Original Research

Surgical site infections: incidence, bacteriological profiles and risk factors in a tertiary care teaching hospital, western India

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Received Aug 14, 2016. Accepted Aug 29, 2016

Abstract

Background: A surgical site infection (SSI) is an unintended and oftentimes preventable consequence of surgery. SSIs are associated with patient morbidity and increased healthcare costs. SSIs are commonest nosocomial infections after urinary tract infections (UTI).

Objective: The present study was aimed at obtaining the incidence and bacteriological profiles of SSI and determining various risks factors influencing the SSI rate at tertiary care hospital, Gujarat, Western India.

Materials and Methods: All patients who underwent various surgeries in Shree Krishna hospital from July 2013 to May 2014 were included with approval from Human Research Ethics Committees. Details of the surgery and patient profile along with various risk factors were collected in predesigned proforma. If there was infection then the suspected samples were obtained from wounds and processed without delay using standard microbiological methods. Infection rates and risk factors were calculated using SPSS13.

Result: During the study period 1181 surgeries were conducted. Overall SSI rate was 3.38%. The most common organism isolated was *Escherichia coli* (34.8%). Increasing age, diabetes mellitus, prolonged preoperative hospital stay, and ASA score >3, emergency surgery, prolonged duration of surgery (more than 75th percentile of NNIS duration cut point) and contaminated and dirty surgical sites were found to be associated with higher rate of SSI.

Conclusion: Continuous surveillance of surgical site infections and study of factors that might increase the risk is important to reduce SSI rates if communicated to surgeons on time.

Key words: Surgical site infections (SSI), class of surgery, risk factors

Introduction

Infection has always been a feature of human life. Surgical site infections (SSIs) are a common cause of healthcare-associated infection. The United States Centers for Disease Control and Prevention (CDC) has developed criteria that define surgical site infection as infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure or within 90 days if prosthetic material is implanted at surgery.(1) SSI are commonest nosocomial infections after urinary tract infections, responsible for increasing cost, substantial morbidity, and occasional mortality related to surgical operations and continue to be a major problem even in hospital with most modern facilities and standard protocols of preoperative preparation and antibiotic prophylaxis.

The rate of SSI varies greatly worldwide and from hospital to hospital. The rate of SSI varies from 2.5% to 41.9% as per different studies.(2) Infection rates in the 4 surgical classifications (clean, clean-contaminated, contaminated and dirty wounds) have been published in many studies but

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2017.14082016597	

most literature refers to the work of Cruse and Foord as a benchmark for infection rates.[3,4] Before the routine use of prophylactic antibiotics infection rates were 1–2% or less for clean wounds, 6–9% for clean-contaminated wounds, 13–20% for contaminated wounds and about 40% for dirty wounds[3,4]. Since the introduction of routine prophylactic antibiotic use, infection rates in the most contaminated groups have reduced drastically. Infection rates in US National Nosocomial Infection Surveillance (NNIS) system hospitals were reported to be: clean 0.27%, clean-contaminated 4.65%, contaminated 10.17% and dirty 21.67%[5]. There is, however, considerable variation in each class according to the type of surgery being performed.[5] In recent years there has been shift noted toward infection with antibiotic resistant strains of both gram positive and gram negative organisms, in SSI.[6] The microbiologist play important role in monitoring and warning clinicians of infections and resistant strains. Monitoring the rate of SSI, revising antibiotic prophylaxis policy, and reducing the risk factors wherever possible will lead to reduction in SSI.

Materials and Methods

This prospective study was carried out on patients who underwent various surgeries from surgery unit of Shree Krishna Hospital, Karamsad from July 2013 to June 2014. Study was approved from Human Research Ethics Committees. Details of the surgery and patient profile along with various risk factors were collected in predesigned proforma which include age, diabetes, preoperative hospital stay, ASA score, nature and type of surgery, type of anaesthesia, duration of surgery, and surgical technique. If there was infection then the suspected samples were obtained from wounds and processed without delay using standard microbiological methods.[7] Infection rates and risk factors were calculated using Microsoft Excel.

Statistics

The analysis was performed by using SPSS 13. Chi-square tests were performed to identify all potential significant risk factors for developing any type of SSI, superficial incisional SSI, deep incisional SSI, and organ/space SSI. All results with p-values less than 0.05 were considered potentially significant SSI predictors.

Result

Out of 1181 patients, 40 patients developed SSI (3.38%). Out of 40 infected cases, 38 cases were culture positive (95%, 38/40), while 2 cases were culture negative (5%, 2/40). The pathogens isolated were *Escherichia coli* (16 isolates, 34.8%), *Klebsiella pneumoniae* (7 isolates, 15.2%), *Staphylococcus aureus* (5 isolates, 10.9%), *Pseudomonas aeruginosa* (5 isolates, 10.9%), *Acinetobactor baumannii (*4 isolates, 8.7%), *Enterococcus* spp. (3 isolates, 7.1%), *Enterobacter cloacae* (2 isolate, 4.3%), *Serratia fonticola,* Cogulase negative *staphylococcus, Pseudomonas luteola* and *Morganella morganii* (1 isolate, 2.2%).

The rate of infection was highest in age group more than 55 (4.61%, 19/460, p value 0.8956).

Table 1 shows that patients were divided into different groups having different preoperative hospital stay. Highest rate of infection (44.4) was found in patients having preoperative hospital stay between 7–13 days and p value is 0.12822 suggesting increased preoperative stay is a significant independent risk factor for development of SSI.

Table 2 shows that the patients were given different ASA score according to their preoperative physical status. It was found that ASA score of more than ≥3 is associated with high rate (35.8%) of infection and p value is 0 stating a highly significant association between ASA score of ≥3 and infection.

In patients with emergency surgery the infection rate was 6.35% (23/362), while in patients operated electively the rate was 2.07% (17/819).

Table 3 shows that the surgeries were divided into various classes according to type and site of surgery. In dirty wound the infection rate is highest (37.5%) and p value is <0.0000001 stating highly significant association between class IV wound and infection.

Table 4 shows that the surgeries were divided into 3 groups according to the time taken during the surgery. Highest rate of infection was found with duration of surgery >120 min (22.3%) and p value is 0.00000 stating a highly significant association between duration of surgery >120 min and infection.

Patients with anaemia were seen to be more prone to SSI. Anaemia diminishes resistance to infection. Preoperative anaemia is an important predictor of infection and has been proved by several other studies [8,9]. In the present study also, anaemia was found to be significantly associated with SSI.

Table 1: Correlation of Infection rate with preoperative hospital stay

Pre-operative hospital stay (days)	No. of patients	No. of infected patients	Infection Rate (%)	Statistical significant
0–1	887	29	3.26	χ^2 for linear trend: 2.314
2–6	283	07	2.47	P=0.12822
7–13	09	4	44.4	

Table 2: Infection rate with ASA score

ASA score	No. of patients	No. of infections	Infection Rate (%)	Statistical significant
1	744	3	0.40	χ^2 for linear trend- 136.178
2	370	13	3.51	P=0
≥3	67	24	35.8	

Table 3: Rate of SSI by surgical site class

Class	No. of patients	No. of infections	Infection Rate (%)	Statistical significant
Clean	681	9	2.25	χ^2 113.4
Clean contaminated	272	06	2.2	df-3
Contaminated	174	10	5.75	P= <0.0000001
Dirty/infected	53	15	37.5	

Table 4: Correlation of SSI between duration of surgery and rate of SSI

Duration (minutes)	No. of patients	No. of infections	Infection Rate (%)	Statistical significant
0-60	408	6	1.64	χ^2 for linear trend-50.853
60-120	670	11	1.67	P= 0.00000
>120	103	23	22.3	

Present study showed higher rate (6.83%, 33/483) of infection in patients given general anaesthesia than patients given spinal anesthesia (1.52%, 6/394).

In the present study the rate of SSI was 4.94% (22/445) in operations performed by junior doctors compared to rate in operations performed by senior consultants which was 2.24% (18/736).

Discussion

The present study was carried out in 1181 patients who underwent various surgeries. The rate of SSI varies greatly worldwide and from hospital to hospital. The rate of SSI varies from 2.5% to 41.9% as per different studies.[2]The present study shows SSI rate 3.38% which is comparable with rate of SSI reported by Cruse and Foord et al (4.7%).[10]

In present study patients were divided in 6 age groups. The rate of SSI was highest (4.13%) in age group >55 years which is comparable to other studies.[11,12] This is due to poor immune response, existing co morbidities in old patients and reduced compliance with treatment.

David H. Culver National[12] reported higher rate of infection in patients with diabetes mellitus which is similar to the present study.

Prolonged preoperative hospital stay was found to be associated with higher rate of infection. Prolonged preoperative hospital stay leads to colonization with antimicrobial resistant microorganisms and itself directly affects patient's susceptibility to infection either by lowering host resistance or by providing increased opportunity for ultimate bacterial colonization. Ercole F.F[13] and Lilani S.P[14] also reported higher rate of SSI in patients with prolonged preoperative hospital stay.

ASA score is highly predictive for development of SSI. In the present study risk of SSI was increased with ASA score more than 3 (35.8%). Uchino M[15] also reported ASA score more than 3 associated with higher rate of SSI. ASA score is associated with other risk factors i.e. diabetes mellitus, obesity, malnutrition, other infection, smoking, etc.

Surgical sites were classified using CDC's criteria. In present study, rate of SSI is increased with surgical site class. Seyd Mansour Razavi et al. also showed similar results.[16]

The infection rate is higher in patients undergoing emergency surgery than in elective surgery as reported by other workers.[11,17] Emergency surgeries were usually performed by junior doctors, more often with complication and have more dirty cases.

Our finding of higher rate of SSI with increasing duration of surgery was consistent with finding of other workers.[13,14] The simplest explanation for an increased infection rate with longer procedure is that a longer exposure time will increase the level of contamination of the wound and subsequently the degree of damage to the tissues, and greater fatigue among

the members of surgical team will lead to breaks in sterile technique.

The rate of SSI also varies from surgeon to surgeon. The skill and experience of surgeon directly affects the degree of contamination of the surgical site through breaks in technique or inadvertent entry in to a viscous. The skill of surgeon also affects the condition of surgical site and therefore its resistance to infection. In the present study the rate of SSI was 4.94% in operations performed by junior doctors compared to rate in operations performed by senior consultants (2.24%). Ercole F.F [(13)] also reported higher rate of infection in operations performed by junior doctors.

In infection control programs study of risk indices helps in surveillance and control efforts. Surveillance of surgical site infections with feedback of appropriate data to surgeons would be desirable to reduce SSI rates.

Conclusion

The present study was carried out with the aim to study incidence of surgical site infection, various risk factors contributing to it, microbial profile causing SSI, and their antimicrobial susceptibility pattern. Overall incidence of SSI was 3.38%. Increasing age, diabetes mellitus, prolonged preoperative hospital stay, and ASA score >3 are associated with higher rate of infection. Emergency surgery, prolonged duration of surgery (more than 75th percentile of NNIS duration cut point) and contaminated and dirty surgical sites are associated with higher rate of SSI. *E. coli* (34.8%) is most common pathogen followed by *Klebsiella pneumoniae* (15.2%), *Staphylococcus aureus* and *Pseudomonas aeruginosa* (10.9%). Gram negative organisms were major cause of SSI. Most organisms are resistant to commonly used antimicrobial agents, e.g. Cefuroxime, Ceftriaxone, Gentamycin, Ciprofloxacin, and Cotrimoxazole due to injudicious use of antibiotics. Appropriate use of antibiotics and proper aseptic practices can reduce the rate of SSI. This can also reduce major problem of antimicrobial resistance in hospital acquired infections.

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How to cite this article: Shah KH, Singh SP, Rathod J. Surgical site infections: incidence, bacteriological profiles and risk factors in a tertiary care teaching hospital, western India. Int J Med Sci Public Health 2017;6:173-176

Source of Support: Nil, **Conflict of Interest:** None declared.