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Prevalence of Nosocomial Surgical Site Infections and Drug Resistance Pattern of Causative Bacteria

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Abstract: Post-operative nosocomial infection possesses a constant threat to the public health where proper hygienic procedures are not maintained appropriately and antibiotics resistance is growing rapidly. Sometimes it even endangers the patient's life undergone surgery. Treatment of nosocomial infection is becoming difficult all over the world due to increasing trend of antibiotic resistance. The present study aimed to evaluate the prevalence of post-operative nosocomial surgical site infection, identification of the causative organisms and their antibiotic resistance pattern. We have been investigated total 294 patients undergone surgery, among them 16 (5.44%) got nosocomial infection. We found *E. coli* (42.86%) is the major etiologic agents of post-operative surgical site nosocomial infection following other Coliform (14.29%), *P. aeruginosa* (14.29%), *S. aureus* (14.29%), *S. pyogenes* (7.14%) and *Klebsiella sp*. (7.14%). All the pathogens were found to be resistant to more than one antibiotics though amikacin and imipenem showed best activity against the major nosocomial infection causing bacteria *E. coli.*

Keywords: Nosocomial infection, Antibiotic resistance, Surgical-site infection.

INTRODUCTION

Nosocomial or hospital-acquired infections are defined as infections which are acquired during the hospital stay that are identified at least 48–72 hours following admission to health institutions. They cause morbidity and mortality, functional disability, emotional suffering and economic burden among the hospitalized patients.

Postoperative wound infection can occur from first day onwards to many years after an operation but commonly occurs between the fifth and tenth days after surgery. It can be characterized by various combinations of the signs of infection (e.g. pain, tenderness, warmth, erythema, swelling, drainage etc.). The site of infection may be limited to the suture line or may become extensive in the operative site and the infecting microorganisms are variable, depending on the type and location of surgery, and antimicrobials received by the patient. Surgical site infections (SSIs) which account 17% of all health care-associated infections are the second most common hospital acquired infections next to urinary tract infections. They occur after approximately 3% of all operations and result in greater lengths of stay and additional costs [1].

The emergence of poly antimicrobial resistant strains of hospital pathogens has also presented a challenge in the provision of good quality inpatient care. The battle between bacteria and their susceptibility to drugs is yet problematic among public, researchers, clinicians and drug companies who are looking for effective drugs. In addition to this, postoperative wound infection by resistant bacteria worsens the condition and it has become serious problem in developing countries owing to poor infection prevention program, crowding hospital environment and irrational prescription of antimicrobial agents [2]. Treatment of post-operative wound infection with antibiotics is becoming a challenge for surgeons as multidrug resistance is reported to be high. It is therefore important to have knowledge regarding the prevalent microorganism in the surgical units and their susceptibility patterns to antibiotics so that proper treatment can be started earlier. It is also essential to take appropriate steps to curtail the spread of infection within the unit [3]. Considering those facts, we conducted a cross sectional study to determine the prevalence of hospital acquired or nosocomial surgical site infections and to determine antimicrobial resistant pattern of causing bacteria.

METHODS AND MATERIALS

Patient Criteria

A cross-sectional study was carried out between April 2014 and June 2014 at a renowned Hospital in Bangladesh. A total 294 patients undergone surgery at that time were enrolled in this study. A standardized questionnaire was used to obtain data from the patients.

Specimen Collection and Processing

Pus swabs were aseptically obtained using sterile cotton wool swabs from surgical sites before the wound was cleaned by antiseptic solution. The swab specimens were transported to the Microbiology Laboratory within 1-2 hours of collection.

The specimens were inoculated on nutrient agar, Mac-Conkey agar, Mannitol salt agar, Blood agar and Chocolate agar. Plates were thereafter incubated at 37°C for 24-48 hours. Primary cultures were sub cultured following the standard procedures.

Identification of bacterial pathogens

Pure cultures on secondary plates were characterized using physical appearances on selective and differential media. The organisms are then finally identified on the basis of their morphological characteristics including size and shape of the organism, arrangement of the cells, presence or absence of the spores, regular or irregular forms, acid fastness, gram reaction etc.; cultural and physiological characteristics including H_2S production, nitrate reduction, deep glucose agar test, fermentation of different carbohydrates etc. All these characteristics were then compared with the standard description of ‘‘Bergey’s Manual of Determinative Bacteriology’’, 8th edition [18].

Antibiotic susceptibility testing

Antibiotics susceptibility test was performed by Kirby-Bauer disk diffusion method [19]. Bacterial suspensions were prepared from fresh culture grown overnight onto nutrient agar plates by using sterile normal saline and the turbidity of the suspension was adjusted to 0.5 McFarland Standard that corresponds to approximately $1x10^8$ CFU/mL of suspension. A sterile cotton swab was dipped into the inoculum then streaked on the Mueller-Hinton agar plate properly. Then antibiotic disks impregnated with selected antibiotic discs for each isolate were dispensed onto the dried agar surface using a sterile forceps. The plates were incubated overnight at 37°C. After incubation period, the resulted zone of inhibition was compared with that of CLSI guideline [20] for the interpretation of the data and categorization of the test strains as intermediate, sensitive, or resistant. The use antibiotic discs were penicillin (10 IU), ampicillin (10 μg), erythromycin (5 μg), ceftazidime (30 μg), ciprofloxacin (5 μg), cotrimoxazole (25 μg), gentamycin (10 μg), amikacin (30 μg), imipenem (10 μg), nitrofurantoin (30 μg), nalidixic acid (30 μg), clindamycin (2 μg), oxacillin (1 μg), cefoxitin (10 μg), cephalothin (30 μg), amoxycillin-clavulanic acid (10 µg), ceftriaxone (30µg), cefotaxime (30µg), meropenem (10 µg), doxycycline (30µg) and nitrofurantoin (300µg).

RESULTS AND DISCUSSION

We have been investigated total 294 patients in surgery wards of the hospital. We got 16 patients (5.44%) infected in surgical site after 2-5 days of surgery. Among them 5 (31%) patients were male and 11 (69%) patients were female of different ages.

Table-1: Prevalence of bacterial isolates in hospital acquired post-operative surgical site infection

Causative Bacteria	Frequency	Percentage (%)
E. coli	6	42.86
other Coliform	2	14.29
Klebsiella sp.	1	7.14
Pseudomonas aeruginosa	2	14.29
Staphylococcus aureus	2	14.29
Streptococcus pyogenes	1	7.14
Total	**14**	**100**

From two (2) samples we didn’t find any growth on the different selective media. *E. coli* was most predominant (42.86%) in cases followed by *P.* aeruginosa (14.26%) and *S. aureus* (14.26%), *Klebsiella* sp. (7.14%) and *S. pyogenes* (7.14%). We also found coliform bacteria in 14.29% cases. All bacterial cultures were subjected to antibiotic susceptibility testing according to Kirby-Bauer disc diffusion method.

Nosocomial infections are concerned public health threat, because of their high frequency, morbidity, mortality and cost [4]. Many of these infections are associated with microorganisms that are resistant to antibiotics and can easily spread by hospital personnel [5].

In this study, the incidence rate of nosocomial infection was 5.88%. We found that in most countries 5-10% of patients in hospitals at any time have acquired an infection. The National Prevalence Survey in the U.K. and Ireland showed a prevalence of hospital-acquired infection of 9% (range: 2-29 %) [5]. We found that in a study of the WHO with 28861 patients (47 hospitals in 14 countries), the overall percentage of nosocomial infection was 8.4% (range 3-21%), with surgical site infections in 0.3 to 3.1%, urinary tract infection in 0.3 to 4.7 %, respiratory tract infection in 1.1 to 4.1 % and others [5], and with a prevalence of nosocomial infection in different wards from 6 to 43%

due to different patient populations, invasive procedures and severity of underlying diseases [6].

Table-2: Antibiotic resistance pattern of the isolated pathogens

Antibiotics	**Resistance of bacterial pathogens**					
	E. coli N(%)	Coliform N(%)	*Klebsiella* sp. N(%)	*P. aeruginosa* N(%)	*S. auerus* N(%)	*S. pyogenes* N(%)
Amoxicillin+Clavulanic acid	5(83)	2(100)	1(100)	2(100)	1(50)	-
Amikacin	1(17)	0(0)	0(00)	1(50)	1(50)	-
Azithromycin	3(50)	2(100)	1(100)	0(00)	0(00)	0(00)
Cefixime	-	-	-	-	-	0(00)
Cephalexin	-	-	-	-	-	1(100)
Ceftriaxone	2(33)	2(100)	-	0(00)	2(100)	0(00)
Cefuroxime	-	-	-		2(100)	0(00)
Ceftazidime	4(67)	-	1(100)	1(50)	1(50)	
Cephradine	-	-	-	-	1(50)	0(00)
Ciprofloxacin	3(50)	1(50)	-	0(00)	0(00)	0(00)
Cefotaxime	5(83)	1(50)	1(100)	1(50)	-	-
Cotrimoxazole	4(67)	0(00)	1(100)	0(00)	0(00)	-
Doxycycline	3(50)	-	-	1(50)	-	-
Erythromycin	-	-	-	-	-	1(100)
Gentamicin	3(50)	1(50)	0(00)	1(50)		
Imipenem	0(00)	-	-	1(50)	2(100)	0(00)
Levofloxacin	-	-	1(100)	-	-	-
Nalidixic Acid	-	-	-	-	-	-
Netilimicin	-	1(50)	-	-	-	-
Nitrofurantoin	-	-	-	-	-	-
Metronidazole	3(50)	-	-	-	-	-
Merupenem	3(50)	1(50)	1(100)	1(50)	-	0(00)
Pefloxacin	-	-	-	-	-	0(00)

Note: - denotes this antibiotic was not applied to the respective pathogen.

Postoperative surgical site wound infection is one of the most common forms of nosocomial infections that can complicate the surgical procedures [7]. Surveillance for post-operative surgical site wound infection (PWI) is an essential part in control and prevention of PWIs. Bacterial culture of infected wounds revealed *E. coli*, *P. aeruginosa* and *S. aureus*, *S. pyogenes, Klebsiella* sp and coliform as the common pathogens. These results are similar to other studies carried out in Iran and Nepal that have reported similar organisms associated with PWI [8, 9].

Few of previous studies showed a higher proportion of Gram positive organisms, especially *S. aureus*, associated with PWI [10]. In our present study and some other recent studies, predominance of Gram negative organisms in PWI is reported [10]. This difference in the pattern of distribution of pathogens in different setups can be explained by the fact that distribution of pathogens involved in infection process is usually dependent on the study population and local antimicrobial use pattern which results in the emergence of pathogens that have the potential to resist currently used antibiotics [11]. Another reason for the predominance of Gram negative organisms may be the fact that most of the infected patients in our study had undergone abdominal surgery and gram negatives are predominantly reported to be involved in intra-abdominal procedures [12]. *E. coli* (42.86%) *was* the commonest gram negative bacteria isolated. *E. coli* invasion of the wound is a clear case of poor hospital hygiene, just like other implicated organisms which are frequent agents of nosocomial infections [13].

In our study antibiotic susceptibility data revealed that *E. coli* was highly resistant to amoxycillin+clavulanic acid and cefotaxime (83%) and highly sensitive to ceftriaxone (33%). *S. aureus* was highly (100%) resistant to ceftriaxone, cefuroxime and imipenem. *P. aeruginosa* was highly (100%) resistant to amoxycillin+clavulanic acid. *S. pyogenes* was highly resistant to cephalexin and erythromycin (100%). This increased resistance against these antibiotics might be the result of increased use of these antibiotics as these antibiotics are extensively used in the selected wards for prophylaxis as well as postoperatively to prevent infections and as empirical treatment for infected cases. Literature suggests that antibiotic use is proportional to antibiotic resistance [14]. A study conducted in Kenya had reported that gentamicin was effective against most of the isolates of *E. coli*, *Pseudomonas aeruginosa* and *Proteus vulgaris* [15].

A study conducted in Nepal in 2003 reported that 47.2% of the bacterial isolates were multidrug

resistant. This situation raises a serious concern suggesting a very high resistance gene pool due perhaps to gross misuse, overuse and inappropriate use of the antibacterial agents [16, 17].

CONCLUSION

Gram negative microorganisms (especially *E. coli*) were commonly involved in hospital acquired post-operative surgical site infection. The antibiotic amikacin and imipenem were shown as best active against *E. coli*. Patients with nosocomial infections need to be prescribed antibiotics based on empirical data gathered from antimicrobial susceptibility testing. To reduce the incidence of nosocomial infections, ensuring appropriate hygiene of the hospitals and patients, the correct use of antibiotics following the standard protocol should be ensured.

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