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Clinical Study to Determine the Incidence of Surgical site Infections in Clean Contaminated Wounds in A Tertiary Care Hospital

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ABSTRACT
Surgical site infections are the most common healthcare associated infections in tertiary care hospitals. Surgical site infections not only increase the morbidity and mortality of the patients but also results in increased hospital stay and health care cost. Despite the advances made in Asepsis and Antisepsis and the availability of a wide range of newer antibiotics, surgical site infections are the most difficult and important problem in surgical practice. The study was conducted at a tertiary care center for period of 9 months. 300 patients undergoing surgical procedures with wounds being classified under Clean and clean contaminated wounds were considered for the study. Each patient was followed up from the time of admission till discharge from the hospital and also for 30 days postoperatively. Sterile cotton swabs will be obtained from the depth of wounds showing signs and symptoms of surgical site infection and were sent to Microbiology Department for culture and sensitivity. Data was analyzed and entered. Surgical site infection was present in 73 out of 300 patients (24.33%). 282 were elective and 18 were emergency surgeries. Out of 300 patients, 46 were diabetic, of which 37(50.68%) had surgical site infection, and 56 were hypertensive, of which 13(17.81%) had surgical site infection. Proportion of patients with surgical site infection was significantly higher in patients with drains kept (53%) as compared to patients without drains kept (47%). There was correlation between post-operative swabs indicating wound contamination to be the most important cause of surgical site infection.

INTRODUCTION

Surgical site infections are the most common healthcare associated infections and account for more than $3.2 billion in attributable cost per year in tertiary care hospitals[1,2]. Surgical site infections (SSI's) are infections occurring up to 30 days after surgery (or up to 1 year in patients receiving in plants) and affecting either the incision or deep tissue at the operation site[3]. Despite the advances made in Asepsis and Antisepsis and the availability of a wide range of newer antibiotics, surgical site infections are the most difficult and important problem in surgical practice. Surgical site infections not only increase the morbidity and mortality of the patients but also results in increased hospital stay and health care cost. There are estimated additional 11 days of hospitalization for each surgical site infection per patient. The incidence and pattern of surgical site infections not only differs from hospital to hospital but also differs on the basis of various patient factors as well as type and duration of surgery. The picture of surgical site infection has undergone tremendous change in recent years[4]. With advances in discovery of antimicrobial, hopes ran high that the days of postoperative wound infections (SSI) were over. Contrary to this, wide spread and inappropriate use of antibiotics has led to the emergence of antibiotic resistant bacterial isolates[5]. In the pre-antibiotic era, Staphylococci and Streptococci were found to be more common pathogens in wound infection(SSI) and even now-a-days, Staphylococcal infection of surgical site infection is important but strains of Staphylococcus have become resistant to most of the antibiotics in common use. This has been essentially due to the injudicious use of antibiotics and greater reliance on antibiotics rather than use of the time honored methods of asepsis and antisepsis[6]. The menace of antibiotic resistance continues to grow and is posing a real challenge to the medical world[7]. Moreover, infection by Gram Negative Bacillary group of bacteria is of equal and even of more importance currently. Surgical site infections are classified as Clean, Clean-Contaminated, Contaminated and Dirty[8].

Various risk factors such as environmental, treatment and patients factors like history of skin or soft tissue infections, immuno-suppression, chronic diseases like diabetes, obesity etc. are associated for the development of the surgical site infection. The CDC provides a new and updated evidence based recommendation for the prevention of SSIs. Full body bath with soap (antimicrobial or non-antimicrobial) or an antiseptic agent the night before or the morning of the operation, Appropriate antimicrobial prophylaxis before incision, Skin preparation with an alcohol based agent, Adjunct measures-maintenance of normothermia, glycemic control with targets <200mg/dL and the provision of supplemental oxygen are some of the preventive measures of SSI. The above study was conducted to study the incidence of surgical site infections in clean contaminated wounds in a tertiary care hospital.

MATERIALS AND METHODS

Study Place: The study was conducted at a tertiary care hospital for a period of 9 months.

Study Design: Prospective observational study.

Inclusion Criteria: Patients with clean contaminated wounds (Elective or emergency, Laproscopic or open cholecystectomy and appendicectomy), willing to participate and follow up till 30 days post procedure.

Exclusion Criteria: Patients with clean, contaminated and dirty wounds, unable to come for follow up, Immuno-compromised, terminally ill and mentally challenged, neonates, children and pregnant women.

Sample Size: 300 patients.

Data Analysis: The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0. For statistical significance, $p<0.05$ was considered statistically significant.

Ethical Consideration: All the necessary ethical permissions were taken from the Institutional Ethical Committee before starting the study.

All the patients were assessed pre-operatively, intra-operatively and post-operatively. Surgical sites were considered to be infected according to the criteria of CDC definitions of surgical site infections[8]. The surgical site was classified as clean, clean-contaminated, contaminated and dirty as per National Research Council Classification Criteria (1964). This classification is based on the extent of intra operative contamination[9]. Each patient will be followed up from the time of admission till discharge from the hospital and also for 30 days post-operatively. Detailed history of the patients was taken. Post-operative findings such as day of surgical site infection, day of 1st dressing and frequency of change of dressing were noted. Surgical site was examined in post-operative period for 30 days for suggestive signs and symptoms of surgical site infection which includes fever, erythema, increased local temperature, discharge and its type serous (non-purulent) or purulent (pus). Sterile cotton swabs were obtained from the depth of wounds showing signs and symptoms of surgical site infection and were sent to Microbiology Department for culture and sensitivity.

RESULTS AND DISCUSSIONS

Majority (191(63.67%)) of patients did not have co-morbidities. Hypertension was present in 56(18.67%) patients followed by diabetes mellitus (46(15.33%)), chronic kidney disease (9(3.00%)), bronchial asthma (7(2.33%)), COPD (5(1.67%)) and hypothyroidism (3(1.00%)). Seizure disorder was present in only 2 out of 300 patients (0.67%). Majority (239(79.67%)) of patients had lap surgery. 61 out of 300 patients (20.33%) had open surgery. Surgical site infection was present in 73 out of 300 patients (24.33%). In majority (285(95.00%)) of patients, SSI preventive measures were not taken. Wound irrigation was given to 9(3.00%) patients. 6 out of 300 patients (2.00%) were given antiseptic for local application. 1 patient died after day 3.

Post-Operative Day 3: Majority (257(85.67%)) of patients did not have infection. Superficial infection was present in only 43 out of 300 patients (14.33%).

Post-Operative Day 6: Majority (233(77.93%)) of patients did not have infection. Superficial infection was present in 63(21.07%) patients. Deep infection was present in only 3 out of 299 patients (1.00%).

Post-Operative Day 10: Majority (241(80.60%)) of patients did not have infection. Superficial infection was present in 53(17.73%) patients. Deep infection was present in only 5 out of 299 patients (1.67%).

Post-Operative Day 15: Majority (284(94.98%)) of patients did not have infection. Superficial infection was present in 12(4.01%) patients followed by deep infection (2(0.67%)). Organ space infection was present in only 1 out of 299 patients (0.33%).

Post-Operative Day 21: Majority (290(96.99%)) of patients did not have infection. Superficial infection was present in 8(2.68%) patients. Deep infection was present in only 1 out of 299 patients (0.33%).

Post-Operative Day 30: Majority (294(98.33%)) of patients did not have infection. Deep infection was present in 3(1.00%) patients. Superficial infection was present in only 2 out of 299 patients (0.67%). 1 patient died after day 3.

Post-Operative Day 3: Majority (285(95.00%)) of patients had no growth. Gram positive bacteria was seen in 6(2.00%) patients. Acintobacter sp, *E.Coli* and Klebsiella pneumonia was present in only 3 out of 300 patients (1.00%) each.

Post-Operative Day 6: In majority (245(81.94%)) of patients, no growth was seen. *E.Coli* was present in 21(7.02%) patients followed by contaminated (18(6.02%)), Klebsiella pneumoniae (9(3.01%)) and gram positive bacteria (6(2.01%)). Acintobacter sp was present in only 3 out of 299 patients (1.00%).

Post-Operative Day 10: In majority (257(85.95%)) of patients, no growth was seen. *E.Coli* was seen in 15(5.02%) patients followed by gram positive bacteria (9(3.01%)), Pseudomonas sp (9(3.01%)) and contaminated (6(2.01%)). Klebsiella oxytoca and proteus vulgaris was present in only 3 out of 299 patients (1.00%) each.

Post-Operative Day 15: In majority (284(94.98%)) of patients, no growth was seen followed by contaminated (12(4.01%)). Klebsiella oxytoca was present in only 3 out of 299 patients (1.00%).

Post-Operative Day 21: In majority (296(99.00%)) of patients, no growth was seen. *E.Coli* was present in only 3 out of 299 patients (1.00%).

Post-Operative Day 30: In majority (296(99.00%)) of patients, no growth was seen. 3 out of 299 patients (1.00%) showed contamination.

In above study Proportion of patients with surgical site infection was significantly higher in total 37 (50.68%) patients with Diabetes mellitus. In case of Hypertension only 13 (17.81%) patients developed Surgical site infection. Rest no other co-morbidity is associated with Surgical site infection. In above study, incidence of SSI in co-morbid was seen on lower side except Diabetes mellitus and hypertensive patients. Study done by Guohua *et al*.[10] shows that incidence of surgical site infection in diabetic and non-diabetic patients was 14.3% and 2.5% respectively.

Mean±SD of hospital stay(days) in patients with surgical site infection was 4.83±2.46 which was significantly higher as compared to patients without surgical site infection (4.43±1.51) (p<0.213). In above study association of SSI with hospital stay was not significant. Study done by Edin *et al*.[11] shows no significant independent association between preoperative length of stay and risk of SSI while SSI and postoperative LOS were significantly associated. In above study, distribution of surgical site infection was comparable with pre- operative intervention. A total of

Table 1: Distribution of associated co-morbidities of study subjects

Associated comorbidities	Frequency	Percentage
No co-morbidities	191	63.67
Bronchial asthma	7	2.33
Diabetes mellitus	46	15.33
Hypertension	56	18.67
COPD	5	1.67
Seizure disorder	2	0.67
Chronic kidney disease	9	3.00
Hypothyroidism	3	1.00

Table 2: Descriptive statistics of duration of stay (days) of study subjects.

Duration of stay (days)	Mean±SD	Median (25th75th percentile)	Range
Pre-op stay (days)	1.81±1.76	2(1-2)	0-12
Post-op stay (days)	2.93±1.01	3(2-3)	1-8
Duration of hospital stay (days)	4.74±2.27	4(4-5.25)	2-20

Table 3: Distribution of Open/Laproscopic surgery of study subjects.

Open/Laproscopic surgery	Frequency	Percentage
Lap surgery	239	79.67
Open surgery	61	20.33
Total	300	100.00

Table 4: Distribution of surgical site infection of study subjects.

Surgical site infection	Frequency	Percentage
Absent	227	75.67
Present	73	24.33
Total	300	100.00

Table 5: Distribution of any SSI preventive measures taken of study subjects.

Any SSI preventive measures taken	Frequency	Percentage
None	285	95.00
Antiseptic for local application	6	2.00
Wound irrigation	9	3.00
Total	300	100.00

Table 6: Distribution of CDC score of study subjects.

CDC score	No infection	Superficial infection	Deep infection	Organ space infection
Post-operative day 3	257(85.67)	43(14.33)	0(0.00)	0(0.00)
Post-operative day 6	233(77.93)	63(21.07)	3(1.00)	0(0.00)
Post-operative day 10	241(80.60)	53(17.73)	5(1.67)	0(0.00)
Post-operative day 15	284(94.98)	12(4.01)	2(0.67)	1(0.33)
Post-operative day 21	290(96.99)	8(2.68)	1(0.33)	0(0.00)
Post-operative day 30	294(98.33)	2(0.67)	3(1.00)	0(0.00)

Table 7: Distribution of wound organism on swab of study subjects

Wound organism on swab	Frequency	Percentage
Post-operative day 3		
No growth	285	95.00
Acintobacter sp	3	1.00
E.coli	3	1.00
Gram positive bacteria	6	2.00
Klebsiella pneumonia	3	1.00
Post-operative day 6		
No growth	245	81.94
Acintobacter sp	3	1.00
Contaminated	18	6.02
E. Coli	21	7.02
Gram positive bacteria	6	2.01
Klebsiella pneumoniae	9	3.01
Post-operative day 10		
No growth	257	85.95
Contaminated	6	2.01
E.coli	15	5.02
Gram positive bacteria	9	3.01
Klebsiella oxytoca	3	1.00
Pseudomonas sp	9	3.01
Proteus vulgaris	3	1.00
Post-operative day 15		
No growth	284	94.98
Contaminated	12	4.01
Klebsiella oxytoca	3	1.00
Post-operative day 21		
No growth	296	99.00
E.coli	3	1.00
Post-operative day 30		
No growth	296	99.00
Contaminated	3	1.00

37 patients some pre-operative intervention of which 13 patients (17.81%) without SSI 24 patients (10.57%). SSI who underwent some pre-operative intervention showed not statistically significance with SSI (p-value = 0.102) Howard and colleagues reported that preoperative biliary stenting increased the incidence of wound infection in a study of 138 patients with obstructive jaundice (28.4% vs 13.3%, p<0.022)[12] while Limongelli *et al*.[13] also found wound infections significantly more frequent in stented compared with non-stented patients.

Distribution of surgical site infection was comparable with total of 282 (94%) patients who under went elective procedure out of which 67 (91.78%) had SSI and total 18 patients who underwent emergency procedure of which 6 patients (8.22 %) had SSI. (p-value = 0.359) SSI with patients who underwent elective/emergency surgery showed not statistically significance with SSI. Tan LT *et al*.[14] reported that 248 patients were included in their study, with 67 being elective surgical cases and 181 emergency surgical cases. Elective surgery reported a higher rate of SSIs, 19.40%, as compared with 15.47% in emergency surgery. Odds Ratio (OR) obtained with simple logistic regression is 1.315 with 95% Confidence Interval (CI) 0.636-2.722 and p-value of 0.460. The average time for elective surgery is 117 minutes and 78 minutes for emergency surgery. The longer surgery duration may contribute to the increase rate of SSI amongst elective surgery. In above study, proportion of patients with surgical site infection was significantly higher in patients with drains kept (53%) as compared to patients without drains kept (47%). (p<.0001). Study done by Guohua *et al*.,[10] shows that incidence of SSI in patients with post-operative drainage was 6.1% and in patients without post-operative drainage it was 0.8% only.

In above study, Surgical site infection developed in 73 out of 300 patients. So the incidence of Surgical site infection in our study is 24.33%.

Post-Operative Day 3: Majority (257 (85.67%)) of patients did not have infection. Superficial infection was present in only 43 out of 300 patients (14.33%).

Post-Operative Day 6: Majority (233 (77.93%)) of patients did not have infection. Superficial infection was present in 63 (21.07%) patients. Deep infection was present in only 3 out of 299 patients (1.00%).

Post-Operative Day 10: Majority (241 (80.60%)) of patients did not have infection. Superficial infection was present in 53 (17.73%) patients. Deep infection was present in only 5 out of 299 patients (1.67%).

Post-Operative Day 15: Majority (284 (94.98%)) of patients did not have infection. Superficial infection was present in 12 (4.01%) patients followed by deep infection (2 (0.67%)). Organ space infection was present in only 1 out of 299 patients (0.33%).

Post-Operative Day 21: Majority (290 (96.99%)) of patients did not have infection. Superficial infection was present in 8 (2.68%) patients. Deep infection was present in only 1 out of 299 patients (0.33%).

Post-Operative Day 30: Majority (294 (98.33%)) of patients did not have infection. Deep infection was present in 3 (1.00%) patients. Superficial infection was present in only 2 out of 299 patients (0.67%). Lilan *et al*.[15] reported that out of the total 190 patients included in their study, 17 developed surgical site infection with the overall infection rate of 8.95%. Surgical site infection rate was 3.03% in clean surgeries and 22.41% in clean-contaminated surgeries. The difference was found to be statistically significant (p = 0.0012). M Haridas *et al*. observed that post-operative complications in general surgery were associated with many factors one of which was class of wound. They found that dirty wound cases had highest prevalence of complications (48%) as compared to contaminated wounds (29%) or clean wounds (17%). Study done by Ouedraogo *et al*.[16] shows that clinically, the incidence of SSI was higher in emergency surgery than in scheduled surgery (84.2 vs. 15.8%, p<0.05). Contaminated or dirty surgery was more risky than clean surgery (p<0.05).

CONCLUSION

Incidence of Surgical Site Infection was present in 73 out of 300 patients (24.33%). Out of 300 cases, 282 were elective and 18 were emergency surgeries. Elective cases had an incidence of 91.78% and emergency cases had more incidence of 8.22%. Out of 300 patients, 46 were diabetic, of which 37(50.68%) had surgical site infection and 56 were hypertensive, of which 13(17.81%) had surgical site infection. Incidence of the surgical site infection increased with the use of drain. There was correlation between post-operative swabs indicating wound contamination to be the most important cause of surgical site infection. Most common organism responsible for surgical site infection were found to be *E.Coli*, gram positive bacteria, Klebsiella sp, Pseudomonas aeruginosa. Therefore, the core strategy to control surgical site infection is to prevent wound contamination along with the control of other risk factors. Surgeon can reduce post-operative surgical site infection by controlling certain factors. Prior optimization of patients in emergency surgeries, preoperative planning, meticulous technique can reduce blood loss and duration of surgery. Most of the cases had Surgical Site Infection detected on 6th day followed by 10th and 3rd post- operative day.

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