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A Study on Antimicrobial Susceptibility Pattern of Bacterial Infections in Burn Wound Patients in a Tertiary Care Hospital, Salem

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A B S T R A C T

Skin being the largest organ of our human body and Out of numerable immune preclusion mechanisms in our body skin is one of the momentous defence. For those patients who survive initial burn injury infection is an imperative issue. Burn wound injuries are one of the most common, invasive and devastating forms of trauma. Despite the recent advances in burn wound management, bacterial infections persist as an important complication and leading cause of morbidity and mortality among burnt patients. The leading issue in burns wound management is culpability of the burn wound to colonisation of bacteria. Disparity of bacterial flora isolated is appreciated during the period of wound healing. This descriptive study was performed in the department of Microbiology, in conjunction with the burns wards in a Tertiary care hospital. This study was conducted from 2022 October to 2022 December. Organisms are identified based on the morphology of the colonies, Gram stain appearance, testing for presence of catalase enzyme, testing for presence of oxidase enzyme, testing of motility by hanging drop method. Antibiotic susceptibility test was done using modified Kirby Bauer's disc diffusion method on Mueller Hinton Agar as per Clinical and Laboratory Standards Institute Guidelines. Out of 100 patients, majority of them belongs to 21-40 years and female patients were 61%. Out of 100 samples processed, 67 sample showed bacterial growth and 43 sample showed no growth. Among the 67 sample with growth, gram negative isolates (68.6%) were more compared to gram positive isolates(31.3%). *Klebsiella* species (26.8%) were the most predominant organism isolated followed by *Pseudomonas aeruginosa* (16.4%), *Proteus* species (11.9%), *Acinetobacter baumannii* (8.9%), *Escherichia coli* (4.4%) among gram negative organisms. In the gram positive isolates, *Staphylococcus aureus* were (16.4%), followed by Coagulase negative *Staphylococcus* (10.4%), *Enterococcus* species (4.4%). *Klebsiella* is the most common isolate among all followed by *Pseudomonas*, *Staphylococcus aureus*. Piperacillin and tazobactam, carbapenem has increased sensitivity when compared to other drugs for Gram negative pathogens, where as Cotrimoxazole, Amoxycillin Clavulanic acid, Ciprofloxacin all have very high resistance.

Introduction

Burn wound injuries are one of the most common, invasive and devastating forms of trauma. Despite the recent advances in burn wound management, bacterial infections persist as an important complication and leading cause of morbidity and mortality among burnt patients.

Nearly 73% of post-burn deaths occurring within five days have been reported to be sepsis-related. Burn wounds are highly susceptible to colonization and infection and this is the major problem in the management of burn victims. Initially, the burnt area is considered free of microbial contamination (Liwimbi and Komolafe, 2007; Fatima Kabanangi *et al.*, 2021).

Major burn wounds usually become infected within 3-5 days after admission, so it is obvious that the infection arises from the patient's own bacterial flora and is not an exogenous occurrence.

Predominant risk factors for burn wound infection are the size of burn wound, i.e., the percentage of total body surface area (TBSA) burnt and the duration of hospitalization (Hisham A. Abbas *et al.*, 2013; Vishwajith *et al.*, 2021).

The main aim and objectives of this study to determine the microbial profile of burn wound infection and also to determine the antimicrobial susceptibility patterns of the isolated organisms

Materials and Methods

Surface swab collected from patients with Burn wound infections admitted in Burns ward.

Sample collection

To obtain a culture of burn surface, topical agents were first removed with a guaze soaked in sterile saline. The method of collection was deep swabbing, or aspiration of the bleb. Then the sample was collected by two sterile swab sticks. For dry wounds the swab was moistened with sterile saline. After the collection, the swab were immediately transported to the laboratory for further processing.

Sample processing

One of the swab sticks was used for direct gram staining. By the other swab stick, the sample was inoculated in Nutrient agar, Blood agar, MacConkey plates and incubated for 18 to 24 hours at 37˚C.

At the end of the incubation period, the plates were examined for the growth and the preliminary identification was made based on colony morphology, gram staining, motility and the series of biochemical tests (catalase, coagulase and oxidase tests).

Anti-microbial susceptibility testing

Antimicrobial susceptibility test was done for all bacterial isolates as per CLSI guidelines by Kirby Disk Diffusion method on Muller Hinton agar.

Implication

The use of prophylactic antibiotics is common practice with burnt patients. Drug resistant bacteria with intrinsic resistance towards antibiotics, the ability to survive longer in the hospital environment and hand-to-hand transmission of bacteria reflect their easy spread and the possible causes of outbreak. So continuous surveillance and update of antibiotic resistance pattern of microorganisms is imperative for infection control programs and accurate antibiotic treatment in the burnt patients.

Thus this will help to determine the predominant bacterial agents causing burn wound infection in our healthcare setup and their antimicrobial profile will help the policy makers in formulation of strategies for rational and effective use of antimicrobial agents which in turn lead to control of spread of antibiotic resistance genes in the community and in the reduction of morbidity and mortality associated with better management of burn wound patients.

Results and Discussion

Age and sex wise distribution

Out of 100 patients, majority of them belongs to 21-40 years and female patients were 61%.

Distribution of isolates

Out of 100 samples processed, 67 sample showed bacterial growth and 43 sample showed no growth. Among the 67 sample with growth, gram negative isolates (68.6%) were more compared to gram positive isolates (31.3%). *Klebsiella* species (26.8%) were the most predominant organism isolated followed by *Pseudomonas aeruginosa* (16.4%), *Proteus* species (11.9%), *Acinetobacter baumannii* (8.9%), *Escherichia coli* (4.4%) among gram negative organisms. In the gram positive isolates, *Staphylococcus aureus* were (16.4%), followed by Coagulase negative *Staphylococcus* (10.4%), *Enterococcus* species (4.4%) (Table 3).

The gram negative isolates were highly sensitive to Imipenem (100%) followed by Piperacillin-Tazobactam (84%), Cefoperazone-Sulbactam (74%), Amikacin, Gentamicin. They showed least sensitivity to Amoxicillin-Clavulunicacid (36%).

The gram positive isolates showed high sensitivity to Linezolid & Vancomycin (100%) followed by Doxycycline, Erythromycin, Clindamycin. They showed high resistance to Ampicillin.

Burn injuries are a global public health problem and still remain the leading cause of disability and unintentional death (WHO, 2018; Roman *et al.*, 2012).

In developing nations 17% of permanent and 18% of temporary disabilities in children exposed to burns. Even in those who survive results in a convincing amount of morbidity, sustained hospitalization, impairmen (Burns, 2018).

Overall following changes in immune system happens in patients with major burns 1. fall in number of helper T cells, 2. rise in number of suppressor T cells, 3 reduced production of monocyte and macrophage, and 4. Fall of immunoglobulin levels (Lawrence C. Madoff and Florencia Pereyra, 2012) Increased cytokine levels contribute to the dysregulation of immune system.

Initial colonization taking place at the site of burns which then proceed to invade if unchecked leading to bacteremia and sepsis, ending up with increased mortality (Pruitt and McManus, 1984).

The present study is carried out to determine the bacteriological profile and antimicrobial susceptibility patterns among the patients admitted in the burns ward at a tertiary care hospital in Tamil Nadu, swab was collected from these patients and inoculated in appropriate culture media, the isolates are identified based on standard procedures employing methods like Gram staining, standard biochemical reactions etc. the identified isolates sensitivity to antimicrobial agents are obtained by Kirby bauer disc diffusion method according to CLSI guidelines 2021.

Out of 100 patients, majority of them belongs to 21-34 years 34%). Similar to study conducted by Kavitha *et al.,* (2018). Out of the 100 patients 39 percentage are male and 61 percentage are female.

Contrast to our study by study showing increased incidence in male are Agnihothri *et al.,* (2004). Caroline Mohr O'Hara *et al.,* 2000; Proteus *et al.,* 2000) and Kaur *et al.,* (2006). In Kavitha *et al.,* (2018) study conducted in Telengana showed percentage of female is 58% which higher than male (Church *et al.,* 2006).

Table.1 Age wise distribution

Age group (years)	No. of patients
13-20	5
21-30	34
31-40	25
41-50	14
51-60	11
>60	10
Total	100

Table.2 Sex wise distribution

Sex	No. of patients
Female	**61**
Male	**39**
Total	**100**

Table.3 Distribution of isolates

Organism (n=67)	No. of isolates (%)
Gram negative isolates (n=46)	
***Klebsiella* species**	18(26.8%)
Pseudomonas aeruginosa	11(16.4%)
***Proteus* species**	8(11.9%)
Acinetobacter baumannii	6(8.9%)
Escherichia coli	3(4.4%)
Gram Positive isolates (n=21)	
Staphylococcus aureus	11(16.4%)
Coagulase negative *Staphylococcus*	7(10.4%)
***Enterococcus* species**	3(4.4%)
Total	67 (100%)

Table.4 Antimicrobial sensitivity pattern of gram negative bacterial isolates

Organism / Drugs	Klebsiella spp	Pseudomonas spp	Proteus spp	Acinetobacter spp	Escherichia coli
AMC	38%	-	37%	-	33%
CIP	69%	36%	50%	67%	33%
COT	39%	-	37%	50%	67%
GEN	80%	63%	75%	50%	33%
AK	76%	72%	75%	67%	67%
CTX	57%	-	62%	-	67%
CFS	80%	81%	75%	67%	67%
PTZ	92%	90%	87%	83%	67%
IPM	100%	100%	100%	100%	100%
CAZ	-	54%	-	83%	-
CPM	-	72%	-	-	-

Table.5 Antimicrobial sensitivity pattern of gram positive bacterial isolates

Organism / Drugs	*Staphylococcus aureus*	CoNS	*Enterococcus* spp
AMP	37%	42%	67%
COT	63%	57%	-
DOXY	71%	57%	100%
ERYTHRO	54%	85%	67%
CD	54%	85%	67%
LZ	100%	100%	100%
VA	100%	100%	100%
CEFOXITIN	81%	57%	-

Fig.1 Age wise distribution

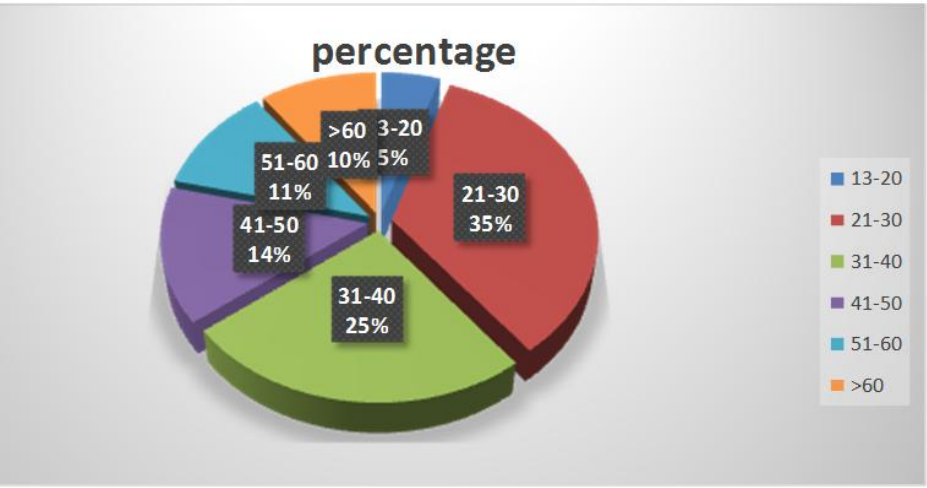


Fig.2 Sex wise distribution

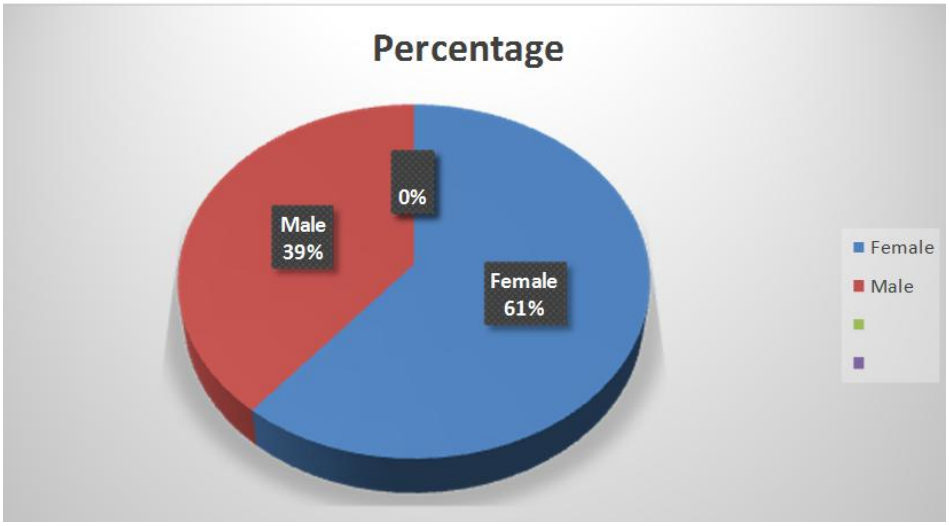
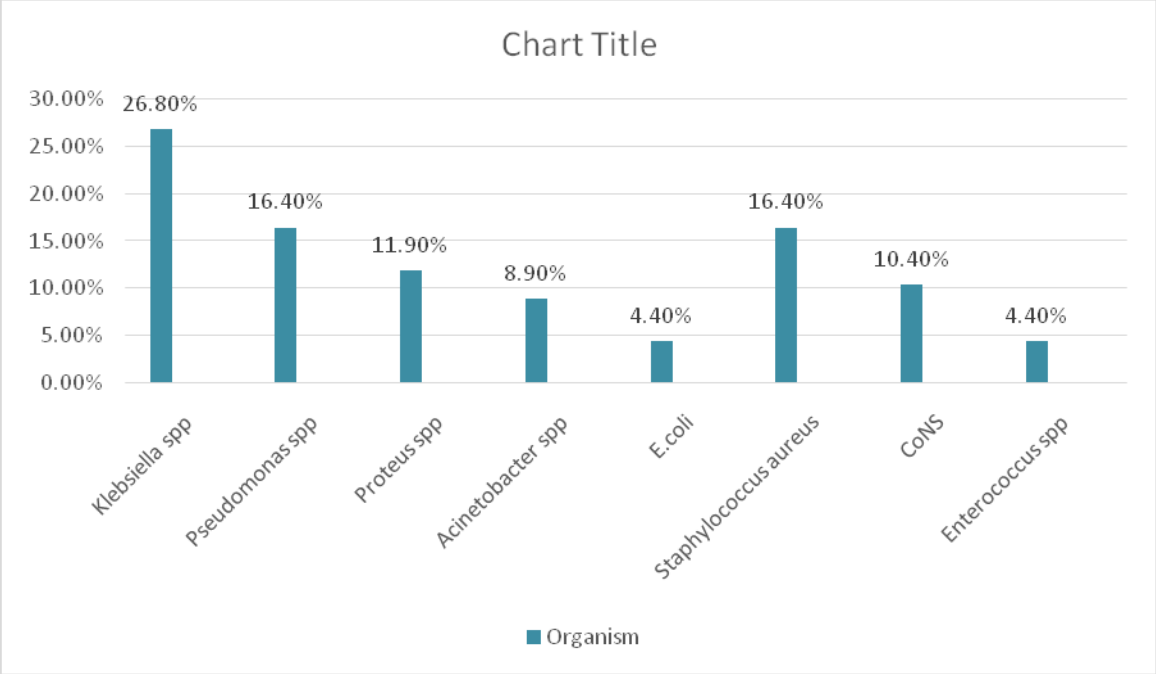


Fig.3 Distribution of isolates



Antimicrobial susceptibility test

Gram negative bacteria were the predominating bacteria with 46 isolates and 68.6% and Gram positive isolates were only 21 (31.3%). This pattern is similar to the observation in Saaiq *et al.*, (2015).

Whereas study conducted by, Lakshmi *et al.*, (2015); Kavitha *et al.*, (2018); Alghalibi *et al.*, (2011) and Naveen Saxena *et al.*, (2013) had Grampositive bacteria predominantly.

Klebsiella spp in our study showed 92% of the isolates are sensitive to piperacillin – Tazobactam and 8% are resistant to it. 100% of the isolates are sensitive to Imipenem and 10% are resistant to it. similar to study by contrast to results obtained by Jyoti sonawane (2010) where 96.3% sensitivity to imipenem obtained.

In *Pseudomonas aeruginosa* 100 % of the isolates are sensitive to imipenem and no resistant to it. Contrast to our study by study showing 76% sensitivity shown by Prabat Ranjan *et al.*, (2010). Ciprofloxacin in our study sensitive to 37% similar to study by Prabat Ranjan *et al.*, (2010).

Proteus spp in our study showed sensitive to both Amoxyclav and cotrimoxazole showed 37% and resistance were 63%. This goes well in line with Desai *et al.*, (2011). 87 % of the isolates are sensitive to Piperacillin- Tazobactam and. 75% of the iolates are sensitive to Cefoperazone – Sulbactam, gentamycin and Amikacin. In contrast to work done by Madhavi and Shaziaparveen (2015) in which 100% resistance to Cotrimoxazole and 100% sensitivity to Amikacin mentioned.

Escherichia coli in our study showed sensitivity about 67% of the isolates are sensitive to Cefoperazone – sulbactam, 33% to Gentamycin and 20% a. 67% of the isolates are sensitive to Ceftriaxone and contrast to our study by Mishra *et al.*, (2000).

Staphylococcus aureus in our study showed 100% of the isolates are sensitive to vancomycin, Linezolid, and 71 % to Doxycyclin. This is similar to study done by Fantahunbiadglegne *et al.*, (2009). *Klebsiella* is the most common isolate among all followed by *Pseudomonas Staphylococcus aureus*.

Piperacillin and tazobactam, carbapenem has increased sensitivity when compared to other drugs for Gram negative pathogens, where as Cotrimoxazole, Amoxycillin Clavulanic acid, Ciprofloxacin all have very high resistance

The use of prophylactic antibiotics is common practice with burnt patients. Drug resistant bacteria with intrinsic resistance towards antibiotics, the ability to survive longer in the hospital environment and hand-to-hand transmission of bacteria reflect their easy spread and the possible causes of outbreak.

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