INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

PREVALENCE OF SURGICAL SITE INFECTIONS FOLLOWING ELECTIVE KIDNEY TRANSPLANTATION

Original Research

Mustafeez Ahmed Wassan[1]*, Muhammad Hassam Mehdi[2], Talha Adil[3], Muneeb Islam[4], Ijaz Ahmad[5], Ali Sabir Hussain[6], Eman Aslam[7]
[1]RMO, Gambat Institute of Medical Sciences (GIMS), Gambat, Pakistan.
[2]Medical Officer, Department of Surgery & Allied, Peshawar General Hospital, Peshawar, Pakistan.
[3]House Officer, Combined Military Hospital, Muzaffarabad, Pakistan.
[4]Lecturer, Department of Microbiology, Faculty of Chemical and Life Sciences, Abdul Wali Khan University, Mardan, Pakistan.
[5]State Key Laboratory of Bioelectronics, School of Biological Sciences & Biomedical Engineering, Southeast University, Nanjing, China.
[6]Final Year MBBS Student, Liaquat College of Medicine and Dentistry, Karachi, Pakistan.
[7]Final Year MBBS Student, Wah Medical College, Islamabad, Pakistan.
Corresponding Author: Mustafeez Ahmed Wassan, RMO, Gambat Institute of Medical Sciences (GIMS), Gambat, Pakistan, mustafeezahmedwassan196@gmail.com
Acknowledgement: The authors thank the clinical staff and data management team for their support throughout the study.

Conflict of Interest: None　　Grant Support & Financial Support: None

ABSTRACT

Background: Surgical site infections (SSIs) are a major postoperative complication in kidney transplant recipients, compromising graft outcomes and increasing healthcare burden. Immunosuppression, comorbid conditions, and perioperative factors contribute to the heightened risk of infections in this population.

Objective: To evaluate the prevalence and associated risk factors of SSIs among patients undergoing elective kidney transplantation at a tertiary care center.

Methods: A cross-sectional study was conducted over eight months at a tertiary hospital in Lahore. A total of 200 adult patients undergoing elective kidney transplantation were enrolled using consecutive sampling. SSIs were identified based on CDC criteria within 30 days postoperatively. Data were collected on demographic, clinical, and intraoperative variables. Statistical analysis included univariate and multivariate logistic regression to identify independent risk factors. All procedures were conducted in compliance with ethical guidelines and IRB approval.

Results: The overall prevalence of SSIs was 17%, with superficial infections accounting for 58.8% of cases. Significant risk factors included diabetes mellitus (AOR: 1.96; 95% CI: 1.02–3.76), surgical duration >3 hours (AOR: 2.83; 95% CI: 1.45–5.54), use of surgical drains (AOR: 3.12; 95% CI: 1.61–6.03), and low serum albumin levels (AOR: 2.27; 95% CI: 1.13–4.56). These findings indicate a strong correlation between modifiable clinical factors and SSI development.

Conclusion: SSIs remain a significant concern in kidney transplant patients. Identification and management of modifiable risk factors can substantially reduce infection rates, improve graft outcomes, and support evidence-based infection control practices in transplant surgery.

Keywords: Cross-Sectional Studies, Diabetes Mellitus, Immunosuppression, Kidney Transplantation, Postoperative Complications, Prevalence, Risk Factors, Surgical Site Infection.

INTRODUCTION

Surgical site infections (SSIs) are among the most common complications following major surgeries and remain a significant concern in the context of organ transplantation, where patients are especially vulnerable due to immunosuppressive therapy and the complexity of the procedures involved (1). Kidney transplantation, recognized as the optimal treatment for end-stage renal disease, has evolved dramatically over recent decades, improving survival and quality of life. However, postoperative complications such as SSIs continue to jeopardize patient outcomes, prolong hospital stays, and inflate healthcare costs. Despite advances in surgical techniques, antibiotic prophylaxis, and perioperative care, SSIs still represent a notable postoperative burden in kidney transplant recipients (2,3). Elective kidney transplantation offers patients the best chance for a return to near-normal life compared to long-term dialysis. Nevertheless, this benefit is often threatened by postoperative infections, with SSIs accounting for a considerable proportion. These infections not only delay wound healing but can also lead to graft dysfunction, sepsis, and increased mortality rates (4). Due to the immunosuppressive regimens required to prevent graft rejection, kidney transplant recipients are particularly susceptible to infections that might be relatively benign in immunocompetent individuals. Thus, understanding the prevalence and risk factors associated with SSIs in this population is crucial for improving postoperative care and long-term transplant outcomes (5,6).

The prevalence of SSIs in kidney transplantation varies widely across regions and healthcare settings, with studies reporting rates ranging from 2% to over 20%. This wide variation is influenced by multiple factors, including patient demographics, comorbidities such as diabetes mellitus and obesity, the skill of the surgical team, and institutional infection control practices (7). Despite this recognition, many healthcare systems, especially in resource-limited settings, still struggle to quantify and manage the problem effectively. Moreover, while numerous studies have assessed SSIs in general surgical populations, fewer have focused specifically on elective kidney transplantation, leaving a gap in understanding the unique risk profile of these patients. Existing literature underscores the importance of targeted infection prevention strategies in transplant recipients (8,9). For instance, factors such as prolonged operative time, reoperation, lymphocele formation, and delayed graft function have all been linked to an increased risk of SSI. The use of certain immunosuppressive agents, especially those impacting neutrophil function or wound healing, may further exacerbate the risk (10). Despite these known associations, there is a lack of consensus on standardized protocols to prevent SSIs in elective kidney transplant patients, reflecting the need for context-specific research to inform evidence-based practice.

Furthermore, given the increasing incidence of multidrug-resistant organisms and the changing microbial landscape, ongoing surveillance and updated research are essential. SSIs caused by resistant bacteria pose an even greater challenge, often requiring prolonged hospitalizations, use of broad-spectrum antibiotics, and, in some cases, reoperation. In transplant centers, where patients are often clustered and share similar risk profiles, such infections can spread quickly if not promptly identified and contained (11,12). This highlights the need not only for preventative measures but also for rapid diagnostic and therapeutic interventions. Despite the known risks and consequences of SSIs, most available studies are retrospective in nature or focus predominantly on broad surgical cohorts, with limited cross-sectional analyses specific to kidney transplant recipients. A cross-sectional approach offers a valuable snapshot of the current prevalence and can help identify modifiable risk factors associated with SSIs in this vulnerable population. Such data are critical for shaping local infection control policies and tailoring preventive strategies. In light of these considerations, the present study aims to evaluate the prevalence of surgical site infections among patients undergoing elective kidney transplantation and to identify associated clinical and demographic factors. By shedding light on the extent and nature of this issue within a specific cohort, the findings are expected to contribute to better-targeted interventions and improve patient outcomes in transplant programs. The ultimate objective is to generate evidence that informs both clinical practice and policy, thereby reducing the burden of SSIs in kidney transplant recipients.

METHODS

This cross-sectional study was conducted over a period of eight months at a tertiary care hospital in Lahore, with the aim of evaluating the prevalence and associated factors of surgical site infections (SSIs) in patients undergoing elective kidney transplantation. The research adhered strictly to ethical and methodological standards to ensure the validity and reproducibility of the findings. Participants included in the study were adult patients, aged 18 years or older, who underwent elective kidney transplantation during the study period.

Patients were selected consecutively from the hospital's transplant registry. Inclusion criteria encompassed all individuals scheduled for elective kidney transplantation, with the capacity to provide informed consent and without active infections at the time of surgery. Exclusion criteria involved patients undergoing emergency transplant procedures, those with a history of recent infections within the past two weeks, patients receiving re-transplantation, and individuals with incomplete clinical or follow-up data. These criteria were established to minimize confounding variables and to ensure that only primary, uncomplicated cases were assessed for SSI risk. The sample size was determined using a standard formula for prevalence studies, assuming an expected SSI prevalence of 15%, with a 95% confidence level and a 5% margin of error. This yielded a minimum sample size of 196 patients, rounded to 200 to compensate for potential dropouts or incomplete records (2,3). All participants provided written informed consent prior to inclusion in the study, and ethical approval was obtained from the hospital's Institutional Review Board (IRB).

Data were collected using a structured proforma developed by the research team. Patient demographic data, including age, gender, body mass index (BMI), presence of diabetes mellitus or hypertension, and smoking status, were recorded. Preoperative variables such as hemoglobin level, serum albumin, and creatinine levels were noted. Intraoperative variables included surgical duration, estimated blood loss, type of surgical incision, and use of surgical drains (13). Postoperative data captured the presence of any surgical site infection, identified according to the Centers for Disease Control and Prevention (CDC) criteria. These criteria classify SSIs as superficial incisional, deep incisional, or organ/space infections occurring within 30 days of the operation. Clinical diagnosis was supported by microbiological culture reports when applicable, and all infections were confirmed by the surgical or infectious disease team (14,15). Data collection was carried out prospectively by trained research assistants who monitored patients throughout their postoperative hospital stay and conducted follow-up visits or telephonic interviews up to 30 days post-surgery to identify late-onset infections. The reliability of outcome assessment was ensured by cross-verifying infection data with electronic medical records and microbiological laboratory reports. To assess the factors associated with SSIs, both univariate and multivariate statistical analyses were employed. The data were entered into SPSS version 26.0 for statistical analysis. Continuous variables were presented as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Normality of the continuous data was assessed using the Shapiro-Wilk test, and all data were found to be normally distributed. Independent sample t-tests were used to compare means of continuous variables between patients with and without SSIs. Chi-square tests were employed for categorical variables.

Variables showing a p-value less than 0.2 in univariate analysis were further included in a binary logistic regression model to identify independent predictors of SSI occurrence. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated, and a p-value of less than 0.05 was considered statistically significant. This statistical approach allowed for adjustment of potential confounding variables and improved the robustness of the findings. Throughout the study, confidentiality of patient information was strictly maintained. All data were anonymized, and access was restricted to study investigators only. The research protocol aligned with the Declaration of Helsinki and local ethical standards to ensure the dignity, rights, and welfare of the participants. By following a transparent, systematic approach, this study aimed to provide clinically relevant insights into the prevalence and determinants of SSIs among kidney transplant recipients. The findings are expected to support improved clinical protocols and infection prevention strategies within transplant units.

RESULTS

A total of 200 patients who underwent elective kidney transplantation were included in the study. The mean age was 45.6 ± 12.4 years, with a predominance of males (66%). Nearly half (49%) of the patients were diabetic, while 78% had hypertension and 21% reported current or past smoking. The mean body mass index (BMI) was 26.8 ± 4.3 kg/m². Surgical site infections were identified in 34 out of the 200 patients, corresponding to a prevalence rate of 17%. Among the SSI cases, the most frequently observed type was superficial incisional infection (58.8%), followed by deep incisional (23.5%) and organ/space infections (17.6%). Univariate analysis revealed several significant associations with the development of SSIs. Diabetes mellitus was more prevalent among those who developed infections (64.7%) compared to those who did not (45.8%) with a p-value of 0.031. Likewise, patients with a BMI ≥ 30 were significantly more likely to experience SSIs (29.4% vs. 16.9%, p = 0.048). Prolonged surgical duration exceeding three hours (61.8% vs. 27.1%, p = 0.002), the use of surgical drains (70.6% vs. 32.5%, p = 0.001), and low serum albumin levels below 3.5 g/dL (55.9% vs. 22.9%, p = 0.006) were also significantly associated with infection occurrence. Multivariate logistic regression analysis confirmed four independent predictors of SSIs. Diabetes mellitus was associated with nearly double the odds of infection (AOR: 1.96; 95% CI: 1.02–3.76; p = 0.044). Surgical duration longer than three hours significantly increased the likelihood of infection (AOR: 2.83; 95% CI: 1.45–5.54; p

= 0.002). The use of surgical drains was associated with the highest odds ratio (AOR: 3.12; 95% CI: 1.61–6.03; p = 0.001). Additionally, patients with low serum albumin had increased odds of developing an SSI (AOR: 2.27; 95% CI: 1.13–4.56; p = 0.021).

Table 1: Demographics of Study Participants (n = 200)

Variable	Mean ± SD / n (%)
Age (years)	45.6 ± 12.4
Gender (Male)	132 (66%)
BMI (kg/m²)	26.8 ± 4.3
Diabetes Mellitus	98 (49%)
Hypertension	156 (78%)
Smoking Status	42 (21%)

Table 2: Surgical Site Infection (SSI) Occurrence

Variable	n (%)
Total patients	200
Patients with SSI	34
SSI prevalence	17%

Table 3: Risk Factors for SSI (Univariate Analysis)

Risk Factor	SSI Present (n=34)	SSI Absent (n=166)	p-value
Diabetes Mellitus	22 (64.7%)	76 (45.8%)	0.031
BMI ≥ 30	10 (29.4%)	28 (16.9%)	0.048
Surgical duration > 3 hrs	21 (61.8%)	45 (27.1%)	0.002
Use of drains	24 (70.6%)	54 (32.5%)	0.001
Low serum albumin (<3.5 g/dL)	19 (55.9%)	38 (22.9%)	0.006

Table 4: Multivariate Analysis of SSI Risk Factors

Risk Factor	Adjusted Odds Ratio (AOR)	95% CI	p-value
Diabetes Mellitus	1.96	1.02–3.76	0.044
Surgical duration > 3 hrs	2.83	1.45–5.54	0.002
Use of drains	3.12	1.61–6.03	0.001
Low serum albumin	2.27	1.13–4.56	0.021

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

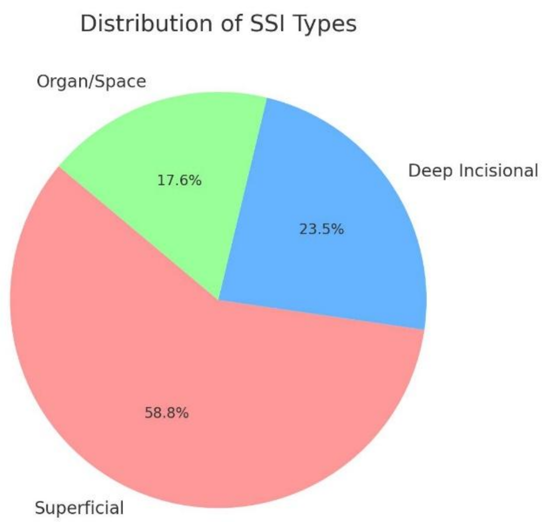

Figure 2 Distribution of SSI Type

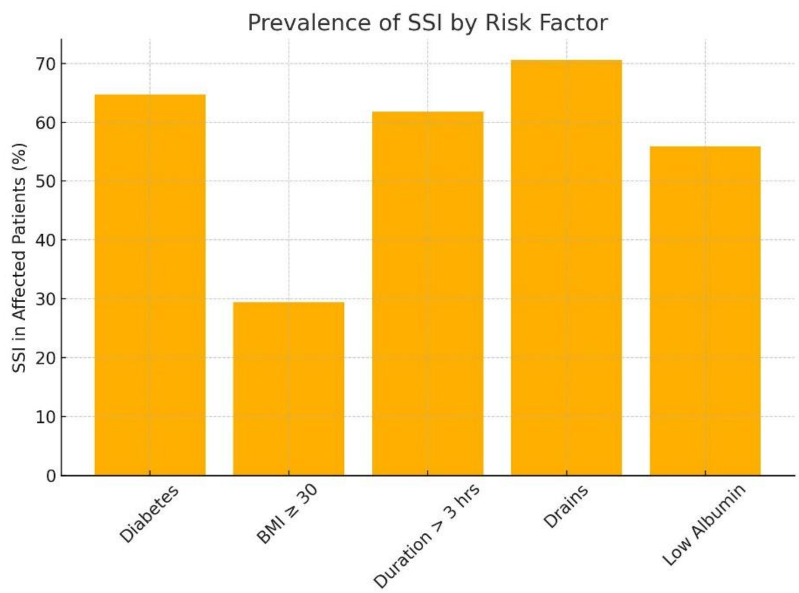

Figure 2 Prevalence of SSI by Risk Factor

DISCUSSION

The findings of this study reinforce the ongoing concern regarding surgical site infections (SSIs) in kidney transplant recipients, particularly in resource-constrained settings. The overall SSI prevalence of 17% observed aligns with existing literature, where rates have ranged from 7% to 25%, influenced by regional practices, patient risk profiles, and perioperative protocols (16). The predominance of superficial incisional infections in this cohort mirrors previously reported trends, suggesting consistent infection patterns across institutions globally. Diabetes mellitus emerged as a significant independent risk factor in both univariate and multivariate analyses. This finding has been corroborated by several studies that highlighted impaired immune function and delayed wound healing in diabetic patients as major contributors to SSI risk (17-19). The elevated BMI in SSI-positive patients also echoes global evidence identifying obesity as a modifiable predictor of poor surgical outcomes (20). High adipose tissue levels may impair perfusion and oxygenation at the wound site, predisposing to infection. The finding that extended surgical duration significantly increased SSI risk aligns with previous reports indicating that procedures exceeding three hours correlate with higher bacterial exposure and tissue trauma (21). Similarly, the use of drains—though often necessary—was shown to triple the risk of infection, potentially due to serving as a conduit for microbial entry. This association was further supported by findings from a study which observed increased infection rates linked to reoperations and drain usage in transplant patients (22).

A novel yet expected association was the role of hypoalbuminemia in SSI development. Low serum albumin is reflective of poor nutritional and inflammatory status, both of which compromise wound healing. This aligns with a study which highlighted the utility of perioperative markers like albumin in predicting adverse outcomes post-transplant (23). Despite these valuable insights, several limitations are acknowledged. First, the single-center design limits the generalizability of findings across diverse geographic and institutional settings. The sample size, while statistically adequate, may not capture less frequent or late-onset infections. Additionally, the study did not stratify infections by microbial etiology or assess antimicrobial resistance patterns, which are increasingly relevant in transplant populations (24). A key strength of this study lies in its prospective nature and rigorous 30-day follow-up, ensuring timely detection of infections. The structured data collection and comprehensive statistical modeling further enhance the reliability of the results. These findings underscore the importance of identifying high-risk patients preoperatively to tailor prophylactic and intraoperative strategies accordingly.

Future research should prioritize multicenter longitudinal studies with microbiological profiling to understand pathogen-specific trends and resistance. Randomized controlled trials examining the efficacy of modified prophylactic antibiotic regimens or immunosuppressive

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

adjustments in high-risk cohorts would be valuable. Additionally, interventions targeting modifiable risk factors such as nutritional rehabilitation and optimized surgical duration could serve as practical steps toward SSI reduction. In conclusion, surgical site infections remain a prevalent and preventable complication following elective kidney transplantation. Diabetes, obesity, prolonged surgery, drain use, and hypoalbuminemia independently predict increased risk. By integrating these findings into clinical protocols, healthcare providers can better anticipate and mitigate SSI risks, ultimately improving transplant outcomes and patient safety.

CONCLUSION

This study highlights a notable prevalence of surgical site infections following elective kidney transplantation, with diabetes, prolonged surgery, drain usage, and hypoalbuminemia identified as key risk factors. These findings emphasize the need for tailored perioperative strategies and early risk stratification to minimize infection-related morbidity and optimize transplant outcomes in vulnerable populations.

AUTHOR CONTRIBUTION

Author	Contribution
Mustafeez Ahmed Wassan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Hassam Mehdi	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Talha Adil	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muneeb Islam	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ijaz Ahmad	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ali Sabir Hussain	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Eman Aslam	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Yüksel E, Akkoç H. Urinary Tract Infection in Kidney Transplant Recipients: The predictors and two-year outcomes. Dicle Tıp Dergisi. 2022.

2. Hajimohammadi K, Makhdoomi K, Zabihi RE, Parizad N. Treating post-renal transplant surgical site infection with combination therapy: a case study. Br J Nurs. 2021;30(8):478-83.

3. Matos JA, Gomes ADS, Lima C, Schmaltz CAS, Oliveira CR, Silva GMD, et al. Systematic review on efficacy of preventive measures for surgical site infection by multiple-drug resistant gram-negative bacilli. Braz J Infect Dis. 2022;26(6):102705.

4. Schreiber PW, Laager M, Boggian K, Neofytos D, van Delden C, Egli A, et al. Surgical site infections after simultaneous pancreas kidney and pancreas transplantation in the Swiss Transplant Cohort Study. J Hosp Infect. 2022;128:47-53.

5. Schreiber PW, Hoessly LD, Boggian K, Neofytos D, van Delden C, Egli A, et al. Surgical site infections after kidney transplantation are independently associated with graft loss. Am J Transplant. 2024;24(5):795-802.

6. Wong RBK, Minkovich M, Famure O, Li Y, Lee JY, Selzner M, et al. Surgical site complications in kidney transplant recipients: incidence, risk factors and outcomes in the modern era. Can J Surg. 2021;64(6):E669-e76.

7. Ostaszewska A, Domagala P, Zawistowski M, Karpeta E, Wszola M, Kosieradzki M. Single-center Experience with Perioperative Antibiotic Prophylaxis and Surgical Site Infections in Kidney Transplant Recipients. 2021.

8. Liu G, Deng Y, Zhang S, Lin T, Guo H. Robot-Assisted versus Conventional Open Kidney Transplantation: A Meta-Analysis. Biomed Res Int. 2020;2020:2358028.

9. Lee SD, Rawashdeh B, McCracken EKE, Cantrell LA, Kharwat B, Demirag A, et al. Robot-assisted kidney transplantation is a safe alternative approach for morbidly obese patients with end-stage renal disease. Int J Med Robot. 2021;17(5):e2293.

10. Carrion A, Raventós C, Lozano F, Semidey ME, Gallardo I, Trilla E. A Robot-Assisted Complete Urinary Tract Extirpation in a Patient with Simultaneous Panurothelial Carcinoma: A Case Report. J Endourol Case Rep. 2020;6(4):483-6.

11. Taminato M, Morais R, Fram D, Pereira R, Esmanhoto CG, Pignatari A, et al. Risk factors for colonization and infection by resistant microorganisms in kidney transplant recipients. Revista brasileira de enfermagem. 2021;74Suppl 6 Suppl 6.

12. Noor H, Verdiales C, Moser M. Protective Effect of Subcutaneous Drains on Wound Infections in Kidney Transplantation. Transplant Proc. 2023;55(9):2110-3.

13. Zawistowski M, Nowaczyk J, Domagała P. Prophylactic intra-abdominal drainage following kidney transplantation: a systematic review and meta-analysis. Pol Przegl Chir. 2021;93(4):1-10.

14. Dziri S, Azzabi A, Tlili G, Sahtout W, Soumaya BN, Wafa S, et al. Prevalence and Predictive Factors of Urinary Tract Infection in Kidney Transplant Recipients: A 10-Year Study. Experimental and clinical transplantation : official journal of the Middle East Society for Organ Transplantation. 2024;22 Suppl 1:285-9.

15. El Hennawy HM, Safar O, Faifi ASA, El Hennawy MH, Alghamdi B, Ali A, et al. Navigating risks: insights on unrelated overseas renal transplantations from two Saudi centers. BMC Nephrol. 2025;26(1):221.

16. Amara D, Nunez M, Parekh J, Greenstein S, Foley D, Stock P, et al. Left Ventricular Ejection Fraction and Previous Cardiac Revascularization: Impact on Patient Survival, Graft Survival, and Complications in Kidney Transplant Recipients. Transplant Direct. 2025;11(7):e1802.

17. Luo Y, Gong J, Yang S. Knee and hip arthroplasty joint surgical site wound infection in end-stage renal disease subjects who underwent dialysis or a kidney transplant: A meta-analysis. Int Wound J. 2023;20(7):2811-9.

18. Alotaibi N. Incidence and risk factors of infections following kidney transplantation. Journal of infection and public health. 2024;17 8:102491.

19. Herrera S, Carbonell I, Cofan F, Cucchiari D, Abalde I, Bernabeu E, et al. Impact of robotic-assisted kidney transplantation on post-transplant infections: a case-control study. World J Urol. 2023;41(10):2847-53.

20. El Hennawy H, Khattab A, Atta EA, Awadh A, Safar O, Qarni MA, et al. Do We Need a Predischarge Psychosocial Evaluation? A Case Report on Peri-Allograft Abscess in a Noncompliant Elderly Kidney Transplant Patient. Transplant Proc. 2025;57(3):453-6.

21. Albassam BA, Albekairy AM, Shawaqfeh MS. Compliance with surgical prophylaxis guidelines in liver and kidney transplantations. Int J Clin Pharm. 2020;42(6):1425-32.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

22. Shamsaeefar A, Amiri B, Nikoupour H, Kazemi K, Moosavi SA, Motazedian N, et al. Comparative analysis of polypropylene and dual mesh incisional hernia repair methods in open surgery following organ transplantation: a single-center retrospective cohort study. Hernia. 2025;29(1):89.

23. Bansal A, Maheshwari R, Chaturvedi S, Bansal D, Kumar A. Comparative analysis of outcomes and long-term follow-up of robot-assisted pediatric kidney transplantation, with open counterpart. Pediatr Transplant. 2021;25(3):e13917.

24. Gioco R, Sanfilippo C, Veroux P, Corona D, Privitera F, Brolese A, et al. Abdominal wall complications after kidney transplantation: A clinical review. Clin Transplant. 2021;35(12):e14506.

