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RESEARCH ARTICLE

SURGICAL SITE INFECTION IN CLEAN SURGERIES: ROLE OF RISK FACTORS

***Dr. Anjali Swami, Dr. Saiprasad Patil, Dr. Badhuli Samal and Dr. Jayanthi Shastri**

Department of Microbiology, T.N.M.C and BYL Nair Hospital, Mumbai, Maharashtra, India

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ABSTRACT

Background: Surgical site infection (SSI) is a potentially preventable complication. The aim of this study was to detect the incidence of surgical site infection in clean surgeries, risk factors involved, and organisms isolated.

Study design: From June 2009 to January 2010, patients admitted for surgery under General, Orthopedic, and Cardiovascular surgery departments in a tertiary care Hospital were included in the study. The exclusion criteria included, age less than 18 years and more than 80 yrs. The parameter studied were age, sex, presence of diabetes, congestive heart failure, chemotherapy, tobacco use, remote site infection, length of preoperative stay, antimicrobial prophylaxis and duration of surgery. Appropriate sample from suspected sites of infection were cultured and antimicrobial susceptibility of cultured organism was tested. Patients were followed up after discharge telephonically.

Results: Two hundred and seventy patients were studied. Of these 10(3.7%) developed SSI. The cases were Mastectomy (11.11%), Inguinal hernia (7.24%), Hip replacement (4.76%), Laminectomy (4.34%),CABG (3.33%). Organisms isolated were *Staphylococcus aureus* (4), CoNS (2), *E.coli* (2), *Pseudomonas sp.* (2). Preoperative hospital stay was associated with significantly higher infection rate (p-0.001). Underlying chemotherapy, diabetes, remote infection, duration of surgery were associated with increased risk of surgical site infection.

Discussion: Preoperative hospital stay was found to be the most important factor leading to surgical site infection. Diabetes, chemotherapy, congestive heart failure, duration of surgery, though not statistically significant, appeared to be important. Half of the isolates were multiresistant strains, they could be hospital acquired. Preoperative "Higher" antibiotics do not lower postoperative infection rate.

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INTRODUCTION

Surgical site infection (SSI) is a potentially preventable complication (Leigh Neumayer *et al*., 2007). It still remains a major cause of morbidity and mortality, despite improvements in infection control techniques and surgical practice, and imposes substantial demands on healthcare resources.SSI is the third most common nosocomial infection, accounting for 14% to 16% of all hospital-acquired infections and 38% of nosocomial infections in surgical patients (Leigh *et al.,* 2007). The initial step towards preventing SSI is to identify high risk factors (Patrick Pessaux *et al.,* 2005). The aim of this study to detect the incidence of surgical site infection in clean surgeries, risk factors involved, and organisms isolated.

Corresponding author: Dr. Anjali Swami,
Department of Microbiology, T.N.M.C and BYL Nair Hospital, Mumbai, Maharashtra, India.

Study design

400 patients admitted for surgery under General, Orthopedic, and Cardiovascular surgery departments in a tertiary care Hospital from Jun'09-Jan'10 were included in the study. The study was approved by the hospital Ethics committee and all the patients included in the study gave their informed consent. Structured proforma was used for recording patient information. Each patient was followed up from the time of admission until discharge from the hospital postoperatively and also for 30 days (up to 1 yr. in case of implant) telephonically. Patients were assessed preoperatively, intraoperatively and postoperatively. The exclusion criteria included, age less than 18 years and more than 70 yrs. The parameter studied were age, sex, diabetes, congestive heart failure, chemotherapy, tobacco use, remote site infection, length of preoperative stay, antimicrobial prophylaxis, duration of surgery. Surgical wound was inspected at the time of first dressing and weekly thereafter for 30 days or followed telephonically for one year if implant is in place. Wound

infection was diagnosed if any one of the following criteria was fulfilled: Serous or non-purulent discharge from the wound; pus discharge from the wound; Signs of inflammation: edema, redness, increased local temperature, fever >38^{0}C, tenderness; incision deliberately opened by surgeon. Stitch abscesses were excluded in this study. Two sterile cotton swabs were used to collect the discharge from the infected wound. Swabs were pre moistened with sterile peptone water. Smear was prepared from one swab and subjected to Gram staining (Duguid, 1996) and Second swab was placed on Blood agar (BA), Chocolate agar (CA) and MacConkey's agar (MA) The organisms were isolated and identified according to standard microbiological techniques and the antimicrobial susceptibility testing was done according to CLSI guidelines (Jorgensen *et al*., 2007). MRSA (Meticillin Resistant *Staphylococcus aureus*) detection was done by using cefoxitin (30µg) disc (Jorgensen *et al.,* 2007 and CLSI, 2007). Inducible clindamycin resistance was tested by D-test (Jorgensen *et al.,* 2007 and CLSI, 2007).

RESULTS

Only clean surgeries were included in the study. 130 patients were lost during follow up. Out of total 270 patients, 182 were male patients and 88 were female patients with their age ranging from 21 years to 80 years. As seen in Table 1, of the 290 cases, majority (55) were operated for inguinal hernia followed by operations for hydrocele (43). Maximum infection rate was observed in mastectomies (11.11%) for breast malignancy, followed by inguinal hernia (7.27%), hip replacement (4.76%), laminectomy (4.34%), CABG (3.33%). Surgeries like hydrocele, thyroidectomy, breast adenoma excision had no surgical site infection. Highest wound infection rate was seen in the age group of 41-50 years (6.25%) and no infection was seen in the age groups of 21-30 years and 71-80 years (Table 2).

Table 1. Infection rate in different operative procedures

Operation	No. performed	No. of patients infected	Percent infected
Inguinal hernia	55	4	7.27%
Hydrocele	43	0	0
CABG	30	1	3.33%
Mastectomy	27	3	11.11%
Laminectomy	23	1	4.34%
Hip replacement	21	1	4.76%
Breast adenoma excision	20	0	0
Knee replacement	19	0	0
Parathyroid adenoma excision	15	0	0
Thyroidectomy	15	0	0
Splenectomy	2	0	0
Total	270	10	3.70%

Table 2. Age wise infection rate

Age (yrs)	No. of patients	No. infected	Percent infected
21 to 30 yrs	29	0	0
31 to 40 yrs	70	1	1.42%
41 to 50 yrs	64	4	6.25%
51 to 60 yrs	58	3	5.17%
61 to 70 yrs	42	2	4.76%
71 to 80 yrs	7	0	0
Total	270	10	3.70%

No sex wise predilection was seen. None of the patients who were operated within first two days of admission to the ward had wound infection, whereas highest infection rates were observed in patients in whom preoperative stay was more than 5 days (31.81%) (Table 3). The difference was found to be statistically significant using Fischer's exact test (p-value: 0.000000914).

Shaving was done in all patients with razor night prior to surgery, no clippers were used. Scrubbing solution used was Beta dine scrub in all cases. All patients undergoing surgery received Beta dine scrub or Dettol bath on the day of surgery. All patients undergoing surgery received preoperative antimicrobial prophylaxis. In most of the cases it was induced an hour before the skin incision, although patients undergoing CABG received 1st dose of antibiotic just after anaesthetic induction. Antimicrobial prophylaxis was continued intraoperative and postoperative period from 3 to 7 days depending upon risk of the procedure (Table 4).

Table 3. Incidence of surgical site infection by duration of preoperative hospital stay

Preoperative stay (days)	No. of patients	No. infected	Percent infected
1	173	0	0
2	33	0	0
3	30	1	3.33%
4	12	2	16.70%
≥5	22	7	31.81%
Total	270	10	3.70%

Table 4. Antimicrobial prophylaxis

Operation	Antibiotics	Duration post-op
Inguinal hernia	Ce/Ci	3 days
Hydrocele	Ce/Ci	3 days
CABG	Pt + Ak	5 days
Mastectomy	Ce/Ci	3 days
Laminectomy	Ce/Ci	3 days
Hip replacement	Ce/Ci + Sul. Or Pt + Ak	7 days
Breast adenoma excision	Ce/Ci	3 days
Knee replacement	Ce/Ci + Sul. Or Pt + Ak	7 days
Parathyroid adenoma excision	Ce/Ci	3 days
Thyroidectomy	Ce/Ci	3 days
Splenectomy	Ce/Ci + Metro.	3 days

Ce :Cefotaxime, Ci : Ceftriaxone, Pt : Piperacillin + Tzobactum, Ak : Amikacin, Sul : Sulbactum, Metro : Metronidazole.

Table 5. Incidence of surgical site infection with regard to predisposing factors

Predisposing factors	No. of patients	No. infected	Percent infected
Tobacco	28	0	0.0%
Chemotherapy	21	3	14.3%
Diabetes	21	1	4.8%
Congestive Heart Failure	12	2	16.7%
Remote infection	6	1	16.7%
Nil	182	3	1.6%
Total	270	10	3.7%

Table 6. Duration of surgery and surgical site infection rate

Duration of surgery (min)	No. infected	No. of patients	Percent infected
< 30	0	49	0.0%
30 to 60	5	125	4.0%
60 to 120	3	72	4.2%
> 120	2	24	8.3%
Total	10	270	3.7%

Underlying chemotherapy, diabetes, remote infection (ie: furunculosis, lower respiratory tract infection, urinary tract infection, history of congestive heart failure) was particularly associated with increased risk of surgical site infection (Table 5). Duration of surgical procedures varied from less than 30 minutes to more than 120 minutes. There was no infection in surgeries lasting for less than 30 minutes. Infection rate was low 4.0% and 4.2% for operations lasting for 30 to 60 minutes and 60 to 120 minutes respectively, which was raised to 8.3% in surgeries lasting for more than 120 minutes (i.e. CABG, Hip replacement) (Table 6). In infected wounds *Staphylococcus aureus* (4nos.) was the commonest isolate followed by coagulase negative staphylococcus species (2nos.)*, Escherichia coli* (2 nos.), *Pseudomonas spp.* (2 nos.) Out of the ten isolates four were found to be resistant to multiple antibiotics, which includes two MRSA (methicillin resistant *Staphylococcus aureus*), one methicillin resistant coagulase negative staphylococcus species, and one ESBL (extended spectrum beta lactamase) producing *E.coli. Pseudomonas spp*. isolates were resistant to cefoperazone.

Statistical analysis

Data measured on continuous scale were analysed using Fischer's exact test. $P < 0.05$ was taken as statistically significant.

DISCUSSION

The results of this study provide an overview of incidence, microbiology, risk factors related to SSI in clean surgeries. The incidence of surgical site infection has been observed to vary considerably from study to study. In foreign literature surgical site infection rate for clean wounds varies from 0.7% to 7.4%, while in India is found to be 4.04% to 30%[6-28]. The overall infection rate in the present study was 3.7%. When considering the surgical site infection rates for any hospital, detail analysis of infection rate for specific type of operation is necessary so as to pinpoint the problem, areas that may be associated with significant infection rates even if overall infection rate in insignificant. S P Lilani and N Jangle (2005) (Lilani *et al.,* 2005) had found maximum infection rate in mastectomies (25%) for breast malignancy, while patients with surgeries for hydrocele, fibroadenoma breast, thyroid and parathyroid had no surgical site infections. In the present study maximum infection rate was seen in mastectomies (11.11%) for breast malignancy, followed by inguinal hernia (7.27%), Hip replacement (4.76%), Laminectomy (4.34%), CABG (3.33%). Surgical site infection rate was more in patients between 41-70 years of age. No sex wise predilection was seen.

A prolonged preoperative stay with exposure to hospital environment and its ubiquitous diagnostic procedures, therapies and microflora have been shown to increase the rate of surgical site infection. Present study shows statistically significant correlation between preoperative stay and rate of surgical wound infection. This is in agreement with the reported literature. In the present study all patients received antimicrobial prophylaxis. So the effect of antimicrobial prophylaxis on the development of surgical site infection could not be inferred. In the present study duration of operation was directly proportional to the rate of surgical site infection but the association was statistically insignificant. Maximum infection rate of 8.3% was observed in those operations which were lasting for more than 2 hours, but there was no evidence of SSI in operations lasting less than 30 minutes. Findings were similar to those by Garibaldi *et al.* (1991), Lilani *et al.* (2005). The incidence of surgical wound infection in patients having either of these risk factors (Chemotherapy, Diabetes, Congestive heart failure, Remote infection (like Furunculosis, Lower respiratory tract infection, Urinary tract infection) was 10.5%, as compared to those without risk factors, the overall infection rate being 3.7%. Findings were similar to those by Cruse and Foord, (1973), Lilani *et al.* (2005). In the present study, out of the ten isolates four were found to be resistant to multiple antibiotics, which includes two MRSA (methicillin resistant *Staphylococcus aureus*), one methicillin resistant coagulase negative staphylococcus species, and one ESBL (extended spectrum beta lactamase) producing *E.coli and Pseudomonas spp*. In summary, Preoperative hospital stay was found to be the most important factor leading to surgical site infection. Diabetes, chemotherapy, congestive heart failure, duration of surgery, though not statistically significant, appeared to be important. The isolates which were multiresistant strains, could be hospital acquired. A systematic approach, with special attention to multiple risk factors related to the patient, the procedure, and the hospital environment will help reduce incidence of SSI.

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