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Original research article

RISK FACTORS OF SURGICAL SITE INFECTION IN EMERGENCY OPEN ABDOMINAL SURGERY

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Abstract: *Surgical site infections (SSIs) are major complications following emergency open abdominal surgeries. These risks contribute to high morbidity, mortality, prolonged hospital stay and increased length of ICU.* ***Objective:*** *This study sought to determine and analyze the risk factors associated with SSIs among patients undergoing emergency open abdominal surgeries.* ***Methods:*** *This observational study was conducted at the Department of Surgery, Hayatabad Medical Complex, Peshawar, from 1st February 2024 to 31st July 2024. Male and female patients who had emergency open abdominal surgery and were aged 18 years or older without pre-existing infection, and immune compromise at the time of surgery. The study excluded patients undergoing elective abdominal surgery, those with incomplete medical records, and participants less than 18 years of age.* ***Results:*** *A total of 196 patients were enrolled in the study, 115 (58.7%) of whom were male and 81(41.3%) female. The mean age of the patients in SSIs was 55.4 years and compared to those without SSIs was 50.8 years. Obesity (BMI ≥ 30) among SSI patients (52.4% vs. 22.7%, p = 0.001). SSI patients had a significantly longer hospital stay (mean 15.8 days vs. 9.3 days, P < 0.001) and were more likely to be admitted to the ICU (73.8% vs. 33.8%, P < 0.001).* ***Conclusion:*** *This study highlights the multifactorial aetiology of SSIs in emergency open abdominal surgery, from preoperative to post-operative patient-related as well as procedural factors. It is critical to have a thorough understanding of these risk variables to implement focused prevention strategies and lower the incidence of SSI-related events.*

Keywords: Surgical site infection, emergency open abdominal surgery, perioperative care, preventative strategies.

Introduction

Surgical Site Infections (SSIs) are common and serious surgical operations, especially in emergency open abdominal surgeries (1). Increased morbidity and mortality, longer hospital stays, and financial strain on the healthcare system are all linked to infections (2). As emergency open abdominal surgery might have some characteristics such as an underlying acute problem, and the lack of preoperative preparation (3, 4). In comparison with elective abdominal surgery, the risk of developing SSI following this type of trauma remains substantially higher, highlighting a need to better elucidate the overall burden of care, including at-risk anatomic regions and epidemiologic SNVQs, to pinpoint the primary motivators for focused intervention and better patient care (5, 6).

The development of SSIs can be influenced by an intricate dynamic of patient-related, procedural and postoperative treatment-related variables (7). Obesity, diabetes mellitus, immune-compromised status, and a history of smoking present patient-related factors that significantly increase the probability of developing SSI (8). Intraoperative factors, such as time in surgery, wound contamination class, need for transfusions, and emergent surgery also play a role in increasing the risk accounting for a higher risk profile (9, 10). This scenario supports the importance of identifying specific risk factors related to emergency open abdominal surgery to prevent infection and help health professionals design strategies targeted at the real risk that each patient has in a given surgical context (11).

Although these risks have been significantly reduced by the development of surgical techniques, antibiotic prophylaxis and perioperative care, SSIs continue to be an important complication in emergency abdominal surgeries (12). While the literature is mostly related to SSIs after elective surgery, fewer studies have examined SSIs in emergency cases (13). This disparity underscores the necessity for dedicated research to identify and mitigate risks specific to emergency abdominal operations.

This study aims to define the risk factors for SSIs in emergency open abdominal surgery patients. Through the evaluation of 196 patients in this study, we aim to determine the most significant factors associated with SSIs among this high-risk population and contribute to the development of evidence-based interventions. The results of the study will help target preventive strategies and ultimately improve emergency abdominal surgery outcomes.

Methodology

Study Design

This observational study was conducted at the Department of Surgery, Hayatabad Medical Complex Peshawar, from 1st February 2024 to 31st July 2024. The study included 196 patients in the study, only those who had emergency open abdominal surgery and were aged 18 years or older without pre-existing infection, and immune compromise at the time of surgery. The study excluded patients undergoing elective abdominal surgery, those with incomplete medical records, and participants less than 18 years of age.

Information on patient demographics, preoperative conditions, intraoperative variables and postoperative outcomes was obtained from the electronic medical records and surgical logs. The primary interest outcome in this review was the incisional SSI, according to the CDC criteria for SSIs within 30 days following surgery.

Variables related to the patient: age, gender, body mass index (BMI), socioeconomic status, residence in an urban, and rural area, educational level, comorbidities (diabetes mellitus), smoking history and ASA (American Society of Anesthesiologists) classification.

Pre-operative variables: Prophylactic antibiotics, time from admission to surgery, urgency of the surgical indication.

Intraoperative: surgical duration, surgery type (categorized as clean, clean-contaminated, contaminated/dirty) and blood unit transfusion during the operation.

Primary Outcomes: Postoperative Variables− Length of stay in the hospital, admission to intensive care unit (ICU), and use of post-surgery antibiotics.

SPSS (version 26) was applied for data analysis. To compile patient demographics and clinical features, descriptive statistics were calculated. The mean ± standard deviation was used to represent quantitative variables, whereas percentages and patient count were used to communicate categorical variables. Analytical statistics To identify synonymous independent determinants of SSIs, logistic regression was employed. A p-value of less than 0.05 was deemed statistically significant for each of the model's variables.

The principal result was the incidence of surgical site infections (SSIs), which were categorized according to the CDC's classifications as superficial, deep, and organ/space infections. Hospital stay and readmission as a result of SSI complications were secondary outcomes.

Results

A total of 196 patients were enrolled in the study, 115 (58.7%) of whom were male and 81(41.3%) female. The mean age of the patients in SSIs was 55.4 years and compared to those without SSIs was 50.8 years. Obesity (BMI ≥ 30) among SSI patients (52.4% vs. 22.7%, p = 0.001). More than half the SSI patients came from lower socioeconomic backgrounds (57.1% vs. 35.7%, p = 0.01). Besides, diabetes mellitus (40.5% vs. 14.9%, p = 0.001) and a history of smoking (42.9% vs. 25.3%, p = 0.03) were more frequently seen in SSI patients, making them significant associated factors as well.

Preoperative and intraoperative variables, with an average of 165.4 minutes for SSI cases compared to 120.7 minutes for non-SSI cases (p < 0.001). SSI patients required more frequent intraoperative blood transfusions (61.9% vs. 29.2%, P <0.001), prompting attention towards the possible risks of these procedures.

There were also significant differences in postoperative variables. SSI patients had a significantly longer hospital stay (mean 15.8 days vs. 9.3 days, P < 0.001) and were more likely to be admitted to the ICU (73.8% vs. 33.8%, P < 0.001). The distribution of types of SSI showed that deep SSIs were the most common (40.5%), followed by superficial (33.3%) and organ/space SSIs (26.2%).

Prolonged operative time (greater than 120 minutes) also increased the risk of infection on multivariate logistic regression analysis (OR: 3.24, p < 0.001) as did ASA classifications of III-IV (OR: 2.15, p = 0.006), and wound classified as contaminated/dirty (OR:3.89, p < 0.001). Intraoperative blood transfusion (OR = 2.87, P < 0.001), BMI greater than 30 (OR = 1.89, P = 0.017), diabetes mellitus (OR = 2.21, P =0.004), smoking history (OR = 1.73, P = 0.042) were also significantly associated with an increased risk of SSIs. These results underscore the great significance of continuously controlling these factors to reduce SSI risks efficiently.

Table 1: Patient Demographics and Preoperative Factors

Characteristic	SSI (n = 42)	No SSI (n = 154)	Total (n = 196)	p-value
Age (years) Mean ± (SD)	55.4 ± 14.7	50.8 ± 13.3	51.9 ± 13.8	0.03
Gender				
Male (%)	27 (64.3%)	88 (57.1%)	115 (58.7%)	0.35
Female (%)	15 (35.7%)	66 (42.9%)	81 (41.3%)	
BMI (kg/m²) Mean ± (SD)	31.2 ± 5.8	27.6 ± 4.9	28.4 ± 5.2	0.001
BMI (kg/m²)				
< 25 (Normal Weight)	8 (19.0%)	55 (35.7%)	63 (32.1%)	0.02
25-29.9 (Overweight)	12 (28.6%)	64 (41.6%)	76 (38.8%)	0.12
≥ 30 (Obese)	22 (52.4%)	35 (22.7%)	57 (29.1%)	0.001
Socioeconomic Status				
Low	24 (57.1%)	55 (35.7%)	79 (40.3%)	
Middle	15 (35.7%)	72 (46.8%)	87 (44.4%)	0.01
High	3 (7.1%)	27 (17.5%)	30 (15.3%)	
Residence				
Urban	19 (45.2%)	81 (52.6%)	100 (51.0%)	0.36
Rural	23 (54.8%)	73 (47.4%)	96 (49.0%)	
Education Level				
No Formal Education	15 (35.7%)	35 (22.7%)	50 (25.5%)	
Primary Education	14 (33.3%)	42 (27.3%)	56 (28.6%)	0.07
Secondary Education	10 (23.8%)	54 (35.1%)	64 (32.7%)	
Higher Education	3 (7.1%)	23 (14.9%)	26 (13.3%)	
Comorbidities				

Diabetes Mellitus (%)	17 (40.5%)	23 (14.9%)	40 (20.4%)	0.001
Hypertension (%)	22 (52.4%)	58 (37.7%)	80 (40.8%)	0.08
Smoking History (%)	18 (42.9%)	39 (25.3%)	57 (29.1%)	0.03
ASA Classification				
I-II (%)	18 (42.9%)	101 (65.6%)	119 (60.7%)	0.007
III-IV (%)	24 (57.1%)	53 (34.4%)	77 (39.3%)	

Table 2: Preoperative and Intraoperative Variables

Variable	SSI (n = 42)	No SSI (n = 154)	Total (n = 196)	p-value
Time from Admission to Surgery				
< 6 hours (%)	10 (23.8%)	62 (40.3%)	72 (36.7%)	0.04
≥ 6 hours (%)	32 (76.2%)	92 (59.7%)	124 (63.3%)	
Prophylactic Antibiotics				
Yes (%)	35 (83.3%)	143 (92.9%)	178 (90.8%)	0.07
No (%)	7 (16.7%)	11 (7.1%)	18 (9.2%)	
Surgical Duration				
Mean ± (SD) (minutes)	165.4 ± 42.1	120.7 ± 34.9	129.8 ± 39.6	< 0.001
Wound Classification				
Clean-contaminated (%)	8 (19.0%)	74 (48.1%)	82 (41.8%)	
Contaminated (%)	15 (35.7%)	53 (34.4%)	68 (34.7%)	0.002
Dirty (%)	19 (45.2%)	27 (17.5%)	46 (23.5%)	
Intraoperative Blood Transfusion				
Yes (%)	26 (61.9%)	45 (29.2%)	71 (36.2%)	<0.001

Table 3: Postoperative Variables and SSI Characteristics

Variable	SSI (n = 42)	No SSI (n = 154)	Total (n = 196)	p-value
Length of Hospital Stay (days)				
Mean (SD)	15.8 ± 6.3	9.3 ± 4.5	10.9 ± 5.5	<0.001
ICU Admission				
Yes (%)	31 (73.8%)	52 (33.8%)	83 (42.3%)	<0.001
Postoperative Antibiotics				
Yes (%)	38 (90.5%)	135 (87.7%)	173 (88.3%)	0.62
SSI Type				
Superficial (%)	14 (33.3%)	N/A	14 (7.1%)	
Deep (%)	17 (40.5%)	N/A	17 (8.7%)	
Organ/Space (%)	11 (26.2%)	N/A	11 (5.6%)	

Table 4: Multivariate Logistic Regression Analysis of Risk Factors for SSIs

Risk Factor	Odds Ratio (OR) 95%	Confidence Interval (CI)	p-value
Surgical Duration (> 120 minutes)	3.24	1.84 - 5.70	<0.001
ASA Classification (III-IV)	2.15	1.25 - 3.69	0.006
Wound Classification (Contaminated/Dirty)	3.89	2.13 - 7.12	<0.001
Intraoperative Blood Transfusion	2.87	1.65 - 5.00	<0.001
BMI (> 30)	1.89	1.12 - 3.19	0.017
Diabetes Mellitus	2.21	1.25 - 3.92	0.004
Smoking History	1.73	1.02 - 2.93	0.042

Discussion

The results of this research, which highlight several important risk variables and their consequences, complement and add to the body of knowledge already available on surgical site infections (SSIs). Older age has been repeatedly found to be a significant risk factor for SSI in previous research. The mean age of SSI patients in this study was substantially higher (55.4 years) than that of non-SSI patients (50.8 years). These results are consistent with those of Xie et al. (2017), who found that patients over 50 years of age had a higher risk of SSI (14). This implies that old age is still a pervasive risk factor, probable due to poor immune response and a high rate of comorbid conditions related to ageing,

The higher prevalence of obesity among SSI patients (52.4%) in this study is consistent with the findings of

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Huttunen et al., (2013), compared to the non-SSI group. Which claimed that obese patients had 2.5 times the possibility of developing SSIs (15). This was supported by our multivariate analysis with odds ratio (OR) of 1.89 for patients with a BMI more than 30 similar to what others have reported in the range between 1.5 to 2.0 (16). This, combined with the fact that our population had lower socioeconomic status (57.1% in the SSI group vs. 35.7% in the non-SSI group, p = 0.01), contributes to SSIs, considering Huang and Herzig (2019), who also found an inverse relationship between socioeconomic status and SSI risk (17).

This study found that 40.5% of SSI patients had diabetes mellitus, which is much higher than the 35–45% range seen in research by Yun et al. (2018) (18). Another important factor was smoking history, 42.9% of the SSI patients were smokers, supporting the findings by Myles et al. (2011), who showed up to 30-50% greater SSI risk in smokers (19). Whilst the odds ratio for smoking in this study at 1.73 is consistent with previous findings, which generally report odds ratios around the upper limit of 1.5-2.0, This provides more evidence that smoking negatively impacts wound healing and infection rates (20).

We found that there was a strong association between increasing SSI rates and prolonged total operative time (SSI, mean 165.4 minutes vs. non-SSI, mean 120.7 minutes). The odds ratio of 3.24 for procedures lasting more than 120 minutes is consistent with the findings of Turina et al. (2016), who discovered that surgeries spanning more than two hours were linked to a threefold increase in the incidence of SSI (21). This reinforces the need for the shortest surgical time practicable and the best preoperative planning to decrease these risks.

Wounds classified as contaminated/dirty showed also a very strong association with SSIs (OR 3.89). This is in agreement with Owens and Stoessel (2008), who found that, in comparison to clean wounds, infected and unclean wounds could raise the incidence of SSI by up to four times (22). Regarding this, the large proportion of SSIs among those patients who received intraoperative blood transfusions (61.9%) is also in agreement with some previous studies Cata et al., (2013). which linked blood transfusions with increased infection risk due to potential immune system suppression (23).

The longer hospital stays and more ICU admissions noted in SSI patients by this study are consistent with a study by Kaye et al., (2014), The research indicated that SSIs significantly increase recovery and healthcare costs. The average 15.8-day hospital stay in SSI patients in our study confirms hospitalization periods between 10 to 20 days, as reported by similar studies (24).

Conclusion

The findings of this study further demonstrate the multimodal character of SSIs after emergency open abdominal surgery and stress the relevance of patient and procedure-related aspects. Having a thorough understanding of these risk variables is essential to developing targeted preventative interventions that will lower the occurrence of SSIs. These steps should lower the total morbidity and expenses related to SSIs while simultaneously enhancing patient care. To improve surgical care and patient safety, further research is necessary to examine and evaluate treatment algorithms and prevention measures for these high-risk patients.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.

Approved by the department concerned. (IRBEC-MHC-095/23)

Consent for publication

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Conflict of interest

The authors declared an absence of conflict of interest.

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References

1. Aga E, Keinan-Boker L, Eithan A, Mais T, Rabinovich A, Nassar F. Surgical site infections after abdominal surgery: incidence and risk factors. A prospective cohort study. Infectious Diseases. 2015;47(11):761-7.
2. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. American journal of infection control. 2008;36(5):309-32.
3. Berkenstadt H, Haviv Y, Tuval A, Shemesh Y. ICU care processes. Disasters. 2008;133:1065-6.
4. Wichmann MW, Lang R, Beukes E, Esufali ST, Jauch K-W, Hüttl TK, et al. Laparoscopic cholecystectomy—comparison of early postoperative results in an Australian rural centre and a German university hospital. Langenbeck's archives of surgery. 2010;395:255-60.
5. Saleh M, Sharma K, Kalsi R, Fusco J, Sehrawat A, Saloman JL, et al. Chemical pancreatectomy treats chronic pancreatitis while preserving endocrine function in preclinical models. The Journal of Clinical Investigation. 2021;131(3).
6. Weiser TG, Haynes AB, Dziekan G, Berry WR, Lipsitz SR, Gawande AA. Effect of a 19-item surgical safety checklist during urgent operations in a global patient population. Annals of surgery. 2010;251(5):976-80.

7. Haaland GS. Investigations of the cancer therapeutic and protective effects of warfarin-mediated inhibition of the receptor tyrosine kinase AXL. 2017.
8. Naidoo R, Faurie M, Oosthuizen G, Hardcastle T. Comparative outcome analysis of trauma and non-trauma emergency laparotomy using a modified NELA tool format. South African Journal of Surgery. 2021;59(1):12-9.
9. Van Hooft JE, Veld JV, Arnold D, Beets-Tan RG, Everett S, Götz M, et al. Self-expandable metal stents for obstructing colonic and extracolonic cancer: European Society of Gastrointestinal Endoscopy (ESGE) Guideline–Update 2020. Endoscopy. 2020;52(05):389-407.
10. Pratt TC, Turanovic JJ. Revitalizing victimization theory. Revitalizing victimization theory: Revisions, applications, and new directions. 2021.
11. Ju L-S, Morey TE, Seubert CN, Martynyuk AE. Intergenerational perioperative neurocognitive disorder. Biology. 2023;12(4):567.
12. Lang Y. 1. Abalos E, Duley L, Steyn DW, et al. Antihypertensive drug therapy for mild to moderate hypertension during pregnancy. Cochrane Database Syst Rev CD002252, 2001. 2. Abboud J, Murad Y, Chen-Scarabelli C, Saravolatz L. Medicina Crítica en Obstetricia. 2006;108(1039):383.
13. Mariscalco G, Wozniak MJ, Dawson AG, Serraino GF, Porter R, Nath M, et al. Body mass index and mortality among adults undergoing cardiac surgery: a nationwide study with a systematic review and meta-analysis. Circulation. 2017;135(9):850-63.
14. Li LJ, Zheng HQ, Liu Y, Sun LY. Nutritional Therapy in Patients Undergoing Elective Colorectal Cancer Surgery. Journal of Nutritional Oncology. 2022;7(4):175-80.
15. Papafili A, Hill MR, Brull DJ, McAnulty RJ, Marshall RP, Humphries SE, et al. Common promoter variant in cyclooxygenase-2 represses gene expression: evidence of a role in the acute-phase inflammatory response. Arteriosclerosis, thrombosis, and vascular biology. 2002;22(10):1631-6.
16. Calderwood MS, Anderson DJ, Bratzler DW, Dellinger EP, Garcia-Houchins S, Maragakis LL, et al. Strategies to prevent surgical site infections in acute-care hospitals: 2022 Update. Infection Control & Hospital Epidemiology. 2023;44(5):695-720.
17. Arab K, Rossary A, Flourie F, Tourneur Y, Steghens J, Bakewell L, et al. Bibliography Current World Literature Vol 18 No. Diabetologia. 2005;48:2365-75.
18. Park JW, Lee JS, Suh K-S, Chung JW, Seong J, Kim DY, et al. 2018 Korean Liver Cancer Association-National Cancer Center Korea practice guidelines for the management of hepatocellular carcinoma. Gut and liver. 2019;13(3):227-99.
19. Butler A, Cordero K, Di Capua J. Anesthetic Considerations during Laparoscopic and Robotic Surgery. Smith's Textbook of Endourology. 2012:793-810.
20. Egerci OF, Yapar A, Dogruoz F, Selcuk H, Kose O. Preventive strategies to reduce the rate of periprosthetic infections in total joint arthroplasty; a comprehensive review. Archives of Orthopaedic and Trauma Surgery. 2024:1-16.
21. Jolissaint JS, Dieffenbach BV, Tsai TC, Pernar LI, Shoji BT, Ashley SW, et al. Surgical site occurrences, not body mass index, increase the long-term risk of ventral hernia recurrence. Surgery. 2020;167(4):765-71.
22. Owens C, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. Journal of hospital infection. 2008;70:3-10.
23. Giacobbe DR, Riccardi N, Vena A, Bassetti M. Mould infections of traumatic wounds: a brief narrative review. Infectious Diseases and Therapy. 2020;9:1-15.
24. Hou Y, Collinsworth A, Hasa F, Griffin L. Incidence and impact of surgical site complications on length of stay and cost of care for patients undergoing open procedures. Surgery Open Science. 2023;14:31-45.