



ORIGINAL RESEARCH PAPER

General Surgery

STUDY OF MICROORGANISMS RESPONSIBLE FOR SURGICAL SITE INFECTIONS IN PATIENTS UNDERGOING LAPAROTOMY

KEY WORDS: surgical site infection, laparotomy, Escherichia coli, wound contamination

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ABSTRACT

Background: Surgical site infections (SSI) are major risk of surgery and represent a substantial burden of disease for both patients and healthcare services in terms of morbidity, mortality and financial cost as well as increases the discomfort and disability experienced by patients following surgical procedures. The pathogenesis of SSI has been associated both with the endogenous contamination, burden of organism and virulence factors of pathogens. In present study we studied microorganisms responsible for surgical site infections in patients undergoing laparotomy.

Material and Methods: Present study was a hospital based retrospective study conducted in cases of surgical site infection in patients who underwent laparotomy at our tertiary care hospital, detected micro-organism on microbiological culture study.

Results: In present study, total number of cases studied were 348 & SSI was noted in 38 cases. Incidence of SSI was 10.92%. Most common age group was 41-50 years (26.32%), followed by 51-60 years (23.68%). Male to female ratio was 2:1. SSI was more common in emergency laparotomies (71.05%), ASA grade II/IV patients, surgeries lasting for more than 2 hours & were diagnosed on day 5-7 (55.26 %). Most wounds were clean contaminated (44.74 %) & contaminated (28.95%) as per CDC classification. Anemia (39.47 %), Diabetes (23.68 %), Obesity (21.05 %) & Smoking (15.79 %) were common risk factors noted. SSI was commonly noted in small bowel surgeries (13.16 %), herniotomy (13.16 %), gastric surgery (10.53 %), appendicectomy (10.53 %) & cholecystectomy (10.53 %). *Escherichia coli* (55.26 %) was most common organism isolated in present study, other organisms were *Staphylococcus aureus* (36.84 %), *Klebsiella spp.* (10.53 %), *Pseudomonas* (10.53 %) & *Coagulase Negative Staphylococci* (10.53 %).

Conclusion: A pre-existing medical illness, male gender, prolonged operating time, the wound class, emergency surgeries and wound contamination strongly predispose to wound infection.

INTRODUCTION

Surgical site infection (SSI) is defined as a wound infection that occurs within 30 days of an operative procedure or within a year if an implant is left in place and the infection is thought to be secondary to surgery.¹ SSIs account for a high proportion of the total number of hospital acquired infections (HAIs) and have a great impact on patients health care cost, morbidity, and mortality worldwide.^{2,3}

Surgical site infections (SSI) are major risk of surgery and represent a substantial burden of disease for both patients and healthcare services in terms of morbidity, mortality and financial cost as well as increases the discomfort and disability experienced by patients following surgical procedures.³

Clinical presentation of SSI varies from a spontaneous wound discharge within 7-10 days of an operation to a life-threatening postoperative complication. The usual presentation of infected surgical wound can be characterized by pain, tenderness, warmth, erythema, swelling and pus formation.^{4,5}

The pathogenesis of SSI has been associated both with the endogenous contamination such as skin flora and exogenous contamination by healthcare personnel or contaminated surgical instruments. Other factors such as burden of organism and virulence factors of pathogens also play a major role in occurrence of SSI.⁶ In present study we studied microorganisms responsible for surgical site infections in patients undergoing laparotomy.

MATERIAL AND METHODS

Present study was a hospital based retrospective study conducted in the Department of General Surgery at Yenepoya Medical College and Hospitals, Mangalore. For present study cases of SSI from 2014-2019 were studied. Institutional ethical committee approval was taken.

Inclusion Criteria

- Cases of surgical site infection in who underwent laparotomy at our tertiary care hospital, detected micro-organism on microbiological culture study.

Exclusion Criteria

- Culture negative SSIs
- Patients underwent laparotomy outside

In this study, all patients who were admitted in General surgery, who had surgical site infection followed by laparotomy were taken into consideration. Wound swab which was sent for culture and sensitivity, reports were collected and analysed. Statistical analysis was done using descriptive statistics. For qualitative variables mean and standard deviation and for quantitative variable frequency and percentage were used for analysis.

RESULTS

In present study, total number of cases studied were 348 & SSI was noted in 38 cases. Incidence of SSI was 10.92%. Most common age group was 41-50 years (26.32%), followed by 51-60 years (23.68%). Male to female ratio was 2:1. SSI was more common in emergency laparotomies (71.05%), ASA grade II/IV patients, surgeries lasting for more than 2 hours & were diagnosed on day 5-7 (55.26 %). Most wounds were clean contaminated (44.74 %) & contaminated (28.95%) as per CDC classification. Anemia (39.47 %), Diabetes (23.68 %), Obesity (21.05 %) & Smoking (15.79 %) were common risk factors noted.

Table 1- General characteristics

Parameter	Number of patients	Percentage
Age (in years)		
< 20	1	2.63
21-30	2	5.26

31-40	5	13.16
41-50	10	26.32
51-60	9	23.68
61-70	8	21.05
71-80	3	7.89
Gender		
Male	25	65.79
Female	13	34.21
Type of surgery		
Elective	11	28.95
Emergency	27	71.05
ASA status of patients		
I	6	15.79
II	8	21.05
III	12	31.58
IV	9	23.68
V	3	7.89
Class of wounds		
Clean	6	15.79
Clean contaminated	17	44.74
Contaminated	11	28.95
Dirty	4	10.53
Duration of surgery		
< 1 hour	4	10.53
1-2 hours	7	18.42
1-2 hours	23	60.53
>3 hours	4	10.53
Co-morbid factors		
Anemia	15	39.47
Diabetes	9	23.68
Obesity	8	21.05
Smoking	6	15.79
Retroviral disease	3	7.89
Chronic liver disease	3	7.89
Diagnosed on post-operative day		
Day 5-7	21	55.26
Day 8-12	11	28.95
Day 12-18	4	10.53
After day 18	2	5.26

In present study SSI was commonly noted in small bowel surgeries (13.16 %), herniotomy (13.16 %), gastric surgery (10.53 %), appendicectomy (10.53 %) &cholecystectomy (10.53 %).

Table 2- Surgical Procedure

Surgical Procedure	No. of patients	Percentage
Small Bowel Surgeries	5	13.16
Herniotomy	5	13.16
Gastric Surgery	4	10.53
Appendicectomy	4	10.53
Cholecystectomy	4	10.53
Herniorrhaphy	3	7.89
Incisional Hernia repair	3	7.89
Colorectal surgery	3	7.89
Suprapubic Cystolithotomy	2	5.26
Bladder Surgery	2	5.26
Splenectomy	2	5.26
Trans Vesical Prostatectomy	1	2.63

Escherichia coli (55.26 %) was most common organism isolated in present study, other organisms were *Staphylococcus aureus* (36.84 %), *Klebsiella spp.* (10.53 %), *Pseudomonas* (10.53 %) &*Coagulase Negative Staphylococci* (10.53 %).

Table 3- Isolated organisms

Isolated organisms	No. of patients (n=38)	Percentage
<i>Escherichia coli</i>	21	55.26
<i>Staphylococcus aureus</i>	14	36.84
<i>Klebsiella spp.</i>	4	10.53

<i>Pseudomonas,</i>	4	10.53
<i>Coagulase Negative Staphylococci</i>	4	10.53
<i>Providencia spp.</i>	1	2.63
<i>Citrobacter spp</i>	1	2.63
<i>Proteus mirabilis</i>	1	2.63

DISCUSSION

Advances in infection control practices such as improved operating room ventilation, sterilization methods, barriers, surgical technique, and availability of antimicrobial prophylaxis. Despite these activities, SSIs remain a substantial cause of morbidity and mortality among hospitalized patients. This may be partially explained by the 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 immunocompromising underlying diseases.²

There are some known risk factors associated with the surgical wound infection and disruption. Important amongst them are overweight, increasing age, poor nutrition, diabetes, jaundice, smoking, malignant growth, presence of prior scar or radiation at the incision site, non-compliance with post-operative instructions (such as early excessive exercise or lifting heavy objects), surgical error, increased pressure within the abdomen due to: fluid accumulation (ascites); inflamed bowel; severe coughing; straining; or vomiting, long-term use of corticosteroid medication, duration of operation, perioperative infusion, type of wound and length of hospital stay other medical conditions such as: diabetes; kidney disease; cancer; immune problems; chemotherapy; radiation therapy.^{7,8}

In study by Adeyinka A et al.,⁹ wound assessment was done using standardized criteria stipulated by the CDC & an incidence rate of SSI was 38.1%. Identified risk factors for SSI include anemia, contaminated and dirty wounds, retroviral disease status, physiological status (ASA scores IV and V), prolonged surgery time, cadre of surgeon, emergency surgeries and use of drains. The high incidence of SSI observed in this study was found more in patients that presented with septic abdomen and those that had large bowel procedures.

Aroub Alkaaki et al.,¹⁰ studied 337 patients, overall incidence of SSI was 16.3%; 9% patients had deep infections, and 45% had combined superficial and deep infections. The incidence of SSI in open versus laparoscopic operations was 35% versus 4% (p < 0.001). The bacteria most commonly isolated were extended-spectrum β -lactamase-producing *Escherichia coli*, followed by *Enterococcus* species. Only 23% of cultured bacteria were sensitive to the prophylactic antibiotic given preoperatively. The independent predictors of SSI were open surgical approach, emergency operation, longed operation duration and male sex. Similar findings were noted in present study.

In study by Marie Josée et al.,¹¹ overall incidence of SSI was 10.9%. The most common pathogens isolated were *Klebsiella ssp* (55%), followed by *Escherichia coli* (15%) and *Proteus ssp* (12%), *Acinetobacter* (9%), *Staphylococcus aureus* (6%) and coagulase-negative staphylococci (3%). The pathogens revealed different levels of antibiotic resistance; amoxy-clavulanic acid (98.8%), gentamicin (92.6%), ciprofloxacin (78.1%) and ceftriaxone (53.3%). On the other hand, Amikacin and imipenem were the only two most effective antibiotics for all isolated pathogens with 100% sensitivity. The associated risk factors were found to be an increased age, ASA class, wound classification, skills and experience of the surgeon, longer duration of surgery (> 2 h), prolonged duration of hospital stay, blood transfusion and emergency surgery.

In other studies, *S. aureus*, has been found to be the

predominant cause of SSI, which can be explained by its presence in the skin as normal flora and can thus enter to deep site during surgery.^{11,12}

In our study we found that *Escherichia Coli* was the most frequently isolated organism, followed by *Staphylococcus aureus*, *Klebsiella*, *Proteus*, *Pseudomonas*, *Coagulase Negative Staphylococci*, and others. It only seems logical to conclude that the organisms were from the resident flora of the skin or the intestines. *E Coli* was frequently positive in cases in which hollow viscus had perforated.

In study by Raghav Jindal,¹³ that maximum SSI were caused by *E.coli* species (54.55%), followed by *Klebsiella* species (42.05%) and *Pseudomonas* species (18.18%) [15]. In this study, we have found that organisms isolated from surgical site were most sensitive to amikacin (81.81%), followed by imipenem (69.31%), colistin (55.69%) and gentamycin (39.77%). Similar findings were noted in present study.

In study by Vikrant Negi et al.,¹⁴ *E. coli* (46.4%) was the commonest gram negative bacteria isolated followed by *P. aeruginosa* (15.9%) and *Citrobacter* spp (15.9%). Similar observations have been reported by various other authors also. Antimicrobial profile of gram positive isolates revealed maximum sensitivity to vancomycin, teicoplanin and linezolid, whereas among gram negative isolates meropenem, piperacillin-tazobactam, and amikacin were found to be most sensitive.

In study by Patel Sachin M,¹⁵ 32 patients developed surgical site infections (16%). Out of 32 infected cases, 28 cases were culture positive (87.5%), while 4 cases were culture negative (12.5%). The pathogens isolated were *Escherichia coli* (35.7%), *Klebsiella* spp (21.4%), *Coagulase negative Staphylococci* (14.3%), *Pseudomonas aeruginosa* (14.3%), *Staphylococcus aureus* (7.1%) and *Proteus mirabilis* (7.1%).

Prophylaxis is indicated for laparotomy procedures, as infection, stasis due to obstruction many times associated with colorectal procedures, morbid obesity, malignancy leads to increased risk for sepsis as well as SSIs. Although the local flora is altered in these patients, antibiotic spectrum should be directed at gram-negative aerobes and anaerobic bacteria is recommended.^{16,17}

CONCLUSION

A pre-existing medical illness, male gender, prolonged operating time, the wound class, emergency surgeries and wound contamination strongly predispose to wound infection. Pre-operative antimicrobial prophylaxis & an organized system of wound surveillance/ reporting are the most effective means to reduce the wound infection.

Figure legends

- Table 1- General characteristics
- Table 2- Surgical Procedure
- Table 3- Isolated organisms

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