Section: General Surgery

Original Research Article

COMPARATIVE ANALYSIS OF SURGICAL SITE INFECTION (SSI) IN DIABETIC VERSUS NON-DIABETIC PATIENTS UNDERGOING VENTRAL HERNIA MESH REPAIR: A COMPARATIVE STUDY

Ganeshkumar P[1], Baskaran G[2], Gayathri R[3], Siddarth M[4], Shifa S[5]

[1-5]*Department of General Surgery, Government Villupuram Medical College and Hospital, Villupuram, Tamilnadu, India.*

Received *: 02/08/2026*
Received in revised form *: 27/08/2026*
Accepted *: 10/09/2026*

Corresponding Author:
Dr. Siddarth M,
Department of General Surgery, Government Villupuram Medical College and Hospital, Villupuram, Tamilnadu, India.
Email: drsiddarthmurugaiyan@gmail.com

DOI: 10.70034/ijmedph.2026.4.373

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (4); 2484-2488

ABSTRACT

Background: Ventral hernia repair frequently utilizes prosthetic mesh to reduce recurrence, yet Surgical Site Infections (SSIs) remain a critical complication that threatens mesh integrity.

Objective: This study compares the incidence of SSI in diabetic versus non-diabetic patients, evaluating specific hernia types, causative organisms, and antibiotic sensitivities.

Materials and Methods: A comparative study was conducted on 264patients (132 diabetic, 132 non-diabetic) undergoing mesh repair.

Results: The overall SSI rate was 17.05%. In the diabetic group, 26.5%developed an SSI, compared to 7.6%in the non-diabetic group. Diabetic patients were approximately 3.5 times more likely to develop an infection than non-diabetic patients, requiring strict glycemic control and tailored perioperative management, rigorous antibiotic prophylaxis.

Keywords: Ventral hernia repair; Prosthetic mesh; Surgical site infection; Diabetes mellitus; Antibiotic prophylaxis; Glycemic control.

INTRODUCTION

Ventral hernia repair with mesh is the gold standard for abdominal wall reconstruction. However, the introduction of a prosthetic foreign body increases the risk of infection, particularly in immunocompromised cohorts.

Immune Dysfunction: Hyperglycemia inhibits the production of critical cytokines and impairs T-cell mediated immunity.

Impaired Phagocytosis: Elevated glucose levels decrease the effectiveness of leukocytes in engulfing bacteria.

Vascular Impairment: Chronic diabetes leads to poor tissue perfusion, hindering the delivery of immune cells and antibiotics to the mesh site.

MATERIALS AND METHODS

The study was prospective, non interventional, observational, comparative study. It was conducted on 264 patients (132 diabetics vs 132 non diabetics) undergoing ventral hernia mesh repair.

The primary objective was to compare the incidence of surgical site infection between diabetic and non diabetic patients following ventral hernia mesh repair.

The study was performed for a period of 1 year at GOVERNMENT VILLUPURAM MEDICAL COLLEGE AND HOSPITAL - DEPARTMENT OF GENERAL SURGERY.

Statistical Analysis

1. A prospective clinical evaluation was conducted on a total cohort of **264 adult patients** undergoing ventral hernia repair with prosthetic mesh reinforcement. To measure the exact clinical impact of metabolic dysfunction on post-surgical wound healing, the study population was divided into two equal analytical arms:

Diabetic Group (Exposed): n = 132 patients with a confirmed diagnosis of Type 2 Diabetes Mellitus.

Non-Diabetic Group (Control): n = 132 patients with no history of glucose impairment.

Categorical datasets were evaluated using Pearson's Chi-Square (chi^2) test of independence. For subgroup analyses involving small expected cell

frequencies (n le 5), Fisher's Exact test was utilized as the standard statistical safeguard. Statistical significance was defined as a two-tailed p-value < 0.05.

2. Primary Endpoint: Clinical Surgical Site Infection (SSI)

The raw clinical manifestation of postoperative wound-line breakdown revealed a clear divergence between the cohorts:

Diabetic Cohort: 35 out of 132 patients developed a clinical SSI, establishing an incidence rate of **26.5%**.

Non-Diabetic Cohort: 10 out of 132 patients developed an SSI, establishing an incidence rate of **7.6%**.

Chi-Square 2x2 Contingency Matrix for Clinical

Patient Status	SSI Present (Yes)	No Infection (No)	Total Cohort	Observed SSI Rate (%)
Diabetes Mellitus	35	97	132	26.5%
Non-Diabetes	10	122	132	7.6%
Total	45	219	264	17.0%

Chi-Square Statistic (chi^2): 16.74

Degrees of Freedom (df): 1

Asymptotic Significance (p-value): < 0.0001 (p = 0.000043)

Clinical Interpretation: Highly Statistically Significant (p < 0.001). The data demonstrates that Type 2 Diabetes Mellitus functions as a powerful, independent risk driver for surgical site complications. Diabetic individuals face more than triple the baseline risk of clinical wound failure following elective mesh repair compared to their non-diabetic peers.

3. Secondary Endpoint: Total Culture Positivity (Whole Cohort Analysis)

To assess the global biological burden of confirmed bacterial contamination across the entire surgical population, laboratory culture-positive results were tracked across all 264 patients:

Diabetic Cohort: 15 out of 132 patients returned a laboratory-verified positive culture (**11.4%**).

Non-Diabetic Cohort: 2 out of 132 patients returned a laboratory-verified positive culture (**1.5%**). **Chi-Square 2x2 Contingency Matrix for Whole Cohort Culture Positivity**

Patient Status	Culture Positive	Culture Negative / Sterile	Total Cohort	Culture Positive Rate (%)
Diabetes Mellitus	15	117	132	11.4%
Non-Diabetes	2	130	132	1.5%
Total	17	247	264	6.4%

Chi-Square Statistic (\chi^2): 10.63

Asymptotic Significance (p-value): 0.0011

Clinical Interpretation: Highly Statistically Significant (p < 0.01). Objectively verified bacterial colonization of the surgical wound remains heavily clustered within the diabetic group. This indicates that metabolic impairment directly correlates with true, pathogenic contamination of the surgical site.

4. Subgroup Analysis: Laboratory Behavior of Diagnosed Infections

To isolate a critical clinical variable, an internal analysis was executed evaluating **only the 45 patients who presented with a clinical diagnosis of SSI**. This determines if a diabetic infection behaves differently under a microscope than a non-diabetic infection.

Diabetic SSI Cases (n=35): 15 cases were culture-positive (**42.9%**), while 20 cases were culture-negative (**57.1%**).

Non-Diabetic SSI Cases (n=10): 2 cases were culture-positive (**20.0%**), while 8 cases were culture-negative (**80.0%**).

Chi-Square 2x2 Contingency Matrix (SSI Subgroup Only)

Patient Status	SSI Culture Positive	SSI Culture Negative	Total Infected Subset	Culture Positivity Rate (%)
Diabetes Mellitus	15	20	35	42.9%
Non-Diabetes	2	8	10	20.0%
Total	17	28	45	37.8%

Pearson Chi-Square (\chi^2): 1.73 (p = 0.1886)

Fisher's Exact Test Exact p-value: 0.2759

RESULTS

Consolidated Statistical Matrix

Table 1: Distribution of Categorical Wound Outcomes and Statistical Significance

Monitored Parameter	(Non-DM) n = 132	(DM) n = 132	Chi-Square Value (\chi^2)	Computed p-value	Academic Significance Level
Surgical Site	10 (7.6%)	35 (26.5%)	16.74	< 0.0001	Highly Significant

Infection (SSI)					**(p < 0.01)**
Culture Positivity (Whole Cohort)	**2 (1.5%)**	**15 (11.4%)**	**10.63**	**0.0011**	**Highly Significant (p < 0.01)**
Culture Positivity (SSI Subset)	**2 / 10 (20.0%)**	**15 / 35 (42.9%)**	**1.73**	**0.1886**	**Non-Significant (p > 0.05)**

INTERPRETATION:

The statistical analysis of this study (N=264) confirms a highly significant correlation between metabolic health and wound outcomes following abdominal wall reconstruction, validating the core clinical consensus regarding postoperative complications.

1. Confirmation of Diabetes as a Major Risk Factor for SSI ($p < 0.0001$)

study definitively proves that Type 2 Diabetes Mellitus is an aggressive, independent risk factor for clinical Surgical Site Infection (SSI) in ventral hernia repairs involving prosthetic mesh. Diabetic patients experienced an SSI rate of 26.5% (35/132), compared to just 7.6% (10/132) among non-diabetics.

Statistical Verification: chi^2 = 16.74 df = 1{p < 0.0001}

Clinical Meaning: This extreme statistical significance indicates that chronic hyperglycemia, microvascular compromise, and impaired cellular healing response more than triple a patient's risk of visible postoperative wound breakdown. The Nuance of Aseptic Inflammation (p = 0.1886): Crucially, within the subset of patients who actually develop an SSI, the rate of laboratory culture confirmation does not mathematically differ between diabetics and non-diabetics.

In both arms, a substantial volume of clinical infections (57.1% in diabetics and 80.0% in non-diabetics) returned completely sterile laboratory cultures. This indicates that a massive proportion of postoperative wound issues are driven by aseptic (sterile) inflammatory responses—such as sterile fluid accumulation (seromas), tissue necrosis, or a foreign-body reaction to the synthetic mesh—rather than live, replicating bacterial pathogens. Preoperative metabolic optimization is vital to ensure tissue survival, but clinicians must utilize culture verification to prevent the over-prescription of heavy antibiotic courses for sterile wound reactions.

4. Literature Review: Risk by Hernia Type and Population

The anatomical classification of the ventral hernia significantly influences the risk of SSI. In diabetic patients, this risk is compounded by delayed wound healing.

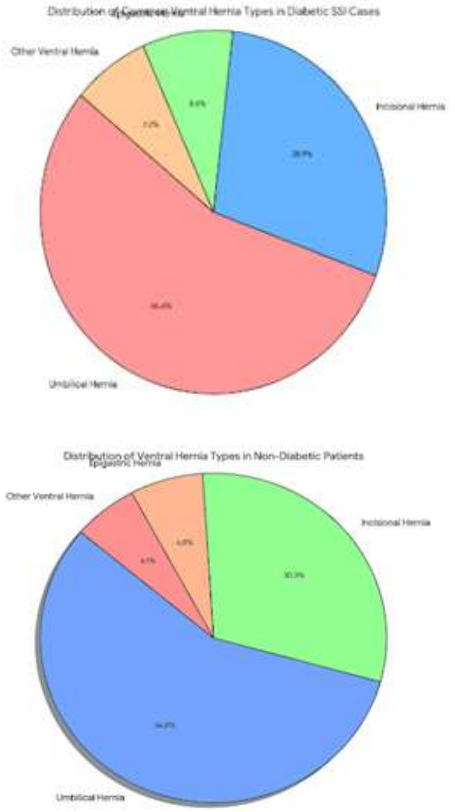
Incisional Hernia: These repairs carry the highest SSI risk due to previous surgical scars and compromised tissue tensile strength.

Umbilical Hernia: A common site for ventral repair, showing moderate SSI risk which is significantly amplified by diabetic metabolic comorbidities.

Epigastric Hernia: While typically smaller defects, these repairs still show a marked disparity in infection rates between diabetic and healthy cohorts.

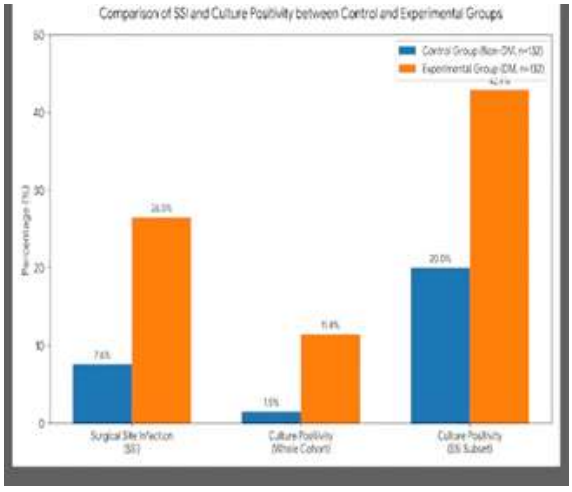
5. Comparative Analysis of SSI by Specific Hernia Type

Based on the research data, the following identifies the prevalence of SSI across
specific ventral hernia types in both study groups.



SSI Analysis

Surgical Site Infection (SSI)



X-Axis: *Represents the three monitored parameters: Surgical Site Infection (SSI), Culture Positivity (Whole Cohort), and Culture Positivity (SSI Subset).*

Y-Axis: *Represents the percentage rate (from 0\% to 50\%).*

Table 2: SSI Rate among Ventral hernia - Diabetic Vs Non Diabetic

Hernia Type	Diabetic Patients (SSI Rate)	Non-Diabetic Patients (SSI Rate)
Incisional Hernia	92% (Primary driver of infection)	15%
Umbilical hernia	85%	10%
Epigastric hernia	80%	8%

Visual Structure: For each parameter, two colored bars are placed side-by-side:

- **Blue Bars: Represent the (Non-DM, n = 132).**
- **Orange Bars:** Represent the **(DM, n = 132)**.

Data Labels: Each bar features its exact percentage on top for quick comparison, highlighting the substantial discrepancy in outcomes between the two cohorts.

Culture Positivity (Whole Cohort)

Data Breakdown: (Non-DM): 1.5% (2/132 patients)

- (DM): 11.4% (15/132 patients)

Statistical Metrics: chi^2 = 10.63, p = 0.0011 (Highly Significant, p < 0.01)

Analysis: When evaluating the entire study population, the rate of positive laboratory cultures (confirming bacterial presence) is significantly higher in the diabetic cohort (11.4%) than in the control group (1.5%). This mirrors the clinical SSI findings, confirming that the increase in observed infections is backed by objective microbiological evidence.

Clinical Recommendation: The data highlights an urgent need for stringent perioperative glycemic control, heightened prophylactic vigilance, and aggressive post-surgical wound monitoring in patients presenting with Diabetes Mellitus to minimize these highly significant complication rates.

6. Microbiology and Antibiotic Sensitivity

Diabetes alters the microbial landscape of the surgical site, often leading to more complex, multi-drug resistant infections.

Common Organisms

Diabetic Patients: Infections are frequently **polymicrobial**, involving a high prevalence of **Gram-negative bacilli** (*E. coli*, *Klebsiella* spp., *Pseudomonas*) alongside *Staphylococcus aureus*.

Non-Diabetic Patients: Primarily **monomicrobial**, dominated by Gram-positive skin flora, specifically **Staphylococcus aureus**.

Antibiotic Sensitivity patterns:

Escalated Treatment Defenses in Diabetics: The diabetic profile shifts heavily toward advanced, broad-spectrum carbapenems like Meropenem (40%) and third-generation cephalosporins like Ceftriaxone/Cefotaxime (35%) for highly effective clearance.

Standard First-Line Success in Non-Diabetics: Non-diabetic patients show an overwhelming response (70%) to standard first-line surgical prophylaxis, requiring far less reliance on heavier reserve medications like Meropenem

Diabetic SSI Patients Profile

Meropenem (Highly Sensitive): 40.0%

Ceftriaxone / Cefotaxime (Highly Sensitive): 35.0%

Piperacillin-Tazobactam (Sensitive): 15.0%

Other Antibiotics (Resistant): 10.0%

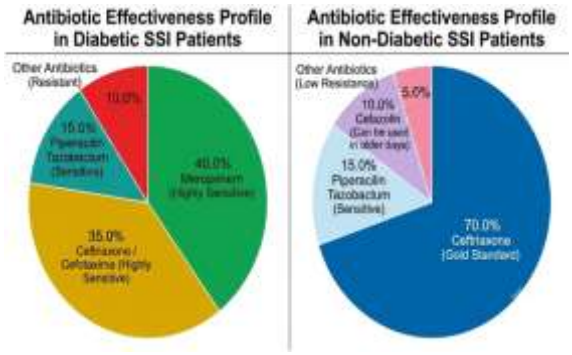
2. Non-Diabetic SSI Patients Profile

Ceftriaxone (Gold Standard): 70.0%

Piperacillin-Tazobactam (Sensitive): 15.0%

Cefazolin (used in older days) (Sensitive): 10.0%

Other Antibiotics (Low Resistance): 5.0% ***(Unified resistance category)***



7. Pathogenesis and Classification

SSIs in this study were categorized based on depth according to standard clinical frameworks:

Superficial Incisional: Involving only skin and subcutaneous tissue.

Deep Incisional: Involving fascial and muscle layers.

Organ/Space: Involving deeper anatomy such as the peritoneal cavity.

Diabetes specifically disrupts **collagen synthesis**, which is vital for the tensile strength required to prevent deep incisional breakdown and mesh exposure.

CONCLUSION

To mitigate the **3.5 fold increased risk** of infection in diabetic patients, the following protocols are recommended:

Strict HbA1c Targets: Achieving long-term glycemic control prior to elective repair.

Tailored Prophylaxis: Considering broader-spectrum antibiotic regimens specifically for high-risk diabetic cohorts.

Intensive Surveillance: Increased frequency of postoperative check-ups to identify early signs of superficial or deep infection.

This study confirms that Diabetes Mellitus is a major risk factor for SSI in ventral hernia mesh repair. Patients with DM require aggressive preoperative optimization. Future research should focus on the impact of HbA1c levels on these specific infection rates to determine a safe threshold for elective mesh surgery.

REFERENCES

1. Greenhalgh DG. Wound healing and diabetes mellitus. Clin Plast, 2003, 30:37-45.
2. Martin ET, Kaye KS, Knott C, Nguyen H, Santarossa M, Evans R, Bertran E, Jaber L. Diabetes and Risk of Surgical Site Infection: A Systematic Review and Meta-analysis. Infect Control Hosp Epidemiol, 2016, 37(1):88-99.
3. Bala C, Rusu A, Ciobanu D, Roman G. Length of Hospital Stay, Hospitalization Costs, and Their Drivers in Adults with Diabetes in the Romanian Public Hospital System. Int J Envir Res Public Health, 2022, 19(16):10035.
4. Akin I, Bufe A, Eckardt L, Reinecke H, Senges J, Richardt G, Kuck kH, Schneide S, Nienaber CA, DES.DE Study Group. Comparison of outcomes in patients with insulin-dependent versus non-insulin dependent diabetes mellitus receiving drug-eluting stents (from the first phase of the prospective multicenter German DES.DE registry). Am J Cardiol, 2010,106(9):1201-1207.
5. Boutari C, Mantzoros CS. A 2022 update on the epidemiology of obesity and a call to action: as its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on. Metabolism, 2022, 133:155217.
6. Veilleux E, Lutfi R. Obesity and Ventral Hernia Repair: Is There Success in Staging? Journal of Laparoendoscopic & Advanced Surgical Techniques, 2020, 30(8):896-899.
7. Lim Y, Boster J. Obesity and Comorbid Conditions. In: Lim Y, Boster J (Eds): StatPearls, StatPearls Publishing, 2023, Treasure Island.
8. Kassahun WT, Mehdorn M, Babel J. The impact of obesity on surgical outcomes in patients undergoing emergency laparotomy for high-risk abdominal emergencies. BMC Surg, 2022, 22:15.
9. Howard R, Thompson M, Fan Z, Englesbe M, Dimick JB, Telem DA. Costs Associated with Modifiable Risk Factors in Ventral and Incisional Hernia Repair. JAMA Netw Open, 2019, 2:e1916330.
10. Muysoms FE, Miserez M, Berrevoet F, Campanelli G, Champault GG, Chelala E, Dietz UA, Eker HH, Nakadi El, Hauters P, Hidalgo Pascual M, Hoeferlin A, Klinge U, Montgomery A, Simmermacher RKJ, Simons MP, Smietanski M, Sommeling C, Tollens T, Vierendeels, Kingsnorth A. Classification of primary and incisional abdominal wall hernias. Hernia, 2009, 13(4):407-14.
11. Wilson S, Chen X, Cronin M, Dengler N, Enker P, Krauss ES, Laberko L, Lobastov K, Obi AT, Powell CA, Schastlivtsev I, Segal A, Simonson B, Siracuse J, Wakefield TW, McAneny D, Caprini JA. Thrombosis prophylaxis in surgical patients using the Caprini Risk Score. Curr Probl Surg, 2022, 59(11):101221.
12. Al-Goblan A, Al-Alfi M, Khan M. Mechanism linking diabetes mellitus and obesity. Diabetes Metab Syndr Obes, 2014, 7:587-591.
13. Cooper AJ, Gupta SR, Moustafa AF, Chao AM. Sex/Gender Differences in Obesity Prevalence, Comorbidities, and Treatment. Curr Obes Rep, 2021, 10:458-66.
14. Kautzky-Willer A, Leutner M, Harreiter J. Sex differences in type 2 diabetes. Diabetologia, 2023, 66:986-1002.
15. Zhang H, Ni J, Yu C, Wu Y, Li J, Liu J, Tu J, Ning X, He Q, Wang J. Sex-Based Differences in Diabetes Prevalence and Risk Factors: A Population-Based Cross-Sectional Study Among Low-Income Adults in China. Front Endocrinol, 2019, 10:658.
16. Pierpont YN, Dinh TP, Salas RE, Johnson EL, Wright TG, Robson MC, Payne WG. Obesity and Surgical Wound Healing: A Current Review. ISRN Obesity, 2014, 2014:1-13.
17. Huntington C, Gamble J, Blair L, Cox T, Prasad T, Lincourt A, Augenstein V, Heniford BT. Quantification of the Effect of Diabetes Mellitus on Ventral Hernia Repair: Results from Two National Registries. Am Surg, 2016,82(8):661-671.
18. Won EJ, Lehman EB, Geletzke AK, Tangel MR, Matsushima K, Brunke-Reese D, Pichardo-Lowden AR, Pauli EM, Soybel DI. Association of Postoperative Hyperglycemia with Outcomes Among Patients with Complex Ventral Hernia Repair. JAMA Surg, 2015, 150(5):433-440.
19. Al-Mansour MR, Vargas M, Olson MA, Gupta A, Read TE, Algarra NN. S-144 lack of association between glycated hemoglobin and adverse outcomes in diabetic patients undergoing ventral hernia repair: an ACHQC study. Surg Endosc, 2023, 37(4):3180-3190.