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A Study on Risk Factors Affecting Surgical Site Infections at a Tertiary Care Hospital

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Abstract

Introduction: Surgical Site infections (SSI) still remain a significant problem following an operation and the third most frequently reported nosocomial infections. SSI contributes significantly to increase health care costs in terms of prolonged hospital stay and lost work days. The main additional costs are related to re-operation, extra nursing care and interventions, and drug treatment costs. The indirect costs, due to loss of productivity, patient dissatisfaction and litigation, and reduced quality of life have been studied extensively. *Methodology:* The material for the present study was obtained from patient's undergone surgery in Department of General Surgery, BMC & RI, Bangalore, from 1st Jan 2012 to 30th June 2013. Surgical site were considered to be infected according to the definition by NNIS. The wounds were classified according to the wound contamination class system proposed by U.S. National Research Council. *Results:* A study of 400 operated cases was carried out of which 39 were diagnosed to be having surgical site infection as per the CDC criteria. *Conclusion*: Thus the incidence of SSI in this study is 9%.

Keywords: NNIS; Surgical Site; Risk Factors.

Introduction

A number of observations by nineteenth-century physicians and investigators were critical to our current understanding of the pathogenesis, prevention, and treatment of surgical infections.

In 1846, Ignaz Semmelweis, a Magyar physician, took a post at the Allgemein Krankenhaus in Vienna. He noticed that the mortality from puerperal ("childbed") fever was much higher in the teaching ward (1:11) than in the ward where patients were delivered by midwives (1:29). He also made the interesting observation that woman who delivered before arrival on the teaching ward had a negligible mortality rate [1].

He then hypothesized that puerperal fever was caused by putrid material transmitted from patients dying of this disease by carriage on the examining fingers of the medical students and physicians who frequently went from the autopsy room to the wards. The low mortality noted in the midwives' ward, Semmelweis realized, was due to the fact that midwives did not participate in autopsies. Fired with the zeal of his revelation, he posted a notice on the door to the ward requiring all caregivers to rinse their hands thoroughly in chlorine water before entering the area. This simple intervention reduced mortality from puerperal fever to 1.5%, surpassing the record of the midwives. In 1861, he published his classic work on childbed fever based on records from his practice. Unfortunately, Semmelweis' ideas were not well accepted by the authorities of the time [2].

Louis Pasteur performed a body of work during the latter part of the nineteenth century that provided the underpinnings of modern microbiology, at the time known as *germ theory*. His work in humans followed experiments identifying infectious agents in silkworms. He was able to elucidate the principle that contagious diseases are caused by specific

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microbes and that these microbes are foreign to the infected organism. Using this principle, he developed techniques of sterilization critical to oenology (the science and study of all aspects of wine and winemaking) and identified several bacteria responsible for human illnesses, including *Staphylococcus*, *Streptococcus*, and Pneumococcus [3].

Joseph Lister, the son of a wine merchant, was appointed professor of surgery at the Glasgow Royal Infirmary in 1859. In his early practice, he noted that more than 50% of his patients undergoing amputation died due to postoperative infection. After hearing of Pasteur's theory, Lister experimented with the use of a solution of carbolic acid, which he knew was being used to treat sewage. He first reported his findings to the British Medical Association in 1867 using dressings saturated with carbolic acid on 12 patients with compound fractures; 10 recovered without amputation, one survived with amputation, and one died of causes unrelated to the wound. In spite of initial resistance, his methods were quickly adopted throughout Europe.

Wound infection can be predicted to a certain extent. Because wound defences and wound repair are vulnerable to many of the same defects, predictive of infection are usually also predictors of dehiscence or other wound failure [4].

Haley and colleagues were the first to publish on the importance of identifying individual patients who are at high risk of surgical site infection in each category of operative procedure with the hope that the approach would result in an increase in the efficiency of routine surgical site infection surveillance and control. Analyzing 10 possible risk factors by step-wise multiple logistic regression techniques, a model was developed containing four risk factors

1. Abdominal operations,
2. Operations lasting longer than 2 hours,
3. Contaminated or dirty-infected operation by the traditional wound classification system, and
4. Patients having three or more different diagnoses, and utilized the resultant formula to predict an individual patient's probability of developing a postoperative surgical site infection. This approach was then tested on another group of 59,352 surgical patients admitted from 1975 to 1976 and was found to be a valid predictor of surgical site infection [5].

Haley and colleagues concluded that their simplified index predicted surgical site infection risk approximately twice as well as the traditional classification of wound contamination. Utilizing this model, low, medium, and high-risk levels of developing surgical site infection were identified in each of the categories of the traditional wound classification system. The overall surgical site infection rate in this study did progressively increase from clean (2.9%), to clean-contaminated (3.9%), to contaminated (8.5%), to dirty-infected (12.6%). However, a wide range of infection risk in patients in each category was noted in clean operations, 1.1% (low risk) to 15.8% (high risk); in clean-contaminated operations, 0.6% (low risk) to 17.7% (high risk); in contaminated operations, 4.5% (medium risk) to 23.9% (high risk); and in dirty-infected operations, 6.7% (medium risk) to 27.4% (high risk). It should be noted that no low-risk category patients were identified in contaminated and dirty-infected operations [6].

Following the work of Haley and colleagues, investigators at the Centers for Disease Control and Prevention (CDC) reported on a composite risk index used in the National Nosocomial Infections Surveillance (NNIS) System. This risk index was based on a modification of the one developed in the Study on the Efficacy of Nosocomial Infection Control (SENIC) project. The NNIS risk index uses the traditional wound classification system but attempts to improve on the SENIC index in several ways. First, instead of utilizing three discharge diagnoses to identify host factors as a risk of infection, the NNIS risk index uses a dichotomization of the American Society of Anesthesiology score. Its ease for collecting data and its objectivity seem advantageous. Second, the NNIS risk index uses a procedure-related cut point to indicate a long duration of surgery for an individual procedure, rather than a 2-hour cut point for all procedures.

Methodology

Inclusion Criteria

All patients above 12 years undergoing surgery in Department of General Surgery.

Exclusion Criteria

1. Patients with known preoperative infection including dirty wounds.
2. Those undergoing revision surgery.
3. Stitch abscess cases.

Method of Collection of Data

An elaborate study of these cases with regard to date of admission, history, clinical features date of surgery, type of surgery, emergency or elective, preoperative preparation and postoperative management is done till patient is discharged from hospital, and then followed up the patient on OPD basis for any signs of wound infection.

The wounds were examined for suggestive Signs/ Symptoms of infection in the post operative period, during wound dressing or when the dressings were soaked. In history, presenting complaints, duration, associated diseases, coexistent infections at a remote body site, personal history including diet, smoking, and alcoholism were noted.

Operative findings which include, type of incision, wound contamination, drain used and its type, and duration of operation were studied. Postoperative findings which included, day of wound infection, day of 1st dressing and frequency of change of dressing.

Findings on the day of diagnosis of wound infection were noted which included fever, erythema, discharge, type and colour and the exudates was collected from the depth of the wound using sterile cotton swab and was sent to microbiology department for culture and sensitivity.

Results

Infection is more commonly seen among 51 to 60y old patients with an incidence of 21.57%. Youngest patient being 19yr old and oldest being 70y old.

Incidence of infection among males is 9.44.%; whereas incidence of infection among females is 8.22%.

Most of the patients were anemic with infection rate of 13.56%. Hypoproteinemic patients had infection rate of 19.05%, diabetes mellitus had infection rate of 20%, obesity had infection rate of 23.07%, RTI had infection rate of 11.76% and malignancies had infection rate of 21.05%.

156 of 400 cases received pre op antibiotics, 5 cases were infected with incidence of 3.2% where as patients who did not receive pre op antibiotics (244) had an infection rate of 12.7%.

53% cases had operation in less than 1hrs with incidence of infection of 4.25%, 39.25% of cases had operation in 1 to 2 hrs with an incidence of infection of 13.38% and 7.75% of cases had duration of operation >2 hrs. Thus incidence of infection was 19.35 %. It was more with longer duration of surgery.

Table 1: Incidence in relation to age group

Age	No. of Cases	Infected	Percentage
12-20	48	2	4.17%
21-30	117	6	5.13%
31-40	75	6	8%
41-50	70	8	11.43%
51-60	51	11	21.57%
61-70	6	3	50%
71-80	8	0	0%
Total	400	36	

Table 2: Incidence in relation to sex

Sex	No. of Cases	Infected	Percentage
Male	254	24	9.44%
Female	146	12	8.22%

Table 3: Incidence in relation to anemia, hypoproteinemia, diabetes, remote infections and malignancies

Risk Factors	No. of Cases	Infected	Percentage
Anemia	59	8	13.56%
Hypoproteinemia	42	8	19.05%
Diabetis Mellitus	30	6	20%
Obesity	26	6	23.07%
RTI	34	4	11.76%
Malignancy	19	4	21.05%

Table 4: Incidence in relation to prophylactic antibiotic

Pre OP Antibiotic	No. of Cases	Incidence	Percentage
Given	156	5	3.2%
Not Given	244	31	12.7%
Total	400	36	-

Table 5: Incidence in relation to duration of surgery

Duration in Hrs	No. of Cases	Incidence	Percentage
<1	212	9	4.25%
1 to 2	157	21	13.38%
> 2	31	6	19.35%

Discussion

The present study shows that the majority of SSI is more among 51-60 yrs age group followed by 41- 50 yr group probably because of more number of surgeries performed in these age groups. The younger age groups had lesser incidence of SSI. This confirms the understanding that there is a gradual rise in incidence of wound infection as age advances although in this study the 61-70 age group had higher incidence owing to lesser number of surgeries in this group. Likewise Cruse and Foord observed in their study that older patients are more likely to develop infection in clean wounds than younger patient [7].

Similar findings were demonstrated by Mead, et al, who observed an increased wound infection in patients less than 1 year old (2.7%) or greater than 50 years old (2.8%) versus those 1 to 50 years old (0.7%).

The high incidence of 21.57% in patients aged 51-60 years in our study is perhaps due to decreased immunocompetence and increased chances of co-morbid factors like Diabetes Mellitus, Hypertension, Chronicailments like Asthma, conditionsrequiring Steroid therapy and personal habits like Smoking and Alcoholism. Age, obviously is animmutable patient characteristic and even, if it is a risk factor for wound infection, it appears to be at most a modest one.

Incidence among the risk factors like anemia 13.56%, hypoprotenimia 19.05%, diabetes mellitus 20%, obesity 23.07%, RTI 11.76% and malignancies 21.05%. Similar results were also obtained in other studies [7]. Cause being the reduced immuno-competence, wound healing factors, hyperglycemia, and pre-existing infections.

Preoperative hospitalization of more than 10 days had an incidence of 11.90%. The rates of SSIs increased with the increasing duration of pre operative hospitalization. The higher incidence of infections due to a longer stay in the hospital could be attributed to the increased colonization of patients with nosocomial strains in the hospital with staphylococcus aureus (60%) and MRSA (50%) and also, a longer pre-operative stay in the hospital reflected the severity of the illness and the co- morbid conditions which required patient work- up and or therapy before the operation. Similar results were obtained in other studies like in the study by Syed Mansour Razavi et al which showed 1-15 days of pre op admission had SSI of 18.6% where as more than 15 days had infection rate of 25.9%. Nongyao Kasatqibal et al 2006 also had increased risk of SSI with increasing duration pre operative hospital stay.

The pre operative antibiotic prophylaxis reduced the rate of SSIs from 12.7% to 3.2%. Antibiotic prophylaxis reduced the microbial burden of the intra operative contamination to a level that could not overwhelm the host defenses. The pre operative antibiotic prophylaxis could decrease post operative morbidity, shorten the hospital stay and it could also reduce the overall costs which were attributable to the infection.

Seyd Mansour Razavi in 2005, showed that administration of prophylactic antibiotic half an hour before the operation would bring about the best results and the lowest SSI. In 2010 Philipp Kirchhoff showed that antibiotic prophylaxis in preventing postoperative complications in colorectal surgery is well established through many studies. However, there is still a debate about the duration of the antibiotic treatment and the kind of antibiotic which should be used. In summary, most studies favour one to three intravenous doses of a second generation cephalosporin with or without metronidazole with the first dose being administered before skin incision. In 2001 Reiping tang, MD [8] et al in contrast to other reports, there was three times more predominant in surgical procedures preceded by antibiotic prophylaxis in colonic surgeries. This might be explained by the fact that these were contaminated wounds with increased risk of infection.

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Similar results were present in many studies, Seyd Mansour Razavi 2005; Lul Raka et al in 2006, Mahesh C B et al in 2010 all had similar results.

Conclusion

- Majority of patients in the study belong to age group of 51-60 years which account for 21.57%.
- Hypoproteinemia, obesity, diabetes mellitus were found to be the main risk factors with more number of SSI's.
- Infection rate was found to be increasing as the number of pre- op hospitalisation increased.
- Prophylactic antibiotic therapy was found to decrease the rate of SSI's.

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