Original Article

BACTERIOLOGICAL TRENDS AND CULTURE – SENSITIVITY PATTERNS OF BURN WOUNDS AT BURN UNIT, MAYO HOSPITAL, LAHORE

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Abstract

Objectives: To determine the pattern of bacterial growth over time and to devise an antibiogram based on sensitivities to antibiotics in burn wounds of patients amitted in burn unit admitted to burn unit, Mayo hospital, Lahore.

Design: Descriptive case series.

Place and Duration of Study: Burn unit of Mayo Hospital Lahore from august 2013 to august 2014.

Patients and Methods: All consecutive burn patients admitted within 72 hours of their injury from August 2013 to August 2014 were included. Patients who died before the 2nd culture were excluded from the study. 181 culture reports of 79 burn patients with burn areas between 5 and 70 % were studied. Cultures were sent on the third day of burn and then weekly. The reports were scrutinized for organism type and antibiotic sensitivity. The shift in organism pattern on subsequent cultures was noted.

Results: Of the 79 patients 44 were females and 35 were males. 61 were flame burns, 7 were acid burns while 11 were high voltage electric contact and flash burns. Mean age of patients was 33.22 ± 12.74 years and mean percentage of burn surface area was 33.18 ± 13.33%. All patients had mixed thickness burns mostly deep partial thickness variety. Staphylococcus aureus was the most common pathogen isolated on initial cultures (68.18%). Pseudomonas aeruginosa (28.46%) and enterobacteraciae (26.15%) were the most common isolates on subsequent cultures. Tazobactam / Piperacillin (35.32% of organisms) followed by Cefperazone / Sulbactam (19.27% of organisms) and Amikacin (16.97% of organisms) were the most sensitive antibiotics on culture and sensitivity.

Conclusion: Our study shows that the microbial pro-

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file of a burn wound shifts from an initial predominantly gram positive isolate to a later predominantly gram negative isolate. Also Tazobactam/Piperacillin was found to be the most sensitive antibiotic on culture and sensitivity in our study.

Keywords: Burn wounds, Burn microorganisms, Burn antibiotics, burn antibiogram.

Introduction

A burn is damage to body's tissues caused by heat, chemicals, electricity or radiation.[1]

The skin functions to regulate the body temperature and also acts as a barrier against microorganisms. Skin injury causes loss of these functions. Infection is responsible for 75% of all deaths in patients with burns exceeding 40% of the Total Body Surface Area (TBSA).[2]

Immediately following a thermal burn, the surface of the burn wound is free from microorganisms. However, deep cutaneous structures often contain staphylococci, which colonize the wound surface during the subsequent 48 hours. Over the following 5 – 7 days, gram – negative and gram – positive bacteria colonize the wound. These potential pathogens typically come from the patients' gastrointestinal tract, upper respiratory tract, the hospital environment or through contact with health care workers. Significant thermal injuries induce a state of immunosuppression that also predisposes the burn patients to infectious complications.[3,4]

The focus of medical care should be to prevent infection. However, antibiotics appear to be of no value in the prophylaxis of burn wound infections. When an infection is identified, antimicrobial therapy should be directed at the pathogen recovered on culture. In the setting of invasive infection or evidence of sepsis, empiric therapy is often initiated.[5] A local burn facility's antibiogram must be established to help direct empiric therapy so as to allow prompt treatment of imminent septic episodes before the culture results have arrived.

Keeping in mind the magnitude of Burn Wound Infection in a burn ward, this study was initiated in order to identify the microbial pattern at the study center. It would also help devise an Antibiogram for the mentioned Burn Unit.

Patients and Methods

This was a descriptive case series. From august 2013 to august 2014 a total of 79 consecutive burn patients fulfilling the inclusion criteria i.e., 2nd and 3rd degree burn patients with injury of less than 72 hours duration with any mechanism of burn and fulfilling the burn unit admission criteria[6] were included as burn duration exceeding this period would lead to an already mixed growth on wound culture. A true shift in microbial pattern would then be difficult to assess. Cultures were sent on the 3rd day of injury and then weekly. 181 swabs were taken from burn wounds having excessive slough, burn escher, abscess or burn area having cellulitis around it on nonburned skin using sterile culture swabs and transported immediately in a sterile container to the clinical pathology lab at the study center. The swabs were tested for microbes and their antibiotic susceptibility. In 60 patients' two cultures, in 15 patients 3 cultures and in 4 patients four cultures were sent before the wounds were ready for grafting. Though cultures from burn wound areas more than 70% were also sent, none of these patients survived long enough for subsequent cultures to be sent and they were excluded from the study. All 2nd and 3rd degree burns were treated with silver sulphadiazine dressings or saline dressings in preparation for grafting where appropriate. The burn wounds were washed daily to get rid of loose necrotic tissue and remains of the previous day's ointment. Each report was analyzed for the type of organism and their sensitivity to different antibiotics. Results were displayed in tabulated form and analyzed. An antibiogram was devised according to the NCCLS – M39A guidelines.[7]

Results

Total 79 patients were included in the study out of which 44 were females and 35 were males. Overall range was between 15 and 60 years. All patients had burn surface area between 5% and 70% (See table 1).

Table 1:

	No	Age (Years)	Percentage Burn (%)
Female	44	32.66 ± 12.18	31.27 ± 12.85
Male	35	33.91 ± 13.55	35.57 ± 13.71
Total	79	33.22 ± 12.74	33.18 ± 13.33

There were 61 (77.22%) flame burns, 11 (13.92%) electric burns and 7 (8.86%) acid burns. All patients

Table 2:

The frequency with which the organisms were isolated in the different types of burns									
Type of Organism Isolated	Flame Burns (No. of Cultures = 136)		In Electirc Burns (No. of Cultures = 27)		In Acid Burns (No. of Cultures = 18)		Total 1st Culture (N = 79)	Total Subsequent Cultures (N = 102)	Total
	1st Culture	Subsequent Cultures	1st Culture	Subsequent Cultures	1st Culture	Subsequent Cultures	Total Organisms N = 88	Total Organism N = 130	N = 218
Staphlococcus aureus	46	02	08	06	06	0	60 (68.18%)	08 (6.15%)	68 (31.19%)
Pseudomonas aeroginosa	06	22	02	09	04	06	12 (13.63%)	37 (28.46%)	49 (22.48%)
Enterobacteraciae species	02	23	02	05	04	06	08 (9.09%)	34 (26.15%)	42 (19.27%)
Eschericia Coli	02	10	0	08	0	06	02 (2.27%)	24 (18.46%)	26 (11.93%)
Proteus	0	15	0	03	03	02	03 (3.41%)	20 (15.38%)	23 (10.55%)
Klebsiella	01	05	0	0	02	02	03 (3.41%)	07 (5.38%)	10 (4.59%)

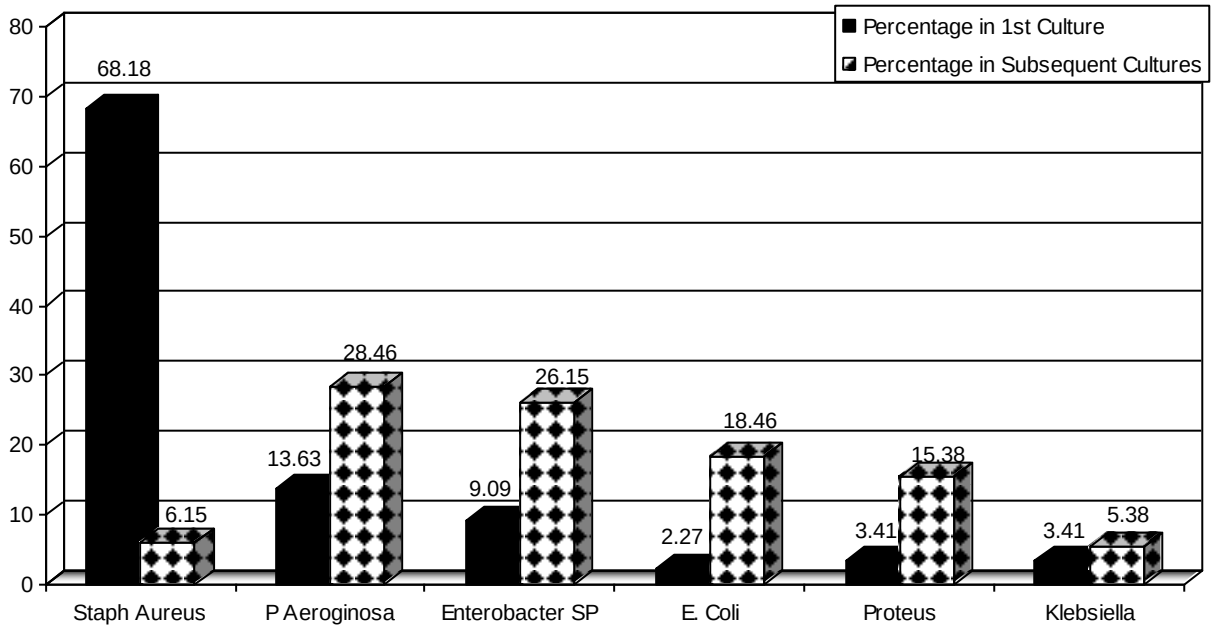

Figure 1: Figure showing results of individual organisms on 1st and subsequent cultures.

had mixed thickness burns, mostly deep partial thickness. Six different microorganism types and a total of 218 organisms were found on culture and sensitivity reports in a total of 181 swabs. These include staphy-

lococcus aureus, pseudomonas aeroginosa, Enterobateraciae species, E.Coli, Proteus and Klebsiella (see table 2 for details).

No anaerobes were cultured. There was a clear shift from gram positive to gram negative pattern. This was demonstrated by 60 gram positive and 28 gram negative microbes in the first cultures as compared to 08 gram positive and 122 gram negative microbes on subsequent cultures (See figure 1).

First Culture reports showed single isolates in 48 (60.76%) cases, twin isolates in 12 (15.19%), triple isolates in 5 (6.33%) and no growth in 14 (17.72%) cases. Subsequent culture reports showed single isolate in 54 cases (52.94%), twin isolates in 38 (37.25%) cases and no growth in 10 (9.8%) cases. *This shows a clear shift from single organism growth to a mixed growth on culture.*

Despite the shift in the microbe isolates mentioned, sensitivity to antibiotics showed a consistent and definitive trend for all microbes (See Table 3 and 4). Tazobactam/Piperacillin (35.32% of organisms), Sulbactam/Cefoperazone (19.27% of organisms) and Amikacin (16.97% of organisms) were the antibiotics to which the organisms were most susceptible.

Table 3:

Antibiotics to which the organisms were most susceptible	
Organisms	Antibiotics
Staph aureus	Tazobactam / Piperacillin Nezkil Vancomycin Imipenem
P aeroginosa	Sulbactam/Cefoperazone Tazobactam / Piperacillin Ciprofloxacin
Enterobacter sp	Tazobactam/Piperacillin Sulbactam / Cefoperazone Amikacin
E coli	Tazobactam / Piperacillin Amikacin Cefuroxime
Proteus	Tazobactam / Piperacillin Imipenem Sulbactam / Cefoperazone
Klebsiella	Tazobactam / Piperacillin Amikacin Imipenem Ciprofloxacin

Table 4:

An antibiogram based on the culture reports at the study center burn ward								
Sr.	Antibiotic	Staph. Aureus	Pseudomonas Aeroginosa	Enterobacteraciae	Escheicia Coli	Proteus	Klebsiella	Total N = 218
1.	Tazobactam / Pipiracillin	16	15	13	10	19	4	77 (35.32%)
2.	Cefoperazone and sulbactam	3	16	10	3	9	1	42 (19.27%)
3.	Amikacin	2	8	10	7	6	4	37 (16.97%)
4.	Imipenem	7	8	6	1	10	3	36 (16.51%)
5.	Ciprofloxacin	1	9	4	1	3	3	21 (9.63%)
6.	Nezkil	12			1	3		16 (7.34%)
7.	Moxyfloxacin	5	4	6				15 (6.88%)
8.	Aztreonam	1	4		3	1	2	11(5.04%)
9.	Sparaxin	4	1	5		1		11 (5.04%)
10.	Vancomycin	8			1	2		11 (5.04%)
11.	Ceftazidime	1	4		1	3		09 (4.13%)

Sr.	Antibiotic	Staph. Aureus	Pseudomonas Aeroginosa	Enterobacteraciae	Escheicia Coli	Proteus	Klebsiella	Total N = 218
12.	Meronem	1	2	4		1	1	09 (4.13%)
13.	Augmentin	6			1	1		08 (3.67%)
14.	Cephradine	4	1		2	1		08 (3.67%)
15.	Doxycycline	2	3	2			1	08 (3.67%)
16.	Cefoperazone	2	1	2	2			07 (3.21%)
17.	Cefuroxime	1	1		4			06 (2.75%)
18.	Amoxycillin	4			1			05 (2.29%)
19.	Cefotaxime	1	1		2	1		05 (2.29%)
20.	Gentamycin	1	2	1	1			05 (2.29%)
21.	Tobramycin	1	1		1		2	05 (2.29%)
22.	Ceftriaxone		2		1	1		04 (1.83%)
23.	Enoxabid	4						04 (1.83%)
24.	Ofloxacin	1			1		2	04 (1.83%)
25.	Ampicillin	3						03 (1.38%)
26.	Cephalexin	1	2					03 (1.38%)
27.	Tetracycline				1		2	03 (1.38%)
28.	Methicillin			2				02 (0.92%)

Discussion

Septicemia is the principal killer of burn patients[8]. Microorganisms reported to be associated with burn wound infections include gram – positive, gram-negative and fungal organisms.[5] Increasing antibiotic misuse and growing organism resistance necessitates the development of a reliable and accurate antibiogram.

In this study the changing microbiological patterns of burn wounds with time were studied and an antibiogram was developed.

In a study by Miller et al, 30 out of 44 cultures sent at the time of admission did not exhibit any significant growth except mixed skin flora.[9] They concluded that the collection of cultures during the initial 24 hours of burn is neither cost effective, nor decides or alters the course of treatment.

That is the reason, cultures were sent on the third day and then weekly in our study. First cultures showed a predominance of gram positive Staphylococcus Aureus (68.18% of the total number of organisms) in burns from all aetiologies. Staphylococcus aureus has been found to be the most prevalent organism on cultures during the first week.[10,11]

Pseudomonas aeruginosa (28.46%) and Enterobacteraciae (26.15%) were the most common organisms isolated on subsequent cultures. Altoparlak et al and Macedo et al in separate studies found Pseudomonas aeruginosa to be the most common organisms in the ensuing cultures.[10,11]

Staphylococcus aureus was also the most common isolate found overall in the study (31.19%). Other microbes isolated were Pseudomonas aeruginosa (22.48%), Enterobateraciae species (19.27%), E. Coli (11.93%), Proteus (10.55%) and Klebsiella (4.59%). Most studies have reported Pseudomonas aeroginosa[12-14] while others have found Staphylococcus aureus to be the most frequently isolated burn wound pathogen overall.[15,16] Some studies have shown Klebsiella to be the most common burn wound isolate.[17,18] Acinetobacter is fast emerging as a burn wound pathogen in India and some other countries.[12,13,14] Surprisingly no acinetobacter isolates were cultured in this study. Further studies need to investigate this phenomenon. No fungi or yeast infections were noted. This may be due to the effect of silver sulfadiazine which

was used for the wound management as it is effective against both fungi and yeast. It has been noticed that the spectra of pathogens in a burn unit varies with time as well as geographical area.[19] There was no difference noted in colonization pattern among burns from different aetiologies. This may be due to the fact that normal skin flora is similar for every person and colonization by these organisms occur regardless of mechanism of burn. Reig, et al, noted that electric current was the most common aetiology for burn wound infections (55.5%).[20]

Tazobactam – Piperacillin combination (35.32% organisms susceptible) which is essentially active against extended spectrum beta lactamases (ESBLs) remained the most effective drug against all microbes. The sensitivies to Tazobactam / Piperacillin combination were Staphylococcus aureus (23.53%), Pseudomonas aeruginosa (30.61%), enterobacteraciae (30.95%) and Eschericia coli (38.46%) in the series. Tazobactam has been seen to be highly effective against burn wound microbes in other studies.[17] The high susceptibility of Staphylococcus aureus to Tazobactam has been demonstrated by Denny et al.[21] The combination of Cefoperazone and Sulbactam (19.27% organisms susceptible) was also sensitive against the series microbes. It was also most sensitive for Pseudomonas aeruginosa (32.65% susceptible). Other studies have also indicated good efficacy of Cefoperazone and Sulbactam as compared to Cefoperazone alone against Pseudomonas aeruginosa.[17,22,23] Amikacin was also one of the sensitive antibiotics (16.97% of organisms susceptible). In one study, Klebsiella and Proteus from burn wounds showed 100% sensitivity to Amikacin.[15] In this series, Klebsiella showed a 40% and Proteus 26.09% susceptibility to Amikacin.

Conclusion

Our study shows that the microbial profile of a burn wound shifts from an initial predominantly gram positive isolate to a later predominantly gram negative isolate. The most common isolate from burn wounds on the 3rd day of burn was Staphylococcus aureus. Pseudomonas aeruginosa was the most common pathogen isolated on later cultures. Most of the pathogens were sensitive to Tazobactam / Piperacillin combination. Pathogens were also sensitive to Cefoperazone / Sulbactam preparation and Amikacin.

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