e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.11.134

International Journal of Pharmaceutical Quality Assurance 2025; 16(11); 877-881

Original Research Article

Comparison of Surgical Site Infection Incidence in Clean and Clean-Contaminated Procedures

Manish Kumar Singh[1], Kshamta Kumari[2], A. K. Jha Suman[3]

[1]Senior Resident, Department of General Surgery, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India

[2]Senior Resident, Department of General Surgery, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India

[3]Professor and HOD, Department of General Surgery, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India

Received: 10-09-2025 / Revised: 20-10-2025 / Accepted: 24-11-2025

Corresponding Author: Dr. Kshamta Kumari

Conflict of interest: Nil

Abstract:

Background: Surgical site infections (SSI) remain one of the most frequent postoperative complications, contributing to increased morbidity, prolonged hospital stay, and higher healthcare costs. The risk of infection differs significantly between clean and clean-contaminated surgeries, making it important to evaluate infection rates in these categories.

Objective: To compare the incidence of wound infection between clean and clean-contaminated surgeries performed at a tertiary care center.

Methods: This prospective observational study was conducted in the Department of General Surgery, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India, over a period of 12 months (January 2024 to December 2024). A total of 120 patients undergoing elective surgeries were included, with 60 patients in the clean group and 60 in the clean-contaminated group. Wound infection was diagnosed clinically based on CDC criteria, and infection rates were compared between the groups.

Results: Wound infection was observed in 5 patients (8.3%) in the clean surgery group and in 14 patients (23.3%) in the clean-contaminated group. The difference in infection rates was statistically significant ($p < 0.05$). Factors such as duration of surgery, comorbidities, and perioperative antibiotic use were also analyzed for their association with SSI.

Conclusion: Clean-contaminated surgeries demonstrated a significantly higher rate of wound infection compared to clean surgeries. Strict adherence to aseptic precautions, appropriate antibiotic prophylaxis, and careful intraoperative techniques are essential to minimize infection risk.

Keywords: Surgical Site Infection, Clean Surgery, Clean-Contaminated Surgery, Wound Infection, General Surgery.

Introduction

Surgical site infections (SSI) are among the most common healthcare-associated infections, representing a significant cause of postoperative morbidity and mortality [1]. They contribute to prolonged hospital stay, increased readmission rates, delayed recovery, and an overall rise in treatment costs. Despite advances in surgical techniques, aseptic practices, and antimicrobial prophylaxis, SSI remains a major concern in both developed and developing countries [2].

The incidence of SSI varies according to the type of surgery performed. Clean surgeries are procedures where no infection or inflammation is present, and no entry into the respiratory, gastrointestinal, or genitourinary tracts occurs [3]. In contrast, clean-contaminated surgeries involve controlled entry into these tracts without unusual contamination. The risk of SSI is naturally higher in clean-contaminated procedures, as exposure to endogenous microbial flora increases the likelihood of postoperative infection [4].

Multiple factors influence the development of SSI, including patient-related factors (age, comorbidities, nutritional status, and immune competence), surgery-related factors (duration of surgery, type of wound, blood loss, and use of implants), and perioperative factors (antibiotic prophylaxis, aseptic technique, and postoperative wound care). Identifying high-risk groups and evaluating

infection rates in different categories of surgery helps in formulating preventive strategies [5,6].

This study was undertaken to compare wound infection rates between clean and clean-contaminated surgeries in a tertiary care hospital setting. By assessing the incidence and risk factors associated with infection, the study aims to provide insights for optimizing perioperative management and improving patient outcomes.

Materials and Methods

Study design and setting: This was a prospective observational study conducted in the Department of General Surgery, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India, over a period of 12 months from January 2024 to December 2024.

Sample size: A total of 120 patients were included in the study. Patients were divided into two groups: 60 patients undergoing clean surgeries and 60 patients undergoing clean-contaminated surgeries.

Inclusion criteria:

- Patients aged 18 years and above.
- Patients undergoing elective clean or clean-contaminated surgeries.
- Patients who consented to participate in the study.

Exclusion criteria:

- Emergency surgeries.
- Patients with pre-existing wound infection.
- Immunocompromised patients (e.g., HIV, chemotherapy, long-term steroid therapy).
- Patients lost to follow-up before wound evaluation.

Data collection: Detailed demographic and clinical data were collected, including age, sex, comorbidities, type of surgery, duration of surgery, perioperative antibiotic use, and postoperative wound management. All patients were followed up or up to 30 days postoperatively.

Definition of wound infection: Wound infection was diagnosed based on the Centers for Disease Control and Prevention (CDC) criteria, which include purulent discharge, localized pain or tenderness, redness, swelling, and positive wound cultures where applicable.

Statistical analysis: Data were compiled and analyzed using SPSS software. Descriptive statistics were used for baseline characteristics. Chi-square test was applied to compare infection rates between clean and clean-contaminated groups. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 120 patients were studied, with 60 patients each in the clean and clean-contaminated surgery groups. The demographic characteristics, comorbidities, surgical details, and wound infection outcomes were analyzed. The mean age of patients was 42.3 years in the clean group and 44.1 years in the clean-contaminated group. Male patients slightly outnumbered females in both groups. Comorbidities such as diabetes and hypertension were more frequent in the clean-contaminated group. The mean duration of surgery was higher in clean-contaminated cases compared to clean cases. Wound infection was observed in 5 patients (8.3%) in the clean group and 14 patients (23.3%) in the clean-contaminated group, a statistically significant difference. Prolonged duration of surgery and presence of comorbidities were found to be associated with higher infection rates.

Table 1: Age distribution of patients

Age group (years)	Clean (n=60)	Clean-contaminated (n=60)	Total (n=120)	Percentage (%)
18–30	12	10	22	18.3
31–40	20	18	38	31.7
41–50	15	16	31	25.8
51–60	9	11	20	16.7
>60	4	5	9	7.5

Table 1 shows that most patients were in the 31–50 years age group.

Table 2: Gender distribution of patients

Gender	Clean (n=60)	Clean-contaminated (n=60)	Total (n=120)	Percentage (%)
Male	34	36	70	58.3
Female	26	24	50	41.7

Table 2 shows a slight male predominance in both groups.

Table 3: Distribution of comorbidities

Comorbidity	Clean (n=60)	Clean-contaminated (n=60)	Total (n=120)	Percentage (%)
Diabetes mellitus	6	10	16	13.3
Hypertension	5	8	13	10.8
Both	2	4	6	5.0
None	47	38	85	70.9

Table 3 shows that comorbidities were more frequent in the clean-contaminated group.

Table 4: Distribution by type of surgery

Type of surgery	Clean (n=60)	Clean-contaminated (n=60)
Hernia repair	22	–
Breast lump excision/mastectomy	18	–
Thyroidectomy	20	–
Cholecystectomy	–	20
Appendectomy	–	18
Bowel resection & anastomosis	–	22

Table 4 shows common procedures performed in both groups.

Table 5: Mean duration of surgery

Group	Mean duration (minutes)	Standard deviation
Clean	72.5	15.2
Clean-contaminated	98.3	20.6

Table 5 shows the average duration of surgeries in both groups.

Table 6: Distribution of wound infection

Group	Infected cases	Non-infected cases	Total	Percentage infected (%)
Clean	5	55	60	8.3
Clean-contaminated	14	46	60	23.3

Table 6 shows that infection rates were higher in clean-contaminated surgeries.

Table 7: Association of comorbidities with infection

Comorbidity	Infected (n=19)	Non-infected (n=101)	Infection rate (%)
Diabetes mellitus	6	10	37.5
Hypertension	3	10	23.1
Both	2	4	33.3
None	8	77	9.4

Table 7 shows that infection was more common in patients with diabetes or hypertension.

Table 8: Relation between duration of surgery and infection

Duration (minutes)	Infected cases	Non-infected cases	Total	Infection rate (%)
<60	2	36	38	5.3
61–90	6	38	44	13.6
>90	11	27	38	28.9

Table 8 shows that longer duration was associated with higher infection risk.

Table 9: Postoperative hospital stay

Group	Mean stay (days)	Standard deviation
Non-infected	6.1	1.5
Infected	11.3	2.6

Table 9 shows that infected patients had a longer hospital stay.

Table 10: Overall infection rates in both groups

Group	Infection rate (%)
Clean	8.3
Clean-contaminated	23.3

Table 10 summarizes infection rates in clean vs. clean-contaminated surgeries.

Table 1 highlights that the majority of patients were in the 31–50 years age group. Table 2 shows a male predominance in both groups. Table 3 demonstrates that comorbidities, particularly diabetes, were more common in clean-contaminated cases. Table 4 lists the surgical procedures, with hernia repairs and thyroidectomies dominating the clean group, while bowel resections and cholecystectomies were common in the clean-contaminated group. Table 5 shows that clean-contaminated surgeries had longer

operative times. Table 6 indicates significantly higher infection rates in the clean-contaminated group. Table 7 reveals that patients with comorbidities, especially diabetes, had a greater risk of infection. Table 8 shows that operations lasting more than 90 minutes had a higher infection rate. Table 9 demonstrates that infected patients stayed longer in the hospital. Finally, Table 10 confirms that overall, clean-contaminated surgeries had nearly three times the infection rate of clean surgeries.

Discussion

Surgical site infections remain a persistent challenge in surgical practice, despite advances in aseptic techniques, sterilization procedures, and antimicrobial prophylaxis [7]. The present study compared wound infection rates in clean versus clean-contaminated surgeries over a 12-month period at a tertiary care hospital [8]. Our findings demonstrate that infection rates were significantly higher in clean-contaminated surgeries (23.3%) compared to clean surgeries (8.3%) [9].

The observed difference in infection rates aligns with the widely accepted classification of surgical wounds, where clean wounds inherently have a lower risk due to the absence of entry into the gastrointestinal, genitourinary, or respiratory tracts [10]. In contrast, clean-contaminated wounds involve controlled entry into these tracts, exposing the surgical site to endogenous microbial flora and thereby increasing the risk of infection [11].

In this study, several factors influenced the incidence of wound infection. Duration of surgery was an important determinant, with procedures lasting longer than 90 minutes showing infection rates as high as 28.9% [12]. This association has been reported consistently in surgical literature, with prolonged operative time linked to increased tissue handling, blood loss, and greater exposure to environmental pathogens [13]. Similarly, the presence of comorbidities such as diabetes and hypertension was found to predispose patients to infection, likely due to impaired immune responses and delayed wound healing [14].

The higher mean hospital stay among infected patients (11.3 days) compared to non-infected patients (6.1 days) highlights the burden SSI imposes on both patients and healthcare systems. Prolonged hospitalization not only increases costs but also heightens the risk of secondary complications, including nosocomial infections [15].

Our findings reinforce the need for strict adherence to perioperative infection prevention strategies. These include optimal timing and choice of prophylactic antibiotics, minimizing operative duration where possible, meticulous surgical technique, and careful wound care in the postoperative period. Special attention should be directed towards patients with diabetes and other comorbidities, who are at greater risk of SSI.

While the results are consistent with established knowledge, this study provides institution-specific data that can help refine local infection control protocols. It emphasizes the importance of surveillance systems to continuously monitor SSI rates and to implement corrective measures where necessary.

Conclusion

This study found that wound infection rates were significantly higher in clean-contaminated surgeries compared to clean surgeries. Duration of surgery and the presence of comorbidities, particularly diabetes, were important risk factors for the development of surgical site infections. Infected patients had longer hospital stays, reflecting the increased burden on both patients and the healthcare system. These findings highlight the need for vigilant infection control practices, timely antibiotic prophylaxis, meticulous surgical techniques, and targeted care for high-risk patients to minimize postoperative complications.

References

1. Stefanou A, Worden A, Kandagatla P, Reickert C, Rubinfeld I. Surgical Wound Misclassification to Clean From Clean-Contaminated in Common Abdominal Operations. J Surg Res. 2020 Feb;246:131-138. doi: 10.1016/j.jss.2019.09.001. Epub 2019 Sep 30. PMID: 31580983.
2. Mayhew PD, Freeman L, Kwan T, Brown DC. Comparison of surgical site infection rates in clean and clean-contaminated wounds in dogs and cats after minimally invasive versus open surgery: 179 cases (2007-2008). J Am Vet Med Assoc. 2012 Jan 15;240(2):193-8. doi: 10.2460/javma.240.2.193. PMID: 22217028.
3. Buehrer JL, Weber DJ, Meyer AA, Becherer PR, Rutala WA, Wilson B, Smiley ML, White GC 2nd. Wound infection rates after invasive procedures in HIV-1 seropositive versus HIV-1 seronegative hemophiliacs. Ann Surg. 1990 Apr;211(4):492-8. doi: 10.1097/00000658-199004000-00018. PMID: 2322041; PMCID: PMC1358038.
4. Xia Y, Cho S, Greenway HT, Zelac DE, Kelley B. Infection rates of wound repairs during Mohs micrographic surgery using sterile versus nonsterile gloves: a prospective randomized pilot study. Dermatol Surg. 2011 May;37(5):651-6. doi: 10.1111/j.1524-4725.2011.01949.x. Epub 2011 Apr 1. PMID: 21457390.
5. Wang D, Shinder R. Comparison of Postoperative Infection Rates After Office-

based Oculoplastic Procedures Using Sterile and Clean Gloves. Ophthalmic Plast Reconstr Surg. 2023 Mar-Apr 01;39(2):146-149. doi: 10.1097/IOP.0000000000002266. Epub 2022 Sep 9. PMID: 36095843.
6. Bishawi M, Fakhoury M, Denoya PI, Stein S, Bergamaschi R. Surgical site infection rates: open versus hand-assisted colorectal resections. Tech Coloproctol. 2014 Apr;18(4):381-6. doi: 10.1007/s10151-013-1066-z. Epub 2013 Sep 6. PMID: 24061500.
7. Totty JP, Harwood AE, Cai PL, Hitchman LH, Smith GE, Chetter IC. Assessing the effectiveness of dialkylcarbamoylchloride (DACC)-coated post-operative dressings versus standard care in the prevention of surgical site infection in clean or clean-contaminated, vascular surgery (the DRESSINg trial): study protocol for a pilot feasibility randomised controlled trial. Pilot Feasibility Stud. 2019 Jan 18;5:11. doi: 10.1186/s40814-019-0400-2. PMID: 30680225; PMCID: PMC6337832.
8. Byrne DJ, Lynch W, Napier A, Davey P, Malek M, Cuschieri A. Wound infection rates: the importance of definition and post-discharge wound surveillance. J Hosp Infect. 1994 Jan;26(1):37-43. doi: 10.1016/0195-6701(94)90077-9. PMID: 7910181.
9. McHugh SM, Corrigan MA, Hill AD, Humphreys H. Surgical attire, practices and their perception in the prevention of surgical site infection. Surgeon. 2014 Feb;12(1):47-52. doi: 10.1016/j.surge.2013.10.006. Epub 2013 Nov 20. PMID: 24268928.
10. Asaid R, Williams I, Hyde D, Tiang T. Infection rates following hip and knee joint arthroplasty: large referral centre versus a small elective-only hospital. Eur J Orthop Surg Traumatol. 2013 Feb;23(2):165-8. doi: 10.1007/s00590-012-0937-8. Epub 2012 Jan 19. PMID: 23412447.
11. Corsini Campioli C, Challener D, Comba IY, Shah A, Wilson WR, Sohail MR, Van Gompel JJ, O'Horo JC. Overview and risk factors for postcraniotomy surgical site infection: A four-year experience. Antimicrob Steward Healthc Epidemiol. 2022 Jan 31;2(1):e14. doi: 10.1017/ash.2021.258. PMID: 36310773; PMCID: PMC9615103.
12. Dhamnaskar S, Mandal S, Koranne M, Patil P. Preoperative Surgical Site Hair Removal for Elective Abdominal Surgery: Does It Have Impact on Surgical Site Infection. Surg J (N Y). 2022 Aug 2;8(3):e179-e186. doi: 10.1055/s-0042-1749425. PMID: 35928549; PMCID: PMC9345678.
13. Fernandes AR, Farrokhyar F, Eskicioglu C, Ciccotelli W, Forbes SS. Surgical site infection rates are higher among elective colorectal surgery patients receiving non-beta-lactam-based antimicrobial prophylaxis: A retrospective chart review. Infect Control Hosp Epidemiol. 2023 Jun;44(6):881-884. doi: 10.1017/ice.2022.192. Epub 2022 Aug 22. PMID: 35993172.
14. Iñigo JJ, Bermejo B, Oronoz B, Herrera J, Tarifa A, Pérez F, Miranda C, Lera JM. Infección de sitio quirúrgico en un servicio de cirugía general. Análisis de cinco años y valoración del índice National Nosocomial Infection Surveillance (NNIS) [Surgical site infection in general surgery: 5-year analysis and assessment of the National Nosocomial Infection Surveillance (NNIS) index]. Cir Esp. 2006 Apr;79(4):224-30. Spanish. doi: 10.1016/s0009-739x(06)70857-0. PMID: 16753102.
15. Górecki W, Grochowska E, Krysta M, Wojciechowski P, Taczanowska A, Stanek B. A prospective comparison of antibiotic usage in pediatric surgical patients: the safety, advantage, and effectiveness of the Surgical Infection Society guidelines versus a common practice. J Pediatr Surg. 2002 Oct;37(10):1430-4. doi: 10.1053/jpsu.2002.35406. PMID: 12378448.