ORIGINAL RESEARCH

A hospital based cross-sectional study assessing antimicrobial susceptibility pattern of microorganisms involved in the pathogenesis of surgical site infection

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ABSTRACT
Aim: The aim of the present study was to evaluate the antimicrobial susceptibility pattern of microorganisms involved in the pathogenesis of surgical site infection. **Methods:** The study was a cross sectional study which was carried in the Department of Microbiology, for the period of one year, after taking the approval of the protocol review committee and institutional ethics committee. Total 380 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. Out of 380 samples, 200 samples were culture positive (52.63%). **Results:** Among 200 positive samples 110 (55%) were males. Maximum no. of culture positive samples in age 20-30 years (31%) followed by 30-40 (20%) and then followed by 40-50 (15%) of age group respectively. Out of 200 culture positive samples *S. aureus* (22%) was the most common pathogen isolated followed by Escherichia coli. (22%), Citrobacter spp. (15%) and Pseudomonas aeruginosa (12%) respectively. Among gram negative bacilli, *E. coli* was most sensitive to Imipenem followed by Amikacin and Piperacillin Tazobactam whereas for *Citrobacter* spp., Imipenem followed by Gentamicin, Ciprofloxacin was the drug of choice then for *Klebsiella* spp., Imipene followed by Gentamicin, Amikacin was the drug of choice. Among gram positive organism, S.aureus showed maximum antibiotic sensitivity to Linezolid followed by Vancomycin, Amikacin whereas CONS was sensitive to Linezolid followed by Vancomycin and Gentamicin. **Conclusion:** The present study concluded that the increasing resistance to antimicrobials increases the risk of morbidity and mortality; therefore, there is urgent need of implementation of measures to restrict the health care associated infection. Rational use of antimicrobials, proper hygiene, and strict asepsis should be applied in all health care.
Key words: Antimicrobial, susceptibility, pattern, microorganisms, surgical site infection

INTRODUCTION

Infections caused by an invasive surgical procedure that occurs in the wound are commonly referred to as surgical site infections (SSIs).[1] It is clinically characterized as an infection that occurs within 30 days of surgery (or within a year if an implant is left in place after the procedure) and affects either the incision or deep tissue at the site of the surgery.[2] These infections can be superficial or deep incisional infections, or infections affecting organs or body spaces. SSIs are the most common infections associated with health care settings. They are associated with significant morbidity and over one-third of postoperative deaths have been reported to be linked to SSI.[3,4] SSI will double the duration of a patient's hospital stay and therefore increase the cost of health care.[4] Contamination of wound site and pathogenicity of microorganisms, balanced against the host's immune response will determine the occurrence of SSI.[5-7] The organism which causes SSI-are usually derived from the endogenous environment, that is the patient skin or opened viscus).

The most common microorganism cultured from SSIs is Staphylococcus aureus.[8-10] When a viscus, such as the large bowel, is opened, tissues are likely to be contaminated by numerous organisms. For example, Enterobacteriaceae and anaerobes can cause SSI after colorectal surgery.[11] The presence of a foreign body from prosthetic surgery reduces the number of pathogenic organisms required to cause SSI.[12,13] Microorganisms, which are non-pathogenic such as Staphylococcus epidermidis, may also cause SSI in such environment. The type of wound also dictates the presence of microorganisms at surgical sites. For instance, operations on sterile sites have less than 2%, whereas, SSI will occur more than 10% after operations in “contaminated” or “dirty” sites.[14,15]
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.[16] 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.[17]
The aim of the present study was to evaluate the antimicrobial susceptibility pattern of microorganisms involved in the pathogenesis of surgical site infection.

MATERIALS AND METHODS

The study was a cross sectional study which was carried in the Department of Microbiology, for the period of one year, after taking the approval of the protocol review committee and institutional ethics committee. Total 380 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. Out of 380 samples, 200 samples were culture positive (52.63%).
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.[18,19] 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.[20] Antibiotics used for susceptibility testing were: Amikacin, Ampicillin/Sulbactam, Ceftriaxone, Ciprofloxacin, Gentamicin, Piperacillin-Tazobactum, Imipenem, Azithromycin, Vancomycin, Linezolid, Ofloxacin, Cefoxitin.

STATISTICAL ANALYSIS: Data was entered in Microsoft excel spreadsheet and analysed using appropriate statistical software application.

RESULTS

Table 1: Demographic details

Gender	No of patients=200
Male	110 (55%)
Female	90 (45%)
Age in year	**Culture Positive**
Below 20	30 (15)
20-30	62 (31)
30-40	40 (20)
40-50	30 (15)
50-60	22 (11)
Above 60	16 (8)

Among 200 positive samples 110 (55%) were males. Maximum no. of culture positive samples in age 20-30 years (31%) followed by 30-40 (20%) and then followed by 40-50 (15%) of age group respectively.

Table 2: Distribution of Organisms Causing Surgical Site Infection

Organism	No. of isolates (%)
Staphylococcus aureus	44 (22)
Escherichia coli	44 (22)
Citrobacter spp.	30 (15)

Pseudomonas aeruginosa	24 (12)
Klebsiella spp.	22 (11)
CONS	16 (8)
Enterobacter spp.	10(5)
Acinetobacter spp.	6 (3)
Proteus spp.	4 (2)
Total	200

Out of 200 culture positive samples *S. aureus* (22%) was the most common pathogen isolated followed by Escherichia coli. (22%), *Citrobacter* spp. (15%) and Pseudomonas aeruginosa (12%) respectively.

Table 3: *In vitro* Antibiotic Sensitivity in Isolated Gram Negative Bacteria

Drugs	***Escherichia coliv* (n=44)**	***Citrobacterv* spp. (n=30)**	***Klebsiella* spp. (n=22)**	***Pseudomonas aeruginosa* (n=24)**	***Enterobacter* spp. (n=10)**
	S	**S**	**S**	**S**	**S**
Gentamicin	30	14	8	13	6
Ciprofloxacin	12	11	6	13	5
Piperacillin/Tazobactam	33	9	5	14	7
Amikacin	37	11	7	15	6
Ampicillin/Sulbactam	16	6	4	8	4
Impinem	42	22	13	15	8
Ceftriaxone	12	7	3	10	3

Among gram negative bacilli, E.coli was most sensitive to Imipenem followed by Amikacin and Piperacillin Tazobactam whereas for *Citrobacter* spp., Imipenem followed by Gentamicin, Ciprofloxacin was the drug of choice then for *Klebsiella* spp., Imipene followed by Gentamicin, Amikacin was the drug of choice. For Pseudomonas aeruginosa, Imipenem followed by Piperacillin Tazobactam, Gentamicin was the drug of choice and for *Enterobacter* spp., Imipenem followed by Amikacin, Piperacillin Tazobactam showed maximum sensitivity.

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

Drugs	***Staphylococcus aureus* (n=44)**	**Cons (n=16)**
	S	**S**
Azithromycin	28	11
Vancomycin	44	15
Linezolid	46	16
Gentamicin	37	13
Ofloxacin	38	11
Cefoxitin	36	10
Amikacin	40	11

Among gram positive organism, S.aureus showed maximum antibiotic sensitivity to Linezolid followed by Vancomycin, Amikacin whereas CONS was sensitive to Linezolid followed by Vancomycin, and Gentamicin.

DISCUSSION

As a part of innate immunity, the main function of intact skin in humans is to control the microbes that are resident on the skin surface and also it prevents the underlying tissues from colonization or invasion by pathogens. If due to any condition (wounds) where there is exposure of subcutaneous tissue due to loss of integrity of skin it provides good environment for colonization and proliferation of microorganisms and so any wound is at risk of developing infection.[21] Infections occurring in the wound are major barriers for healing which shows impact on patients, which may prolong the hospital stay and effects the quality of life[22] and wound healing requires a healthy environment which will result in normal healing process and also with minimal scar formation.[23] Resistance patterns of SSI-associated bacteria vary globally, depending on the region, local epidemiology reports, and susceptibility testing methodology. Bacterial resistances pose a challenge and complicated the SSI treatment. Most of the data on drug resistance were obtained from high-income countries.[24,25] However, there were limited reports on the prevalence and incidence of resistant bacteria causing SSI, especially from developing countries.[24,26] Among 200 positive samples 110 (55%) were males. Maximum no. of culture positive samples in age 20-30 years (31%) followed by 30-40 (20%) and then followed by 40-50 (15%) of age group respectively. 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%).[27] In contrast to our study Gangania P et al reveals that 20% Females shows almost equal distribution of 19% of males.[28] Out of 200 culture positive samples S.aureus (22%) was the most common pathogen isolated followed by Escherichia coli. (22%), Citrobacter spp. (15%) and Pseudomonas aeruginosa (12%) respectively. This result is consistent with reports from other studies SP Lilani, Mulu W.[29,30] 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.[27]

Among gram negative bacilli, E.coli was most sensitive to Imipenem followed by Amikacin and Piperacillin Tazobactam whereas for Citrobacter spp., Imipenem followed by Gentamicin, Ciprofloxacin was the drug of choice then for Klebsiella spp., Imipene followed by Gentamicin, Amikacin was the drug of choice. For Pseudomonas aeruginosa, Imipenem followed by Piperacillin Tazobactam, Gentamicin was the drug of choice and for Enterobacter spp., Imipenem followed by Amikacin, Piperacillin Tazobactam showed maximum sensitivity. The findings were consistent with the previous study conducted by M. saleem et al who also showed that E. coli showed high sensitivity to Imipenem.[31] Among gram positive organism, S.aureus showed maximum antibiotic sensitivity to Linezolid followed by Vancomycin, Amikacin whereas CONS was sensitive to Linezolid followed by Vancomycin, and Gentamicin. 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%).[32] The rise in antibiotic resistance emphasizes the importance of sound hospital infection control, rational prescribing policies, and the need for new antimicrobial drugs and vaccines. In general, the current study showed that the reported antibiotic susceptibility data was similar to the previous overall susceptibility pattern of isolates in the study area.[33-35]

CONCLUSION

The present study concluded that the increasing resistance to antimicrobials increases the risk of morbidity and mortality; therefore, there is urgent need of implementation of measures to restrict the health care associated infection. Rational use of antimicrobials, proper hygiene, and strict asepsis should be applied in all health care.

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