ORIGINAL RESEARCH PAPER

General Surgery

A PROSPECTIVE STUDY OF SURGICAL SITE INFECTION IN ELECTIVE ABDOMINAL SURGERIES

KEY WORDS: SSI, HAI.

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ABSTRACT

Surgical site infection (SSI) is the most common health care associated infection(HAI). Between 2-5% of patients undergoing surgery are estimated to develop SSI. Surgical site infections are associated with increased length of hospital stay, cost of treatment, loss of productivity in time off and increase in morbidity and mortality.

INTRODUCTION:

Wound infection continues to be a baffling problem since time immemorial. Before the antisepsis era risk of surgery was exceedingly high due to the enormous rates of surgical infection. The simple introduction of hand washing by Semmelweis resulted in a decrease in mortality due to puerperal sepsis from 12% to 2% [1] .Joseph Lister, a British surgeon introduced the principles of antisepsis. Lister's work radically changed surgery from an activity associated with infection and death to a discipline that could eliminate sufferings and prolong life.

Surgical site infection is defined as an infection that occurs at or near a surgical incision within 30 days of the procedure or within one year, if an implant is left in a place [2] .SSI was recorded as per the Centers for disease control criteria for defining surgical site infection as mentioned below:

Superficial incisional SSI:

Infection occurs within 30 days after the operation and infection involves only skin and subcutaneous tissue of the incision and at least one of the following:

1. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
2. Organism isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
3. At least one of the following sign or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture negative.
4. Diagnosis of superficial incisional SSI by the surgeon or attending physician.

Deep incisional SSI :

Infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissues (e.gfascial and muscle layers) of the incision and at least one of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38 degree), localized pain, or tenderness, unless site is culture negative.
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of a deep incisional SSI by surgeon or attending physician.

Organ/Space SSI:

Infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g. organ or spaces), other than the incision, which was opened or manipulated during an operation and at least one of the following:

1. Purulent drainage from a drain that is placed through a stab wound into the organ/ space.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of an organ/space SSI by a surgeon or attending physician.

The National Research Council created a classification that is commonly used to predict the risk of SSI based on the level of perioperative contamination. Four wound classes with increasing risk of SSIs were described: clean, clean contaminated, contaminated and dirty wounds[2] .

Surgical Wound Classification :

Class	Criteria
Class 1: Clean wounds	An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition clean wounds are primarily closed and, if necessary, drained with closed drainage.
Class 2: Clean Contaminated wounds	An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Operations involving biliary tract and appendix are included in this category, provided no evidence of infection or major break in technique is encountered.
Class 3: Contaminated wounds	Open, fresh, accidental wounds. In addition, operations with major break in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, non purulent inflammation is encountered are included in this category.

Class 4: Dirty wounds	Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organism causing postoperative infection werepresent in the operative field before the operation.

MATERIALS AND METHODS

This prospective study was carried out in the department of General Surgery after getting clearance from Institutional Ethics Committee at Dr. Rajendra Prasad Government Medical College, Tanda during study period i.e December 2014 to March 2016 under Surgery were included in the study.

INCLUSION CRITERIA:

1. All consecutive patients admitted under surgery department of Dr. Rajendra Prasad Government Medical College Tanda for elective abdominal surgery.

EXCLUSION CRITERIA:

1. Patients undergoing reoperation.
2. Patients where implants in the form of mesh were used.
3. Patients operated for emergency surgical conditions.
4. Patients lost during follow up.

Preoperative preparation

Preparation of the operative site was done by shaving of hair at surgical site just before surgery. Antibiotic prophylaxis was given in clean and clean contaminated elective surgery. Intravenous cefuroxime was given as prophylactic antibiotic. One dose of prophylactic antibiotic was given within 1hour of surgery. In cases where surgery, lasted longer than four hours or with major blood loss then additional intra-operative doses of antibiotic were given. In contaminated and dirty wounds therapeutic antibiotics were used for 3-5 days after the prophylactic dose.

SSI rate per hundred operative procedures was calculated by dividing number of surgical site infections with number of specific operating procedure and result multiplied by hundred. Quantitative data was expressed as frequency and percentage.

OBSERVATIONS

The following observations were made.The age of the patients in our study ranged from 1 to 82 years with a mean age of 42.7 years(Table-1).

Table-1:Age wise distribution of patients

Age	Number	Percentage
0-10	12	4
11-20	10	3.3
21-30	37	12.4
31-40	78	26
41-50	84	28
51-60	47	15.6
61-70	21	7
>70	11	3.7
Total	300	100

The sex distribution of the study showed that out of 300 patients, 74(24.7%) were males and 226 (75.3%) were females(**Table-2**)

Table 2: Sex distribution

Sex	No of Patients	Percentage
Male	74	24.7
Female	226	75.3

Out of 300 elective surgical patients, 24 (8%) were clean surgical wounds, 274 (91.4%) clean-contaminated surgical wounds, 1 (0.3%) contaminated surgical wounds and 1 (0.3%) dirty surgical wounds**(Table 3**).

Table 3:Class wise distribution of operative wounds

Class of wound	No. of operations	Percentage
I: Clean	24	8
II: Clean-contaminated	274	91.4
III: Contaminated	1	0.3
IV: Dirty	1	0.3

Out of 300 patients, 17(5.66 %) developed SSI. Out of these 17 cases, 10(58.8%) were superficial incisional SSI, 3(17.6%) deep incisional SSI and 4(23.6%) were of organ space SSI**(Table 4)**.

Table 4: Types of SSI

Types of SSI	No of SSI(n=17)	Percentage
Superficial incisional	10	58.8
Deep incisional	3	17.6
Organ space	4	23.6
Total	17	100

SSI rate was 100% in dirty surgical wound, 100 % in contaminated wounds, 5.1% in clean-contaminated wounds and 4.1% in clean wounds(**Table-5):**.

Table-5: Correlation of class of wound with SSI

Class of wound	No. of operations	No of SSI	SSI rate
I: Clean	24	1	4.1
II: Clean contaminated	274	14	5.1
III: Contaminated	1	1	100
IV: Dirty	1	1	100

Out of 24 clean surgical wounds, 11 were herniotomy for inguinal hernia in children, 9 were anatomical repair for epigastric, periumbilical and umbilical hernia, 3 Mayo's repair for epigastric hernia and 1 case of varicocelectomy for varicocele. One patient out of 24 cases of class I surgical wounds developed superficial incisional SSI, in which anatomical repair was done for epigastric hernia in a 82 years elderly male who was a known smoker and hypertensive. (**Table -6**)

Table 6:Clean wounds (Class I) and SSI

Clean wounds	No of cases	No of SSI	Type of SSI
Herniotomy	11	-	-
Anatomical repair	9	1	Superficial incisional
Mayo's repair	3	-	-
Varicocelectomy	1	-	-
Total	24	1	1 Superficial incisional

Out of 274 clean-contaminated surgical wounds, 14 (5.1%) cases developed SSI. Out of 14 cases of SSI, 9 were superficial incisional, 2 deep incisional & 3organ space SSI. (**Table-7**)

Table 7: Clean contaminated wounds (Class II) and SSI

Clean contaminated wounds	No of Cases	No of SSI	Type of SSI
Open cholecystectomy & others	148	8	5 Superficial incisional, 2 Deep incisional & 1 Organ space.
Laparoscopic cholecystectomy	77	1	1 Superficial incisional
Laparoscopic ureterolithotomy	1	1	1 Organ space
Enucleationhydatid cyst	3	-	-
Subtotal radical gastrectomy	5	-	-
Right hemicolectomy	5	1	1 Superficial incisional
Interval appendicectomy	2	2	-
Transverse colostomy	1	-	-

Abdominoperineal resection	2	1	1 Superficial incisional
Anterior resection	1	1	1 Superficial incisional
Diagnostic laparoscopy	1	-	-
Open urological operations	26	1	1 Superficial incisional
Total	274	14	9 Superficial incisional, 2 Deep incisional & 3 Organ space.

In contaminated surgical wounds, there was only 1 case of open cholecystectomy for empyema gall bladder. Intraoperatively gall bladder was grossly distended, inflamed and densely adherent to liver bed. During dissection gall bladder got ruptured leading to gross spillage of pus, this patient developed intraabdominal abscess which required percutaneous drainage.(**Table-8**)

Table 8: Contaminated wounds (Class III) and SSI

Contaminated wounds	No ofcases	No of SSI	Type of SSI
Open cholecystectomy for empyema gall bladder	1	1	Organ space

In this patient enucleation and external drainage of infected hydatid cyst was done for infected hydatid cyst liver and this patient developed deep incisional SSI. Initially this patient had PAIR and USG guided percutaneous drainage for hydatid cyst liver 4 months before admission and patient presented with purulent discharge at drain site and hydatid liver disease. Preoperatively on pus culture and sensitivity, sample revealed coagulase sensitive *Staphylococcus aureus* hence classified as dirty surgical wound**(Table 9)**.

Table 9:Dirty wound (Class IV) and SSI

Dirty wound	No of cases	No of SSI	Type of SSI
Enucleation and external drainage of infected hydatid cyst	1	1	Deep incisional

Pus discharge from wound was the commonest (47%) clinical feature of SSI in our study followed by pain incision site (29.4%), fever (23.5%), wound dehiscence (17.6%), tenderness (17.6%), redness (11.6%), pus discharge drain (11.6%) and swelling (5.8%).**(Table-10)**

Table-10:Clinical features of SSI

	Pus discharge	Pain	Fever	Wound dehiscence	Redness	Swelling	Tenderness	Pus discharge from drain
Superficial (n=10)	5	3	1	-	2	1	1	-
Deep (n=3)	3	2	1	3	-	-	2	-
Organ space (n=4)	-	-	2	-	-	-	-	2
Total N=(17)	8	5	4	3	2	1	3	2
Percentage	47	29.4	23.5	17.6	11.6	5.8	17.6	11.6

SSI rate was 100% in anterior resection, open cholecystectomy with cholecystoenteric fistula closure and laparoscopic ureterolithotomy and least in patients of laparoscopic cholecystectomy (1.2%).(Table -11)

Table 11: Rate of SSI across different operative procedures

Operative procedure with SSI	No of operations	No of SSI	%
Open cholecystectomy	142	4	2.8
Open cholecystectomy with closure of cholecystoenteric fistula	2	2	100
Open cholecystectomy with choledocholithotomy	4	2	50
Laparoscopic cholecystectomy	77	1	1.2
Pancreaticoduodenectomy	2	1	50
Anatomical repair	9	1	11
Abdominoperineal resection	2	1	50
Right hemicolectomy	5	1	20
Anterior resection	1	1	100
Laparoscopic ureterolithotomy	1	1	100
Nephrolithotomy	4	1	25
Enucleationhydatid cyst	3	1	33.3

Out of 17 samples subjected to culture, 10 (58.8%) turned out to be positive and 7 were sterile. Out of these 10 samples with positive isolates4 samples were Staphylococcus aureus, 1 sample of Coagulase negative Staphylococci (CoNS), 1 sample of Pseudomonas aeruginosa, 3 samples of Escherichia coli and 1 had 2 isolates i.e Escherichia coli (E.coli) and Klebsiella pneumoniae**(Table 12)**.

Table 12: Profile of aerobic microorganism isolated

Microorganism isolated	No of cases	Percentage
Staphylococcus aureus	4	23.4
Coagulase negative staphylococci	1	5.8
Escherichia coli	3	17.6
Escherichia coli, Klebsiella pneumonia	1	5.8
Pseudomonas aeruginosa	1	5.8
Pus /drain culture sterile	7	41
Total	17	100

DISCUSSION

In this study we observed the rate of SSI, profile of aerobic microorganisms and association of SSI with nature of elective abdominal surgery. In our study, majority of patients i.e 75.3% were females and 24.7% patients were males however in study by Kakati B et al [3]fromUttarakhand India, in their study have reported that 51.5% were males and 48.6% were females. Majority of our patients (75.3%) were of gall stone disease which is higher in females. In the present study, the overall SSI rate was 5.66% (17/300) which is consistent with the 5% SSI rate observed by Pathak et al [4] and Sahu et al [5]. Previous studies from India, have reported SSI rate up to 30%. Majority of SSI in our study were superficial incisional SSI (58%), followed by organ space (23.5%) and then deep incisional (17.6%). Health protection agency of United Kingdom also states that most of the SSI affects the superficial layer of the wounds [6]. Study by Bogdanic, et al [7], also reported that majority of the infection were superficial incisional (66.6%) followed by organ space (22.2%) and then deep incisional SSI (11%). Agarwal et al [8] have also reported correlation of SSI with type of operative procedure. In the present study, out of 17 cases of SSI, 10 (58.8%) had a positive culture result and 7 (41.2%) were culture negative.In 43.5% of the cases, no growth was found bySiddique AMJ et al [9] in their study similar to our study. However study by Patel et al [10] showed 87.5% of culture results positive.

Out of ten positive culture results, Staphylococcus aureus was isolated in 4 (40%), E.coli in 4(40%), Coagulase negative Staphylococci in 1(10%), Pseudomonas in 1(10%). In one patient two pathogens E.coli and Klebsiella were isolated. Afifi et al [11] also observed Staphylococcus aureus as most frequent single pathogen followed by E. coli, Klebsiella pneumoniae, Proteus and Pseudomonas aeruginosa.

CONCLUSION

Surgical site infection is one of the important complication of surgery. Contaminated and dirty wounds though rarely encountered in elective surgery SSIs are frequenly reported in these wounds.SSI rate specific operative procedure varies for different operations. However, major limitation lies in the

lack of attention to the varying risk for infection among patients in each class of wound.

REFERENCES

1. Howard JM, Barker WF, Culbertson R, Grotziner PJ, Iovine VM, Keehn RJ et al. Postoperative wound infections: The influence of Ultraviolet irradiation of the operating room and of various other factors. Ann of Surgery 1964;160:1-132.
2. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR: The Hospital Infection control practices Advisory Committee Guidelines for the prevention of the surgical site infection. Infect Control HospEpidemiol 1999; 20:247-80.
3. Kakati B, Kumar A, Gupta P, Sachan PK, Thakuria B. Surgical site abdominal wound infections: Experience at a north Indian tertiary care hospitalJIACM 2013;14(1):13-9.
4. Pathak A, Saliba EA, Sharma S, Mahadik VK, Shah H, Lundborg CS. Incidence and factors associated with surgical site infections in a teaching hospital in Ujjain, India. American Journal of Infection Control 2014;42:11-15.
5. Singh RR, Bansal DB, Deb KS, Aggarwal A, Puar GS. Bacteriological profile and antimicrobial susceptibility in SSI in electiveabdominal surgeries. Int J Res Health Sci [Internet]. 2014 Jan31;2(1):331-4.
6. Health Protection Agency. Surveillance of Healthcare Associated Infections. Report: 2008. Health Protection Agency.2008.http://www.hpa. Org. uk. web/ web/ HPAwebfile/HPA web–C/1216193833496.
7. Bogdanic B, Bosnjak Z, Budimir A, Augustin G , Milosevic M, Plecko V et al. Surveillance of Surgical Site Infection after Cholecystectomy Using the Hospital in Europe Link for Infection Control through Surveillance Protocol Surgical infec 2013;14(3):283-87.
8. Saxena A, Singh MP, Brahmchari S, Banerjee M. Surgical site infection among post operative patients of tertiary care in central India-A prospective study. Asian journal of Biomedical and Pharmaceutical Sciences. 2013;3(17),41-44.
9. Saxena A, Singh MP, Brahmchari S, Banerjee M. Surgical site infection among post operative patients of tertiary care in central India-A prospective study. Asian journal of Biomedical and Pharmaceutical Sciences. 2013;3(17),41-44.
10. Mahesh C B, Shivkumar S, Suresh B S, Chidanand S, Vishwanathy. A prospective study of surgical site infections in a teaching hospital. J ClinDiag Res 2010;4:3114-19.
11. Afifi IK, Labah EA, Ayad KM. Surgical site infections after elective general surgery in Tanta University Hospital: rate, risk factors and microbiological profile. Egyptian J Med Microbiol 2009;18:61-70.