ORIGINAL ARTICLE

To Study Microbiological Profile of Wound Infections in Patients Admitted to Surgical ICU

Dr Amarpreet Kaur,[1] MBBS, Dr Veenu Gupta,[1] MBBS, MD, Dr P.L Gautam,[2] MBBS, MD
Dr Menal Gupta,[1] MBBS, MD

[1]Junior resident, Microbiology, [1]Professor & Head, Microbiology, [2]Professor & Head, Critical Care Medicine

[1]Professor, Microbiology

[1]Department of Microbiology & [2]Critical Care Medicine, Dayanand Medical College & Hospital, Ludhiana

ABSTRACT

Introduction: Surgical site infections represent the primary source of nosocomial infections in surgical patients and contribute significantly to postoperative morbidity and mortality rates. The extensive and indiscriminate application of antibiotics has resulted in the gradual emergence of antibiotic resistance.

Aims and objectives: To study microbiological profile of wound infections.

Material and methods: This study was conducted for a period of one year. All wound exudate samples from patients suspected of wound infections admitted in hospital were included. Identification and antimicrobial susceptibility testing (AST) of the isolates was done by Vitek-2 system.

Results: A total of 166 patients suspected with wound infections admitted in surgical ICU were enrolled in the study. Out of 166 patients, 122 patients were culture positive and a total of 148 isolates were obtained. Gram negative isolates were predominant (83.1%) as compared to gram positive (16.9%). Most common isolate was *E. coli* (33.8%) followed by *Klebsiella pneumoniae* (25.7%) and showed maximum sensitivity for tigecycline (90% and 65.8% respectively) followed by amikacin (76% and 63.2% respectively). Out of 148 isolates, 77.7% were multi drug resistant and 58.1% were extensively drug resistant. No isolate was pan drug resistant.

Conclusions: This study concluded that gram-negative multidrug-resistant flora predominated among various wound infections in our tertiary care hospital. Raising awareness, detecting organisms within hospital settings, implementing rigorous infection control practices, and using antibiotics judiciously are essential in combating this serious threat.

KEY WORDS: Wound infections, antimicrobial susceptibility testing, multidrug resistant

INTRODUCTION

Wound infection can be defined as the invasion of organisms into tissues after a breakdown of local and systemic host defenses.[1] A major wound infection is indicated by pus discharge from the wound and may require a secondary procedure to ensure proper drainage. This condition can be accompanied by systemic symptoms or a delay in the patient's return home. In a minor wound infection, there is discharge of pus or serous fluid without significant discomfort or systemic symptoms.[2] Wound infection is the most common and troublesome issue in the process of wound healing.[3] Reports indicate that skin and soft tissue infections (SSIs) are linked to a 2 to 11 fold increase in mortality risk, with 75% of SSI-related deaths being directly attributable to the infection.[4] It is the second most common hospital-acquired infection, leading to patient discomfort, prolonged hospital stays and higher

Correspondence: *Dr. Veenu Gupta, Professor & Head, Microbiology, DMCH*
Phone: 9814736051 - Email: vsunilgupta@rediffmail.com

therapy costs, causing an excessive increase in the cost of an operation. Completely preventing surgical wound infections appears to be an unattainable goal.[5,6] Despite modern surgical and sterilization techniques and prophylactic use of good antibiotics, postoperative wound infection remains a major contributory factor of patient's morbidity.[7] This study aims to investigate the microbiological profile of wound infections in patients admitted to Surgical ICU. It will provide useful data to develop local guidelines for prevention and management of wound infections in the ICUs.

MATERIAL AND METHODS

This study was a prospective one-year study conducted on patients admitted in Surgical ICU, after obtaining approval from the Institutional Ethical Committee. Various samples like pus, tissue, wound swab were obtained from patients suspected with wound infection and were processed as per standard protocols.[8] They were cultured on blood and MacConkey agar and incubated at 37ºC for 24-48 hrs. Identification and antibiotic sensitivity testing (AST) of the isolates was done by the Vitek2 system.[9] The isolates were then characterized into multi-drug resistant (MDR) which are non-susceptible to ≥1 agent in ≥3 antimicrobial categories, extensively drug resistant (XDR) as non-susceptible to ≥1 agent in all but ≤ 2 categories and pan-drug resistant isolates (PDR) as non-susceptible to all antimicrobial agents.[10] Statistical significance was set to $p < 0.05$. Data were analyzed using the SPSS 21.0 software.

OBSERVATIONS AND RESULTS

A total of 1010 patients were admitted and wound infections were suspected in 166 patients. Out of these, 122 had confirmed wound infection on the basis of culture with infection rate of 73.5%. Site of wound was diabetic foot/gangrene, traumatic, post operative and abscess/cellulitis. Majority of patients were in age group of 61-80 years (36.9%), whereas minimum patients were in the age group of >80 years (1.6%). Majority of patients were males (80.3%) as compared to females (19.7%). Comorbid illness was present in 63.1% patients and diabetes mellitus was the most common comorbidity (37.7%). Most common risk factor was sepsis observed in 52.5% patients. Mean ICU stay was 7.1 days. Mean APACHE 2 score was 14.7 (Table 1).

A total of 148 isolates were obtained (monomicrobial growth was present in 96 patients and in 26 patients, polymicrobial growth was obtained).gram negative organisms were predominant 123(83.1%) than gram positive 25(16.9%) (Table 2). Most common isolate was *E. coli*

Table 1 Characteristics of patients with wound infections (n=122).

Characteristic	Patients with wound infections (n=122)
Mean Age(years)	50.7
Male:Female	4.1:1
Mean APACHE 2 score	14.7
Mean ICU Stay(days)	7.1
Risk factors	
Sepsis	64(52.5%)
Alcohol intake	20(16.4%)
Immobilisation	11(9%)
Elderly(>70years)	18(14.8%)
Smoker	7(5.7%)
Immunocompromised	2(1.6%)
Outcome	
Survived	78(63.9%)
Expired	44(36.1%)

Table 2 Distribution of isolates (n=148).

Gram negative isolates	n (%)
Escherichia coli	50(33.8)
Klebsiella pneumoniae	38(25.7)
Acinetobacter baumannii	13(8.7)
Pseudomonas aeruginosa	8(5.4)
Enterobacter aerogenes	3(2)
Enterobacter cloacae	3(2)
Citrobacter freundii	3(2)
Proteus mirabilis	3(2)
Morganella morgannii	1(0.7)
Serratia marcescens	1(0.7)
Gram positive isolates	
Enterococcus faecalis	3(2)
Enterococcus faecium	9(6.1)
Staphylococcus aureus	10(6.8)
Staphylococcus epidermidis	1(0.7)
Staphylococcus haemolyticus	1(0.7)
Staphylococcus hominis	1(0.7)

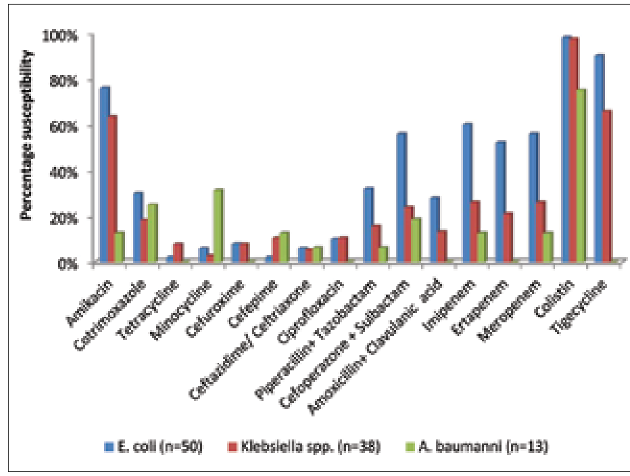

Fig. 1 Antimicrobial susceptibility of predominant gram negative isolates

Table 3 % Antimicrobial susceptibility of Gram negative isolates.

Antibiotics	***E. coli* (n=50)**	***K. pneumoniae* (n=38)**	***A. baumanni* (n=13)**	***Enterobacter* spp. (n=6)**	***Pseudomonas* spp. (n=8)**
Amikacin	76	63	13	50	62.5
Cotrimoxazole	30	18	25	0	15.5
Tetracycline	2	8	0	0	0
Minocycline	6	3	31	16.7	0
Cefuroxime	8	8	0	0	0
Cefepime	2	11	13	33.3	50
Ceftazidime/ Ceftriaxone	6	5	6	0.0	50
Ciprofloxacin	10	11	0	16.7	25
Piperacillin+ Tazobactam	32	16	6	0	37.5
Cefoperazone + Sulbactam	56	24	19	33.3	50
Amoxicillin+ Clavulanic acid	28	13	0	0	0
Imipenem	60	26	13	33.3	50
Ertapenem	52	21	0	16.7	0
Meropenem	56	26	13	33.3	25
Colistin	98	97	75	100	75
Tigecycline	90	66	0	50	-

(33.8%) followed by *K. pneumonia* (25.7%). *E. coli* and *K. pneumoniae* showed maximum sensitivity for tigecycline (90% and 65.8% respectively) followed by amikacin (76% and 63.2% respectively) (Fig. 1, Table 3). Among gram positive isolates, *Enterococcus spp*. (8.1%) were common followed by *Staphylococcus aureus* (6.8%). *Enterococcus spp.* showed maximum sensitivity for linezolid (91.7%) followed by teicoplanin (66.7%). All *S. aureus* isolates were susceptible for linezolid and teicoplanin (Fig. 2). Out of 12 isolates of *Enterococcus spp*., 16.7% were vancomycin resistant (VRE).

Among 148 bacterial isolates, 77.7% isolates were multi drug resistant and 58.1% were extensively drug resistant. No isolate was pan drug resistant. Out of 122 patients, 78 (63.9%) patients survived and 44 (36.1%) expired.

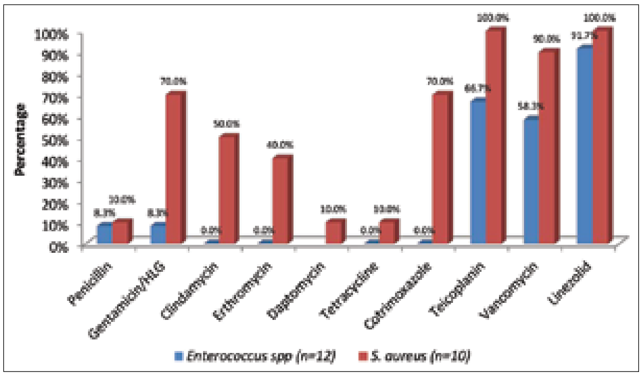

Fig. 2 Antimicrobial susceptibility of predominant gram positive isolates

DISCUSSION

The control of wound infections has become increasingly difficult due to the widespread resistance of bacteria to antibiotics. Hence, there is need to screen and confirm such isolates. Therefore, culture and antibiotic susceptibility testing play a crucial role in the treatment of wound infections. Over a period of 1 year, 1010 patients were admitted in Surgical ICU and wound infections were present in 122 patients with an infection rate of 12.1%.

In our study, majority of patients were in age group of 61-80 years (36.9%), in concordance with study done by Goswami *et al*.[11] Males were more (80.3%) as compared to females (19.7 %) with male to female ratio of 4.1:1, whereas a study done by Saleem *et al* showed 63.2% males and 36.8% females.[12] Out of 122 patients, 37.7% patients were diabetic, similar to study by Kallakuri, who also observed diabetes as the predominant comorbidity (33.3%).[7] High blood sugar can raise the risk of infections and hinder wound healing.

Gram negative isolates were predominant (83.1%) as compared to gram positive isolates (16.9%), similar to reported in literature by Pondei (Gram negative = 85.1% and Gram positive = 14.9%).[13]

Most common organism isolated was *E. coli* (33.8%) followed by *K. pneumoniae* (25.7%). Various other studies also show the same reports.[14-16] In the study by Surendra B. Patil *et al* and Sonawane *et al*., the predominant isolate was *Pseudomonas aeruginosa* (32.2%) and *S. aureus* (35%) which is in contrast to our study.[17,18]

E. coli isolates showed good sensitivity to tigecycline (90%) followed by amikacin (76%) and least sensitive to tetracycline and cefepime (2% each), findings are similar with other studies.[19,20] In contrast to our study, low sensitivity to amikacin (42.7% - 50%) was observed by various authors.[21,22] *K. pneumoniae* showed 63.2% susceptibility to amikacin, in concordance to study done by Narinder Kaur et al.(66.6%).[23] In our study, out of 148 isolates, 77.7% isolates were MDR and 58.1% were XDR. A study from Dhaka showed 67.1% MDR isolates.[24] The proportion of vancomycin resistance among *Enterococcus spp*. was 16.7%, similar to study in Ethiopia where VRE rate was 16.4%.[25]

CONCLUSION

This study presents data on the microbial flora associated with various wound infections in our tertiary care hospital. *E. coli* and *K. pneumoniae* were the predominant isolates in wound infections. Bacterial isolates showed high to moderate resistance to various classes of antibiotics. The susceptibility data could be useful in developing empiric treatment strategies for pyogenic infections. Strict health policies should be enforced to restrict unsupervised antibiotic use, along with ongoing monitoring and reporting of antibiotic resistance. To conclude, raising awareness and improving detection of these organisms in hospital settings, along with implementing strict infection control practices and using antibiotics wisely, will aid in combating this serious threat.

REFERENCES

1. Leaper DJ. Wound Infection. In: Russell RCG, William NS, Bulstrode CJK, eds. Bailey & Love's Short Practice of Surgery; 24th ed. London: Arnold; 2004:118-32.
2. Nicholas RL. Wound Infection rates following clean operative procedures: Can assume them below? (Editorial). Infect Cont Hosp Epidemiol. 1992; 13:455.
3. Ban KA. American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. J Ame Coll Surg. 2017; 224(1):59-74.
4. Awad SS. Adherence to surgical care improvement project measures and post-operative surgical site infections. Surg infect. 2012; 13(4):234-37.
5. Martone WJ and Garner JS. Proceedings of the 3rd decennial international conference on nosocomial infections. Am J Med. 1991; 91(3):S1-3.
6. Steven M, Steinberg J. Investigation and treatment of surgical infection. In: Cuscheri A, Steele RJC, Moossa AR, eds. Essential Surgical Practice, 3rd ed. London: Butterworth Heinemann; 1995:20.
7. Kallakuri K, Suprada K, Bahadur BR, Rao KG. Post operative wound infection: a descriptive study. Int J Reprod Contracept Obstet Gynecol. 2024; 13(7):1731-34.
8. Collee JG, Marr W Specimen collection, culture containers and media In: Collee JG, Fraser AG, Marmion BP, Simmons A (eds) Mackie & McCartney. Practical Medical Microbiology. 14 ed. Edinburgh: Churchill Livingstone; 1996; p. 95-111.
9. Wayne PA. National committee for clinical laboratory standards Performance standards for antimicrobial disc susceptibility testing 2002; 12:1-53.
10. Alkofide H, Alhammad AM, Alruwaili A, Aldemerdash A, Almangour TA, Alsuwayegh A, et al. Multidrug-Resistant and Extensively Drug-Resistant Enterobacteriaceae: Prevalence, Treatments, and Outcomes-A Retrospective Cohort Study. Infect Drug Resist. 2020; 13:4653-62.
11. Goswami NN, Trivedi HR, Goswami AP, Patel TK, Tripathi CB. Antibiotic sensitivity profile of bacterial pathogens in postoperative wound infections at a tertiary care hospital in Gujarat, India. J Pharmacol Pharmacother. 2011; 2(3):158-64.
12. Saleem M, Mahadevan K, Rangasamy B, Gopal R. Bacterial Profile and Antimicrobial Susceptibility Pattern of Surgical Site Infections – A Retrospective Study Medical Science. Ind J Appl Res. 2015 ;5(10).
13. Pondei K, Fente BG, Oladapo O. Current microbial isolates from wound swabs, their culture and sensitivity pattern at the Niger Delta University Teaching Hospital, Okolobiri, Nigeria. Trop Med Health. 2013; 41(2):49-53.
14. Mantravadi HB, Chinthaparthi MR, Shravani V. Aerobic isolates in pus and their antibiotic sensitivity pattern: a study conducted in a teaching hospital in Andhra Pradesh. Int J Med Sci Pub Health. 2015; 4:1076-79.
15. Raza MS, Chander A, Ranabhat A. Antimicrobial susceptibility patterns of bacterial isolates in postoperative wound infections in a tertiary care hospital, Kathmandu, Nepal. Open J Med Microbiol. 2013; 3:159163.
16. Taiwo SS, Okesina AB, Onile BA. In vitro antimicrobial susceptibility pattern of bacterial isolates from wound infections in University of Ilorin teaching hospital. Afr J Clin Exp Microbiol. 2002; 3:6-10.
17. Patil SB, Paramne A, Harsh S. Antibiotic susceptiility of wound isolates in plastic surgery patients at a tertiary care centre. Ind J Plast Surg. 2016; 49(2):198-205.
18. Sonawane J, Kamath N, Swaminathan R, Dosani K. Bacterial profile of surgical site infections and their antibiograms in a Tertiary Care Hospital in Navi Mumbai. Bombay Hosp J. 2010; 52(3):358-61.
19. Sah P, Khanal R, Upadhaya S. Skin and soft tissue infections: Bacteriological profile and antibiotic resistance pattern of the isolates. J Univ Col Med Science 2013; 1:18-21.
20. Soumya K, Jaya S. Prevalence and antimicrobial susceptibility patterns of bacteria isolated from skin and wound infections. J Microbiol. Biotech. Res 2014; 4:39-45.
21. Srinivasan S, Vartak AM, Patil A, Saldanha J. Bacteriology of the burn wound at the Bai Jerbai Wadia hospital for children, Mumbai, India. A 13 year study, Part I - Bacteriological profile. Ind J Plast Surg. 2009; 42(2):213-18.
22. Dhar S, Saraf R, Singh K, Raina B. Microbiological profile of chronic burn wounds among patients admitted in burn unit. JK science. 2007; 9(4):182-85.
23. Kaur N, Kaur A, Singh S. Prevalence of ESBL and MBL producing gram negative isolates from various clinical samples in a tertiary care hospital. Int J Curr Microbiol Appl Sci. 2017; 6(4):1423-30.
24. Alam, M. M., Islam M. N., Hossain Hawlader M. D., Ahmed, S., Wahab, A., Islam, M., Uddin, K. R (2020). Prevalence of multidrug resistance bacterial isolates from infected wound patients in Dhaka, Bangladesh: A cross-sectional study. Int J Surg. 2020(28):56-62.

25. Godebo G, Kibru G, Tassew H. Multidrug-resistant bacterial isolates in infected wounds at Jimma University Specialized Hospital, Ethiopia. Ann Clin Microbiol Antimicrob. 2013; 23(7).