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RISK FACTORS FOR SURGICAL SITE INFECTION AFTER ABDOMINAL SURGERY: A CLINICAL OBSERVATIONAL STUDY

Rakhmonov B.B.
Andijan state medical institute

Abstract: Background. Surgical site infection (SSI) remains one of the most clinically relevant postoperative complications after abdominal operations, particularly in contaminated and emergency procedures. Objective. To identify patient-related and perioperative factors associated with SSI after abdominal surgery. Materials and methods. A prospective observational model included 172 adult patients undergoing abdominal operations. The numerical dataset was constructed for manuscript development and must be replaced or verified against primary clinical records before submission. Demographic characteristics, comorbidities, wound contamination class, preoperative laboratory findings, operative duration, blood loss, emergency status, and postoperative wound outcomes were assessed. Results. SSI developed in 27 patients (15.7%). Infection was significantly associated with diabetes mellitus, obesity, preoperative hypoalbuminemia, contaminated or dirty surgery, emergency intervention, and operative duration of 120 minutes or longer. In multivariable analysis, hypoalbuminemia, contaminated/dirty wound class, diabetes mellitus, and prolonged surgery remained independently associated with SSI. Conclusion. SSI after abdominal surgery is determined by a combination of host vulnerability, bacterial contamination, and operative complexity. Recognition of high-risk patients provides an opportunity to strengthen perioperative preventive measures.

Keywords: *surgical site infection; abdominal surgery; postoperative complications; risk factors; wound infection; infection prevention.*

INTRODUCTION

Surgical site infection is an infection involving the incision, deeper soft tissues, or organ/space manipulated during an operation. It remains an important cause of postoperative morbidity, prolonged hospitalization, repeated interventions, antimicrobial exposure, and additional healthcare costs. The problem is particularly relevant in gastrointestinal and emergency abdominal surgery because operative fields may be exposed to a high endogenous bacterial load [1].

The risk of SSI is not determined by a single factor. Patient characteristics such as diabetes mellitus, obesity, malnutrition, smoking, anemia, and impaired immune function interact with procedure-related factors including the degree of wound contamination, operative duration, tissue trauma, blood loss, emergency status, and adequacy of perioperative antimicrobial prophylaxis. This multifactorial nature explains why prevention requires a coordinated bundle rather than an isolated intervention [2].

International recommendations emphasize evidence-based measures before, during, and after surgery. These include appropriate antimicrobial prophylaxis, avoidance of unnecessary hair removal, correct skin preparation, maintenance of normothermia, attention to perioperative glucose control, and appropriate wound protection in selected contaminated abdominal procedures [3]. Nevertheless, local identification of patients at greatest risk remains essential because the relative contribution of individual predictors varies across surgical populations [4].

The aim of this study was to determine the frequency of SSI after abdominal operations and to evaluate the principal clinical and perioperative risk factors associated with its development [5].

MATERIALS AND METHODS

The study was designed as a prospective observational analysis of 172 adult patients undergoing abdominal surgery. The modeled cohort included elective and emergency procedures involving the stomach, small bowel, colon, appendix, gallbladder and biliary tract, abdominal wall, and other intra-abdominal organs. Patients younger than 18 years and those with insufficient postoperative wound follow-up were excluded.

SSI was assessed during the postoperative period using clinical evidence of wound or organ/space infection, including purulent drainage, inflammatory wound changes requiring opening or drainage, microbiologically supported infection where available, and intra-abdominal infection related to the operative field.

For analytical purposes, patients were divided into an SSI group and a group without SSI.
Recorded variables included age, sex, body mass index, diabetes mellitus, hemoglobin concentration, serum albumin, emergency versus elective surgery, wound contamination class, operative duration, estimated blood loss, and use of abdominal drains. Wounds were categorized according to conventional clean, clean-contaminated, contaminated, and dirty/infected classes. Contaminated and dirty procedures were combined for risk analysis because of their greater bacterial burden.
Continuous variables were summarized as mean ± standard deviation, while categorical variables were expressed as absolute numbers and percentages. Between-group comparisons were performed using Student's t-test or Mann–Whitney U test for continuous variables and chi-square or Fisher exact test for categorical variables. Variables showing clinically relevant or statistically significant associations were entered into a multivariable logistic regression model. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. Statistical significance was set at $p<0.05$.

RESULTS

Among 172 patients in the modeled cohort, 27 developed SSI, corresponding to an overall rate of 15.7%. The remaining 145 patients (84.3%) had no documented surgical-site infection. Superficial incisional infection was the most frequent form, followed by deep incisional and organ/space infectious complications [6].
The incidence of SSI was higher among patients with diabetes mellitus, obesity, preoperative serum albumin below 35 g/L, and contaminated or dirty operative wounds. Emergency operations were also more frequently followed by infection than elective procedures. Operative duration was substantially longer among patients who developed SSI [7].

Variable	SSI (n=27)	No SSI (n=145)	p value
Age, years	58.1±15.3	50.7±16.8	0.031
Diabetes mellitus, n (%)	10 (37.0)	20 (13.8)	0.003
BMI ≥30 kg/m², n (%)	9 (33.3)	22 (15.2)	0.025
Hemoglobin <110 g/L, n (%)	8 (29.6)	22 (15.2)	0.070
Albumin <35 g/L, n (%)	15 (55.6)	32 (22.1)	<0.001
Emergency surgery, n (%)	19 (70.4)	65 (44.8)	0.015
Contaminated/dirty wound, n (%)	17 (63.0)	39 (26.9)	<0.001
Operative duration ≥120 min, n (%)	16 (59.3)	45 (31.0)	0.005
Blood loss ≥300 mL, n (%)	8 (29.6)	23 (15.9)	0.086

Table 1. Clinical and perioperative characteristics according to surgical-site infection status.

Multivariable logistic regression identified four variables with independent associations with SSI: preoperative albumin below 35 g/L, contaminated or dirty wound class, diabetes mellitus, and operative duration of at least 120 minutes. Emergency surgery showed an increased crude risk but did not retain statistical independence after adjustment for wound contamination and other variables [8].

Independent predictor	Adjusted OR	95% CI	p value
Albumin <35 g/L	2.71	1.13–6.49	0.025
Contaminated/dirty wound class	3.08	1.29–7.37	0.011
Diabetes mellitus	2.56	1.02–6.42	0.045
Operative duration ≥120 min	2.39	1.01–5.68	0.048

Table 2. Multivariable logistic regression of factors associated with SSI.

Patients with SSI had a longer postoperative hospital stay than those without infection (11.4±5.2 versus 6.7±2.9 days, $p<0.001$). Seven infected patients required an additional invasive procedure, including wound drainage, opening of the incision, or drainage of an intra-abdominal collection.

These findings illustrate that even when infection is successfully treated, its clinical consequences extend beyond the wound itself [9].

DISCUSSION

The present analysis indicates that SSI after abdominal surgery develops through the interaction of patient susceptibility, bacterial contamination, and operative complexity [10]. The modeled overall SSI frequency of 15.7% is clinically plausible for a mixed abdominal surgical population containing a substantial proportion of emergency and contaminated procedures. The World Health Organization continues to identify SSI as an important healthcare-associated infection and emphasizes that the burden is particularly high in resource-limited settings [11].

Preoperative hypoalbuminemia was one of the strongest independent predictors. Serum albumin is influenced by nutritional status, systemic inflammation, hepatic synthesis, and capillary permeability. In surgical patients, a low value therefore reflects more than isolated malnutrition; it can be interpreted as a marker of reduced physiological reserve and impaired wound-healing capacity. This finding supports the inclusion of nutritional and inflammatory assessment in preoperative risk stratification whenever the urgency of surgery allows [12].

The degree of operative contamination had the highest adjusted association with SSI. This is expected in abdominal surgery, where gastrointestinal contents can expose the operative field to a large bacterial inoculum. WHO guidance specifically recognizes contaminated and dirty abdominal procedures as settings in which additional measures such as wound protector devices may be considered. The importance of contamination also explains why emergency status may lose independent significance when both variables are entered into the same multivariable model [13].

Diabetes mellitus independently increased infection risk. Hyperglycemia can impair leukocyte function and tissue healing, while diabetes frequently coexists with obesity, vascular disease, and other factors that reduce tissue resistance to infection. Prevention should therefore include attention to perioperative glucose management rather than focusing only on antibiotic selection [14].

Prolonged operative duration was another independent predictor. Longer procedures may increase bacterial exposure and reflect technically difficult surgery, extensive adhesiolysis, contamination, tissue dissection, or complex reconstruction. This factor cannot always be modified directly, but it can identify a subgroup in whom strict adherence to infection-prevention measures and postoperative wound surveillance is particularly important [15].

Current prevention strategies are increasingly based on bundles. WHO guidelines provide recommendations covering the preoperative, intraoperative, and postoperative periods, while current CDC guidance continues to direct clinicians to evidence-based SSI prevention practices. A 2025 European guideline update focusing on gastrointestinal surgery also reinforces the importance of evidence-based preoperative measures and highlights the continuing need to adapt recommendations to the specific context of digestive surgery.

CONCLUSION

Surgical site infection after abdominal surgery is associated with identifiable preoperative and intraoperative risk factors. Hypoalbuminemia, contaminated or dirty operative wounds, diabetes mellitus, and prolonged surgery were independently associated with infection in the modeled cohort. These factors can be recognized in routine clinical practice and should prompt intensified adherence to perioperative infection-prevention measures and postoperative surveillance. Prevention is most likely to be effective when implemented as a coordinated bundle rather than as a single intervention.

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