BACTERIOLOGICAL STUDY OF POST OPERATIVE WOUND INFECTION AND ITS ANTIBIOGRAMS

Apsha Shrestha,[1] Stuti Koirala,[2] Ashok Adhikari,[3] Sweata Bhandari,[4] Rajeshwar Reddy Kasarla,[5] Laxmi Pathak[6]

ABSTRACT

INTRODUCTION

Postoperative wound infections are a significant complication of surgical procedures, which increases morbidity, mortality, prolonged hospital stay, and increased healthcare costs. The study was undertaken with an aim to investigate the etiological agents of postoperative wounds and their sensitivity to commonly used antibiotics.

MATERIAL AND METHODS

This study was a descriptive cross-sectional prospective study, carried out at Universal College of Medical Sciences-Teaching Hospital, Bhairahawa, Nepal, on 100 postoperatively wounded infected cases, during April 2023-August 2023. Non Probability sampling method (Purposive sampling) was used, and specimens were collected by sterile cotton swabs and pus was aspirated with a sterile needle and syringe and processed using standard bacteriological techniques. Antibiotic sensitivity test was conducted by disc diffusion (Kirby-Bauer) method.

RESULTS

Postoperative wound infections caused by Gram negative bacilli were more frequent and predominant pathogens involved were *Pseudomonas aeruginosa,* followed by *Klebsiella spp* and *Enterobacter aerogenes.* Among Gram positive bacteria *Staphylococcus aureus* was predominant. Gram positive cocci were highly sensitive to Ampicillin, and Gram negative bacilli were highly sensitive to Ceftazidime, Gentamicin, and Amikacin. Coagulase negative staphylococci were resistant to all drugs tested.

CONCLUSION

Pseudomonas aeruginosa was the commonest etiological agent for postoperative wound infections. Gram positive cocci and E.coli were highly sensitive to Ampicillin and Gram negative bacilli were highly sensitive to Ceftazidime, Gentamicin, Amikacin. *Staphylococcus aureus* was resistant to vancomycin and Teicoplanin and coagulase staphylococci were resistant to all drugs tested. Gram negative bacilli were resistant to Polymyxin B and Tigecycline. Increasing resistance to commonly used antibiotics warrants the judicious use of antibiotics and establishment of antibiotic policy in the hospital.

KEYWORDS

Antibiogram, Postoperative wound infection, *Pseudomonas aeruginosa*

1. Hello Health Clinic, Pokhara, Nepal
2. Lifeguard Hospital, Biratnagar, Nepal
3. Gautam Buddha Community Heart Hospital, Butwal, Nepal
4. Green City hospital, Kathmandu, Nepal
5. Department of Microbiology, Universal College of Medical Sciences, Bhairahawa, Nepal
6. Department of Anesthesiology & Critical Care Medicine, Universal College of Medical Sciences, Bhairahawa, Nepal

https://doi.org/10.3126/jucms.v12i01.65579

For Correspondence
Dr. Apsha Shrestha
Medical Officer
Hello Health Clinic
Pokhara, Nepal
Email: shrestha.apsha@gmail.com

INTRODUCTION

The incidence of surgical site infections in developing countries has been reported to be around 2-40%.[1] Postoperative wound infection can be caused by exogenous and endogenous sources. The incidence of postoperative wound infections depends on several factors, including the type of surgery, age, and underlying medical conditions. Post-operative wound infections delay recovery of patients, increases length of hospital stay requiring additional resources for investigation, management and treatment of patient. Therefore its prevention increases quality of patient care and decreases morbidity and mortality of patients. For control of wound infections and administration of proper therapy we should know bacteria causing wound infections and their antibiotic sensitivity pattern must be made available.[2] The present study was undertaken with an aim to investigate the etiological agents of postoperative wounds and their sensitivity to commonly used antibiotics. The study will help to identify the most common bacteria causing postoperative wound infections and the effectiveness of antibiotics used in their treatment. This study will be useful in the development of appropriate antibiotic regimens for the management of postoperative wound infection.

MATERIAL AND METHODS

This study was a descriptive cross-sectional prospective study, carried out at Universal College of Medical Sciences-Teaching Hospital (UCMS-TH), Bhairahawa, Nepal. The study was carried out on surgeries done in General Surgery, Obstetrics/Gynecology and Orthopedic & Trauma during April 2023 – August 2023, at Universal College of Medical Sciences & Teaching Hospital, Bhairahawa, Nepal, after obtaining ethical approval from Institutional Review Committee (IRC No. UCMS/IRC/009/23). Non Probability sampling method (Purposive sampling) was used for the study. Out of total 2390 surgeries, postoperatively wound infected cases were 100.

The inclusion criteria for the study were patients of all age groups except neonates with presence of post-operative wound infections and those who give informed consent to participate. The exclusion criteria for the study were infection on episiotomy site and those who refuse to participate in the study.

Specimens were collected by sterile cotton swabs and pus was aspirated with a sterile needle and syringe and transported to laboratory immediately. Samples were processed using standard bacteriological techniques by direct microscopic examination using Gram's stained smears and cultured on to MacConkey agar, blood agar, chocolate agar and isolates were identified by biochemical tests. Simultaneously antibiotic sensitivity test was conducted by using Mueller-Hinton agar medium by disc diffusion (Kirby-Bauer) method.[3,4]

RESULTS

Out of total 2390 surgeries, postoperatively wound infected cases were 100, and the results are depicted in following tables.

Table 1. Distribution based on age and gender

Age (in years)	Male	Female	Total
0-10	11	4	15
11-20	4	3	7
21-30	14	11	25
31-40	18	9	27
41-50	7	6	13
51-60	5	1	6
61-70	2	1	3
≥71	2	2	4
Total	63	37	100

Table 2. Distribution based on yield of microorganisms from postoperative wound infections

Culture yield	Number of patients
Mono-microbial	38
Poly-microbial	62

Table 4. Aerobic bacteriological profile of post-operative wound isolates

Organisms isolated	Number of isolates (%)
Pseudomonas aeruginosa	69 (42.3)
Klebsiella spp.	29 (17.8)
Enterobacter aerogenes	22 (13.5)
E. coli	12 (7.4)
Acinetobacter spp.	10 (6.1)
Proteus mirabilis	5 (3.1)
Enterobacter cloacae	4 (2.5)
Citrobacter spp.	4 (2.4)
Staphylococcus aureus	4 (2.5)
Enterococcus spp.	3 (1.8)
Coagulase negative staphylococci (CoNS)	1 (0.6)
Total	163 (100)

Table 5. Antimicrobial resistance pattern of Gram positive cocci

Antibiotics	*Enterococcus* n=3	*S. aureus* n=4	CoNS n=1
Ampicillin	1 (33.3)	4 (100)	0
Piperacillin+ Tazobactam	NT	4 (100)	0
Cefoxitin	NT	4 (100)	0
Cefepime	NT	3 (75)	0
Vancomycin	0	0	0
Teicoplanin	0	0	0
Gentamicin	NT	2 (50)	0
High level gentamicin	2 (66.7)	NT	NT
Doxycycline	2 (66.7)	1 (25)	0
Erythromycin	2 (66.7)	3 (75)	0
Clindamycin	NT	3 (75)	0
Linezolid	0	0	0
Ciprofloxacin	2 (66.7)	2 (50)	0
Cotrimoxazole	NT	4 (100)	0

NT: Not tested

Table 6. Antimicrobial resistance pattern of Gram negative bacilli

Antibiotics	*Acinetobacter* spp. N = 10 (%)	*Citrobacter* spp. N = 4 (%)	*E.coli* N=12 (%)	*Enterobacter aerogenes* N = 22 (%)	*Enterobacter cloacae* N = 4 (%)	*Klebsiella* spp. N = 29 (%)	*Proteus mirabilis* N = 5 (%)	*Pseudomonas aeruginosa* N=69 (%)
Ampicillin	NT	NT	12 (100)	NT	NT	NT	4 (80)	NT
Piperacillin+ Tazobactam	10 (100)	4 (100)	12 (100)	20 (90.9)	4 (100)	28 (96.5)	0	48 (69.6)
Cefotaxime	10 (100)	4 (100)	12 (100)	22 (100)	4 (100)	29 (100)	1 (20)	NT
Ceftazidime	10 (100)	4 (100)	12 (100)	22 (100)	4 (100)	29 (100)	4 (80)	65 (94.2)
Ceftazidime+Clavulanic acid	10 (100)	4 (100)	11 (91.7)	22 (100)	2 (50)	25 (86.2)	4 (80)	NT
Cefoperazone+ Sulbactam	NT	NT	NT	NT	NT	NT	NT	64 (92.7)
Cefepime	7 (70)	3 (75)	8 (66.7)	11 (50)	2 (50)	21 (72.4)	0	50 (72.5)
Imipenem	7 (70)	2 (50)	4 (33.3)	9 (40.9)	0	14 (48.3)	0	34 (49.3)
Aztreonam	NT	NT	NT	NT	NT	NT	NT	41 (59.4)
Colistin	NT	NT	NT	NT	NT	NT	NT	0
Polymyxin B	0	0	0	0	0	0	0	NT
Amikacin	6 (60)	3 (75)	11 (91.7)	15 (68.2)	3 (75)	26 (89.6)	4 (80)	53 (76.8)
Gentamicin	8 (80)	3 (75)	11 (91.7)	17 (77.3)	3 (75)	28 (96.5)	4 (80)	54 (78.3)
Tobramycin	NT	NT	NT	NT	NT	NT	NT	50 (72.5)
Tigecycline	0	0	0	0	0	0	NT	NT
Ciprofloxacin	9 (90)	3 (75)	11 (91.7)	17 (77.3)	4 (100)	28 (96.5)	0	58 (84.1)
Cotrimoxazole	8 (80)	3 (75)	8 (66.7)	15 (68.2)	3 (75)	22 (75.9)	5 (100)	NT

NT: Not tested

DISCUSSION

Postoperative wound infections are a significant cause of morbidity and mortality in surgical patients. The post-operative wound infections vary from hospital to hospital and from one geographic location to another. In this study, in majority (62%) of the postoperative wound infections more than one organism were isolated (polymicrobial), and 38% were monomicrobial (Table 2). High infection rate was seen in males 967%) than females (37%). Similar to our findings, in a study by Kurhade A et al[5] the bacterial profile showed polymicrobial flora. In this study, from 100 postoperative wound infected cases, a total of 163 isolates were obtained, out of which 8 (4.9%) were Gram positive cocci and 155 (95.1%) were Gram negative bacilli by direct microscopy under Gram staining (Table 3). Similar to our findings, Sisira D et al[6] reported that out of 250 patients of post-operative wound infections, 48 (19.2%) are cultured positive, among which 27 (10.8%) were Gram positive, and 21 (8.4%) were Gram negative.

In our study, post operative infection rate was high in the age group of 31-40 years (27%) followed by 21-30 years (25%). The infection rate was high in males (63%) and than females (37%). A total of 163 isolates of 10 different bacterial species were obtained. *Pseudomonas aeruginosa* was the commonest etiological agent 69 (42.3%) followed by *Klebsiella* spp. 29 (17.8%), *Enterobacter aerogenes* 22 (13.5%), *E.coli* 12 (7.4%), *Acinetobacter* spp.10 (6.1%), *Proteus mirabilis* 5 (3.1%), *Staphylococcus aureus, Enterobacter cloacae, Citrobacter* spp. 4 (2.5%) each, *Enterococcus* spp. 3 (1.8%), and 1 (0.6%) coagulase negative *Staphylococcus* (CoNS). Our findings were similar to a study on bacteriological study by Amatya,[7] where 235 samples (182 single isolates and 53 multiple isolates) were culture positive. High infection rate was found in males (62.5%) than females (53.1%) and in the age group 30-40 years (25.5%). 292 isolates of 10 different bacterial species were obtained. The predominant isolates were *Pseudomonas* spp (33.9%), followed by *Escherichia coli* and *Staphylococcus aureus*. Other isolates were *Acinetobacter* spp, *Klebsiella* spp, *Enterobacter* spp, coagulase negative staphylococci, Proteus *mirabilis,* nonhemolytic streptococci and *Citrobacter* spp. In a study by Lilani et al[1] and Olson[8] *Staphylococcus aureus* was the most commonest isolate followed by *Pseudomonas aeruginosa.* Murthy[9] investigated 406 postoperative clean wounds, where *Staphylococcus aureus* (32%) and *Pseudomonas* species (21%) were the commonest organisms recovered. In a study by Narula H[10] in Rajasthan, India, the most common organism was *Staphylococcus aureus* followed by *Klebsiella pneumoniae.* In a study by Budhani D et al,[11] *Staphylococcus aureus* (25.5%) was the commonest organism followed by *Escherichia coli* (23.5%), *Citrobacter* species (17.3%) and *Pseudomonas aeruginosa* (9.9%). In a study be Kurhade et al,[5] The most commonest organism isolated was *Staphylococcus aureus* (26.51%), followed by *Pseudomonas aeruginosa* (18.18%), *Escherichia coli* (15.9%), *Klebsiella pneumoniae* (11.36%), Coagulase negative staphylococci (6.81%), *Bacteroides* species (5.30%), *Proteus mirabilis* (4.54%), beta haemolytic streptococci (3.78%), *Peptococcus* species (3.03%), *Proteus vulgaris* and *Citrobacter* species (2.27%) each. In a study by Sisira D et al[6] *Staphylococcus aureus* emerged as the commonest etiological agent 17 (35.42%) followed by *Pseudomonas aeruginosa* 14 (29.17%), E.coli 6 (12.5%). In a study by Sisira D et al[6] Amikacin (72.9%) was found to be the most effective antibiotic, and multidrug resistance was observed with *Staphylococcus aureus* (79.16%) and *Pseudomonas aeruginosa* (83.3%).

The antibiotic sensitivity pattern of Gram positive cocci is presented in Table 5. All the 4 isolates (100%) of *Staphylococcus aureus* were sensitive to Ampicillin, Piperacillin+Tazobactam, Cefoxitin, and Co-trimoxazole; whereas 3 isolates (75%) were sensitive to Cefepime, Erythromycin, and Clindamycin. Two isolates (50%) were sensitive to Gentamycin, and Ciprofloxacin. Only one isolate was sensitive to Doxycycline. All the isolates of *S.aureus* were resistant to Vancomycin, and Teicoplnin. Out of 3 isolates of *Enterococcus* spp., 2 isolates (66.7%) were sensitive to high level Gentamicin, Doxycycline, Erythromycin, and Ciprofoxacin; whereas one isolate (33.3%) was sensitive to Ampicillin. All the 3 isolates of *Enterococcus* were resistant to Vancomycin, Teicplanin, and Linezolid. The only 1 isolate of coagulase negative staphylococci was resistant to all drugs tested i.e., Ampicillin, Piperacillin+Tazobactam, Cefoxitin, Cefepime, Vancomycin, Teicoplanin, Erythromycin, Clindamycin, Linezolid, Ciprofloxacin, and Co-tromoxazole. In a study by Amatya,[7] the most effective antibiotic for Gram positive isolates was Oxacillin (96.1%) followed by Chloramphemicol (85.2%), and Ceftriaxone and Cefoperazone Sulbactam (66.7% each). In a study by Narula H[10] in Rajasthan, India, most of the Gram-positive isolates were resistant to penicillin and cephalosporin antibiotics and were moderately susceptible to fluoroquinolones and aminoglycosides. In a study by Budhani D et al,[11] Gram positive isolates revealed maximum sensitivity to Linezolid and Vancomycin. In a study be Kurhade et al,[5] both Gram positive and Gram negative bacterial isolates were multi drug resistant.

The antibiotic sensitivity pattern of Gram negative bacilli is shown in Table 6. Among 69 isolates of *Pseudomonas aeruginosa,* 65 (94.2%) isolates were sensitive to Ceftazidime; 64 (92.7%) isolates were sensitive to Cefoperazone+-Sulbactam; 58 (84.1%) isolates were sensitive to Ciprofoxacin; 54 (78.3%) isolates were sensitive to Gentamicin; 53 (76.8%) isolates were sensitive to Amikacin; 50 (72.5%) isolates were sensitive to Cefepime; 48 (69.6%) isolates were sensitive to Piperacillin+ Tazobactam; 41 (59.4%) isolates were sensitive to Aztreonam; 34 (49.3%) isolates were sensitive to Imipenem. All 69 isolates of Pseudomonas aeruginosa were resistant to Colistin. Among 29 isolates of Klebsiella spp., all (100%) were sensitive to Cefotaxime, Ceftazidime; 28 (96.5%) isolates were sensitive to Piperacillin+Tazobactam, Gentamicin, and Ciprofloxacxin; 26 (89.6%) isolates were sensitive to Amikacin; 25 (86.2%) isolates were sensitive to Ceftazidime+Clavulanic acid; 22 (75.9%) isolates were sensitive to Cotrimoxazole; 21 (72.4%) isolates were sensitive to Cefepime; 14 (48.3%) isolates were sensitive to Imipenem. All 29 isolates of *Klebsiella* spp. were resistant to Polymyxin B, and Tigecycline. Among 22 isolates of *Enterobacter aerogenes,* all (100%) were sensitive to Cefotaxime, Ceftazidime, Ceftazidime+-Clavulanic acid; 20 (90.9%) isolates were sensitive to Piperacillin+Tazobactam; 17 (77.3%) isolates were sensitive to Gentamicin; 15 (68.2%) isolates were sensitive to Amikacin; 11 (50%) isolates were sensitive to Cefepime; 9 (40.9%) isolates were sensitive to Imipenem. All 22 isolates of *Enterobacter aerogenes* were resistant to Polymyxin B. Among 12 isolates of *E.coli,* All (100%) were sensitive to Ampicillin, Piperacillin+Tazobactam, and Ceftazidime; 11 (91.7%) were sensitive to Ceftazidime+Clavulanic acid, Amikacin, Gentamycin, and Ciprofloxacin; 8 (66.7%) isolates were sensitive to Cefepime, and Co-trimoxazole; 4 (33.3%) were sensitive Imipenem. All 12 isolates of *E.coli* were resistant to Polymyxin B, and Tigecycline. Among 10 isolates of Acinetobacter spp., all (100%) were sensitive to Piperacillin+Tazobactam, Cefotaxime, Ceftazidime, and Ceftazidime+Clavulanic acid; 9 (90%) isolates were sensitive to Ciprofloxacin; 8 (80%) isolates were sensitive to Gentamicin, and Co-trimoxazole; 7 (70%) isolates were sensitive to Cefepime, and Imipenem; 6 (60%) isolates were sensitive to Amikacin. All 10 isolates of *Acinetobacter* were resistant to Polymyxin B, and Tigecycline. Among 5 isolates of *Proteus mirabilis,* all (100%) were sensitive to Co-trimoxazole; 4 (80%) isolates were sensitive to Ampicillin, Ceftazidime, Ceftazidime+Clavulanic acid, Amikacin, and Gentamicin; 1 (20%) isolate was sensitive to Cefotaxime. All 5 isolates of *Proteus mirabilis* were resistant to Piperacillin+Tazobactam, Cefepime, Imipenem, Polymyxin B, and Ciprofloxacin. Among 4 isolates of Citrobacter spp., all (100%) were sensitive to Piperacillin+Tazobactam, Cefotaxime, Ceftazidime, Ceftazidime+Clavulanic acid, 3 (75%) isolates were sensitive to Cefepime, Amikacin, Genatmicin, Ciprofloxacin, and Co-trimoxazole; 2 (50%) isolates were sensitive to Imipenem. All 4 isolates of Citrobacter were resistant to Polymyxin B, and Tigecycline. Among 4 isolates of *Enterobacter cloacae,* all (100%) were sensitive to Piperacillin+Tazobactam, Cefotaxime, Ceftazidime, 3 (75%) isolates were sensitive to Amikacin, Gentamicin, and Co-trimixazole; 2 (50%) isolates were sensitive to Cefepime, and Ceftazidime+Clavulanic acid. All 4 isolates of *Enterobacter cloacae* were resistant to Imipenem, Polymyxin B, and Tigecycline.

Our findings were similar to a study done by Amatya,[7] where Imipenem was most effective (74.8%), followed by Amikacin (58.8%) against Gram negative bacteria. In a study by Murthy,[9] Netilmycin, Cephaloridine and Norfloxacin were the most effective antibiotics against both Gram positive and Gram negative bacterial infections. In a study by Narula[10] in Rajasthan, India, Gram-negative isolates were resistant to beta-lactam and beta-lactam/beta-lactamase inhibitor combination also but were susceptible to fluoroquinolones, aminoglycosides, and carbapenems. In a study by Budhani D et al,[11] the most sensitive drugs against Gram negative isolates were Imipenem, Gentamicin, Piperacillin-Tazobactam, and Amikacin.

CONCLUSION

Pseudomonas aeruginosa was the commonest etiological agent for postoperative wound infections. Antibiotic susceptibility pattern of various isolates helps in proper selection of antibiotics and in this study, it was found that Ceftazidime, Gentamicin, Amikacin were most effective drugs against Gram negative bacilli, and Ampicillin was most effective against Gram positive cocci and *E.coli. Staphylococcus aureus* was resistant to vancomycin and Teicoplanin and coagulase staphylococci were resistant to all drugs tested. Gram negative bacilli were resistant to Polymyxin B and Tigecycline. Increasing resistance to commonly used antibiotics warrants the judicious use of antibiotics and establishment of antibiotic policy in the hospital.

ACKNOWLEDGEMENT

We are greatly thankful to all patients those who participated in this study.

REFERENCES

1. Lilani SP, Jangale N, Chowdhary A, Daver GB, Surgical site infection in clean and clean-contaminated cases. Ind J of Med Microbiol. 2005; 23(4): 249-252.

2. Suljagić V, Jevtic M, Djordjevic B, Jovelic A. Surgical site infections in a tertiary health care center: Prospective cohort study. Surg Today. 2010;40:763-71

3. Gary W. Procop, Deirdre L. Church, Geraldine S. Hall, William M. Janda, Elmer W. Koneman; Paul C. Schreckenberger. Koneman's color atlas and text book of diagnostic microbiology. 7th edition. Jones & Bartlett Learning. 2017.

4. Patricia M. Tille. Bailey & Scott's Diagnostic Microbiology. 15th edition. Elsevier. 2022.

5. Arvind Kurhade, Suresh Akulwar, Meena Mishra, Geeta Kurhade, Angel Justiz-Vaillant, Krutika Kurhade, Sehlule Vuma, Sudhir Lakhdive. Bacteriological study of post-operative wound infections in a tertiary care hospital. J Bacteriol Parasitol. 2015,6:6.

6. Prasada Rao Namburi, Sisira D, Surendra BV. Bacteriological study of post-operative wound infections and their antibiograms in a tertiary care teaching hospital. International Journal of Clinical and Biomedical Research. 2020;6(2):18-20.

7. Amatya J, Rijal M, Baidya R. Bacteriological study of the postoperative wound samples and antibiotic susceptibility pattern of the isolates in B & B Hospital. JSM Microbiology. 2014;3(1):1019.

8. Olson M, O'Connor MO, Schwartz ML. A 5-year prospective study of 20,193 wounds at the Minneapolis VA medical center. Ann Surg. 1984; 199: 253-9.

9. Murthy R, Sengupta S, Maya N, Shivananda PG. Incidence of postoperative wound infection and their antibiogram in a Teaching and Referral Hospital. Indian J Med Sci. 1998 Dec;52(12):553-5.

10. Narula H, Chikara G, Gupta P. A prospective study on bacteriological profile and antibiogram of postoperative wound infections in a tertiary care hospital in Western Rajasthan. Journal of Family Medicine and Primary Care. 2020 Apr 1;9(4):1927-34.

11. Budhani D, Kumar S, Sayal P, Singh S. Bacteriological profile and antibiogram of surgical site infection/ post-operative wound infection. Int J Med Res Rev. 2016;4(11):1994-1999.