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CLINICOPATHOLOGICAL AND BACTERIOLOGICAL PROFILE OF SURGICAL SITE INFECTIONS IN EMERGENCY LAPAROTOMIES

Yogeshwar P Shukla[A], Ramabhilash Dubey[B], Achal Gupta[C], Chandrakala Datta[D],
[A] - *Senior Resident, Department Of Oncosurgery, Bombay Hospital Mumbai*
[B] - *Assistant Professor, Department Of Surgery, Shyam Shah Medical College, Rewa*
[C] - *Professor, Department Of Surgery, Gajra Raja Medical College, Gwalior*
[D] - *Assistant Professor Department Of Surgery, Gajra Raja Medical College, Gwalior*

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Corresponding Author

Dr. Ramabhilash Dubey
Assistant Professor,
Department Of Surgery,
Shyam Shah Medical College,
Rewa (M.P.)
Email: ramabhilashdubey1961@gmail.com
Mobile : 9425185607

Abstract:

Context: SSIs are the third most frequently reported nosocomial infection accounting for 14% to 16% of all nosocomial infections among hospitalized patients.

Aims: To find the incidence of surgical site infections and factors influencing. To find the most common bacterial pathogen and its sensitivity pattern causing SSI.

Methods and Material: A prospective study was conducted in a tertiary care hospital in central India over a period of 2 year and included 200 patients (82% male & 18% female), who underwent emergency laparotomy. These cases were followed for 1 month after surgery to know the incidence of SSI and factors influencing SSI. Parameters studied were preoperative diagnosis, age of patients, haemoglobin, blood sugar profile, duration of surgery, bacteriological profile of infected cases and antibiotic sensitivity pattern of the cultured organism.

Statistical analysis used: SPSS version 11.5 was for statistical analysis.

Results: The overall incidence of SSI was 37%. The higher incidence was associated with increasing age, anaemia (Hb< 10 gm %) and preoperative blood sugar level (RBS > 140 mg/dL). Staph. Aureus and E. Coli were most commonly associated with SSI in this region. Emerging resistance to common antibiotics such as amoxicillin, class I and II cephalosporin and aminoglicosides was noted.

Conclusions: There is a higher incidence of SSI in developing countries in contrast to western studies, which is multifactorial. SSI surveillance is recommended for institutes to identify the common pathogens and antibiotics to be used accordingly.

Key-words: Laparotomy; Surgical site infection; bacteriology; antibiotic resistance.

Key Messages: There is a high incidence of SSI in developing countries which is multifactorial. The most common pathogens being Staph aureus and E. coli with an emerging resistance to commonly used antibiotics.So SSI surveillance is recommended for institutes to identify the common pathogens and antibiotics to be used accordingly.

Introduction

Infection of surgical site is neither new nor rare. Before 19th century, surgical patients commonly developed postoperative infections and this was known as 'irritative fever' followed by purulent discharge from their incisions, overwhelming sepsis and often death. It was not until the late 1860s, after Joseph Lister introduced the 'Principles of Antisepsis' that postoperative infectious morbidity and mortality decreased substantially.[1] Lister's work radically changed surgery from an activity associated with infection and death to a discipline that could eliminate suffering and prolong life. Surgical site infections (SSI) are the third most frequently reported nosocomial infection accounting for 14% to 16% of all nosocomial infections among hospitalized patients.[2]

SSI increases the morbidity and mortality among the surgical patients thus increasing the burden to the health care and the society. Seven to 10 days of additional post-operative day stay is found in patients with SSI and a risk of 2-11 times for death than those without SSI. [3,4]

Infection in any location along the surgical tract after a surgical procedure is known as surgical site infection. The Centre for disease control's (CDC)National Nosocomial Infection Surveillance (NNIS) system has developed standardized surveillance criteria for defining SSIs. SSI involves a complex relationship among microbial characteristics (e.g. degree of contamination and virulence of pathogen), patient characteristics (e.g. immune status and comorbid conditions) and surgical characteristics (e.g. type of procedure, introduction of foreign material and amount of tissue damage).

The study aims to find the incidence of SSI and factors influencing its development with regard to emergency laparotomies. And also to find the common bacterial pathogen causing SSI and their sensitivity pattern in a government tertiary care centre in a developing country like India.

Subjects and Methods

A prospective study was conducted at department of Surgery, at a tertiary care hospital in central India, The study was conducted after approval from Institutional Ethics Committee and adheres to the tenets of Declaration of Helsinki. Data were collected after written informed consent from patients or guardian.

Inclusion criteria and methodology: 200 patients of age 15-83 years, who presented to the surgery department with acute abdomen and were planned to be taken for emergency laparotomy and were operated within 24 hours of admission. Cases with SSI were classified according to CDC's NNIS standardized surveillance criteria for defining SSI. [1]

A detailed history and clinical examination of all the patients was done. Preoperative investigations done were namely haemoglobin, complete blood count, random blood sugar, blood urea and serum create nine. Preoperative intravenous antimicrobial prophylaxis, preoperative skin preparation, closure of surgical incision in layers, and postoperative antibiotics were kept constant in all cases.

Postoperatively patients were examined by same surgeon in all the cases. First postoperative examination was done after 48 hours or even earlier if there was soakage or patient had high temperature or disproportionate pain at the site of wound and thereafter it was done every second day or as and when needed. All cases were followed till skin suture removal and were told signs and symptoms of SSI. Patients were asked to return as soon as they noticed any such sign or symptom for a period of one month from the day of surgery after discharge. On each visit a detailed examination of the patient was carried out and all signs of infection were promptly noted and reported. Any discharge from the incision site was collected for culture and sensitivity.

Statistical analysis

An association between SSI and various factors under study was evaluated in the form of percentages and chi-square test of significance. The analysis was done using software MS Excel 2010 and MedCalc version 12.7. Percentages and proportions were calculated wherever appropriate. Percentages were rounded off to first decimal digit.

Results

Demographic details

Of the total 200 patients 164 (82%) were males and 36 (18%) were females, With mean age of the patients of 42.5 years with a range of 15 to 83 years and standard deviation of 9.19 years.

Age Group (In Years)	Male	Female	Total (%)
15-30	48	6	54(27%)
31-45	40	26	66(33%)
46-60	46	2	48(24%)
>60	30	2	32(16%)
Total	164	36	200

Pre-Operative Diagnosis	Total(%)
Perforation Peritonoitis	98(49%)
Intestinal Obstruction	38(19%)
Blunt Abdominal Trauma	16(8%)
Obstructed Inguinal Hernia	12(6%)
Pyoperitonium	10(5%)
Ruptured Liver Abscess	6(3%)
Penitrating Abdominal Injury	8(4%)
Hydtid Cyst	6(3%)
Abdominal Tb	3(1.5%)
Fecal Fistula	3(1.5%)
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All the cases in the study group were contaminated as per classification of surgical wounds.

Factors affecting SSI

Overall incidence of SSI was found to be 37%. The incidence was found increase with age with lowest 18.51% in age group of 15-30years and maximum 62.50% in beyond 60 years of age the trend was found to be statistically significant (χ^2 18.827, p <0.001).

Age Group (In Years)	SSI	Total	Percentage
15-30 yrs	10	54	18.51%
31-45 yrs	22	66	33.33%
46-60 yrs	22	48	45.83%
>60 yrs	20	32	62.50%
Total	74	200	37.00%

38(46.3%) out of 82 patients who had a hemoglobin below 10mg% developed SSI, 28 out of 56 patients having haemoglobin in range of 10-12gm% developed SSI and only 6 out of 62 developed SSI among patients who had there haemoglobin above 12gm%. The association was statistically significant with χ^2=27.215, degree of freedom 2 and a P value of <0.001.

48(41.3%) out of 116 patients having pre-operative blood glucose level of more than 140 mg/dL developed SSI against 24(28.5%) out of 84 patients with FBSL less than 140 mg/dL developing SSI. Statistical analysis showed the χ^2=9.359, dF=2 and p<0.001 thus finding being statistically significant.

Incidence of SSI in surgeries lasting for less than two hours was 35.1% (52/148) where as it was 42.8%(18/42) in surgeries lasting two to three hours and 40%(4/10) when operating time was more than three hours. The increase in rate was statistically insignificant (p=0.807). The rate of SSI was 31.1%(28/90) in surgeries performed by consultants and 40.0%(44/110) in surgeries performed by resident trainees, the difference was statistically insignificant (p=0.248).

Bacteriological profile

Bacteria On Culture	No. Of Cases	Percentage
Staph.aureus	23	34.72%
E. Coli	21	31.94%
Klebsiella	11	16.66%
Staph. Epidermidis	5	6.94%
Pseudomonas	3	4.16%
Enterococcus	2	2.77%
Acinetobector	1	1.38%
Citrobector	1	1.38%
No Growth	5	6.94%
Total	72	99.95%

32(44.44%) cases the discharge from the stitch line appeared within 48 hours of the surgery, in 30(41.66%) cases it appeared from third to seventh day and in 10 cases it appeared after seventh day. Most common organism grown in culture from the wound discharge was *Staphylococcus aures*. Out of 23 *Staphylococcus auresisolated* 10(43.4%) were found to be methisillin resistant (MRSA). of the 3 *Pseudomonas* isolated 1(33%) was resistant to Gentamicin.

Discussion

Incidence of SSI reported by different workers has differed considerably from different parts of India. The overall surgical site infection rate in present study was 37%.A study by Subramaianet al in AIIMS reported an infection rate of 24.8% and a similar study in Aligarh by Gangulyet al reported a rate of 38.8%.[5,6] Studies by Agarwal (1972), Rao and Harsha (1975), Kowliet al. (1995) and Anvikar (1999) have shown surgical site infection rates in India to be between 2.5 to 41.9 %.[7-10] The incidence however is much higher than that in other countries; for instance in USA the SSI rate was estimated to be 2.8% and 2-5% in Europian countries.[11] The higher incidence of SSI in Indian hospitals reflects poor consciousness about health care associated infections and infection control practices.

Risk factors

While studying the incidence on surgical site infection against age group it was found the chance of SSI increases with increasing age lowest 18% (10/54) found in age group 15-30years, 33% (22/66) in age group of 31 to 45yeras, 46% (22/48) in age group of 46 to 60 years and 62% (20/32) in age beyond 60 years. Mean age of patients with SSI was 48.5 years with a standard deviation of 16.9 years. The statistical analysis shows the Chi Square (χ^2) as 18.827 with p= 0.0003 thus the association is statistically significant. Suchitra *et al* found age more than 45 years to be the risk factor for developing SSI.[12] In a similar study by Mawalla *et al* SSI incidence against age was found to be 12 out of 61 (19.6%) patients in age group below 21years, 18/77 (23.3%) in age group 21 to 40years, 21/68(30.8%) in age group 41 to 60years, 14/44 (31.8%) in patients beyond 60 years of age.[13] In a similar study from India similar results were shown of increasing incidence of SSI with increasing age.[11]

In our study SSI was higher in patients having preoperative hemoglobin of less than 10gm%. Statistical analysis shows Chi Square χ^2=27.215, degree of freedom 2 and p<0.0001. This data is in accordance with the other studies on the subject.[14] It goes without saying that, the ability to fight infections is compromised in patients with low haemoglobin.

Present study found 67% of the patients who developed SSI had a pre-operative blood glucose level more than 140 mg/dL. (p= 0.0093) Similar finding was made by Kamat*et al* at a tertiary hospital in Goa, they found pre-operative fasting blood glucose level (FBSL) to be statistically significant variable associated with SSI. Kamat*et al* found mean FSBL to be 153 mg/dL in patients with SSI and a value of 115 mg/dL in non SSI surgical patients with p= 0.015. Thus similar to present study.[11] Similar findings were made by Sulijagic*et al* from Serbia.[15]

Malone DL *et al*, (2001)also found the duration of operation to be a significant, independent risk factor regardless of wound class.[14] The incidence of SSI increased 3-fold (2.1-6.4%) as operations went from <20 to >4 hr duration. Kamat*et al* found 46.2% SSI in cases operated for 1 to 3 hours and 80.0% incidence in cases with operating time 4 to 7 hours.[11] Mawalla*et al* found an incidence of 20.3% in cases operated for less than 3 hours and 50.0% when operating time was three hours or more with an Odds ratio of (OR) 3.2 and p= 0.033.[13] These were in similar tone with the findings of our study as 28% incidence of SSI in cases operated for two hours or less, 42% in those operated for more than two and less than or equal to three hours, and 40% in cases lasting more than three hours[8-10,16,17]

The present study found an incidence of SSI to be 31% in cases operated by consultants ant that to be 40% in cases operated by residents. The statistical analysis shows a Chi Square for above relation as χ^2=1.334 and p= 0.248 thus the experience of the operating surgeon was not found to be statistically significant in relation to development of SSI. Similar findings were made by Mawalla*et al* as 25.8% of SSI in cases operated by consultants and an incidence of 26% in cases operated by residents with p= 0.37 thus statistically insignificant.[13]

Micro-organisms

Staph. Aureus found in 23 (35%) cases, the commonest organism causing surgical site infections (SSI). *E.Coli* the second most common organism found in 21(32%) cases. *Klebsiella*causing 11 (17%), *Staph.Epidermidis* causing 5 (7%), *Pseudomonas* causing 3 (4%), *Enterococcus* 2(3%), and one each by *Acinetobector* and *Citrobector*. Another long term study by NNIS found the distribution of pathogens in SSI from 1986 to 1996 and found the most common organism to be *Staphylococcus aureus* followed by coagulase negative staphylococci, *Enterococcus spp., Escherichia coli, Pseudomonas aeruginosa, Enterobecter spp.*, and *Klebsiella*spp. in that order.[1] Among various studies from India Suchitra*et al* found the commonest etiologic agents were *S. aureus* and *Enterococcus faecalis*. In total, 33.3% (*n*=45) of the organisms isolated were *S. aureus* of which 14.0% (*n*=19) were methicillin-resistant *S.aureus* strains (MRSA), and 33.3% (*n*=45) of the organisms were *E. faecalis*of which 1.4% (*n*=2) were vancomycin- resistant *Enterococci* (VRE). *Pseudomonas aeruginosa* (24.4%; *n*=33), *Escherichia coli* (7.4%; *n*=10) and *Klebsiella*spp. (1.4%; *n*=2) were also isolated.[12]

Lilani*et al* also found *S. aureus as most* common causative organism followed by *Pseudomonas aeruginosa*, *Escherichia coli* and *Klebsiella*spp. Similar findings were made by Subramanian *et al*, Khan *et al*, Kamat*et al*, Gautam*et al* at various parts of the India and at different times.[5,11,16,18]

In present study antibiogram revealed a 100% sensitivity to Imipenam, followed by 82% for Vancomycin, third generation Cephalosporins were active against 70 to 79% of the isolates. one case of pseudomonas was found resistant to Gentamicin while all three were sensitive to Amikacin. Present study antibiogram revealed a good number of isolates resistant to common antibiotics such as amoxicillin, class I and II cephalosporin and aminoglicosides. Number of studies in litereture indicate gradual increase in the emergence of antibiotic resistence in surgical patients.[7-10,16] Lilani*et al* found 33% resistence in *Staph. Aureus* to methicillin but none of the strain was resistant to Vancomycin. Present study found 10(43%) isolates of *Staph. Aureus* to be methicillin resistance and all of them sensitive to Vancomycin.*Pseudomonas* resistant to gentamicin is another problem and has been identified by many workers, present study also found one strain to be resistant.[12,16] We found 1(33%) of the 3 *Pseudomonas* isolated to be resistant to Gentamicin. The problem of resistance is due to indiscriminate use of antibiotics, the study found majority of gram positive isolates to be sensitive to Vancomycin and majority of gram negative strains sensitive to Meropenam this could be explained by the fact that these antibiotics are relatively rare in hospital and are more expensive so they are rarely misused.

The major limitation of the study is the sample size being small. The surgeries were not performed by the same surgeon and so the factors such as tissue handling and surgical techniques were not a constant in all the cases thus can act as a confounding factor in the study.

Conclusion

There is a higher incidence of SSI in the study which is multifactorial. Apart from non modifiable factors as age and pre-operative diagnosis a closer observation needs to done in modifiable factors as anemia, blood sugar and operating time. The most common pathogens being Staphylococcus aureus and E. coli with an emerging resistance to commonly used antibiotics.

There is need for identical studies in health care facilities to identify locally prevalent factors in order to rectify them to decrease the morbidity and mortality associated with SSI. Also to identify the common pathogens their sensitivity pattern and emerging resistance so as to aid in rationale use of antibiotics thus preventing further antibiotic resistance.

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