Original research article

A study to evaluate the incidence of surgical site infections and their antibiogram among obstetric patients: an observational study

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Abstract

Aim: The aim of the present study is to identify bacterial etiology of surgical site infections and their antibiogram.

Material and Methods: The study was a cross-sectional study which was carried in the Department of Obstetrics and Gynaecology, PMCH, Bihar, India.for 1 year. 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 Mac Conkey 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. All the isolates were tested for antimicrobial susceptibility by Kirby Bauer disk diffusion technique on Muller Hinton Agar.

Results: Out of 610 samples, 200 samples were culture positive (32.8%). Maximum no. of culture positive samples in age 20-30 years (33.5%) followed by 30-40 (16.5 %) and then followed by 40-50 (14.5%) of age group respectively. Out of 200 culture positive samples *S.aureus* (26.5%) was the most common pathogen isolated followed by *Escherichia coli*. (22.5%), *Citrobacter spp*. (15.5%) and *Pseudomonas aeruginosa* (9.5%) respectively. Among gram negative bacilli, *E.coli* was most sensitive to Imipenem 88.89%) followed by Amikacin (77.77%) and Piperacillin Tazobactam (73.33%) whereas for *Citrobacter spp*., Imipenem (74.19%) followed by Gentamicin (45.16%), Ciprofloxacin (41.93%) was the drug of choice then for *Klebsiella spp*., Imipenem (76.47%) followed by Gentamicin (47.05%), Amikacin (47.05%) was the drug of choice. For *Pseudomonas aeruginosa*, Imipenem (68.42%) followed by Piperacillin Tazobactam (63.16%), Gentamicin (57.89%) was the drug of choice and for *Enterobacter spp.*, Imipenem (76.92%) followed by Amikacin (53.84%), Piperacillin Tazobactam (53.84%) showed maximum sensitivity. Among gram positive organism, *S.aureus* showed maximum antibiotic sensitivity to Linezolid (96.22%) followed by Vancomycin (94.33%), Amikacin (83.02%) whereas *CONS* was sensitive to Linezolid (93.33%) followed by Vancomycin (86.67%), and Gentamicin (80%).

Conclusion: Despite of modern surgical techniques and antimicrobial availability and use, SSIs are common among patients undergoing gynaecological surgeries. Bacterial resistance is a serious threat for treating infections and exists for more commonly available and used antimicrobials.

Keywords: SSIs, antibiotic sensitivity, pathogen

Introduction

Surgical site infections (SSI) are a common consequence of surgery, with reported incidence rates ranging from 2 to 20%.They are to blame for rising treatment costs, hospital stay lengths, and considerable morbidity and death. Even in hospitals with the most sophisticated facilities, SSI remains a big concern despite technological breakthroughs in infection control and surgical methods.[1,2]Exogenous and/or endogenous micro organisms enter the operating site either during the operation (primary infection) or after the surgery (secondary infection) (secondary infection). Primary infections are more dangerous and generally emerge five to seven days after surgery.[3] The majority of SSIs are simple infections that affect just the skin and subcutaneous tissue, although they can occasionally escalate to necrotizing infections. Pain, discomfort, warmth, erythema, swelling, and pus development are all common symptoms of an infected surgical incision.[4,5]Patient-related factors (old age, nutritional status, pre-existing infection, co-morbid illness) and procedure-related factors (poor surgical technique, prolonged surgery duration, pre-operative part preparation, inadequate sterilisation of surgical instruments) can all have a significant impact on the risk of SSIs. Aside from these risk factors, the virulence and invasiveness of the organism in question, the physiological condition of the wound tissue, and the host's immunological integrity are other crucial variables in determining whether infection develops.[2,6]

Surveillance data suggest that the types of causative organisms associated with SSI have not significantly changed over the past 10–15 years; however, the proportion of different types of causative organisms has changed. Antimicrobial-resistant organisms are causing an increasing proportion of SSIs, and there has been a rise in the number of infections caused by atypical bacterial and fungal organisms. These changing proportions have been attributed to the increasing acuity of surgical patients, the increase in the number of immunocompromised patients, and the increasing use of broad-spectrum antibiotics.[7]Over the past many years, there has been a huge increase in the number of SSI cases as reported by hospitals and it has been observed that many of the cases which were deemed serious were caused by gram negative organisms. Furthermore, the irrational use of high dose broad spectrum antibiotics and antimicrobial resistance has further accelerated this scenario. In developing countries like India, where hospitals have inadequate infrastructure, poor infection control practices, overcrowded wards and practice of irrational use of antimicrobials, the problem of SSIs gets more convoluted. The aim of the present study is to identify etiologic profile of surgical site infections and their antibiogram.

Material and methods

The study was a cross-sectional study which was carried in the Department of Obstetrics and Gynaecology, PMCH, Bihar, India.for 1 year, after taking the approval of the protocol review committee and institutional ethics committee. Total 610 patients with SSIs of any age, who had surgical wound pus, discharge, or signs of sepsis were include in this study.

Methodology

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.[8,9]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.[10]

Antibiotics used for susceptibility testing were: Amikacin, Ampicillin / Sulbactam, Ceftriaxone, Ciprofloxacin, Gentamicin, Piperacillin-Tazobactum, Imipenem, Azithromycin, Vancomycin, Linezolid, Ofloxacin, Cefoxitin.

Methicillin resistance was detected by taking cefoxitin (30µg) as a surrogate marker and was confirmed by using PBP2a latex agglutination test, *Staphylococcus aureus*-ATCC 25923, *Escherichia coli*- ATCC 25922 and *Pseudomonas aeruginosa*ATCC 27853 were used as control strains for AST. All dehydrated media, reagents and antibiotic discs were procured from Hi Media Laboratories Pvt. Ltd., Mumbai, India.

Statistical analysis

The recorded data was compiled entered in a spreadsheet computer program (Microsoft Excel 2010) and then exported to data editor page of SPSS version 20 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics included computation of percentages, means and standard deviations were calculated.

Results

Out of 610samples, 200 samples were culture positive (32.8%). The age wise distribution of the subjects has been shown in the (Table 1) with maximum no. of culture positive samples in age 20-30 years (33.5%) followed by 30-40 (16.5 %) and then followed by 40-50 (14.5%) of age group respectively. Out of 200 culture positive samples *S.aureus* (26.5%) was the most common pathogen isolated followed by *Escherichia coli*. (22.5%), *Citrobacter spp*. (15.5%) and *Pseudomonas aeruginosa* (9.5%) respectively (Table 2). Among gram negative bacilli, *E.coli* was most sensitive to Imipenem 88.89%) followed by Amikacin (77.77%) and Piperacillin Tazobactam (73.33%) whereas for *Citrobacter spp*., Imipenem (74.19%) followed by Gentamicin (45.16%), Ciprofloxacin (41.93%) was the drug of choice then for *Klebsiella spp*., Imipenem (76.47%) followed by Gentamicin (47.05%), Amikacin (47.05%) was the drug of choice. For *Pseudomonas aeruginosa*, Imipenem (68.42%) followed by Piperacillin Tazobactam (63.16%), Gentamicin (57.89%) was the drug of choice and for *Enterobacter spp.*, Imipenem (76.92%) followed by Amikacin (53.84%), Piperacillin Tazobactam (53.84%) showed maximum sensitivity (Table 3). Among gram positive organism, *S.aureus* showed maximum antibiotic sensitivity to Linezolid (96.22%) followed by Vancomycin (94.33%), Amikacin (83.02%) whereas *CONS* was sensitive to Linezolid (93.33%) followed by Vancomycin (86.67%), and Gentamicin (80%) (Table4).

Table 1: Age wise Distribution of Culture Positive Patients

Age in year	**Culture Positive**
Below 20	28 (14)
20-30	67 (33.5)
30-40	33(16.5)
40-50	29 (14.5)
50-60	23(11.5)
Above 60	20 (10)

Table 2: Distribution of Organisms Causing Surgical Site Infection

Organism	**No. of isolates (%)**
Staphylococcus aureus	53(26.5)
Escherichia coli	45 (22.5)
Citrobacter spp.	31(15.5)
Pseudomonas aeruginosa	19(9.5)

Klebsiella spp.	17 (8.5)
CONS	15 (7.5)
Enterobacter spp.	136.5)
Acinetobacter spp.	4 (2)
Proteus spp.	3 (1.5)
Total	200

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

Drugs	***Escherichia coli*** **(%)(n=45)**	***Citrobacter spp.*** **(%) (n=31)**	***Klebsiella spp.*** **(%) (n=17)**	***Pseudomonas aeruginosa*** **(%) (n=19)**	***Enterobacter spp.*** **(%) (n=13)**
	S	**S**	**S**	**S**	**S**
Gentamicin	30 (66.67)	14(45.16)	8 (47.05)	11 (57.89)	5(38.46)
Ciprofloxacin	11. (24.44)	13 (41.93)	6(35.29)	10 (52.63)	6(46.15)
Piperacillin/ Tazobactam	33 (73.33)	10 (32.25)	5 (29.41)	12 (63.16)	7 (53.84)
Amikacin	35 (77.77)	13 (41.93)	8 (47.05)	11 (57.89)	7(53.84)
Ampicillin/ Sulbactam	14 (31.11)	7(22.5)	4 (23.53)	5 (26.31)	3 (23.07)
Impinem	40 (88.89)	23 (74.19)	13 (76.47)	13 (68.42)	10 (76.92)
Ceftriaxone	10 (22.22)	8 (25.80)	3 (17.64)	8 (42.10)	3 (23.08)

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

Drugs	***Staphylococcus aureus*** **(%) (n=53)**	**CONS (%) (n=15)**
	S	**S**
Azithromycin	32(60.38)	9 (60)
Vancomycin	50 (94.33)	13(86.67)
Linezolid	51 (96.22)	14 (93.33)
Gentamicin	42 (79.24)	12 (80)
Ofloxacin	43 (81.13)	11 (73.33)
Cefoxitin	36 (67.92)	8 (53.33)
Amikacin	44 (83.02)	10(66.67)

Discussion

Wound Infections are the most commonly reported entity following surgical procedures from the hospitals. Regardless of the current advances in surgical procedures, availability of broad spectrum antibiotics, clean and safe wound management practices and modern hospital management systems, SSIs still remain a challenge for practicing surgeons and health care personnel's. Moreover, the patients undergoing surgery have an extra threat of microbial colonies circulating in the hospital environment which may make them susceptible to SSIs. The burden of antimicrobial resistance adds to the burden. Most of the SSIs are hospital acquired and vary from one health care facility to another.

In the present study the Culture positive SSI rate was 32.8%. Where as various other studies from India have shown the rate of SSI to vary from 6.1% to 38.7%.[11-14] The main Reason behind may bedue to the lack of attention towards the infection control measures, inappropriate hand hygiene practices and overcrowded hospitals.

The findings in the study revealed that maximum culture positivity of the patients were with the age group 20-30 (33.5%) years followed by 30-40 (16.5%) years. Similar results was showed by previous study conducted by Gangania PS et al.[15] they concluded that maximum no of SSI was in 16-45years of age group (24%) patient. This may be due to heavy work load, stress at this age group and less number of patients. Whereas in another study conducted by Negi V et al.[16] found that patients with age >50 years had a higher incidence of SSI (51.8%) in comparison to an incidence of 12.4% among the patients who were ≤30 years of age. Advancing age is an important factor for the development of SSIs, as in old age patients there is low healing rate, low immunity, increased catabolic processes and presence of co-morbid illness like diabetes, hypertension, etc.

S.aureus (26.5%) was the most common pathogen isolated followed by *E.coli* (22.5%). This result is consistent with reports from other studies SP Lilani, Mulu W.[12,17]*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.[16]

In the present study among gram negative organism, *E.coli* was most sensitive to Imipenem 88.89%) followed by Amikacin (77.77%) and Piperacillin Tazobactam (73.33%). The findings are consistent with the previous study conducted by M. saleem et al who also showed that *E. coli* showed high sensitivity to Imipenem.[18] In this study *Citrobacter spp*., Imipenem (74.19%) followed by Gentamicin (45.16%), Ciprofloxacin (41.93%) was the drug of choice then for *Klebsiella spp*., Imipenem (76.47%) followed by Gentamicin (47.05%), Amikacin (47.05%) was the drug of choice. The findings are consistent with the study conducted by Jyoti Sonawane et al who also showed that *Citrobacte*r and *Klebsiella* showed high sensitivity to Imipenem.[19]

We observed *Pseudomonas aeruginosa*, Imipenem (68.42%) followed by Piperacillin Tazobactam (63.16%), Gentamicin (57.89%) was the drug of choice. Similar results were shown by Jyoti Sonawane et al.[19] Imipenem, Piperacillin/ Tazobactum, Gentamicin and Amikacin were found to be more efficient antibiotics against gram negative bacilli . Similar results were observed by M. saleem et alwho showed that Amikacin, Imipenem, Piperacillin/ Tazobactum, were found to be more efficient antibiotics against gram negative bacilli.[18]Among gram positive organism, *S.aureus* showed maximum antibiotic sensitivity to Linezolid (96.22%) followed by Vancomycin (94.33%), Amikacin (83.02%). 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%).[20]Linezolid and Vancomycin were found to be more efficient antibiotics against gram positive cocci. This finding was in tandem with the study conducted by Vikrant Negi et al., 2015, who also reported that Vancomycin and Linezolid found to be more efficient antibiotics against gram positive cocci.[16]

Conclusion

SSIs are widespread among patients having operations, despite current surgical methods and antibiotic availability and usage, according to the findings of this study. Bacterial resistance is a severe challenge to treating illnesses, and it exists for antimicrobials that are more widely available and utilised.

Reference

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. Owens CD, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. J Hosp Infect. 2008;70(Suppl 2): 3-10.
3. Pradhan GB, Agrawal J. Comparative study of post operative wound infection following emergency lower segment caesarean section with and without the topical use offusidic acid. Nepal Med Coll J. 2009;11(3):189-91.
4. Ahmed MI. Prevalence of nosocomial wound infection among postoperative patients and antibiotics patterns at teaching hospital in Sudan. N Am J Med Sci .2012;4(1):29-34.
5. Mulu W, Kibru G, Beyene G, Datie M. Postoperative nosocomial infections and antimicrobial resistance patterns of bacterial isolates among patients admitted at FelegeHiwot Referral Hospital, Bahirdar, Ethiopia. Ethiop J Health Sci. 2012;22(1):7-18.
6. Masaadeh HA, Jaran AS. Incident of Pseudomonas aeruginosa in post-operative wound infection. Am J Infect Dis. 2009;5:1–6.
7. SievertDM, RicksP, EdwardsJR, SchneiderA, PatelJ, SrinivasanA, et al. Antimicrobial-resistant pathogens associated with healthcare-associated infections: Summary of data reported to the national healthcare safety network at the centers for disease control and prevention, 2009-2010. Infect Control HospEpidemiol 2013;34:1-4.
8. MacFaddin J. Biochemical Tests for Identification of Medical Bacteria. 3 rded. Philadelphia: Lippincott Williams and Wilkins; 1976.
9. Forbes BA, Sahm DF, Weissfeld AS. Bailey and Scott's Diagnostic Microbiology.10th ed. St. Louis, Misssouri, USA: Mosby Inc.; 1998
10. Clinical and Laboratory Standard Institute. Performance Standards for Antimicrobial Susceptibility Testing.2007;1(1).M2 A9. Pennsylvania, USA: Clinical and Laboratory Standard Institute.
11. Malik S, Gupta A, Singh PK, Agarwal J, Singh M. Antibiogram of aerobic bacterial isolates from postoperative wound infections at a tertiary care hospital in india. Journal of Infectious Diseases Antimicrobial Agents. 2011;28:45-51.
12. Lilani SP, Jangale N, Chowdhary A, Daver GB. Surgical site infection in clean and clean-contaminated cases. Indian J Med Microbiol. 2005 ;23(4):249-52.
13. Khan A K A, 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):671-4.
14. Chakarborty SP, Mahapatra SK, Bal M, Roy S. Isolation and identification of [14] vancomycin resistant Staphylococcus aureus from postoperative pus sample. Al Ameen J Med Sci. 2011; 4(2):152-68.
15. Gangania PS, 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.
16. Negi V, Pal SJuyal 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)
17. Mulu W, Kibru G, Beyene G, Damtie M. Postoperative nosocomial infections and antimicrobial resistance pattern of bacteria isolates among patients admitted at FelegeHiwot Referral Hospital, Bahirdar, Ethiopia. Ethiopian Journal of Health Sciences. 2012; 22(1):7–18.

18. 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):ISSN - 2249-555X.
19. Sonawane J , Kamath N, Swaminathan R, Dosani K. Bacteriological profile of Surgical Site Infections and their Antibiograms in A Tertiary Care Hospital Navi Mumbai. Bombay Hospital Journal.2010;52(3).
20. 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.

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