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Original Article

Spectrum of Aerobic Microorganisms seen in Postoperative Wound Infections at Pakistan Institute of Medical Sciences (PIMS) Islamabad

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Abstract

Background: Postoperative wound infection continues to be a major complication for patients undergoing operative procedures, and remains a cause of concern for surgeons.

Objective: The aim of this study was to determine spectrum of microorganisms in postoperative wound infections in general surgical wards at Pakistan Institute of Medical Sciences, Islamabad.

Methodology: This prospective observational study was conducted by the Surgical Unit III, PIMS, Islamabad, from July 2012 to June 2014. Data of the patients developing postoperative wound infection of various types were collected and analyzed. Data included clinical features, primary diagnosis, and type of surgery performed, timing when evidence of wound infection was observed, the causative microorganism, and their antibiotic sensitivity pattern.

Results: During the study period, 1621 patients were admitted to the surgical ward; out of which 1375 underwent surgery. Among them, 136 patients developed wound infections, giving an overall wound infection rate of 9.9%. In these patients, 129 pathogens were isolated from 121 positive culture samples. In 15 (11.0%) cases, no organism was grown. Majority of the wounds were infected with a single microbial organism (113, 93.4%); while 8 samples (6.6 %) were infected with 2 different types of microbes. The most frequently isolated pathogen was E. Coli (grown in 43 cases, 33.3%); followed by MRSA (20.2%). The antibiotic sensitivity of various bacteria was studied, and it showed change in the sensitivity pattern of E. Coli.

Conclusion: The *E. coli* is dominating organism in postoperative wound infection in general surgical wards at our hospital. It is showing a change in susceptibility pattern. The problem of emerging drug resistance among bacteria can be minimized by adopting strict aseptic surgical procedures, judicial use of antibiotics, and proper wound care.

Limitation of the study: Anarobic cultures were not performed

Keywords: Postoperative wound infection, microbial sensitivity, surgical site infection.

Introduction

Patients undergoing various surgical procedures are at risk of acquiring infections at the site of incision. These infections are a common problem, not only in our set up, but also all over the world. Surgical wound infections account for 14% to 17% of all hospital-acquired infections; and about 38% of nosocomial infections in surgical patients.[1] They have serious consequences for outcomes

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and costs, especially in countries with limited financial resources, because they can significantly increase morbidity, including hospital stay, thus making patients further susceptible to infection from within the hospital. Therefore such infections are a serious, yet mostly preventable threat to surgical patients. Besides increasing morbidity, they can be a contributing factor to mortality.

Accurate prevalence of postoperative wound infections is difficult to ascertain because although surgical site infection is a relatively serious problem in our region, there are scanty reports in local literature on the pathogens that are involved in such infections. Secondly, most of these studies are mainly from the microbiology laboratory records which may not show the complete clinical picture. Another important issue is that wound infections often manifest after patients are discharged and are missed by hospital-based surveillance.[2] Although these cannot be completely eradicated, taking prompt control measures against the most commonly isolated organism and improving wound care, may lead to the minimum of wound infection.[3] Therefore, emphasis should be put on their prevention. A high bacterial load in the postoperative surgical wound is a major risk factor for the development of postoperative infections.[4]

The rate of surgical wound infections is, therefore, strongly influenced by operating theatre quality.[1] For their prevention, there is a need to adopt basic principles of asepsis and sterilization, and to make judicious use of prophylactic and therapeutic antibiotics,[5] as misuse of antibiotics leads to increased bacterial resistance and their dissemination.[6]

The aim of this study was to determine spectrum of microorganisms in postoperative wound infections in general surgical wards at Pakistan Institute of Medical Sciences, Islamabad; and to study sensitivity of the isolates so that recommendations can be made for their prevention and empirical antibiotic treatment.

Methodology

The prospective observational study was conducted at Pakistan Institute of Medical Sciences, General Surgical Wards from July 2012 to June 2014.

Inclusion criteria: All adult patients admitted / operated in general surgical ward for various indications over study period, that later developed wound infections.

Exclusion criteria: Cases that had undergone any surgical procedure in the previous one month were excluded from this study.

Data collection procedure: Data of the patients developing postoperative wound infection of various types were collected. Information was obtained about age and gender of patients, type of surgical procedure, and antibiotics used. Although pus culture was part of the routine protocol for wound infections, informed written consent was obtained from all patients for inclusion in the study; and approval from Hospital Ethical Committee was also acquired. The results obtained were used in the improved management of the patients.

Antibiotic prophylaxis was administered according to the institutional policy. We used first/second generation antibiotics administered 30 minutes before induction of anaesthesia, through intravenous route. Operations were performed with strict aseptic techniques. The surgical sites were examined on the 2nd post-operative day and then daily for pain, redness, warmth, swelling, and purulent drainage at the incision site; until the patients were discharged. Post-discharge examination of the surgical site was performed for all patients in the outpatient clinic for any evidence of wound infection, on weekly basis; the surveillance was continued for up to 30 days after surgery.

Culture identification and sensitivity testing: Standard operating procedures for pus sample collection, transport, culture and susceptibility testing for isolated organisms were followed to ensure procedural quality. Pus specimens were collected using sterile pus culture cotton swabs placed in sterilized containers; with aseptic techniques to avoid contamination from skin. Samples were submitted to the laboratory for processing. The samples were plated on MacConkey agar using calibrated wire loops, and were then incubated in aerobic atmosphere at 37°C for 24 hours.

Bacterial identification was done by colony morphology analysis, Gram stain, and routine biochemical tests. Susceptibility testing was done using the disk diffusion technique.

All information was entered to a specific proforma.

Data analysis: The data collected was entered and analyzed using SPSS version 16.0. Descriptive statistics was used to show simple frequencies and means.

Limitation of the study: Anarobic cultures were not performed.

Results

During the study period, 1621 patients were admitted to the surgical ward under surgical unit-III. Out of them 1375 were operated for various procedures (elective and emergency), including 734 males (53.4%) and 641 females (46.6%). Among these cases, 136 patients developed wound infections, giving an overall wound infection rate of 9.9% (including emergency and elective cases).

Out of these 136 patients, 129 pathogens were isolated from 121 positive culture samples. In 15 (11.0%) cases, no organism was grown. Majority of the wounds were infected with a single microbial organism (113, 93.4%); while 8 samples (6.6 %) were infected with 2 different types of microbes. The most frequently isolated pathogen was E. coli, grown in 43 cases (33.3%); followed by MRSA (20.2%). Other organisms included Klebsiella species, Acinetobacter spp. Pseudomonas species, Proteus species and Streptococci. Their relative frequencies are given in the figure-1.

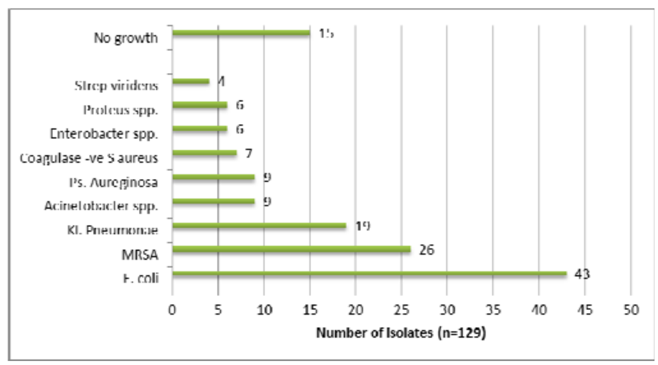

Figure-1: The microorganisms grown from pus samples

Table I: Relative antibiotic sensitivity of various bacterial strains (in percent)

Antibiotics / Bacteria	Ami	AmC	CefS	Ceft	Cftz	Imi	Lev	Cip	Tob	Cot	BP	Ery	Van	Lin	Cli	G	Chl
E. coli	74	35	60	25	23	86	32	34	29	18	-	-	-	-	-	-	-
Pseudomonas	62	-	60	20	50	62	50	45	60	-	-	-	-	-	-	-	-
Acinatobacter	12	-	10	01	02	06	02	03	44	-	-	-	-	-	-	-	-
Enterococci	-	38	-	-	-	-	14	12	-	03	-	-	90	-	-	-	50
MSSA	-	-	-	-	-	-	74	71	-	48	02	64	99	100	80	82	90
MRSA	-	-	-	-	-	-	10	09	-	24	03	11	99	100	42	13	35

Legend:
MSSA= Methicillin sensitive Staphylococcus aureus **MRSA**= Methicillin resistent Staphylococcus aureus
Ami=Amikacin **AmC**=Amoxicillin+Clavulanic acid **CefS**=Cefoperazone+Salbactum **Ceft**=Ceftriaxone
Cftz=Ceftazidim **Imi**=Imipenem **Lev**=Levofloxacin **Cip**=Ciprofloxacin **Tob**=Tobramycin **Cot**=Co-tramaxazole
BP=Benzyl Penicillin **Ery**=Erythromycin **Van**=Vancomycin **Lin**=Linezolid **Cli**=Clindamycin **G**=Gentamycin
Chl=Chloramphenicol

(Source: PIMS lab data year 2013, personal communication)

The antibiogram for various frequently isolated bacteria was studied. It showed variable degree of sensitivity of bacteria to the commonly used antibiotics (table-I). Sensitivity of E. Coli to amikacin, imipenem and cefoperazone+salbactum was more than 60%, while it was less than 30% for Amoxicillin+clavulinate, ceftriaxone, ceftazine, levofloxacin, tobramycin and levofloxacin. On the other hand, MRSA showed 100% sensitivity for vancomycin and linezolids. However, the sensitivity of MRSA for benzyl penicillin, levofloxacin, ciprofloxacin, gentamycin and erythromycin was less than 10%. Sensitivity of acinatobacter for tobramycin was around 44% while for most of the other antibiotics it was less than 10%.

Discussion

The incidence of postoperative wound infections and the spectrum of pathogens infecting such wounds vary with regions, and within the same region in different hospitals. It may even show seasonal variations. This in fact depends on a number of factors including locality of the hospital, the predominant catering populations, relative workload of emergency versus elective cases, institutional policies regarding antibiotic selection, and presence or effectiveness of infection control strategies. The incidence of contracting wound infection goes on increasing as the age of the patient increases, owing to weakened immune system response, reduced metabolism rate and other aging factors. The wound infection rate in our study was 9.9% (including both elective and emergency cases). The figures for wound infection rate quoted in the international literature for incidence of these infections are much lower and vary from 4.4%[7] - 5.2%;[8] while a Brazilian study reported an incidence of just 1.8%.[9] On the other hand, local literature reflects somewhat higher incidence, e.g. 6.5% from Peshawer,[10] and 11.4% from a general hospital in Karachi catering poor strata of the society.[11] Our results come to lay in between the two; and are similar to the figure of 9.3% reported from Nawabshah.[12]

With the exception of clean operative procedures, surgical wound infections are recognized as having a polymicrobial etiology, involving both aerobic and anaerobic microorganisms. Rapidly emerging nosocomial pathogens and the problem of multi-drug resistance necessitates periodic review of isolation patterns and sensitivity in surgical practice.[13] Regular evaluation of antibiotic sensitivity profile is helpful to make guidelines for dealing with the wound infections at the outset and for which antibiotic to start with.[14]

We observed that the most common pathogen involved in postoperative wound infections was *E. coli* (33.3%); followed by *MRSA* (20.2%); *Klebsiella species* (14.7%); *Pseudomonas aeruginosa* and *Acinetobacter spp* (each 6.9%); *Coagulase negative Staphylococcus* (5.4%); *Enterobacter spp.* and *Proteus spp.* (each 4.7%); and *Strep. Viridens* (3.1%). The frequency of Gram positive pathogens was 28.7% (37 out of 129) and that of Gram negative pathogens was 71.3% (92 out of 129). The two most frequently reported organisms causing surgical site infections are *Staph. aureus* and *Eschrechia coli*. Majority of the studies from local[3,5,12,15,] and international literature[16-19] have indicated that *Staph. aureus* was the most common bacteria cultured from infected wounds. The slight variations in frequency of positive cultures are due different settings, study population and use of antibiotic drugs. The prevalence of *Staph aureus* was reported to be significantly higher in specimens from ICU patients;[20] indicating the inherent tendency of these strains to become endemic in the critical care units as well as their propensity for nosocomial spread. In the past decade, new methicillin-resistant *Staphylococcus aureus* (*MRSA*) strains have emerged as a predominant cause of community-associated skin and soft-tissue infections.[21] On the other hand, only few reports have shown dominance of *E. coli* in wound cultures as observed in the current study.[13,15,17,22] The predominance of E. coli in surgical site infections has been previously reported as well in a study published by the authors.[23] Other bacteria like *Pseudomonas aeruginosa*[3,15] *Klebsiella spp*.[13,15] *Streptococcal pnaemoniae*[22] and *Proteus spp*.[15] have also been isolated from cultures of postoperative wounds; however, these organisms used to be third or fourth in the lists.

Our results revealed that most strains of *E. cloi* were sensitive to amikacin, imipenem, and cefoperazone+salbactum; but sensitivity to other third generation cephalosporins and quinolones was quite low. Previously, this bacteria has shown 100% sensitivity to penicillin derivatives and carbapenem;[13] sulbactam potentiated sulfoperazone, and meropenam;[24] quinolones and 3rd generation cephalosporins.[22] These results indicate a change in the sensitivity pattern of *E. coli.*

This study shows sensitivity of *MRSA* to vancomycin, linezolid, and clindamycin. *Staphylococcus aureus* isolates have shown 76% sensitivity against gentamicin in a study;[25] while in another study 65% strains of *staph aureus* were sensitive to ofloxacin.[26] Although the infecting strains of MRSA have been demonstrated to be susceptible to recommended non-β-lactam oral agents,[21] it shows multi-drug resistance, and infections caused by these isolates are difficult to treat. However, Ahmad SS et al from Karachi have observed that vancomycin, fusidic acid, chloramphenicol and fosfomycin can be considered as good choices.[27] Khurram M et al from Rawalpindi have also reported that all strains of MRSA were sensitive to vancomycin and linezolid.[24]

More than 60% of *Pseudomonas auregenosa* were sensitive to amikacin, quinolones and third generation cephalosporins. This bacteria shows sensitivity to gentamycin,[25] imepenam, and sparfloxacin in more than 70% cases.[24] The sensitivity of *Acinetobacter* was 44% for tobramycin, but it was poor for most of the other antibiotics. *Acinetobacter* species are becoming difficult to treat day by day due to increasing number of resistant isolates,[28] especially the 'multi-drug resistant' *Acinetobacter spp*.[29]

The problem in wound infection management is due to the growing spread of resistant microorganisms, including both Gram-negative and Gram-positive pathogens.[30] *E. coli* resistance against most of the commonly used antibiotics has been observed to be on the rise.[31] One of the major risk factors for emerging strains of drug-resistant *E. coli* and other species is previous exposure to antimicrobials.[32] These drug resistant infections can be minimized to some extent by judicial use of antibiotics and adherence to strict infection control strategies.[28] The type of surgical antimicrobial prophylaxis is determined by the spectrum and pattern of antimicrobial resistance of pathogens causing surgical site infections.[17] Due to high drug resistance among common pathogens, antibiotic use policy should strictly follow WHO guidelines and their unnecessary use should be discouraged.[33]

This is a small study from single general surgical unit. There is a need that regular evaluation of antibiotic sensitivity patterns should be conducted at the institutional or higher level in order to devise an empiric drug therapy. The lack of anaerobic culture system was an additional limitation.

Conclusion

The *E. coli* is dominating organism in postoperative wound infection in general surgical wards at our hospital. It is showing a change in susceptibility pattern. Other pathogens grown from infected wounds include *Staph aureus, Kl pneumoniae, Pseudomonas spp*. Though it is not possible to eradicate the surgical wound infections completely, but by taking proper preventive measures and adopting strict aseptic surgical procedures, judicial use of antibiotics, and proper wound care, this problem can be minimized. Otherwise these infections will go on increasing, with consequent rise in wound-related morbidity and mortality.

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