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Dr. Milan Joshi

Junior Resident, Department of
General Surgery, Apollo BGS
Hospital, Mysuru, Karnataka,
India

Dr. Srinath S

Consultant Surgeon, Department
Of General Surgery, Apollo BGS
Hospital, Mysuru, Karnataka,
India

Dr. Jayanth BN

Consultant Surgeon, Department
Of General Surgery, Apollo BGS
Hospital, Mysuru, Karnataka,
India

Retrospective and prospective study of surgical site infection, associated risk factors and profile of causative micro-organisms in laparotomy wounds

Dr. Milan Joshi, Dr. Srinath S and Dr. Jayanth BN

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Abstract

Background: Surgical site infection (SSI), is a major complication of surgery and third most commonly reported nosocomial infection. SSI increase length of stays in hospital, costs of health care and morbidity and mortality of patients. This study aims to determine the incidence, associated risk factors and type of pathogenic organisms causing laparotomy wound infection.

Methods: This study was done on 200 patients who underwent elective and emergency laparotomy. Diagnosis of wound infection was clinical. Discharge from all wounds was subjected to microbiological analysis.

Results: The incidence of SSI following laparotomies is 25%. Risk factors being emergency laparotomy, dirty wound, male sex, increased age, smoking, diabetes mellitus, obesity, haemoglobin < 10 gm %, albumin < 3gm/dl, duration of surgery > 2hrs. Most common organism isolated was *E. coli*.

Conclusion: In handling laparotomy cases all aseptic precautions should be maintained, risk factors should be identified early and infections should be treated as per culture sensitivity pattern.

Keywords: Surgical site infection, emergency laparotomy, diabetes, risk factors for SSI

1. Introduction

Postoperative wound infections, also known as surgical site infections (SSIs), complicate the recovery course of many patients.

The microbiological profile of infections depends on the nature of the procedure, site where incision is made, and whether a body cavity or hollow viscus is entered during surgery [1]. Most surgical site infections are caused by skin commensals which might enter the skin incision during surgery; thus most common pathogens are all gram-positive cocci-*Staphylococcus epidermidis*, *S. aureus* (most common) [2], and *Enterococcus* spp. In surgeries in which we enter a body cavity like the abdomen or chest, gram-negative bacilli such as *Escherichia coli* and *Klebsiella* spp. are potential pathogens. Also in surgeries performed on the upper and lower gastrointestinal tract or urogenital tract, anaerobic bacteria prevail as infection pathogens.

After a thorough review of literature it has been found that there have been many advances in infection control practices which include improved operating room ventilation, better sterilization methods, aseptic barriers, good surgical techniques, and availability of wide range of antimicrobial prophylaxis. Despite this surgical site infections remain a substantial cause of morbidity and mortality among hospitalized patients. This may be due to emergence of antimicrobial-resistant pathogens and the increased numbers of surgical patients who are elderly and/or have a wide variety of chronic, debilitating, or immune-compromising underlying diseases. There also are increased numbers of prosthetic implant and organ transplant operations performed. Therefore, to bring about a reduction in the risk of these surgical infections, a methodical but realistic approach must be applied. We also need to be aware that this risk is influenced by characteristics of the patient, operation, personnel, and hospital [3].

2. Materials and Methods

This is a retrospective and prospective study done on 200 patients admitted and who underwent laparotomies in Surgical Department of a tertiary care centre, Apollo BGS Hospitals, Mysore from June 2015 to December 2018. An elaborate study of these cases with regard to history, clinical features of wound infection, type of surgery, emergency or elective, preoperative

Corresponding Author:

Dr. Milan Joshi

Junior Resident, Department of
General Surgery, Apollo BGS
Hospital, Mysuru, Karnataka,
India

investigations, personal history including diet, smoking, and alcoholism, history of any previous abdominal surgeries and peri operative sepsis was taken, duration of operation, length of hospital stay and postoperative management is done till patient is discharged from hospital, and then followed up the patient on OPD basis for any signs of wound infection. Retrospective case details were recorded from medical record section, microbiology department and medical record software. Findings on the day of diagnosis of wound infection were noted which included fever, erythema, discharge, type and colour and the exudates was collected from the depth of the wound using sterile cotton swab and was sent to microbiology department for culture and sensitivity.

2.1 Inclusion criteria

All cases admitted for elective or emergency laparotomies in surgical department of Apollo BGS Hospitals, Mysore.

2.2 Exclusion criteria

1. Patients less than 12 years of age
2. Patients with active tuberculosis
3. Patients with HIV
4. Patient on steroid therapy
5. Patients undergoing chemotherapy
6. Pregnant ladies

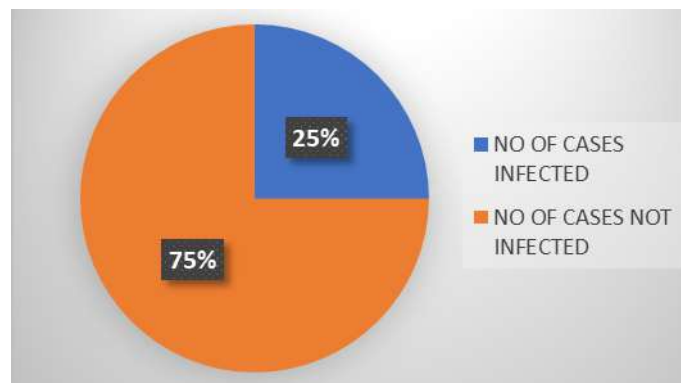
2.3 Data Analysis: All of the data was recorded on excel sheets with regards to the age and sex of the patient, type of surgery, co-morbidities, duration of surgery, type of surgery, drain placement, preoperative Haemoglobin and Albumin, and all data was analysed using the statistical methods of CHI SQUARE test.

3. Results

3.1 Incidence of surgical site infection.

This study included 200 abdominal surgical patients, out of which 50 were infected.

Bringing the incidence of SSI to 25%.



Graph 1: Incidence of surgical site infection

3.2 Age and gender distribution.

Among the 200 cases 98 were male patients and 102 were females. Of the 98 male patients 31 had wound infection in the post-operative period while amongst 102 females only 19 had postoperative wound infections.

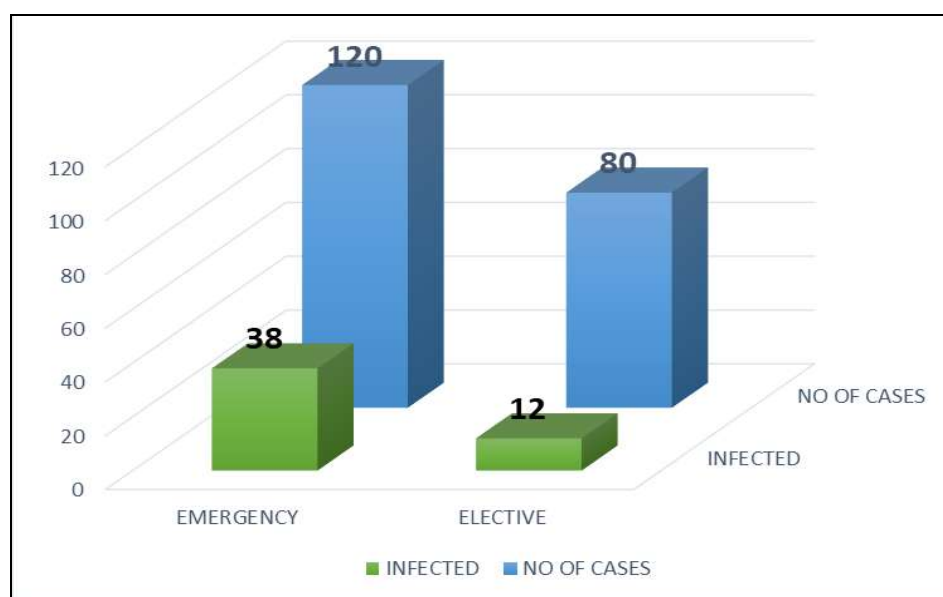
Infection is more commonly seen in patients aged > 60 years with an incidence of 33.84% and also among 51-59 years (30%). Youngest patient in this study was 15 years and oldest 92 years.

Table 1: Incidence in relation to sex

Infection	Sex		Total	Chi square value	df	P value
	Female	Male				
Absent	83	67	150	4.508 ^a	1	.034 Sig
Present	19	31	50			
Total	102	98	200			

3.3 Comparison between elective and emergency cases

Of all the laparotomies 120 were emergency and 80 were elective. in my study the rate of infection in emergency laparotomies (31.66%) was higher as compared to elective cases (15%).



Graph 2: Incidence in relation to type of operation

3.4 Comparison of incidence of SSI with BMI.

In this study most patients were having a BMI of >25, followed by 23-24.9. Incidence of infection was more in extreme of the

BMI of 23 -24.9 which was 36.53% followed by in <18kg/m² which was 27.77%. Group 18.5 – 22.9 had a infection rate of 24.24%. Lowest rate was found in >25kg/m² group (18.55%).

Table 2: Incidence in relation to BMI

infection	BMI (kg/m ²)				Total	Chi square value	Df	P value
	<18.5	18.5-22.9	23-24.9	>25				
Absent	13	25	33	79	150	5.924 ^a	3	.115 NS
Present	5	8	19	18	50			
Total	18	33	52	97	200			

3.5 Type of surgery and use of drain with incidence of SSI.

As this study involves the cases of patients having undergone laparotomies, there are no clean cases studied here. Highest

number of cases were clean-contaminated cases followed by dirty cases. Incidence of infection was highest in dirty cases that is 42.30% followed by in contaminated cases of 22.22%.

Table 3: Incidence in relation to type of SSI

Infection	Type of Surgery			Total	Chi square value	df	P value
	Contaminated	Clean-Contaminated	Dirty				
Absent	14	105	31	150	8.946 ^a	2	.011 Sig
Present	4	25	21	50			
Total	18	130	52	200			

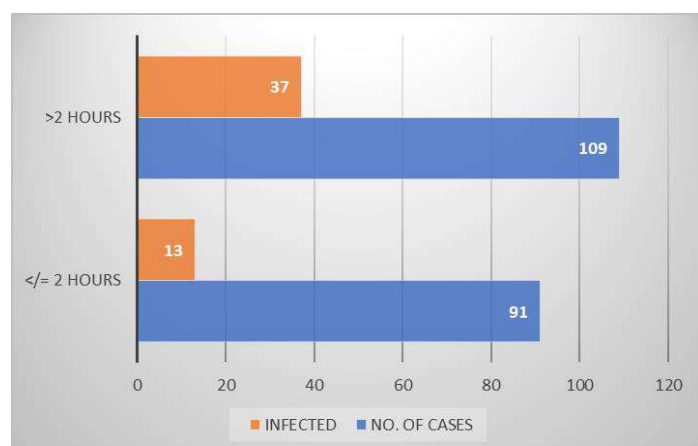
Table 4: Incidence with use of drains

Infection	Drain		Total
	Used	Not Used	
Present	25	25	50
Absent	67	83	150
Total	92	108	200

Out of 200 patients, 92 cases had drain usage of which 25 got infected, whereas out of the 108 with no drains 25 got infected.

3.6 Comparison of duration of surgery with the incidence of SSI

Of the total 200 cases, 91 lasted for less than 2 hours and 109 lasted for more than 2 hours. Of these the rate of infection was 33.94% among surgeries lasting for more than two hours.

**Graph 3:** Incidence of SSI with duration of surgery**3.7 Comparison of co morbidities and nutritional status with incidence of SSI**

Total 45 patients out of 200 were Diabetics of which 20 had postoperative wound infection as compared to 30 infection. Smoking as a co-morbidity was present among 24 patients among which 9 cases got infected and 41 got infected among non-smoker.

Out of total number of cases, 59 had hypoalbuminemia of which 25 developed surgical site infections. Amongst 141 with normal albumin levels 25 developed infection.

Out of the 74 anemic patients 26 had wound infection, amounting to a rate of 35.13% as apposed to 19.04% amongst patient with normal haemoglobin levels.

Table 5: Incidence of SSI with Diabetes as risk factor

Infection	DM		Total	Chi square value	df	P value
	Absent	Present				
Absent	125	25	150	11.708 ^a	1	.001 Sig
Present	30	20	50			
Total	155	45	200			

Table 6: Incidence of SSI with smoking as risk factor

Infection	Smoking		Total	Chi square value	df	P value
	Absent	Present				
Absent	135	15	150	9.800 ^a	1	.002 Sig
Present	36	14	50			
Total	171	29	200			

Table 7: Incidence of SSI with Hypoalbuminemia as risk factor

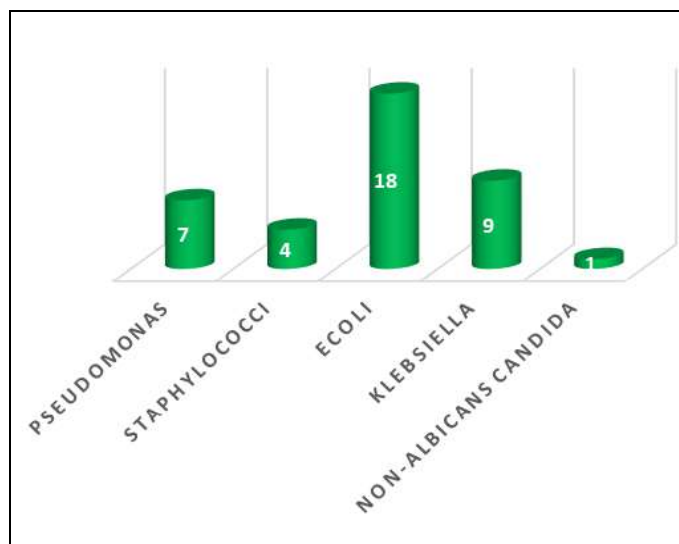
Infection	Hypoalbuminemia		Total	Chi square value	df	P value
	Absent	Present				
Absent	116	34	150	13.471 ^a	1	<.0001
Present	25	25	50			
Total	141	59	200			

Table 8: Incidence of SSI with Anaemia as risk factor

Infection	Anaemia		Total	Chi square value	df	P value
	Absent	Present				
Absent	102	48	150	6.435 ^a	1	.011 Sig
Present	24	26	50			
Total	126	74	200			

3.8 Spectrum of microorganisms isolated.

In this study the organism most commonly isolated was *E. coli* (18) followed by *Klebsiella* (9) and *Pseudomonas aeruginosa* (7). Few of the pus culture reports had no growth even after 48 hours of incubation.



Graph 4: Type of organism isolated from infected wound

4. Discussion

Surgical site infection (SSI) has always been a major complication of surgery and trauma and has been documented for 4000–5000 years [4]. Now surgical site infections are the third most commonly reported nosocomial infections and account for 25% of the same. For surgical patients, SSIs are the most common nosocomial infections and are shown to be the leading cause of operation related adverse events [5]. As defined by the Centre for Disease Control and Prevention (CDC), these infections typically occur within 30 days of an operation at the site or part of the body where the surgery took place, or within a year if an implant is left in place and the infection is thought to be secondary to surgery [6-8]. The overall infection rate in abdominal surgeries depends on various factors such as hospital settings, surgeon's operative techniques, patients' comorbidities and nutritional status.

The overall incidence of SSI for laparotomies performed in this study was 25% falling within the range of data on SSI from various parts of India (6.09 to 38.7%). When compared to western literature these infection rates are higher than the set range for European countries (2.5%) or US (2.8%) [9]. These statistical differences in infection rates in Indian hospitals may be due to unavailability of resources to prevent infections and due to the ignorance of basic infection control measures and guidelines. Most of these infections were superficial (54%) SSI. Males having a higher incidence of surgical site infection of 32.65% as compared to 17.64% in female patients showed significance with a P value of 0.034. This can be attributed to humoral and cell-mediated immune responses and absence of immunosuppressive effects by androgenic hormones being more prominent in females [10-11].

The high incidence of 33.84% in patients above 60 years, in this study is perhaps due to weakened immune system and increased co-morbid factors which may tend to increase with increasing age and are also independent statistically significant risk factors for developing SSI as per this study like Diabetes Mellitus (P value – 0.001, poor nutrition (Anemia (P value -0.011, hypoalbuminemia (P value -<0.0001)) and smoking (P value - 0.002).

In emergency surgeries inadequate pre-operative preparation, the underlying conditions more frequency of contaminated or dirty wounds are possibly predisposing to a higher infection rate (P value- 0.008). This study showed that increased operative time was associated with a higher incidence of SSI and was

statistically significant (P value – 0.010) which has been assessed and established by previous studies also.

The most common organism isolated in our study was *E. coli* (36%) followed by *Klebsiella* (18%) and *Pseudomonas* (16%). Staphylococcal infection was found in 8% patients. And one patient had infection with Non Albicans Candida. This is consistent with findings of other workers [12-13]. In abdominal surgeries the opening of the gastrointestinal tract increases the likelihood of coliforms, gram negative bacilli which was our finding in this study.

5. Conclusion

From this study we can conclude that the presence of proper infrastructure and resources an upto date knowledge of all aseptic precautions and guidelines by hospital staffs involved and prompt identification of high risk factors in all patients is a must in perioperative period. Improvement in surgeon factors like surgical technique and tissue handling should also be inculcated in young surgeons from the start to help in prevention of SSI. These steps are necessary because as quoted by Sir William Osler "Except on few occasions, the patient appears to die from the body's response to infection rather than from it". Therefore here "prevention is the only cure" and preventing infection should be one of the topmost priority for a surgeon.

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