Original Research Article

To identify bacterial aetiology of surgical site infections and their antibiogram to find drug useful for empirical treatment.

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Abstract

Aim: The aim of the present study is to identify bacterial etiology of surgical site infections and their antibiogram to find drug useful for empirical treatment. **Material and methods:**The study was a crosssectional study which was carried in the Department of General Surgery, PMCH, Bihar, Indiafor 18 months. 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. All the isolates were tested for antimicrobial susceptibility by Kirby Bauer disk diffusion technique on Muller Hinton Agar. **Results:** Out of 410 samples, 200 samples were culture positive (48.78%). Among 200 positive samples 109 (54.5%) were males. 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:** We conclude that despite of modern surgical techniques and antimicrobial availability and use, SSIs are common among patients undergoing surgeries. Bacterial resistance is a serious threat for treating infections and exists for more commonly available and used antimicrobials.

Key words: bacterial,etiology

Introduction

Surgical site infections (SSI), one of the most common causes of nosocomial infections are a common complication associated with surgery, with a reported incidence rates of 2-20%[1]. They are responsible for increasing the treatment cost, length of hospital stay and significant morbidity and mortality. Despite the technical advances in infection control and surgical practices, SSI still continue to be a major problem, even in hospitals with most modern facilities[2]. These

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infections are usually caused by exogenous and/ or endogenous micro organisms that enter the operative wound either during the surgery (primary infection) or after the surgery (secondary infection). Primary infections are usually more serious, appearing within five to seven days of surgery[3].Majority of SSIs are uncomplicated involving only skin and subcutaneous tissue but sometimes can progress to necrotizing infections. The usual presentation of infected surgical wound can be characterized by pain, tenderness, warmth, erythema, swelling and pus formation[4,5]A number of patient related factors (old age, nutritional status, pre existing infection, co-morbid illness) and procedure related factors (poor surgical technique, prolonged duration of surgery, pre operative part preparation, inadequate sterilization of surgical instruments) can influence the risk of SSIs significantly [2]. In addition to these risk factors, the virulence and the invasiveness of the organism involved, physiological state of the wound tissue and the immunological integrity of the host are also the important factors that determine whether infection occurs or not[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 bacterial etiology of surgical site infections and their antibiogram to find drug useful for empirical treatment.

Material and methods

The study was a crosssectional study which was carried in the Department of General Surgery, PMCH, Bihar, Indiafor 18 months. after taking the approval of the protocol review committee and institutional ethics committee. Total 410 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.

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 410samples, 200 samples were culture positive (48.78%) (Table1). Among 200 positive samples 109 (54.5%)were males (Table 1). The age wise distribution of the gender has been shown in the (Table 2) 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 3). 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 4). 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%) (Table5).

Table 1: Gender wise distribution of Culture positive Patients

Gender	No of patients
Male	109 (54.5%)
Female	91 (45.5%)

Table-2: 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-3: 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 4: 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 5: 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 48.78%. Whereasvarious other studies from India have shown the rate of SSI to vary from 6.1% to 38.7%[11-14]. Themain Reason behind may bedue to the lack of attention towards the infection control measures, inappropriate hand hygiene practices and overcrowdedhospitals.In our study, it was observed that rate of infection was higher in male patients (54.5%). 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%)[15]In contrast to our study Gangania P et al reveals that 20% Females shows almost equal distribution of 19% of males[16]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 Pooja Singh Gangania who 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[16].*S.aureus* (26.5%) was the most common pathogen isolated followed by *E.coli* (22.5%). Thisresult 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[15]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[20]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%).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[15].

Conclusion

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

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