



Emerging Changes in Mortality Pattern of Burn Patients in Relation to Resistant Bacterial Isolates in a Tertiary Care Hospital

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Authors' contributions

This work was carried out in collaboration between all authors. Author LKM designed the study. Author SS performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript and managed literature searches. Authors RKM and CH managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BMRJ/2016/23746

Editor(s):

(1) Gyanendra Singh, Gene Therapy & Louisiana Vaccine Center, School of Medicine, LSU Health Sciences Center, Louisiana, USA.

Reviewers:

(1) Patrick Akpaka, The University of the West Indies, Trinidad & Tobago.

(2) Iduh Michael Unata, Usmanu Danfodiyo University, Sokoto, Nigeria.

(3) Ketan Vagholkar, D.Y.Patil University, India.

Complete Peer review History: <http://sciencedomain.org/review-history/13347>

Original Research Article

Received 19th December 2015

Accepted 8th February 2016

Published 18th February 2016

ABSTRACT

Burn injury is a global public health problem with approximately 265,000 deaths annually. In India, over 1000,000 people are moderately or severely burnt every year and an annual mortality rate is 100,000 to 140,000. This study was aimed to identify and analyze the demographic aspects, various micro-organisms responsible for burn wound infections and antimicrobial resistance as predictors of mortality in burn patients so that preventive measures can be recommended and implemented to reduce mortality among burn patients. Wound swabs from 75 patients admitted in Burn unit with TBSA (total burn surface area) between 10% - 60% and having age between 10- 60 years were included in the study. In our study, case fatality rate was 26.7% with maximum mortality between 19-26 yrs of age and among females (36.6%). As the percentage of burns increase, the mortality rate also increases. The most common organism isolated was *Pseudomonas aeruginosa*

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(45%), followed by *Klebsiella pneumoniae* (28.2%) and *Acinetobacter baumannii* (19.7%) and all the bacterial isolates in expired patients were MDR (multidrug resistant). MBL (metallo-beta-lactamase) producing isolates were more common among non-survivors than among survivors. This suggests that all the isolates should be screened for drug resistance parameters to reduce mortality and antibiotic policy should be framed for burn unit to prevent the spread of MDR organisms in admitted patients. Further strict infection control strategies should be implemented to achieve the ultimate objective of improving infection related morbidity and mortality in burn patients.

Keywords: Mortality; burn wound infections; antimicrobial resistance.

1. INTRODUCTION

Burn injury has a major impact on morbidity and mortality and is considered as a global public health problem, which accounts for approximately 265,000 deaths annually. Mortality is higher among low- and middle-income countries compared to high income countries, and 50% of the total deaths occur in the South-East Asia Region [1]. In India, over 1000,000 people are moderately or severely burnt every year and an annual mortality rate is 100,000 to 140,000 [1,2]. This high mortality rate in India is due to illiteracy, poor living conditions, neglect of children, and certain social customs. Even the non-fatal cases may lead to significant morbidity in the form of disfigurement and disability, often with resulting stigma and rejection. Also it increases the hospital stay and cost of treatment which leads to financial constraints in a developing country like India where most of the population belongs to low or medium income group. Hence to prevent mortality in burn patients, factors which are directly related to mortality need to be studied. This study was undertaken in our hospital with the aim to identify and analyze the demographic aspects, various micro-organisms responsible for burn wound infections and antimicrobial resistance as predictors of mortality in burn patients. This study further extends to compare these factors between surviving and non-surviving burn patients so that preventive measures can be recommended and implemented to bring down the number of deaths among burn patients.

2. MATERIALS AND METHODS

Study was done over a period of one year from January to December 2011 in the department of Microbiology and department of Burns & Plastic surgery of a tertiary care hospital, New Delhi. Seventy-five patients admitted in Burn unit with total burn surface area (TBSA) between 10% - 60% and having age between 10- 60 years were included in the study. Consent was taken from all

patients included in the study. Data were obtained and recorded prospectively during the hospital course. Follow up of all patients were done until discharge or death. Patients readmitted for reconstructive surgery were excluded from the study. The variables chosen to predict mortality during the hospital course included age, gender, total burn surface area, burn wound infections, presence of multiresistant bacteria in wound including ESBL (Extended spectrum β - lactamase) and MBL (Metallo β -lactamase) producing organisms. Bacterial isolates were identified by culture, staining, motility, oxidase test, catalase test and other relevant biochemical tests and all the isolates were tested against various antibiotics by Kirby Bauer's disc diffusion method & zone diameters were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) guidelines [3]. ESBL production was determined by using phenotypic confirmatory test as per CLSI guidelines [3]. Strains resistant to carbapenems were screened for Metallo beta lactamase (MBL) production by using Disc Potentiation test in which Imipenem disc 10 μ g and Imipenem - EDTA disc (Hi Media) were placed on inoculated plates. After 16-18 hrs incubation at 35°C, the zone of inhibition were recorded and an increase in zone size of atleast 7 mm around the Imipenem- EDTA disc compared to Imipenem disc alone was considered as MBL producers [4]. The relationship between various factors was studied using multivariate logistic regression analysis.

3. RESULTS

Out of 75 burn patients included in the study, 55 (73.3%) discharged and 20 patients were expired with a case fatality rate of 26.7%. In this study, most of the burn cases belonged to age group of 19-26 yrs followed by 27- 34 yrs, with maximum mortality in the age group of 19-26 yrs as shown in Table 1 (not statistically significant). Out of 75 patients, 41(54.6%) were females and 34 (45.4%) were males, with mortality rate of 36.6%

(15) among females and 14.7% (5) among males which was found to be statistically significant (p value-0.033). The mean TBSA among survivors was 31.9%, while among non-survivors was 53.4% (statistically significant). As the percentage of burns increase, the mortality rate also increases and mortality was maximum in 50-60% TBSA as shown in Table 1. The most common organism isolated was *Pseudomonas aeruginosa* (45%), followed by *Klebsiella pneumoniae* (28.2%) and *Acinetobacter baumannii* (19.7%), while no organism was grown in 4 patients. Comparison of isolates among survivors and non-survivors did not show any statistically significant difference between various isolates as shown in Table 2. The terms "multidrug resistance (MDR)" has been defined as resistance to ≥ 3 classes of antimicrobial agents [5]. In our study, out of 67 Gram negative bacilli isolated, MDR was found in 55 cases (82%) and all the bacterial isolates in expired patients were MDR. Also these isolates were screened for ESBL production and MBL production. Among Gram negative isolates, 49.2% (33) of the isolates were ESBL producing and 19.4% (13) were MBL producing. MBL producing isolates were more commonly seen among non-survivors than among survivors and the difference in MBL production between the two groups were found to be statistically significant however, no statistically significant difference was found among ESBL producing strains in two groups (Table 3).

Table 1. Age-wise and TBSA distribution of survivors and non-survivors

Age group	Expired	Discharge	Total	p-value
10-18 yrs	3	6	9	0.116
19-26 yrs	10	13	23	
27-34 yrs	5	15	20	
35-42 yrs	1	13	14	
>42 yrs	1	8	9	
Percentage of burn				
10-20%	0	11	11	0.000
20-30%	0	9	9	
30-40%	1	20	21	
40-50%	3	11	14	
50-60%	16	4	20	

*p-value <0.05- statistically significant

4. DISCUSSION

Despite advances in topical and parenteral antimicrobial therapy, bacterial infection remains a critically important issue in burn patients and associated mortality. Epidemiological studies of

mortality in burn patients are a prerequisite for effective burn prevention programs. In our study the case fatality rate was found to be 26.7% which is lower compared to other studies from India [6,7]. This is due to the fact that in this study only patients with 10-60% of TBSA were included, thereby excluding > 60% TBSA who are more prone to death. Since TBSA > 60% have a very high mortality rate, it is difficult to assess other parameters in such patients and TBSA < 10% are generally not admitted and seen only in the outpatient department. Age and sex are important determinants in burn mortality. In our study, most common age group involved in burn injuries as well as deaths were seen from 19-26 years of age followed by 27-35 yrs of age, which is similar to other studies [7]. This age group people are generally active and are exposed to hazardous situations both at home and at work. The mortality rate was higher among females (36.6%) than males (14.7%), which has also been reported in other studies from India [6,8]. This is because females are more exposed to fire injuries during domestic activities and dowry death and also they wear synthetic clothes like saree, dupatta etc. covering whole body which can easily catch fire and spread rapidly to involve large surface area of the body.

Table 2. Bacterial isolates from burn wound swabs among survivors and non-survivors

Isolates	Expired	Discharge	Total	p-value
<i>P. aeruginosa</i>	11	21	32	0.521
<i>K. pneumoniae</i>	6	14	20	
<i>A. baumannii</i>	3	11	14	
<i>S. aureus</i>	0	4	4	
<i>E. cloacae</i>	0	1	1	
No growth	0	4	4	
Total	20	55	75	

*p-value <0.05- statistically significant

Table 3. Distribution of MDR, ESBL and MBL isolates among survivors and non-survivors

Resistance	Expired	Discharge	Total	p-value
N=68				
MDR				
Yes	20	35	55	0.013
No	0	12	12	
ESBL				
Yes	7	26	33	0.128
No	13	21	34	
MBL				
Yes	8	5	13	0.005
No	12	42	54	

*p-value <0.05- statistically significant

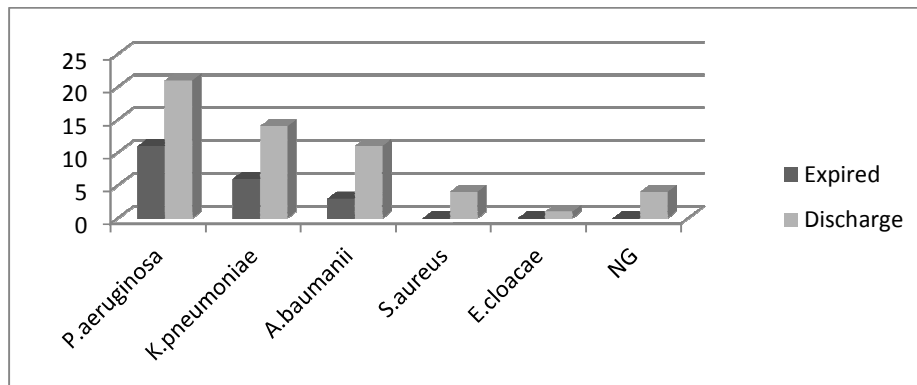


Fig. 1. Distribution of bacterial isolates among discharged and expired patients

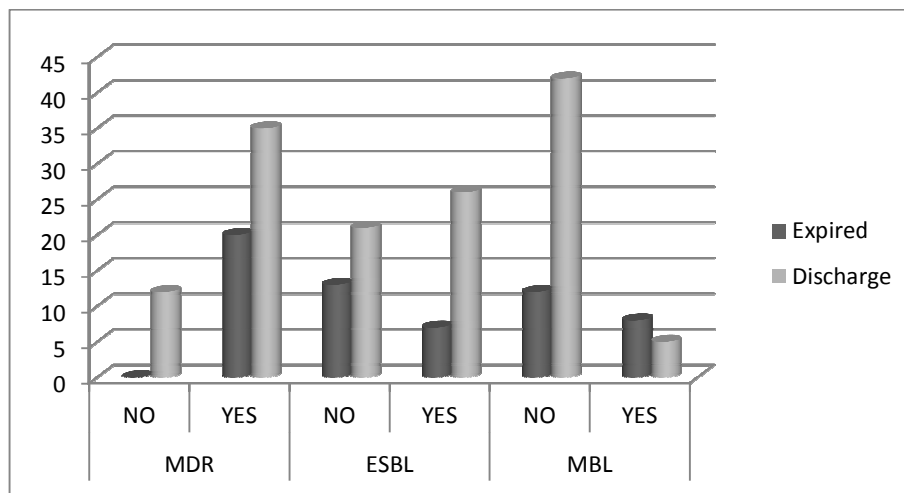


Fig. 2. Distribution of MDR, ESBL and MBL isolates among discharged and expired patients

Bacterial infections are more common in burn with significant morbidity and mortality. The most common organism isolated from burn wound swab among dead patients was *P.aeruginosa* followed by *K. pneumoniae* and *A. baumannii*, which was similar to other study from Iran [9-11]. However no significant difference was found when compared with the patients who were discharged. Hospital acquired strain are difficult to treat as they are caused by multidrug resistant (MDR) organisms and also it spreads rapidly. In this study, 80.9% of the gram negative bacilli isolated were multidrug resistant and all the patients who died were having infection with multidrug resistant organisms, suggesting the role of MDR strains in mortality. This result is similar to other study from Iran where multidrug resistance was found in 88.4% of the isolates from expired patients due to burn injuries[9]. The ability to produce β -lactamases is one of the most important mechanism of resistance of

bacteria to β -lactam antibiotics. ESBL belonging to groups SHV, TEM, CTX-M have mainly been implicated in the transfer of drug resistance in gram negative organisms. ESBL producing organisms exhibit co-resistance to many other classes of antibiotics like quinolones and aminoglycosides resulting in limitation of therapeutic options [12,13]. In our study, no significant difference in the mortality was found with the presence of ESBL production. This is due to the fact that the strain which were not ESBL producing were resistant to both β -lactam and β -lactam- β -lactamase inhibitor combination suggesting the presence of AmpC production. However, the isolates were not tested specifically for Amp C production and hence cannot be included in the study. Treatment of ESBL and AmpC producing strains has emerged as a major challenge in hospitalised patients with limited antibiotics in hand like carbapenems. Currently hospital

acquired infections are found resistant to carbapenem due to the presence of carbapenem hydrolysing β -lactamase like Metallo β -lactamases (MBL) [13]. Detection of MBL production in MDRO from burn infection has tremendous therapeutic consequences, as the treatment option for such isolates are very limited i.e. polymyxin B and colistin. In our study, 19.4% of gram negative bacilli isolated were metallo β -lactamase producers and MBL production is seen more among non-survivor group than among survivor group. This is due to the fact that the treatment options for such strains is colistin and tigecycline which is available with difficulty in government hospitals and the procedure for procurement of these drugs is tedious and time consuming thereby making these drugs unavailable for such patients and increasing mortality. Another study from India [14] showed 15.6% of gram negative bacilli as MBL producers. However, limited literature is available regarding the prevalence of MDR, ESBL and MBL in expired patients in critical areas of hospital like burn ward. Hence further studies are required to assess the significance of bacterial infections and drug resistance in the mortality of burn patients.

5. CONCLUSION

In light of the findings of this study, it appears absolutely essential that all the isolates should be screened for drug resistance parameters to reduce mortality and fully operational antibiotic policy should be framed for burn unit to prevent the spread of multidrug resistant organisms in admitted patients. Further strict infection control strategies should be implemented to achieve the ultimate objective of improving infection related morbidity and mortality in burn patients.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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