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Impact of obesity severity on early and late outcomes following elective incisional hernia repair: A prospective cohort study

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Abstract

BACKGROUND: Obesity is a well-recognized risk factor for incisional hernia formation and is associated with increased postoperative morbidity after abdominal wall reconstruction. However, the influence of obesity severity on short- and long-term outcomes following elective incisional hernia repair remains inadequately defined.

MATERIALS AND METHODS: This prospective observational study included 101 obese patients (body mass index [BMI] ≥ 30 kg/m^2) undergoing elective incisional hernia repair over 18 months. Perioperative, postoperative, and long-term outcomes were evaluated, and multivariable logistic regression was performed to identify independent predictors of surgical site infection and hernia recurrence.

RESULTS: Among the 101 patients with obesity, 48 (47.5%) had Grade I, 30 (29.7%) had Grade II, and 23 (22.8%) had Grade III obesity. Increasing obesity severity was significantly associated with higher rates of surgical site infection (6.3% vs. 16.7% vs. 34.8%; P = 0.006), wound dehiscence (2.1% vs. 6.7% vs. 21.7%; P = 0.009), chronic postoperative pain (4.2% vs. 13.3% vs. 26.1%; P = 0.018), and hernia recurrence (4.2% vs. 10.0% vs. 26.1%; P = 0.014). Grade III obesity remained independently associated with recurrence after adjustment for mesh-to-defect ratio (mesh:defect area ratio) and other clinical covariates. A progressively lower mesh-to-defect ratio with increasing obesity grade was independently associated with recurrence, emphasizing the importance of adequate mesh reinforcement in obese patients.

CONCLUSIONS: Increasing BMI was associated with greater wound morbidity, prolonged hospitalization, and higher recurrence after incisional hernia repair. Maintaining an adequate mesh-to-defect ratio may reduce recurrence, particularly in severe obesity, while laparoscopic repair demonstrated favorable perioperative outcomes.

Keywords:

Hernia recurrence, incisional hernia, obesity, surgical site infection, ventral hernia repair

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Introduction

Incisional hernia continues to represent one of the most common postoperative complications following laparotomy, with reported incidence rates ranging between 5% and 70%. Elevated body mass index (BMI) has been established as a principal risk factor, as obese patients exhibit an approximately threefold greater probability of incisional hernia development.[1] Obesity, conventionally defined by a BMI of ≥30 kg/m^2, has grown into a substantial worldwide health concern and is recognized as a contributor to elevated perioperative morbidity.[2] Obesity is an independent etiological factor in the development of both

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primary and incisional ventral hernias. The underlying pathophysiology is believed to involve chronically raised intra-abdominal pressure along with compromised collagen synthesis and altered wound healing.[3] The prevalence of obesity has risen substantially across the globe over recent decades. Contemporary evidence suggests that approximately 60% of patients presenting for ventral hernia repair (VHR) have a BMI of ≥30 kg/m^2, while concomitant ventral hernia is present in approximately 8% of individuals undergoing bariatric surgery.[4] According to the World Health Organization (WHO), approximately 2.5 billion adults worldwide are overweight, while nearly 890 million are affected by obesity, accounting for nearly two-fifths and one-sixth of the worldwide adult population, respectively.[5] In India, the growing obesity burden has been highlighted by the Indian Council of Medical Research–India Diabetes (INDIAB) study, which reported an estimated 254 million adults with generalized obesity and nearly 351 million with abdominal obesity nationwide.[6] Open retromuscular mesh repair remains a well-established technique for incisional hernia management, with the sublay position offering durable reinforcement and low recurrence rates due to favorable distribution of intra-abdominal forces. However, open repair is associated with substantial postoperative morbidity and surgical site infections, especially among obese individuals.[7,8] In contrast, laparoscopic repair has demonstrated favorable outcomes with reduced morbidity, shorter hospitalization, less postoperative pain, and comparable recurrence rates, leading to its increasing preference in obese patients.[9,10] Moreover, approach-related differences in postoperative pain and physical activity restriction may contribute to variations in wound healing outcomes.[11] Evidence regarding the optimal body weight for incisional hernia repair remains limited, and the benefit of compulsory preoperative weight reduction is still debated. Moreover, no definitive consensus exists concerning the most appropriate surgical approach for obese patients undergoing repair of incisional hernia. The primary objective of the present study was to examine the impact of elevated BMI on early postoperative outcomes following incisional hernia repair, including wound healing, surgical site infection, postoperative morbidity, and duration of hospital stay. The secondary objectives were to analyze the interplay between obesity and late postoperative outcomes such as chronic pain, mesh-related complications, hernia recurrence, and reoperation rates, as well as to analyze the influence of surgical approach on postoperative findings among obese patients who underwent incisional hernia repair.

Materials and Methods

This prospective observational study was conducted in the Department of General Surgery at a Tertiary Care Referral Center over a period of 18 months, following approval from the Institutional Review Committee. Out of 118 patients initially evaluated for inclusion, 101 consecutive patients fulfilling the inclusion criteria were enrolled for final analysis [Figure 1]. Sample size was calculated based on the anticipated difference in surgical site infection rates between obesity grades (WHO classification obesity). Assuming an surgical site infection (SSI) incidence of 10% among Grade I obesity and 35% among Grade III obesity, with $\alpha = 0.05$ and power of 80%, a minimum sample size of 90 patients was required. To compensate for potential loss to follow-up, 101 patients were included in the final analysis. This research was executed and presented in conformity with the Strengthening the Reporting of Cohort, Cross-sectional and Case-control Studies in Surgery (STROCSS) 2021 criteria and Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for observational studies. Patients aged ≥ 18 years with obesity (BMI ≥ 30 kg/m^2) and a clinically and radiologically confirmed incisional hernia were enrolled after obtaining written informed consent. Patients undergoing emergency surgery for obstructed or strangulated hernia, patients with active intra-abdominal sepsis, pregnancy, abdominal wall malignancy, severe systemic illness precluding surgery, or immunocompromised status were excluded.

Hernia defects were additionally classified based on the classification system established by the European Hernia Society (EHS) based on width and anatomical location.[12] Fundamental demographic and clinical parameters, encompassing age, sex, smoking status, comorbidities, previous abdominal surgeries, recurrent hernia status, and hernia defect size, were recorded. In accordance with the WHO obesity classification, patients were categorized into three groups: Grade I (BMI 30–34.9 kg/m^2), Grade II (BMI 35–39.9 kg/m^2), and Grade III obesity (BMI ≥ 40 kg/m^2). Preoperative evaluation included routine hematological and biochemical investigations along with ultrasonography or contrast-enhanced computed tomography when indicated for assessment of fascial defect characteristics.

The operative approach was determined according to surgeon preference, defect morphology, patient characteristics, and intraoperative findings. In open repairs, a lightweight polypropylene macroporous mesh was used in the retromuscular sublay position. In laparoscopic repairs, a composite dual-surface mesh suitable for intraperitoneal placement was utilized for intraperitoneal onlay mesh (IPOM)/IPOM-plus techniques. Mesh selection was standardized according to the operative approach and surgeon preference. Standard perioperative antibiotic prophylaxis and postoperative analgesic protocols were followed in all patients.

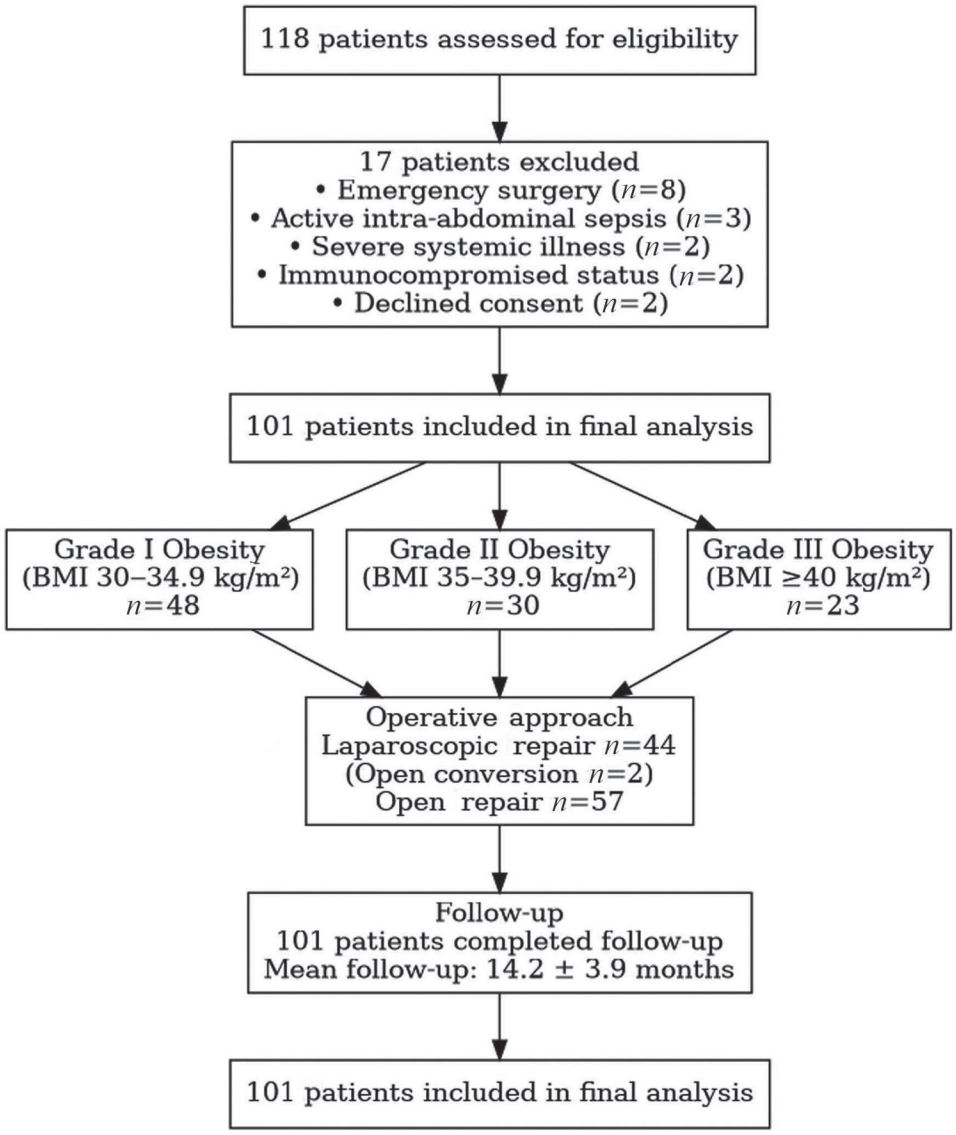


Figure 1: Study flow diagram demonstrating patient selection, exclusion criteria, obesity stratification, and operative allocation

The study endpoints were broadly categorized into primary and secondary outcomes. Primary endpoints encompassed surgical site infection, wound-related complications, overall postoperative morbidity, and length of hospital stay. Secondary endpoints included seroma formation, pain intensity evaluated through the visual analogue scale, mesh infection, chronic pain, hernia recurrence, need for reoperation, and patient-reported satisfaction during the follow-up period. All patients underwent structured prospective follow-up through scheduled outpatient visits to facilitate systematic assessment of both immediate and delayed postoperative outcomes.

The statistical framework employed the Statistical Package for the Social Sciences version 26.0 (IBM Corp., Armonk, NY, USA) for all analyses. Normality among continuous variables was first established using the Shapiro–Wilk test. Continuous data were thereafter expressed as mean ± standard deviation, and differences across groups were examined using Student's t test or one-way analysis of variance where applicable. The Chi-square test and Fisher's exact test served as the analytical tools for categorical variables, with selection guided by expected frequency distributions. Variables emerging as potentially significant ($P < 0.10$) from univariate analysis were entered into separate multivariable logistic regression models to identify independent predictors of surgical site infection and hernia recurrence, respectively, and adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were calculated. For the recurrence model, the mesh-to-defect ratio was entered instead of defect size because it incorporates both defect size and mesh dimensions and was considered a more clinically relevant technical variable, thereby minimizing

potential multicollinearity. As no variable exhibited missing data exceeding 5%, complete-case analysis was pursued without imputation. A *P* value below 0.05 on two-tailed testing was adopted as the threshold for statistical significance.

Results

The final study cohort comprised 101 obese patients who underwent elective incisional hernia repair. Based on WHO obesity classification, 48 (47.5%) patients had Grade I obesity, 30 (29.7%) had Grade II obesity, and 23 (22.8%) had Grade III obesity.

Age distribution was comparable across obesity grades, whereas the prevalence of diabetes mellitus, hypertension, and mean hernia defect size increased significantly with increasing obesity severity (all $P < 0.05$). Mean BMI increased significantly across obesity grades (32.8 ± 1.4 vs. 37.2 ± 1.3 vs. 43.6 ± 3.2 kg/m^2; $P < 0.001$) [Table 1].

Hernia characteristics according to the EHS classification are presented in Table 2. Midline defects predominated in all groups, while larger defects (W3) were significantly more frequent among Grade III obese patients ($P = 0.020$).

Mesh dimensions increased significantly with obesity severity because of larger fascial defects. Mean mesh area was significantly greater in Grade III obesity (298.6 ± 68.4 cm^2) compared with Grade I obesity (185.4 ± 42.6 cm^2; $P < 0.001$). This progressive reduction in mesh-to-defect ratio paralleled the increasing recurrence

Table 1: Baseline demographic and clinical characteristics stratified by obesity grade

Variables	Grade I obesity (*n* = 48)	Grade II obesity (*n* = 30)	Grade III obesity (*n* = 23)	Total (*n* = 101)	*P* value
Mean age (years), mean ± SD	45.4 ± 11.8	45.9 ± 10.2	45.6 ± 11.0	45.6 ± 11.1	0.930
Mean BMI (kg/m^2), mean ± SD	32.8 ± 1.4	37.2 ± 1.3	43.6 ± 3.2	36.1 ± 4.8	<0.001
Female sex, *n* (%)	21 (43.8)	17 (56.7)	15 (65.2)	53 (52.5)	0.349
Diabetes mellitus, *n* (%)	3 (6.3)	6 (20.0)	8 (34.8)	17 (16.8)	0.011
Hypertension, *n* (%)	5 (10.4)	7 (23.3)	9 (39.1)	21 (20.8)	0.008
Smoking history, *n* (%)	9 (18.8)	8 (26.7)	7 (30.4)	24 (23.8)	0.512
Recurrent hernia, *n* (%)	2 (4.2)	0 (0)	3 (13.0)	5 (5.0)	0.101
Mean defect size (cm), mean ± SD	5.8 ± 1.9	6.7 ± 2.3	8.2 ± 2.8	6.7 ± 2.4	<0.001

BMI = body mass index, SD = standard deviation

Table 2: Hernia characteristics according to European Hernia Society classification

Variables	Grade I (*n* = 48)	Grade II (*n* = 30)	Grade III (*n* = 23)	*P* value
Midline hernia (M1–M5)	41 (85.4)	25 (83.3)	19 (82.6)	0.450
Lateral hernia (L1–L4)	7 (14.6)	5 (16.7)	4 (17.4)	
W1 (< 4 cm)	18 (37.5)	8 (26.7)	4 (17.4)	
W2 (4–10 cm)	25 (52.1)	18 (60.0)	11 (47.8)	
W3 (> 10 cm)	5 (10.4)	4 (13.3)	8 (34.8)	0.020

Table 3: Mesh characteristics according to obesity grade

Variables	Grade I (*n* = 48)	Grade II (*n* = 30)	Grade III (*n* = 23)	*P* value
Mean defect size (cm)	5.8 ± 1.9	6.7 ± 2.3	8.2 ± 2.8	< 0.001
Mean mesh area (cm^2)	185.4 ± 42.6	224.8 ± 51.3	298.6 ± 68.4	< 0.001
Mean mesh overlap (cm)	4.8 ± 0.7	5.1 ± 0.8	5.3 ± 0.9	0.071
Mean mesh-to-defect ratio	5.6 ± 1.2	5.3 ± 1.1	4.8 ± 1.0	0.032

Table 4: Operative characteristics according to surgical approach

Variables	Laparoscopic repair (*n* = 44)	Open repair (*n* = 57)	*P* value
Mean operative time (min), mean ± SD	96.4 ± 18.7	82.1 ± 21.5	0.002
Mean blood loss (mL), mean ± SD	74.5 ± 28.4	132.8 ± 45.2	0.0003
Retromuscular mesh placement, *n* (%)	4 (9.1)	46 (80.7)	< 0.0001
IPOM/IPOM-plus technique, *n* (%)	40 (90.9)	11 (19.3)	< 0.0001
Drain placement required, *n* (%)	8 (18.2)	31 (54.4)	0.0004
Mean hospital stay (days), mean ± SD	3.1 ± 1.2	5.8 ± 2.1	< 0.0001
Conversion to open surgery, *n* (%)	2 (4.5)	—	

IPOM = intraperitoneal onlay mesh

Table 5: Early postoperative outcomes across obesity grades

Postoperative outcomes	Grade I (*n* = 48)	Grade II (*n* = 30)	Grade III (*n* = 23)	*P* value
Surgical site infection, *n* (%)	3 (6.3)	5 (16.7)	8 (34.8)	0.006
Seroma formation, *n* (%)	4 (8.3)	5 (16.7)	7 (30.4)	0.028
Wound dehiscence, *n* (%)	1 (2.1)	2 (6.7)	5 (21.7)	0.009
Postoperative ileus, *n* (%)	2 (4.2)	2 (6.7)	4 (17.4)	0.118
Mean VAS pain score (POD-1)	4.8 ± 1.1	5.7 ± 1.3	6.5 ± 1.5	< 0.001
Mean hospital stay (days)	3.4 ± 1.3	5.1 ± 1.8	7.2 ± 2.4	< 0.001
ICU admission, *n* (%)	0 (0)	1 (3.3)	3 (13.0)	0.041

VAS = visual analog scale, ICU = intensive care unit, POD-1 = postoperative day 1

Table 6: Multivariate logistic regression for predictors of surgical site infection

Variables	Adjusted odds ratio (aOR)	95% CI	*P* value
Grade III obesity	4.82	1.71–13.56	0.003
Diabetes mellitus	3.14	1.18–8.39	0.021
Open surgical approach	3.87	1.44–10.39	0.007
Operative time > 90 min	2.65	1.03–6.82	0.043

aOR = adjusted odds ratio, CI = confidence interval

Table 7: Late outcomes and hernia recurrence during follow-up

Variables	Grade I (*n* = 48)	Grade II (*n* = 30)	Grade III (*n* = 23)	*P* value
Mean follow-up duration (months)	14.2 ± 3.8	13.9 ± 4.1	14.5 ± 3.6	0.812
Chronic postoperative pain, *n* (%)	2 (4.2)	4 (13.3)	6 (26.1)	0.018
Mesh infection, *n* (%)	1 (2.1)	2 (6.7)	4 (17.4)	0.032
Hernia recurrence, *n* (%)	2 (4.2)	3 (10.0)	6 (26.1)	0.014
Reoperation required, *n* (%)	1 (2.1)	2 (6.7)	5 (21.7)	0.011
Patient satisfaction score (0–10)	8.6 ± 1.1	7.8 ± 1.4	6.9 ± 1.7	<0.001

observed across obesity grades during follow-up (5.6 vs. 5.3 vs. 4.8; $P = 0.032$) [Table 3].

Operative outcomes are summarized in Table 4. Relative to open repair, the laparoscopic approach was found to be linked with lower blood loss (74.5 ± 28.4 vs. 132.8 ± 45.2 mL; $P = 0.0003$), reduced drain requirement (18.2% vs. 54.4%; $P = 0.0004$), and shorter hospital stay (3.1 ± 1.2 vs. 5.8 ± 2.1 days; $P < 0.0001$), despite a longer operative duration (96.4 ± 18.7 vs. 82.1 ± 21.5 min; $P = 0.002$).

Early postoperative outcomes are summarized in Table 5. A progressive increase in obesity grade was accompanied by a statistically significant rise in the rates of surgical site infection (6.3%, 16.7%, and 34.8%; $P = 0.006$), seroma formation ($P = 0.028$), wound dehiscence ($P = 0.009$), postoperative pain scores ($P < 0.001$), prolonged hospitalization ($P < 0.001$), and requirement for ICU admission ($P = 0.041$).

Multivariable logistic regression identified Grade III obesity, diabetes mellitus, open surgical approach, and operative duration > 90 min as independent predictors of surgical site infection [Table 6].

Late outcomes are presented in Table 7. Chronic postoperative pain, mesh infection, hernia recurrence, and reoperation rates increased significantly with obesity severity, while patient satisfaction decreased progressively across obesity grades (all $P < 0.05$). Hernia recurrence was observed in 4.2%, 10.0%, and 26.1% of Grade I, II, and III obese patients, respectively ($P = 0.014$).

Table 8: Multivariable logistic regression analysis for hernia recurrence

Variables	Adjusted OR (aOR)	95% CI	*P* value
Grade III obesity	4.18	1.23–14.17	0.022
Mesh-to-defect ratio (per unit increase)	0.71	0.54–0.94	0.016
Diabetes mellitus	2.26	0.80–6.40	0.123
Hypertension	1.54	0.53–4.45	0.425
Open surgical approach	2.83	1.01–7.96	0.048
Smoking history	1.49	0.51–4.37	0.463
Recurrent hernia at presentation	2.63	0.68–10.12	0.161

aOR = adjusted odds ratio, CI = confidence interval

Multivariable logistic regression analysis demonstrated that Grade III obesity (aOR 4.18, 95% CI: 1.23–14.17; $P = 0.022$), lower mesh-to-defect ratio (aOR 0.71 per unit increase, 95% CI: 0.54–0.94; $P = 0.016$), and open surgical approach (aOR 2.83, 95% CI: 1.01–7.96; $P = 0.048$) were independent predictors of hernia recurrence. Diabetes mellitus, hypertension, smoking history, and recurrent hernia at presentation were not independently associated with recurrence [Table 8].

According to the Clavien–Dindo classification, postoperative complications occurred in 34 (33.7%) patients. Most complications were minor (Grade I–II) and managed conservatively. Eight patients experienced Grade III complications requiring procedural intervention, one patient developed a Grade IV complication requiring intensive care management, and no postoperative mortality was observed.

Discussion

The present prospective study demonstrated that increasing BMI was significantly associated with adverse early and late outcomes following incisional hernia repair. Patients with Grade III obesity had significantly higher rates of surgical site infection, seroma formation, wound dehiscence, prolonged hospitalization, chronic postoperative pain, mesh infection, recurrence, and reoperation than patients with lower obesity grades. Furthermore, laparoscopic repair was associated with considerably diminished operative blood loss and a shorter hospital stay despite a relatively longer operative duration. These findings highlight the substantial influence of obesity on perioperative morbidity and long-term durability following abdominal wall reconstruction.

Obesity has consistently been recognized as one of the strongest predictors of poor outcomes after ventral and incisional hernia repair. Parker *et al.*,[13] in a systematic review and meta-analysis evaluating predictors of ventral hernia recurrence, identified obesity as a major independent determinant of recurrence and postoperative morbidity. Similarly, Finan *et al.*[14] demonstrated that obesity significantly increases the risk of surgical site infection following VHR, particularly in association with prolonged operative duration and metabolic comorbidities. In the present study, surgical site infection increased progressively from 6.3% in Grade I obesity to 34.8% in Grade III obesity, while Grade III obesity independently predicted surgical site infection on multivariate analysis (aOR 4.82; $P = 0.003$). These findings further support the detrimental effect of excessive adiposity on postoperative wound healing.

The pathophysiological basis for poor outcomes in obese patients is multifactorial. Increased intra-abdominal pressure, impaired collagen metabolism, reduced tissue perfusion, chronic inflammation, and technical difficulty during surgery all contribute to compromised fascial healing and mesh integration. Vidović *et al.*[15] demonstrated that obesity significantly contributes to recurrence following incisional hernia repair because of persistent mechanical stress on the abdominal wall. Likewise, Hawn *et al.*[16] emphasized that wound-related complications are among the strongest predictors of long-term repair failure and need for reoperation. In the current study, recurrence increased significantly from 4.2% in Grade I obesity to 26.1% in Grade III obesity ($P = 0.014$), while reoperation rates increased from 2.1% to 21.7%. These findings underscore the long-term adverse implications of obesity in abdominal wall surgery. The higher recurrence observed in Grade III obesity may partly reflect the greater prevalence of large fascial defects and associated comorbidities in this group. However, after adjustment for mesh-to-defect ratio, diabetes mellitus, hypertension, smoking status, recurrent hernia, and operative approach, Grade III obesity remained an independent predictor of recurrence, suggesting a direct adverse effect of severe obesity on long-term repair durability. The concept of the mesh-to-defect ratio has been emphasized by Tulloh and de Beaux[17], who proposed that adequate mesh coverage relative to defect size is fundamental to durable VHR. They highlighted that an insufficient mesh to defect ratio may predispose to recurrence despite technically successful mesh implantation. In the present study, the mesh-to-defect ratio progressively decreased from Grade I to Grade III obesity despite increasing mesh size, indicating that larger fascial defects in severely obese patients require proportionally greater mesh reinforcement. The independent association between a lower mesh-to-defect ratio and recurrence observed in our study supports this concept and suggests that achieving an adequate mesh to defect ratio may be particularly important in obese patients to optimize long-term repair durability.[17]

The progressive increase in wound morbidity noted in the current investigation agrees with the findings reported by Tastaldi *et al.*,[18] who demonstrated significantly higher wound complication rates with increasing BMI after open VHR. Their analysis showed that obesity was strongly associated with surgical site infection, seroma formation, and wound dehiscence, findings that closely parallel the present results. Similarly, Liang *et al.*[19] reported that obesity remains a major contributor to postoperative wound complications and healthcare utilization after abdominal wall reconstruction, emphasizing the importance of perioperative optimization strategies in this population.

Open retromuscular mesh repair remains a widely accepted technique for incisional hernia repair because of its biomechanical advantages and low recurrence rates. Holihan *et al.*,[7] in a systematic review and network meta-analysis, demonstrated that retromuscular mesh placement is associated with less recurrence and fewer wound complications compared with onlay or inlay techniques. However, open repair is also associated with extensive soft tissue dissection and increased wound morbidity, particularly in obese individuals.

In the present study, open repair was associated with significantly greater blood loss, increased drain placement, and prolonged hospital stay. Furthermore, open surgical approach independently predicted surgical site infection on multivariate analysis (aOR 3.87; $P = 0.007$), reinforcing the vulnerability of obese patients to wound-related complications after extensive open dissection.

Minimally invasive techniques have increasingly gained popularity in obese patients because of their ability to reduce wound morbidity while maintaining acceptable recurrence rates. Itani *et al.*,[20] in a randomized controlled trial comparing laparoscopic and open ventral incisional hernia repair, demonstrated significantly lower wound complication rates following laparoscopic repair with comparable long-term recurrence. Comparable results were documented by Tsereteli *et al.*,[21] who noted satisfactory morbidity rates and minimal recurrence following laparoscopic VHR in morbidly obese individuals. Alizai *et al.*[22] further demonstrated that laparoscopic IPOM repair in obese individuals was associated with lower morbidity compared with open sublay repair. In the current study, laparoscopic repair resulted in significantly lower blood loss (74.5 vs. 132.8 mL; $P = 0.0003$) and shorter hospital stay (3.1 vs. 5.8 days; $P < 0.0001$), supporting the growing preference for minimally invasive approaches in obese patients.

Despite the advantages of laparoscopy, operative duration was significantly longer in the laparoscopic group. This finding is consistent with previous literature and likely reflects increased technical complexity related to adhesiolysis, defect closure, and mesh fixation in obese individuals. Alizai *et al.*[22] similarly reported prolonged operative duration in obese patients undergoing laparoscopic repair. In the present study, operative duration exceeding 90 min independently predicted surgical site infection, highlighting the importance of operative efficiency and meticulous surgical technique in reducing postoperative morbidity.

Chronic postoperative pain and reduced patient satisfaction are increasingly recognized as important determinants of long-term quality of life after hernia repair. Lauscher *et al.*[23] demonstrated that long-term symptomatic outcomes after incisional hernia repair are strongly influenced by postoperative complications and recurrence. In the current study, chronic postoperative pain increased progressively with obesity severity, affecting 26.1% of Grade III obese patients compared with 4.2% of Grade I obese patients. However, because baseline preoperative pain scores were not recorded, it cannot be definitively determined whether these differences were entirely attributable to postoperative factors or partially influenced by preexisting symptom burden. Similarly, patient satisfaction scores declined significantly with increasing BMI, suggesting that obesity adversely affects both objective surgical outcomes and postoperative functional recovery.

Mesh-related complications remain an important challenge following VHR. Sanchez *et al.*[24] demonstrated that mesh infection is strongly associated with obesity, wound infection, and postoperative wound breakdown. In the present study, mesh infection occurred in 17.4% of Grade III obese patients compared with only 2.1% in Grade I obesity. This observation further emphasizes the importance of perioperative infection prevention, careful patient selection, and optimization of modifiable risk factors before surgery.

The findings of the present study support increasing emphasis on preoperative optimization strategies in obese patients undergoing abdominal wall reconstruction. A similar study demonstrated that obesity significantly increases postoperative morbidity after abdominal wall reconstruction and recommended careful perioperative risk modification strategies including weight reduction, glycemic optimization, and smoking cessation.[25] Similarly, Jairam *et al.*,[26] in the preventing incisional hernia with mesh augmentation (PRIMA) trial, highlighted the importance of reinforcement strategies in high-risk abdominal wall patients to reduce long-term hernia-related morbidity. These concepts are particularly relevant in obese individuals who remain at substantially higher risk for wound complications and recurrence.

The present study has several strengths, including its prospective design, obesity stratification according to WHO classification, assessment of both early and late postoperative outcomes, and incorporation of multivariate regression analysis. The present findings highlight the importance of obesity-specific risk stratification in incisional hernia repair. Patients with Grade III obesity experienced higher wound morbidity, longer hospitalization, greater recurrence rates, and lower patient satisfaction than those with lower obesity grades. These results suggest that obesity is a major determinant of postoperative outcomes rather than merely a comorbidity. Preoperative optimization through weight reduction, glycaemic control, smoking cessation, and nutritional support may improve surgical outcomes, while laparoscopic repair appears to offer favorable perioperative outcomes when technically feasible. Nevertheless, certain limitations should be acknowledged. This was a single-center observational study with a relatively modest sample size and intermediate follow-up duration. Selection bias related to operative approach cannot be entirely excluded because surgical technique was determined according to surgeon preference and hernia characteristics. In

addition, absence of formal quality-of-life instruments such as EuraHS-QoL or Carolinas Comfort Scale may have limited comprehensive functional outcome assessment. Another limitation of the present study is that baseline preoperative pain scores were not prospectively documented. Consequently, postoperative pain comparisons among obesity groups should be interpreted cautiously, as preexisting differences in pain perception or symptom severity could not be assessed. Recurrence analysis should be interpreted cautiously because the relatively small number of recurrence events limited the robustness of multivariable modeling.

Despite these limitations, the present study provides clinically meaningful prospective evidence regarding the impact of obesity on incisional hernia repair outcomes. Increasing BMI was associated with significantly greater wound morbidity, postoperative complications, and recurrence, while laparoscopic repair demonstrated favorable perioperative outcomes compared with open surgery. These findings emphasize the importance of individualized operative planning, careful perioperative optimization, and long-term surveillance in obese patients undergoing incisional hernia repair.

Conclusions

Elevated BMI was significantly associated with increased perioperative morbidity, wound-related complications, prolonged hospitalization, and higher recurrence following incisional hernia repair. Severe obesity emerged as an independent predictor of adverse postoperative outcomes. Our findings further emphasize that achieving an adequate mesh-to-defect ratio is an important technical consideration for minimizing recurrence, particularly in patients with Grade III obesity who present with larger fascial defects. Careful selection of appropriately sized mesh, together with meticulous perioperative optimization and individualized operative planning, may improve long-term repair durability in this high-risk population.

Author contributions

SS: Concept design, definition of intellectual content, literature search, data acquisition, data analysis, manuscript preparation, manuscript editing. DP: Literature search, manuscript preparation, manuscript editing, manuscript review. NK: Data acquisition, data analysis, manuscript preparation, manuscript review. FK: Definition of intellectual content, literature search, data acquisition, data analysis, statistical analysis. VB: Manuscript editing, manuscript review. AK: Concept design, literature search. PK: Manuscript preparation, manuscript editing, manuscript review. SM: Manuscript editing, manuscript review

Ethical policy and Institutional Review Board statement

This study was conducted in full accordance with the ethical principles outlined in the Declaration of Helsinki. The research was reviewed and approved by the Office of the Ethics Committee, Indira Gandhi Institute of Medical Sciences (IGIMS)(Number: 1482/IEC/IGIMS/2024) on March 20, 2024.

Declaration of patient consent

Patient was enrolled in the study after duly signed informed consent.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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