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Research Article

Aerobic Bacteriological Profile and Antimicrobial Susceptibility Pattern in Postoperative Wound Infections at a Tertiary Care Hospital

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ABSTRACT:

Background: Postoperative wound infections are global problem in the field of surgery associated with long hospital stay, higher treatment expenditure, morbidity and mortality. The spectrum of infecting agents varies in each institution and same institution at different time points. Surveillance of surgical site infection with feedback of appropriate data to surgeons would be desirable to reduce surgical site infection rate. Hence we conducted this research to determine the prevalence and antimicrobial susceptibility patterns of aerobic bacteria in post surgical wound infected patients in ACS Medical College & Hospital, Chennai. **Materials and Methods:** Pus samples collected from the patients were processed using standard bacteriological methods to be used for bacterial isolation and Antimicrobial Susceptibility pattern.

Results: Among the 102 pus samples, 61 (59.80%) had bacterial growth and in that 51(83.61%) were monomicrobial and 10(16.39%) were polymicrobial with a total of 73 bacterial isolates. Among the 73 bacterial isolates 33 (45.20%) were Gram positive cocci and 40 (54.80%) were Gram negative bacilli. The most common bacteria isolated was Staphylococcus aureus 19 (26.03%), followed by Escherichia coli 18 (24.65%) and Coagulase Negative Staphylococcus 11 (15.07%). Antibiotic susceptibility test of the isolates showed that Vancomycin (100%) and Linezolid (100%) followed by Amikacin (93.94%) were the most effective antibiotics for Gram positive bacteria and for Gram negative isolates Amikacin (85%), Cefaperazone-sulbactam (80%) and Gentamycin (77.5%) were found to be the most effective.

Conclusion: Surveillance of the postoperative wound infection should be done in each and every hospital at regular intervals to evolve the control strategies and reduce the infection rate.

Key Words: Postoperative wound infection, Staphylococcus aureus, Escherichia coli

INTRODUCTION

Postoperative wound infection, also known as surgical site infection (SSI) is one of the most common surgical complications in the world particularly in developing countries[1]. As defined by the Centers for Disease Control and Prevention (CDC) these infections typically occur within 30 days of an operation at the site or part of the body where the surgery took place, or within a year if an implant is left in place and the infection is thought to be secondary to surgery[2-4].

Inspite of modern standards of preoperative preparation, antibiotic prophylaxis and operative technique, postoperative wound infections remain a serious problem. They lead to many complications, increased morbidity and mortality and may require hospital admission, intravenous antibiotics and even surgical re-intervention. Bacterial colonization on the patient’s skin and alimentary and genital tract are the principal contributing sources that lead to postoperative wound infections. Following bacterial colonization, the risk of developing postoperative wound infections are related to various host and perioperative factors. However, a vast majority of these infections are preventable.

Most of these infections are superficial limited to the skin and subcutaneous tissue and readily treated with a regimen of local care and antibiotics. Deep infections involving the fascia and muscle, or organ space are less frequently encountered but are associated with greater morbidity and mortality, readmission rates, longer hospital stay and increased overall hospital associated costs[5].The incidence of infection varies from surgeon to surgeon, from hospital to hospital, from one surgical procedure to another and most importantly from one patient to another.

The spread of antimicrobial resistance is now a global problem, which is due to significant changes in microbial genetic ecology, as a result of indiscriminate use of antimicrobials[6]. The emergence of high anti-microbial resistance among bacterial pathogens has made the management and treatment of post-operative wound infections difficult. The situation is serious in developing countries due to irrational prescriptions of antimicrobial agents. Moreover the rising of multidrug resistant strains pose challenges in the management of postoperative wound infections[7].

Employing methods that could reduce the incidence of postoperative wound infections would significantly reduce patient morbidity and mortality. Surveillance of postoperative wound infection with feedback of appropriate data to surgeon would be desirable to reduce the surgical site infection rate[8]. Hence the present study was conducted with an objective to evaluate the various pathogens causing postoperative wound infections in our hospital with their antibiotic susceptibility pattern.

MATERIALS AND METHODS

The present study was conducted in the Department of Surgery and Department of Microbiology, ACS Medical College and Hospital, Chennai from February 2016 to June 2016. The study included 102 pus samples collected from clinically suspected cases of postoperative wound infections of all age groups and both the sexes admitted in the General surgery department of our Hospital. All the wound infections other than postoperative wound were excluded from the study. Patients with surgeries done more than thirty days were excluded from the study. An informed consent was taken from all the patients.

A. *Sample collection*: The samples were collected from the depth of the wound with strict aseptic precautions with the help of dry sterile cotton swab sticks for bacteriological examination. Two culture swabs from each sample were obtained, one for direct smear study and the other for aerobic culture and sent immediately to the laboratory for investigation.

B. *Processing of sample*: From the two swabs collected for each sample one was used to make smear for detection of pus cells and microorganisms[9]. Other swab was used to inoculate onto Blood agar and MacConkey agar media and incubated at 37°C for 24 hours. After incubation, identification of bacteria from positive cultures was done with standard microbiological technique which included Gram staining and biochemical reactions[10]. The antibiotic sensitivity test of all isolates was performed as per Clinical Laboratory Standards Institute (CLSI) guidelines by modified Kirby Bauer's disc diffusion method[11].

RESULTS

Out of the 102 pus samples included in our study, 61(59.80%) were culture positive for aerobic bacteria whereas 41(40.20%) were sterile (Table 1)

Table 1 Percentage of Bacterial growth in Postoperative wound infection

Total No of Samples	Growth/No growth	No of Samples	Percentage
102	Growth	61	59.80
	No growth	41	40.20

Among the total 102 pus samples, 53 (51.96%) were from male patients and 49 (48.04%) were from female patients and out of the 61 culture positive samples, 35 (57.38%) were from male patients and 26 (42.62%) were from female patients. (Table 2)

Table 2 Sex Distribution in Postoperative wound Infection

Sex	Total Samples (n = 102)	Culture Positive Samples (n = 61)
Male	53 (51.96%)	35 (57.38%)
Female	49 (48.04%)	26 (42.62%)

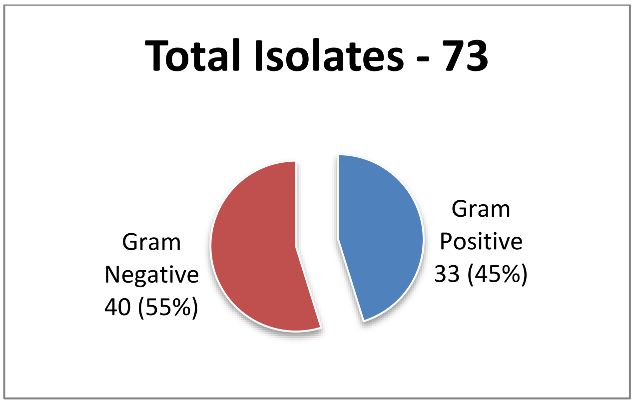
Out of the 61 culture positive samples 51(83.61%) were monomicrobial and 10 (16.39%) were polymicrobial with a total of 73 bacterial isolates. (Table 3)

Table 3 Pattern of Bacterial isolation in Postoperative wound infection

Pattern of organism isolated	No of samples	No of isolates
Pure	51 (83.61%)	51
Mixture (2 organisms)	8 (13.11%)	16
Mixture (3 organisms)	2 (3.28%)	6
TOTAL	**61**	**73**

Among the 73 bacterial isolates 40 (54.79%) were Gram negative bacilli and 33 (45.21%) were Gram positive cocci.

Chart 1: Distribution of Gram Positive and Gram Negative bacteria



The most commonly isolated organism was Staphylococcus aureus 19 (26.03%) followed by Escherichia coli 18 (24.65%) and CONS (Coagulase Negative Staphylococcus) 11(15.07%). (Table 4)

Table 4 Distribution of Bacterial isolates in Postoperative wound infection

Organism Isolated	No of Isolates	Percentage
S.aureus	19	26.03
E.coli	18	24.65
CONS	11	15.07
Pseudomonas	9	12.33
Klebsiella	6	8.22
Proteus	3	4.11
Enterococcus	3	4.11
Acinetobacter	2	2.74
Citrobacter	2	2.74
TOTAL	**73**	**100.00**

The most effective antibiotic for Gram Positive isolates were Vancomycin and Linezolid followed by Amikacin (Table 5) and for Gram negative isolates Amikacin, Cephalosporin-sulbactam and Gentamycin. (Table 6)

Table 5 Antibiotic susceptibity pattern of Gram Positive Cocci in Postoperative wound infection

Antibiotics	S. aureus (n = 19)	CONS (n = 11)	Enterococci (n = 3)	Total (n = 33)
Ciprofloxacin 5mcg	16(84.21%)	5 (45.45%)	2 (66.67%)	23 (69.70%)
Gentamycin10mcg/HLG* 120mcg	19 (100%)	7 (63.64%)	*3 (100%)	29 (87.88%)
Cotrimoxazole 25mcg	11 (57.89%)	2 (18.18%)	2 (66.67%)	15 (45.45%)
Amikacin 10mcg	17 (89.47%)	11 (100%)	3 (100%)	31 (93.94%)
Amoxclav 15mcg	11 (57.89%)	4 (36.36%)	3 (100%)	18 (54.55%)
Erythromycin 15mcg	14 (73.68%)	4 (36.36%)	2 (66.67%)	20 (60.61%)
Vancomycin 30mcg	19 (100%)	11 (100%)	3 (100%)	33 (100%)
Linezolid 15mcg	19 (100%)	11 (100%)	3 (100%)	33 (100%)
Ampicillin 10mcg	9 (47.36%)	3 (27.27%)	3 (100%)	15 (45.45%)

Table 6 Antibiotic susceptibility pattern of Gram Negative Bacilli in Postoperative wound infection.

Antibiotics	E.coli (n = 18)	Pseudomonas (n = 9)	Klebsiella (n = 6)	Proteus (n = 3)	Citrobacter (n = 2)	Acinetobacter (n = 2)	Total (n =40)
Ciprofloxacin5mcg	9 (50%)	7 (77.78%)	5 (83.33%)	1 (33.33%)	1 (50%)	1 (50%)	24 (60%)
Amikacin10mcg	17 (94.44%)	8 (88.89%)	5 (83.33%)	2 (66.67%)	1 (50%)	1 (50%)	34(85%)
Ceftazidime30mcg	4 (22.22%)	5 (55.56%)	3 (50%)	1 (33.33%)	1 (50%)	1 (50%)	15(37.50%)
Cefaperazone – Sulbactam50/50mcg	16 (88.89%)	7 (77.78%)	5 (83.33%)	2 (66.67%)	1 (50%)	1 (50%)	32 (80%)
Cefotaxime 30mcg	2 (11.11%)	5 (55.56%)	3 (50%)	2 (66.67%)	0	0	12 (30%)
Ampicillin 10mcg	3 (16.67%)	1 (11.11%)	0	0	0	0	4 (10%)
Gentamycin 10mcg	15 (83.33%)	6 (66.67%)	4 (66.67%)	3 (100%)	2 (100%)	1 (50%)	31 (77.5%)

DISCUSSION

Postoperative surgical wound infections have been found to pose a major problem in the field of surgery for a long time. Although surgical wound infections cannot be completely eliminated, a reduction in the infection rate to a minimum level could have significant benefits, by reducing postoperative morbidity and mortality and wastage of health care resources.

Among the 102 samples included in our study 61 (59.80%) had bacterial growth. This culture positivity rate in our study is in accordance with Biadglign et al[12] study in which the culture positivity is 53.0%. But Taye, 2005[13] and Tesfahunegn et al, 2009[14] reported culture positivity of 14.8% and 44.1% which is much lower than our study whereas Amrita et al[15] and Guta et al[16]reported higher culture positivity of 84% and 92%. This difference in culture positivity rate may be due to variation in common nosocomial pathogens inhabitant, difference in policy of infection control and prevention between countries and hospitals and study design used in the researches.

Bacterial growth was not seen in 41 (40.20%) samples, which could attribute to the normal healing process of the wound by host immune system, antimicrobial activity or appropriate use of antiseptics for cleaning the wounds. It could also be due to anaerobic bacteria or fungi infection which we could miss due to the use of culture media that only support the aerobic bacteria[17,18].

Out of the 102 samples included in our study, 53 (51.96%)

were from males and 49 (48.04%) were from females, which shows a slight male preponderance in postoperative wound infections. In Insan NG et al[19] study 77.4% males and 22.6% females and in Divya P[6] et al study 73.2% males and 26.8% females were prone for postoperative wound infections. In Rao R et al[8] study 60% males and 40% females had postoperative wound infection.

In our study monomicrobial isolates were found in 51(83.61%) and polymicrobial isolates in 20 (16.39%) of culture positive samples. But Jain K et al[20] study reported 92.30% monomicrobial and 7.6% polymicrobial isolation whereas Jnaneshwara KB[21] et al study reported monomicrobial isolation in 76.58% and polymicrobial isolation in 23.42% of aerobic bacterial growth positive samples. But Gacometti A et al[22] study reported monomicrobial isolation in 44.1% and polymicrobial in 55.9% of postoperative wound infected patients.

The most commonly isolated bacteria was Staphylococcus aureus 19 (26.03%) followed by Escherichia coli 18 (24.65%). This is in accordance with Insan NG et al[19] study which reported Staphylococcus aureus 25.5%, followed by Escherichia coli 15.9% were the most common isolated bacteria. A similar study by Divya P et al[6] also supported Staphylococcus aureus followed by Escherichia coli were the most commonly isolated bacteria. Predominance of Staphylococcus aureus in postoperative wound infection is also consistent with reports from Lilani SP et al[23] in (2001-2002), Zafar A et al[24] and Citron DM et al[25]. The normal flora nature of Staphylococcus aureus in the skin and anterior nares, which can enter to deep site during surgery of the natural barrier of the skin, could be the possible justification for its high prevalence.

Antibiotic sensitivity testing of this study showed that Vancomycin 100% , Linezolid 100% followed by Amikacin 93.94% were the most effective antibiotics against Gram positive bacteria. Divya P et al[6] study also supported the result Vancomycin 100% and Linezolid 100% were the most effective antibiotics for Gram positive isolates. In our study, Staphylococcus aureus showed high sensitivity also for Gentamycin 100%. The least effective antibiotic for Gram positive isolates were Ampicillin 45.45%.and Cotrimoxazole 45.45%.

For Gram negative bacteria Amikacin 85%, followed by Cefaperazone-sulbactam 80% and Gentamycin 77.5% were the most effective antibiotics and Ampicillin 10% followed by Cefotaxime 30% were the least effective antibiotics.

This knowledge of the most likely causative organism and prevailing drug susceptibility pattern helps to select empirical antibiotic treatment options to reduce the mortality and morbidity in post operative wound infections. Here lies the importance of formulating an Institutional Antibiotic policy to follow in that institution, in order to reduce the healthcare cost, associated with postoperative wound infections.

CONCLUSION

Postoperative wound infections are real risks associated with any surgical procedure and represent a significant burden contributing to morbidity and mortality and increased cost to health care services around the world. Therefore periodic surveillance of postoperative wound infections should be done in every hospital at regular intervals to evolve the control strategies and reduce the infection rate.

REFERENCES

1. Fan Y, Wei Z, Wang W, Tan L,Jiang H, Tian L, Cao Y, Nie S. The incidence and Distribution of Surgical Site Infection in Mainland China: A Meta-Analysis of 84 Prospective Observational Studies. *Sci. Rep.* 4, 6783; DOI:10.1038/srep06783 (2014).
2. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, EG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control HospEpidemiol.*1992;13 (10): 606-608.
3. Barie PS, Wilson SE. Impact of evolving epidemiology on treatments for complicated skin and skin structure infections: the surgical perspective. *J. Am. Coll. Surg*. 2015; 220(1): 105-106.
4. Horan TC Andrus M, Dudeck MA, CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control.2008; 36(5): 309-332.
5. Azoury SC, Farrow NE, Hu QL, Soares KC, Hicks CW, Azar F, RodriguezChronic-Unda N, Poruk KE, Cornell P, Burce KK, Cooney CM, Nguyen HT, Eckhauser FE. Postoperative abdominal wound infection-epidemiology, risk factors, identification and management. *Chronic Wound Care Management and Research* 2015; 2: 137-148.
6. Divya P, Krishna S, Mariraj J, Pushpalatha H. Aerobic Bacteriological Profile of Post-Operative Surgical Wound Infections and Their Antibiogram in A Tertiary Care Hospital. 2015; 3(6): 6310-6316.
7. Malik S, Gupta A, Singh KP, Agarwal J, Singh M. Antibiogram of Aerobic Bacterial Isolates from Post-operative Wound Infections at a Tertiary Care Hospital in India. *J Infect Dis Antimicrob Agents* 2011; 28: 45-51.
8. Rao R, Sumathi S, Anuradha K, Venkatesh D, Krishna S. Bacteriology of postoperative wound infections. *Int J Pharm Biomed Res* 2013; 4(2): 72-76.
9. Cheesbrough M. District Laboratory Practice in Tropical Countries. 2nd ed. New York: Cambridge University Press; 2006.
10 Washington C, Allen S. Koneman'scolor atlas and textbook of Diagnostic Microbiology. 6thed. Philadelphia: Lippincott Williams and Wilkins; 2006.
11 Performance Standards for Antimicrobial Disk Susceptibility Tests; Approved Standard-Ninth Edition. CLSI.M2-A9;26:1.

12 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): 173-177.

13 Taye M.(2005). Wound infection in TikurAnbessa hospital, surgical department. Ethiop Med J 43(3): 167-174.

14 Tesfahunegn Z, Asrat D, Woldeamanuel Y. Bacteriology of surgical site and catheter related urinary tract infections among patients admitted in Mekelle hospital, Mekelle, Tigray, Ethiopia. *Ethiop Med J*. 2009; 47(2): 117-127.

15 Amrita S, Sheetal R, Narendra N. Aerobic microorganisms in postoperative wound infections and their antimicrobial susceptibility patterns. *J Clin Diag Res.* 2010; 4(6): 3392-3396.

16 Guta M, Aragaw K, Merid Y. Bacteria from infected surgical wounds and their antimicrobial resistance in Hawassa University Referral Teaching Hospital, Southern Ethiopia. *AJMR* 2014; 8(11): 1118-1124.

17 Pondel 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.

18 Mengesha RE, Kasa BGS, Saravanan Muthupandian, Berhe DF, Wasihun AG. Aerobic bacteria in post surgical wound infections and pattern of their antimicrobial susceptibility in Adyer Teaching and Referral Hospital, Mekelle, Ethiopia. *BMC Research Notes* 2014; 7: 575.

19 Insan NG, Payal N, Singh M, Yadav A, Chaudhary BL, Srivastava A. Post operative wound infections: Bacteriology and Antibiotic Sensitivity Pattern. *Int J Cur Res Rev* 2013; 5(13): 74-79.

20 Jain K, Chavan NS, Jain SM. Bacteriological profile of post-surgical wound infection along with special reference to MRSA in central India, Indore. *Int J Intg Med Sci* 2014; 1(1): 9-13.

21 Jnaneshwara KB, Singh RE, Lava R, Murlimanju BV. The Bacterial Profile of the Postoperative wound infection in a South Indian Hospital. International journal of Pharmaceutical, Chemical and Biological Sciences 2015; 5(3) : 676 – 682.

22 Giacometti A, Cirioni O, Schimizzi AM, Prete MSD, Barchiesi F, Errico MMD, Petrelli E and Scalise G. Epidemiology and Microbiology of Surgical Wound Infections *J Clin Microbiol* 2000; 38(2): 918-922.

23 Lilani SP, Jangale N, Chowdhary A, Daver GB. Surgical site infection in clean and clean-contaminated cases. *Indian Journal of Medical Microbiology* 2005; 23(4): 249-252.

24 Zafar A, Anwar N, Ejaz H. Bacteriology of infected wounds – A study conducted at children’s hospital Lahore. *Biomedica* 2008; 24: 71-74.

25 Citron DM. Bacteriology of moderate to severe Diabetic foot infections and in vitro activity of antimicrobial agents. *J Clin Microbiol.* 2007; 45(9): 2819.