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Research Article

Incidence, Risk Factors, and Outcomes of Postoperative Drain-Associated Morbidity in Surgical Patients

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Abstract: ***Introduction:*** In orthopedic surgery, surgical drains are frequently utilized to prevent the accumulation of fluid, but may also contribute to the development of surgical complications associated with surgical drains. The purpose of this study was to establish the morbidity rate, risk factors, and complications after postoperative drain placement in orthopedic surgery patients. **Methods:** A descriptive cross-sectional study was conducted at Department of General Surgery, MTI, GOMAL Medical College, D.I.Khan from October, 2025 to March 2026. The entire population of 125 patients who underwent orthopedic surgery with a postoperative drain was enrolled, using consecutive sampling. Data pertaining to age, clinical, operative, drain and outcome were gathered. The statistical analysis was done with SPSS version 26. Multivariable logistic regression and Chi square and independent sample t-tests were used to determine independent predictors of drain associated morbidity. The p value < 0.05 was set as statistically significant. **Results:** Morbidity after surgery was 34 (27.2%) of which surgical site infection was the commonest. Hospital stay, readmission and reoperation rates were significantly higher, along with delayed wound healing, in the patients who had drain associated morbidity. Extended duration of drainage, obesity, diabetes mellitus, smoking, emergency surgery, prolonged operative time and contaminated wounds were independently associated with postoperative drain-related morbidity in a multivariable analysis ($p<0.05$). **Conclusions:** Drain-associated morbidity is still prevalent after orthopedic surgery, and this morbidity is linked to poor clinical outcomes. Early removal of drains, proper care of the drains and optimization of modifiable risk factors may minimize postoperative complications and enhance the patient's recovery.

Keywords: Postoperative drains; Drain-associated morbidity; Surgical site infection; Orthopedic surgery

INTRODUCTION

Surgical drains are commonly employed in many surgical disciplines to help drain collections of blood or serous fluid, bile, lymph or other fluids from the operating site, which helps to decrease dead space and the risk of fluid accumulation following a surgical procedure.[1] Closed suction drains, like the Jackson-Pratt and Redivac drains, are now a vital part of postoperative care after abdominal, breast, hepatobiliary, colorectal, orthopedic, vascular, and plastic surgical procedures.[2] Surgical drains are used to aid in the healing of wounds and to detect postoperative bleeding or anastomotic leakage, but their routine use is debated.[3]

Despite the development of more advanced surgical techniques, the use of minimally invasive surgery, improvements in perioperative infection prevention and the implementation of enhanced recovery after surgery (ERAS) protocols, postoperative drain-associated morbidity is still a considerable surgical problem.[4] There are over 300 million major surgical procedures performed each year globally, and around 10-20% of surgical patients develop complications following surgery, especially in LMIC settings with limited health care resources.[5] Surgical site infections (SSIs) are among the most common HAI infections in hospitalized surgical patients and represent almost one-third of all HAI infections. They are one of the most common causes of longer hospital stays, higher healthcare costs, rehospitalization, and postoperative death.[6] Longer drainage time, improper handling of the drain, obesity, diabetes mellitus, smoking, malnutrition, immunosuppression, emergency surgery, contaminated wounds, and length of the surgical procedure have been shown to be risk factors for the development of drain-related complications.[7]

A variety of patient, disease and procedure-related factors have been suggested as contributing factors to postoperative drain-associated morbidity.[8] Patients who are older, obese, diabetic, hypoalbuminemic, anemic, smokers, with cancer, and/or patients with chronic kidney disease or immunosuppressive therapy are at risk for poor wound healing and for postoperative infections.[9] In the same way, emergency surgery, dirty or contaminated surgical wounds, longer surgical time, substantial operative blood loss, complex surgery, and longer time of retention of the drains are independent risk factors for poor outcomes.[1, 10] The principles of

Enhanced Recovery After Surgery (ERAS) are now being increasingly followed, with a trend to avoid unnecessary placement of drains and their removal as early as possible if clinically safe to minimise the potential morbidity associated with the procedure.[11]

Although there are several studies that have assessed the rates and risk factors for individual postoperative complications.[12-14] The data on the overall incidence of postoperative drain-associated morbidity, risk factors associated with this morbidity, and postoperative morbidity outcomes associated with postoperative drains are limited, especially in developing countries where patient characteristics, surgical practice, and healthcare infrastructure vary greatly from that found in developed countries. Awareness of the incidence of drain related complications, and the identification of modifiable risk factors are critical for maximizing drain use, optimizing peri-operative decision making, minimizing preventable complications, and maximizing patient outcomes. In addition, local proof is essential for the establishment of standard institutional procedures for the insertion of drains, maintenance, monitoring and their timely extraction. The purpose of the present study is therefore to describe the incidence of drain-associated morbidity in surgical patients, to determine the risk factors associated with postoperative drain use, and to assess the clinical outcomes of post-drain surgery, such as surgical site infection, hospital stay, re-intervention and postoperative recovery. The results of this study will help to inform evidence-based surgical practice and to guide strategies for enhancing patient safety and reducing unnecessary complications associated with the use of drains.

MATERIALS AND METHODS

This study was conducted using a descriptive cross-sectional study design carried out in the Department of General Surgery, MTI, GOMAL Medical College, D.I.Khan. The study was conducted over a period of one year, from October, 2025 to March 2026.

The sample size was estimated in OpenEpi Version 3.01 for estimating a population proportion. A study by Yuan et al. in the past reported that surgical patients had an 18.5% rate of postoperative complications associated with the drain.[15] The minimum sample size was determined to be 118 patients with an anticipated frequency (p) of 18.5% and an absolute precision (d) of 7% at a 95% confidence level. A total of 125 patients were enrolled in the study to adjust for the fact that not all records were complete and that some patients dropped out.

A non-probability consecutive sampling was used. All patients who met the inclusion criteria and had orthopedic surgical procedures with postoperative drain placement were consecutively enrolled until the necessary number of patients was obtained.

The study included patients ≥18 years of age who had undergone an elective or emergency orthopedic surgical procedure involving postoperative drainage placement with informed written consent for participation. Patients were recruited regardless of the orthopedic diagnosis, and there were an equal number of males and females. Those who had surgical site infection at the time of surgery, chronic osteomyelitis, pathological fractures due to malignancy, immunocompromised conditions (HIV/AIDS), patients receiving long-term immunosuppressive therapy or chemotherapy, patients having incomplete clinical records, patients where drain was inserted with non-operative indications and patients who were lost to follow-up after surgery prior to drain removal were excluded from the study.

Eligible patients were recruited from the 'Orthopedic Ward and Trauma Center' consecutively after obtaining approval from the Institutional Review Board and permission from the Head of the Orthopedic Department. All participants had given informed consent in writing prior to enrollment. Demographic data pertaining to age, gender, BMI, smoking status, diabetes mellitus, hypertension and other related comorbidities were obtained on a semi-structured data collection proforma. Clinical data such as mechanism of injury, diagnosis, type of surgical procedure, length of surgery, wound classification, type of drain placed, drain output, the duration of the drain in place and whether the patient received any perioperative antibiotics were recorded from patient records and operative notes.

Patients were observed daily during hospitalization until the time of drain removal and discharge. The site of insertion of the drain was assessed regularly for signs of erythema, tenderness, discharge, swelling, pain, blockage, accidental dislodgement, persistent drainage, hematoma, seroma formation and other signs of a drain. The surgical site infection was diagnosed based on the 'Centers for Disease Control and Prevention' (CDC) criteria.[16] Other postoperative parameters, such as hospital stay, reinsertion of the drain, reoperation, readmission and mortality, were also recorded, if applicable. All collected data were checked for completeness and kept confidential before entering them into the study database.

The collected data was entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous data such as age, BMI, surgery time, drain placement time, drain output and hospital stay were reported as mean ±SD or median (IQR) depending on the distribution of data. Frequencies and percentages were used to present qualitative variables like gender, type of surgery, comorbidities, smoking status, wound classification, drain-related complications, and postoperative outcomes. Drain-associated morbidity was

defined as the percentage of patients that had one or more drain-related complication(s) during the postoperative period. The Chi-square test and Fisher's exact test were used to analyses the association between drain-associated morbidity and categorical independent variables. For comparison of continuous variables, independent sample t-test was used. Variables that were statistically significant in univariate analysis were included in a multivariable binary logistic regression to determine independent predictors of postoperative drain-associated morbidity. A p-value of less than 0.05 was considered statistically significant throughout the analysis.

RESULTS

The study involved 125 patients aged 44.8 ± 15.2 years; with most patients between the age of 41 and 60 years. Nearly two thirds of the study population were male. The majority of the patients were overweight or obese, and diabetes mellitus, hypertension and current smoking were frequent pre-existing comorbidities among the patients. (Table 1)

Emergency orthopedic procedures were performed on most patients, and the majority received closed suction drains. The operative time averaged around 119 minutes, and the average drain time was 4.8 days. Almost half of the procedures required more than two hours, and almost all patients received perioperative antibiotics. (Table 2)

Drain-associated morbidity was noted in 27.2% of patients after the surgery. The most common complication was surgical site infection, with drain-site pain, persistent drainage, seroma formation, drain blockage, accidental drain dislodgement, hematoma, and occasional drain reinsertion being the other common complications. A few patients had more than one complication related to the drain in the postoperative period. (Table 3)

The factors associated with postoperative drain-associated morbidity were found to be significantly more likely to be: advanced age, obesity, diabetes mellitus, hypertension, smoking history, emergency surgery, longer operative duration, contaminated wound and longer drain placement time in comparison to the patients without morbidity. Women had no significant association with the presence of complications related to the drains. (Table 4)

Patients with PADM had significantly worse clinical outcomes, such as longer hospital stay, readmission, and reoperation and wound healing, than those without PADM. There was little mortality and no difference between the two groups. (Table 5)

Longer drain duration was the most powerful independent predictor of morbidity associated with drains in multivariate logistic regression. In addition to the above, other identified factors that remained as independent risk factors after adjustment for the other potential risk factors included obesity, diabetes mellitus, smoking status, emergency surgery, prolonged operative time and contaminated wound, while age was not found to be an independent risk factor for postoperative morbidity related to the presence of a drain. (Table 6)

Table 1. Baseline demographic and clinical characteristics of the study participants (n = 125)

Variable	**n (%) / Mean ± SD**
Age (years)	44.8 ± 15.2
18–40 years	48 (38.4)
41–60 years	52 (41.6)
>60 years	25 (20.0)
Gender	
Male	79 (63.2)
Female	46 (36.8)
BMI (kg/m²)	26.3 ± 4.1
Normal (<25)	49 (39.2)
Overweight (25–29.9)	51 (40.8)
Obese (≥30)	25 (20.0)
Smoking status	
Yes	37 (29.6)
No	88 (70.4)
Diabetes mellitus	
Yes	33 (26.4)
No	92 (73.6)

Hypertension	
Yes	41 (32.8)
No	84 (67.2)

Table 2. Surgical and drain-related characteristics (n = 125)

Variable	**n (%) / Mean ± SD**
Type of surgery	
Elective	54 (43.2)
Emergency	71 (56.8)
Procedure duration (minutes)	118.6 ± 31.4
<120 minutes	67 (53.6)
≥120 minutes	58 (46.4)
Wound classification	
Clean	61 (48.8)
Clean-contaminated	45 (36.0)
Contaminated	19 (15.2)
Drain type	
Closed suction drain	103 (82.4)
Passive drain	22 (17.6)
Drain duration (days)	4.8 ± 1.9
≤5 days	81 (64.8)
>5 days	44 (35.2)
Drain output (mL)	265.7 ± 98.3
Perioperative antibiotics	
Yes	120 (96.0)
No	5 (4.0)

Table 3. Incidence and types of postoperative drain-associated morbidity (n = 125)

Variable	**n (%)**
Overall drain-associated morbidity	34 (27.2)
No morbidity	91 (72.8)
Surgical site infection	15 (12.0)
Persistent drainage	9 (7.2)
Drain blockage	7 (5.6)
Accidental drain dislodgement	5 (4.0)
Seroma formation	6 (4.8)
Hematoma	4 (3.2)
Drain-site pain requiring intervention	18 (14.4)
Re-insertion of drain	3 (2.4)

Table 4. Association between baseline variables and postoperative drain-associated morbidity (n = 125)

Variable	**Morbidity Present (n=34)**	**Morbidity Absent (n=91)**	**p-value**
Age (years), Mean ± SD	50.9 ± 14.8	42.5 ± 14.9	0.008
Male gender	25 (73.5)	54 (59.3)	0.148
BMI ≥30 kg/m²	13 (38.2)	12 (13.2)	0.003
Diabetes mellitus	16 (47.1)	17 (18.7)	0.002
Hypertension	16 (47.1)	25 (27.5)	0.041
Smoking	16 (47.1)	21 (23.1)	0.011
Emergency surgery	26 (76.5)	45 (49.5)	0.007
Procedure ≥120 minutes	23 (67.6)	35 (38.5)	0.004
Contaminated wound	11 (32.4)	8 (8.8)	0.001
Drain duration >5 days	24 (70.6)	20 (22.0)	<0.001

Table 5. Postoperative outcomes according to drain-associated morbidity (n = 125)

Outcome	Morbidity Present (n=34)	Morbidity Absent (n=91)	p-value
Hospital stay (days), Mean ± SD	10.3 ± 3.6	6.1 ± 2.1	<0.001
Readmission	7 (20.6)	3 (3.3)	0.002
Reoperation	5 (14.7)	2 (2.2)	0.013
Complete wound healing	27 (79.4)	89 (97.8)	0.001
Mortality	1 (2.9)	0 (0.0)	0.272

Table 6. Multivariable binary logistic regression analysis for predictors of postoperative drain-associated morbidity

Variable	Adjusted OR	95% CI	p-value
Age (>60 years)	1.68	0.81–3.49	0.162
Obesity (BMI ≥30 kg/m²)	2.74	1.18–6.37	0.019
Diabetes mellitus	2.58	1.14–5.84	0.023
Smoking	2.19	1.01–4.76	0.047
Emergency surgery	2.31	1.04–5.12	0.039
Procedure duration ≥120 minutes	2.67	1.18–6.02	0.018
Contaminated wound	3.46	1.35–8.87	0.010
Drain duration >5 days	5.81	2.46–13.73	<0.001

DISCUSSION

The present study aimed to assess the morbidity and risk factors associated with postoperative drain use in orthopedic patients and their associated clinical outcomes. In total, a total of 27.2% of patients had at least one complication associated with the drain, the most common of which was surgical site infection. Patients with drain-associated morbidity had significantly longer hospital stays, higher rates of readmission and reoperation, and slower wound healing. Multivariable analysis also revealed that the presence of obesity, diabetes mellitus, smoking, emergency surgery, prolonged operative time, and contaminated wounds were independent predictors of postoperative morbidity associated with the presence of a drain. Overall, these results highlight the need for proper management of the drains and optimization of modifiable risk factors to achieve better postoperative results.

The total morbidity associated with the use of a drain after surgery in this study is similar to what has recently been reported in the orthopedic literature. In a study from Lahore conducted in 2025, it was found that the rate of SSI in orthopedic implant surgery was 11.7%, and postoperative complications significantly affected patient morbidity. We assessed the overall drain-associated morbidity in our study but surgical site infection (SSI) was the most prevalent morbidity, suggesting that infectious morbidity still constitutes the greatest burden related to postoperative drains. Similarly, despite advances in surgical technique and post-operative management, there have been recent higher incidences of post-operative complications related to the drains.[17, 18]

The most frequent drain-related complication among our patients was surgical site infection. This is in line with Bilal Bukhari et al. (2025), who found that SSI was the most common postoperative complication after orthopedic implant surgery.[17] Similarly, in a systematic review and meta-analysis of 45 studies with over 1.5 million orthopedic patients, Liu et al. (2025) found that SSI is still one of the most prevalent postoperative complications despite the recent advances in infection prevention strategies.[9] These results are consistent with our findings, indicating that preventing SSI must continue to be a key priority when managing postoperative drains.

We found that obesity was an independent predictor on multivariable analysis and was strongly associated with postoperative drain-related morbidity in our study. The results are in line with those of a systematic review of Stewart et al. (2023) that found an increased risk of postoperative SSI after orthopedic surgery was associated with an increase in BMI of more than 2-fold.[19] The findings align with those of Rahman et al. (2025), who found that obesity was an independent risk factor for increased rates of postoperative infection after implant surgery in Pakistan.[20] Obesity can affect tissue perfusion, cause an increase in dead space, extend the drainage time of wounds, and delay the healing process, risking the development of complications after surgery.

Morbidity associated with smoking postoperatively was significantly associated with postoperative drain-associated morbidity and remained associated after adjustment for confounding variables in our cohort. Fan et al. (2023) and Zeng et al. (2025) also found smoking to be an independent risk factor for postoperative SSI.[21, 22] Tobacco smoke hinders tissue oxygenation, lessens collagen deposition, and slows wound healing which can lead to infection and other wound complications after surgery.

In our study, contaminated wounds were strongly related to postoperative complications associated with drains. These results are very similar to the findings from Liu et al. (2023) in their meta-analysis, which revealed that wound contamination is one of the most significant risk factors for postoperative SSI.[23] The higher incidence of infection and wound healing delays in contaminated wounds may be due to greater bacterial contamination and increase in tissue injury in contaminated wounds.

There are some limitations of this study. First, the study was carried out in a single tertiary care hospital, and so may not be generalizable to other care settings. Second, it may have been a non-probability consecutive sampling method which caused selection bias. In addition, given the relatively small sample size, fewer rarer complications associated with the drainage were identified. Fourth, only in-hospital outcomes were analyzed and long-term postoperative complications after hospital discharge were not analyzed. Lastly, surgeons' experience, surgical techniques, use of drains, and postoperative treatment were not analyzed, which could have affected the incidence of drain-related morbidity.

CONCLUSION

Drain-associated morbidity is a common complication after orthopedic surgery, occurring in more than one-quarter of surgical patients. The most frequent complication was surgical site infection, which led to longer hospital stays, higher reoperation and readmission rates as well as delayed wound healing. The duration of the drainage was the strongest independent risk factor found for morbidity, while obesity, diabetes mellitus, smoking, emergency surgery, a prolonged operative time and contaminated wounds were also significant risk factors. By careful patient selection, optimizing modifiable risk factors, careful aseptic care of the drain, and early removal of the drain, postoperative complications can be significantly reduced, and clinical outcomes can be improved. Standardized evidence-based drain management protocols are recommended to improve patient safety and patient recovery after surgery.

REFERENCES

1. Salib, M., et al., *Optimizing surgical drain removal: a narrative review of timing, criteria, and evidence-based practices.* Cureus, 2025. **17**(10).
2. Ibrahem, M.A.-m., et al., *Different Types and Importance of Negative Pressure Drain.* The Egyptian Journal of Hospital Medicine, 2023. **91**(1): p. 4418-4421.
3. Catton, J.A. and D.N. Lobo, *The use of drains in gastrointestinal surgery*, in *Recent Advances in Surgery 31*. 2024, CRC Press. p. 13-26.
4. Allos, H. and R. Hasbun, *Current understanding of infection of the Ventricles and its complications.* Expert Review of Anti-infective Therapy, 2024. **22**(12): p. 1023-1042.
5. Diehl, T.M., et al., *Surgery as a global health need.* Clinics in colon and rectal surgery, 2022. **35**(05): p. 362-370.
6. Zewdu, S., et al., *The burden of surgical site infection and associated factors among patients admitted to the surgical ward in resource-limited countries: an institutional-based cross-sectional study.* Frontiers in Surgery, 2025. **12**: p. 1571033.
7. Raffenot, C., et al., *Risk factors for nosocomial meningitis in patients with external ventricular drainages.* Journal of Intensive Care, 2025. **13**(1): p. 1-10.
8. Marschal, V., et al., *Incidence, risk factors, clinical and cognitive impact of secondary hemorrhage after spontaneous aneurysmal subarachnoid hemorrhage.* Brain and Spine, 2026: p. 106073.
9. Rastogi, A., et al., *Renal foot in diabetes: implications for wound healing and solutions.* Advances in Wound Care, 2026. **15**(5): p. 325-347.
10. Shailabh, S., et al., *Surgical site infections: A narrative review of risk factors, prevention, and emerging innovations.* Journal of Laboratory Physicians, 2025.
11. Mithany, R.H., et al., *Revolutionizing surgical care: the power of enhanced recovery after surgery (ERAS).* Cureus, 2023. **15**(11).
12. Lange, N., et al., *Analysis of risk factors for perioperative complications in spine surgery.* Scientific Reports, 2022. **12**(1): p. 14350.
13. Xusanboyev, B., et al., *Postoperative Complications in Abdominal Surgery: Incidence, Risk Factors, and Evidence-Based Preventive Strategies.* International Journal of Clinical & Translational Medicine, 2026. **1**(4): p. 182-192.
14. Madsen, H.J., et al., *Associations between preoperative risk, postoperative complications, and 30-day mortality.* World Journal of Surgery, 2022. **46**(10): p. 2365-2376.
15. Yuan, Y., et al., *The implementation of enhanced recovery after surgery pathway in patients undergoing posterior thoracolumbar fusion for degenerative spinal deformity.* BMC Musculoskeletal Disorders, 2023. **24**(1): p. 29.
16. Simon, S.D., *Centers for Disease Control and Prevention (CDC)*, in *Encyclopedia of Big Data*. 2022, Springer. p. 158-161.
17. Bukhari, S.A.B., et al., *Incidence and Risk Factors of Surgical Site Infection Following Orthopedic Implant Surgeries in a tertiary Healthcare setting at Lahore.* Pakistan Journal of Medicine and Dentistry, 2026. **15**(1).
18. Liu, H., et al., *Risk factors for surgical site infections after orthopaedic surgery: A meta-analysis and systematic review.* International wound journal, 2025. **22**(5): p. e70068.
19. Stewart, K.E., et al., *Trends and prediction of surgical site infection after elective spine surgery: an analysis of the American college of surgeons*

National surgical quality improvement project database. Surgical Infections, 2023. **24**(6): p. 506-513.
20. Rahman, A., et al., *Impact of obesity on joint replacement surgery outcomes: A comparative study*. Cureus, 2025. **17**(3).
21. Fan Chiang, Y.H., et al., *Smoking increases the risk of postoperative wound complications: A propensity score-matched cohort study.* International wound journal, 2023. **20**(2): p. 391-402.
22. Zeng, Y., et al., *Risk factors for surgical site infection in patients after hysterectomy: a systematic review and meta-analysis.* Journal of Hospital Infection, 2025. **163**: p. 30-41.
23. Liu, X., et al., *A meta-analysis of risk factors for non-superficial surgical site infection following spinal surgery*. BMC surgery, 2023. **23**(1): p. 129.