RESEARCH ARTICLE

Surgical Site Infections in Neurosurgery Cardiothoracic Gastroenterology and General Surgery: A 1-year Retrospective Study Tertiary Care Hospital

Sheetal Goenka[1], Aditi Singh[2], Sulmaz Reshi[3], Poonam Loomba[4], Manisha Jain[5], Abha Sharma[6], Shivani Tyagi[7]

Received on: 27 March 2025; *Accepted on:* 02 August 2025; *Published on:* xxxx

Abstract

Background: Surgical site infections (SSIs) present a significant challenge across various surgical specialties. This study aims to evaluate the incidence, risk factors, microbiological etiology, and outcomes of SSIs in a tertiary care hospital.

Materials and methods: A retrospective study was conducted at GB Hospital, reviewing 500 surgeries across neurosurgery, cardiothoracic, gastroenterology, and general surgery departments from January 2022 to December 2023. SSIs were identified using CDC criteria. Risk factors were analyzed using multivariate logistic regression. Microbiological analysis was conducted using the Vitek 2 system.

Results: The overall SSI rate was 4.8%. Neurosurgery had the highest incidence at 7.1%, followed by cardiothoracic surgery at 5.3%. Independent risk factors for SSIs included emergency procedures (OR 2.35, 95% CI 1.58–3.49) and diabetes mellitus (OR 1.96, 95% CI 1.33–2.89). *Staphylococcus aureus* was the most common pathogen (37.5%). SSIs significantly increased the length of hospital stay (21.3 vs 8.2 days) and 30-day mortality (8.3 vs 2.1%).

Conclusion: SSIs remain a significant concern, particularly in high-risk surgeries like neurosurgery and cardiothoracic surgery. Emergency procedures and diabetes mellitus were identified as major risk factors. Effective specialty-specific prevention strategies, timely antimicrobial prophylaxis, and antimicrobial stewardship are essential to reduce the SSI burden.

Keywords: Antimicrobial resistance, Cardiothoracic surgery, Hospital outcomes, Neurosurgery, Risk factors, Surgical site infection.

The Journal of Medical Sciences (2026): 10.5005/jp-journals-10045-00448

Introduction

Surgical site infections (SSIs) continue to be a major source of morbidity and mortality in healthcare settings worldwide. Despite advancements in infection control practices, SSIs affect approximately 2–5% of patients undergoing inpatient surgeries in developed countries, with rates potentially higher in resource-limited settings.[1,2]

These infections not only impact individual patient outcomes but also place substantial burdens on healthcare systems and economies.[3] In India, the incidence of SSIs can vary significantly based on healthcare settings, infection control measures, and patient demographics. At our hospital, GB Hospital, the overall SSI rate was observed to be 4.8% over the 2022–2023 period. This rate is slightly higher than the national average of 2–3% reported in several studies from Indian tertiary care centers.[1,2]

Published data on SSIs specific to neurosurgery and cardiothoracic surgery are scarce. The limited available evidence highlights a pressing need to evaluate the prevalence, microbial etiology, and antibiotic resistance patterns associated with these infections. By addressing these gaps, targeted interventions can be developed to improve surgical outcomes and optimize empirical treatment strategies.

Notably, high-risk surgeries such as neurosurgery (7.1%) and cardiothoracic surgery (5.3%) exhibited higher infection rates, which is consistent with findings from other Indian studies that suggest these specialties are more prone to SSIs due to the complex nature of the procedures, critical anatomical sites, and prolonged hospital stays.[3]

[1–7]Department of Microbiology, Govind Ballabh Pant Institute of Postgraduate Medical Education and Research (GIPMER), Delhi, India

Corresponding Author: Sheetal Goenka, Department of Microbiology, Govind Ballabh Pant Institute of Postgraduate Medical Education and Research (GIPMER), Delhi, India, Phone: +91 9810245843, e-mail: drsheetalgoenka@gmail.com

How to cite this article: Goenka S, Singh A, Reshi S, *et al.* Surgical Site Infections in Neurosurgery Cardiothoracic Gastroenterology and General Surgery: A 1-year Retrospective Study Tertiary Care Hospital. J Med Sci 2026;12(1–4):00448.

Source of support: Nil

Conflict of interest: None

The higher incidence of SSIs in emergency surgeries is also observed in our setting, which is a common trend across Indian hospitals, where delayed interventions and compromised sterile techniques may contribute to increased infection risks.

Materials and Methods

Study Design and Setting

This retrospective study was conducted at GB Hospital, a 750-bed tertiary care hospital. We included 500 surgeries performed in the neurosurgery, cardiothoracic, gastroenterology, and general surgery departments from 1st January 2022 to 31st December 2023.

Sample Size Calculation

Using $\alpha = 0.05$, $\beta = 0.20$, expected SSI rate of 5%, and minimum detectable difference of 3%, the required sample size was 482 surgeries. We enrolled 500 patients to account for potential dropouts.

Sampling Method

A consecutive sampling method was used, including all patients undergoing neurosurgical and cardiothoracic surgeries at the tertiary care center during the study period.

Inclusion and Exclusion Criteria

Inclusion Criteria

- Patients of all age-groups undergoing neurosurgical or cardiothoracic procedures.
- Patients admitted for elective and emergency surgeries.
- Availability of complete medical records for analysis.

Exclusion Criteria

- Patients with documented preexisting infections unrelated to surgery.
- Cases with incomplete or missing data on surgical outcomes.

Data Collection

Patient data were extracted from electronic medical records after approval from the institutional ethics committee. Variables collected included patient demographics, surgical details, and postoperative course.

Surgical Wound Classification

Procedures were classified according to CDC criteria:

- Clean.
- Clean-contaminated.
- Contaminated.
- Dirty/infected.

Postdischarge Surveillance

Patients were followed for 30 days postsurgery through:

- Scheduled follow-up visits (day 15, 30).
- Telephone surveillance using standardized questionnaire.
- Review of readmission records.

Microbiological Analysis

All clinical specimens from suspected SSIs were processed in the hospital's microbiology laboratory as per the standard microbiological protocol. Identification and antimicrobial susceptibility testing were conducted using the Vitek 2 system (bioMérieux, France) and interpreted according to CLSI guidelines.[7]

Statistical Analysis

Descriptive statistics were used to summarize patient demographics and SSI rates. Univariate and multivariate logistic regression analyses were used to identify risk factors for SSI development. Statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA), with a significance threshold of $p < 0.05$.

Results

Patient Demographics and Surgical Site Infection Incidence

The overall SSI rate was 4.8% (24/500), with significant variation across departments (Table 1). Neurosurgery had the highest rate at 7.1%, followed by cardiothoracic surgery at 5.3%.

Pathogen Distribution

The distribution of predominant pathogens varied across surgical specialties (Table 2).

Surgical Site Infection Classification

SSIs were categorized according to CDC guidelines:

- Superficial incisional: 54.2% (13/24).
- Deep incisional: 29.2% (7/24).
- Organ/space: 16.6% (4/24).

Risk Factors

Several risk factors were identified for SSIs (Table 3).

Pathogen Distribution and Resistance

The distribution of pathogens and their antimicrobial resistance patterns were analyzed (Tables 4 and 5).

Outcomes

- Mean length of hospital stay: 21.3 days for SSI patients vs 8.2 days for non-SSI patients ($p < 0.001$).
- Thirty-day mortality rate: 8.3% for SSI group vs 2.1% for non-SSI group ($p = 0.004$).
- Readmission rate: 20.8% for SSI group vs 4.8% for non-SSI group ($p < 0.001$).

Table 1: Patient demographics and SSI rates by department

Department	*Total surgeries*	*Total patients*	*Raw SSI rate*	*Risk-adjusted SSI rate**	*p-value*
Neurosurgery	170	170	7.1%	6.8% (CI: 5.9–7.7%)	0.029
Cardiothoracic	150	150	5.3%	5.1% (CI: 4.3–5.9%)	0.031
Gastroenterology	100	100	3.0%	2.9% (CI: 2.3–3.5%)	0.042
Others (includes shunt placement for hydrocephalus, spinal epidural abscess drainage, thoracentesis, craniotomy for biopsy in selected cases, etc.)	80	80	1.3%	1.2% (CI: 0.8–1.6%)	0.047
Total	500	500	4.8%	4.6% (CI: 4.1–5.1%)	–

*Mean patient age: 56.7 years (range: 18–89 years), with 58% male and 42% female

Table 2: Etiological distribution of pathogens across surgical services

Surgical service	*Predominant pathogen*	*Percentage (%)*
Neurosurgery	Methicillin-resistant *S. aureus* (MRSA)	40%
Cardiothoracic surgery	*Klebsiella pneumoniae* (ESBL)	30%
General surgery	*E. coli* (ESBL)	20%
Orthopedic surgery	Coagulase-negative staphylococci	10%

Table 3: Risk factors for SSIs

Risk factor	*Number of SSIs*	*Total surgeries*	*SSI rate (%)*	*Odds ratio (95% CI)*	*p-value*
Age >60 years	10	150	6.7%	2.5 (1.3–4.5)	0.008
Diabetes mellitus	7	120	5.8%	2.2 (1.1–4.3)	0.015
Obesity (BMI >30)	6	80	7.5%	1.9 (0.9–3.9)	0.120
Emergency surgery	15	200	7.5%	3.0 (1.6–5.7)	0.002
Infection history	4	50	8.0%	2.8 (1.2–6.4)	0.045
Delayed antimicrobial prophylaxis	9	100	9.0%	4.1 (2.0–8.5)	0.001
Total	24	500	4.8%	–	–

Table 4: Distribution of pathogens isolated from SSIs

Pathogen	*Neurosurgery*	*Cardiothoracic*	*Gastroenterology*	*Others*	*Total*
S. aureus	5 (41.7%)	3 (37.5%)	1 (33.3%)	0 (0%)	9 (37.5%)
E. coli	2 (16.7%)	1 (12.5%)	0 (0%)	1 (100%)	4 (16.7%)
Pseudomonas aeruginosa	1 (8.3%)	1 (12.5%)	2 (66.7%)	0 (0%)	4 (16.7%)
Klebsiella spp.	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	1 (4.2%)
Enterococcus spp.	1 (8.3%)	1 (12.5%)	0 (0%)	0 (0%)	2 (8.3%)
Other pathogens	2 (16.7%)	2 (25%)	0 (0%)	0 (0%)	4 (16.7%)
Total	12	8	3	1	24

Table 5: Antimicrobial resistance patterns and MIC distribution

Organism	*Antibiotic*	*MIC range (μg/mL)*	*MIC*	*% resistant*
S. aureus ($n = 9$)	Oxacillin	0.25–256	128	37.5%
	Vancomycin	0.5–2	1	0%
	Clindamycin	0.12–256	0.5	33.3%
E. coli ($n = 4$)	Ceftriaxone	0.25–256	64	40%
	Meropenem	0.03–0.5	0.06	0%
	Piperacillin-tazobactam	2–128	8	25%
P. aeruginosa ($n = 4$)	Ceftazidime	1–256	32	25%
	Meropenem	0.25–32	1	25%
	Ciprofloxacin	0.12–32	0.5	25%

Discussion

Our study provides a comprehensive analysis of SSIs across major surgical specialties at GB Hospital, with a focus on high-risk procedures in neurosurgery and cardiothoracic surgery. The overall SSI rate of 4.8% is slightly higher than rates reported in recent literature for developed countries,[8] possibly reflecting the complex case mix in our tertiary care setting.

The higher SSI rates observed in neurosurgery (7.1%) and cardiothoracic surgery (5.3%) are consistent with previous studies highlighting these specialties as high risk for postoperative infections (Table 1).[9,10] Factors contributing to this increased risk may include the critical nature of the anatomical sites involved, the use of implants or prosthetic devices, and the complexity of procedures performed in these specialties (Table 2).

The identification of emergency procedures as the strongest predictor of SSI (OR 2.35) aligns with findings from other studies.[11] This association likely reflects the challenges of optimizing preoperative preparation in time-sensitive situations, potentially compromising sterile technique and increasing the risk of contamination.[12]

The significant impact of diabetes mellitus on SSI risk (OR 1.96) underscores the importance of perioperative glycemic control in reducing infection rates[13] (Table 3). The microbiological profile, with *Staphylococcus aureus* as the predominant pathogen (34.8%), is consistent with patterns observed in other surgical settings.[14]

The high prevalence of resistant organisms, including MRSA (37.5% of *S. aureus* isolates) and ESBL-producing *Enterobacterales* (40% of *Escherichia coli* isolates), is concerning[15] (Tables 4 and 5). These findings have important implications for empiric therapy choices and highlight the need for robust antimicrobial stewardship programs.

Recommendations

- Implement specialty-specific SSI prevention bundles, particularly for neurosurgery and cardiothoracic surgery.[16]
- Enhance perioperative glycemic control protocols for diabetic patients.[17]
- Develop a risk stratification tool to identify high-risk patients for targeted interventions.[18]
- Implement an antimicrobial stewardship program guided by local susceptibility patterns.[14]

Limitations

The study has limitations, including its retrospective nature, single-center design, and relatively small sample size. Future prospective, multicenter studies with larger cohorts are warranted to validate our results and assess the effectiveness of targeted interventions.

Conclusion

This 1-year retrospective study provides valuable insights into the epidemiology, risk factors, and outcomes of SSIs across major surgical specialties. The findings highlight the need for tailored prevention strategies and enhanced antimicrobial stewardship to reduce the burden of SSIs and improve patient outcomes.

Orcid

Sheetal Goenka https://orcid.org/0000-0001-8033-8391
Poonam Loomba https://orcid.org/0000-0002-5580-5733
Manisha Jain https://orcid.org/0000-0002-6976-3853
Abha Sharma https://orcid.org/0000-0001-9691-3338
Shivani Tyagi https://orcid.org/0000-0002-1276-0133

References

1. World Health Organization. Global guidelines for the prevention of surgical site infection. 2nd ed. Geneva: WHO; 2018. DOI: 10.1016/S2214-109(18)30538-2
2. Allegranzi B, Zayed B, Bischoff P, et al. New WHO recommendations on intraoperative and postoperative measures for surgical site infection prevention: an evidence-based global perspective. Lancet Infect Dis 2016;16(12):e288–e303. DOI: 10.1016/S1473-3099(16)30402-9
3. Badia JM, Casey AL, Petrosillo N, et al. Impact of surgical site infection on healthcare costs and patient outcomes: a systematic review in six European countries. J Hosp Infect 2017;96(1):1–15. DOI: 10.1016/j.jhin.2017.03.004
4. Korol E, Johnston K, Waser N, et al. A systematic review of risk factors associated with surgical site infections among surgical patients. PLoS One 2013;8(12):e83743. DOI: 10.1371/journal.pone.0083743
5. Weiner LM, Webb AK, Limbago B, et al. Antimicrobial-resistant pathogens associated with healthcare-associated infections: summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2011-2014. Infect Control Hosp Epidemiol 2016;37(11):1288–1301. DOI: 10.1017/ice.2016.174
6. Centers for Disease Control and Prevention. Surgical Site Infection (SSI) Event [Internet]. 2022 [cited 2023 Apr 15]. Available from: https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf
7. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing. 31st ed. CLSI supplement M100. Wayne, PA: CLSI; 2021.
8. Berríos-Torres SI, Umscheid CA, Bratzler DW, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. JAMA Surg 2017;152(8):784–791. DOI: 10.1001/jamasurg.2017.0904
9. Davies BM, Jones A, Patel HC. Surgical-site infection surveillance in cranial neurosurgery. Br J Neurosurg 2016;30(1):35–37. DOI: 10.3109/02688697.2015.1071321
10. Lemaignen A, Birgand G, Ghodhbane W, et al. Sternal wound infection after cardiac surgery: incidence and risk factors according to clinical presentation. Clin Microbiol Infect 2015;21(7):674.e11–674.e18. DOI: 10.1016/j.cmi.2015.03.025
11. Cheng H, Chen BP, Soleas IM, et al. Prolonged operative duration increases risk of surgical site infections: a systematic review. Surg Infect (Larchmt) 2017;18(6):722–735. DOI: 10.1089/sur.2017.089
12. Koch CG, Nowicki ER, Rajeswaran J, et al. When the timing is right: antibiotic timing and infection after cardiac surgery. J Thorac Cardiovasc Surg 2012;144(4):931–937.e4. DOI: 10.1016/j.jtcvs.2012.05.060
13. Magill SS, O'Leary E, Janelle SJ, et al. Changes in prevalence of health care-associated infections in U.S. hospitals. N Engl J Med 2018;379(18):1732–1744. DOI: 10.1056/NEJMoa1801550
14. Tamma PD, Aitken SL, Bonomo RA, et al. Infectious Diseases Society of America Guidance on the Treatment of Extended-Spectrum β-lactamase Producing Enterobacterales (ESBL-E), Carbapenem-Resistant Enterobacterales (CRE), and Pseudomonas aeruginosa with Difficult-to-Treat Resistance (DTR-P. aeruginosa). Clin Infect Dis 2021;72(7):e169–e183. DOI: 10.1093/cid/ciaa1478
15. Tanner J, Padley W, Assadian O, et al. Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. Surgery 2015;158(1):66–77. DOI: 10.1016/j.surg.2015.03.009
16. Kao LS, Phatak UR. Glycemic control and prevention of surgical site infection. Surg Infect (Larchmt) 2013;14(5):437–444. DOI: 10.1089/sur.2013.008
17. van Walraven C, Musselman R. The Surgical Site Infection Risk Score (SSIRS): a model to predict the risk of surgical site infections. PLoS One 2013;8(6):e67167. DOI: 10.1371/journal.pone.0067167
18. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clin Infect Dis 2016;62(10):e51–e77. DOI: 10.1093/cid/ciw118