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Study of the Bacteriological Profile and Their Antimicrobial Susceptibility Pattern in Patients with Skin Infections

M. Nandini[1] and S. B. Kiran Madhusudhan[1*]

[1]Department of Microbiology, Sree Balaji Medical College and Hospital Affiliated to Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study group consisted of 150 patients both male and female between 1 – 80 years, with primary and secondary skin infections who attended the out- patient department of Dermatology and surgery at Sree Balaji medical college and hospital a tertiary care hospital in Chennai, Tamilnadu, South India. Patients admitted as in patients in the above two department were also taken for this study. 28 out of 150 cases had primary bacterial and 122 had secondary bacterial skin infections. In this study the prevalence of Methicillin resistant Staphylococcus aureus (MRSA) (40.8%) and Extended spectrum beta-lactamases (ESBL) (40.5%) producers among Enterobacteriaceae was higher. Estimation of MRSA and ESBL has to be done in tertiary care hospital to prevent and curtail further spread of these strains in hospital acquired infections. These isolates pose a serious threat for use of routine groups of antimicrobials.

Keywords: Enterobacteriaceae; acquired infections; gastro-intestinal tract; genito-urinary and oro-pharyngeal mucosa.

**Corresponding author: E-mail: kiran.b@bharathuniv.ac.in;*

1. INTRODUCTION

Skin is the largest organ of the body, with surface area of 1.5-2.0 square meters in an average adult. It is flexible, tough and acts as a barrier to invasions [1] and consists of a stratified, cellular epidermis and an underlying dermis of connective tissue [2]. Skin helps in electrolyte balance, regulation of water, thermoregulation and also acts as a barrier against microorganisms and other external noxious agents [3]. Development of bacterial infections occurs in three following steps – bacterial adherence to host cells, evasion of host defence mechanism, and by elaborations of toxins of bacteria and its virulence factors [4]. Loss of skin integrity leads to exposure of subcutaneous tissue, which provides moist, warm and nutritious environment that is conducive for colonisation of microbes. These microbes originate from environment, surrounding skin and endogenous source like gastro-intestinal tract, genito-urinary and oro-pharyngeal mucosa [5,6]. By virtue of their incidence and severity, bacterial skin infections represent a major clinical problem. Epidemiological studies in United States in 2005 showed that among the common diseases encountered in clinical practice, bacterial skin disease is one of them and accounts to approximately 14.2 million ambulatory care visits [7].

In the developing world like India, majority of skin diseases are transmissible and can be preventable and controllable [8-10]. Skin infections have contributed to longer stay in the hospital with increase in cost of hospitalisation, morbidity and mortality. This is likely to play a significant role in development of antimicrobial resistance [8,11]. Studies have shown that in-patients with skin infections, hospital stay is about 6 -10 days more than if wound heals without infections, which almost doubles the cost of treatment [12,13]. Immune-compromised status like Acquired immunodeficiency syndrome (AIDS) and diabetes mellitus can easily convert a mild infection into a rapidly advancing to life-threatening condition [14].

Selection of antimicrobials for bacterial skin infection is based on culture and sensitivity test. But initial antimicrobial therapy remains empirical [11]. Bacteria have developed ways to adapt to antimicrobial therapy [15]. In the last two decades there has been an increase in infections by organisms that were resistant to commonly used antimicrobials [2]. Increasing prevalence of Methicillin resistance among *Staphylococcus* and extended spectrum betalactamase producers (ESBL) among gram negative pathogens in hospital as well as in the community is posing a great challenge to the clinician to start on empirical antimicrobial therapy [16-18].

2. MATERIALS AND METHODS

2.1 Design of the Study

Single centre, cross sectional and analytical study.

2.2 Study Period

The work was carried out from January 2015 to January 2016, over a period of one year.

2.3 Place of the Study

Department of Microbiology, Central laboratory of Sree Balaji Medical College and Hospital a tertiary care hospital in Chennai, Tamil nadu South India.

2.4 Statistical Analysis

Statistical analysis as carried out using statistical package for social sciences and EPI - Software by statistician. The proportional data of this cross sectional study were tested using Pearson's chi square analysis test and Binomial proportion test. The clinical and laboratory data thus obtained and analysed using the statistical package of the Microsoft office Excel 2007 Enterprise Edition.

2.5 Study Group

Study group included 150 patients, in the age group 1- 80 years.

2.5.1 Inclusion criteria

The study included 150 patients who were in and out-patients in department of dermatology and surgery at Sree Balaj Medical College and Hospital, Chennai.

2.5.2 Exclusion criteria

Those who had one or more combination of the following were excluded.

Neonates, Use of antimicrobials in previous one week, Pregnant patients, Known Human

Iimmunodeficiency Virus (HIV) and cancer patients, Refusal to give consent for participating in the study.

3. RESULTS

This cross-sectional study was carried out during the period January 2015 to January 2016 at Sree Balaji medical college and hospital. Chrompet, Chennai. Specimens were obtained from patients with skin infections of Dermatology and surgery departments as out- patient and in-patients. In the study swabs from 150 patients of both sexes from 1 to 80 years were studied, 28 cases were primary bacterial skin disease and 122 cases were secondary bacterial skin infections. The specimens were processed in the microbiology department of central laboratory in the hospital to identify the bacteriological profile of skin infections, antimicrobial susceptibility pattern of the organisms isolated, incidence of Methicillin resistant *Staphylococcus aureus* and ESBL producing Enterobacteriaceae among them.

Out 49 *S. aureus* isolated from the samples, 20 (40.8%) were cefoxitin resistant and were considered as Methicillin resistant *S. aureus* (MRSA). 29 (59.2%) showed sensitive to cefoxitin and were considered as Methicillin sensitive *S. aureus* (MSSA).

Table 1. Demographic characters of the study

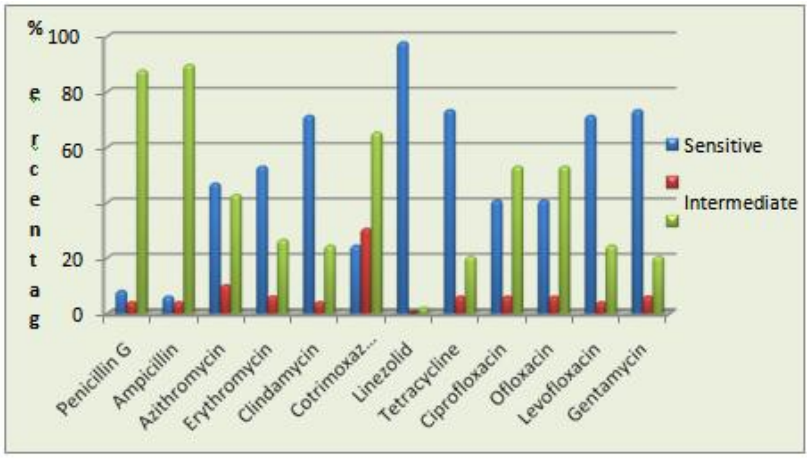
Age group in years	Male	Female	Number n=150 (%)
1-10	3	2	5(3.3)
11-20	9	7	16(10.6)
21-30	16	10	26(17.3)
31-40	30	13	43(28.6)
41-50	15	7	22(14.6)
51-60	13	7	20(13.3)
61-70	6	3	9(6.0)
71-80	5	4	9(6.0)
Total no. Patients	97(64.6%)	53(35.3%)	150

Table 2. Prevalence of MRSA and MSSA isolates of *S. aureus*

Total *S. aureus* N=49	Number of isolates	Percentage %
MSSA	29	59.2
MRSA	20	40.8

Fig. 1. *Staphylococcus aureus* on nutrient agar

Fig. 2. Escherichia coli on Mac conkey agar



Graph 1. Shows antimicrobial susceptibility pattern of *S. aureus* isolates

Fig. 3. Biochemical reactions of *Escherichia coli*

Fig. 4. Showing cefoxitin resistance and inducible clindamycin resistance in *S. aureus*

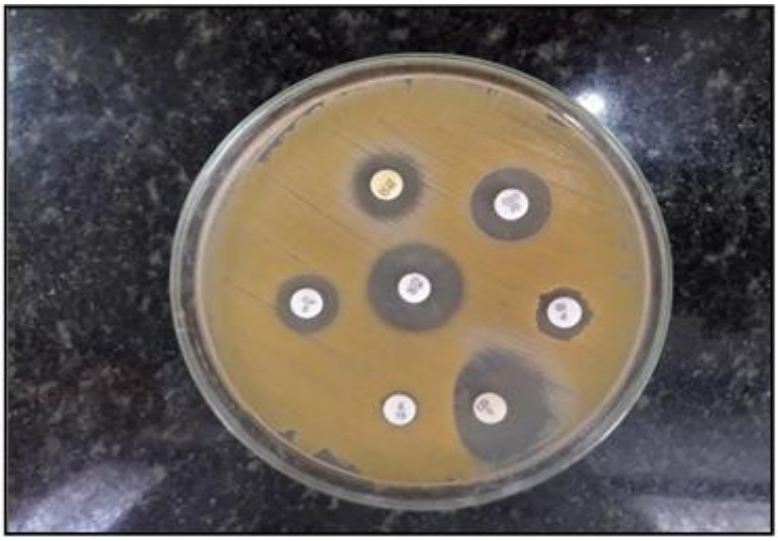


Fig. 5. Showing cefoxitin sensitive and inducible clindamycin resistance in *S. aureus*

4. DISCUSSION

In this study, out of 150 samples with bacterial skin infections, 97(64.6%) were from males and 53(35.3%) from female, male preponderance. The male predominance may be due to increased environmental exposure and chances of accidents while earning for livelihood [9] or may be due to our social behaviour where diseased males are brought earlier to hospital for treatment than female [18-19].

In the present study, Enterobacteriaceae (*E. coli* - 20, *Klebsiella* - 11, Proteus – 8) were the second most common pathogens causing secondary skin infections, this was in concordant with the study by Abdallah et al. [20] who also found that after *S. aureus*, Enterobacteriaceae was the second common pathogen in secondary bacterial skin infections. But there was lower resistance to Levofloxacin (24.4%) in this study, which was in correlation to the study (23.9%) and Prabhu et al. [21] (23.0%). In contrast to our study (23.5%), (21.4%) (25%) showed lower resistance to Ciprofloxacin.

But in contrast to ours results, showed lower sensitivity to Gentamycin (11%), Ciprofloxacin (21%) and Amikacin (15%). In our study the sensitivity pattern of Meropenem (75%),

Imipenem (62.5%) and Piperacillin-Tazobactum (81.2%). Extended spectrum beta lactam antimicrobials agents are the common drugs used for empirical treatment of Gram negative infections, but emerging ESBL producing bacterial are posing a serious threat to the continued use of this group of antimicrobials [22].

In our study ESBL producing Enterobacteriaceae were 15 (40.5%), out of total 15 isolates, E. coli was 9 (40.9%), *Klebsiella* was 5 (45.4%) and *Proteus mirabilis* was 1(25%). (total ESBL was 53%, ESBL producing E. coli was 40% and ESBL positive *Klebsiella* was 42.5%),(total ESBL – 42.2%, ESBL producing *Klebsiella* – 42.5% and ESBL positive E. coli – 40%), (total ESBL – 44.2%, ESBL positive E. coli – 47.2% and ESBL producing *Klebsiella* – 50%), (Total - 47.6%, *E. coli* – 48% and *Klebsiella* – 56%).

In this study the prevalence of MRSA (40.8%) and ESBL (40.5%) producers among Enterobacteriaceae was high and other recent studies also have shown that there is increased prevalence all over the world. These isolates pose a serious threat for use of routine groups of antimicrobials. Estimation of MRSA and ESBL has to be done in tertiary care hospital to prevent and curtail further spread of these strains in hospital acquired infections [23]. .

Bacterial skin infections are a varied group of clinical entity and knowledge of the causative organism of these infections in a specific geographical region will guide us in the judicious selection of antimicrobials for empirical therapy [24]. In our study, *Staphylococcus aureus* is the predominant causative organism in both primary as well as secondary bacterial skin infections. Hence first line of antimicrobial therapy must be selected against this pathogen. Gram negative bacteria are emerging as causative organism in skin infections especially secondary type. To treat such infections beta-lactamases inhibitor will be more appropriate. The treatment of bacterial skin infections has become a great challenge due to increasing spread of antimicrobial resistance among the bacteria especially ESBL producing Enterobacteriaceae and MRSA strains [25]. Wounds are a risk factor for colonization with ESBL and MRSA, hence the clinical microbiology laboratory has to isolate, identify the pathogens causing bacterial skin infections and to screen and confirm isolates for ESBL production and MRSA as a routine [23-25].

5. CONCLUSION

The emergence of multidrug resistant strains warrants the need for antimicrobial stewardship to curb the increase of such strains and to preserve the effectiveness of antimicrobials for better management of the patient. Since there is changing trends in causative organisms in bacterial skin infections and their antimicrobial susceptibility pattern, there is an urgent need for constant monitoring through prospective studies and continuous antimicrobial surveillance programme.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The study was approved by Institutional Ethics Committee, Sree Balaji Medical College and Hospital, Chrompet, Chennai – 44, Bharath institute of higher education and research.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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