

# PATTERN OF BACTERIAL PATHOGENS IN BURN WOUND INFECTIONS IN IBADAN, NIGERIA

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**SUMMARY.** A retrospective study of 85 patients with burn wound infections was carried out in University College Hospital, Ibadan, Nigeria, between April 1998 and March 2001. A total number of 85 specimens consisting of 35 wound swabs (41.2%) and 50 wound biopsies (58.8%) were processed during the period. Burn wound infections were significantly more frequent in children and adolescents (5-20 yr) than in adults ( $p < 0.05$ ). *Klebsiella* species was the pathogen most commonly isolated, constituting 34.4%. This was closely followed by *Pseudomonas aeruginosa* (29.0%) and *Staphylococcus aureus* (26.8%). The rate of isolation of Gram-negative organisms was more than twice that of Gram-positive organisms. More than 75% of the Gram-negative isolates were resistant to gentamicin, a commonly used antibiotic for Gram-negative infections, but sensitive to ceftazidime and pefloxacin. Gram-positive isolates were predominantly *Staphylococcus aureus* sensitive to azithromycin and pefloxacin. This study highlights the predominant bacterial pathogens and their antimicrobial profile among infected burn wounds in our centre.

## Introduction

Infection is a major cause of morbidity and mortality in hospitalized burn patients.<sup>1</sup> The infection is due to the combined effect of impairment of the host natural defence system, colonization of the burn wound site, and systemic dissemination of the colonizing organisms.<sup>2</sup>

The denatured protein of the burn eschar provides nutrition for the organisms. Avascularity of the burned tissue places the organisms beyond the reach of host defence mechanisms and systemically administered antibiotics.<sup>3</sup> This constitutes a serious threat to the management of such patients.

Burn wound infections are largely hospital-acquired and the infecting pathogens differ from one hospital to another.<sup>4</sup> Wound sepsis in burn patients constitutes a significant percentage of surgical wound infections. The prevalence rate of surgical wound infection was 4.4% in Ibadan in 1979<sup>5</sup> and rose minimally to 4.9% in the same centre 18 years later.<sup>6</sup>

Accurate identification of these pathogens may be difficult outside specialist centres owing to inappropriate methods of specimen collection and inadequate laboratory facilities.

There is a need to assess the pattern of bacterial pathogens responsible for burn wound infections in a specialist centre like ours, where the required medical personnel and adequate laboratory facilities are available. This will form useful data for initiating empiric treatment pending the outcome of the culture results.

## Materials and methods

This retrospective study spanning a period of three years (April 1998-March 2001) was carried out in University College Hospital, Ibadan, Nigeria. The results of wound swabs and biopsies taken from patients with burn wound infections were retrieved from the Medical Microbiology laboratory, taking cognizance of the patients' names and hospital numbers. Thereafter, individual case notes were sorted out from the hospital's records department. Information regarding the patient's age and sex, aetiology of burns, type of specimen taken, prophylactic antibiotic use and culture results, and antibiotic sensitivity patterns were extracted.

Burn patients without documented clinical evidence of wound infections were excluded from the study.

Wound swabs and biopsies were taken from infected burn wounds by the use of swab sticks and scalpel blades respectively. The specimens were transported to the laboratory where they were cultured onto blood agar and MacConkey agar and incubated aerobically at 37 °C for 48 h. Suspicious isolates were confirmed by standard microbiological methods.<sup>7</sup> The antibiotic susceptibility of each isolate was tested manually according to NCCLS recommendations for disc diffusion.<sup>8</sup>

The number of patients managed for surgical wound infection in the same period was also noted.

The data collected were analysed with the aid of the Statistical Package for Social Sciences (Version 10) computer software. A  $p$  value  $< 0.05$  was taken as significant.

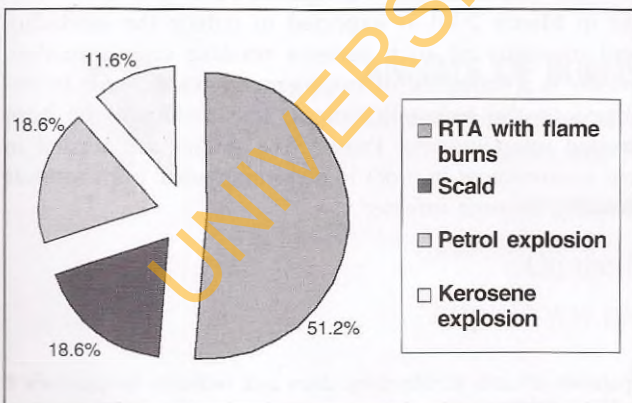
## Results

Adolescents and patients in their early childhood accounted for 45 of the burn wound infections (52.9%), while only two cases (2.4 %) were seen in the elderly. Male patients accounted for 47 (55.3%), while 38 (44.7%) were seen among their female counterparts. There was no significant difference in the frequency of burn wound infections by sex ( $\chi^2 = 0.953$ ,  $df = 1$ ,  $p = 0.329$ ) (Table I).

**Table I** - Frequency of burn wound infections by age and sex of patients

Variable	Number	Percentage
Age (yr)		
< 10	25	29.4
10-20	20	23.5
21-40	24	28.2
41-60	10	11.8
> 60	2	2.4
Unspecified	4	4.7
Total	85	100
Sex		
Male	47	55.3
Female	38	44.7
Total	85	100

Road traffic accidents with flame burns accounted for more than 50% of the burn injuries seen, while domestic petrol and kerosene explosions were responsible for 16% and 10% respectively (Fig. 1).



**Fig. 1** - Aetiology of burn wounds (RTA = road traffic accidents).

A total number of 85 specimens from infected burn wounds consisting of 35 (41.2%) wound swabs and 50

(58.8%) wound biopsies were processed. Isolates were recovered from 25 of the wound swabs processed (71.4%), while wound biopsy gave an isolation rate of 46 (90.2%). The difference was statistically significant ( $p < 0.05$ ).

Ninety-three isolates were recovered from the specimens, of which 67 (72%) were Gram-negative organisms and 26 (28%) were Gram-positive. *Klebsiella* species and *Pseudomonas aeruginosa* accounted for more than 80% of the Gram-negative organisms, while Gram-positive organisms were predominantly *Staphylococcus aureus* (96.2%).

*Klebsiella* species was the most frequent pathogen isolated (34.4%), followed by *Pseudomonas aeruginosa* (29.0%) and *Staphylococcus aureus* (26.8%). Table II shows the distribution of the isolates.

**Table II** - Frequency of isolates recovered from infected burn wounds

Isolates	Number	Percentage
<i>Klebsiella</i> species	32	34.4
<i>Pseudomonas aeruginosa</i>	27	29.0
<i>Staphylococcus aureus</i>	25	26.8
<i>Proteus</i> species	6	6.5
<i>Escherichia coli</i>	2	2.2
<i>Streptococcus pyogenes</i>	1	1.1
Total	93	100

Only two isolates (6.3%) of *Klebsiella* species and five isolates (18.5%) of *Pseudomonas aeruginosa* were sensitive to gentamicin, an antibiotic commonly used for Gram-negative infections. Table III shows the antibiotic sensitivity pattern of the isolates.

**Table III** - Antibiotic sensitivity pattern of the isolates

Isolate	Ampicillin (10 mcg)	Penicillin (2 IU)	Cloxacillin (5 mcg)	Gentamicin (5 mcg)	Ceftriazone (30 mcg)	Ceftazidime (30 mcg)	Azithromycin (15 mcg)	Pefloxacin (10 mcg)
<i>Klebsiella</i> sp. (N = 32)	-	-	-	2 (6.3%)	8 (25.0%)	20 (62.0%)	-	24 (75.0%)
<i>Pseudomonas aeruginosa</i> (N = 27)	-	-	-	5 (18.5%)	4 (14.9%)	19 (70.4%)	-	22 (82.0%)
<i>Staphylococcus aureus</i> (N = 25)	0	0	0	2 (8.0%)	9 (36.0%)	-	20 (80.0%)	21 (84.0%)
<i>Proteus</i> sp. (N = 6)	-	-	-	4 (67.0%)	4 (67.0%)	5 (83.0%)	-	5 (83.0%)
<i>Escherichia coli</i> (N = 2)	-	-	-	0	1 (50.0%)	2 (100.0%)	-	2 (100.0%)
<i>Streptococcus pyogenes</i> (N = 1)	1 (100.0%)	1 (100.0%)	-	-	-	-	-	-

## Discussion

The burn wound is considered one of the major health problems in the world, and infection is one of the most frequent and severe of complications in patients who have sustained burns.<sup>7</sup>

In this study, a higher percentage (52.9%) of burn wound infections occurred in early life (< 20 yr), while a lower percentage (2.4%) was seen in the elderly (> 60 yr). This is in agreement with the findings of Pruitt et al.<sup>2</sup> Road traffic accidents with flame burns accounted for more than 50% of burn injuries seen during the study period. This was the period of a scarcity of petroleum products in Nigeria when people often travelled with petroleum products in their vehicles and these ignited at the slightest opportunity.

Burn wound infection is a component of surgical wound sepsis. Our study found that burn wound infection constituted 16% of surgical wound infections in our centre, which is consistent with the report by Ogunsola et al. published in 1998.<sup>4</sup> More isolates were recovered from wound biopsies than from wound swabs. This is in keeping with the fact that a wound biopsy is a more representative sample of an infected wound as it is devoid of surface contaminants.

Gram-negative isolates almost tripled the number of Gram-positive pathogens. This does not agree with the submission of Odugbemi and Coker<sup>10</sup> but is consistent with the work done by Oni et al. in 1997.<sup>6</sup>

*Klebsiella* species was the most frequent pathogen isolated, accounting for 34.4% of cases. However, a similar study from India showed that *Pseudomonas aeruginosa* was the most frequent pathogen isolated, accounting for 36% of the total number of the organisms.<sup>11</sup>

The high prevalence rate of *Klebsiella* species in our study may be related to an outbreak of cases involving the organism reported a few years previously in the same centre.<sup>6,12</sup>

Eighty per cent of the Gram-negative isolates were *Klebsiella* species and *Pseudomonas aeruginosa*, almost all of which were multidrug resistant. Nevertheless, only two isolates (6.3%) of *Klebsiella* species and five strains

(18.5%) of *Pseudomonas aeruginosa* were sensitive to gentamicin, an antibiotic commonly prescribed for Gram-negative infections. The fact that renal blood flow and glomerular perfusion are acutely compromised in major burns is well established;<sup>13</sup> this, coupled with the likely deposition of haemoglobin and/or myoglobin in deep burns and the effects of sepsis, may further compromise renal function. Gentamicin should therefore be used with caution in such patients. The Gram-positive isolates were predominantly *Staphylococcus aureus*, which were resistant exclusively to ampicillin and cloxacillin but sensitive only to azithromycin and pefloxacin. These were probably strains of methicillin-resistant *Staphylococcus aureus* (MRSA).

In 1999 Okesola et al. reported that 35% of *Staphylococcus aureus* isolated from infected wounds in Ibadan were MRSA.<sup>14</sup> This high prevalence rate of MRSA in our environment calls for routine testing of all *Staphylococcus aureus* isolates from wound specimens for methicillin resistance. This will serve to curb the spread of this organism and also to institute early and appropriate therapy, with an ultimate reduction in the cost of management of these patients.

## Conclusion

Antibiotic resistance due to inappropriate use of drugs is a common finding in our environment. Both medical and paramedical staff must be educated regarding the rational use of antibiotics. Similarly, the community at large must be enlightened through proper health education programmes about the dangers inherent in self-medication.

The establishment of a separate burns unit in our centre in March 2001 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. Prospective studies are needed in our environment in order to determine when burn wounds actually become infected.

**RESUME.** Les Auteurs ont effectué une étude rétrospective de 85 patients atteints d'infections dues aux brûlures hospitalisés à University College Hospital, Ibadan, Nigeria, entre avril 1998 et mars 2001. En tout, 85 spécimens, qui consistaient en 35 tampons (41,2%) et 50 biopsies (58,8%) provenant des lésions, ont été examinés pendant cette période. Les infections des brûlures étaient plus fréquentes, en manière significative, parmi les enfants et les adolescents (5-20 ans) par rapport aux adultes ( $p < 0.05$ ). L'espèce *Klebsiella* était le pathogène isolé le plus fréquemment (34,4%), suivi par *Pseudomonas aeruginosa* (29,0%) et *Staphylococcus aureus* (26,8%). Le taux d'isolement des organismes à Gram négatif était plus de deux fois supérieur à celui des organismes à Gram positif. Plus de 75% des espèces isolées à Gram négatif étaient résistantes au gentamicine, un antibiotique communément utilisé seulement pour les infections à Gram négatif, mais sensibles au ceftazidime et à la péfloxacine. Les organismes isolés à

Gram positif étaient surtout le *Staphylococcus aureus* sensible à l'azithromycine et à la péfloxacine. Les Auteurs dans cette étude ont mis en lumière les pathogènes bactériens principaux et leur profil antimicrobien parmi les brûlures infectées traitées dans leur centre.

**BIBLIOGRAPHY**

1. McManus A.T., Mason A.D., jr, McManus W.F., Pruitt B.A., jr: A decade of reduced Gram-negative infections and mortality associated with improved isolation of burned patients. Arch. Surg., 129: 1306-9, 1994.
2. Pruitt B.A., Colonel M.C., McManus A.D.: Opportunistic infections in severely burnt patients. Am. J. Med., 76: 146-154, 1984.
3. Order S.E., Mason A.D., jr, Switzer W.F., Moncrief J.A.: Arterial vascular occlusion and devitalization of burn wounds. Ann. Surg., 161: 502-8, 1965.
4. Ogunsola F.T., Oduyebo O., Iregbu K.C., Coker A.O., Adetunji A.: A review of nosocomial infections at LUTH: Problems and strategies for improvement. J. Nigerian Infection Control Association, 1: 14-20, 1998.
5. Montefiore D.G., Alausa K.O., Cooke A.R. et al.: Epidemiology surveillance of hospital-acquired wound infections. Nig. Med. J., 9: 289-93, 1979.
6. Oni A.A., Bakare R.A., Okesola A.O., Ogunlowo H.A.: Pattern of bacterial pathogens in surgical wound infections. Afr. J. Med. and Med. Sci., 26: 139-40, 1997.
7. Zorgani A., Zaidi M., Ranka R., Shahen A.: The pattern and outcome of septicemia in a burns intensive care unit. Ann. Burns and Fire Disasters, 15: 179-82, 2002.
8. Cowan S.T., Steel K.J.: Characters of Gram-negative bacteria. In: "Manual For the Identification of Medical Bacteria", 94-150, Cambridge University Press, Cambridge, 1995.
9. National Committee for Clinical Laboratory Standards for Antibacterial Disk Susceptibility Tests. Approved Standards M2-A5, Vallanova, 1993.
10. Odugbemi T., Coker A.O.: Prevalent hospital-acquired infection in Nigeria: Prevention and cure. Postgraduate Doctor Middle East, 11: 332-9, 1987.
11. Revathi G., Puri J., Jain B.K.: Bacteriology of burns. Burns, 24: 347-9, 1998.
12. Akindele J.A., Gbadegehin R.A.: Outbreak of neonatal *Klebsiella* septicemia at University College Hospital, Ibadan, Nigeria. Tropical and Geographical Medicine, 46: 151-3, 1994.
13. Ramzy P.I., Barret J.P., Herndon D.N.: Thermal injury. Critical Care Clinics, 15: 333-52, 1999.
14. Okesola A.O., Oni A.A., Bakare R.A.: Prevalence and antibiotic sensitivity pattern of methicillin-resistant *Staphylococcus aureus* in Ibadan, Nigeria. J. Hosp. Infect., 41: 74-5, 1999.

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