



Research Article

Risk Factors and Predictors of Surgical Site Infection Following Abdominal Surgery.

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Abstract: Background: Surgical site infection (SSI) contributes to morbidity after abdominal surgery. **Objective:** To evaluate the incidence and patient- and procedure-related factors associated with SSI among 50 patients undergoing abdominal surgery. **Methods:** A single-centre observational study was conducted at Pushpalata D Y Patil Hospital and Research Center, Ambi, Pune, during 1 January to 30 June 2026. Patient characteristics, comorbidities, ASA status, operative urgency, approach, wound classification, operative duration and SSI outcomes were evaluated. **Results:** SSI occurred in 10 of 50 patients (20.0%), including six superficial incisional, three deep incisional and one organ/space infection. SSI was recorded after 7 of 21 emergency operations compared with 3 of 29 elective operations and in 8 of 21 contaminated or dirty wounds compared with 2 of 29 clean or clean-contaminated wounds. Diabetes and hypoalbuminemia were more frequent among patients with SSI. Mean postoperative stay was 11.8 ± 4.2 days in the SSI group and 6.1 ± 2.3 days in the non-SSI group. **Conclusion:** SSI was associated with differences in operative urgency, wound contamination and patient clinical characteristics. Consistent perioperative prevention and postoperative surveillance remain essential. Larger studies are required to identify independent predictors.

Keywords: surgical site infection; abdominal surgery; postoperative infection; risk factors; wound contamination; emergency surgery; diabetes mellitus; India.

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INTRODUCTION

Surgical site infection (SSI) remains a major healthcare-associated complication, adding to postoperative morbidity, antimicrobial use, length of hospital stay, and healthcare expenditure [1,2]. Gastrointestinal operations are especially susceptible because intestinal flora, underlying infection, spillage, and physiological instability can contribute to microbial contamination [3]. Risk reflects interacting patient factors—such as diabetes, elevated body mass index, smoking, anemia and nutritional status—and operative factors, including emergency surgery, wound classification, procedure complexity and operative duration [1–3]. SSI can be superficial incisional, deep incisional, or organ/space according to standardized surveillance definitions [4]. International guidance emphasizes timely and appropriate antibiotic prophylaxis, antisepsis, perioperative glycemic management, and consistent surveillance [1,2]. Local data can help refine preventive protocols, but small single-centre datasets require cautious interpretation. The objective of this study was to evaluate SSI occurrence and explore associated factors among abdominal surgery cases at a tertiary care centre in Ambi, Pune. [3]

MATERIALS AND METHODS

2.1. Setting and design

This hospital-based observational study included 50 patients undergoing abdominal surgery in the Department of Surgery, Pushpalata D Y Patil Hospital and Research Center, Ambi, Pune, Maharashtra, India, between 1 January 2026 and 30 June 2026.

2.2. Eligibility and sample

Eligible cases were adults aged 18 years or older who underwent an abdominal operative procedure, elective or emergency, with sufficient perioperative records and SSI surveillance. Procedures outside the defined abdominal cohort, duplicated operative episodes without a prespecified handling rule, and cases with unascertainable outcomes were excluded. Fifty cases constituted a feasibility sample; no formal a priori power calculation was established.

2.3. Recorded variables

Candidate variables included age, sex, diabetes, hypertension, smoking, obesity, hemoglobin, albumin, American Society of Anesthesiologists (ASA) status, emergency versus elective operation, open versus laparoscopic approach, operative wound

class, operative duration, drains, and adherence to indicated prophylaxis. SSI category, culture results, debridement, reoperation, readmission and hospital stay comprised outcomes.

2.4. Outcome definitions and surveillance

SSI was classified according to relevant CDC/NHSN criteria as superficial incisional, deep incisional or organ/space infection [4,5]. Postoperative surveillance was assessed over 30 days, including post-discharge follow-up. Surgical wounds were categorized as clean, clean-contaminated, contaminated or dirty/infected.

2.5. Microbiological investigation

Clinically indicated wound swabs or deep-tissue specimens were evaluated using routine laboratory methods. Identification and antimicrobial susceptibility testing followed institutional laboratory procedures. Culture results were interpreted in conjunction with clinical SSI criteria.

2.6. Statistical analysis

Categorical variables were summarized as counts and percentages, and continuous variables as mean $\pm$ standard deviation. Unadjusted comparisons were performed using Fisher's exact test, with odds ratios (ORs) and 95% confidence intervals reported where appropriate. Because only 10 SSI events occurred, multivariable regression was not undertaken to avoid unstable estimates. Associations were not interpreted as causal effects.

RESULTS

3.1. Baseline characteristics

The cohort comprised 50 patients with mean age 46.8 ± 15.2 years. Thirty patients (60.0%) were male; 14 (28.0%) had diabetes, 18 (36.0%) had anemia, and 13 (26.0%) had hypoalbuminemia (Table 1).

Table 1. Baseline demographic and clinical characteristics (N = 50)

Characteristic	n (%)
Age 18–40 years	17 (34.0)
Age 41–60 years	21 (42.0)
Age >60 years	12 (24.0)
Male	30 (60.0)
Female	20 (40.0)
Diabetes mellitus	14 (28.0)
Hypertension	12 (24.0)
Current smoking	11 (22.0)
Obesity	10 (20.0)
Preoperative anemia	18 (36.0)
Hypoalbuminemia	13 (26.0)
ASA I–II	36 (72.0)
ASA III–IV	14 (28.0)

ASA, American Society of Anesthesiologists.

3.2. Operative characteristics

Twenty-nine operations (58.0%) were elective and 21 (42.0%) emergency. An open approach was used in 34 cases (68.0%). Twenty-one wounds (42.0%) were contaminated or dirty/infected (Table 2).

Table 2. Operative characteristics (N = 50)

Variable	n (%)
Elective surgery	29 (58.0)
Emergency surgery	21 (42.0)
Open surgery	34 (68.0)
Laparoscopic surgery	16 (32.0)
Clean	6 (12.0)
Clean-contaminated	23 (46.0)
Contaminated	13 (26.0)
Dirty/infected	8 (16.0)
Duration ≤ 120 min	31 (62.0)
Duration > 120 min	19 (38.0)
Drain placement	22 (44.0)

3.3. SSI incidence and type

Ten of 50 cases (20.0%) developed SSI. Six were superficial incisional infections, three deep incisional, and one organ/space infection. Eight of ten cases yielded a positive culture. Four required debridement and one underwent reoperation (Table 3).

Table 3. Surgical site infections and their classification

Outcome	n (%)
SSI	10 (20.0% of all patients)
No SSI	40 (80.0% of all patients)
Superficial incisional SSI	6 (60.0% of SSI cases)
Deep incisional SSI	3 (30.0% of SSI cases)
Organ/space SSI	1 (10.0% of SSI cases)
Culture-positive SSI	8 (80.0% of SSI cases)
Debridement	4 (40.0% of SSI cases)
Reoperation	1 (10.0% of SSI cases)

3.4. Patient-related associations

SSI proportions were higher among patients with diabetes (6/14), obesity (5/10), hypoalbuminemia (6/13) and ASA III–IV status (6/14). Patient-related associations are summarized in Table 4.

Table 4. Candidate patient-related factors and SSI

Exposure	SSI / exposed	No SSI / exposed	SSI rate (%)
Age >60 years	4	8	33.3
Male sex	7	23	23.3
Diabetes	6	8	42.9
Smoking	4	7	36.4
Obesity	5	5	50.0
Anemia	6	12	33.3
Hypoalbuminemia	6	7	46.2
ASA III–IV	6	8	42.9

Risk-factor categories were assessed separately; exposure groups may overlap.

3.5. Operative associations

SSI developed after seven of 21 emergency procedures (33.3%) compared with three of 29 elective procedures (10.3%). Eight of 21 contaminated/dirty wounds developed SSI (38.1%) compared with two of 29 clean/clean-contaminated wounds (6.9%). Similarly, seven infections occurred among 19 operations longer than 120 minutes (Table 5).

Table 5. Operative associations with surgical site infection

Exposure contrast	SSI exposed	SSI comparator	Unadjusted OR (95% CI)	Fisher p
Emergency vs elective	7/21	3/29	4.33 (0.97–19.43)	0.073
Open vs laparoscopic	9/34	1/16	5.40 (0.62–46.96)	0.138
Contaminated/dirty vs other wounds	8/21	2/29	8.31 (1.54–44.79)	0.011
Duration >120 vs ≤120 min	7/19	3/31	5.44 (1.20–24.70)	0.030

OR, odds ratio; CI, confidence interval. Wald confidence intervals are presented for unadjusted estimates; exact small-sample intervals may differ. Operative duration was dichotomized at 120 minutes for descriptive comparison.

3.6. Microbiology

Among the eight culture-positive SSI cases, three yielded *Escherichia coli*, two *Staphylococcus aureus*, and one each *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Enterococcus* spp. (Table 6).

Table 6. Microorganisms recovered from culture-positive SSI cases

Organism	Isolates (n)
<i>Escherichia coli</i>	3
<i>Staphylococcus aureus</i>	2
<i>Klebsiella pneumoniae</i>	1
<i>Pseudomonas aeruginosa</i>	1
<i>Enterococcus</i> species	1
Total	8

Data are presented as the number of primary isolates identified among culture-positive SSI cases.

3.7. Postoperative outcomes

Mean postoperative stay was 11.8 ± 4.2 days among patients with SSI and 6.1 ± 2.3 days among those without SSI. Two patients with SSI required infection-related readmission, and no deaths occurred (Table 7).

Table 7. Postoperative outcomes by SSI status

Parameter	SSI (n=10)	No SSI (n=40)
Postoperative stay, days, mean $\pm$ SD	11.8 ± 4.2	6.1 ± 2.3
Wound debridement	4 (40.0%)	0
Reoperation	1 (10.0%)	0
SSI-related readmission	2 (20.0%)	0
Deaths	0	0

DISCUSSION

4.1. Principal observations

SSI occurred in 20.0% of patients, with variation according to clinical characteristics and operative exposures. Interpretation of the infection proportion requires consideration of the operative case mix, surveillance duration and diagnostic criteria. International studies have identified differences in SSI burden by procedure type, wound contamination and healthcare setting [3].

4.2. Patient-related contributors

Diabetes, obesity, anemia, hypoalbuminemia and ASA status are clinically plausible markers of SSI vulnerability. Hyperglycemia can interfere with host defense and wound healing, while malnutrition and anemia may reflect reduced physiological reserve. Such variables are correlated with underlying disease severity and cannot be interpreted as independent causal predictors from simple unadjusted comparisons [1,2]. [6]

4.3. Emergency procedures and wound class

Emergency surgery often follows obstruction, perforation or intra-abdominal sepsis, may involve abbreviated preoperative optimization, and is associated with different contamination profiles from elective operations. A wound-class gradient is biologically plausible because gastrointestinal spillage or established infection increases bacterial inoculum. Emergency status and wound contamination should ideally be modeled jointly in a larger cohort to reduce confounding. [7]

4.4. Operative duration and approach

Prolonged operations may reflect complex anatomy, procedural difficulty, extended tissue exposure or intraoperative complications. Comparisons between open and laparoscopic approaches are especially susceptible to case-selection bias. Therefore, an unadjusted association should not be interpreted as evidence that the surgical approach itself causes infection. [8]

4.5. Microbiological implications

Potential pathogens in abdominal SSI include enteric Gram-negative bacilli, staphylococci, enterococci and other organisms, depending on operative anatomy and wound conditions. Culture results must be considered alongside clinical criteria, sampling technique and local antimicrobial susceptibility. A very small number of isolates cannot determine an institution-wide antibiogram. [9]

4.6. Prevention and surveillance

WHO and CDC guidance advocate integrated perioperative prevention, including appropriate timing of indicated antibiotic prophylaxis, skin preparation, temperature maintenance and perioperative glucose management [1,2]. Robust case definitions and active post-discharge surveillance are needed to avoid under-ascertainment [4]. [10]

4.7. Strengths and limitations

This study evaluated routinely available patient and operative characteristics, SSI classification and postoperative outcomes. Its main limitations include the modest sample size, limited number of SSI events, single-centre setting and potential confounding by clinical indication. Post-discharge surveillance and the diversity of abdominal procedures may also influence outcome ascertainment. The number of events did not support reliable estimation of multiple independent predictors.

CONCLUSION

Surgical site infections after abdominal surgery may be associated with overlapping patient-related and operative factors, particularly emergency presentation, contamination, prolonged procedures and compromised host status. Rigorous

surveillance and standardized perioperative prevention are essential. Larger prospective cohorts with sufficient SSI events are needed to distinguish independent predictors and evaluate interventions.

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