftazidime (Fortum), 100-150 mg per kg body weight per day (up to 9 g per day). Pain relievers are instituted also. Wound dressing is thereafter done as frequently as recommended whether a patient underwent surgery or not[14,15].

2.4. Sample collection

Questionnaires on demography such as age, sex, occupation, level of education and clinical data werecollected through a structuredquestionnaire and from the medical record at admission at the study sites; BICU and Burns Ward D2C. On day five of admission,wound swabs are taken for culturing and sensitivity tests. The surface of the woundis cleaned with sterile normal saline to prevent contamination. Excess saline is gently blotted from the wound bed with sterile gauze. Each sample is collected aseptically, wound is swabbed with a sterile cotton-tip swab stick by rotating the swab stick between the fingers. The swab stick is moved across the entire wound surface. The swab stick is quickly put in Stuart's transport medium and transported to the KATH Microbiology Laboratory.

2.4. Laboratory procedures

2.4.1. Culture and identification

Each sample was inoculated on Blood agar and MacConkey agar and incubated aerobically at 35-37 ℃ for 18-24 hours. A slide smear was prepared from each swab and Gram staining was done and reported. Overnight growth on MacConkey agar and/or Blood Agar was identified in accordance with standardoperating protocols for bacteria identification at the KATH Microbiology Laboratory depending on the bacteria isolated and the morphological features observed.

2.4.2. Antibiotic susceptibility tests

Kirby-Bauer disc diffusion method was employed to determine the susceptibility of the bacteria isolate to antibiotics according to standard protocols. The following antibiotics were used: gentamicin (10 μg), amikacin (30 μg), ceftazidime (30 μg), ciprofloxacin (10 μg), meropenem (10 μg), chloramphenicol (10 μg), cefuroxime (30 μg), ceftriaxone (30 μg), ampicillin (10 μg), cotrimoxazole (25 μg), cefotaxime (30 μg).

2.5. Data entry and analysis

Data entry and analysis was done using Statistical Package for Social Sciences (SPSS version 20 (SPSS, Inc., Chicago, IL, USA). The quantitative data was analyzed using descriptive statistics summarized and displayed on graphs and charts.

3. Results

Table 1 below shows the demographic data of the study participants. A total of 86 patients participated in the study comprising of 51 (59.3%) males and 35 (40.7%) females. Persons aged 0-5 years suffered mostly from burns, (58.1%) followed by age 31-35 years

(7.0%) with years 46-50 and 56^{+} years both recording (1.2%). Participants who have not received any form of education was 44.2% while Junior High School and Tertiary both recorded 4.7%.

3.1. Etiology of burns

It showed the etiology of burns with scalding being the commonest etiology comprising hot water 30 (34.9%); hot soup 8 (9.3%) and hot oil 6 (7.0%). Open flame burnscaused by either petrol or fire, 26 (30.2%) followed by gas explosion 12 (14.0%) and contact burns 4 (4.7%).

3.2. Substances used as first aid

Information about first aid substances used by patients could be obtained from only 10 patients out of the 86 considered for this study. Of the 10 patients who had first aid administered to them, 4 used brine wash as first aid treatment, 2 used eggs, 2 used gentian violet, 1 person used grounded snail shell and 1 person used honey.

Table 1

Demography of study participants.

Characteristics	Number of patients	
	n (Total=86)	Percentage (%)
Sex		
Male	51	59.3
Female	35	40.7
Age (years)		
0-5	50	58.1
6-10	4	4.7
11-15	5	5.8
16-20	3	3.5
21-25	3	3.5
26-30	4	4.7
31-35	6	7.0
36-40	3	3.5
41-45	4	4.7
46-50	1	1.2
51-55	2	2.3
56^{+}	1	1.2
Level of education		
None	38	44.2
Pre- school	16	18.6
Primary school	15	17.4
Junior high school	4	4.7
Senior high school	9	10.5
Tertiary	4	4.7

3.3. Pathogens isolated

Pseudomonas aeruginosa was the commonest pathogen isolated 26 (30.2%), followed by *Pseudomonas* spp. 21 (24.4%), *Escherichia coli* 17 (19.8%), *Klebsiella* spp. 12 (14.0%). Coagulase negative Staphylococcus (CNS) accounted for 2 (2.3%).

3.4. Prevalence of infection

Table 2 shows the total prevalence of infection of 90.7%, with *Pseudomonas aeruginos* are cording the highest prevalence, 30.7%.

Table 2

Prevalence of infection.

Nameof isolates	Number of isolates	Percentage(%)
Pseudomonas aeruginosa	26	30.2
Pseudomonas spp.	21	24.4
Escherichia coli	17	19.8
Klebsiella spp.	12	14.0
CNS	2	2.3
Total	78	90.7

3.5. Ward distribution of pathogens

Table 3 shows the distribution of pathogens at the wards D2C and BICU. *Pseudomonas aeruginosa* was the most common isolate associated with both wards.

Table 3

Ward distribution of pathogens.

Nameof isolates	BICU	D2C	Total
Pseudomonas aeruginosa	10	16	26
Pseudomonas spp.	9	12	21
Escherichia coli	9	8	17
Klebsiella spp.	8	4	12
CNS	0	2	2
Total	36	42	78

3.6. Antibiotics administered before culture and sensitivity

Figure 1 shows cefuroxime (51%) was the antibiotic mostly administered to the burn patients followed by ciprofloxacin (12%), combination of amoksiclav and ceftriaxone (9%) and ceftriaxone only (9%).

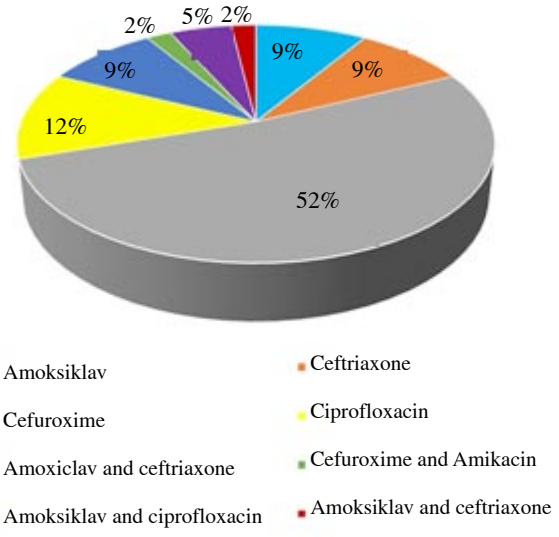

Figure 1. Antibiotics administered before culture and sensitivity.

3.7. Organisms and their sensitivity patterns

Table 4 shows the sensitivity patterns of the various isolates to antibiotics. Meropenem showed the highest sensitivity to all the pathogens isolated.

Table 4

Organisms and their sensitivity patterns [*n*(%)].

Antibiotics	*Pseudomonas aeruginosa*	*Pseudomonas* spp.	*Escherichia coli*	*Klebsiella* spp.
Gentamycin	21 (87)	15(79)	12(71)	8(57)
Amikacin	8 (80)	6(67)	3(75)	5(100)
Ceftazidime	6 (75)	9(60)	2(58)	2(100)
Ciprofloxacin	14 (70)	7(54)	9(75)	2(31)
Meropenem	23(100)	19(80)	12(100)	12(100)
Chloramphenicol	4(36)	0(0)	6(37)	3(50)
Cefuroxime	7(47)	4(44)	10(77)	2(20)
Ceftriaxone	6(67)	6(86)	5(56)	1(12)
Ampicillin	0(0)	0(0)	1(12)	0(0)
Cotrimoxazole	0(0)	0(0)	0(0)	0(0)
Cefotaxime	5(62)	8(100)	6(55)	0(0)

4. Discussion

Our study revealed a very high prevalence of wound infection: 90.7% with Gram negative species isolated from nearly all cases. This suggests that most of the wounds from which cultures were made were old acute wounds that resulted in long hospital stay and hence with high numbers of Gram negative bacteria. Studies by Hwee *et al*., 2015 supports this view by stating that there is a correlation between a long hospital stay and higher incidence of burn infection[16].

Also, studies by Bessa e*t al*., 2013 confirms the high prevalence of Gram negative bacteria isolates from most wounds with long duration of healing and long hospital stay[17].

The above results indicate that burn wound infection continues to be a major challenge for BICU. The current study revealed *Pseudomonas aeruginosa* as the commonest isolate in the Old BurnsWard D2C and other *Pseudomonas* species as the commonest isolate in the BICU. *Pseudomonas aeruginosa* as the commonest isolate in the oldBurns Ward D2C is consistent with studies by Yousefi-Mashouf and Hashemi (2006) which reported *Pseudomonas aeruginosa* as the predominant infection causing pathogen in theirBurns Center[18]. Similar finding was also reported by Dash *et al.* (2013) with *Pseudomonas aeruginosa* a predominant isolate (49.4%) in a tertiary care hospital in India[19]. The high frequency of this bacteria can be associated with the increasing level of resistance of *Pseudomonas aeruginosa* to most antibiotics[20]. Other *Pseudomonas* spp. as the commonest isolate in the BICU is similar to Kulkarni *et al*.(2015) report[21]. Saleh and Noshad (2014) also reported *Pseudomonas* as the common causative pathogen in their burns Centre[22]. Sharma &Hans and Agnihotri *et al*. reported a high incidence of *Pseudomonas* spp. isolated intheir study[23,25]. *Pseudomonas* spp. (33.6%) was identified as the commonest isolate in thestudy by Lakshmi *et al*., [25]. Similar findings on *Pseudomonas* spp. as the commonestburns isolate have been reported by others[23,26]. From the current study, CNS accounted for 2.3% of organisms isolated from the burn wound. This finding is similar to a study by Mama *et al.*, in which they reported a 14.5% CNS isolated from wounds[27]. Prevalence of Staphylococcus aureus in other burns centers havebeen reported, however in the current study only CNS was isolated which accounted for 2 (2.3 %). CNS is a normal skin flora and common contaminant of wound most often isolated[27].

The only Gram positive isolate was CNS while Gram negative bacteria identified were *Pseudomonas aeruginosa*, *Pseudomonas* spp., *Klebsiella* spp. and *Escherichia coli*. The findings from the current study is consistent with studies by Revathi *et al*.; Shahzad *et al*; Mundhada *et al*.; Lashkmi *et al*.[28-31]. Formthe current study, *Escherichia coli* 17(19.8%) and *Klebsiella* spp. 12(14.0%) were alsoidentified. Agnihotri *et al.* reported *Klebsiella* spp. Prevalence of (3.9%) in their fiveyear retrospective study of aerobic burn wound infection[24]. In their three year review ofantibiogram of burn isolates, Bayram *et al.* reported 10% prevalence of *Escherichia coli*[32].

From the current study, most of the isolates were sensitive to Meropenem (B- lactam antibiotic)and Amikacin (an aminoglycoside). Meropenem was similarly being reported by Guggenheim *et al*. in a similar burn study as the most sensitive antimicrobial compared to otherantimicrobials[33]. The current study is also consistent with findings by Bayram *et al*., Lashkmi *et al*. [25,32]. Mundhada *et al*. reported similar findings in their studythat gram negatives were susceptible to Imipenem (B-lactam antibiotic) and Amikacin (anaminoglycoside)[31].

Prevalence of infection in the current study was 90.7% indicating that burn wound infectioncontinues to be a major challenge burn centers face as infection is associated with delayedwound healing and increased length of hospital stay. This finding is consistent with a study byMelake *et al*. in which they reported burn wound infection prevalence of 36%[34].

The current study showed 11% of patients who received some form of first aid in the form ofgrounded shells, eggs and honey. This finding is consistent with a study by Abubakar *et al*., who in their study reported that some of these first aid substances such as cow dung, mud among others may be important source of infection to the burns patients, hence need for public education and sensitization on burns and the requisite form of first aid that can be administered to reduce infection of burn wound[35].

The current study showed children aged 0-5 years suffered from burns the most. Underdevelopment of the cognitive function of children and their tendency to move about during their early developmental stage causes them to pull and push objects which may containvery hot liquids causing them to sustain severe burns injuries[36]. This finding is consistent with most studies by Agbenorku; Dissanaike *et al.*; Natterer *et al*. who have reported a high incidence in this same age group[36-38]. Kemp *et al.* also reported 58% burns injury resulting from scalds, 72% of burns occurring in children less than 5years withhighest prevalence occurring in 1 year olds with commonest scalding agent being hot beverage, 55%[39].

In the current study, 59.3% of the patients were males and 40.7% were females. Similarfindings have been reported by studies conducted at other burns centers. Iqbal &Saaiq, recorded 66.84% males and 33.15% females in their study[40]. Ogundipe *et al.* also recorded a male dominance of 52.2% than females 47.8%[39]. Gupta *et al.* also reported that out of 892 patients, 485 (54%) were males and 407 (46%) were females[42].

From the current study, scalding (51.2%) was noted as the commonest etiology of burns suffered by mostly children. This is consistent with study by Delgado *et al.* n which they reported scalding as the most common cause of burns in children under 5 years[43]. The study revealed hot water as the leading scalding agent. This is consistent with study byAgbenorku, in which hot water accounted for the highest etiology(68.1%) followed by hot soup (15.6%), hot oil (9.2%)[36]. Similar findings have been reported[40,44]. High resistance to antibiotic may be due to self-medication, inappropriate antibiotic use as a result of unavailability of guideline regarding drug selection[27]. From the current study, it may be concluded that some of the patients may have already developed resistance to antibiotics that were administered to them. Subsequently, antibiotics administered to them prior to culture may possibly affect bacteria growth and resistance. Paruk *et al.* in their study in intensive care units in South Africa reported that inappropriate antibiotics administered to patients were associated with poor patient outcome[45].

Pseudomonas aeruginosa and *Pseudomonas* spp. were the most common pathogens isolated in this study. Meropenem, a B-lactam antibiotic, was identified as the most sensitive antibiotic. Overall prevalence of burn wound infection in the current study was 90.7%. Scalding was the commonest etiology of burn in the study and was mostly suffered by children aged 0-5 years.

Males had high predominance of burn injuries compared to females.

Conflict of interest statement

The authors report no conflict of interest.

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