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Frequency of Surgical Site Infection in Patients Undergoing Exploratory Laparotomy in Tertiary Care Hospital, Karachi

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ABSTRACT

Background: Infection of the surgical site is one of the major unfavorable events prevailing in patients hospitalized post-surgery and is one of the dominant contributors to postoperative complications. This study aimed to determine the frequency of surgical site infection in patients undergoing emergency exploratory laparotomy at a Tertiary Care Hospital.

Methods: A descriptive study was conducted at the Department of Surgery, Civil Hospital, Karachi, from February 22, 2021, to August 22, 2021, in which, after obtaining verbal consent from patients, data were collected prospectively. Using non-probability consecutive sampling, 115 patients were included who met the diagnostic criteria. Data analysis was conducted using SPSS Version 20. Qualitative variables were presented as frequencies and percentages, and quantitative data was presented as simple descriptive statistics, giving mean and standard deviation. To ascertain the impact of the effect modifiers on the outcome variable, they were controlled through stratification. After stratification chi-square test was applied, taking a p-value of ≤0.05 as significant.

Results: Mean age, duration of surgery and length of hospital stays in our study was 42.98±5.35 years, 2.89±1.68 hours and 3.78±1.41 days. 60 (52.2%) were male and 55 (47.8%) were female. Out of 115 patients included in this study, 25 (21.7%) and 90 (78.3%) had and did not have surgical site infection.

Conclusion: Such high frequency, even after taking maximum precautionary measurements, demonstrates that potentially alterable independent determinants for surgical site infection after abdominal surgery might be considered plausible indicators of SSI and that an appropriate course of action to prevent them needs to be considered.

Keywords: Wound Healing, Nosocomial Infection, Laparotomy, Postoperative Complication, Risk Factors, Surgical Site Infection.

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INTRODUCTION

Surgical site infections (SSI) are frequently reported nosocomial infections and are not only a crucial cause of morbidity and mortality but also cause a serious economic burden throughout the world [1-2]. The consequences it has on the hospital as well as on the patient are unfavorable. This results in the patient and their family suffering from social and economic loss due to the increasing length of stay of patient[3]. The determinants of SSI's incorporate wound factors, surgery-related factors, and host factors[4-5]. The department of surgery is a setting with an excessive occurrence of nosocomial infection, and proliferating substantiation proposes progress has been made in the practices for infection control, including enhanced sterilization methods, barriers, operating room ventilation, techniques for surgery, and obtainability of antimicrobial prophylaxis[6]. The rates of SSI appeared to span between fewer than 1% to greater than 10%, and 75% of SSI-related demises are continuously accountable to SSI[7,8,].They are a prime source of recurrent admission, which may lead to drawbacks like delay in the healing of wounds and correction surgery[9].

The CDC definitions for monitoring of surgical site infections take into consideration 3 classes of wound infections: superficial, deep incisional SSI, and organ/space SSI. Patients can be debilitated due to SSI, and this can lead to greatly increased health care costs[10]. Several elements influencing the rate of infection include skin preparation, wound contamination, the duration of pre-operative hospital stay, drainage of wounds, patient's age, duration of surgery, and technique and skill of the surgeon[11]. Several studies regarding bacteriology show that both gram-negative and gram-positive microorganisms have participated in the occurrence of infection of surgical wounds[12]. High energy trauma, severance of soft tissue wounds, and alterations in vascularity leads to an exponential rise in the complication rate[13]. The significant consequences suffered by patients with SSI necessitate efforts to develop strategies to prevent these infections. The factors related to the management and care are extrinsic, and the patient-related factors are intrinsic[14]. Another study followed all patients who underwent emergency exploratory laparotomy and found the occurrence of this infection to be 17.7%[15].

SSIs continue to be a crucial difficulty in hospital practice even though there is a better understanding of the disease pathophysiology, standard preoperative, per-operative, and postoperative protocols, antibiotics, and sterilization techniques. The majority of the international and local studies showed variable prevalence from 10-75%[15,16,17]. To enhance patient outcomes and to reduce the financial burden, it becomes essential to reduce the incidence of SSI. Data from this study would provide the much needed local perspective in light of the fact that we have different geographical, socioeconomic status and demographics when compared to international patients. Moreover, this study would potentially offer new information to clinician that can influence clinical practice of wound management and help in development of a standard wound surveillance system. Therefore, the objective was to determine the frequency of surgical site infection in patients undergoing emergency exploratory laparotomy at Tertiary Care Hospital, Karachi.

METHODS

This descriptive study was conducted at the Department of Surgery, Civil Hospital, Karachi, over six months from February 22, 2021, to August 22, 2021 (IRB-2192/DUHS/Approval/2021/83). A total of 115 patients were included in this study and the participants were selected using non-probability consecutive sampling. Patients aged 20–60 years of either gender undergoing emergency exploratory laparotomy were included if they had an ASA score of ≤ 2. Exclusions were applied to non-consenting patients, those with a history of recent hospitalization or infection, skin diseases, thyroid disorders, malignancy, chronic liver disease, asthma, COPD, congestive cardiac failure, stroke, or pregnancy, as well as patients presenting after 24 hours. Ethical approval was obtained from the institutional ethical review committee, and written informed consent in Urdu was secured. Perioperative prophylaxis involved administering 1.5 grams of Cefuroxime Sodium IV. Participants were monitored during hospital admission and followed up post-discharge for 30 days to identify surgical site infections (SSIs) per operational definitions. Data collection included demographic and clinical characteristics, and patients who missed follow-ups were excluded. Quantitative variables such as age, length of hospital stay, and surgery duration were recorded, along with qualitative variables including gender, residence, comorbidities, and SSI occurrence. Data analysis was conducted using SPSS Version 20. Mean and standard deviations were calculated for normally distributed variables, while medians and interquartile ranges were used for non-normal distributions. Frequencies and percentages were computed for qualitative variables. Stratification was applied to control effect modifiers, and post-stratification analysis using chi-square or Fisher's exact test assessed the influence of these factors on SSI outcomes, with a p-value of ≤ 0.05 considered statistically significant.

RESULT

A total of 115 patients undergoing exploratory laparotomy at the Department of Surgery, Civil

Hospital, Karachi, were included in this study. The age of the patients ranged from 20 to 60 years, with a mean age of 42.98 ± 5.35 years. The average duration of surgery and length of hospital stay were 2.89 ± 1.68 hours and 3.78 ± 1.41 days, respectively. Of these patients, 25 (21.7%) developed surgical site infections (SSI), while 90 (78.3%) did not. Tables 1–3 present the distribution of surgical site infections based on demographic, clinical, and other factors, with a significant association observed only for hypertension (p = 0.04).

Table 1: Surgical Site Infection (SSI) According to Demographic Variables

Variable	SSI Yes (%)	SSI No (%)	Total (%)	P-Value
Age (Years)				
20–30	1 (4%)	15 (16.7%)	16 (13.9%)	0.29
31–40	16 (64%)	42 (46.7%)	58 (50.4%)	
41–50	3 (12%)	15 (16.7%)	18 (15.7%)	
51–60	5 (20%)	18 (20%)	23 (20%)	
Gender				
Male	16 (64%)	44 (48.9%)	60 (52.2%)	0.13
Female	9 (36%)	46 (51.1%)	55 (47.8%)	
Residence				
Urban	19 (76%)	59 (65.6%)	78 (67.8%)	0.23
Rural	6 (24%)	31 (34.4%)	37 (32.2%)	

Table 1: Shows the cohort included 60 (52.2%) males and 55 (47.8%) females. Regarding age distribution, 16 (13.9%) patients were aged 20–30 years, 58 (50.4%) were aged 31–40 years, 18 (15.7%) were aged 41–50 years, and 23 (20%) were aged 51–60 years. A majority of patients, 78 (67.8%), resided in urban areas, while 37 (32.2%) were from rural regions.

Table 2: Surgical Site Infection (SSI) According to Clinical Variables

Variable	SSI Yes (%)	SSI No (%)	Total (%)	P-Value
ASA Status				
ASA I	18 (72%)	52 (57.8%)	70 (60.9%)	0.14

ASA II	7 (28%)	38 (42.2%)	45 (39.1%)	
Duration of Surgery				
< 3 Hours	10 (40%)	48 (53.3%)	58 (50.4%)	0.17
> 3 Hours	15 (60%)	42 (46.7%)	57 (49.6%)	
Hypertension				
Yes	13 (52%)	28 (31.1%)	41 (35.7%)	0.04*
No	12 (48%)	62 (68.9%)	74 (64.3%)	

Table 2 shows that the ASA classification revealed that 70 (60.9%) patients were ASA I, and 45 (39.1%) were ASA II. The duration of surgery was less than three hours in 58 (50.4%) patients and more than three hours in 57 (49.6%) patients.

Table 3: Surgical Site Infection (SSI) According to Other Factors

Variable	SSI Yes (%)	SSI No (%)	Total (%)	P-Value
Diabetes Mellitus				
Yes	3 (12%)	17 (18.9%)	20 (17.4%)	0.31
No	22 (88%)	73 (81.1%)	95 (82.6%)	
BMI ≥ 27.5 kg/m²				
Yes	8 (32%)	34 (37.8%)	42 (36.5%)	0.36
No	17 (68%)	56 (62.2%)	73 (63.5%)	
Smoking				
Yes	9 (36%)	27 (30%)	36 (31.3%)	0.36
No	16 (64%)	63 (70%)	79 (68.7%)	

**Statistically significant.*

Table 3 shows the study population; 20 (17.4%) patients had type 2 diabetes mellitus, and 41 (35.7%) had hypertension. Dyslipidemia was observed in 16 (13.9%) patients, while 42 (36.5%) had a BMI ≥ 27.5 kg/m². Smoking was reported in 36 (31.3%) patients.

DISCUSSION

The department of surgery is a setting with an excessive occurrence of nosocomial infection, and proliferating substantiation proposes progress has been made in the practices for infection control, including enhanced sterilization methods, barriers, operating room ventilation, techniques for surgery, and obtainability of prophylactic antibiotic [4]. Nevertheless, surgical site infection (SSI) continues to be an important reason for morbidity, lengthens the duration of hospital stay, and elevates the demise rate. The incidence of SSI appears to span from fewer than 1% to greater than 10%, and 75% of SSI-related demises are contiguously accountable to SSI [7-8,18]. The occur-rence of SSI not only poses a serious threat to the well-being and survival of patient but also thrusts a heavy financial burden on their household and community [2,19]. In the management of surgical patients, it is vital to diagnose and treat infections timely. Therefore, it is important to be aware of the factors attributed to SSI and take appropriate mea-sures for its prevention, alleviation of patients' pain, ensuring their recovery, and reducing treatment costs.

Our study included a total of 115 patients. Mean age, duration of surgery and length of hospital stays in our study was 42.98±5.35 years, 2.89±1.68 hours and 3.78±1.41 days. 60 (52.2%) were male and 55 (47.8%) were female. Out of 115 patients, 25 (21.7%) and 90 (78.3%) had and did not have surgical site infection.

Another study included 70 patients. From this, SSI occurred in 9 (12.9%; 95% confidence interval (CI): 6.9-22.7%) patients, inclusive of 5 patients who had injury of the bowel (small bowel; n=3, colonic injuries; n=2). Almost every case was diagnosed within 7 days of hospital stay. Superficial incisional (skin and subcutaneous tissue) SSI occurred in each of the patients. None of the pre-established variables, incorporating injury of the bowel (p=0.08) or period of surgery (p=0.09), exhibited a precisely remarkable relation with the occurrence of SSI[20].

Another study who had included 1,171 cases where they had gone through laparotomy, found that OS-SSI had occurred in 172 of these cases. The model incorporated the variables considered to influence the occurrence of SSIs and the variables that were accessible to the surgical expert close to the commencement of the laparotomy for damage-control. The two factors that mainly attributed to OS-SSIs were trauma laparotomy and resection of colon. The predictive models area under the curve verified on the trial sample was 0.78 (95% confidence interval, 0.71-0.85). Utilizing this retrospective cohort the likelihood of OS-SSI could be precisely calculated drawing upon a coalescence of elements accessible to surgical expert prior to the commencement of an emergency laparotomy. For the actual assessment of likelihood of OS-SSI during surgery a Web-based calculator is under design. There is requirement of the prospective substantiation of its generalized applicability to further trauma cohorts and of its benefit on-site[21].

In a separate study of 1,501 cases where they had gone through laparotomy, the inclusion criteria were met by 503 patients. Young patients (median, 28.0 years; range, 22.0-40.0 years) who had penetrating (74%) or bowel (80%) trauma, and DCL (36%) and SSI (44%; superficial, 25%; deep, 3%; organ/space, 25%) were frequent. Despite numerous risk factors, the occurrence of superficial SSIs was not very frequent with skin incisions left open (9.8%), as compared to any skin closure (31.1%, $p < 0.001$), while no variance in superficial SSI was noted ($p = 0.64$) after complete ($n = 224$) or loose skin closure ($n = 136$). For the assessment of the anticipation of both fascial dehiscence and superficial SSIs, multivariate logistic regression analysis was utilized. After alteration for various confounding factors, each closure of skin was associated with nine times increased risk for superficial SSIs and six times for fascial dehiscence[22].

A further study had 1,322 cases, in which the median score for injury severity was 19 for those who had experienced blunt injury (54%), in which most cases were male (77%) with a median age of 33 years. S-SSI occurred in 88 (7%) cases. Raised final lactate, requirements for transfusion, loss of blood, and wound classification occurred in patients whom S-SSI occurred. Cases with large bowel or mesenteric injury were mainly included in the cases that had S-SSI than those without S-SSI. Raised complications and lengthened hospital stay were also associated with superficial SSI. Full-thickness injury of the large gut, damage control laparotomy, and resection of large bowel were among the parameters that contributed most to the model[23].

A different study included 337 patients. The altogether occurrence of SSI was 16.3% (55/337); 25 cases (45%) had both deep and superficial infections, and 5 cases (9%) had deep infections. The occurrence was 35% versus 4% ($p < 0.001$) of SSI in open compared to laparoscopic procedures. Extended-spectrum β-lactamase-producing Escherichia coli was the most commonly isolated microorganism, followed by Enterococcus species. Sensitivi-

ty to the antibiotic given prophylactically preoperatively was only seen in 23% of cultured bacteria. Emergency procedures, open surgical approach, male gender, and prolonged duration of procedure were the independent predictors of SSI[24].

Another study included 1,138 patients who fulfilled the criteria for inclusion; 36 patients developed an infection during the hospital stay, and two incidents occurred after discharge. Identification of 6 independent elements related to the prevalence of SSI was done through multivariate analysis: preprocedural white blood cell count more than 10×10(9)/L; diabetes; wound classification (clean contaminated; contaminated; dirty); cancer; postoperative drainage; and duration of surgery greater than 120 minutes[25].

CONCLUSION

Potentially alterable independent determinants for SSI after abdominal surgery might be considered plausible indicators of SSI, and the appropriate course of action to prevent them needs to be considered to diminish SSI and enhance the outcome of patients. It advocated standardized medical care, disinfection, and sterilization of apparatus and equipment with cautious management of intensive techniques to dominate such grave infections in well well-planned and efficacious fashion. Based on international standards systems for conventional observation of infections at surgical sites should work productively to lessen the occurrence and prevalence rates of SSIs to the lowest levels. Since most infections become manifest after discharge, post-discharge surveillance is highly recommended. Moreover, it is imperative to refine patient management and consequences through the formation of clinical guidelines that are suitable for the local context.

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CONFLICT OF INTEREST

There is no conflict of interest.

PATIENT CONSENT

Informed consent was taken from each participant.

ETHICAL APPROVAL

The study was approved by the Institutional Review Board (IRB-2192/DUHS/Approval/2021/83).

AUTHORS' CONTRIBUTIONS

All authors contributed equally.

REFERENCES

1.Shah D, Padshala R, Chaudhary SR, Khan S, Mallik S, Varrassi G. Predicting superficial surgical site infections: a study of the risk factors and an assessment scale from Western India. Cureus. 2023 Oct 25;15(10):e47657. doi:10.7759/cureus.47657. PMID: 38021607; PMCID: PMC10669653.

2. Monahan M, Glasbey J, Roberts TE, Jowett S, Pinkney T, Bhangu A, Morton DG, de la Medina AR, Ghosh D, Ademuyiwa AO, Ntirenganya F, Tabiri S; NIHR Global Research Health Unit on Global Surgery. The costs of surgical site infection after abdominal surgery in middle-income countries: Key resource use In Wound Infection (KIWI) study. J Hosp Infect. 2023 Jun;136:38-44. doi: 10.1016/j.jhin.2023.03.023. Epub 2023 Apr 21. PMID: 37086854.

3. Pop-Vicas AE, Young A, Knobloch MJ, Heise C, Bowers B, Safdar N. Surgeons' mental models of surgical site infection: insights into adherence with complex prevention bundles. Infect Control Hosp Epidemiol. 2022 Sep;43(9):1249-55. doi:10.1017/ice.2021.161. PMID: 33985608.

4. Silva C, Samaan C, Shamloul N, Kamrani P, Sun H, Urbonas R, et al. Predictive value of excision site bacterial burden and development of surgical site infection: a retrospective cohort study. J Am Acad Dermatol. 2024 Feb;90(2):372-4. doi:10.1016/j.-jaad.2023.07.1042. PMID: 37704107.

5. Bekiari A, Pappas-Gogos G, Dimopoulos D, Priavali E, Gartzonika K, Glantzounis GK. Surgical site infection in a Greek general surgery department: who is at most risk? J Wound Care. 2021 Apr 2;30(4):268-74. doi:10.12968/jowc.2021.30.4.268. PMID: 33856911.

6. Cohen NS, Bock JM, May AK. Sepsis and postoperative surgical site infections. Surgery. 2023 Aug;174(2):403-5. doi:10.1016/j.surg.2023.01.006. PMID: 36775759.

7. Mensah J, Bediako-Bowan AA, Amoako-Adusei A, Acheampong F, Sheriff M, Adu-Aryee NA. Antibiotic use in surgical infections at a tertiary teaching hospital in Ghana. Ghana Med J. 2024 Sep;58(3):207-14. doi:10.4314/gmj.v58i3.5. PMID: 39398086; PMCID: PMC11465725.

8. Bhat RA, Isaac NV, Joy J, Chandran D, Jacob KJ, Lobo S. The effect of American Society of Anesthesiologists score and operative time on surgical site infection rates in major abdominal surgeries. Cureus. 2024 Feb 28;16(2):e55138. doi:10.7759/cureus.55138. PMID: 38558689; PMCID: PMC10979762.

9. Zheng ZQ, Liu YY, Luo WW, Zhang HW, Wang YY, Wang H, et al. [Investigation and factor analysis of postoperative surgical site infections in emergency abdominal surgery in China from 2018 to 2021 based on Chinese SSI Surveillance]. Zhonghua Wei Chang Wai Ke Za Zhi. 2023 Sep 25;26(9):827-36. Chinese. doi:10.3760/cma.j.cn441530-20230619-00216. PMID: 37709690.

10. Meena R, Chakravarti S, Agarwal S, Jain A, Singh S, Dey S. A prospective study of surgical site infection with its risk factors and their correlation with the NNIS Risk Index. J West Afr Coll Surg. 2023 Oct-Dec;13(4):26-33. doi:10.4103/jwas.jwas_6_23. PMID: 38449542; PMCID: PMC10914107.

11. Jatoliya H, Pipal RK, Pipal DK, Biswas P, Pipal VR, Yadav S, et al. Surgical site infections in elective and emergency abdominal surgeries: a prospective observational study about incidence, risk factors, pathogens, and antibiotic sensitivity at a government tertiary care teaching hospital in India. Cureus. 2023 Oct 31;15(10):e48071. doi:10.7759/cureus.48071. PMID: 38046494; PMCID: PMC10690067.
12. Croke L. Novel strategies to prevent surgical site infections. AORN J. 2023 Oct;118(4):P7-P10. doi:10.1002/aorn.14015. PMID: 37750790.
13. LiBrizzi CL, Sabharwal S, Forsberg JA, Leddy L, Doung YC, Morris CD, et al. Does the use of negative pressure wound therapy and postoperative drains impact the development of surgical site infections? A PARITY Trial secondary analysis. J Bone Joint Surg Am. 2023 Jul 19;105(Suppl 1):34-40. doi:10.2106/JBJS.22.01185. PMID: 37466578.
14. Rajak R, Mandal NS. Evaluation of surgical site infection after elective surgeries at a tertiary care hospital. Cureus. 2023 Dec 20;15(12):e50844. doi:10.7759/cureus.50844. PMID: 38249181; PMCID: PMC10798382.
15. Mengistu DA, Alemu A, Abdukadir AA, Mohammed Husen A, Ahmed F, Mohammed B, et al. Global incidence of surgical site infection among patients: systematic review and meta-analysis. Inquiry. 2023;60:46958023116254 9. doi:10.1177/00469580231162549. PMID: 36964747; PMCID: PMC10041599.
16. Amirah A, Harahap J, Willim HA, Suroyo RB, Henderson AH. Effect of comorbidities on the incidence of surgical site infection in patients undergoing emergency surgery: a systematic review and meta-analysis. J Clin Med Res. 2024 Aug;16(7-8):345-54. doi:10.14740/jocmr5222. PMID: 39206107; PMCID: PMC11349128.
17. Xu Z, Qu H, Gong Z, Kanani G, Zhang F, Ren Y, et al. Risk factors for surgical site infection in patients undergoing colorectal surgery: a meta-analysis of observational studies. PLoS One. 2021 Oct 28;16(10):e0259107. doi:10.1371/journal.pone.0259107. PMID: 34710197; PMCID: PMC8553052.
18. Chen Y, Guo H, Gao T, Yu J, Wang Y, Yu H. A meta-analysis of the risk factors for surgical site infection in patients with colorectal cancer. Int Wound J. 2023 Oct 31;21(2):e14459. doi:10.1111/iwj.14459. Retraction in: Int Wound J. 2025 Mar;22(3):e70266. doi:10.1111/iwj.70266. PMID: 37904719; PMCID: PMC10828529.
19. Weiser TG, Regenbogen SE, Thompson KD, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet. 2008;372:139-44. DOI: 10.1016/S0140-6736(08)60878-8.
20. Chowdhury S, Bahatheq S, Alkaraawi A, Falatah MM, Almutairi RF, Alfadhel S, et al. Surgical site infections after trauma laparotomy: An observational study from a major trauma center in Saudi Arabia. Saudi Med J. 2019 Mar;40(3):266–70. DOI: 10.15537/smj.2019.3.24005.
21. Wei S, Green C, Kao LS, Padilla-Jones BB, Truong VTT, Wade CE, et al. Accurate risk stratification for development of organ/space surgical site infections after emergent trauma laparotomy. J Trauma Acute Care Surg. 2019 Feb;86(2):226–31. DOI: 10.1097/-TA.0000000000002143.
22. Seamon MJ, Smith BP, Capano-Wehrle L, Fakhro A, Fox N, Goldberg M, et al. Skin closure after trauma laparotomy in high-risk patients: Opening opportunities for improvement. J Trauma Acute Care Surg. 2013 Feb;74(2):433–9; discussion 439–40. DOI: 10.1097/TA.0b013e31827e2589.
23. Isbell KD, Hatton GE, Wei S, Green C, Truong VTT, Woloski J, et al. Risk stratification for superficial surgical site infection after emergency trauma laparotomy. Surg Infect (Larchmt). 2021 Jan 5. DOI: 10.1089/-sur.2020.242.
24. Alkaaki A, Al-Radi OO, Khoja A, Alnawawi A, Alnawawi A, Maghrabi A, et al. Surgical site infection following abdominal surgery: A prospective cohort study. Can J Surg. 2019 Apr 1;62(2):111–7. DOI: 10.1503/cjs.004818.
25. Cheng K, Li J, Kong Q, Wang C, Ye N, Xia G. Risk factors for surgical site infection in a teaching hospital: A prospective study of 1,138 patients. Patient Prefer Adherence. 2015 Aug 14;9:1171–7. DOI: 10.2147/PPA.S86153.