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ORIGINAL ARTICLE *Volume 15 (Issue 1), 2026*

PAKISTAN JOURNAL OF MEDICINE & DENTISTRY

Risk-Profiling and Early Wound Complications Following Lower-Limb Amputation with Primary Stump Closure at Mayo Hospital Lahore

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ABSTRACT

Background: Early wound complications and risk profiling are also important issues in patients with lower-limb amputation, especially amputation of the knee below (BKA). The objective of this study was to assess clinical determinants and early wound outcomes of below-knee amputations that were treated with primary stump closure at Mayo Hospital, Lahore.

Methods: A prospective descriptive case series was done in the East Surgical Ward at the Mayo Hospital Lahore, a tertiary teaching hospital, over a period of six months (from May 2025 to November 2025). Consecutive enrollment of 77 patients aged 18-70 years with peripheral arterial disease and wet gangrene necessitating BKA was enrolled. All amputations were done through the long-posterior flap technique under spinal anesthesia. The duration of monitoring postoperative SSI was seven days. The data were examined through descriptive statistics, Chi-square, and logistic regression; a p-value below 0.05 was found to be significant.

Results: SSI was present in 53 (68.8%) patients. The average age was 63 years old, and the majority of them were male (59, 76.6%). The frequent comorbidities were anaemia (71, 92.2%), poor glycaemic control (53, 68.8%), leukocytosis (45, 58.4%), renal failure (25, 32.5%), and peripheral arterial disease (40, 51.9%). The multivariate analysis presented a positive relationship between male gender and decreased risk of SSI (OR = 0.116, 95% CI: 0.014-0.973, p = 0.047).

Conclusion: Post-below-knee amputation using primary stump care has a high incidence of surgical site infection. The male gender seems to be less likely to develop SSI whereas other comorbidities and poor glycemic control are not significantly related with early wounds complications.

Keywords: Amputation, Surgical Site Infection, Surgical Wound Closure, Risk Factors, Peripheral Arterial Disease.

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How to cite: Ghalib S, Janjua MH, Naseer MA, Wasay HA, Siddique MU, Nazia. Risk-Profiling and Early Wound Complications following Lower-Limb Amputation with Primary Stump Closure at Mayo Hospital, Lahore. Pak J Med Dent. 2026 September ;15(1): A-B. Doi: https://doi.org/10.36283/ziun-pjmd15-1/025.

Received: Mon, December 01, 2025 **Accepted:** Mon, January 12, 2026 **Published:** Wed, January 14, 2026

INTRODUCTION

The early wound complications including is among the most frequently observed postoperative complications and a significant source of morbidity, extended hospital stay, and healthcare expenses

globally [1]. Although perioperative care has improved, surgical site infections SSIs still impact 2-5 % of all surgical operations with much higher rates in lower-limb amputation cases because of impaired vascular supply and infected wound backgrounds [2]. The most common indication of lower-extremity amputation is below-knee amputation (BKA), which is often done due to advanced peripheral arterial disease, diabetic foot complications, and infected lower-extremity gangrene, which inherently places the patient at high risk of postoperative infection [3,4]. Early detection of clinical and pathological prognostic factors of SSI in such high-risk populations is essential to enhance surgical performance and avoid postponed recovery [5].

Various patient-related and disease-related conditions have been associated with the occurrence of postoperative infections on amputation stumps, such as diabetes mellitus, anemia, renal dysfunction, leukocytosis, and smoking, all of which leads to poor wound healing and poor immune response [6]. The local conditions, including peripheral arterial disease, wet gangrene, and osteomyelitis are additional contributors to tissue ischemia, further increasing microbial load and putting patients at a significantly increased risk than other surgical groups [7,8]. Even though a number of studies have been done internationally to assess the predictors of SSIs, there is a scarcity of prospective data in low resource settings, especially the South Asian populations where delay to presentation, uncontrolled diabetes, and prevalence of peripheral vascular disease are prevalent [9,10]. Moreover, there is a lack of evidence on early (7 days) postoperative SSI in primary stump closure during BKA, providing a major knowledge gap in clinical recommendation and risk-stratification instruments to surgeons.

Therefore, the objective was to clinical determinants and outcomes of below knee amputations with primary stump closure in mayo hospital Lahore.

METHODS

The prospective descriptive case series study was conducted in the East Surgical Ward of Mayo Hospital Lahore, a tertiary care referral and teaching hospital connected to King Edward Medical University. The research was carried out within six months, from May 2025 to November 2025, after the approval of the Institutional Review Board (IRB No.: 395/RC/KEMU/2025). The study population involved patients coming to the Surgical Emergency or the Outpatient Department who needed below-knee amputation in accordance with the clinical examination. The amputations were done by the long-posterior flap technique under the spinal anesthesia. The surgical procedures were carried out by surgeons or by postgraduate trainees under strict supervision of consultants in order to maintain uniformity and surgical standardization.

The sample size of 77 patients was calculated using OpenEpi version 3.0.0 (Atlanta, GA, USA) based on a 95 % confidence interval, 10 % absolute precision, and a prevalence rate of 27.5 expected to occur surgical site infection incidence 11. The non-probability consecutive sampling method was implemented and all the patients who met the eligibility criteria in the targeted period were enlisted. The inclusion criteria were male and female patients with 18-70 years of age having a history of peripheral arterial disease, diabetic foot ulcer or wet or dry gangrene with amputations of the body below the knee, and those who were scheduled to undergo primary stump closure after the surgery. The patients who had undergone a minor amputation of a limb or debridement of the same limb previously were excluded, as well as those who were presenting with multi-organ failure or had dementia and other psychiatric illnesses that were confirmed by a medical history, clinical assessment, or prior medical records were also excluded.

The preoperative measures involved demographic data, comorbidity, lab results, and local limb status. All patients were subjected to below-knee amputation with standardized surgical procedures following primary stump closure. All the patients were postoperatively treated with intravenous moxifloxacin 400mg 1/day and Augmentin 1.2 g 2/day, as well as nutritional optimization, hemoglobin replacement, and glycemic regulation with insulin therapy. During the hospital stay, the patients were monitored and followed up seven days after surgery to identify the occurrence of surgical site infection. The trained postgraduate residents recorded all the clinical findings, contributing factors, and postoperative complications on a structured proforma. The patients were grouped post hoc as two groups in terms of developing a surgical site infection (infection vs. no infection) and comparative analysis was carried out between the two groups.

The analysis was done using SPSS version 26 (IBM Corp., Armonk, NY, USA). Quantitative variables like age were reported under median and interquartile range (IQR) where the qualitative variables like gender, glycemic control, anemia, leukocytosis, renal failure, smoking status, peripheral arterial disease, wet gangrene, osteomyelitis, and surgical site infection were reported under frequencies and percentages. Associations between categorical variables and surgical site infection were performed using chi-square and Fishers Exact tests. The univariate and multivariate logistic regression were used to find potential predictors and independent predictors of surgical site infection. A p-value less than 0.05 were taken as statistically significant.

RESULTS

Table 1: Baseline Characteristics and Frequency Distribution of Study Population (n = 77)

Variable	Category	Frequency (%)
Gender	Female	18 (23.4)
	Male	59 (76.6)
Poor glycemic control	No	24 (31.2)
	Yes	53 (68.8)
Anemia	No	6 (7.8)
	Yes	71 (92.2)
Leukocytosis	No	32 (41.6)
	Yes	45 (58.4)
Renal failure	No	52 (67.5)
	Yes	25 (32.5)
Smoker	No	66 (85.7)
	Yes	11 (14.3)
Peripheral arterial disease (PAD)	No	37 (48.1)
	Yes	40 (51.9)
Wet gangrene	No	24 (31.2)
	Yes	53 (68.8)
Osteomyelitis	No	64 (83.1)
	Yes	13 (16.9)

IQR: Interquartile range

A total of 77 patients who received below-knee amputation with primary stump closure were identified. The median age was 63 years (IQR = 17), and most of them were male (59 patients, 76.6%). Glycemic control was poor in 53 patients (68.8% of the total) and the majority of the patients were anemic (71 patients, 92.2%). There were 40 peripheral arterial disease patients (51.9%), 53 wet gangrene patients (68.8%), and 13 osteomyelitis patients (16.9%). Among 77 patients, a total of 53 patients (68.8%), had developed surgical site infection, whereas 24 (31.2%) had no infection. The median POD of SSI occurrence was 3 days (IQR = 3), median POD of stump opening was 4 days

(IQR = 5), indicating that the majority of wounds-related complications were noticed during the first few days post-surgery.

Table 1 presents the baseline characteristics and significant comorbidities of the study population.

Table 2: Chi-Square Analysis for Association of Clinical Variables with SSI

Variable	Category	Population n (%)	No Infection n (%)	Infection n (%)	P-value (Fisher's Exact)
Gender	Female	18 (23.4)	3 (3.9)	15 (19.5)	0.156
	Male	59 (76.6)	21 (27.3)	38 (49.4)	
Poor glycemic control	No	24 (31.2)	10 (13.0)	14 (18.2)	0.196
	Yes	53 (68.8)	14 (18.2)	39 (50.6)	
Anemia	No	6 (7.8)	1 (1.3)	5 (6.5)	0.659
	Yes	71 (92.2)	23 (29.9)	48 (62.3)	
Leukocytosis	No	32 (41.6)	24 (31.2)	8 (10.4)	0.455
	Yes	45 (58.4)	29 (37.7)	16 (20.8)	
Renal failure	No	52 (67.5)	18 (23.4)	34 (44.2)	0.435
	Yes	25 (32.5)	6 (7.8)	19 (24.7)	
Smoker	No	66 (85.7)	21 (27.3)	45 (58.4)	1
	Yes	11 (14.3)	3 (3.9)	8 (10.4)	
PAD	No	37 (48.1)	14 (18.2)	23 (29.9)	0.325
	Yes	40 (51.9)	10 (13.0)	30 (39.0)	
Wet gangrene	No	24 (31.2)	9 (11.7)	15 (19.5)	0.437
	Yes	53 (68.8)	15 (24.7)	38 (49.4)	
Osteomyelitis	No	64 (83.1)	19 (24.7)	45 (58.4)	0.529
	Yes	13 (16.9)	5 (6.5)	8 (10.4)	

PAD: Peripheral arterial disease

The bivariate analysis revealed that there were no statistically significant relationships between SSI and demographic or clinical variables (all $p > 0.05$). The incidence of SSI in females was 15 (83.3%),

in patients with inadequate glycemic control was 39 (73.6%), and in patients with peripheral arterial disease were 30 (75%). Table 2 shows the correlation between demographic and clinical variables and the occurrence of surgical site infection with chi-square and Fisher Exact tests.

Table 3: Univariate Logistic Regression for Potential Risk Factors of SSI

Variable	Category	No Infection n (%)	Infection n (%)	OR (95% CI)	P-value
Age (years), Median (IQR)	-	65.5 (17.25)	61 (18)	0.963 (0.914–1.014)	0.155
SSI POD	-	-	3 (2)	-	-
Stump POD	-	-	4 (2)	-	-
Gender	Female	3 (3.9)	15 (19.5)	1	0.140
	Male	21 (27.3)	38 (49.4)	0.362 (0.094–1.395)	
Poly Glycemic Control	No	10 (13)	14 (18.2)	1	0.184
	Yes	14 (18.2)	39 (50.6)	1.990 (0.721–5.494)	
Anemia	No	1 (1.3)	5 (6.5)	1	0.437
	Yes	23 (29.9)	48 (62.3)	0.417 (0.046–3.378)	
Leukocytosis	No	24 (31.2)	8 (10.4)	1	0.326
	Yes	29(37.7)	16 (20.8)	0.604 (0.221–1.653)	
Renal Failure	No	18 (23.4)	34 (44.2)	1	0.349
	Yes	6 (7.8)	19 (24.7)	1.676 (0.569–4.942)	
Smoker	No	21 (27.3)	45 (58.4)	1	0.763
	Yes	3 (3.9)	8 (10.4)	1.244 (0.299–5.171)	
PAD	No	14 (18.2)	23 (29.9)	1	0.227
	Yes	10 (13)	30 (39)	1.826 (0.688–4.849)	

Wet Gangrene	No	9 (11.7)	15 (19.5)	1	0.421
	Yes	15 (24.7)	38 (49.4)	1.520 (0.548–4.215)	
Osteomyelitis	No	19 (24.7)	45 (58.4)	1	0.535
	Yes	5 (6.5)	8 (10.4)	0.676 (0.196–2.333)	

PAD: Peripheral arterial disease

Univariate logistic regression revealed that there were no statistically significant variables that predicted SSI ($p > 0.05$). The non-significant trends were observed with male gender (OR = 0.362), younger age (OR = 0.963), no PAD or poor glycemic control (OR = 1.990), which indicated possible protective or risk factors. Table 3 indicates the univariate logistic regression analysis of the possible risk factors of surgical site infection.

Table 4: Multivariate Logistic Regression for Independent Predictors of SSI

Variable	Category	No Infection n (%), 24(31.2)	Infection n (%), 53(68.8)	OR (95% CI)	P-value
Age (years), Median (IQR)	-	65.5 (17.25)	61 (18)	0.963 (0.908–1.021)	0.209
Gender	**Female**	3 (3.9)	15 (19.5)	0.116 (0.014–0.973)	0.047*
	Male	21 (27.3)	38 (49.4)		
Poly Glycemic Control	**No**	10 (13)	14 (18.2)	2.019 (0.672–6.063)	0.211
	Yes	14 (18.2)	39 (50.6)		

IQR: Interquartile range.

Male gender was the only significant independent predictor of SSI in multivariate analysis, with an odds ratio of 0.116 (95% CI: 0.014-0.973) indicating that males had eighty-eight percent less likelihood of developing an infection, as compared to females. The age and poor glycemic control were not significant, but there has been a tendency of poor glycemic control to increase the risk of

infection (OR = 2.019, p = 0.211). Table 4 shows the multivariate logistic regression analysis that reveals the independent predictors of surgical site infection.

DISCUSSION

In this study, 77 patients who underwent below-knee amputation with primary stump closure were assessed in order to identify the incidence and predictors of early wound infections including surgical site infection (SSI). The incidence of SSI was 68.8 percent, and the median time to develop SSI was 3 days. The only significant independent predictor (with an 88 % lower odds of infection) was male gender as determined by multivariate analysis. There were also non-significant trends of other variables such as age and poor glycemic control to higher risk of infection. Clinical and demographic variables, such as anemia, leukocytosis, renal failure, PAD, wet gangrene, and osteomyelitis did not show statistically significant bivariate relationships with SSI.

The high rate of SSI is consistent with the literature describing high incidences of infection after below-knee amputations in groups with comorbid conditions, including diabetes and PAD [12,13]. Past research indicated that most wound-related complications arise in the first week after surgery [14], which is in line with our median SSI onset on the third day. Early infections are probably attributed to factors like delayed wound healing, impaired perfusion and high bacterial load in diabetic or ischemic tissue [15]. We find our results suggest the importance of close monitoring during the very precarious postoperative period. The finding of male gender as a protective factor is contrary to some literature that implies vexed risks of infection in males in generation of lifestyle-related aspects and comorbid conditions [16,17]. Nonetheless, no significant gender disparities in SSI have been reported by other studies, indicating the possibility of variability among populations [18]. The observed trends of increased SSI among patients with poor glycemic control and PAD are aligned with the known pathophysiological processes that influence wound healing [19].

These results, clinically, indicate that pre- and postoperative monitoring and maximization of systemic variables are still essential in SSI prevention [20,21]. The reduced risk in males could have been caused by the unmeasured factors, including the level of activity, nutritional status or compliance with wound care [22]. The presence of high SSI rates in this group highlights the need to employ standardized perioperative antibiotic treatment, high-quality surgical practice, and proper selection of patients [23]. Another important finding in our study is the possibility of focal interventions to high-risk subgroups, especially females and patients with uncontrolled diabetes [24,25].

The limitations of this study include that it is a single-center study with a small sample, which can influence the external validity of the results. Limited follow-up (short) prevented the evaluation of late-onset SSI or functional results in the long-term. Future research needs to concentrate on multicenter prospective studies that involve larger populations and longer follow-up duration in order to confirm the risk factors and effectiveness of prevention strategies. The role of preoperative optimization and improved postoperative care in decreasing SSI also requires investigation.

CONCLUSION

Below-knee amputation with primary stump closure is a prone cause of early wound complications, with a prevalence of about two thirds of the patients. Male gender was observed as a strong independent predictor in this cohort, which was related to reduce chances of infection, whereas age, poor glycemic control, and comorbid conditions were not significant. These results highlight the importance of careful observations during the early postoperative period, the importance of surgical attention, and systemic factor optimization in order to minimize the risk of infections. High-risk patients, especially females and uncontrolled diabetics, can be targeted with interventions to improve the outcome of surgery and the quality of postoperative recovery.

FUNDING

None

CONFLICT OF INTEREST

None

ETHICAL APPROVAL

The research was carried out within six months, from May 2025 to November 2025, after the approval of the Institutional Review Board (IRB No.: 395/RC/KEMU/2025). The prospective descriptive case series study was conducted in the East Surgical Ward of Mayo Hospital Lahore, a tertiary care referral and teaching hospital connected to King Edward Medical University.

AUTHORS' CONTRIBUTION

All authors contributed equally as per ICMJE guidelines.

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