



SURGICAL SITE INFECTIONS IN CLEAN AND CLEAN CONTAMINATED SURGERIES

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ABSTRACT **Aims And Objectives :-** The above study of "Surgical site infections and its prevention" has been Formulated to prospectively perform audit of SSIs, including collation of data of Surgeries for a period of around Twenty-two months. It is also aimed at analysing the Risk factors and dissemination of surveillance data for advocating uniform hospital Antibiotic policy and reducing infection in hospitals. **Materials & Methods :-** The present study was conducted on patients admitted in surgery department. A total of 129 "Clean" & "Clean contaminated" elective surgeries in the General Surgery unit were Included in the study. The study included all patients irrespective of their age, sex, associated co-morbidities and previous surgeries. Information was collected from the patients after a written, valid, informed consent. Representative surgeries which were taken for each group included:

- 1) Inguinal hernia meshplasties out of which 25 were bilateral inguinal hernias with both sides operated in the same sitting, 36 were unilateral hernias. The mesh used for all the surgeries was a 3 inch by 6 inch polypropylene mesh. Lichtenstein repair was done for all the cases. The inguinal hernias were included in the group of "Clean surgeries with implant", the implant i.e. the polypropylene mesh, being a permanent one.
- 2) Hydrocoele repair in the 'Clean group without implant'. Jaboulay's repair was performed in all the 29 hydrocoele repairs.
- 3) Open Cholecystectomies were in the Clean-contaminated group'. There were 39 open cholecystectomies

Most of the patients were admitted a day prior to the planned surgery.

Results :-

I. Results of 'clean surgeries with permanent implant (inguinal hernia Meshplasties): A total of 61 inguinal hernia meshplasties were performed. The operated hernias included 25 Bilateral hernias operated in the same sitting, 36 unilateral hernias. Out of these 61 Cases, 3 cases i.e. 4.9 % developed surgical site infections.

II. Results of 'Clean surgeries without implant': Total number of 29 hydrocele repairs were performed. The infection rate in our hydrocele repairs was 17.3%.

III. Results of "Clean contaminated cases": A total number of 39 open cholecystectomies were operated out of which 6 Developed SSI. The infection rate in our open cholecystectomies was 15.4%

Thus our study clearly demonstrates that SSIs are just the tip of an iceberg, with a plethora of associations and implications that also need to be tackled Simultaneously. However, Widespread and larger scale studies in varied set ups are Mandatory to ascertain their overall impact.

KEYWORDS :**INTRODUCTION**

Surgical site infection is a common malady mostly caused due to a healthcare associated infection. Surgical-site infection (SSI) is defined by the Centre for Disease Control and Prevention (CDC) as a proliferation of pathogenic micro-organism which develops in an incision site either within the skin and subcutaneous fat (superficial), musculo-fascial layers (deep), or in an organ or cavity, if opened during surgery.

SSIs are the third most frequently reported nosocomial infections, Urinary tract Infection being first and pneumonia being second. It accounts for 14-16% of all Nosocomial infections among hospitalised patients. Among surgical patients, SSIs are the most common nosocomial infections, accounting for 38% of all such infections. Between 5 and 10% of patients undergoing surgery are estimated to develop an SSI with an associated increased length of stay and increase in morbidity and mortality. However, prevalence studies tend to underestimate SSI because many of these infections occur after the patient has been discharged from hospital.

SSI can double the hospital stay of the patient, thereby doubly accelerating the costs of health care. In addition, deep incisional SSIs involving organ spaces as compared to SSIs confined to the superficial incisions are associated with even greater increase in hospital stay and cost. Strategies for prevention of SSIs help to reduce surgical patients morbidity, mortality and length of stay and save costs for the HealthCare institutions. The various infection control practises include thorough pre-operative hand washing, intranasal application of ointments which protect against the Methicillin-resistant Staphylococcus aureus (MRSA), operating room ventilation, sterilization methods, barriers, surgical techniques. Also, the prevention of surgical infection relies on optimisation of patient

factors and use of a variety of evidence-based pharmacological and non Pharmacological measures. At the forefront of these measures is antimicrobial Prophylaxis, which has been shown to be effective at reducing risk of surgical site infection, Despite of the above measures, SSIs still cause considerable morbidity and Mortality, thus burdening the healthcare system.

AIMS AND OBJECTIVES

The above study of "Surgical site infections and its prevention" has been Formulated to prospectively perform audit of SSIs, including collation of data of Surgeries for a period of around Twenty-two months. It is also aimed at analysing the Risk factors and dissemination of surveillance data for advocating uniform hospital Antibiotic policy and reducing infection in hospitals.

MATERIALS & METHODS

The present study was conducted on patients admitted in surgery department. A total of 129 "Clean" & "Clean contaminated" elective surgeries in the General Surgery unit were Included in the study. The study included all patients irrespective of their age, sex, associated co-morbidities and previous surgeries. Information was collected from the patients after a written, valid, informed consent. Representative surgeries which were taken for each group included:

- 1) Inguinal hernia meshplasties out of which 25 were bilateral inguinal hernias with both sides operated in the same sitting, 36 were unilateral hernias. The mesh used for all the surgeries was a 3 inch by 6 inch polypropylene mesh. Lichtenstein repair was done for all the cases. The inguinal hernias were included in the group of "Clean surgeries with implant", the implant i.e. the polypropylene mesh, being a permanent one.
- 2) Hydrocoele repair in the 'Clean group without implant'. Jaboulay's repair was performed in all the 29 hydrocoele repairs.

3) Open Cholecystectomies were in the Clean-contaminated group'. There were 39 open cholecystectomies Most of the patients were admitted a day prior to the planned surgery.

The patients were categorised based on their age and sex distribution and data for This was collected. Also the associated co-morbidities were noted for each patient, Such as diabetes mellitus. The diagnosed cases of diabetes mellitus were either on oral Hypoglycaemic agents or on insulin.

The duration of the surgeries was also an important factor in the occurrence or an SSI. The time was calculated from the time of incision up to the complete closure of the skin.

Standardised surgical antibiotic protocols were followed for all the above mentioned surgeries.

Wounds with purulent discharge were opened and swabs were collected under All aseptic precautions. These swabs were processed aerobically and anaerobically by Standard methods over blood agars and plain agars for a period of three days. Antibiotic sensitivity of the cultured organisms was tested with the antibiotics in use At our hospital. The reports of the wound cultures and antibiotic sensitivities were Available within 3 days of sending the swabs to our microbiology laboratory.

RESULTS

All patients were categorised into surgical groups (as stated in methods) and Occurrence of SSIs was assessed in relation to the following parameters (to Determine clinical significance):

- 1) Age distribution
- 2) Sex distribution
- 3) Medical co-morbidities (Diabetes mellitus)
- 4) Duration of surgery
- 5) SSIs at different follow up intervals
- 6) Organism cultured (if infected)
- 8) Pre and post-operative hospital stay

VI. Results of 'clean surgeries with permanent implant(inguinal hernia Meshplasties):
A total of 61 inguinal hernia meshplasties were performed

The operated hernias included 25 Bilateral hernias operated in the same siting, 36 unilateral hernias. Out of these 61 Cases, 3 cases i.e. 4.9 % developed surgical site infections.

1) Age Distribution:

The patients operated for inguinal hernia meshplasties were all above 20 Years of age.

Age groups	Operated cases	Infected cases	% of infection
0-10	0	0	0
11-20	0	0	0
21-30	8	0	0
31-40	8	0	0
41-50	8	1	12.5
51-60	14	0	0
61-70	15	2	13.3
71-80	8	0	0
81-90	0	0	0

2) Sex Distribution:

All the 61 operated cases of inguinal hernia meshplasties were male patients.

	Operated cases	Infected cases	% of infected cases
Diabetics	18	1	5.5
Non- diabetics	43	2	4.6

3) Medical Co-morbidities (Diabetic status):

Out of the 61 operated cases 18 patients were diabetic. Only one patient out of the 18 diabetic patients undergoing inguinal hernia Meshplasties developed SSI. The remaining 2 infected cases were amongst the 45 Non-diabetic ones.

4) Duration of surgery and rates of infection:

All the 61 cases of inguinal hernia meshplasties were completed within a span of 30 minutes to less than 2 hours,

5) Diagnosis of SSIs at different follow up intervals:

Out of the 43infected inguinal hernia meshplasties, 1 was diagnosed as

SSIs on post-operative day one due to development of fever spikes, other causes of fever ruled out. The remaining 2 were diagnosed during the second wound check on Being 7th or 8th post operative day.

6) Organisms culture:

None of the diagnosed cases of SSIs in the hernia repairs, showed any purulent Discharge or wound gaping. Fever, redness, tenderness and oedema were the Presenting features in most of the cases. Hence, no culture swabs could be sent from The infected hernias and thus no organisms pinpointed.

7) Pre And Post Operative Hospital Stay:

All the patients were admitted a day prior to the surgery and stayed in the Wards till discharge.

II. Results of 'Clean surgeries without implant':

Total number of 29 hydrocele repairs were performed. The infection rate in our hydrocele repairs was 17.3%.

1) Age Distribution

Age groups	Operated cases	Infected cases	% of infection
0-10	0	0	0
11-21	2	0	0
21-30	3	0	0
31-40	5	0	0
41-50	7	1	14
51-60	6	2	33.3
61-70	4	1	25
71-80	2	1	50
81-90	0	0	0

2) Sex distribution

All the operated hydroceles were males, obviously.

3) Medical co-morbidities (Diabetic status):-

	Operated cases	Infected cases	% of infected cases
Diabetics	9	0	0
Non- diabetics	20	5	25

4) Duration of surgery:

All the operated hydroceles were completed within a span of an hour and a Half.

5) SSIs at different follow up intervals:-

1 out of the 5 infected cases was detected during the first wound check on 2nd Post-operative day. 2 patients were picked up at the time of suture removal on Day 7th or 8th. The remaining 2 cases developed haematomas which got Infected and were detected late, 15 days after the surgery,.

6) Organisms cultured:

Pus samples were taken from the 6 infected wounds and cultured. The organisms isolated were Staphylococcus aureus from 2 samples, Coagulase negative staphylococcus from 1 sample. 2 samples exhibited no growth.

7) Pre and post-operative hospital stay :

All the patients were admitted a day before the surgery

II. Results of "Clean contaminated cases":-

A total number of 39 open cholecystectomies were operated out of which 6 Developed SSI. The infection rate in our open cholecystectomies was 15.4%.

1) Age Distribution

Age groups	Operated cases	Infected cases	% of infection
0-10	0	0	0
11-21	0	0	0
21-30	4	2	50
31-40	12	0	0
41-50	13	2	15.34
51-60	5	0	0
61-70	3	2	66.6
71-80	2	0	0
81-90	0	0	0

2) Sex Distribution:-

Out of 39 cases 26 were females and 13 are males.

3) Medical co-morbidities (diabetic status)

8 out of the 39 operated patients were diabetics. 1 patient out of the 6 infected cases was a diabetic.

	Operated cases	Infected cases	% of infected cases
Diabetics	8	1	12.5
Non- diabetics	31	5	16.1

4) Duration of surgery:

All the open cholecystectomies were performed within a span of 3 hours. The Dose of antibiotics was not required to be repeated in any of the cases. The Incidence of SSIs based on the surgical duration cannot be concluded due to each Surgery extending for around the same number of hours.

5) SSIs at different follow up intervals:-

Of the 6 infected cases were detected during the 1st wound check on post-Operative day 2 and the hospital stay of these patients extended to around 5 days. Remaining 1 case presented With discharge from the wound site on post- operative day 5 and was re-admitted for management of SSI.

6) Organisms cultured:-

All the 6 infected cases showed varied growth of organisms. Coagulase negative Staphylococci, E Coli, Acinetobacter, Pseudomonas were the organisms Cultured from 5 swabs. The remaining 1 swab exhibited no growth. 4 out of 6 Patients were empirically started on Amoxicillin & clavulanic acid out of which 1 healed completely. The other two were started on Cefotaxim and Amikacin Respectively.

8) Pre And Post-operative Hospital Stay

All the operated cases were admitted a day prior to the surgery. The 6 infected cases were kept in the wards for at least 3 days after the detection of surgical site infection. 1 out of these 6 was readmitted on day 5 post-operatively and was in the wards for a period of 5 days thereafter.

DISCUSSION

Infection of the surgical site is a frequent nosocomial problem. The incidence Of surgical site infections (SSIs) recorded in the course of the audit depends on the definition of "wound infection" adopted, on the intensity of surveillance for its occurrence as well as the prevalence of risk factors for SSI in the particular patient group being audited.

Surgeries have been divided into various groups which is clean, clean Contaminated, contaminated and dirty (infected) based on predefined, standardised, Specific peri-operative characteristics. ^[1] The representative surgeries falling in each Group included hernioplasties, Hydroceles in the clean group, elective Cholecystectomies as the clean contaminated. ^[1] In accordance with these, in our study Which is based primarily on the clean and clean contaminated group we have Incorporated inguinal hernia meshplasties in the clean group with implant. Hydrocele surgeries were included in the clean group without implant. In the clean Contaminated group we included open cholecystectomies.

The occurrence of SSIs, is governed by various factors which include both patient characteristics as well as operative and post-operative issues. Increased Number of prosthetic implants and organ transplantations being done lately, contribute Significantly to the SSI burden. The Central sterilization and surveillance Department (CSSD) and "Hospital infection control committee" are important Partners in the prevention of SSIs. Advances in infection control practises include Improved operating room ventilation, sterilization methods, improvised surgical Techniques and availability of better antimicrobial prophylaxis. ^[1]

Despite these latest technological advances, SSIs remain a substantial cause of Morbidity and mortality in most hospitalised patients. This may be partially Explained by the rampant emergence of antimicrobial resistant pathogens and Increased association of medical co-morbidities amongst patients VIS a vis their age, Nutritional status and immunodeficiencies, further compounded by lack of awareness And delayed presentation to clinicians.

Most western studies have reported rates of SSIs in clean surgeries between 1-4% as also less than 2% in a few cases ^[2]. 5-30% SSI rates have been indicated in different studies done in clean contaminated cases ^[3]. But the population studied, environmental factors, other factors influencing SSIs in the western studies are Significantly

different from the conditions in India. A study conducted at Mayo Hospital in Lahore, with almost similar settings as in India, reported an infection rate At 5.05% in clean and 8.39% amongst the clean contaminated cases ^[4]. Another Study by Hernandez from Peru in 2005, reported rates of 13.9% and 15.9% amongst clean And clean contaminated cases respectively ^[5]. The post operative wound Infection rate in our study was 6.5% in clean cases with a permanent implant (inguinal Hernia meshplasties With a polypropylene mesh), 17.2% in clean surgeries without Implant and 15.4% In clean contaminated cases which included open Cholecystectomies. Though the infection rates are low and in accordance with the Universal standards in our clean surgeries with implant, i.e. the inguinal hernia Meshplasties, the higher infection rates in other clean surgeries and the clean Contaminated ones at our hospital could be due to strict, vigilant follow ups, well Educated population presenting at the earliest warning signs and no dropouts as the Patients were very closely followed. Authors of previously published studies have suggested that each SSI is Associated with a mean attributable increase of 7-10 days in the duration of post- Operative hospitalization. ^[6] An Indian study, estimated an overall loss of 12 Patient-days per episode of SSI ^[7]. The average post-operative hospital stay at our Hospital was 3-5 days in all the cases. Patient's age is an important marker towards the incidence of surgical site Infections. Risk factors among elderly and young patients vary, as do their clinical Presentations. The mortality rate, duration of hospitalization and the costs associated With hospital care are higher for elderly patients with SSIs than younger patients. Also, studies have shown an increased risk of SSIs after 40 years of age ^[8,9]. Our Study also has a similar trend with all the 3 infected cases of inguinal hernia Meshplasties being above 40 years of age. Additionally, the infected hydroceles were Also above 40 years of age. This can be attributed to multiple factors like low healing Rates, malnutrition, malabsorption, increased catabolic processes and lowered Immunity among the elderly population. The infected open cholecystectomies did not Exhibit such a trend.

SSIs are shown to be higher in males as compared to females in a few reported studies. ^[10] The study conducted at Mayo hospital, Lahore showed that 6 of 52 operated males (11.5%) and 5 of the 48 female patients (10.4%) developed SSI ^[4]. AS our study includes only males in two of the categories and in the third which is open cholecystectomy there is no difference between infection rates in male and female patients, so our study does not show any male preponderance in Contrast to the above studies.

The contribution of diabetes to SSI risk is controversial ^[11,12]. Diabetes mellitus has been reported as being notorious to produce overwhelming sepsis from even a minor wound. It is a major predictor of post-surgery morbidity and mortality, with approximately 30% to 40% of complications occurring in these patients. ^[13]

Duration of surgery is another risk factor for SSI. It has been observed that Wound infection rate is influenced by the duration of surgery ^[14]. Many studies claim That the infection rates are directly proportional to the surgical duration ^[15]. The Surgeries extending beyond 240 minutes have shown higher incidence of wound Infection ^[16]. The inguinal hernia meshplasties, hydrocele repairs were completed Within a span of maximum I and half hours. None of our cholecystectomies extended Beyond a duration of 3 hours. Therefore, it was difficult to compute the infection rates Based on the surgical duration at our hospital.

Many studies have reported Staphylococcus aureus as the commonest isolate from the post-operative wound infection in clean cases ^[17]. The commonest bacterial Isolates found in clean contaminated cases in various studies were S. Aureus, E.coli, Klebsiella, Pseudomonas and Streptococci ^[17]. An Indian study performed by Lilani et al also showed predominance of Pseudomonas in the infected clean contaminated cases ^[3]. This study has also shown that the clean contaminated cases usually exhibit A polymicrobial flora closely resembling the normal endogenous microflora of the Resected organ ^[3]. Arora et al have quoted a figure of 87% for positive cultures ^[3]. The commonest presentation of wound infection in our setup was redness and Swelling around the wound with associated systemic features like fever in a few Hernioplasties . None of the hernias showed wound dehiscence and no mesh removals were Needed. No cases of septicaemia, spreading cellulitis or necrotising fasciitis, Which usually show a polymicrobial culture, were seen by us. Staphylococcus aureus And Coagulase negative staphylococci were the organisms isolated from clean cases Without implants. The clean contaminated cases exhibited Coagulase negative Staphylococci, E.coli, Pseudomonas, Acinetobacter as the

microbial spectrum. This is more or less similar to the microbiological spectrum seen in the above mentioned studies. Our study also demonstrated 23% of negative cultures with positive ones being 77%. A prolonged pre-operative hospital stay with exposure to hospital environment and its ubiquitous diagnostic procedures, therapies and microflora have been shown to increase the rates of SSIs. Kowli et al reported an infection rate of 17.4% when pre-operative hospital stay was 0-7 days and an infection rate of 71.4% when pre-operative stay of more than 21 days^[18]. In our present study, all the patients were admitted a day prior to the surgery. Hence, there is no definite co-relation between increased rates of surgical site infections and hospital stay in our study.

CONCLUSION:

Thus our study clearly demonstrates that SSIs are just the tip of an iceberg, with a plethora of associations and implications that also need to be tackled simultaneously. However, widespread and larger scale studies in varied set ups are mandatory to ascertain their overall impact.

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