

## FREQUENCY OF STERNAL WOUND INFECTION IN DIABETIC PATIENTS AFTER CABG IN THE DEPARTMENT OF PESHAWAR INSTITUTE OF CARDIOLOGY

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DOI: <https://doi.org/10.5281/zenodo.15959378>

### Keywords

Sternal wound infection, diabetes mellitus, coronary artery bypass grafting

### Article History

Received on 30 May 2025

Accepted on 30 June 2025

Published on 16 July 2025

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### Abstract

Sternal wound infections (SWIs) remain a persistent complication after coronary artery bypass grafting (CABG), particularly among diabetic patients who have impaired immunity, microvascular complications, and delayed wound healing. Despite technological advancements, including heightened surveillance and improved perioperative care, infection control continues to be a major challenge in this high-risk population. This study aimed to determine the frequency of SWIs among diabetic patients undergoing isolated CABG and to identify associated risk factors contributing to infection development. A retrospective observational study was conducted at the Peshawar Institute of Cardiology, including 163 diabetic patients who underwent isolated CABG. Patients with emergency surgeries, pre-existing infections, or concurrent procedures were excluded. SWIs were classified as superficial or deep based on established clinical criteria. Data were analyzed using SPSS Version 27. Univariate and multivariate analyses assessed associations between clinical variables and SWI occurrence, with  $p$ -values  $<0.05$  considered statistically significant. Out of 163 patients, 17 (10.4%) developed SWIs—12 (7.4%) superficial and 5 (2.9%) deep. Prolonged ICU and hospital stays were significantly associated with SWIs ( $p < 0.001$  for both). Other variables, including age, BMI, HbA1c, gender, co-morbidities, and preoperative CRT, did not show significant associations. *Staphylococcus aureus* and coagulase-negative staphylococci were the predominant pathogens identified.

### INTRODUCTION

A deep infection of the sternum (Sternal wound infection (SWI)) is one of the most serious and prevalent of postoperative complications in cardiac surgery, which is especially true for patients with diabetes<sup>[1]</sup>. More than a decade has passed since modern technology, as well as the role of doctors and nurses, has changed; however, SWI has not diminished its impact on morbidity, mortality, and medical expenses most recently<sup>[2]</sup>. The occurrence of SWI in patients has been

changing radically where some researches have determined the rate among the general population of cardiac surgery to be as low as 1% and up to 8% while the people who are diabetic have a much higher risk of getting SWI<sup>[3,4]</sup>. The pathophysiology of this tendency to a greater extent is as follows: the immunological defense mechanism becomes blunted; microcirculation is affected and the functioning of the connective tissue, mainly through collagen synthesis is disturbed.

These, in turn, all contribute to the slow wound healing process and consequently make the wound more susceptible to infections<sup>[5]</sup>. Diabetes mellitus has been long considered to be the ultimate challenge among postoperative infections owing to its systemic influence on glucose metabolism and immune function. To elucidate, the increased blood sugar level prevents leukocytes from battling the microorganisms, thus the fewer number of leukocytes are able to counteract the microbial attack<sup>[6]</sup>. Not to mention that diabetics will be subjected to procedures such as having internal mammary artery grafts wide open, the operation will be lengthy and may require re-exploration all of which further contribute to the likelihood of getting SWI<sup>[4]</sup>. As diabetes is a growing pandemic and the number of heart bypass operations done each year is increasing, the discovery and mitigation of these risk factors in the population with this chronic disease are very important for the new research areas<sup>[6]</sup>. In the clinics, wounds can be slightly infected by bacteria or even the infection process can go deep into the sternal wound, which is known as a Deep Sternal Wound Infections (DSWI), and in complex cases, it is required to remove the infection surgically, and patients stay in a hospital bed for a long period while in the worst example the mediastinitis may occur where the patient in severe situations usually dies the dead rate being high as well<sup>[4]</sup>. Many bacterial agents seem to be present in SWI, with *Pseudomonas aeruginosa* and *Klebsiella* being the most regular among them, while gram-positive organisms such as *Staphylococcus aureus* and coagulase-negative *Staphylococcus* species are on the second and third places<sup>[7]</sup>. The constant increase in the antibiotic-resistant pathogens, however, directs proper treatment strategies to successful prophylaxis, early diagnosis, and precise plan of antibiotics. The study is aimed at the evaluation of the EOWSI incidence rate among diabetic patients undergoing CAB identifying the related factors. Furthermore, the results of the cover letter can help to pay attention to the antibiogram analysis of the bacteria, thus enabling the minimum resistance which is

helpful in developing the most efficient method of the empirical treatment.

### Materials And Methods

The researchers undertook this retrospective observational study at Peshawar Institute of Cardiology. A total of 163 patients were enrolled. The research population represented the group of patients with diabetes that were subjected to CABG. Inclusion criteria for the study involved patients who had been diagnosed with diabetes and those who were undergoing isolated CABG. Exclusion criteria, on the other hand, involved patients undergoing emergency surgeries, preoperative infections, and concurrent procedures besides the CABG. Data were drawn from electronic health records and contain all the necessary details such as demographic information, comorbidities, surgical details, and postoperative courses, and microbiological findings. The sternal wound infections were categorized into the superficial and deep based on the review done by Song, Y, et al<sup>[8]</sup>. Microbiological test consisted of wound swab cultures from the bacteria or tissues collected from the infected sites. Antibiotic susceptibility testing was done on the isolates using the Kirby-Bauer disk diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines (CLSI, 2020). Statistical analysis was conducted using SPSS Version 27. Univariate and multivariate analyses were performed to assess risk factors for SWI, with a p-value of <0.05 considered statistically significant.

### Results:

A total of 163 patients undergoing CABG were included in the study, out of which 17 patients (10.4%) developed sternal wound infections. Among these, 5 (2.9%) were classified as deep infections, while 12 (7.4%) were superficial. Univariate analysis was performed to assess the association between various continuous variables and the development of sternal wound infections. The p-values for age ( $p = 0.374$ ), weight ( $p = 0.768$ ), height ( $p = 0.821$ ), BMI ( $p = 0.840$ ), HBA1C ( $p = 0.428$ ), and pre-operative CRT ( $p =$

0.236) indicated no statistically significant associations with the development of sternal wound infections. Conversely, ICU stay and hospital stay demonstrated statistically significant associations with the occurrence of sternal wound

infections, with p-values of less than 0.001 for both variables, suggesting that prolonged hospital and ICU stays are associated with a higher likelihood of developing sternal wound infections.

#### UNIVARIATE ANALYSIS

	SWI	N	Mean	Std. Deviation	p-value
AGE	NO	146	59.05	8.670	.374
	YES	17	57.06	9.107	
WEIGHT	NO	146	73.05	11.167	.768
	YES	17	73.88	9.829	
HEIGHT	NO	146	158.57	13.680	.821
	YES	17	159.35	11.968	
BMI	NO	146	29.5947	6.27137	.840
	YES	17	29.2784	4.24206	
HBA1C	NO	146	8.2712	1.50438	.428
	YES	17	7.9647	1.50621	
PREOP_CRT	NO	146	1.0062	.29452	0.236
	YES	17	.9165	.29004	
ICU_STAY	NO	146	1.94	.241	<0.001
	YES	17	2.29	.985	
HOSPITAL_STAY	NO	146	4.02	.185	<0.001
	YES	17	5.76	3.800	

Binary logistic regression analysis was conducted using the Enter method in SPSS Version 27 to evaluate the relationship between categorical variables and the occurrence of sternal wound infections. The results indicated that none of the categorical variables, including gender, comorbidities, pre-operative CRT, sternal wound type, LIMA/BIMA usage, and reoperation status, were significantly associated with the development of sternal wound infections. Odds ratios (OR) and 95% confidence intervals (CI) for each variable were calculated, but none demonstrated statistical significance.

The Odds Ratios and 95% Confidence Intervals for the categorical variables were as follows:

Gender (OR = 1.12, 95% CI = 0.45 - 2.78, p = 0.812), Co-morbidities (OR = 1.27, 95% CI = 0.52 - 3.10, p = 0.608), Pre-operative CRT (OR = 1.61, 95% CI = 0.73 - 3.56, p = 0.236), Sternal Wound Type (OR = 1.35, 95% CI = 0.56 - 3.27, p = 0.516), LIMA/BIMA Usage (OR = 0.84, 95% CI = 0.32 - 2.21, p = 0.721), and Reoperation Status (OR = 1.42, 95% CI = 0.57 - 3.57, p = 0.465).

The findings suggest that, among the assessed variables, only prolonged ICU and hospital stays were significantly associated with the occurrence of sternal wound infections following CABG, while other variables did not exhibit a statistically significant impact.

BINARY LOGISTIC REGRESSION

VARIABLES	ODDS RATIO (OR)	95% CI	P-VALUE
GENDER	1.12	0.45 - 2.78	.812
CO-MORBIDITIES	1.27	0.52 - 3.10	0.608
PRE-OP CRT	1.61	0.73-3.56	0.236
STERNAL WOUND TYPE	1.35	0.56 - 3.27	0.516
LIMA/BIMA	0.84	0.32 - 2.21	0.721
REOPERATION STATUS	1.42	0.57 - 3.57	0.465

Anti-biogram is attached herewith showing all the bacterial susceptibilities and resistances

Patient #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Bacterial Species	Staphylococcus (CoNS)	Staphylococcus aureus	Acinetobacter baumannii	Staphylococcus (CoNS)	Streptococcus agalactiae	Acinetobacter baumannii	Klebsiella species	Staphylococcus aureus	Staphylococcus (CoNS)	Escherichia coli	Escherichia coli	Staphylococcus (CoNS)	Escherichia coli	Pseudomonas aeruginosa	Staphylococcus	Staphylococcus aureus	Klebsiella species
Amikacin	S	R	R	S	R	R	R	R	S	R	R	S	R	R	S	R	R
Ampicillin	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R
Cefepime	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Cefoperazone/Sulbactam	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Cefotaxime	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Ceftazidime	R	R	R	R	R	R	I	R	R	R	R	R	R	R	R	R	I
Ceftriaxone	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Chloramphenicol	S	S	R	S	-	R	S	S	S	S	S	S	S	S	S	S	S
Ciprofloxacin	R	R	R	S	-	R	S	R	R	S	S	R	S	S	R	R	S

Clindamycin	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Co-amoxiclav	R	R	R	R	S	R	S	R	R	R	S	S	R	R	S	R	S
Co-trimoxazole	R	R	R	R	-	R	R	R	I	R	R	R	R	R	R	I	R
Doxycycline	R	I	R	R	-	R	I	R	R	R	R	R	R	R	R	R	I
Erythromycin	R	R	R	R	-	R	R	R	S	R	R	R	R	R	R	S	R
Gentamicin	S	S	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S
Imipenem	S	S	R	S	-	R	S	S	R	S	S	S	S	S	S	R	S
Levofloxacin	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R
Meropenem	R	R	R	R	-	R	R	R	R	R	R	R	R	R	R	R	R
Moxifloxacin	R	R	R	R	-	R	R	R	R	R	R	R	R	R	R	R	R
Penicillin	R	R	R	R	-	R	R	R	R	R	R	R	R	R	R	R	R
Piperacillin+Tazobactam	R	R	R	R	-	R	R	R	R	R	R	R	R	R	R	R	R
Vancomycin	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S

### Discussion

Sternum infections remain an important issue after coronary artery bypass grafting, especially in patients with diabetes. The study estimated a general SWI occurrence of 10.4%, with 2.9% of those being deep while 7.4% were superficial. This reasonably high rate demonstrates this at-risk population's unchanging infection control issue. Lack of any substantial progress in the reduction of risk factors of SWI is the leading cause of the high burden among diabetic patients, notwithstanding the technological advancements in the form of heightened surveillance, biomedical applications, and concurrent care. The main topics in this article are the immunosuppressive nature of diabetes, the microvascular complications, and the impaired wound healing, all well-documented contributors to this increased susceptibility<sup>[9]</sup>. Among various patient characteristics, as well as ICU and hospital stay, prolonged ICU and hospital stays were the only ones identified to be significantly related to SWI development in this study. Nosocomial infections will be more common in patients with extended hospital stays as nosocomial infection rates are higher in hospitals than in other locations<sup>[10]</sup>. On the other hand, the prolonged length of stay in the ICU is an indicative factor of demographics, as more complex postoperative courses with patients requiring more non-surgical or invasive procedures lead to the owner of the infection. This discovery aligns with past research outcomes, which call on reducing patients' time in the ICU and hospital by resorting to recovery protocols and optimized perioperative management<sup>[11]</sup>. Oddly enough, the other potential risks, such as age, BMI, HbA1c levels, preoperative CRT, gender, co-morbidities, and LIMA/BIMA usage, seemed to have no significant association with SWI incidence. On the contrary, this is the case with these studies that consider obesity and poor glycemic control to be the critical factors contributing to infection risk. The statistics having no statistical significance in our study may be due to the small sample size, variations in the perioperative management strategy, or other confounding factors that we have not considered.

The anti-bio gram analysis indicates that *Staphylococcus aureus* and coagulase-negative staphylococci were the most common pathogens, thus emphasizing the idea that gram-positive organisms continue to be the leading cause of postoperative infections. The Gram-negative bacteria such as *Pseudomonas aeruginosa* and *Klebsiella* species are also shown to exist, which surprisingly adds more complexity to SWI. Concentration programs to ensure that multidrug-resistant pathogens do not emerge; research should also focus on prevention and treatment of the infectious diseases that such strains are resistant to<sup>[12]</sup>. The selection of empiric antibiotics is a key management issue with SWIs. Our emergent findings can help medical professionals find the best prophylactic and therapeutic plans. An even more refined approach grounded in the local microbiological data is essential due to the high prevalence of resistant organisms. Discerning the role of prophylactic antibiotics, intraoperative antiseptics, and postoperative wound care in reducing infection risks cannot be overstated<sup>[13]</sup>. SWIs' consequences extend beyond mortality as soon as surgery is over. Such patients usually have more extended hospital stays and incur higher costs as more labs are done and drugs are administered<sup>[14]</sup>. They may also develop mediastinitis, strokes or even worse heart problems. Patients suffering, in addition to the efforts drafted to manage the repercussions caused by the following reasons: longer recovery time that comes with more operations and lesser life quality, should not be overlooked<sup>[15,16]</sup>. Despite the challenges we face, future research must consider it essential to develop therapeutics that prevent infections to be looked at meticulously. Specifically, optimal glucose control in the preoperative and postoperative period, the use of dressings that act as barriers against microbes resistant to current drugs, and research on the efficacy of topical application of antibiotics to reduce infections are potential alternatives to explore.

### Conclusion:

In conclusion, this study highlights a notable

frequency of sternal wound infection (SWI) among diabetic patients undergoing CABG, pointing towards the vulnerability of this population to postoperative complications. The findings underscore the critical need for proper perioperative glycemic control, adherence to sterile surgical protocols, and early identifications of risk factors to minimize infection rates. Given the significant morbidity and potential mortality associated with SWI, especially in diabetic patients, implementing targeted strategies and postoperative care plans is essential.

Despite the challenges we face, future research must consider it essential to develop therapeutics that prevent infections to be looked at meticulously. Specifically, optimal glucose control in the preoperative and postoperative period, the use of dressings that act as barriers against microbes resistant to current drugs, and research on the efficacy of topical application of antibiotics to reduce infections are potential alternatives to explore.

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