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Microbiological Profile and Antibiotic Sensitivity Pattern of Burn Wound Infection in an Indian Tertiary Care Hospital

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Infection is an important cause of mortality in the late post burn period. Burn wound swab culture helps in identifying microorganisms and selection of appropriate antibiotics. This aids in control of infection and morbidity, which facilitates early discharge from hospital and reduces the cost of treatment. The present retrospective study of burn wound swab culture was undertaken to determine the bacteriological profile and the antibiotic sensitivity pattern in burn unit of our hospital. Burn wound swabs were cultured and identified by conventional methods. Antibiotic susceptibility was performed by Kirby Bauer disk diffusion method.

Wound swab yielded very high culture positivity (98.6%) from 665 of total specimens. Gram-negative bacilli were responsible for majority of infections in which *Pseudomonas* spp. (61.95%) was the most frequently isolated, followed by Enterobacter spp.(19.73%). Gram-positive cocci were isolated from 14.13% samples. Pan resistance to commonly used antibiotics was observed in 45 (10.92%) isolates of Pseudomonas spp. and 35 (10.9%) isolates of other gram-negative. *Pseudomonas* spp. showed maximum sensitivity to piperacillin-tazobactam (69.8%) while other gram-negative isolates to meropenem, cefoperazone-sulbactam and piperacillin-tazobactam. Gram-positive cocci were sensitive to vancomycin and linezolid.

Key words: Microbiological profile, Burn, Wound infection, Antibiotic sensitivity.

Infection is a leading cause of morbidity and mortality in burn patient. [1, 2] Patients acquire infection because of their destroyed cutaneous barrier, suppressed immune system and prolonged hospital stay.[3, 4] Necrotic tissue in the burn eschar combined with the presence of serum proteins provides a rich culture medium for growth of microorganisms. Along with this, the eschar is avascular which restricts the migration of host immune cells and delivery of systemically administered antibiotics. Microorganisms are transmitted to wound surface either from patient's endogenous flora or from hospital environment through hands of personnel, fomites, diagnostic procedures and invasive therapy.[5]

Burn wound infection can be caused by bacteria, fungi or viruses although majority of infections are caused by bacteria.[6] Surface swab culture is recommended for diagnosis of burn

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infection. The spectrum of infective pathogen and their sensitivity pattern varies from place to place and time to time. Therefore, the periodic review of bacterial isolates and their antibiogram is necessary as it forms the basis for formation of drug regime and regular modification in it.

This study was conducted with the aim to find out the bacterial flora of wound swab from patients in burn unit and to study the antibiogram of different isolated organism.

MATERIAL AND METHODS

This is a retrospective study conducted in the Department of Microbiology from April 2009 to March 2010. The wound swabs from 665 patients admitted to the burn unit were studied. The specimens were received in sterile leak proof container. All the specimens were inoculated on 5% blood agar, MacConkey agar and Thioglycolate broth and incubated overnight at 37°C. The bacterial isolates were identified by conventional biochemical methods according to standard microbiological techniques. [7]

Antimicrobial susceptibility testing was done on Mueller Hinton agar according to CLSI guidelines by Kirby Bauer disk diffusion method. [8.] Antibiotics used for gram-negative bacilli other than pseudomonas were amikacin (30µg), cefepime (30µg), cefixime (5µg), cephotaxime (30µg), cefoperazone-sulbactam (75/30µg), chloramphenicol (30µg), ciprofloxacin (5mg), doxycycline (30µg), gatifloxacin (5mg), meropenam (10µg), piperacillin (100µg), and piperacillin-tazobactum (100/10µg). For Pseudomonas species amikacin (30µg), cefuroxime (30µg), ceftazidime (30µg), cefoperazone-sulbactam (75/30µg), chloramphenicol (30µg), ciprofloxacin (5µg), gentamicin (10µg), gatifloxacin (5µg), meropenam (10µg), piperacillin (100µg), piperacillin-tazobactum (100/10µg), tobramycin (10µg) and for gram positive cocci amoxicillin (10µg), amoxiclav (30µg), clindamycin (2µg), cephalexin, (30mg), cephoxitin, (30µg), ciprofloxacin (5µg), doxycycline (30µg), gentamicin (10µg), gatifloxacin (5µg), linezolid (30g), oxacillin, (1µg), penicillin G (10 U), piperacillin-tazobactum (100/10µg) and vancomycin (30µg) were used.

Standard strain *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 25923 and *Pseudomonas aeruginosa* ATCC 27853 were used as control.

RESULTS

From 665 wound swab specimens, microorganisms were isolated in 656(98.6%) specimens while 9(1.4%) were sterile. Single organism was isolated in 508(76.3%) specimens while 125(18.8%) and 23 (3.5%) specimens yielded two and three isolates respectively. (Table 1)

From 665 specimens 827 strains belonging to 9 species of bacteria were isolated during the course of present study. Gram-negative bacilli were responsible for majority of infections. The most common isolate was *Pseudomonas aeruginosa* (61.95%) followed by Enterobacter species (19.73%). Gram-positive cocci were isolated from 14.13% of swab specimens (Table 2).

Table 3 shows the antibiotic sensitivity pattern of gram-negative bacilli to various antibiotics. *P. aeruginosa* showed maximum sensitivity to piperacillin-tazobactam (69.8%) followed by meropenam (64.9%) and cefoperazone-sulbactam (60.4%). Amikacin, chloramphenicol, cefttazidime, cefuroxime and tobramycin were effective only in 5-10% of isolates.

Enterobacter species were isolated from 132 samples (19.73%). Maximum sensitivity was observed with meropenam (79.4%) cefoperazone-sulbactam (71.6%). and piperacillin-tazobactum (67.8%). Susceptibility to cephalosporins, chloramphenicol and ciprofloxacin was poor. Similar sensitivity pattern was seen with other gram-negative bacteria also.

Only 9 strains of acinetobacter species were isolated during the study with high resistance pattern. Out of 9 strains isolated 3 strains were pan

Table 1. Distribution of bacterial isolates cultured from wound swabs

Bacterial isolates	Number	Percentage
Single organism	508	76.3
Two organism	125	18.8
Three organism	23	3.5
No organism (sterile)	9	1.4
Total	665	100

resistant and others showed low susceptibility to a wide range of antibiotics.

In the present study, multi-drug resistant strains of pseudomonas and gram negative bacilli were isolated. Forty-two strains (10.19%) of pseudomonas were sensitive to only one antibiotic while 45 strains (10.92%) were pan resistant. Similarly, 25 strains (7.78%) of gram-negative isolates were pan resistant while 35 strains (10.9%) were sensitive to one antibiotic only.

All gram-positive cocci isolates were sensitive to vancomycin. Sensitivity to linezolid was 93% and 95% for coagulase positive staphylococci and coagulase negative staphylococci (CNS) respectively. Other antibiotics effective against staphylococci were piperacillin-tazobactum, ciprofloxacin and gatifloxacin. (Table 4) Methicillin resistance was observed in 33.50% of *S.aureus* and 27.40% of (CNS).

Table 2. Prevalence of organisms isolated from swab culture of burn wound

Organism	Number of strain isolated	Percentage
Pseudomonas aeruginosa	412	61.95
Enterobacter species	132	19.73
Citrobacter species	78	11.65
Coagulase positive staphylococci	57	8.57
Coagulase negative staphylococci	37	5.56
Escherichia coli	34	5.11
Klebsiella pneumoniae	35	5.26
Proteus species	33	4.94
Acinetobacter species	9	1.35

Table 3. Antibiotic sensitivity pattern of gram-negative bacilli isolated from burn wound.

Antibiotics	Microorganisms						
(% Sensitivity)	*Pseudomonas* n = 412	*Enterobacter* species	*Citrobacter* species	*Escherichia coli*	*Klebsiella pneumoniae*	*Proteus* species	*Acineto bacter* species
		N = 132	n = 78	n = 34	n = 35	n = 33	n = 9
Amikacin	7.7 %	14.2 %	13.4 %	18.9%	15.3%	15.3%	0%
Cefepime	-	17.8 %	12.9%	11.4%	25%	17.3%	0%
Cefixime	-	4.8 %	2.3%	0%	0%	9%	0%
Cephotaxime	-	4 %	9%	4%	4%	14%	0%
Ceftazidime	4 %	-	-	-	-	-	-
Cefuroxime	1.8 %	-	-	-	-	-	-
Cefoparazone-sulbactum	60.4 %	71.6 %	51.6%	63.1%	61%	79.1%	33%
Chloramphenicol	5 %	15.3 %	11.8%	25.7%	15.3%	15%	0%
Ciprofloxacin	15.2 %	16.8 %	8.5%	0%	30%	16.6%	16%
Doxycycline	-	15.1 %	3.5%	14.7%	0%	0%	16%
Gatifloxacin	28.2 %	44.4 %	46.8%	50%	42.8%	39.1%	33%
Gentamicin	2.9 %	-	-	-	-	-	-
Meropenem	64.9 %	79.4 %	67.2 %	56.2 %	61 %	86.3 %	50%
Piperacillin	32.6 %	12.1 %	8 %	23.5 %	23 %	36.3 %	0 %
Piperacillintazobactum	69.8 %	67.8 %	81.8 %	63.15 %	63.8 %	92.3 %	50%
Tobramycin	1%	-	-	-	-	-	-

DISCUSSION

Burn wound represents a susceptible site for opportunistic colonization by microorganisms of exogenous and endogenous origin. Due to this reason majority of burn wounds are colonized with microorganism. In our study 98.6% of samples showed growth for pathogenic bacteria. Similarly Mehta et al [9] found growth in 97%, Rajput A in 96% [10], Kaur H et al in 95% [11] and Liwimbi in 93%[12]of samples contrary to this Dhar et al[13] isolated organisms from 60.1%and Ram S 21.88% [14]of samples.

The gram-negative bacilli are responsible for majority of infections as they have greater motility, possess many antibiotic resistance mechanisms and secrete various enzymes and toxins that determine the likehood of invasiveness in burn wound.[15] In our study *Pseudomonas aeruginosa* was the predominant isolate (61.95%) followed by Enterobacter species (19.73%). Similar incidence of *Pseudomonas aeruginosa* was reported by other studies. [9, 10, 11, 16, 17,18,19,20, 21, 22, 23]

This predominance may be due to their presence in environmental sources (tap, sinks, railings, mattress), prolonged hospital stay, prior administration of antimicrobial agents and immunosuppressive effects of trauma.

The gram-positive cocci remain a cause of early wound infection and gradually superseded by gram-negative bacilli. In present study gram-positive cocci were isolated in 14.13% of samples. Coagulase positive staphylococci (8.5%) over numbered the coagulase negative staphylococci (5.56%). In other study, Dhar et al [13] and Less et al [24] had reported high prevalence of coagulase positive staphylococci.[12, 10, 21, 23]

Both *Pseudomonas aeruginosa* and enterobacteriaceae group has showed high percentage of resistance to aminoglycosides, fluroquinoles, chloramphenicol and cephalosporin. They were more sensitive to newer antibiotics like meropenam and combination drugs like cefoperazone-sulbactam and piperacillin-tazobactum. These antibiotics were effective as they are used as reserve drug to treat multi-drug resistant bacteria. These results are in accordance with that reported by other investigators. [2, 10,22,25,26]

The isolated gram-positive cocci have showed high percentage of resistance to amoxicillin, cephalexin, gentamicin and doxycycline. The most effective drugs against gram-positive cocci were vancomycin, linezolid and piperacillin-tazobactum.

By antibiotic susceptibility study piperacillin-tazobactum exerted the best activity against almost all organisms followed by meropenam and cefoperazone-sulbactam against gram-negative bacilli. Vancomycin and linezolid were highly effective against gram-positive cocci. [21]

CONCLUSION

The management of burn sepsis is important to reduce post burn mortality. Ideally an attempt should be made to identify the causative microorganism in burn patients and treated with an effective drug as per sensitivity results. Till the culture and sensitivity results are made available an empiric antibiotic treatment may be started based on the knowledge of common pathogens and antibiogram in that geographical setting. The efficacy of antibiotics needs to be re-evaluated periodically because the susceptibility of microorganisms is likely to change over time. With this the medical and paramedical staff must be educated regarding rational use of antibiotics.

A nosocomial infection surveillance system must be introduced to reduce nosocomial infection in burn patients. For this an effective infection control policy is required and continuous surveillance of microorganism and regular updating of their antimicrobial resistance pattern is essential.

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