

TISSUE ISOLATES IN THE BURN UNIT OF THE PHILIPPINE GENERAL HOSPITAL : A FIVE-YEAR REVIEW

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ABSTRACT

From January 1, 1994 to December 31, 1998, tissue isolates taken intraoperatively done at the Microbiology Laboratory of the Philippine General Hospital (PGH) were reviewed with the objective of determining the microbiology and sensitivity patterns of the different tissue isolates of patients admitted to the Burn Unit. Sensitivities of all isolates were done using the disc diffusion method. There were 281 isolates, 62 episodes (22%) of which were mixed cultures. Two hundred thirty two (82.6%) were gram negative organisms while 48 (17%) were gram positive. There was one isolate of *Candida spp.* The top 3 gram negative organisms were *Pseudomonas aeruginosa* (31%), *Enterobacter spp.* (13%), and *Klebsiella spp.* (8%). Among the gram positive organisms, *Staphylococcus aureus* accounted for 11 % of all isolates.

The sensitivity patterns of *P. aeruginosa* to the following drugs were as follows – ceftazidime 27%, piperacillin-tazobactam 68%, imipenem 82%, ciprofloxacin and amikacin 38%, netilmicin 85%, and 8% to gentamicin. *Enterobacter spp.* Showed the following patterns – ceftazidime 32%, piperacillin-tazobactam 74%, imipenem 97%, ciprofloxacin 92%, amikacin 89%, netilmicin 33%, and 16% to gentamicin. Meanwhile, *Klebsiella spp.* exhibited the following sensitivity profile – ceftazidime 29%, piperacillin-tazobactam 77%, imipenem and amikacin 100%, ciprofloxacin 93%, netilmicin 47%, and 21% to gentamicin.

Out of the 27 *S. aureus* isolates tested for oxacillin, 18 (67%) were sensitive to the drug. It is also noteworthy to mention the emerging problem of oxacillin-resistant *S. aureus* (ORSA), which in this series accounted for 33% of all *S. aureus* isolates. No resistance to vancomycin was noted.

As in studies done abroad, this five-year review also noted the predominance of *P. aeruginosa* and *S. aureus*. Thus, when dealing with burn wound infections, it would be helpful to keep these two important pathogens in mind. Sensitivity patterns vary from one institution to another, hence the need for continued surveillance.

INTRODUCTION

Knowledge of the most common etiologic agents involved in a particular infection is of paramount importance. It facilitates the work of the physician especially in the selection of appropriate therapy. Empiric antibiotics would have to be decided on before culture results become available. Ideally, each community and/or institution should be able to determine the most prevalent organisms in order to avoid any delay in the management of patients.

The burn wound is certainly a rich environment for the growth of microorganisms. Not only is there a destruction of the natural skin barrier but there exists a concomitant depression of the humoral and cell-mediated immunity. Thus, the burn wound is easily colonized with potentially invasive organisms derived from both endogenous and exogenous sources. Several foreign epidemiologic studies on the pathogens of burn wounds have utilized surface swab cultures to document infection^{1,2,3,4}. However, burn wound biopsy culture is now recommended as bacteria can penetrate and proliferate beneath the eschar and even breach this barrier to invade the underlying viable tissue^{5,6}.

To date, there is a paucity of local studies on the microbiology of the burn wound^{5,7}. This paper thus aims to review the tissue isolates taken intraoperatively from patients admitted to the Burn Unit of the Philippine General Hospital (PGH). The other objective of the study is to determine the antimicrobial sensitivity patterns of the most common organisms isolated.

METHODOLOGY

Data regarding the number of admissions covering the period from January 1, 1994 to December 31, 1998 were gathered from the Records Section of the Philippine General Hospital.

A review of bacterial isolates from tissues taken intraoperatively was done at the Microbiology Laboratory of PGH. The tissue isolates were then tabulated and their corresponding antibiograms noted. Sensitivity testing was performed using the disk diffusion method of Kirby-Bauer with Mueller-Hinton blood agar. All the antibiotics used were based on the recommendations of the National Committee on Clinical and Laboratory Standards (NCCLS).

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RESULTS

During the 5-year study period, 923 adult and pediatric patients were admitted to the 11-bed capacity Burn Unit of PGH. Upon review of the records of the Microbiology Laboratory, a total of 281 tissue isolates were noted. Sixty-two episodes (22%) were mixed cultures (Table 1).

Table 1. Number of Burn Tissue Isolates, January 1994 to December 1998

Year	Tissue Isolate (No.)	Mixed Culture (No.)
1994	57	12
1995	34	8
1996	14	4
1997	35	6
1997	141	32
TOTAL	281	62

The distribution of organisms is presented in Table 2. Gram negative organisms comprised the largest percentages at 82.6%. Table 3 shows the summary of all the tissue isolates. *Pseudomonas aeruginosa* accounted for 31%. It was consistently the most predominant organisms during the 5-year period, the prevalence ranging from 26 to 33%. Meanwhile, 13% of isolates were *Enterobacter spp.* and 8% were *Klebsiella spp.*

Among the gram positive organisms, *Staphylococcus aureus* was the most common (67%). Overall, it ranked third (11%) among the isolates.

Table 2. Distribution of Burn Tissue Isolates

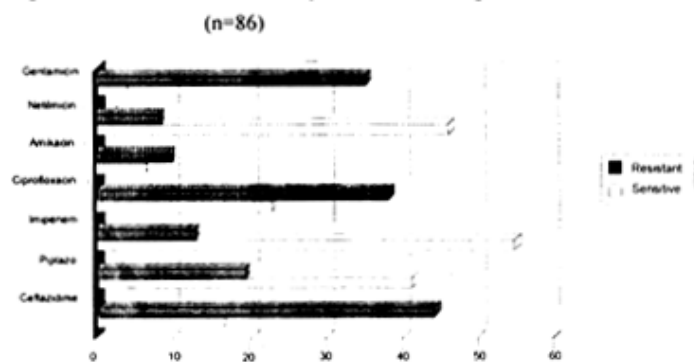
Organism	Number	Percentage
Gram negative	232	82.6
Gram positive	48	17
<i>Candida spp.</i>	1	0.4

Table 3. Summary of Burn Tissue Isolates

Organism	1994	1995	1996	1997	1998	Total	%
<i>P. aeruginosa</i>	15	10	4	11	46	86	31
<i>Enterobacter spp.</i>	6	8	1	5	17	37	13
<i>S. aureus</i>	2	5	1	2	22	32	11
<i>Klebsiella spp.</i>	4	2	1	3	13	23	8
<i>Acinetobacter spp.</i>	6	4	1	3	5	19	7
<i>Providencia spp.</i>	9	3	1	2	4	19	7
<i>Escherichia spp.</i>	6	1	2	-	6	15	5
<i>Proteus spp.</i>	4	1	-	-	5	10	4
<i>Pseudomonas spp.</i>	4	-	1	2	4	11	4
<i>Citrobacter spp.</i>	-	-	-	3	2	5	1.8
<i>Alcaligenes spp.</i>	1	-	-	-	4	5	1.8
<i>Morganella</i>	-	-	1	-	1	2	0.7
<i>Enterococcus</i>	-	-	-	2	7	9	3
<i>Staphylococcus spp.</i>	-	-	1	1	4	6	2
<i>Streptococcus spp.</i>	-	-	-	1	-	1	0.35
<i>Candida spp.</i>	-	-	-	-	1	1	0.35

The antibiogram of *P. aeruginosa* is presented in Figure 1. Ceftazidime, ciprofloxacin, and the aminoglycosides, amikacin and gentamicin showed low sensitivity levels. Only piperacillin-tazobactam, imipenem, and netilmicin performed favorably.

Figure 1. Antimicrobial Sensitivity Pattern of *P. aeruginosa*

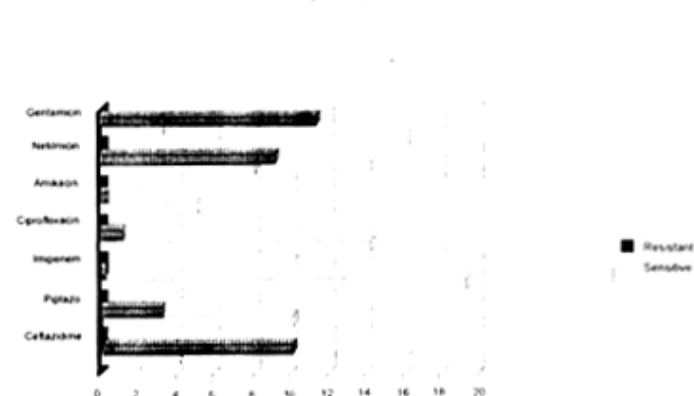


The antimicrobial sensitivity patterns of *Enterobacter spp.* and *Klebsiella spp.* showed a more or less similar trend (figure 2 & 3 respectively). The organisms were less susceptible to ceftazidime, netilmicin, and gentamicin. On the other hand, the antibiotics to which the organisms responded well were piperacillin-tazobactam, imipenem, ciprofloxacin, and amikacin.

Figure 2. Antimicrobial Sensitivity Pattern of *P. Enterobacter spp.* (n=37)

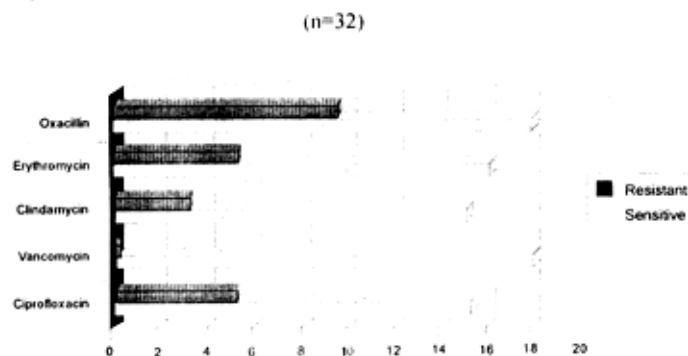


Figure 3. Antimicrobial Sensitivity Pattern of *Klebsiella spp.* (n=23)



Out of the 27 isolates of *S. aureus* tested for oxacillin, 18 (67%) were sensitive to the drug. It is noteworthy to mention the emerging problem of oxacillin-resistant *S. aureus* (ORSA), which in this series accounted for 33% of all *S. aureus* isolates. The organisms, however, remained 100% sensitive to vancomycin (Figure 4).

Figure 4. Antimicrobial Sensitivity Pattern of *S. aureus*



DISCUSSION

The burn wound is the most obvious potential source of sepsis for the seriously burned patient⁷. It belongs to the top four major infections in any population of burn patients - the others being bloodstream, lower respiratory tract, and urinary tract infections^{8,9}. A research done by Sotto et al documented that the incidence of wound infection in patients with extensive burn injuries correlated with high incidence of fatal septicemia⁵.

Two locally-published studies utilized surface swab cultures in order to determine the most common bacterial isolates in their respective burn units¹¹. Only the study done by Lucero et al enumerated the organisms. *P. aeruginosa* headed the list at 39.5%, followed by *Pseudomonas putida* (9.5%), and *S. aureus* (8.9%). The rest of the isolates were all gram negative organisms.

A retrospective study done in China showed that the gram negative rods constituted 55.7% of all pathogens while 40.5 % were gram positive cocci¹⁰. The present review showed a similar trend although the prevalence of the gram negative organisms was much higher while that of the gram positive organisms was lesser.

Several foreign studies have also noted the predominance of *P. aeruginosa* and *S. aureus* in the burn wound. The prevalence of *P. aeruginosa* ranged from 10.9% to 36% while *S. aureus* accounted for 14% to 69%^{10,11,12,13,14,15,16}.

Even in prospective studies, these two organisms were consistently among the top isolates^{7,17,18,19}. A clinicopathological study done by Bariar et al found that most of the burn wounds were sterile from the first to the third postburn day (PBD) except for the growth of *Streptococcus haemolyticus* on the first PBD. As early as the third PBD, gram negative organisms notably *P. aeruginosa* and gram positive organisms especially *S. aureus* invaded the burn wound¹⁹.

Regarding the sensitivity profile of the gram negative isolates in the study, there was high resistance to both ceftazidime and gentamicin. Since there was no correlation done between the timing of collection of burn tissue and the isolates, the authors can only surmise that the isolates could probably be nosocomial in origin since the burn patients had a prolonged hospital stay and their isolates could probably be nosocomial in origin since the burn patients had a prolonged hospital stay and their isolates'

antibiograms closely matched those of the hospital flora. These data could be gleaned from the report of the Infection Control Committee of PGH²⁰. Since piperacillin-tazobactam and imipenem have just been introduced in the mid-1990's, there was less resistance to these drugs. In a comparative study done by Monkaddas et al, piperacillin-tazobactam was found to hold good promise against gram negative infections in burn patients²¹. Ciprofloxacin is another alternative drug and it has been observed to be efficacious and did not cause arthropathy among the immunosuppressed pediatric burn patients²². Because of its broad spectrum of activity, the use of imipenem is slowly increasing in the Burn Unit of PGH. However, in this five year review, resistance has already been observed to be in the range of 0 to 18%. Monkaddas et al noted that as much as 72.2% of aerobic gram negative organisms resistant to imipenem mostly came from patients with burns²³. This observation once again emphasizes the need for the rationale use of antibiotics so as not to promote the emergence of resistant strains.

Another growing concern in the management of burn wound infection is the role of ORSA. Since 1975, it has started to appear and by the late 1980's, its prevalence rose to 31.4% to 55.9%, and by the mid-1990's, it fell to 4.3% to 28%^{24,25}. However, in a study done by Huan et al, as much as 92.2% of *S. aureus* strains isolated from burn wounds were methicillin-resistant²⁶. The 33% prevalence rate noted in the present study is not much different. Fortunately, all *S. aureus* strains were sensitive to Vancomycin.

CONCLUSIONS AND RECOMMENDATIONS

A total of 281 burn tissue isolates were reviewed during a five-year period. Gram negative organisms constituted the majority (82.6%) while only 17% were gram-positive. The three most common gram negative organisms were *P. aeruginosa* (31 %), *Enterobacter spp.* (13%), and *Klebsiella spp.* (8%). Resistance to ceftazidime and gentamicin was high compared to the other antibiotics.

S. aureus was the most common gram-positive isolate and overall, it ranked third (11%). About one-third were oxacillin-resistant. No resistance to vancomycin was noted.

Being a retrospective study, certain inherent limitations were present. There was no analysis done on the timing of collection of specimens - whether the isolate was acquired nosocomially or not. Equally relevant data like clinical and blood culture correlations of the tissue isolates could also be topics for future research work. There was only one isolate of *Candida spp.* but this could have been the result of underreporting, since not all surgeons request for fungal cultures. Even anaerobic cultures were lacking. Multiple organisms can coexist in the burn wound as evidenced by several studies^{14,16,17}.

Notwithstanding all these limitations, the present review hopefully will serve as baseline data for physicians caring for burn patients. Antimicrobial therapy is just a part of the holistic management. The sensitivity profile of the most common isolates will just be guides in the choice of the proper empiric antibiotics.

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