e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(3); 291-296

Original Research Article

Assessment of Microbiology and Antimicrobial Spectrum in Patients with of Surgical Site Infection

Sunil Kumar[1], Ravi Kumar[2], Shashi Kishore[3], Sanjay Nag[4]

[1]Assistant Professor, Department of Microbiology, ANMMC, Gaya, Bihar, India

[2]Assistant Professor, Department of Microbiology, ANMMC, Gaya, Bihar, India

[3]Assistant Professor, Department of Microbiology, ANMMC, Gaya, Bihar, India

[4]Assistant Professor, and HOD, Department of Microbiology, ANMMC, Gaya, Bihar, India

Received: 10-01-2024 / Revised: 13-02-2024 / Accepted: 22-03-2024
Corresponding Author: Dr. Shashi Kishore
Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to evaluate the antimicrobial susceptibility pattern of microorganisms involved in the pathogenesis of surgical site infection.

Methods: The study was a cross-sectional study which was carried in the Department of Microbiology, ANMMC, Gaya, Bihar, India for the period of one year. Total 190 patients with SSIs either sex or any age, who had surgical wound pus, discharge, or signs of sepsis were include in this study. Patients with cellulitis and suture abscess were excluded from this study. Out of 190 samples, 100 samples were culture positive (52.63%).

Results: Among 100 positive samples 58 (58%) were males. Maximum no. of culture positive samples in age 20-30 years (30%) followed by 30-40 (21%) and then followed by 40-50 (14%) of age group respectively. Out of 100 culture positive samples S.aureus (23%) was the most common pathogen isolated followed by Escherichia coli. (21%), Citrobacter spp. (16%) and Pseudomonas aeruginosa (11%) respectively. Among gram negative bacilli, E.coli was most sensitive to Imipenem followed by Amikacin and Piperacillin Tazobactam whereas for Citrobacter spp., Imipenem followed by Gentamicin, Ciprofloxacin was the drug of choice then for Klebsiella spp., Imipene followed by Gentamicin, Amikacin was the drug of choice. Among gram positive organism, S.aureus showed maximum antibiotic sensitivity to Linezolid followed by Vancomycin, Amikacin whereas CONS was sensitive to Linezolid followed by Vancomycin, and Gentamicin.

Conclusion: The present study concluded that the increasing resistance to antimicrobials increases the risk of morbidity and mortality; therefore, there is urgent need of implementation of measures to restrict the health care associated infection. Rational use of antimicrobials, proper hygiene, and strict asepsis should be applied in all health care.

Keywords: antimicrobial, susceptibility, pattern, microorganisms, surgical site infection

Introduction

Surgical site infection (SSI) is the major costliest healthcare-associated infection and a substantial cause of morbidity and mortality throughout the world. [1,2] It occurs near or at the incision site and/or deeper underlying tissue spaces and organs within 30 days of a surgical procedure performed (or up to 90 days for implanted prosthetics). [3] In low and middle-income countries SSI ranked the most frequently reported case of nosocomial infections [4] and in some settings, up to one-third of patients who are operated on [5] can catch SSI, despite standard protocols of preoperative preparation and antibiotic prophylaxis are practiced. [6]

The SSI rate in Ethiopia has been reported to be between 14.8 and 20% [5-9] and surgical patients account for 38% of general surgical wards at various teaching hospitals. [10] It results from mostly bacterial contamination during or after the surgical procedure but only a small portion progresses to clinical infection due to innate host defences removing contaminants. The contamination that will lead to surgical site infection depends on the dose of bacterial contamination, the virulence, and drug resistance of the bacteria. [11] Most SSI infections are preventable [11], however probable development of an infection depends on the age, immunocompromising conditions of the host, or the antimicrobial-resistance (AMR) nature of the infecting microorganisms. [12]

The frequency varies from one hospital to the other and is related to complications. [13] Patients with SSI are twice as likely to die, 60% more likely to spend time in an intensive care unit (ICU), and more than five times more likely to be readmitted to the hospital after discharge. [14] The most common pathogens associated with surgical wound infections are Staphylococcus aureus, Escherichia coli, Klebsiella spp., Proteus spp., Citrobacter spp., Acinetobacter spp., Coagulase negative Staphylococcus aureus and pseudomonas aeruginosa. [15]

Beta-lactam antibiotics are the most widely used antibiotics for SSI prophylaxis and therapy; however, 30% to 90% of antibiotics are misused or overused. [16,17] This inappropriate overuse increases selection pressure, favouring the emergence of drug-resistant bacteria, making the choice of empirical therapy more difficult and expensive, and poses a serious threat to public health, thus increasing the global risk of SSI. [18,19] The condition is more serious due to irrational antimicrobial prescriptions and un-updated empirical therapy. Hence, the use of data from clinical laboratories' antibiotics susceptibility testing (AST) or solid epidemiological data from ongoing nosocomial infection surveillance is needed to minimize the problem. [20]

The aim of the present study was to evaluate the antimicrobial susceptibility pattern of microorganisms involved in the pathogenesis of surgical site infection.

Materials and methods

The study was a cross sectional study which was carried in the Department of Microbiology, ANMMC, Gaya, Bihar, India for the period of one year, Total 190 patients with SSIs either sex or any age, who had surgical wound pus, discharge, or signs of sepsis were include in this study. Patients with cellulitis and suture abscess were excluded from this study. Out of 190 samples, 100 samples were culture positive (52.63%).

Using sterile cotton swabs, two pus swabs/ wound swabs were collected aseptically from each patient suspected of having SSI. Gram-stained preparations were made from one swab for provisional diagnosis. The other swab was inoculated on nutrient agar, 5% sheep blood agar (BA) and MacConkey agar (MA) plates and incubated at 37°C for 24-48 hours before being reported as sterile. Growth on culture plates was identified by its colony characters and the battery of standard biochemical tests. [21,22] All the isolates were tested for antimicrobial susceptibility by Kirby Bauer disk diffusion technique on Muller Hinton Agar and results were interpreted in accordance with Clinical Laboratory Standards Institute guidelines. [23] Antibiotics used for susceptibility testing were: Amikacin, Ampicillin / Sulbactam, Ceftriaxone, Ciprofloxacin, Gentamicin, Piperacillin- Tazobactum, Imipenem, Azithromycin, Vancomycin, Linezolid, Ofloxacin, Cefoxitin.

Statistical Analysis: Data was entered in Microsoft excel spreadsheet and analysed using appropriate statistical software application.

Results

Table 1: Demographic details

Gender	**No of patients=100**
Male	58 (58%)
Female	42 (42%)
Age in year	**Culture Positive**
Below 20	16 (16)
20-30	30 (30)
30-40	21 (21)
40-50	14 (14)
50-60	12 (12)
Above 60	7 (7)

Among 100 positive samples 58 (58%) were males. Maximum no. of culture positive samples in age 20-30 years (30%) followed by 30-40 (21%) and then followed by 40-50 (14%) of age group respectively.

Table 2: Distribution of Organisms Causing Surgical Site Infection

Organism	No. of isolates (%)
Staphylococcus aureus	23 (23)
Escherichia coli	21 (21)
Citrobacter spp.	16 (16)
Pseudomonas aeruginosa	11 (11)
Klebsiella spp.	11 (11)
CONS	9 (9)
Enterobacter spp.	4 (4)
Acinetobacter spp.	3 (3)
Proteus spp.	2 (2)
Total	100

Out of 100 culture positive samples S.aureus (23%) was the most common pathogen isolated followed by Escherichia coli. (21%), Citrobacter spp. (16%) and Pseudomonas aeruginosa (11%) respectively.

Table 3: In-Vitro Antibiotic Sensitivity in Isolated Gram Negative Bacteria

Drugs	***Escherichia coliv*(n=21)**	***Citrobactervspp.* (n=16)**	***Klebsiella spp.* (n=11)**	***Pseudomonas aeruginosa* (n=11)**	***Enterobacter spp.* (n=4)**
	S	**S**	**S**	**S**	**S**
Gentamicin	15	7	4	7	3
Ciprofloxacin	6	5	3	7	2
Piperacillin/Tazobactam	16	4	2	7	3
Amikacin	18	5	3	8	3
Ampicillin/ Sulbactam	8	3	2	4	2
Impinem	20	11	6	8	4
Ceftriaxone	6	3	1	5	1

Among gram negative bacilli, E.coli was most sensitive to Imipenem followed by Amikacin and Piperacillin Tazobactam whereas for Citrobacter spp., Imipenem followed by Gentamicin, Ciprofloxacin was the drug of choice then for Klebsiella spp., Imipene followed by Gentamicin, Amikacin was the drug of choice. For Pseudomonas aeruginosa, Imipenem followed by Piperacillin Tazobactam, Gentamicin was the drug of choice and for Enterobacter spp., Imipenem followed by Amikacin, Piperacillin Tazobactam showed maximum sensitivity.

Table 4: In-Vitro Antibiotic Sensitivity in Isolated Gram-Positive Bacteria

Drugs	***Staphylococcus aureus* (n=23)**	**CONS (n=9)**
	S	**S**
Azithromycin	14	5
Vancomycin	21	8
Linezolid	23	8
Gentamicin	18	6
Ofloxacin	19	5
Cefoxitin	18	5
Amikacin	20	5

Among gram positive organism, S.aureus showed maximum antibiotic sensitivity to Linezolid followed by Vancomycin, Amikacin whereas CONS was sensitive to Linezolid followed by Vancomycin, and Gentamicin.

Discussion

As a part of innate immunity, the main function of intact skin in humans is to control the microbes that are resident on the skin surface and also it prevents the underlying tissues from colonization or invasion by pathogens. If due to any condition (wounds) where there is exposure of subcutaneous tissue due to loss of integrity of skin it provides good environment for colonization and proliferation of microorganisms and so any wound is at risk of developing infection. [24] Infections occurring in the wound are major barriers for healing which

shows impact on patients, which may prolong the hospital stay and effects the quality of life [22] and wound healing requires a healthy environment which will result in normal healing process and also with minimal scar formation. [25] Resistance patterns of SSI-associated bacteria vary globally, depending on the region, local epidemiology reports, and susceptibility testing methodology. Bacterial resistances pose a challenge and complicated the SSI treatment. Most of the data on drug resistance were obtained from high-income countries. [26,27] However, there were limited reports on the prevalence and incidence of resistant bacteria causing SSI, especially from developing countries. [26,28]

Among 100 positive samples 58 (58%) were males. Maximum no. of culture positive samples in age 20-30 years (30%) followed by 30-40 (21%) and then followed by 40-50 (14%) of age group respectively. The results were similar to a study by Vikrant Negi et al, who reported that (74.6%) males were more commonly affected than females (25.5%). [29] In contrast to our study Gangania P et al reveals that 20% Females shows almost equal distribution of 19% of males. [30] Out of 100 culture positive samples S.aureus (23%) was the most common pathogen isolated followed by Escherichia coli. (21%), Citrobacter spp. (16%) and Pseudomonas aeruginosa (11%) respectively. This result is consistent with reports from other studies SP Lilani, Mulu W. [31,32] S. aureus infection is most likely associated with endogenous source as it is a member of the skin and nasal flora and also with contamination from environment, surgical instruments or from hands of health care workers. [33]

Among gram negative bacilli, E.coli was most sensitive to Imipenem followed by Amikacin and Piperacillin Tazobactam whereas for Citrobacter spp., Imipenem followed by Gentamicin, Ciprofloxacin was the drug of choice then for Klebsiella spp., Imipene followed by Gentamicin, Amikacin was the drug of choice. For Pseudomonas aeruginosa, Imipenem followed by Piperacillin Tazobactam, Gentamicin was the drug of choice and for Enterobacter spp., Imipenem followed by Amikacin, Piperacillin Tazobactam showed maximum sensitivity. The findings were consistent with the previous study conducted by M. saleem et al who also showed that E. coli showed high sensitivity to Imipenem. [34] Among gram positive organism, S.aureus showed maximum antibiotic sensitivity to Linezolid followed by Vancomycin, Amikacin whereas CONS was sensitive to Linezolid followed by Vancomycin, and Gentamicin. This was in consistent with the study by Prem Prakash Singh et al., 2015 who also concluded that S. aureus was sensitive to Vancomycin (100%), Linezolid (100%). [35] The rise in antibiotic resistance emphasizes the importance of sound hospital infection control, rational prescribing policies, and the need for new antimicrobial drugs and vaccines. In general, the current study showed that the reported antibiotic susceptibility data was similar to the previous overall susceptibility pattern of isolates in the study area. [36-38]

Conclusion

The present study concluded that the increasing resistance to antimicrobials increases the risk of morbidity and mortality; therefore, there is urgent need of implementation of measures to restrict the health care associated infection. Rational use of antimicrobials, proper hygiene, and strict asepsis should be applied in all health care.

References

1. Forrester JD, Maggio PM, Tennakoon L. Cost of health care-associated infections in the United States. J Patient Saf. 2022;18(2):e477–9.
2. Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. Centers for disease control and prevention guideline for the prevention of surgical site infection, 2017. JAMA Surg. 2017;152(8): 78 4–91.
3. Borchardt RA, Tzizik D. Update on surgical site infections: the new CDC guidelines. Jaapa. 2018;31(4):52–4.
4. Lewis SS, Moehring RW, Chen LF, Sexton DJ, Anderson DJ. Assessing the relative burden of hospital-acquired infections in a network of community hospitals. Infect Control Hosp Epidemiol. 2013;34(11):1229–3 0.
5. Mengesha RE, Kasa BG-S, Saravanan M, Berhe DF, Wasihun AG. Aerobic bacteria in post surgical wound infections and pattern of their antimicrobial susceptibility in Ayder Teaching and Referral Hospital, Mekelle, Ethiopia. BMC Res Notes. 2014;7(1):575.
6. Raza MS, Chander A, Ranabhat A. Antimicrobial susceptibility patterns of the bacterial isolates in post-operative wound infections in a tertiary care hospital, Kathmandu, Nepal. Open J Med Microbiol. 20 13;3(3):159.
7. Godebo G, Kibru G, Tassew H. Multidrug-resistant bacterial isolates in infected wounds at Jimma University Specialized Hospital, Ethiopia. Ann Clin Microbiol Antimicrob. 20 13;12:17.
8. Halawi E, Assefa T, Hussen S. Pattern of antibiotics use, incidence and predictors of surgical site infections in a Tertiary Care Teaching Hospital. BMC Res Notes. 2018; 11 (1):538.
9. Misha G, Chelkeba L, Melaku T. Bacterial profile and antimicrobial susceptibility patterns of isolates among patients diagnosed with

surgical site infection at a tertiary teaching hospital in Ethiopia: a prospective cohort study. Ann Clin Microbiol Antimicrob. 2021; 20(1):33.
10. Spagnolo A, Ottria G, Amicizia D, Perdelli F, Cristina ML. Operating theatre quality and prevention of surgical site infections. J Prev Med Hyg. 2013;54(3):131.
11. National Institute for Health and Care Excellence: Clinical Guidelines. Surgical site infections: prevention and treatment. London: National Institute for Health and Care Excellence (NICE). Copyright © NICE 2020. 2020.
12. Moradali MF, Ghods S, Rehm BHA. Pseudomonas aeruginosa lifestyle: a paradigm for adaptation, survival, and persistence. Front Cell Infect Microbiol. 2017;7:39.
13. Isibor JO, Oseni A, Eyaufe A, Turay A. Incidence of aerobic bacteria and Candida albicans in post-operative wound infections. Afr J Microbiol Res. 2008;2(11):288–91.
14. Organization WH. Global guidelines for the prevention of surgical site infection. Geneva: WHO; 2016.
15. Biadglegne F, Abera B, Alem A, Anagaw B. Bacterial isolates from wound infection and their antimicrobial susceptibility pattern in Felege Hiwot referral Hospital North West Ethiopia. Ethiop J Health Sci. 2009;19(3).
16. Mulu W, Kibru G, Beyene G, Damtie M. Postoperative nosocomial infections and antimicrobial resistance pattern of bacteria isolates among patients admitted at Felege Hiwot Referral Hospital, Bahirdar, Ethiopia. Ethiop J Health Sci. 2012;22(1):7–18.
17. Munckhof W. Antibiotics for surgical prophylaxis. Aust Prescr. 2005;28(2).
18. Ranjan KP, Ranjan N, Bansal SK, Arora D. Prevalence of Pseudomonas aeruginosa in post-operative wound infection in a referral hospital in Haryana, India. J Lab Phys. 2011;2(2):129–32.
19. Li B, Webster TJ. Bacteria antibiotic resistance: new challenges and opportunities for implant-associated orthopedic infections. J Orthop Res. 2018;36(1):22–32.
20. Fadeyi A, Adigun I, Rahman G. Bacteriological pattern of wound swab isolates in patients with chronic leg ulcer. Int J Health Res. 2008.
21. MacFaddin J. Biochemical Tests for Identification of Medical Bacteria. 3 rded. Philadelphia: Lippincott Williams and Wilkins; 1976.
22. Forbes BA, Sahm DF, Weissfeld AS. Bailey and Scott's Diagnostic Microbiology.10th ed. St. Louis, Misssouri, USA: Mosby Inc.; 1998.
23. Clinical and Laboratory Standard Institute. Performance Standards for Antimicrobial Susceptibility Testing.2007;1(1).M2 A9. Pennsylvania, USA: Clinical and Laboratory Standard Institute.
24. Dai T,Huang YY, Sharma SK, Hashmi JT, Kurup DB,Hamblin MR. Topical antimicrobiols for burn wound infections. Recent pat Anti Infect Drug Discov 2010; 5(2):124-151.
25. Kotz P, Fisher J, McCluskey P,Hartwell SD, Dharma H. Use of a new silver barrier dressing Allevyn Ag in exuding chronic wounds. Int wound j 2009; 6:186-194
26. Al waili NS, Salom K, Al Ghamdi AA. Honey for wound healing, ulcers and burns. Scic world j 2011; 11:766-787.
27. National Institute for Health and Clinical Excellence. National collaborating centre for women's and children's health; Caesarean section: clinical guideline; 2003; pp. 5–17.
28. National Institute for Health and Clinical Excellence. Surgical site infection: prevention and treatment of surgical site infection. 2008; pp. 9–11.
29. Iskandar K, Sartelli M, Tabbal M, Ansaloni L, Baiocchi GL, Catena F, Coccolini F, Haque M, Labricciosa FM, Moghabghab A, Pagani L. Highlighting the gaps in quantifying the economic burden of surgical site infections associated with antimicrobial-resistant bacteria. World Journal of Emergency Surgery. 2019 Dec;14:1-4.
30. Negi V, Pal S Juyal D, Sharma M K, Sharma N. Bacteriological Profile of Surgical Site Infections and Their Antibiogram: A Study from Resource Constrained Rural Setting of Uttarakhand State, India. Journal of Clinical and Diagnostic Research. 2015;9(10)
31. Gangania P S, Singh V A, Ghimire S S. Bacterial Isolation and Their Antibiotic Susceptibility Pattern from Post-Operative Wound Infected Patients. Indian J Microbiol Res 2015; 2(4):231-235.
32. Lilani SP, Jangale N, Chowdhary A, Daver GB. Surgical site infection in clean and clean-contaminated cases. Indian journal of medical microbiology. 2005 Oct 1;23(4):249-52.
33. Mulu W, Kibru G, Beyene G, Damtie M. Postoperative nosocomial infections and antimicrobial resistance pattern of bacteria isolates among patients admitted at Felege Hiwot Referral Hospital, Bahirdar, Ethiopia. Ethiopian Journal of Health Sciences. 2012; 22(1):7–18.
34. Saleem M, Subha T V, Balamurugan R, Kaviraj M, Gopal R. Bacterial Profile and Antimicrobial Susceptibility Pattern of Surgical Site Infections – A Retrospective Study. Indian Journal Of Applied .2015;5(10).
35. Singh P P, Begum R, Singh S, Singh MK. Identification and Antibiogram of the Microorganisms Isolated from the Post

operative Surgical Site Infections among the patients admitted in the hospital TMMC & RC, Moradabad. European journal of biomedical and pharmaceutical sciences. 2015;2(4): 932-942.
36. Regasa B, Yilma D, Sewunet T, Beyene G. Antimicrobial susceptibility pattern of bacterial isolates from community-acquired pneumonia patients in Jimma University specialized hospital, Jimma, Ethiopia. Saudi Journal for Health Sciences. 2015 Jan 1;4(1):59.
37. Awoke N, Kassa T, Teshager L. Magnitude of biofilm formation and antimicrobial resistance pattern of bacteria isolated from urinary catheterized inpatients of Jimma university medical center, Southwest Ethiopia. International journal of microbiology. 2019 Feb 10;2019.
38. Diriba K, Kassa T, Alemu Y, Bekele S. In vitro biofilm formation and antibiotic susceptibility patterns of bacteria from suspected external eye infected patients attending ophthalmology clinic, Southwest Ethiopia. International journal of microbe-ology. 2020 Mar 19;2020:1-2.