Original Research Article

Bacteriological profile of surgical site infections

Kanwalpreet Kaur[1*], Loveena Oberoi[2], Pushpa Devi[3]

[1]Senior Resident, [2]Professor, [3]Professor and Head
Department of Microbiology, G.M.C., Amritsar, Punjab, India
[*]Corresponding author email: **tarunbir77@gmail.com**

International Archives of Integrated Medicine, Vol. 4, Issue 12, December, 2017.

Available online athttp://iaimjournal.com/
ISSN: 2394-0026 (P)ISSN: 2394-0034 (O)

Received on: 14-11-2017 **Accepted on:**27-11-2017
Source of support: Nil **Conflict of interest:** None declared.

How to cite this article: Kanwalpreet Kaur, Loveena Oberoi, Pushpa Devi. Bacteriological profile of surgical site infections. IAIM, 2017; 4(12): 77-83.

Abstract

Background: Surgery has made great advances in last 3 quarters of this century and post-operative wound infection is the most common complication faced by surgeon since the advent of surgery.
Aim: To determine the bacteriological profile and antibiogram of surgical site infections.
Materials and methods: This prospective study was done for a period of one year (January 1, 2016 to December 31, 2016) in a Govt. Medical College, Amritsar. The study population included 712 patients suffering from Surgical Site infections in the various wards (Orthopedics, General Surgery, Obstetrics and Gynecology) of our hospital. Two sterile cotton swabs were collected aseptically. Gram stained preparation was made from one swab. The other swab was inoculated on blood agar and Mac Conkey agar and incubated for 48 hours. Growth on culture plate was identified by its colony characters and standard biochemical tests. Antimicrobial sensitivity testing was done by Kirby- Baeur disk diffusion method.
Results: Rate of SSI was 58.00%. A total of 431 isolates were obtained, out of which 428 (99.30%) were bacterial isolates and 3 (0.69%) were fungal isolates. Monomicrobial growth was seen in 395 (95.64%) patients whereas polymicrobial growth was seen in 18 patients (4.35%). Out of 428 bacterial isolates, majority of bacteria were gram negative bacteria (60.74%) but most common isolate was *Staphylococcus aureus*. The microbiological profile of the 260 (60.74%) gram negative bacteria was *Klebsiella pneumoniae* followed by *Pseudomonas aeruginosa*, *Escherichia coli*, *Acinetobacter spp.*, *Citrobacter spp.* and *Proteus spp.* Methicillin resistance was seen in 10.52% of all the *S.aureus* isolates and 21.05% of CONS isolates. No vancomycin resistance in enterococcus was detected. Out of 260 gram negative bacilli, 105 (40.38%) were ESBL producers.
Conclusion: To conclude, there is emergence of MDR gram negative organisms. The prevention of surgical site infections encompasses meticulous operative technique, timely administration of appropriate preoperative antibiotics, and a variety of preventive measures aimed at neutralizing the

threat of bacterial, viral, and fungal contamination posed by operative staff, the operating room environment, and the patient's endogenous skin flora.

Key words

Post-operative, Surgical infections, Bacterial pathogens, Antimicrobial sensitivity, Multidrug resistance.

Introduction

Surgical site infections (SSI), one of the most common causes of healthcare associated infections are a common complication associated with surgery, with a reported incidence rates of 2-20% [1]. Surgery has made great advances in last 3 quarters of this century and postoperative wound infection is the most common complication faced by surgeon since the advent of surgery.

A number of local factors such as hematomas, seromas, suture material, poor surgical technique, degree of contamination and also age, nutrition, hygiene, and other associated diseases play an important role in the etiology of post-operative wound infection. The incidence of surgical site infection differs widely between surgical procedures, hospitals, patients and between surgeons [2,3].

The most commonly isolated bacterial pathogens are *Staphylococcus aureus (S.aureus),* Enterobacteriaceae, Coagulase Negative Staphylococcus (CoNS), Enterococcus and Pseudomonas aeruginosa [4]. In the recent years there has been a growing prevalence of gram negative organisms besides gram positive bacteria as a cause of serious infections in many hospitals. In addition, the widespread use of antimicrobials, together with the length of time over which they have been available have led to major problem of resistant organisms [5]. In such scenario, a working knowledge of the most likely organisms and the prevailing antibiotic sensitivity/resistance pattern will be of great help. The present study was undertaken to determine the bacteriological profile and antibiogram of surgical site infections.

Materials and methods

This Prospective study was done for a period of one year (January 1, 2016 to December 31, 2016) in a Govt. Medical College, Amritsar. The study population included 712 patients suffering from Surgical Site infections (SSI) in the various surgical wards (Orthopedics, General Surgery, Obstetrics and Gynecology,) of our hospital. Two sterile cotton swabs were collected aseptically from each patient suspected of having SSI. Gram stained preparation was made from one swab for provisional diagnosis. The other swab was inoculated on blood agar and Mac Conkey agar and incubated at 37°C for 48 hours before being reported as sterile. Growth on culture plate was identified by its colony characters & the battery of standard biochemical tests [6].

Antimicrobial sensitivity testing was carried out by Kirby-Baeur disk diffusion method on Mueller Hinton agar as per CLSI guidelines. Methicillin resistance in Staphylococcus isolates was tested by cefoxitin disc diffusion method. Extended spectrum beta lactamases (ESBL) production were detected as per CLSI guidelines [7].

Results

Out of 712 patients with surgical site infections, aerobic bacterial growth was obtained in 413 (58.00%) patients. A total of 431 isolates were obtained, out of which 428 (99.30%) were bacterial isolates and 3 (0.69%) were fungal isolates. Monomicrobial growth was seen in 395 (95.64%) patients whereas polymicrobial growth was seen in 18 patients (4.35%).

Maximum positivity was obtained from Orthopedics Department 294 (71.18%), followed by Obstetrics and Gynecology department 78 (18.88%) and General Surgery department 41 (9.92%) (**Table - 1**).

Table - 1: Department specific distribution of positive cases.

Department	No of positive cases	Percentage of positive cases (%)
Orthopedics	294	71.18%
Obstetrics and Gynecology	78	18.88%
General Surgery	41	09.92%

Table - 2: Characterization of various bacterial isolates obtained from patients with surgical site infections.

Organism	No of isolates	Percentage of isolates (%)
Staphylococcus aureus	128	29.90%
Klebsiella pneumoniae	100	23.36%
Pseudomonas aeruginosa	64	14.95%
Escherichia coli	44	10.28%
Coagulase Negative Staphylococcus	37	0 8.64%
Acinetobacter spp	36	08.41%
Citrobacter spp	11	02.57%
Proteus spp	05	01.16%
Enterococcus spp	03	00.70%

Out of 428 bacterial isolates, majority of bacteria were gram negative bacteria (60.74%) as compared to gram positive bacteria (39.25%), but most common isolate was *Staphylococcus aureus* (29.90%). The microbiological profile of the 260 (60.74%) gram negative bacteria was *Klebsiella pneumoniae* 100 (38.46%) followed by *Pseudomonas aeruginosa* 64 (24.61%), *Escherichia coli* 44 (16.92%), *Acinetobacter spp.* 36 (13.84%), *Citrobacter spp.* 11 (4.23%) and *Proteus spp.* 05 (1.92%). Out of 168 gram positive isolates, *Staphylococcus aureus 128* (76.19%) dominated followed by *Coagulase Negative Staphylococcus* 37 (22.02%) and *Enterococcus spp. 03*(1.78%) (**Table - 2**).

Out of 260 gram negative bacilli, 105 (40.38%) were ESBL producers. Antimicrobial profile of both *Staphylococcus aureus* and *Coagulase negative staphylococcus* showed maximum sensitivity to linezolid (98.03% and 97.37% respectively), followed by amikacin (80.85% and 56.52% respectively) and amoxyclav (80.43% and 77.77% respectively). *S.aureus* was found highly resistant to penicillin (10.34%) and ciprofloxacin (10%). Methicillin resistance was seen in 10.52% of all the *S.aureus* isolates and 21.05% of *CONS* isolates. No vancomycin resistance in enterococcus was detected (**Table - 3**).

Antimicrobial profile of most of the gram negative isolates showed maximum sensitivity to piperacillin-tazobactum and sulbactum ceftriaxone. In comparison they showed higher rate of resistance against third generation cephalosporins, gentamicin, and ciprofloxacin (**Table - 4**).

Discussion

Despite the advances in surgical techniques and better understanding of the pathogenesis of wound infection, management of SSIs remains a significant concern for surgeons and physicians in a health care facility. Hospitals serve as a reservoir for SSIs as they harbor a variety of pathogenic microbes [8]. The unrestrained and rapidly spreading resistance to the available array of antimicrobials further contributes to the existing problem [9].

In our study, the rate of surgical site infections was 58.00% which was comparable with the study conducted by Mundhana AS, et al. and Saleem, et al. [10, 11]. A prolonged preoperative stay with exposure to hospital environment, instrumentation, duration of surgery and presence of co-morbid illness like diabetes, hypertension may contribute to increased rate of SSI [12].The lack of attention towards the infection control measures, inappropriate hand hygiene practices and overcrowded hospitals can be the major contributory factors for high infection rate in Indian hospitals [9].

Table - 3: Antibiotic sensitivity pattern of aerobic gram positive bacterial isolates in surgical site infections.

Antibiotics	**Gram positive organisms**		
	Staphylococcus aureus	***CONS***	***Enterococcus spp***
Ampicillin	10.34%	13.15%	0%
Amikacin	80.85%	56.52%	N.T.
Gentamycin	45.09%	34.09%	33.33%
Ciprofloxacin	10%	20.63%	33.33%
Azithromycin	58.33%	28.12%	N.T.
Cotrimoxazole	28.57%	40%	N.T.
Cephalexin	36%	27.27%	N.T.
Cefoxitin	89.48%	78.95%	N.T.
Amoxyclav	80.43%	77.77%	66.66%
Linezolid	98.03%	97.37%	N.T.
Ampilcillinsulbactum	N.T.	N.T.	66.66%
Vancomycin	N.T.	N.T.	100%
Chloramphenicol	N.T.	N.T.	66.66%

Table - 4: Antibiotic sensitivity pattern of aerobic gram negative bacterial isolates in surgical site infections.

Antibiotics	**Gram negative organisms**					
	Klebsiella pneumoniae	**Pseudomonas Aeruginosa**	**Escherichia coli**	**Acinetobacter spp**	**Citrobacter spp**	**Proteus spp**
Amikacin	36%	38.23%	50%	23.25%	23.07%	I4.28%
Gentamycin	14.28%	30.76%	22%	19.04%	42.85%	14.28%
Ciprofloxacin	14.28%	43.33%	12.5%	17.64%	23.07%	33.33%
Ceftazidime	15.62%	37.25%	6.66%	83.33%	22.22%	100%
Ceftriaxone	12.76%	N.T.	17.77%	17.5%	33.33%	25%
Sulbactum ceftriaxone	45%	N.T.	61.90%	68.18%	66.66%	100%
Piperacillin tazobactum	76%	91.66%	72.22%	71.79%	72.72%	85.71%
Cefoperazone	N.T.	34.37%	N.T.	N.T.	N.T.	N.T.
Imipenem	N.T.	58.33%	N.T,	62.50%	N.T.	N.T.
Sulbactum ceftazidime	N.T.	86.36%	N.T.	N.T.	N.T.	N.T.

N.T. = Not tested

In the present study predominance of *S. aureus* (29.90%) was seen and this finding was consistent with reports from other studies (Mundana, Bhave) [10, 13]. Infection with *S. aureus* is most likely associated with endogenous source as it is a member of the skin and nasal flora and also exogenous source with contamination from environment, surgical instruments or from hands of health workers (Adwan G) [14]. In our set up, methicillin resistance was seen in 10.52% of *S.aureus* isolates and 21.05 % of *CONS* isolates. This finding was in concordance with the study conducted by Takesui Y, et al. [15]. In our study *S.aureus* showed high sensitivity to linezolid, Amikacin followed by Amoxyclav. This finding can be of relevant clinical use for the formulation of antibiotic policy of our hospital.

In this study, gram negative bacilli (60.74%) dominated gram positive cocci (39.26%). Studies concordant with our study were of M. Saleem, et al. and Gelaw, et al. [11, 16].The high incidence of gram-negative organisms in the postoperative wound infections can be attributed to be acquired from patient's normal endogenous microflora (Bhave PP) [13]. Findings in this study were *Klebsiella pneumoniae* as the most common organism (23.36%) followed by *Pseudomonas aeruginosa* (14.95%), *Escherichia coli* (10.28%), *Acinetobacter spp*. (8.41%) *and Citrobacter spp*. (2.57%). Similar observations had been reported by various other authors also (Lubega A, et al. and Kikkeri NV, et al) [17, 18].

Multi drug resistance (MDR) is a dreadly problem in nosocomial infections. In the current study, out of 260 gram negative bacilli, 105 were ESBL producers (40.38%). Similar results were given by previous studies (Mundhana AS, et al and V.Rambabu, et al.) who also found (35.29%) and (35.71%) respectively of ESBL producing strains [10,19]. *Klebsiella pneumoniae* was found to be most multidrug resistant followed by *Acinetobacter spp.* and *Pseudomonas aeruginosa* in the current findings. MDR status was displayed in all *Escherichia coli*, *A.baumannii*, *Pseudomonas stuartii* and 87.5% of *Klebsiella spp.* isolates, as documented by Manyahi J, et al. also [20]. In the present study, against most of the gram negative isolates, piperacillin-tazobactum and beta-lactamase inhibitor combination proved to be highly effective whereas third generation cephalosporins, fluoroquinolones and aminoglycosides, the commonly prescribed antibiotics, were least effective drugs. This could be due to the overuse of these drugs and the high prevalence of extended spectrum beta lactamases (ESBLs) among these organisms [21]. Gram negative bacteria are more resistant to antibiotics than gram positive bacteria by virtue of their outer membrane porins [22].

In our study, *Pseudomonas aeruginosa* and *Acinetobacter spp.* had only moderate sensitivity to imipenem. Conversely, results of Shahane V, et al. had shown *Pseudomonas* isolates with good sensitivity to imipenem (100%) [21].

Conclusion

Our study highlights emergence of MDR gram negative organisms though *Staphylococcus aureus* was predominant organism. The prevention of surgical site infections encompasses meticulous operative technique, timely administration of appropriate preoperative antibiotics, and a variety of preventive measures aimed at neutralizing the threat of bacterial, viral, and fungal contamination posed by operative staff, the operating room environment, and the patient's endogenous skin flora.

References

1. Hohmann C, Eickhoff C, Radziwill R, Schulz M. Adherence to guidelines for antibiotic prophylaxis in surgery patients in German hospitals: a multicentre evaluation involving pharmacy interns. Infection, 2012; 40(2): 131–37.
2. April 2013 CDC/NHSN Protocol Corrections, Clarification, and Additions. http://www.cdc.gov/nhsn/PDFs/pscManual/9pscSSIcurrent.pdf (Accessed on July 10, 2013).
3. Pradhan GB, Agrawal J. Comparative study of post-operative wound infection following emergency lower segment caesarean section with and without the topical use of fusidic acid. Nepal Med Coll J., 2009; 11(3): 189–91.

4. Mahmood A. Bacteriology of surgical site infections and antibiotic susceptibility pattern of the isolates at a tertiary care hospital in Karachi. J Pak Med Assoc., 2000; 50: 256-9.
5. Sawhney N, Prabhas R, Singh VA. Post operative wound infections: pattern of bacterial pathogens and their antibiotic sensitivity in a tertiary care hospital of north India. International Journal of Recent Trends in Science and Technology, 2017; 22(3): 214-217.
6. Forbes BA, Sahm DF, Weissfeld AS. Bailey and Scott's Diagnostic Microbiology. 10th ed. St. Louis, Misssouri, USA: Mosby Inc; 1998.
7. CLSI: Performance Standards for Antimicrobial Susceptibility Testing; Twentieth Informational Supplement CLSI Document M100–S20. Wayne, PA: Clinical and Laboratory Standards Institute; 2010.
8. Budhani D, Kumar S, Sayal P, Singh S. Bacteriological profile and antibiogram of surgical site infection/ post-operative wound infection. International Journal of Medical Research and Review., 2016; 4(11): 1994-1999
9. Negi V, Pal S, Juyal D, Sharma MK, Sharma N. Bacteriological Profile of Surgical Site Infections and Their Antibiogram: A Study From Resource Constrained Rural Setting of Uttarakhand State, India. J Clin Diagn Res., 2015; 9(10): 17–20.
10. Mundhada AS, Tenpe S. A study of organisms causing surgical site infections and their antimicrobial susceptibility in a tertiary care government hospital. Indian J Pathol Microbiol., 2015; 58: 195-200.
11. Saleem M. Bacterial Profile and Antimicrobial Susceptibility. Pattern of Surgical Site Infections – A Retrospective Study. Indian Journal of Applied Research, 2015; 5(10): 204-206.
12. Khan AKA, Rashed MR, Banu G. A Study on the Usage Pattern of antimicrobial agents for the prevention of surgical site infections (ssis) in a tertiary care teaching hospital. J ClinDiagn Res., 2013; 7(4): 671–74.
13. Bhave PP, Kartikeyan S, Ramteerthakar MN, Patil NR. Bacteriological study of surgical site infections in a tertiary care hospital at Miraj, Maharashtra state, India. Int J Res Med Sci., 2016; 4(7): 2630-2635.
14. Adwan G, Hasan NA, Sabra I, Sabra D, Al-Butmah S, Odeh S, et al. Detection of bacterial pathogens in surgical site infections and their antibiotic sensitivity profile. Int J Med Res Health Sci., 2016; 5(5): 75-82.
15. Takesue Y, Kusachi S, Mikamo S, Sato J, Watanabe A Hiroshi Kiyota, Iwata S, Kaku M, et al. Antimicrobial susceptibility of pathogens isolated from surgical site infections in Japan: Comparison of data from nationwide surveillance studies conducted in 2010 and 2014-2015. J Infect Chemother., 2017; 23: 339-348.
16. Gelaw A, Gebre-Selassie S, Tiruneh M , Mathios E, Yifru S. Isolation of bacterial pathogens from patients with postoperative surgical site infections and possible sources of infections at the University of Gondar Hospital, Northwest Ethiopia . J Environ Occup Sci., 2014; 3(2): 103-108.
17. Lubega A, Joel B, and Lucy NJ. Incidence and Etiology of Surgical Site Infections among Emergency Postoperative Patients in Mbarara Regional Referral Hospital, South Western Uganda. Surgery Research and Practice, 2017.
18. Setty NH, Nagaraja MS, Nagappa DH, Giriyaiah CS, Gowda NR, Laxmipathy Naik RD. A study on Surgical Site Infections (SSI) and associated factors in a government tertiary care teaching hospital in Mysore, Karnataka. Int J Med Public Health, 2014; 4: 171-5.

19. Rambabu V, Rajasekhar, Reddy DK, Kumar GS. Study on Surgical Site Infections Caused By ESBL Producing Gram Negative Bacteria. J of Evidence Based Med & Healthcare, 2015; 2(38): 6092-6097.
20. Manyahi J, Matee MI, Majigo M, Moyo S, Mshana SE, and Lyamuya EF. Predominance of multi-drug resistant bacterial pathogens causing surgical site infections in Muhimbili national hospital, Tanzania. BMC Research Notes, 2014; 7.
21. Shahane V, Bhawal S, Lele U. Surgical site infections: A one year prospective study in a tertiary care center. International Journal of Health Sciences, 2012; 6(1): 79-84.
22. Bajaj A and Kukanur S. Multidrug Resistant Gram Negative Bacilli Causing Surgical Site Infections: Isolation and antimicrobial susceptibility. Int. J. Curr. Microbiol. App. Sc., 2017; 6(4): 2244-2255.