ORIGINAL ARTICLE

SURGICAL SITE INFECTION AND PATTERN OF ANTIBIOTIC USE IN A TERTIARY CARE HOSPITAL IN PESHAWAR

Waqar Alam Jan, Sajjad Muhammad Khan, Muhammad Jehanzeb, Muazzam

Department of Surgery, Unit 'B' Government Lady Reading Hospital, Peshawar, Pakistan

Background: Surgical site infection (SSI) is most common complication following surgical procedures. The objective of the study was to collect information on SSI regarding the most frequent pathogen in cases operated in casualty of Lady Reading Hospital (LRH) Peshawar, and sensitivity of the isolated pathogens to different antibiotics used. **Methods:** The study was carried out at surgical 'B' unit (SBU) LRH from Jan 1, 2009 till Dec 31, 2009. A total of 100 patients who developed SSI after being operated for peritonitis following traumatic gut perforations, perforated appendix and enteric perforation. The patients included presented to casualty, operated in casualty OT and were shifted to the SBU, LRH. Children and patients operated on the elective list were excluded. Data was collected on specially designed proforma. Demographic details, details of SSI, culture/sensitivity reports and antibiotic used for prophylaxis and after C/S report were recorded. **Results:** Out of a total of 100, 72 had superficial, 20 had organ/space and 8 had deep SSI. Organisms were isolated in 77 cases (77%). E. coli being most common pathogen (46%), followed by Pseudomonas (23%), mixed growth of Staph. Aureus or MRSA (13%), MRSA (5%) AND Staph aureus (4%) in descending order. No growth was reported in 23% of cases. **Conclusion:** E.coli was the most common organism involved in SSI in SBU LRH. The incidence of infection with MRSA in our unit is high. Combination of antibiotics like pipreacillin/Tazobactam, Cefoperazone/Sulbactam, were most effective against the isolated organisms, except MRSA where Linezolid , vancomycin and Tiecoplanin were effective.

Keywords: Surgical site infection (SSI), antibiotics, drug resistance

INTRODUCTION

Surgical site infection (SSI) continues to be the most common complication following surgical procedures. Surgical site infections (SSIs) are not an extinct entity; they account for 14–16% of the estimated 2 million Nosocomial infections affecting hospitalised patients in the United States.[1–3] Internationally, the frequency of SSI is difficult to monitor because criteria for diagnosis might not be standardised.[1] A survey sponsored by the WHO demonstrated a prevalence of Nosocomial infections varying from 3 to 21%, with wound infections accounting for 5–34% of the total.[1,4] The 2002 survey report by the Nosocomial Infection National Surveillance Service (NINSS), indicates that the incidence of hospital acquired infection related to surgical wounds in the United Kingdom is as high as 10% and costs the National Health Service in the United Kingdom approximately 1 billion pounds (1.8 billion dollars) annually.[1] The magnitude of SSI varies considerably in different parts of the world. Rate of SSI in USA has been reported to be 2.6 percent[5], while a report from Tanzania shows this figure to be 19.4%[6]. Collated data on the incidence of wound infections probably underestimate true incidence because most wound infections occur when the patient is discharged, and these infections may be treated in the community without hospital notification. The SSIs are associated not only with increased morbidity but also with mortality. Seventy-seven percent of the deaths of surgical patients were related to surgical wound infection.[1,7] Kirkland *et al* calculated a relative risk of death of 2.2 attributable to SSIs, compared to matched surgical patients without infection.[1,8]

The objective of this study was to find out pathogens involved in surgical site infection in our unit and the sensitivity pattern of these isolated pathogens to different drugs so that we can modify our local protocol of empirical therapy.

PATIENTS AND METHODS

The study was carried out at the Lady Reading Hospital (LRH), Peshawar. A descriptive hospital record based study was carried out from 1st of January 2009 to 31st of December 2009. The study included only those patients who developed surgical site infection after they were operated for peritonitis secondary to bowel perforation. The bowel perforation was due to firearm injuries to abdomen, bomb blast injuries, acute appendicitis, peptic ulcer and enteric fever. All patients included in this study presented to casualty surgical ward, were operated in casualty surgical ward operation theatre and were later shifted to the Surgical B Unit, LRH. Patients less than 12 years of age and those operated in main operation theatre in the elective list were excluded. All patients were given ceftriaxone 1 gm and metronidazole 400 mg i/v pre-op. Post-op all patients were given ceftriaxone 1 gm i/v 12 hourly and metronidazole 400 mg i/v 8 hourly for a mean duration of 5 days.

Diagnosis of SSI was made according to the National Nosocomial infection surveillance criteria as

given in CDC definition of Nosocomial infections.[10,16] Surgical wounds were graded according to the South Hampton wound grading system.[10] A special proforma was used for the study which included the name, age, gender, address, admission number, name of surgeon(s) who performed the operation, operative findings, procedure done, grade of wound, number of operations done, C/S report result and the name of antibiotic to which the organism is sensitive. Ultrasonological reports were seen in cases of organ/ space infection. Data was analysed using SPSS and the results were expressed as percentage, mean and median.

RESULTS

The total number of patients included in the study was 100 (65 males and 35 females). The mean age of patients was 39.98±22.61 (range 12–76). The age distribution of the patients is shown in Figure-1.

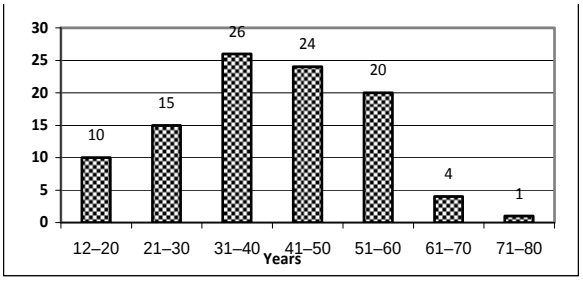

Figure-1: Age distribution of the patients

The mean day of documentation of infection was 5th post-op day, 85 patients were diagnosed during their stay in hospital and 15 were diagnosed after discharge from the hospital. Out of 100 patients 72 had superficial SSI, 20 had organ/space SSI and 8 had deep SSI.

Culture and sensitivity testing of sample was done in all 100 cases. The most common organism isolated was E. coli (46%, i.e., 38% as isolated growth of E. Coli and 8% in mixed growth with another organism) followed by Pseudomonas (22%, i.e., 17% as isolated growth of Pseudomonas and 5% in mixed growth with another organism), MRSA (15%, i.e., as isolated and 10% in mixed growth) and Staph aureus (7%, i.e., 4% as isolated growth, and 3% in mixed growth). No growth was reported in 23% of cases.

Many strains of isolated E. coli were found to be resistant to the commonly used antibiotics like Co-amoxiclav, Cephradine, Cefuroxime, Cefotaxime, Ceftriaxone, Ciprofloxacin and Levofloxacin. These were found sensitive mainly to combination of Pipreacillin/Tazobactam, Cefoperazone/Sulbactam, Meropenem and Tigecycline (Table-1).

The Pseudomonas was also showing the same pattern as E. coli with resistance to conventional antibiotics and was sensitive to combination of Pipreacillin/Tazobactam, Cefoperazone/Sulbactam and Meropenem (Table-2).

Table-1: Sensitivity pattern of E. coli isolated from SSI in SBU, LRH (E. coli alone=38, mixed growth=8)

Drug	Sensitive	Partially sensitive	Resistant	Not checked
Amoxicillin	0	0	2	44
Co-Amoxiclav	0	0	7	39
Pipreacillin/ Tazobactam	44	1	1	0
Ticarcillin/ Clavulanate	15	8	16	7
Ampicillin/ Sulbactam	4	4	1	37
Ceftriaxone	3	7	36	0
Cefuroxime	0	0	43	3
Cefotaxime	0	3	41	2
Ceftazidime	5	15	25	1
Cephradine	0	2	32	12
Cefoperazone/ Sulbactam	39	4	1	2
Cefepime	3	5	10	28
Ciprofloxacin	9	7	30	0
Ofloxacin	4	1	2	39
Levofloxacin	14	3	28	1
Enoxacin	6	3	25	12
Moxifloxacin	4	3	22	17
Sparfloxacin	12	6	16	12
Meropenem	37		2	7
Tigecycline	28	1	0	17
Sulphamethoxazole/ Trimethoprim	0	0	3	43

Table-2: Sensitivity pattern of Pseudomonas auerginosa isolated from SSI in SBU LRH (Pseudomonas alone=17, mixed growth=5)

Drug	Sensitive	Partially sensitive	Resistant	Not checked
Pipreacillin/Tazobactam	22	0	0	0
Ticarcillin/Clavulanate	8	6	3	5
Pipreacillin/Sulbactam	8	1	0	13
Cephradine	4	0	9	9
Cefpodoxime	0	0	3	19
Ceftriaxone	3	3	16	0
Cefuroxime	0	0	17	5
Cefotaxime	1	1	20	0
Ceftazidime	7	0	15	0
Cefoperazone/Sulbactam	22	0	0	0
Cefepime	2	0	2	18
CoTrimoxazole	0	0	3	19
Ciprofloxacin	6	3	13	0
Ofloxacin	2	0	7	13
Levofloxacin	6	0	16	0
Enoxacin	3	3	8	8
Moxifloxacin	2	0	6	14
Sparfloxacin	1	0	4	17
Meropenem	14	0	0	8
Tigecycline	2	0	7	13
Gentamicin	0	0	2	20

Staph aureus was found sensitive to all conventional antibiotics like Co-amoxiclav, Ciprofloxacin, Ofloxacin, Clarithromycin, Ceftriaxone,

Cefotaxime and Co-trimoxazole (Table-3). The MRSA was sensitive to Linezolid, Vancomycin and Teicoplanin. MRSA was found sensitive to Fusidic acid in 9 cases while resistance was seen in 6 cases (Table-4).

Table-3: Sensitivity pattern of Staph aureus isolated from SSI in SBU LRH (Staph alone=4, mixed growth=3)

Drug	Sensitive	Partially sensitive	Resistant	Not tested
Amoxicillin	0	0	2	5
Co-amoxiclav	2	0	0	5
Pipreacillin/Tazobactam	7	0	0	0
Ticarcillin/Clavulanate	7	0	0	0
Clarithromycin	5	0	2	0
Cefotaxime	7	0	0	0
Ceftriaxone	7	0	0	0
Meropenem	4	0	0	3
Ciprofloxacin	7	0	0	0
Ofloxacin	7	0	0	0
Levofloxacin	7	0	0	0
Enoxacin	7	0	0	0
Moxifloxacin	5	0	0	2
Sparfloxacin	7	0	0	0
Tigecycline	5	0	0	2
Co-Trimoxazole	4	0	3	0
Linezolid	7	0	0	0
Vancomycin	7	0	0	0
Tiecoplanin	7	0	0	0
Fusidic acid	7	0	0	0
Sodium fusidate	3	0	0	4

Table-4: Sensitivity pattern of MRSA isolated from SSI in SBU LRH (MRSA alone=5, mixed growth=10 cases)

Drug	Sensitive	Partially sensitive	Resistant	Not tested
Amoxicillin	0	0	2	13
Co-amoxiclav	0	0	6	9
Pipreacillin/Tazobactam	0	0	15	0
Ticarcillin/Clavulanate	0	0	13	2
Pieracillin/Sulbactam	0	0	4	11
Cefotaxime	0	0	13	2
Ceftriaxone	0	0	15	0
Meropenem	0	0	9	6
Ciprofloxacin	0	0	15	0
Ofloxacin	0	0	13	2
Levofloxacin	0	0	15	0
Enoxacin	0	0	15	0
Moxifloxacin	0	0	4	11
Sparfloxacin	0	0	8	7
Tigecycline	0	0	9	6
Co-Trimoxazole	0	0	10	5
Linezolid	15	0	0	0
Vancomycin	15	0	0	0
Tiecoplanin	15	0	0	0
Fusidic acid	9	0	6	0
Sodium fusidate	6	0	0	9
Clarithromycin	0	0	15	0

DISCUSSION

In our study the most frequent pathogen isolated from patients with SSI following exploration for peritonitis secondary to perforated viscera in the peritoneal cavity was E. coli. This is in contrast to National Nosocomial infection surveillance system[11], 1 year surveillance carried out at the Department of Infectious Diseases and Research Center, Isfahan University of Medical Sciences, Isfahan, Iran[12] and 6 month prospective surveillance conducted in the Department of General Surgery of the Rio de Janeiro University Hospital[13] where the most frequent pathogen isolated was Staph aureus. However a study carried out in Nepal named surgical site infection and Antibiotics use pattern in a tertiary care hospital in Nepal showed E.coli to be the most frequently isolated pathogen.[14]

The second most frequently isolated pathogen was Pseudomonas auerginosa in our study while it was coagulase negative staphylococci in National Nosocomial infection surveillance system[11], Klebsiella in 1 year surveillance carried out at the Department of Infectious Diseases and Research Center, Isfahan University of Medical Sciences, Isfahan, Iran[12], E. coli in 6 month prospective surveillance conducted in the Department of General Surgery of the Rio de Janeiro University Hospital[13], and Staph aureus in surgical site infection and Antibiotics use pattern in a tertiary care hospital in Nepal.[14]

Mixed growth of Gram negative rods (E. coli or Pseudomonas) and gram positive cocci (Staph aureus or MRSA) was not reported in any of the studies mentioned above. In our study mixed growth was reported in 13% of cases (Table-5).

The incidence of MRSA is much higher as compared to other studies.[14] Organisms isolated were MRSA which was making up for 68% of the total Staph aureus isolated. Only the Iranian study was coinciding with our study where MRSA was making up for 78.9% of the Staph aureus isolated.[12] No growth of MRSA was reported in the study carried out at Nepal[15] and it was less than 2% in the NNIS system study.[11]

Coagulase negative staphylococci were not reported in the study because of the inability to differentiate between the pathogen and the commensal form of the organism. No growth has been seen in 23 percent of cases and this was due to improper collection of specimen, delay in the transport of specimen to the laboratory, prior use of antibiotics and the lack for growth medium and tests required to identify uncommon pathogens like Bacteroides, Enterococci, Klebsiella and Proteus etc.

Table-5: Frequency of Pathogens isolated from SSI in SBU LRH

Pathogen	Isolated alone	Mixed growth
E. Coli	38%	8%
Pseudomonas	17%	5%
Staph. aureus	4%	3%
MRSA	5%	10%

With the exception of Staph aureus multi drug resistance was found in all other organisms isolated.

This is in accordance with the studies carried out at the Department of Infectious Diseases and Research Center, Isfahan University of Medical Sciences, Isfahan, Iran[12] and Department of General Surgery of the Rio de Janeiro University Hospital.[13] In Iranian study resistance of isolated organisms was 41.7% in Amikacin, 78.6% in Ceftazidime, 85.7% in Ceftriaxone, 61.5% in Ciprofloxacin, 78.8% in Gentamicin, 6.4% in Imipenem, 13% in Meropenem and 70.6% in Trimethoprim/sulfamethoxazole, respectively.[12]

In our study though it was not possible to take out exact percentages of the resistance to different drugs by the isolated pathogen. This is due to the fact that not all the drugs were tested in all the cases. However the trend as shown in the Tables is towards the multi drug resistance. The isolated gram negative rods were mainly sensitive to Pipreacillin/Tazobactam, Cefoperazone/ Sulbactam, Meropenem, and Tigecycline so the combination of cefoperazone and sulbectum was used because it being cheaper was affordable to majority of patients. Only where the pathogen was not sensitive to this combination, another combination of pipiracillin and Tazobactam was used (Table-6). It can be seen from the review of the tables that if the isolated gram negative rod is sensitive to Ciprofloxacin it is sensitive to all other fluoroquinolones. However the reverse is seen in majority but not all the cases.

Table-6: Antibiotic used in SSI after c/s reports

Pathogen	Pipiracillin/ Tazobactam	Cefoperazon/ Sulbectum	Linezolid
E. Coli	7	39	–
Pseudomonas	–	22	–
Staph. Aureus	–	–	7
MRSA	–	–	15

The MRSA was found in all the cases sensitive to Linezolid, Vancomycin and Teicoplanin. Linezolid was used in almost all cases where the growth of staph aureus or MRSA was obtained because firstly, linezolid was the most effective antibiotic against these organisms and secondly, the drug is available both in injectable as well as oral form so we had the option to put patient on oral form of drug after discharge from the hospital. However resistance has developed against Fusidic acid. In Iranian study Vancomycin was the most effective antibiotic against MRSA without any resistance.[12]

The isolated Staph aureus was found sensitive to the commonly used antibiotics like Co-amoxiclav, Ciprofloxacin, Clarithromycin, Co-trimoxazole and also to the linezolid.

Our study was hospital record based and this may have bias because of inability to check the sensitivity of isolated pathogens to all the antibiotics mentioned in the tables. It was carried out for one year and in a single unit. The patients were operated in the casualty surgical operation theatre which deals only with emergency cases. All the cases included were contaminated and dirty. The elective patients operated in the main surgical operation theatre were not included in the study. Perhaps the high percentage of E. coli and Pseudomonas is due to the fact that the study only included patients that have underwent laparatomy and it was carried out in a single unit of the General surgery department of the Lady Reading Hospital Peshawar.

CONCLUSION

The total antibiotic resistance is increasing among pathogens causing SSIs, with an up sloping pattern. Gram negative rods are now resistant to conventional antibiotics and the resistance has even emerged to newer advanced antibiotics. The incidence of MRSA has also increased compared to developed countries. Precise up to date antibiogram allows us toward balancing the rate of total antibiotic resistance to SSIs.

We switched over to combination of cefoperazone/sulbectam instead of ceftriaxone pre-operatively. All cases of peritonitis due to perforated bowel should be given cefoperazone and sulbectum combination empirically, to avoid injudicious use of antibiotics which is the usual practice, and is the cause of up sloping pattern of antibiotic resistance.

REFERENCES

1. Singhal H., Kaur K, Zammit C. Wound infection. 2009. Retrieved from http://emedicine.medscape.com/article/188988-overview.
2. Emori TG, Gaynes RP. An overview of nosocomial infections, including the role of the microbiology laboratory. Clin Microbiol Rev 1993;6:428–42.
3. Haley RW, Schaberg DR, Crossley KB, Von Allmen SD, Mc Gowan JE Jr. Extracharges and prolongation of stay attributable to nosocomial infections: aprospective interhospital comparison. Am J Med 1981;70:51–8.
4. Mayon-White RT, Ducel G, Kereselidze T. An international survey of the prevalence of hospital-acquired infection. J Hosp Infect 1988;11(Suppl A):43–8.
5. Gaynes RP, Culver DH, Horan TC, Edwards JR, Richards C, Tolson JS. Surgical site infection (SSI) rate in the United States, 1992 to 1998: the National Nosocomial Surveillance System basic SSI risk index. Clin Infect Dis 2001;33:S69–77.
6. Eriksen HM, Chugulu S, Kondo S, Lingaas E. Surgical site infections at Kilimanjaro Christian Medical Centre. J Hosp Infect 2003;55:14–20.
7. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection 1999. Hospital Infection Control Practices Advisory Committee. Infect Control Hosp epidemiol 1999;20(4):250–78.
8. Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization, and extra costs. Infect Control Hosp Epidemiol 1999;20(11):725-30.
9. National Nosocomial Infections Surveillance (NNIS) System NNIS report, data summary from January 1992 to June 2002, issued August 2002. Am J Infect Control 2002;30:458–75.
10. Russell RCG, Williams NS, Bulstrode CJK. Wound infection, Baileys & Love's Short Practice of Surgery. (Ed 24th. London; Arnold; 2004. p.122.

11. National Nosocomial Infections Surveillance (NNIS) System report, data summary from October 1986–April 1996, issued May 1996. A report from the NNIS System. Am J Infect Control 1996;24:380–8.
12. Khorvash F, Mostafavizadeh K, Mobasherizadeh S, Behjati M, Naeini AE, Rostami S, *et al*. Antimicrobial susceptibility pattern of microorganisms involved in the pathogenesis of surgical site infection (SSI); A 1 year of surveillance. Retrieved from: http://www.ncbi.nlm.nih.gov/pubmed/18983037.
13. Santos KR, Fonseca LS, Bravo Neto GP, Gontijo Filho PP. Surgical site infection: Rates, etiology and resistance patterns to antimicrobials among strains isolated at Rio De Janeiro University. Infection 1997;25(4):217–20.
14. Giri BR, Pant HP, Shankar PR, Sreeramareddy CT, Sen PK. Surgical site infection and Antibiotics use pattern in a tertiary care hospital in Nepal. J Pak Med Assoc 2008;58(3):148–51.
15. Cruse PJ, Foord R. The epidemiology of wound infection. A 10-year prospective study of 62,939 wounds. Surg Clin North Am 1980;60(1):27–40.

Address for Correspondence:

Dr. Waqar Alam Jan, Associate Professor, Surgical B Unit, Government Lady Reading Hospital, Peshawar, Pakistan.
Cell: +92-300-5825028
Email: waqaralamjan@yahoo.com