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Bacterial Infection of Burn Wound & Its' Clinical Implication

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Abstract: *Objective:* To analyze causative organisms causing burn wound infection during two different periods and compare the results with respect to sensitivity and resistant to different antibiotics. *Study Design:* Observational, cross sectional study. Duration of the study: April 2006 to Dec 2012. Setting: Burn Emergency Unit, Liaquat University Hospital. *Methodology:* All burn patients having BSA 20% or greater, irrespective of the etiology and gender were included in the study. These managed as per protocol of the unit. Swab for culture and sensitivity were taken at 2nd dressing and then on weekly basis for 4 weeks or until the entire burn wounds healed or the grafted. The collected swab(s) is transported in sterile, leak-proof container to central laboratory. At central laboratory these swabs are streak onto MacConkey's agar and on blood agar. These plates are incubated aerobically at 37°C for 20-24 hours. To determine antibiotic sensitivity of isolates obtained, we use "filter paper disc diffusion method" commonly known as "Kirby Bauer method". *Results:* On average swab sensitivity was done on each patient for 4 times. From 4684 swabs sent for bacterial isolates and sensitivity, 371 (8%) were sterile and 4313 reports were positive for different bacterial isolates. This includes 958 from 1st period and 3355 reports from 2nd period. The organisms isolated were single in majority of cases. However 13 reports from 1st period and 171 reports from 2nd period showed more than one organism and finally 4497 bacterial isolates and their sensitivity patterns were available for this study. *Conclusion:* It could be concluded that Acinetobacter is a major threat, as most strains are emerging resistant to commonly used antibiotics. Therefore preventive measures must be focus of our attention to minimize contamination of the burn wound if the prospect of the burn victim is to be changed in our favor.

Key words: Burn Wound infection · Swab Culture · Antibiotic resistance

INTRODUCTION

Burn wound infections are not only serious but also the commonest complication following thermal injury and responsible for 75% of all deaths [1]. This perspective has yet not changed significantly despite advances in acute burn care [2, 3]. After the incidence, for 24-48 hours, burn wound is sterile; soon it is rapidly colonized by normal flora consist mostly of Gram-positive organisms normally present in hair follicles and sweat glands, for example *streptococci* and *S. aureus* [4]. After this period wound becomes colonized with endogenous Gram-negative organisms of respiratory and gastrointestinal tract of the patient's, from hospital environment and healthcare workers [5, 6].

The use of topical antimicrobial agent can reduce overgrowth of microorganism but it seldom prevents colonization. This combined with suppression of the immune system, translocation of organisms from intestinal tract, long hospital stay, multiple diagnostic and therapeutic procedures, all contribute to infections [7,8]. The bacterial isolates from burn wounds show not only geographical variation but may also vary in same patients in different time frame [9]. The rapidly changing nosocomial microorganisms that have tendency to develop resistant to antibiotics necessitate periodic

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review of causative organism and their sensitivity patterns in specialized burn unit.

In the present study, we identified bacterial isolates and their sensitivity pattern at our unit during two different periods. The aim was to know the prevalent organism, antibiotic sensitivity and resistance over the time specified.

MATERIALS AND METHODS

This study carried out at Burns Emergency Unit, Liaquat University Hospital, a tertiary care hospital attached with Liaquat University of Medical & Health Sciences Jamshoro. As this is the only center for Sindh except Karachi, we have very large catchments area. Therefore patients with flame burn/scald having partial skin thickness burns affecting 20% or greater body surface area; while children with 15% or greater body surface area are admitted to our unit. The limits for deep dermal/full thickness burn are 10% for adults and 5% for children. The patients with electric and chemical burns and those presenting with involvement of high priority area are exempted from these limits. All others cases are routinely managed as outpatient and admitted only when they needs grafting/ reconstruction.

Soon after admission and estimation of body surface area (BSA) affected by Lund & Browder charts, we use to do resuscitation in all major burns with crystalloid (Ringolactate) according to Parkland formula. At the same time blood sample is collected for base line biochemistry including screening for hepatitis B & C. The biochemistry is done after every 48 hours for 1st week and then weekly throughout the entire period of hospitalization. Presently we lack support for the early (within 48 of admission) tangential excision and grafting; instead shower wash with antiseptic solution and topical application of 1% silver sulphadiazine is routinely done for all patients for initial period of resuscitation followed by occlusive dressing on every 3rd day. We routinely take swab on 2nd dressing and then on weekly basis for 4 weeks or until the entire burn wounds healed. While dressing is changed, the entirety of the burnt area is thoroughly examined without touching the area, after cleansing the affected area using normal saline. A sterile normal saline soaked swab is rubbed against the burn wound surface; with especial attention to the areas that showed change in appearance as compared to previous dressing. The collected swab is transported in sterile, leak-proof container to central laboratory. At central laboratory these swabs are streak onto MacConkey's agar and on blood agar. These plates are incubated aerobically at 37° C for 20-24 hours. To determine antibiotic sensitivity of isolates obtained, we use "filter paper disc diffusion method" commonly known as "Kirby Bauer method".

The record of 1270 hospitalized patients during last 6 years (2006-2012) was scrutinized. Patients with incomplete records, those who were discharged on request or shifted to other unit for associated injuries or co-morbidities were excluded from the study. Finally record of 1130 patients was available for this study. This includes 310 patients during April 2006- Dec 2007 and 820 for next 4 years (2008-2012) with 1014 and 3670 cultures report respectively. Up to December 2005 we were having 2 general wards for male and females and an operation theatre. In Jan 2008 we were equipped with intensive care unit, semi private rooms for burn patients, shower trolley and specialized equipments like electric dermatome, manual mesher and other facilities; therefore we considered data in two distinct periods.

RESULTS

On average swab sensitivity was done on each patient for 4 times. From 4684 swab sent for bacterial isolates and sensitivity, 371 (8%) were sterile and 4313 reports were positive for different bacterial isolates. This includes 958 from 1st period and 3355 reports from 2nd period. The organisms isolated were single in majority of cases. However 13 reports from 1st period and 171 reports from 2nd period showed more than one organism and finally 4497 bacterial isolates and their sensitivity patterns were available for this study.

Period	No of pts	Swabs taken	Swab +ve	Organisms	+ve swab/pt
1st	310	1110	985	998	3.1
2nd	820	4115	3355	3526	4.3

Microrganism	1st period (998) n (%)	2nd period (3526) N (%)	percent
Staphylococcus aureus	73(7.42)	471(13.35)	<0.0001
Streptococcus Pyogenes	11(1.10)	96(2.72)	
Pseudomonas aeruginosa	421(43.85)	418(12.45)	<0.0001
Klebsiella sp	178(18.07)	672(20.02)	0.185
Enterobacter sp	62(6.30)	170(17.25)	0.0001
Escherichia coli	48(4.87)	188(5.60)	0.413
Serratia sp	22(2.23)	96(2.86)	0.332
Proteus mirabilis	104(10.55)	580(17.28)	0.0001
Enterococcus faecalis	31(3.14)	117(3.48)	0.671
Citrobacter freundii	32(3.24)	221(6.58)	0.0001
Acinetobacter baumannii	16 (1.62)	480(14.30)	<0.0001

DISCUSSION

Intact skin is resistant to the invasion of microorganisms; burn breaks the continuity of the skin, which allow contamination and colonization of the wound. The suppressed immunity, gastrointestinal translocation of microorganism's, prolong hospital stay and repeated dressings of major burns all may contribute to this colonization [10]. This is important clinically because the type and quantity of organism may affect wound healing. This is also important as different organism has variable potential to develop invasive sepsis and septicemia [11]. It is estimated that 75% of all burn related mortality is due to infection and therefore, knowledge of prevalent microorganism and it sensitivity/resistant pattern, along with assessment of severlty of infection, are important factors to take different clinical and therapeutic decisions for burn victims [12]. It is considered that tissue count of pathogenic organism is superior to the surface swab, however at our part of the world we still relay upon report of the swab culture to make clinical decision and approach has been strengthen after work of Uppal SK *et al.* [13] that showed that causative organism isolated after tissue biopsy correlate with that found after swab culture.

The results of this current study showed that modern facilities were efficacious to reduce the no of positive swab cultures. The 88.73% of all swab taken from patients during 1st period showed growth of the organism(s), while for 2nd period it was 81.53%. These results were statistically significant (Chi square at 1 DF < 0001). This apparent reduction in positive swab culture may be attributed to the use of shower, improved antiseptic measures and early surgery due to latest facilities and increased manpower at our unit during 2nd period of this study.

The most common causative organism (43.85%) isolated during 1st period was pseudomonas, this finding is identical to other studies [14,15,16]. Chamania S *et al* [17]has recently performed early excision and graft of the burn between 2nd to 5th day post burn, still the pseudomonas was the predominant (43%) pathogenic organism [17]. During 2nd period of this study the prevalence of pseudomonas infection decreased to 12.45%. During this period we used antiseptic shower and topical application of 1% silver sulphdiazine to all patients having extensive burn of 70% BSA or greater instead of occlusive dressing. This strategy is probably against the favorite habitat of pseudomonas, which proliferates rapidly in dark foggy places. The 2nd most common pathogenic organism during this period was *Klebsiella* (18.07%), followed by *Proteus mirabilis* (10.55%) and *Enterobacter sp* (6.30%). This is in sharp contrast to the 13 years study of Srinivasan S [17] where *Klebsiella* was the commonest (33.91%) pathogenic organism. The difference may be attributed to the fact that he studied only pediatric burn patients whereas our study comprising of patients of all ages. The prevalence of *Staph aureus* infection during this period was only 7.42%, which are again in sharp contrast to the study of de Macedo JL [12] where it was the commonest organism. This may be attributed to the climate difference between temperate and the tropic. Other less common pathogenic organism isolated during this period includes *Enterobacter sp* (6.30%), *Enterococcus faecalis*(3.14%), *Citrobacter freundii* (3.24%) and *Acinetobacter baumannii* (1.62%).

During 2nd period of this study prevalence of pseudomonas infection decreases dramatically to only 12.45% as compared to 43% during initial period, Klebsiella emerged as commonest organism isolated from 20% of all surface swab. This is in agreement with study of Srinivasan [18]. Currently we do not have controlled atmosphere like laminar air flow system at our centre. Therefore for every major burns in addition to topical antibiotic we also use systemic antibiotics' as it significantly reduces "all cause mortality", while it has also been shown that use of even peri-operative antibiotic is associated with increased prevalence of *Klebsiella* [19]. Prevalence of *Proteus vulgaris* also raised almost 70% from 10% to 17% of total surface swabs. However the most striking feature of this period was increased prevalence of *Acinetobacter baumannii* infection from 1.62% during 1st period to 14.30% approx 120 times increased. Review of literature showed that Acinetobacter is currently common pathogenic organism affecting our burns patients, it also most frequent organism isolated from combat-injured [11]. It has also been shown that patients having BSA affected up to 60%, co-morbidities and prolonged hospital stay favors infection with *Acinetobacter* [20]. Although increased mortality associated with Acinetobacter infection is observed but it is not an independent factor of increased mortality [20].

The antibiotic susceptibility to any given organism is dynamic and changes over certain period of time. However critical analysis of routine antibiogram of every burn unit is helpful for making clinical decision to choose an antibiotic empirically until results of the swab culture are available. The sensitivity/resistant pattern of different microorganism's during this study showed that there is general trend of the developing antibiotic resistant over certain period of time.

During 1st period, Tanzobactam Meronem. Sparfloxin Gatifloxin Cefepime Vancomycin Gentamicin Cefpirome, Ticarcillin/ clavulanic acid found effective in 30-60% cases of pseudomonas infection. All these antibiotics were comparatively less effective against Pseudomonas infection during 2nd period. On the other hand Ticarcillin/clavunic acid was able to maintain its sensitivity against *Klebsiella* during both periods of the study. A probable explanation may be that this antibiotic is not used routinely at our center and therefore maintained its potential. Similar we found with Cefpirome, which is also used less frequently. Results showed that all newer antibiotics that were effective against *Acinebacter* during 1st period showed development of resistant during 2nd period to a variable extent.

CONCLUSION

Not only the pathogenic organism affecting burn wounds has changed dramatically during last few years, the development of antimicrobial resistance trends to newer pathogenic organism also posing problem. Currently *Acinetobacter baumannii* is a major threat at our Burn Unit, as most strains are emerging resistant to commonly used antibiotics. Therefore preventive measures must be focus of our attention to minimize contamination of the burn wound if the prospect of the burn victim is to be changed in our favor.

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