Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 2781-2788 | ISSN:2251-6727

Patient-Related Predictors of Surgical Site Infections in Emergency Laparotomy: Role of Subcutaneous Fat Thickness, Stoma Creation, And Comorbidities

(Predictors of SSI in Emergency Laparotomy)

1ST Dr Swagata Brahmachari, MS (General Surgery), Additional Professor,

2ND Dr Aditya Kumar Raut, MS (General Surgery), Clinical Fellow,

3RD Dr Moorat Singh Yadav, MS (General surgery), Additional Professor,

4TH Dr Vikas Lal, MS Department of General Surgery, AIIMS Bhopal, Saket Nagar, Bhopal-462020 (MP), India.

Corresponding author: Dr Vikas Lal, MS (General Surgery), Assistant Professor, Department of General Surgery, AIIMS Bhopal, Saket Nagar, Bhopal-462020 (MP) India

(Received: 16 February 2026 Revised: 25 March 2026 Accepted: 05 April 2026)

KEYWORDS:

laparotomy, risk assessment, stoma, subcutaneous fat, surgical site infection

ABSTRACT:

Background & Objective: Surgical site infection is among the leading causes of postoperative complications, especially in emergency abdominal surgery. In the current article, the influence of subcutaneous fat thickness, comorbidities, and stomas on surgical site infection following emergency midline laparotomy is discussed.

Method: A prospective observational study was conducted at XXXX from February 2020 to September 2022. One hundred sixty patients who underwent emergency midline laparotomy were enrolled, and patients were split into the TSF with a subcutaneous drain or no subcutaneous drain group. Demographic information, comorbidities, BMI, TSF, and perioperative details were collected. SSI and hospital length of stay were documented. SPSS v21.0 was used for statistical analysis.

Result: SSIs happened in 31.25% of patients. Patients diagnosed with diabetes mellitus and having enrolled in TSF (>2.5 cm) were significantly less likely to have an SSI (28% vs. 12.7%, and 82% vs. 42.7%, respectively; p <0.01). Underweight BMI (<18.5) and hypertension contributed to higher SSI rates, with 25% in stoma patients compared to 10% in the drain group. TSF ≥ 2.5 cm and BMI ≥ 25 kg/m² were more prevalent in the control group, highlighting the benefits of subcutaneous drain placement. Patients with SSI had a longer median stay (15.3 days) compared to those without (9.1 days).

Interpretation & Conclusion: Increasing TSF, diabetes mellitus, hypertension, and stoma formation are significant predictors of SSIs following emergent laparotomy. Enhanced preoperative risk stratification and preventative measures, such as subcutaneous drain placement potential, may result in decreasing infection rates that also burden hospitals.

Introduction

Surgical site infection (SSI) is the most common type of healthcare-associated infection and is an essential aspect of patient prognosis. SSIs occur in approximately 2-5% of inpatient surgical patients in the United States.[1,2] SSI rates in Europe range from 2% to 10%, while in China, incidence rates are in the 4% to 6% range.[3-5] Patients undergoing complex operations that involve higher risk factors are more likely to experience an SSI.[6] SSI is associated with increased hospital length of stay (LOS). SSI has a physiological, psychological, and economic toll on patients. [7]

Emergency laparotomy (EL) is a broad term that encompasses a diverse range of time-sensitive and urgent intra-abdominal pathologies that require surgical intervention a short time after the onset of clinical symptoms.[8] Given the invasive nature of surgery, emergency laparotomy carries with it the potential for all types of adverse postoperative events, including death.[9] Perioperative adverse events encompass adverse events that happen in the intraoperative and postoperative

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 2781-2788 | ISSN:2251-6727

period.[10] Adverse events that occur in the post-operative period are important and will undoubtedly have a significant effect on the patient's well-being. But we must also include and report on what we consider to be critical intra-operative events, even if they do not cause post-operative morbidity or affect the patient's post-operative well-being.[11]

The most commonly reported complications worldwide post sigmoid volvulus surgery are SSIs (surgical site infection), pneumonia (chest infection), wound dehiscence, anastomotic leak, and intra-abdominal abscess questions of prevalence and affecting factors vary widely by country and can perhaps be attributed to the presence of an effective health care system, better resources available, and a better surveillance system which allows for better identification of SSIs in developed countries compared with developing nations.[12] The relative risk factors contributing to the development of SSIs can generally be categorized into patient factors and surgical factors.[13] The patient factors include nutritional status, preoperative albumin, co-morbidity illness markers, and immunosuppressed states, while surgical factors include primary emergency surgery, duration of surgery, blood loss, and contaminated operative conditions.[14] The risk factors for surgical site infections could be genetics and genomics of trauma, and the interaction between the host and therapy.[14] The single point mutations of inflammatory genes such as Tumor Necrosis Factor alpha and interleukins play a role in causing the body to react accordingly in response to infection.[15] The infection can occur due to injury, immunocompromised states of the host, resuscitation, or definitive care.

Though there is literature that considers surgical risk factors, we are only aware of a very limited number of prospective, context-based assessments of TSF, comorbidities, or stoma creation on SSIs in emergency laparotomy patients in low-resource settings. This study aimed to assess the patient-related predictors of surgical site infections after emergency midline laparotomy, with a specific focus on subcutaneous fat thickness, stoma presence and associated comorbidities. The study also aimed to measure their significant organizational impacts on postoperative outcomes (including the incidence of SSI and superficial wound dehiscence) and hospital length of stay (LOS).

Materials and methods

A prospective observational study was conducted at XXXX from February 2020 to September 2022. A total of 160 patients undergoing emergency midline laparotomy who were admitted through emergency surgical services were enrolled in the study. The patients were evaluated preoperatively, intraoperatively, and during post-operative follow-up.

Inclusion criteria:

Patients aged between 18-75 years.

Patients undergoing emergency midline laparotomy with midline incisions in the General Surgery Department, AIIMS, Bhopal.

Patients who provided informed consent.

Exclusion criteria:

Patients who do not give consent for the procedure.

2. Patients requiring midline laparotomy for gynaecological surgeries

3. Patient undergoing laparoscopy surgery.

4. Patient's age <18 years and >75 years.

5. Patients with a previous history of laparotomy

Data Collection

Demographic characteristics, comorbidities (diabetes mellitus, hypertension, tuberculosis, etc), body mass index (BMI), nutritional status, and addiction history were recorded. BMI was classified using notions set out by South Asian guidelines. Patients were divided into two groups based on intraoperative management of the subcutaneous wound. The study was approved by the Institutional Ethical Committee of AIIMS, Bhopal.

Preoperative assessment and Operative protocol

The patient demographics (age, gender), comorbidities (diabetes mellitus, hypertension, tuberculosis, bronchial asthma, coronary artery disease), BMI (body mass index), nutritional status (serum albumin), and addiction history (smoking, alcohol, tobacco) were recorded. The BMI was categorized according to South Asian criteria. Serum albumin and hemoglobin were measured prior to the surgery. Duration of intravenous antibiotics, length of

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 2781-2788 | ISSN:2251-6727

stay in the hospital, and all secondary interventions were also documented.

After rectus sheath closure and prior to approximation of the skin, a transverse measurement of subcutaneous fat thickness was obtained 1 cm caudal to the umbilicus using a sterile ruler. A cut-off of 2.5 cm was chosen, using pre-existing literature and ROC-derived cut-offs, to stratify patients into high and low TSF groups. All surgical procedures were performed by surgical teams under routine aseptic techniques. Following fascial closure, the study group underwent subcutaneous placement of a negative pressure drain (flat fenestrated or tubular perforated) in the subcutaneous layer. The drains were subsequently fixed and attached to a vacuum bulb. In the Control group, the fascial layer was absorbed, and the subcutaneous layer was approximated using absorbable sutures along with standard skin closure techniques.

Post-operative monitoring and outcome

All patients were assessed once daily for the events that occurred: Surgical site infections (superficial, deep, and organ-space based on CDC guidelines), Seroma, Hematoma, Superficial wound dehiscence (SWD), Burst abdomen. Patients were followed until discharge and re-examination at suture removal and 4 weeks post-operatively.

Statistical analysis

The data analysis was conducted by SPSS v 21.0. Continuous variables were presented as mean ± standard deviation and compared using Student's t-test. Categorical variables were characterized by Fisher's exact test. A p-value <0.05 was considered statistically significant.

Result

The age distribution is evenly disseminated in both groups, with most patients between the ages of 31–60. There were younger (younger than 30 years: 27.5%) in the study group than in the control (23.7%). Similarly, males predominated in both groups, and even more so in the study group (78.7% compared to 66.2%). The most frequent occupation was laborer (33.7% in both groups), followed by farmers in the study group (31.2%), and by homemakers in the control group (26.2%). This hints at a mainly working-class patient population that could have higher physical exposures and/or comorbid risk factors (Table I).

The most prevalent comorbidities in both groups were hypertension and diabetes mellitus. Diabetes was the same in both groups (17.5%). Coronary heart disease and tuberculosis were more common in the study group. While a higher percentage of the study group were smokers (33.7%), alcohol use was slightly higher in the control group (Table II). The shared use of chewing tobacco supports the notion that both groups had similar risks at baseline. All of these factors, with diabetes, hypertension, and smoking being the most difficult to intervene upon once incorporated into a patient's lifestyle, are associated with wound healing impairment and may contribute to increased risk of SSI.

The data analysis demonstrates that patients with diabetes mellitus and increased thickness of subcutaneous fat tissue (TSF) infections have statistically significantly higher risk rates of surgical site infections (SSIs). Diabetes mellitus was more common in SSI patients (28%) vs non-SSI (12.7%). High TSF (>2.5 cm) was seen in 82% of patients who experienced an SSI vs 42.7% of patients who did not. Underweight BMI (< 18.5) was also found to have an association to SSI infections (Table III). The results of this study emphasise the importance of nutritional status and adiposity in determining the risk of a postoperative infection in patients following an emergency laparotomy. Preoperative risk stratification leads to better targeted wound management strategies.

The findings suggest that some factors related to individual patients could contribute to the risk of surgical site infections (SSI) related to emergency laparotomy. Hypertension (42.5% in controls) and stomas (25% in controls) were found to be statistically significantly more common in those patients that developed SSIs. BMI (≥ 25 kg/m²) and TSF (TSF ≥ 2.5 cm) were more than likely correlates of higher SSI generated in the control group than the study group, signifying an additional protective factor from subcutaneous drain use (Table IV). Just as with prevention of bacteremia, many correlative factors seem to be greatly impacted by comorbid conditions and anatomical factors related to the patients.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 2781-2788 | ISSN:2251-6727

Discussion

This study identified high patient-related risk factors associated with surgical site infections (SSIs) after emergency midline laparotomy in a low-resource tertiary care setting, specifically examining subcutaneous fat thickness (TSF), comorbidities, and stoma formation. The incidence of SSI in the current study, 31.25% among the 160 patients, was comparable to the incidence noted by a similar cohort of emergency laparotomy patients.[16] This highlights the significant burden of SSI in emergency surgery in resource-constrained settings.

A statistically significant relationship between increased TSF and SSI was found in the study. Patients with TSF ≥20 mm had a much higher rate of SSI. This finding supports the hypothesis that increased subcutaneous tissue provides more opportunities for bacterial colonization, which may also delay wound healing. The relationship of TSF and SSI with obesity or preoperative weight loss as independent predictors of SSI in major abdominal surgery was also reported by Ejaz et al. (2017).[17] The role of TSF with gastrointestinal procedures was subsequently reinforced by Utsumi et al. (2022), who reported that superficial incisional surgical site infections were more likely to occur in patients with increased adipose tissue, especially in open surgeries.[18]

We identified some comorbid conditions, such as diabetes mellitus and anemia, that were independent risk factors for SSIs in this cohort. Diabetes was found to be a major predictor of SSIs, consistent with the work of Noorit et al. (2018), who found that diabetic patients undergoing an appendectomy had double the likelihood of developing SSIs compared to non-diabetic patients.[19] Anemia was found less often in the literature to be a direct predictor of SSI because it is well-established for its role in decreasing tissue oxygen tension and impairing immune function, which might explain its association. Our study showed overlapping findings with Ejaz et al. (2017), as hypoalbuminemia and anemia were important aspects of wound healing outcomes.[17]

Stoma formation was also identified as another independent risk factor. We noted that in our study, patients who required stoma formation were more likely to develop an SSI. Stoma's association with enteric contamination could account for the higher SSI rate, as mentioned in Elmonim et al. (2022), who noted that patients undergoing laparotomy for blunt abdominal trauma had increased rates of infection when bowel contents had contaminated the operative sides.[20] Fecal contamination has been substantially related to increased notions of risk of SSI, as mentioned in Noorit et al. (2018).[19] Long-duration surveys were significantly associated with SSI formation. Surgeries more than two hours in length had a higher chance of infection, which identified operative time as a universal risk factor for SSI.[21,22] Longer surgeries also implicated more tissue manipulation and exposure to pathogens. Another important finding in this study was the relationship between SSI and length of hospital stay. For the patients with SSI, the median length of stay was 15.3 days, whereas for patients without infection, it was 9.1 days. This finding was consistent across existing evidence included in the literature and another study by Cheng et al. (2017), who have suggested examining increases in length of stay and costs associated with SSI.[23]

It is also essential to emphasize the interactions across all the risk factors. Patients with the combined risk profile of high TSF, diabetes, anemia, and stoma construction would have high SSI risks as compared to patients with one of these risk profiles. The interactions between pre-operative duration, contaminated wound, and transfusion as they all interact together to increase the risk of SSI.[24] Each of these processes uses a predictive scoring system based on transfusion, colorectal surgery, tachypnea, and blood loss as a cumulative risk. Likewise, while some studies included potential risk factors, such as operative hypothermia, incisional length, etc., they did not find them significant in their studies, nor did we. Their lack of association could have been due to surgical timing (i.e., emergent or otherwise), variances in surgical techniques, or simply study size being a limitation to achieving statistical significance.

Conclusion

In conclusion, the results of this study confirm previously identified predictors of SSI and need to consider patient-level factors, including TSF, comorbidities, and stoma status. These findings also highlight the need for context-specific SSI risk stratification tools that are designed for low-resource, emergency surgical contexts. The development and use of predictive models that identify the risk of SSI could

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 2781-2788 | ISSN:2251-6727

help target perioperative interventions and focused monitoring needed to decrease SSI rates and morbidity.

References

1. Chen W, Lu Z, You L, Zhou L, Xu J, Chen K. Artificial Intelligence-Based Multimodal Risk Assessment Model for Surgical Site Infection (AMRAMS): Development and Validation Study. JMIR Med Inform 2020;8:e18186. https://doi.org/10.2196/18186
2. Waltz PK, Zuckerbraun BS. Surgical Site Infections and Associated Operative Characteristics. Surg Infect (Larchmt) 2017;18:447–450. https://doi.org/10.1089/sur.2017.062
3. Strobel R, Kreis M, Lauscher JC. Surgical site infections-Prevention and treatment strategies. Chirurg 2021;92:385–394. https://doi.org/10.1007/s00104-020-01330-4
4. Lo Giudice D, Trimarchi G, La Fauci V, Squeri R, Calimeri S. Hospital infection control and behaviour of operating room staff. Cent Eur J Public Health 2019;27:292–295. https://doi.org/10.21101/cejph.a4932
5. Shao J, Zhang H, Yin B, Li J, Zhu Y, Zhang Y. Risk factors for surgical site infection following operative treatment of ankle fractures: A systematic review and meta-analysis. Int J Surg 2018;56:124–132. https://doi.org/10.1016/j.ijsu.2018.06.018
6. Zhou J, Ma X. Cost-benefit analysis of craniocerebral surgical site infection control in tertiary hospitals in China. J Infect Dev Ctries 2015;9:182–189. https://doi.org/10.3855/jidc.4482
7. Li PY, Yang D, Liu D, Sun SJ, Zhang LY. Reducing Surgical Site Infection with Negative-Pressure Wound Therapy After Open Abdominal Surgery: A Prospective Randomized Controlled Study. Scand J Surg 2017;106:189–195. https://doi.org/10.1177/1457496916668681
8. Global Guidelines for the Prevention of Surgical Site Infection. WHO Guidelines Approved by the Guidelines Review Committee, Geneva, 2016. https://www.who.int/gpsc/global-guidelines-web.pdf?ua=1
9. Pinkney TD, Calvert M, Bartlett DC, Gheorghe A, Redman V, Dowswell G, et al. Impact of wound edge protection devices on surgical site infection after laparotomy: multicentre randomised controlled trial (ROSSINI Trial). BMJ 2013;347:f4305. https://doi.org/10.1136/bmj.f4305
10. Danwang C, Bigna JJ, Tochie JN, Mbonda A, Mbanga CM, Nzalie RNT, et al. Global incidence of surgical site infection after appendectomy: a systematic review and meta-analysis. BMJ Open 2020;10:e034266. https://doi.org/10.1136/bmjopen-2019-034266
11. Stulberg JJ, Delaney CP, Neuhauser DV, Aron DC, Fu P, Koroukian SM. Adherence to surgical care improvement project measures and the association with postoperative infections. JAMA 2010;303:2479–2485. https://doi.org/10.1001/jama.2010.841
12. Deresse T, Tesfahun E, Gebreegziabher ZA, Bogale M, Alemayehu D, Dessalegn M, et al. Perioperative adverse outcome and its predictors after emergency laparotomy among sigmoid volvulus patients: retrospective follow-up study. Open Access Emergency Medicine 2023 31:383-92. https://doi.org/10.2147/OAEM.S430193
13. Bucataru A, Balasoiu M, Ghenea AE, Zlatian OM, Vulcanescu DD, Horhat FG, et al. Factors Contributing to Surgical Site Infections: A Comprehensive Systematic Review of Etiology and Risk Factors. Clin Pract 2023;14:52-68. https://doi.org/10.3390/clinpract14010006
14. Ahmed J, Sarma NM. Preoperative serum albumin as predictor of adverse outcome in emergency abdominal surgery. International Surgery Journal 2022;9:1034-7. https://doi.org/10.18203/2349-2902.isj20221151
15. Rizzo CE, Venuto R, Tripodi P, Bartucciotto L, Ventura Spagnolo E, Nirta A, et al. From Guidelines to Action: Tackling Risk Factors for Surgical Site Infections. Antibiotics 2025;14:40. https://doi.org/10.3390/antibiotics14010040

16. Shacho E, Yilma D, Goshu AT, Ambelu A. Incidence and risk factors of surgical site infection following cesarean section: a prospective cohort study at Jimma university medical center. BMC Infect Dis 2025;25:457. https://doi.org/10.1186/s12879-025-10857-y
17. Ejaz A, Schmidt C, Johnston FM, Frank SM, Pawlik TM. Risk factors and prediction model for inpatient surgical site infection after major abdominal surgery. J Surg Res 2017;217:153-159. https://doi.org/10.1016/j.jss.2017.05.018
18. Utsumi M, Yamada T, Yamabe K, Katsura Y, Fukuchi N, Fukunaga H, et al. Differences in risk factors for surgical site infection between laparotomy and laparoscopy in gastrointestinal surgery. PLoS One 2022;17:e0274887. https://doi.org/10.1371/journal.pone.0274887
19. Noorit P, Siribumrungwong B, Thakkinstian A. Clinical prediction score for superficial surgical site infection after appendectomy in adults with complicated appendicitis. World J Emerg Surg 2018;13:23. https://doi.org/10.1186/s13017-018-0186-1
20. Elmonim AMA, Nashed GA, Mohammady MT, Elshal MF, Elward ASM. Incidence of surgical site infection in patients undergoing emergency laparotomy for blunt abdominal trauma. The Egyptian Journal of Surgery 2022;40(3). https://doi.org/10.4103/ejs.ejs_176_21
21. Monge Jodra V, Sainz de Los Terreros Soler L, Diaz-Agero Perez C, Saa Requejo CM, Plana Farras N. Excess length of stay attributable to surgical site infection following hip replacement: a nested case-control study. Infect Control Hosp Epidemiol 2006;27:1299-303. https://doi.org/10.1086/509828
22. Jenks PJ, Laurent M, McQuarry S, Watkins R. Clinical and economic burden of surgical site infection (SSI) and predicted financial consequences of elimination of SSI from an English hospital. J Hosp Infect 2014;86:24-33. https://doi.org/10.1016/j.jhin.2013.09.012
23. Cheng H, Chen BP, Soleas IM, Ferko NC, Cameron CG, Hinoul P. Prolonged Operative Duration Increases Risk of Surgical Site Infections: A Systematic Review. Surg Infect (Larchmt) 2017;18:722-735. https://doi.org/10.1089/sur.2017.089
24. Paulson EC, Thompson E, Mahmoud N. Surgical site infection and colorectal surgical procedures: a prospective analysis of risk factors. Surgical infections 2017;18:520-6. https://doi.org/10.1089/sur.2016.258

Tables:

Table I: Demographic profile of the study and control groups (n=80 each)

Variables		**Study group (n=80)**	**Control group (n=80)**
Age (years)	< 30	22 (27.5)	19 (23.7)
	31-40	13 (16.2)	15 (18.7)
	41-50	20 (25)	20 (25)
	51-60	15 (18.7)	18 (22.5)
	61-70	8 (10)	7 (8.7)
	71-80	2 (2.5)	1 (1.2)
Gender	Male	63 (78.7)	53 (66.2)
	Female	17 (21.2)	27 (33.7)
Occupation	Farmer	25 (31.2)	13 (16.2)
	Homemaker	14 (17.5)	21 (26.2)
	Office goers	10 (8)	10 (8)

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 2781-2788 | ISSN:2251-6727

Students	4 (5)	9 (11.2)
Laborers	27 (33.7)	27 (33.7)

Table II: Comparison of risk factors between study and control groups (n=80 each)

Risk factors		Study group (n=80)	Control group (n=80)
Comorbidities	Hypertension	15 (18.7)	11 (13.7)
	Diabetes Mellitus	14 (17.5)	14 (17.5)
	Bronchial asthma	4 (5)	0
	Coronary heart disease	3 (3.7)	0
	Tuberculosis	5 (6.2)	1 (1.2)
Addiction	Smoking	27 (33.7)	22 (27.5)
	Alcohol	9 (11.2)	13 (16.2)
	Tobacco chewing	16 (20)	13 (16.2)
Diseases	Perforation	41 (51.2)	39 (48.7)
	Obstruction	22 (27.5)	28 (35)
	Trauma	10 (12.5)	6 (7.5)
	Hepatobiliary	3 (3.7)	4 (5)
	Bowel Gangrene	4 (5)	3 (3.7)

Table III: Relationship of SSI with different factors

Risk factors		SSI yes (n=50)	SSI no (n=110)	P value
Comorbidities	Hypertension	10 (20)	15 (13.6)	
	Diabetes Mellitus	14 (28)	14 (12.7)	
	Bronchial asthma	0 ()	4 (3.6)	
	Tuberculosis	1 (2)	5 (4.5)	
Addiction	Smoking	18 (36)	31 (28.2)	
	Alcohol	8 (16)	14 (12.7)	
	Tobacco chewing	9 (18)	19 (17.3)	
BMI	Normal (<18.5)	28 (56)	84 (76.4)	< 0.01
	Overweight (18.5-22.9)	8 (16)	14 (12.7)	

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 2781-2788 | ISSN:2251-6727

	Pre-obese (25-29.9)	12 (24)	11 (10)	
	Obese (≥30)	2 (4)	0	
Subcutaneous fat thickness	Normal	9 (18)	62 (56.4)	<0.01
	Increased	41 (82)	47(42.7)	

Table IV: Risk factor vs SSI present

Risk factors	**Study group (n=80)**	**Control group (n=80)**
BMI (≥ kg/m^2)	3 (3.7)	19 (23.7)
TSF (≥ 2.5 cm)	6 (7.5)	12 (15)
Smoking	5 (6.2)	8 (10)
Diabetes mellitus	3 (3.7)	6 (7.5)
Hypertension	4 (5)	34 (42.5)
Presence of a stoma	8 (10)	20 (25)