

Comparative Efficacy of Different Beta (β)-Lactam Antimicrobial Drugs on Pathogens Isolated from Burn Patients

Syed Muhammad Abbas Naqvi^{*}, Asim Shafi^{**}, Muhammad Sadique Khan Qadri^{***}, Aamir Ali Khan^{****}

ABSTRACT

Objective: To determine the sensitivity of different Beta (β)-Lactam antimicrobial drugs on various bacterial pathogens isolated from infected burn wounds.

Study Design: Descriptive, observational study.

Place and Duration; Department of Pathology, Nishtar Medical College Multan, from June to September 2013.

Material & Methods: A Total of 232 swabs were collected from 100 consecutive burn patients showing sign and symptoms of infection. The swabs were cultured & organisms were isolated, and the sensitivity of various Beta (β)-Lactam antimicrobial drugs was observed. The data was collected on a proforma designed for the study.

Result: Out of 100 patients 64 were female. Among 232 cultures, Enterobacteria were isolated in majority of cases followed by Staphylococcus aureus species and Pseudomonas. Imepenem was found the most sensitive drug against all isolates.

Conclusion: Female were more common victim for burn than male. Imepenem was the most effective antimicrobial drug against S.aureus, P. aeruginosa and bacteria belongs to family Enterobacteriaceae

Key words: Burn, Infection, Bacterial pathogens, Beta lactam antimicrobial.

INTRODUCTION

Burn injuries are common and major health problem with great mortality and morbidity throughout the world. It is estimated that 1% population in the world affected by serious burn injury. It is also estimated that burn injury accounts 1% of total disease that comes in hospital for treatment, moreover majority (>95%) of burn injuries occurs in developing countries¹⁻³.

In severe burns whole immunity (specific and non specific) become compromised, defects occur in humoral arm as well as cellular arm of specific immunity. Humoral defect resulted in depression of immunoglobulin and decreased complement titer, while defect in cellular arm of immunity resulting in overall lymphocytopenia with relative increase in T-suppressor cells and decrease in interleukin 2, these all defects in immune system predispose burn patients towards infectious complication. Along with immune suppression, age of the patient, extent and depth of burn injury with microbial factors, are determinative for invasive burn wound infection⁴.

Burn wound sepsis is an imbalance in the normal equilibrium between bacteria and host immune defense, resulting in numerical increase in bacteria. This increase in bacterial count/gram of tissue in first degree and second degree burn breaks up the hair follicles and glands, these bacteria migrates through the tissues and colonize along the dermal cutaneous interface that lead to wound sepsis⁵.

- * Associate Professor, Department of Pathology Nishtar Medical College, Multan
- ** Senior Registrar Surgical Unit 2, Nishtar Hospital, Multan.
- *** Assistant Professor, Department of Community Medicine, Nishtar Medical College, Multan.
- **** Professor & Head, Department of Pathology Nishtar Medical College, Multan

Correspondence to:

Dr. Syed Muhammad Abbas Naqvi
Associate Professor,
Department of Pathology
Nishtar Medical College, Multan.
Cell: 0300-6326302

Considering both medical & surgical, burn care is a great challenge. Infection of wound is more common complication following burn⁶.

β Lactam are more common antibiotics used in burn cases for treatment as well as for prophylaxis. Burn wounds initially colonized and infected with Gram positive bacteria, mainly Staphylococci that are part of normal flora of the skin surface, sweat glands & hair follicles & activated by the burn. Enteric Gram negative bacteria from the patient's own gastro-intestinal tract colonize the burn wound these bacteria produce trouble by producing large quantity of pus, containing toxin that may kill surviving cells and convert partial thickness into full thickness and also create great difficulty in acceptance of skin graft. Absorption of these toxins may cause severe general illness⁷. More over entry of these bacteria from wound into blood stream cause bacteremia that may lead to serious and fatal septicemia. Among these Gram negative bacteria *Pseudomonas aeruginosa* remain a major cause of burn wound colonization, infection, and septicemia⁸.

Despite newly developed antibiotics and anti septics, bacterial infection is the major cause of death in burn patients⁹.

The resistance pattern of bacteria against antimicrobial drugs is increasing day by day¹⁰. The particular level of resistance of bacteria against antibiotics varying from one location to other and the resistance of bacteria against antibiotic becoming global problem⁸.

MATERIAL AND METHODS:

This study was conducted between June to September 2013 in the department of Pathology, Nishtar Medical College Multan. A total of 100 consecutive patients irrespective of age, sex, date and time of burn, time of hospital admission, degree and percentage (%) of burn were registered for this study. The percentage of burn in all patients was assessed by Lund and Browder's criteria and the degree of burn was determined by clinical observation. Specimens of burn wound swabs for

culture were collected. Each swab was taken from Registered patients with their prior consent. All the information concerning the patients i.e. sex, date of admission, type and date of specimen collection, number of visitors per day, history of given antibiotics etc. were recorded on a proforma specially designed for this study.

Following media were used to isolates and perform sensitivity of different pathogens. Blood Agar, Mac-Conkey's Agar, Nutrient Agar while Mueller and Hinton medium was used to perform sensitivity testing.

A Total of 232 swabs were collected from 100 burn patients who have developed sign and symptoms of wound infection at the time of changing of dressing. The infection of wound was determined on the basis of burn wound infection criteria of Pia Appelegreen¹¹.

According to National Committee for Clinical Laboratory Standards (N.C.C.Ls) guide line, susceptibility test of all isolates were performed using different antimicrobial agents by Kirby Bauer method¹².

RESULTS:

Out of 100 patients 36 were male & 64 were female (Table-1). Among 232 cultures, Enterobacteria were isolated in majority of cases followed by *Staphylococcus aureus* species and *Pseudomonas*. Imepenem was found the most sensitive drug against all isolates (Table-2).

Table-1. Summary of General Information of Burn Patients

Total Patients	Total Male Patients	Total Female Patients	Mean Age (Standard Deviation)	Mean TBSA (Standard Deviation)
100	36	64	19 (13)	27(0.15)

Table-2. Summary of Comparison of Sensitivity Pattern of Isolates

Name of Drug	Pseudomonas aeruginosa (n=52)		Staphylococcus aureus species (n=57)		Enterobacteria (n=123)		P-Value
	Sensitive	%	Sensitive	%	Sensitive	%	
Imepenem	36	69	42	74	114	93	0.130
Augmentin			26	46	14	11	0.050*
Vancomycin			57	100			
Clindamycin			30	52			
Cephalothin			37	65.0			
Cefuroxime	05	10	26	46	35	28	0.000*
Amoxicillin			03	5	11	09	0.285
Piperacillin	10	19			51	41	0.003*
Cefepime	21	40			79	64	0.019*
Aztreonam	02	04			17	14	0.018*
Cefotaxime	07	13			36	29	0.022*

DISCUSSION

The rate of development of resistance against new antibiotics is faster than the rate of invention of new antibiotics. *Pseudomonas aeruginosa* is highly resistant to most antibiotics. This resistance develops very rapidly in this organism¹³.

In most cases *P. aeruginosa* found resistant to most first line antibiotics. Antibiotics those has good activity in vitro against *P. aeruginosa* are anti pseudomonal Penicillins like Piperacillin, third and fourth generation Cephalosporins, Aztreonam, Carbapenems, Fluoroquinolones.

Fourth generation Cephalosporin Cefepime, that is equally effective in most clinical trials, is associated with a significant increase in all cause mortality as compared to other broad spectrum β Lactams and Carbapenems¹⁴.

In the present study, Imepenem was found to be an effective drug against *Pseudomonas aeruginosa*, with sensitivity being 69%. In study of Saha et.al¹⁵, majority (99%) isolates of *P. aeruginosa* were sensitive to Imepenem. Rashid et.al¹⁶ stated that Imepenem was the most effective drug against *P. aeruginosa*. In a study by Anuradha et al¹⁷, 74% isolates of *P. aeruginosa* were sensitive to Imepenem. Jazani¹⁸, reported the 73% sensitivity rate of *P. aeruginosa* against Imepenem. In a study

by Mirsalehian et al¹⁹, *Pseudomonas aeruginosa* from burn patients, showed resistance against Imepenem 53%.

Douglas et al²⁰ agreed that Carbapenems are useful in treatment of some cases of multidrug resistant (MDR) strains of *Pseudomonas aeruginosa*. This observation is in favor of present study in which most of *Pseudomonas aeruginosa* strains are MDR and their sensitivity against Imepenem is not as good as compare to other isolates of burn cases.

In present study susceptibility rate to Cefotaxime was 13% that is higher than reported by Zhang et al²¹, where *P. aeruginosa* from 1997 to 2003 showed the susceptibility rate against Cefotaxime 79% in 1997, 39% in 1998, 25% in 2002; respectively. In a study conducted by Singh et al²², 66% strains of *Pseudomonas aeruginosa* were resistant to Cefotaxime.

Aztreonam is a monobactam Beta-lactam drug, has excellent activity against *Pseudomonas* species, but it has a limited treatment option against MDR strains of *Pseudomonas aeruginosa*²⁰. This statement is in agreement to present study where Aztreonam was less effective (4%) against MDR strains of *Pseudomonas aeruginosa*. In study of Saha et al¹⁵, 33.44% strains

were sensitive to Aztreonam.

Present data regarding Piperacillin efficacy (19%) against *Pseudomonas aeruginosa* is not in accordance with the other studies in which *Pseudomonas aeruginosa* remained 90% susceptible to Piperacillin²³. *Pseudomonas aeruginosa* (14%) were resistant to Piperacillin in study of Makaddas and Sanyal²⁴. According to Agnihotri et al²⁵, Piperacillin was found to be the most effective drug against *P. aeruginosa*. While the sensitivity rate of *P. aeruginosa* against Piperacillin was 43% by Jazanii et al¹⁸.

Imepenem showed high (74%) sensitivity rate against *Staph. aureus* in present study while Cephalothin and Clindamycin were moderately 65% and 53% respectively, Amoxicillin (05%), Cefuroxime (46%), and Augmentin (46%) active against these organisms.

In the present study Imepenem was the most effective (93%) drug followed by Cefepime 64% against bacteria belongs to Enterobacteriaceae family. In study by Ronald et al²⁶, 99.1% isolates of Family Enterobacteria were sensitive to Cefepim, less than 30% isolates were sensitive to Piperacillin while less than 12% isolates were sensitive to Amoxicillin Clavulanate, 14% against Aztreonam, and Tobramycin, and 07% against Chloramphenicol. Third generation Cephalosporins were effective in 29% isolates and 4th generation Cephalosporin was effective in 64% isolates. It may be due to extensive usage of 3^{rd,4th} generation Cephalosporin drugs in general practice and hospital practice, without any microbial surveillance, that result in extended spectrum of drug resistance. Inappropriate and/or over-use of antibiotics are most common reasons in increasing the resistance of bacteria against antimicrobial drugs²⁷.

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