Original Research Article

Study of Bacteriological Profile of Post Operative Wound Infection in A Tertiary Care Hospital in North India

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Abstract

Surgical site infections (SSIs) are known to be one of the most common worldwide causes of nosocomial infections account for nearly 20% to 25% of all healthcare associated infections. Aims and objectives to isolate the different organisms from post-operative wound infections, to determine the antibiotic sensitivity pattern of these isolates and to determine the rate of SSI. The post-operative specimen received in Department of Microbiology from the various surgical wards of our hospital and were processed according to standard bacteriological techniques. Antibiotic susceptibility testing was performed by Kirby-Bauer disk diffusion technique. All the staphylococcal isolates were subjected to determination of methicillin resistance by cefoxitin disc diffusion method. Antimicrobial susceptibility testing was carried out for all 278 isolates and the results are depicted *Staphylococcus aureus* strains showed a high degree of resistance for ampicillin (85.7%). Methicillin resistance was seen in 15.7% of all the *S.aureus* isolates. Gram negative isolates showed even higher rate of resistance and commonly prescribed agents like gentamicin, cotrimoxazole and ciprofloxacin were found resistant for most of the gram negative isolates. Meropenem showed good activity against most of the gram negative isolates, including for *P. aeruginosa* and *Acenetobacter spp*, strains which showed high resistance for meropenem also. The present microbiological study has determined the commonest bacteria responsible for the post-operative wound infectons. There was predominance of commonly isolated bacterial species were *S. aureus, E. coli* , *P. aeruginosa* and. To establish the most suitable empirical treatment for each patient, it is very important to know the microbial epidemiology of each institution. Using the results of this study, an initiative for establishing improved hospital antimicrobial policy and antimicrobial prescribing guidelines should be undertaken.

Keywords: Surgical site infection, Antibiotic susceptibility, Multi drug resistant strains, Methicillin resistance *S.aureus* (MRSA).

Introduction

Surgical site infections (SSIs) are known to be one of the most common causes of nosocomial infections worldwide and account for nearly 20% to 25% of all nosocomial infections[1]. The rates of Surgical site infection are reported as range from 2.5% to 41.9% globally resulting in increasing the treatment cost, length of hospital stay and significant morbidity and mortality[2,3]. The situation is more severe in developing countries where resources are scarce and staffs are always in short supply[4]. Surgical site infections (SSI) are the third most commonly reported nosocomial infection and they account for approximately a quarter of all nosocomial infections[5]. These 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[6].

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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]. Despite of the technical advances in infection control and surgical practices, SSI still continue to be a major problem, even in hospitals with most modern facilities[9]. 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[9]. 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[10].

Bacteriological studies have shown that SSIs are universal and the etiological agents involved may vary with geographical location, between various procedures, between surgeons, from hospital to or even in different wards of the same hospital[9]. Irrational use of broad spectrum antibiotics and resulting anti microbial resistance (AMR) has 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. As the control of postoperative complications is an essential component of total quality management, it becomes important to determine the prevalence of surgical site infections, assess the magnitude of the problem and provide a rationale to set priorities in infection control in the hospitals. Hence the present study had been undertaken with the aims and objectives to isolate the different organisms from post-operative wound infections, to determine the antibiotic sensitivity pattern of these isolates and to determine the rate of SSI.

Material and Methods

This study was conducted in the Department of Microbiology, Patna Medical College, Patna and VIMS, Pawapuri, Nalanda from April 2020 to a March 2021. The post-operative specimen (surgical wound pus, serous or seropurulent discharge , wound swab etc.) received in Department of Microbiology from the various surgical wards including general surgery, orthopedic, obstetrics and gynecology, ophthalmology, otorhinolaryngology of our hospital were inoculated and streaked onto nutrient agar, blood agar and MacConkey agar (Hi-Media, India). Plates were incubated aerobically at 37°C for 24 hours[11]. Isolated organisms were processed and identified according to standard bacteriological techniques[12]. Antibiotic susceptibility testing was performed by Kirby-Bauer disk diffusion technique[13]. The drugs used were as per the CLSI 2018 guidelines[14]. All the staphylococcal isolates were subjected to determination of methicillin resistance by cefoxitin disc diffusion method.

Inclusion criteria: Clinically suspected cases of postoperative wound infections from Patients of both sex, age > 14 years, and who developed signs/symptoms of postoperative wound infections and signs of sepsis present concurrently (warmth, erythema, induration, tenderness, pain, raised local temperature) were included.

Exclusion criteria*:* All the wound infections other than postoperative wounds were excluded from the study.

Results

A total of 551 pus specimens were received from 1151 post operative patients with suspected postoperative SSIs in the Microbiology laboratory, 264 (22.93%) cases were culture positive. Monomicrobial growth was seen in 250 samples while 14 samples showed polymicrobial growth. The peak incidence of SSI was observed in age group > 50 years (51.8%). [Table/Fig-1] shows the age wise distribution of various morphotypes in SSIs. Males 197 (74.6%) were more commonly affected than females 67(25.37%) and the sex ratio male: female was 2.9.

Table 1: Age wise distribution of various morphotypes in surgical site infections

Age (years)	Morphotypes			Total
	Monomicrobial	Polymicrobial	Sterile	
14 – 20	10	2	24	36
21 – 30	16	0	25	41
31 – 40	38	0	46	84
41 – 50	50	6	63	119
>50	136	6	142	271
Total	250	14	10	551

Among the 278 bacterial isolates, *S. aureus* (50.4%) and *E. coli* (23.02%) were the commonest organisms. [Table/Fig-2] depicts the characterization of various bacterial isolates obtained from patients with SSIs. Antimicrobial susceptibility testing was carried out for all 278 isolates and the results are depicted in [Table/Fig-3]. *Staphylococcus aureus* strains showed a high degree of resistance for ampicillin (85.7%). Methicillin resistance was seen in 15.7% of all the *S.aureus* isolates. Gram negative isolates showed even higher rate of resistance and commonly prescribed agents like gentamicin, cotrimoxazole and ciprofloxacin were found resistant for most of the gram negative isolates. Meropenem showed good activity against most of the gram negative isolates, including for *P. aeruginosa* and *Acenetobacter spp,* strains which showed high resistance for meropenem (72.7%) also.

Table 2: Characterization of various bacterial isolates obtained from surgical site infections

Organism	No. of isolates (%) (n=278)
Staphylococcus aureus MSSA MRSA	140 (50.35) 114 (81.4) 26(18.57)
Escherichia coli	64 (23)
Pseudomonas aeruginosa	22 (7.9)
Citrobacter species Citrobacter freundii Citrobacter koseri	22 (7.9) 14 (63.6) 8 (36.4)
Acinetobacter species Acinetobacter baumannii Acinetobacter lowfii	14(5.0) 10 (71.4) 4 (28.6)
Klebsiella species Klebsiella pneumoniae Klebsiella oxytoca	8(2.9) 2 (25) 6 (75)
Proteus species Proteus mirabilis Proteus vulgaris	8 (2.9) 4 (50) 24(50)

MSSA: Methicillin sensitive *Staphylococcus aureus*;
MRSA: Methicillin resistant *Staphylococcus aureus*

Table 3: Antibiotic sensitivity pattern of aerobic bacterial isolates in surgical site infections (N=278)

Antibiotics	Isolates (microorganism)						
	S. aureus (n=140)	E. coli (n=64)	P. aeruginosa (n=22)	Citobacter spp.(n=22)	Acinetobacter spp. (n=14)	Klebsiella spp.(n=8)	Proteus spp. (n=8)
AMP	85.7	81.3	100	100	85.7	100	100
AMC	34.3	81.3	81.8	100	71.4	100	75
GEN	17.1	46.9	81.8	45.5	57.1	25	50
AK	8.6	15.6	45.5	18.1	14.3	0	25
AZT	NT	81.3	72.7	100	71.4	100	75
CFP	NT	81.3	NT	100	71.4	100	75
CFT	NT	NT	72.7	NT	NT	NT	NT
CTR	22.9	43.8	81.8	36.4	28.6	50	50
CFX	15.7	NT	NT	NT	NT	NT	NT
CIP	32.9	40.6	90.9	27.3	28.6	25	50
LNZ	0	NT	NT	NT	NT	NT	NT
MRP	NT	12.5	25.9	9.1	0	0	0
PIP	NT	NT	45.5	NT	NT	NT	NT
PTZ	NT	12.5	18.1	9.1	14.3	25	0
TEC	0	NT	NT	NT	NT	NT	NT
VAN	0	NT	NT	NT	NT	NT	NT

AMP: ampicillin; AMC: amoxicillin-clavulanate; GEN: gentamicin ; AK: amikacin; AZT: aztreonam; CFP: cefotaxime; CFT: ceftazidime; CTR: cotrimoxazole; CFX: cefoxitin; CIP: ciprofloxacin; LNZ: linezolid; MRP: meropenem; PIP: piperacillin; PTZ: piperacillin-tazobactam; TEC: teicoplanin; VAN: vancomycin; NT: not tested.

Discussion

Inspite of the advances in surgical techniques and better understanding of the pathogenesis of wound infection, the management of SSIs remains a significant concern for surgeons and physicians in a health care facility. Patients with SSIs face additional exposure to microbial populations present in a hospital environment which is always charged with microbial pathogens. The unrestrained and rapidly spreading resistance to the available antimicrobials further contributes to the existing problem SSIs are mostly hospital acquired and vary from hospital to hospital. In the present study the overall rate of SSI was 22.93% which was in concordance with study of Malik and Gupta et al[15] who has been reported to be 2.5% to 41.9% . The study conducted by Satyanarayana et al who reported the overall rate of SSI as 13.7% in their study this may be due to vary from hospital to hospital . Various other studies from India have shown the rate of SSI to vary from 6.1% to 38.7%.[16-18]. However in comparison to the Indian hospitals the rate of infection reported from other countries is quite low, for instance in USA it is 2.8% and in European countries it is reported to be 2-5%. The lack of attention towards the infection control measures, inappropriate hand hygiene practices and overcrowded hospitals can be the major contributory factors for high infection rate in Indian hospitals.The predominance of male patients was seen in this study with male: female ratio of 2.9and this finding was in contrast to the other studies where a much higher number of female patients have been reported[7,8]. The patients with age >50 years had a higher incidence of SSI (49.18%) in comparison to an incidence of 13.97% among the patients who were ≤30 years of age. The advancing age is an important factor for the development of SSIs, as in old age patients there is low immunity, low healing rate, increased catabolic processes and presence of co-morbid illness like diabetes, hypertension, etc[18] Regarding the duration of the operation a prolonged surgery was found to be a significant risk factor for SSI and it was observed that as the order and the duration of surgery increased, the rate of infection also increased. *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% . In this study predominance of *S. aureus* (50.4%) was seen and this finding was consistent with reports from other studies.As *S. aureus* is a member of the skin and nasal flora Infection, it is most likely associated with endogenous infection. The contamination of hospital environment, surgical instruments or from hands of health care workers further increase the SSI.[19,20].*S. aureus* was the single predominant gram positive bacterial isolate obtained in this study. Special interest in *S. aureus* SSI is mainly due to its predominant role in hospital associated infection and emergence of methicillin resistant *S.aureus* (MRSA) strains. In our study methicillin resistance was seen in 18.57% of *S.aureus* isolates. The study conducted by Kownhar et al who reported incidence of 21.7% which s comparable with our study. Still higher incidences of 45% and 58.2% of MRSA have been documented by Eagye et al[22] and Kaye et al[23] respectively. We found that all the *S. aureus* strains (irrespective of methicillin resistance) were sensitive to vancomycin, teicoplanin and linezolid. This finding can be of relevant clinical use for the formulation of antibiotic policy of our hospital.*E. coli* (23.0%) was the commonest gram negative bacteria isolated followed by *P. aeruginosa* (7.9%) and *Citrobacter spp* (7.9%). Similar observations have been reported by various other authors also[19,24,25] Few studies have reported *P.aeruginosa* as the most frequent isolate in SSI[24,25] which remains a third most isolated strain in this study. As the *E. coli* invasion of the wound is a clear case of poor hospital hygiene, Presence of enteric organisms could be attributed to the patient's normal endogenous microbial fecal flora.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%. Meropenem, piperacillin-tazobactam, and amikacin were found to be the most effective antimicrobial agents whereas ampicillin, amoxicillin-clavulanate and cefotaxime were among the most resistant drugs (table 3). The development and spread of resistant bacterial strains has emerged as a global problem. The appearance of multi drug resistant (MDR) strains over the past decades has been regarded as an inevitable genetic response to the strong selective pressure imposed by antimicrobial chemotherapy which plays a crucial role in evolution of antibiotic resistant bacteria. All cases in our study received prophylactic antimicrobials prior to the surgery. Current recommendations for antimicrobial prophylaxis to prevent SSI advise that an antimicrobial agent be administered within 60 minutes prior to surgery and discontinued soon afterward[26]. .However, more than 50% of our patients received preoperative antimicrobials more than six hours before surgery and almost all patients were treated with antimicrobials after surgery. Many of them were even treated until the day of discharge in an attempt to prevent infection while they were hospitalized. The most widely used combination was a third generation cephalosporin and an aminoglycoside. However, the antimicrobial susceptibility results showed that the isolated bacterial strains were mostly resistant to these agents. Invariably the maximum resistance was observed for ampicillin by nearly all the isolates and this was found to be statistically significant for all except *Proteus* species [Table 3]. The frequent empirical prescription of these antimicrobials as a treatment and prophylaxis in our hospital might have contributed for observed high degree of resistance. Although SSIs cannot be completely eliminated, but reduction of the rate of infection to minimal can have significant benefits by reducing the wastage of healthcare resources, patient morbidity and mortality. This can be achieved by optimal preoperative, intraoperative and postoperative patient care. Also there is good evidence that attention to multiple patient related and procedure related risk factors can decrease the risk of SSIs significantly. This would be supplemented with proper infection control measures and a sound antibiotic policy. The limitation of our study was that, anaerobic bacterial profile and fungal cultures were not done on the wound swabs obtained from SSIs. Further prospective studies can be undertaken in this regard.

Conclusion

The postoperative wound infection is the commonest nosocomial infection . The present microbiological study has determined the commonest bacteria responsible for the post-operative wound infectons. There was predominance of commonly isolated bacterial species were *S. aureus, E. coli , P. aeruginosa* and. To establish the most suitable empirical treatment for each patient, it is very important to know the microbial epidemiology of each institution. The information obtained from this study allows a better understanding of the microbial etiology of SSIs in our hospital which may have epidemiological and therapeutic implications. Using the results of this study, an initiative for establishing improved hospital antimicrobial policy and antimicrobial prescribing guidelines should be undertaken. Also the inappropriate and prolonged use of antibiotics should be avoided as this can lead to the development of resistant micro organisms which are even more difficult to treat.

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