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Prevalence of Wound Infection following Elective Surgery and Their Antimicrobial Susceptibility Pattern

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Abstract
Wound Infection or Surgical site infection (SSI) is most reported healthcare-associated infection and common surgical complication. The emergence of multidrug resistant bacterial pathogens in hospitals is becoming a challenge for surgeons to treat hospital acquired infections. This study aimed to find the microorganisms responsible for SSI and their antibiotic susceptibility profile. This prospective cross sectional observational study was conducted among 92 patients. Among them, 75 (81.5%) were culture positive. Monomicrobial growth was seen in 67 samples while 8 samples showed polymicrobial growth. *Staphylococcus aureus* (26.5%) was the commonest organism followed by *Escherichia coli* (22.8%), *Klebsiella pneumonia* (18.0%), etc. Antimicrobial profile of gram positive isolates revealed maximum sensitivity to vancomycin, teicoplanin and linezolid, whereas among gram negative isolates meropenem, piperacillin-tazobactam, and amikacin were found to be most sensitive. As a result of these problems, routine surveillance for hospital acquired wound infections, including surgical wound infections, is recommended.

Key Words: Wound Infection, Elective Surgery, Bacteriological Profile, Susceptibility Pattern.

Introduction

Surgical infections constitute a large burden of disease globally. Worldwide, SSIs occur in 2%–20% of patients after operation[1]. Rates are likely higher in Low- and Middle-income Countries (LMICs), and a systemic review has shown as SSI represents a financial burden in both high income and LMICs settings. The magnitude of the cost difference depends on the SSI definition used, severity of SSI, patient population, choice of comparator, hospital setting, and cost items included[2].

The incidence of SSI differs depending on the degree of incision contamination. The largest prospective evaluation of SSI after gastrointestinal resection identified 12,539 patients from 343 hospitals in 66 countries. The incidence after gastrointestinal resection was lowest among high HICs (9.4%) and higher among middle-income countries (14%) and low-income countries (LICs) (23%)[3]. SSI defined as infections that occur during one month after a surgical operation or one year after implant surgery and affecting either the injury site or near surgical injuries. It is considered as a major problem in health care centers, resulting in extended length of stay, substantial associated morbidity and mortality, and high excess hospital cost[4].

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[5]. These infections are usually caused by exogenous and/or endogenous microorganisms that enter the operative wound either during the surgery (primary infection) or after the surgery (secondary infection). Exposed subcutaneous tissue provides a favourable substratum for a wide variety of microorganisms to contaminate and colonize, and if the involved tissue is devitalized (e.g., ischemic, hypoxic, or necrotic) and the host immune response is compromised, the conditions become optimal for microbial growth. Wound contaminants are likely to originate from three main sources: (i) the environment (exogenous microorganisms in the air or those introduced by traumatic injury), (ii) the surrounding skin (involving members of the normal skin microflora such as *Staphylococcus epidermidis*, Micrococci, skin diphtheroids, and Propionibacteria), and (iii) endogenous sources[6]. 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[7, 8].

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[5]. 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.

In the recent years there has been a growing prevalence of gram negative organisms as a cause of serious infections in many hospitals[9]. In addition irrational use of broad spectrum antibiotics and resulting anti microbial resistance (AMR) has further deteriorated the condition in this regard. The problem gets more complicated in developing countries due to poor infection control practices, overcrowded hospitals and inappropriate use of antimicrobials. This study aimed to determine the prevalence of SSIs and find out the bacterial pathogens involved with their antibiogram.

Materials and Methods

This prospective Cross-sectional observational study was carried out in the Department of Microbiology, University of Chittagong, Chattogram, with collaboration of different government and private hospitals of Bangladesh. The study subjects were patients undergone any surgery and developed wound infection. Sample was selected by purposive sampling technique.

Data related to age, sex, type of illness, diagnosis, type and duration of surgery, antibiotic therapy, and type of specimens were collected in a pre-design data sheet from the laboratory records. The sites of infection categorized in three categories depending on the type of specimens. Skin and soft tissue infection included pus, wound swab and aural swab, blood stream infection included blood and CV catheter tip, and urinary tract infection included urine specimens. Each sample inoculated into nutrient agar medium and McConkey agar media. The plate cultures incubated for 24 h at 30-37°C and the growth was observed thoroughly. Identification of Gram negative pathogenic bacterial isolates were carried out by API 20E Enterobacteriaceae (BioMérieux Co.). API system has been recognized as a rapid test for bacterial identification. The strips was inoculated by single colony in the suspension media and incubated at 35-37 °C for 18-24 h. The results were recorded based on the special chart, three tests were given a code number, the obtained seven digit numbers expressed to the corresponding organisms regarding to the API index.

All the information recorded in the pre-structured Case Record Form (CRF). Quantitative data were analyzed by mean and standard deviation and qualitative data were analyzed by chi-square test and chi-square (with Yate's correction) test. P value equal or less than 0.05 was considered significant.

Results and Discussion

This study was conducted among 92 patients to find the pattern of microorganisms responsible for post-operative wound infections and their antibiotic susceptibility profile. In the present study the overall rate of SSI was 9.08% which was in concordance with the study conducted by Satyanarayana et al. (2011)[10], who reported the overall rate of SSI as 13.7%. Negi et al. (2015)[9] reported that prevalence of wound infection was 17.8%. Naz et al. (2019)[11] reported 20% patients were clinically diagnosed of having SSIs. Dessie et al. (2016)[12] reported that 107 (9.8%) patients developed surgical site infection.

Demographic profile revealed that maximum numbers of patients (48.9%) were between 31-45 years age group, next 29.3% were between the age group of 46-60 years. Mean age of the patient was 41.68±9.3 years. Out of 100 cases 65.2% of patients were male and 34.8% were female. Male – female ratio was 1.8:1. The result of the demographic profile is shown in Table 1.

The predominance of male patients was seen in study by Negi et al. (2015)[9] with male: female ratio of 2.9:1 and their finding were in contrast to the other studies where a much higher number of female patients were reported[7, 8]. 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.

Figure 1 shows the types of wound infection. On clinic-pathological assessment wound infection categorized into three types- superficial, deep incisional and organ-space SSIs - depending on the site and the extent of infection. Present study showed that 52(56.5%) patients developed superficial infection, 31(33.6%) patients had deep incisional surgical site infection and 9(9.7%) patients developed organ/space infection.

Table 1. Demographic profile of the subjects (n=92)

Variables	Frequency	Percentage (%)
Age (years)		
18-30	14	15.2
31-45	45	48.9
46-60	27	29.3
>60	6	6.5
Mean ± SD	41.68±9.309	
Gender		
Male	60	65.2
Female	32	34.8

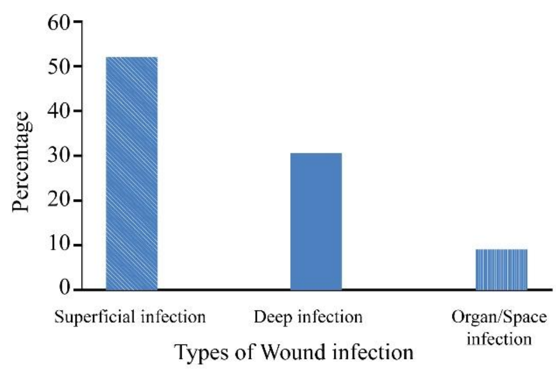

Figure 1. Types of wound infection according to extent of infection (n=92)

Table 2. Distribution of cases according to overall microbiological result (n=92)

Microbial results	Frequency	Percentage (%)	Total number of organisms
Culture positive	75	81.5	83
Monomicrobial growth	67	89.3	67
Polymicrobial growth	8	10.7	16
Culture negative	17	18.4	0

The result of the microbiological assay is shown in Table 2. In this study total of 92 pus specimens were collected. Among them 75(81.5%) specimen were found culture positive and remaining 17 (18.4%) had no bacterial growth. A total of 83 organisms were isolated from 75 culture positive cases. Sixty seven specimens yielded growth of single organism (monomicrobial growth) while 8 samples showed polymicrobial growth.

Dessie et al. (2016)[12] demonstrated that total of 107 pus specimens were collected and processed during the study period. A total of 104 organisms were isolated from 90 (84.1%) culture positive cases. Seventy-six specimens yielded growth of single organism while two isolates were present in rest of the fourteen cases. Naz et al. (2019)[11] reported that mono-microbial growth was seen in 98% samples while 2% samples showed poly-microbial growth. Among the 60 bacterial isolates, *S. aureus* (51.5%) and *Pseudomonas* sp. (20%) were the commonest organisms followed by *E. coli*. *Staphylococcus aureus*, gram positive cocci, is a major human pathogen and a predominant cause of SSIs worldwide with a prevalence rate ranging from 4.6% to 54.4%[13]. In the present study predominant organism was *S. aureus* 22(26.5%). This finding was consistent with reports earlier[7-9].

Table 3. Bacterial isolates obtained from patients with surgical site infection (n=83)

Bacterial isolate	Frequency	Percentage (%)
Gram positive		
S. aureus	22	26.5
Group B Streptococci	3	3.6
Gram negative		
E. coli	19	22.8
P. aeruginosa	12	14.4
K. pneumoniae	15	18.0
Acinetobacter species	7	8.4
Proteus species	5	6.0

Table 3 shows bacterial isolates obtained from patients with surgical site infection. Among the Gram positive isolates, *S. aureus* 22(26.5%) was predominant while *E. coli* 19(22.8%), *K. pneumoniae* 15(18.0%) and *Pseudomonas aeruginosa* 12(14.4%) were the most common isolates of the Gram negative rods. The other isolates were *Acinetobacter species* and *Proteus* species.

Dessie et al. (2016)[12]demonstrated that, among the Gram positive isolates, *S. aureus* 19 (18.3%) was predominant while *E. coli* (23.1%), *Acinetobacter* species (22.1%) and *K. pneumoniae* (9.6%) were the most common isolates of the Gram negative rods. The other isolates were *Pseudomonas*, *Proteus* species, *K. ozaenae, Citrobacter, coagulase* negative *Staphylococcus*, and group B *Streptococci*. Negi et al. (2015)[9] demonstrated that Gram negative isolates comprised of 49.6% of all the aerobic bacterial isolates. *E. coli* (46.4%) was the commonest gram-negative bacteria isolated followed by P. *aeruginosa* (15.9%) and *Citrobacter* species (15.9%). Similar observations have been reported by various other authors also[7,8]. Another study have reported *P.aeruginosa* as the most frequent isolate in SSI[14]. However some studies reported *E. coli* as the most frequent isolate in SSI[12] which remains a third most isolated strain in this study. Presence of enteric organisms could be attributed to the patient's normal endogenous microbial fecal flora[15]. *E. coli* invasion of the wound is a clear case of poor hospital hygiene.

Antibiotic susceptibility results revealed that a high degree of resistance was seen for majority of the bacterial isolates. For gram positive bacteria vancomycin, teicoplanin, linezolid and amikacin were found to be the most effective antibiotics. The degree of resistance was even higher among the gram negative bacteria and the commonly used drugs were found to be more resistant with an average resistance range from 50% to 100%. The rate of SSI observed in this study was comparable to other similar studies carried out in developing countries; however the bacterial isolates detected from our patients showed a high degree of resistance for commonly prescribed antimicrobials in our setup. Although the studies with bigger sample size are sought to make it statistically more relevant.

Conclusion

SSI causes substantial morbidity, mortality and increases economic burden. The frequency of surgical site infection was 9.08 % in this study. *S. aureus* (26.5%), *E. coli* (22.8%), *K. pneumonia* (18.0%) were the common isolated organism. Overzealous empirical used of antibiotics has to lead the emergence of antibiotic resistance. Immediate isolation and targeted antibiotic therapy will decrease the emergence of the resistant strains, morbidity, mortality and cost of the treatment. Development of surveillance, infection prevention, and antimicrobial stewardship programs are important to address excessive or inappropriate antimicrobial usage.

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