Open Access

Original Article

Comparison of Infection Rates in Diabetic versus Non-Diabetic Patients after Elective Surgical Procedures

Usman Ghani, Muhammad Ayub Ashraf, Muhammad Jalil Malik, Mujahid Zulfiqar, Qazi Tafheem ul Haq*, Tayyaba Usman**

Department of General Surgery, Combined Military Hospital, Lahore/National University of Medical Sciences (NUMS) Pakistan, *Department of General Surgery, Combined Military Hospital, Abbottabad/National University of Medical Sciences (NUMS) Pakistan, **Department of Gynecology & Obstetrics, Combined Military Hospital, Lahore/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To determine the frequency of surgical sites infections in diabetic vs. non-diabetic patients after elective surgical procedures.

Study Design: Quasi-experimental study.

Place and Duration of Study: Department of General Surgery Combined Military Hospita, Lahore, Pakistan from Jul 2022 to Jun 2023.

Methodology: Patients aged 20 to 70 years who underwent elective foot and ankle surgeries totaled 210 and were eligible for inclusion in the study. Diabetic patients were assigned to Group A, whereas non-diabetic patients were assigned to Group B. Each patient was observed for the occurrence of surgical site infection.

Results: Gender distribution revealed that 54.3% of patients were male, while 45.7% were female. The mean age of patients was 46.00±5.90 years. The mean BMI was 25.03±2.25 kg/m2. The average durations of surgery and hospital stay were 1.15 hours and 8.14 days, respectively. Among diabetic patients, the mean duration of diabetes was 12.08±3.84 years, and the mean HbA1c level was 7.64±2.03. Among diabetic patients, 14 cases (13.3%) developed infections, while in the non-diabetic group, 8 cases (7.6%) were observed.

Conclusion: In conclusion, our study demonstrated a notable disparity in the incidence of surgical site infections (SSIs) between diabetic and non-diabetic patients undergoing elective surgical procedures. With 13.3% of diabetic patients experiencing SSIs compared to 7.6% in the non-diabetic group, these findings emphasize the heightened vulnerability of diabetic individuals to postoperative complications.

Keyword: Elective Surgery, Diabetes, Surgical Site Infections, Osteosynthesis.

How to Cite This Article: *Ghani U, Ashraf MA, Malik MJ, Zulfiqar M, Haq QT, Usman T. Comparison of Infection Rates in Diabetic versus Non-Diabetic Patients after Elective Surgical Procedures. Pak Armed Forces Med J 2025; 75(Suppl-7): S1140-S1144.*
DOI: https://doi.org/10.51253/pafmj.v75iSUPPL-7.11929

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by-nc/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

It is estimated that between 14 and 16 percent of all nosocomial infections in hospitalized patients are caused by surgical site infections (SSIs). Patients with wound infections often have a longer hospital stay, higher medical costs, and a higher risk of death.[1] No such estimates have been provided for developing countries. Reducing SSI rates by 35% to 50% is possible with the use of surveillance systems and providing surgeons with feedback on their individualized rates.[2] Therefore, SSIs are a top priority for recording infection rates and monitoring after surgical operations. Age, smoking, malnutrition, diabetes, immunological insufficiency, surgical length, and malignancy are only few of the factors demonstrated in several studies to increase the incidence of SSI.[3]

Correspondence: Dr Usman Ghani, Department of General Surgery, Combined Military Hospital, Lahore, Pakistan
Received: 23 Mar 2024; revision received: 31 May 2024; accepted: 03 Jun 2024

Antimicrobial prophylaxis given before surgery can cut the risk of surgical site infections in the musculoskeletal system from 4-8% to 1-3%. Most elective procedures automatically include the use of prophylactic antibiotics.[4,5] However, there are no set guidelines for antibiotic use during elective foot and ankle surgery for adults. Patients with diabetes, other immunosuppressive states, and those who have had procedures involving hardware, prosthetic joints and bone are considered high risk and should get antibiotic prophylaxis as a matter of course, as per the guidelines set forth by the American College of Foot and Ankle Surgeons. Nevertheless, perioperative antibiotic prophylaxis is typically unnecessary for elective soft tissue surgery of the foot and ankle in otherwise healthy patients. Patients without a history of resistant infection are best served by using an antibiotic with a restricted spectrum against Staphylococcus aureus.[6] For individuals with a beta lactam allergy, the recommended antibiotic is cefazolin (or cefuroxime), but clindamycin and vancomycin are alternatives. Similar recommendations have been made by other writers, including first- or second-generation cephalosporins and glycopeptides only in the presence of confirmed multi-resistant skin colonization.[7] Notably, there seems to be a correlation between diabetes and an increase in the frequency of infections in diabetic foot patients. Injury and wound healing may be slowed due to the effects of hyperglycemia, neuropathy, obesity and decreased tissue perfusion. Smoking history or present habits, as well as prolonged surgical procedures, were shown to substantially increase the risk of SSI.[8]

Despite a thorough understanding of the microbiological features of SSIs after orthopedic foot surgery, there is a lack of information specifically for people who undergo diabetic foot surgery. In clean elective surgery the most commonly isolated pathogens are coagulase-negative Staphylococcus and S. aureus. Nonetheless, comparable studies have noted an increase in the frequency of methicillin-resistant S. aureus and S. epidermidis, alongside vancomycin-resistant S. aureus and Enterococcus.[9] In diabetic foot procedures, the topic of whether or not gram-negative perioperative antibiotic prophylaxis is more effective remains open. More problematic individuals with an open wound may be colonized by a wide variety of microorganisms, not only skin pathogens, such as gram-negative bacilli. Although current evidence does not lend itself to altering regular antibiotic prophylaxis, further study may uncover the necessity to do so in this population of patients.[10] To minimize nosocomial infections in general surgery patients, we need a better knowledge and analysis of the different independent variables linked with SSI. Surgical wound infection rates are not frequently monitored in many impoverished countries like Pakistan.

This study seeks to determine the frequency of Surgical Site Infections (SSIs) in diabetic versus non-diabetic patients following elective surgical procedures. It aims to contribute to existing literature by providing insights into the comparative risk of SSIs between these patient groups. Research gaps in Pakistan regarding SSIs in diabetic and non-diabetic populations will be addressed through this investigation.

METHODOLOGY

The Quasi-experimental study was conducted at Department of General Surgery CMH Lahore from July 2022 to June 2023. The study protocol was approved by the Institutional Review Board of hospital (IRB: 513/2024). Patients were divided to diabetic and non-diabetic patients undergoing elective surgery. Patients scheduled for elective surgeries were screened for eligibility criteria and provided informed consent to participate in the study. Sample size of 210 patients was calculated using WHO calculator with a 95% confidence interval and a 5% significance level, assuming 80% of the study's power based on the frequency of surgical site infection to be 58% in diabetic group and 22% in non-diabetic group patients.[11,12] The sampling technique used in this study was consecutive sampling, where patients undergoing elective surgical procedures at our institution were included in the study consecutively until the desired sample size was reached.

Inclusion Criteria: Patients aged between 20 to 70 years who had undergone elective foot and ankle surgeries were eligible for inclusion in the study. Participants not undergoing any treatment that could significantly impact the study outcomes were included.

Exclusion Criteria: Patients with a history of severe allergic reactions to antibiotics, those with significant renal impairment (creatinine clearance <30 mL/min), pregnant or lactating women, and individuals with a history of autoimmune diseases were excluded from the study.

Patients in the study received a single intravenous dose of Ceftriaxone 1g, administered precisely thirty minutes before the start of the initial incision. Surgeries were conducted under general anesthesia, followed by post-operative monitoring as outpatients on the fourteenth and twenty-eighth days post-surgery (Figure). Close observation was maintained to detect any occurrences of surgical site infections (SSIs), characterized by fever, redness, discomfort at the incision site, wound discharge, or abscess formation within twenty-eight days following the surgical procedure.

The collected data were analyzed using IBM Statistical Package for Social Sciences (SPSS), version 27.0. Categorical variables are presented as frequency and percentage and compared by Chi-square test. Continuous variables are expressed as Mean±SD and compared by Independent sample t test and Mann-Whitney U test. Normality was assessed by skewness, kurtosis, Q–Q plots and Shapiro Wilk's test. Logistic regression analysis was employed to identify risk factors of surgical site infections among diabetic patients. Level of significance was set 5% and $p \leq 0.05$ (at 95% CI) was considered significant.

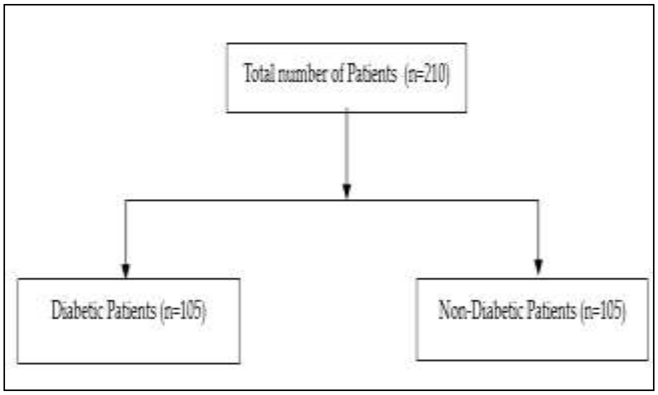

Figure: Patient Flow Diagram (n=210)

RESULTS

A total of 210 patients were included in the study with equal number of diabetic (n=105) and non-diabetic (n=105) patients. Gender distribution revealed that 54.3% of patients were male, while 45.7% were female. The mean age of patients was 46.00±5.90 years. The mean BMI was 25.03±2.25 kg/m². The average durations of surgery and hospital stay were 1.15±0.62 hours and 8.14±2.56 days, respectively. The mean duration of diabetes was 11.82±3.91 years, and the mean HbA1c level was 7.71±2.24 as shown in Table-I.

Table-I: Demographic and Clinical Characteristics of Study Participants (n=210)

Variables	n (%)
Gender, n (%)	
Male	114(54.3%)
Female	96(45.7%)
Age (years) Mean±SD	46.0±5.90
Body Mass Index (kg/m²) Mean±SD	25.03±2.02
Duration of Surgery (Hours) Mean±SD	1.15±0.62
Duration of Hospital Stay (Days) Mean±SD	8.14±2.56
Duration of Diabetes (years) Mean±SD	11.82±3.91
HbA1c (mmol/mol) Mean±SD	7.71±2.24

Hemoglobin A1C: HbA1C

In Table-II, a comparison was made between various variables in diabetic and non-diabetic patients. The distribution of gender showed that 52.4% of diabetic patients were male, compared to 56.2% of non-diabetic patients. However, this difference was not statistically significant (p=0.580). Regarding age, there was no significant difference between diabetic (45.76 years) and non-diabetic (46.25 years) patients (p=0.552). Similarly, there were no significant differences in BMI, hospital stay duration, time of surgery, duration of diabetes, or HbA1c levels between diabetic and non-diabetic groups (p> 0.05 for all comparisons).

Table-II: Comparison of Different Variables in Diabetic and Non-Diabetic Patients (n=210)

Variables	Diabetic Patients (n=105)	Non-Diabetic Patients (n=105)	*p*-value
Gender			
Male, n (%)	55(52.4%)	59(56.2%)	0.580 a
Female, n (%)	50(47.6%)	46(43.8%)	
Age (years), Mean±SD	45.76±5.46	46.25±6.33	0.552 b
Body Mass Index (kg/m²) , Mean±SD	24.88±1.96	25.18±2.08	0.287 b
Hospital Stay (Days), median (IQR)	8.0(6.0-9.0)	8.0(7.0–10.0)	0.408 c
Time of Surgery (Hours), median (IQR)	1.1(1.1–1.2)	1.1(0.6–1.8)	0.997 c
Duration of Diabetes, Mean±SD (Years)	12.08±3.84	11.55±3.98	0.325 b
HbA1c (mmol/mol) , Mean±SD	7.64±2.03	7.78±2.44	0.648 b

a Chi-square test; b Independent sample t test; c Mann-Whitney U test, Hemoglobin A1C: HbA1C

In Table-III, the types of surgeries performed were compared between diabetic and non-diabetic patients. Among diabetic patients, Cavus-cavovarus foot was the most common procedure, accounting for 36.2% of cases, while non-diabetic patients had a lower frequency of Cavus-cavovarus foot surgery (27.6%). Toe surgery was performed in 10.5% of diabetic patients and 3.8% of non-diabetic patients. Other bone surgeries, excluding toes, were performed in 19% of diabetic patients and 25.7% of non-diabetic patients. Charcot neuroarthropathy surgeries were more prevalent in non-diabetic patients (64.3%) compared to diabetic patients (14.3%). Soft tissue surgeries and other procedures showed slight differences between the two groups but without a significant trend.

Table-III: Distribution of Diabetic and Non-Diabetic Patients Undergoing Various Elective Surgical Procedures (n=210)

Elective Surgical Procedures	Diabetic Patients (n=105)	Non-Diabetic Patients (n=105)	*p*-value a
	n (%)	n (%)	
Toe Surgery	11(10.5%)	4(3.8%)	0.061
Other bone surgeries (Excluding Toes)	20(19.0%)	17(25.7%)	0.587
Charcot Neuroarthropathy	15(14.3%)	27(64.3%)	0.038
Cavus-Cavovarus Foot	38(36.2%)	29(27.6%)	0.236
Soft Tissue Surgery	15(14.3%)	18(17.1%)	0.569
Other Procedures	6(5.7%)	10(9.5%)	0.298

Chi-square test

In Table-IV, the rate of surgical site infections was compared between diabetic and non-diabetic groups. Among diabetic patients, 14 cases (13.3%) developed infections, while in the non-diabetic group, 8 cases

(7.6%) were observed. There was no statistically significant difference (p=0.176) in infection rates between the two groups. Table-V presents the risk factors for surgical site infections (SSIs) among diabetic patients (n=105). Among the diabetic patients, 14(13.3%) developed surgical site infections (SSIs). Analysis of risk factors including gender, age, BMI, hospital stay, surgery duration, duration of diabetes, and HbA1c levels showed no significant associations with SSIs. Specifically, the odds ratios for these variables were not statistically significant.

Table-IV: Surgical Site Infection Rates among Diabetic and Non-Diabetic Patients (n=210)

Surgical Site Infection	Diabetic Patients (n=105)	Non-Diabetic Patients (n=105)	*p* value a
	n (%)	n (%)	
Yes	14(13.3%)	8(7.6%)	0.176
No	91(86.7%)	97(92.4%)	

Chi-square test

Table-V: Risk factors for Surgical Site Infections Among Diabetic Group (n=105)

	Surgical site infection		Univariate logistic regression		
	Yes (n=14)	No (n=91)	*p*-value	Un-adjusted Odds Ratio	95% CI for Un-adjusted Odds Ratio
Gender					
Male	7 (50.0%)	48(52.7%)	1		
Female	7 (50.0%)	43(47.3%)	0.848	1.12	0.36–3.44
Age (Years)	47.43±5.77	45.51±5.39	0.221	0.93	0.84–1.04
Body Mass Index	25.04±1.83	24.86±1.98	0.746	0.95	0.71–1.27
Hospital Stay (Days)	6.93±2.53	7.99±2.47	0.142	1.18	0.94–1.48
Time of Surgery (Hours)	1.14±0.11	1.14±0.11	0.972	1.10	0.01–187.5
Duration of Diabetes (Years)	12.05±4.12	12.09±3.83	0.971	1.00	0.87–1.16
HbA1c	7.69±2.96	7.63±1.87	0.918	0.98	0.74–1.30

Hemoglobin A1C: HbA1C

DISCUSSION

Postoperative wound infections, inherent to surgical procedures, represent a serious threat to patients' health and survival. These infections not only prolong illness but also escalate the risk of mortality, underscoring their profound impact on patient outcomes. Efforts to mitigate this risk are crucial in safeguarding patients' well-being and reducing healthcare burdens associated with postoperative complications.[13]

Our study revealed a slightly younger mean age of patients (46 years) compared to the findings of Qamar *et al*., (2015) and Kaafarani *et al*., where the mean ages were 46.54±10.58 years and 60.5±9.4 years, respectively.[14] Our study investigated the rate of surgical site infections (SSIs) between diabetic and non-diabetic groups, revealing that 13.3% of diabetic patients and 7.6% of non-diabetic patients developed infections. This finding is consistent with the results reported by Qamar *et al*., (2023), who observed a higher SSI rate in diabetic patients (9.9%) compared to non-diabetic patients (2.2%). There is no statistically significant difference in infection rates between diabetic and non-diabetic groups (p=0.176) in our study. But Qamar *et al*., (2023) reported the statistically significant difference in infection rates between diabetic and non-diabetic groups (p=0.029) which underscores the elevated risk of SSIs associated with diabetes.[14] Despite these differences, all studies concluded that age did not significantly influence the development of surgical site infections (SSIs), as indicated by non-significant p-values (p=0.599 and p=0.977). This consistency across studies suggests that age may not be a significant risk factor for SSIs in elective surgical procedures.[15]

In our study, we observed a higher rate of surgical site infections (SSIs) among diabetic patients compared to non-diabetic patients, with 13.3% of diabetic patients and 7.6% of non-diabetic patients developing infections. This finding aligns with similar studies, such as Ismat *et al*., s investigation, which reported infection rates of 11.67% in diabetic patients and 6.67% in non-diabetic patients undergoing Elective Surgical Procedures.[16] Additionally, Nakamura *et al*., 's study on laparoscopic colon surgery found infection rates of 9.3% in diabetic patients and 3.4% in non-diabetic patients, indicating a trend of higher infection risk among diabetic individuals across different surgical procedures.[17]

Our study investigated the incidence of surgical site infections (SSIs) among diabetic and non-diabetic patients, revealing a higher rate of infections in diabetic individuals (13.3%) compared to non-diabetics (7.6%). This finding aligns with the results of a meta-analysis involving ten studies and a total of 78,489 patients, which found a pooled frequency of SSI in diabetic patients to be 26.3%. Moreover, the meta-analysis demonstrated a statistically significant association between diabetes mellitus (DM) and the occurrence of SSIs, with a significantly higher frequency of DM observed in the SSI group compared to the Non-SSI group (p=0.01).[18]

The consistency between our study findings and those of the meta-analysis underscores the heightened risk of SSIs associated with diabetes. This highlights the importance of recognizing diabetes as a significant risk factor for surgical complications, necessitating tailored preventive measures and vigilant postoperative monitoring for diabetic patients. Strategies such as optimal glycemic control, preoperative screening and management of diabetic complications, and implementation of evidence-based infection prevention protocols are critical in mitigating the increased infection risk observed in diabetic individuals.

CONCLUSION

In conclusion, our study demonstrated a notable disparity in the incidence of surgical site infections (SSIs) between diabetic and non-diabetic patients undergoing elective surgical procedures. With 13.3% of diabetic patients experiencing SSIs compared to 7.6% in the non-diabetic group, these findings emphasize the heightened vulnerability of diabetic individuals to postoperative complications.

Conflict of Interest: None.

Funding Source: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

UG & MAA: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

MJM & MZ: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

QTH & TU: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Mezemir R, Seid A, Gishu T, Demas T, Gize A. Frequency and root causes of surgical site infections at an academic trauma and burn center in Ethiopia: a cross-sectional study. Patient Safety Surg 2020; 14: 1-7. http://doi.org/10.1186/s13037-019-0229-x
2. Fenny AP, Asante FA, Otieku E, Bediako-Bowan A, Enemark U. Attributable cost and extra length of stay of surgical site infection at a Ghanaian teaching hospital. Infect Prevent Pract 2020; 2(2): 100045. http://doi.org/10.1016/j.infpip.2020.100045
3. Mehtar S, Wanyoro A, Ogunsola F, Ameh EA, Nthumba P, Kilpatrick C, et al. Implementation of surgical site infection surveillance in low-and middle-income countries. Int J Infect Dis 2020; 100: 123-131. http://doi.org/10.1016/j.ijid.2020.07.021
4. Aghdassi SJS, Schröder C, Gastmeier P. Gender-related risk factors for surgical site infections. Results from 10 years of surveillance in Germany. Antimicrob Resistance Infect Control 2019; 8: 1-8. http://doi.org/10.1186/s13756-019-0547-x
5. Zhou J, Wang R, Huo X, Xiong W, Kang L, Xue Y. Incidence of surgical site infection after spine surgery: a systematic review and meta-analysis. Spine 2020; 45(3): 208-216. http://doi.org/10.1097/BRS.0000000000003218
6. Soldevila-Boixader L, Viehöfer A, Wirth S, Waibel F, Yildiz I, Stock M, et al. Risk Factors for Surgical Site Infections in Elective Orthopedic Foot and Ankle Surgery: The Role of Diabetes Mellitus. J Clin Med 2023; 12(4): 1608. http://doi.org/10.3390/jcm12041608
7. Kuruvilla M, Sexton M, Wiley Z, Langfitt T, Lynde GC, Wolf F et al. A streamlined approach to optimize perioperative antibiotic prophylaxis in the setting of penicillin allergy labels. J Allergy Clin Immunol Pract 2020; 8(4): 1316-1322. http://doi.org/10.1016/j.jaip.2019.12.016
8. Mieczkowski M, Mrozikiewicz-Rakowska B, Kowara M, Kleibert M, Czupryniak L. The problem of wound healing in diabetes—from molecular pathways to the design of an animal model. Int J Molecular Sci 2022; 23(14): 7930. http://doi.org/10.3390/ijms23147930
9. Ali KM, Al-Jaff BM. A Study on the Frequency and Source of Staphylococci and Methicillin-resistant Staphylococcus aureus Causing Superficial Incisional Surgical Site Infection. Sci J Koya Uni 2021; 9(1): 114-121. http://doi.org/10.14500/aro.10752
10. Cazzola M, Rogliani P, Salvi SS, Ora J, Matera MG. Use of thiols in the treatment of COVID-19: current evidence. Lung 2021; 199(4): 335-343. http://doi.org/10.1007/s00408-021-00465-3
11. Pathiraja MM. Diagnosis and management of diabetic foot infections. Manag Diabetic Foot Compl 2023; 35(4): 69-82. http://doi.org/10.1007/978-3-031-05832-5_7
12. Raja RA, Abbasi MH, Taj MR, Talha, Qayyum T. Comparison of surgical site infection between diabetic and non-diabetic patients in clean surgical procedures. Bio Clin Sci Res J 2024; 8(2): 1-4. http://doi.org/10.54112/bcsrj.v2024i1.805Biol
13. Siddiqui AA, Alshammary F, Mulla M, Al-Zubaidi SM, Afroze E, Amin J, et al. Frequency of dental caries in Pakistan: a systematic review and meta-analysis. BMC Oral Health 2021; 21(1): 450-455. http://doi.org/10.1186/s12903-021-01802-x
14. Qamar R, Mahmood K, Pervaiz N, Javed R, Sher F, Tufail I et al. Comparative Study on Incidence of Post-operative Wound Infection in Diabetic vs Non-diabetic Patients in Clean Surgical Procedure. Pak J Med Res 2023; 62(1): 14-18.
15. Kaafarani HM, Kaufman D, Reda D, Itani KM. Predictors of surgical site infection in laparoscopic and open ventral incisional herniorrhaphy. J Surg Res 2010; 163(2): 229-234.
16. Ismat U, Khan A, Nawaz A, Mansoor R, Malik AA, Sher F, et al. Surgical site infection in diabetic and non-diabetic patients undergoing laparoscopic cholecystectomy. J Coll Physicians Surg Pak 2019; 26(2): 100-102.
17. Nakamura T, Takayama Y, Sato T, Watanabe M. Risk factors for wound infection after laparoscopic surgery for colon cancer. Surgical Laparoscopy, Endosc Percutan Techniq 2020; 30(1): 45. http://doi.org/10.1097/SLE.0000000000000735
18. AlMohawis LT, Alfraikh SH, Alfalahi I, Alotaibi AH, Alshehri AA, Altamimi IM, et al. Risk of Surgical Site Infection (SSI) in Diabetes Mellitus Patients: Systematic Review and Meta-Analysis. Ann Med Health Sci Res 2021; 11: 1199-202. http://doi.org/10.18203/2349-2902.isj20163601

....