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

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.12.62

International Journal of Pharmaceutical Quality Assurance 2025; 16(12); 369-375

Original Research Article

Application of Modified Ventral Hernia Working Group Classification to Assess the Risk Factors and Predict Post- Operative Outcomes

Anindya Mahapatra[1], Debarchan Ghosh[2], Subhadeep Mondal[3], Sanjeev Kumar Mandal[4]

[1]Senior Resident, Department of General Surgery, Ruby General Hospital, 576 Anandapur Main Road, Kasba, Kolkata, West Bengal, India – 700107

[2]Consultant & Head of the Department, Department of General Surgery, Ruby General Hospital, 576 Anandapur Main Road, Kasba, Kolkata, West Bengal, India – 700107

[3]Consultant, Department of General Surgery, Ruby General Hospital, 576 Anandapur Main Road, Kasba, Kolkata, West Bengal, India – 700107

[4]Consultant, Department of General Surgery, Ruby General Hospital, 576 Anandapur Main Road, Kasba, Kolkata, West Bengal, India – 700107

Received: 01-10-2025 / Revised: 15-11-2025 / Accepted: 29-12-2025

Corresponding Author: Dr. Anindya Mahapatra

Conflict of interest: Nil

Abstract

Introduction: Ventral hernias are common clinical conditions often arising after abdominal surgeries and associated with significant morbidity. Surgical repair aims to prevent complications like incarceration or strangulation, but postoperative outcomes vary due to patient comorbidities and surgical factors.

Aims and Objectives: This study aimed to evaluate the demographic profile, comorbidities, surgical approaches, and postoperative complications including seroma, surgical site infections (SSI), and sinus/fistula tract development, mesh infection, recurrence based on modified Ventral hernia working group classification system(VHWG) in patients undergoing ventral hernia repair.

Materials and Methods: A prospective observational study was conducted on 122 patients undergoing ventral hernia repair. Demographic data, comorbidities, and surgical details were recorded and patients were classified into 3 grades according to modified VHWG classification system. Postoperative complications were assessed at 1 month, 6 months, and 1 year, with seroma, SSI, and sinus/fistula graded for severity.

Results: The study included 122 patients, predominantly female (76.2%), with a mean age of 55.55 ± 9.87 years and most patients belonging to the 51–60 year age group (42.6%). Obesity was the most common comorbidity (51.8%), and surgical approaches were equally distributed between laparoscopic and open methods (50% each). Seroma formation and surgical site infection, mesh infection were significantly associated with higher grades, with Grade 3 showing higher incidence at 1 month (seroma 27.6%, SSI 27.6%,mesh infection 10.3%) and delayed resolution at 1 year (seroma resolution 58.6%, SSI persistence 27.6%; $p < 0.05$). Sinus/fistula tract formation, Wound dehiscence, Recurrence were rare (0.8%) and did not show a statistically significant association with grade ($p > 0.05$)..

Conclusion: Development of post-operative complications like Seroma, Surgical site infection, infected mesh increases with rising grade according to modified Ventral Hernia Working Group classification system. This study demonstrates the validity of Modified ventral hernia working group classification system in predicting the post operative outcomes based on previous risk factors with obesity found to be commonest risk factor.

Keywords: Ventral Hernia, Seroma, Surgical Site Infection, Sinus Tract, Laparoscopic Surgery, Obesity, Ventral Hernia Working Group Classification.

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Introduction

Ventral hernias, defined as non-inguinal and non-hiatal defects of the anterior abdominal wall fascia, represent a frequent clinical condition encountered in general surgical practice and contribute substantially to operative workload worldwide [1]. These hernias commonly arise following previous abdominal surgeries, trauma, or weakening of the abdominal wall and are associated with significant morbidity if left untreated. Surgical repair is typically recommended for patients who are symptomatic or are at high risk of complications such as incarceration or strangulation. However, ventral and incisional hernia repair continues to pose challenges for surgeons due to the wide

variation in clinical presentation and the multiple factors that determine operative complexity [2]. Patient-specific variables such as comorbidities, defect size, tissue quality, and the presence or risk of contamination add further complexity to decision-making and surgical planning [3].The incidence of incisional hernia following laparotomy has been consistently reported to be around 10%, despite advancements in surgical techniques and postoperative care [4]. Furthermore, approximately 10% of repaired hernias recur, underscoring the importance of durable repair techniques and appropriate patient selection. Patients typically present with complaints of localized pain, swelling, or a visible or palpable bulge at the site of the defect. These symptoms may change with posture, Valsalva maneuver, or physical activity, making a thorough clinical examination essential. Examination in both supine and standing positions is often recommended to avoid missing occult or intermittent hernias [5].Numerous risk factors have been implicated in the development of ventral hernias. These include female sex, advanced age, obesity, diabetes mellitus, chronic obstructive pulmonary disease, chronic smoking, long-term systemic steroid use, multiple prior abdominal operations, and a history of mesh infection [6,7]. Understanding these factors is crucial not only for prevention but also for predicting postoperative outcomes. In 2010, the Ventral Hernia Working Group (VHWG) proposed a four-grade classification system to categorize ventral hernias according to patient comorbidities and wound contamination status. This ranged from Grade 1 (clean defects in healthy individuals) to Grade 4 (infected or contaminated defects) [8]. Although widely referenced, the system's universal validity has been limited. Study by Kanter et al have shown improved prediction of surgical site occurrences (SSOs) when Grades 3 and 4 are combined and stratified using the Centers for Disease Control (CDC) wound classification [9]. Long-term validation remains insufficient, though recurrence appears more common in contaminated cases, highlighting the importance of individualized surgical planning [10]. Ventral hernias represent a common surgical challenge influenced by multiple patient and defect-related factors. This study reviews the epidemiology, risk determinants, and classification systems guiding ventral hernia management, with emphasis on post-operative outcomes based on the VHWG grading system.

Table 1: Modified Ventral Hernia working group classification system

Grade 1 Low risk	**Grade 2** Co-morbid	**Grade 3** Potentially contaminated	**Grade 4** Infected
- Low risk of complications - No history of wound infection	- Diabetes - COPD - Immunosuppression - Active smoker - Obese	- Previous wound infection - Stoma present - Violation of gastrointestina tract	- Infected mesh - Septic dehiscence
Grade 1 Low risk	**Grade 2** Co-morbid	**Grade 3** Contaminated	
- Low risk of complications - No history of wound infection	- Diabetes - COPD - Immunosuppression - Active smoker - Obese	- Stoma present - Violation of - gastrointestinal tract - Infected mesh - Septic dehiscence	

Materials and Methods

Study Design: A prospective observational type of study.

Place of study: Ruby General Hospital, Kolkata, West Bengal, India.

Period of study: June 2023 to December, 2025 (18 months).

Study Population: The study population included all consenting patients admitted to Ruby General Hospital for elective or emergency ventral hernia surgery between June 2023 and December 2025, excluding those with acute abdominal diseases or associated malignancy.

Sample size: 122 patients were taken in this study

Study Variable

- Sex (Female, Male)
- Age (continuous and categorized into age groups: 31–40, 41–50, 51–60, 61–70, 71–80 years)
- Body Mass Index (BMI)
- Comorbidities:
- Obesity
- Previous abdominal surgery
- Diabetes mellitus
- Other comorbidities (if any mentioned, e.g., smoking, COPD)
- Type of operation (Laparoscopic vs Open)

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism.

Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

Result

Table 2: Distribution of Study Population by Sex and Age Group

Parameters		Frequency	Percent
Sex	Female	93	76.20%
	Male	29	23.80%
Age Group	31–40	4	3.30%
	41–50	31	25.40%
	51–60	52	42.60%
	61–70	25	20.50%
	71–80	10	8.20%

Table 3: Distribution of Patient Comorbidities, Surgical Details, and Postoperative Outcomes

Parameter	Category	Frequency	Percent
Comorbidity	Obesity	71	51.80%
	Previous Abdominal Surgery	21	15.30%
	Active Smoking	9	6.56%
	Diabetes	16	11.67%
	COPD	9	6.56%
	Immunosuppression	3	2.18%
	History of Wound Infection	3	2.18%
	Septic Dehiscence	2	1.45%
	Presence of Stoma	1	0.70%
	Violation of G.I.T	1	0.70%
	Infected Mesh	1	0.70%
Type of Operation	Laparoscopic	61	50.00%
	Open	61	50.00%
SSI Status	1 Month	16	13.10%
	Absent After 1 Year	106	86.90%
Sinus/Fistula Tract Status	6 Months	1	0.80%
	Absent After 1 Year	121	99.20%
Infected Mesh Status	6 Months	3	2.50%
	Absent After 1 Year	119	97.50%
Wound Dehiscence Status	6 Months	1	0.80%
	Absent After 1 Year	121	99.20%
Recurrence Status	1 Year	1	0.80%
	Absent After 1 Year	121	99.20%

Table 4: Distribution of Mean Statistics of Age and BMI in Study Population

Parameter	Number	Mean	SD	Minimum	Maximum	Median
Age	122	55.55	9.87	32	76	54
BMI (kg/m²)	122	30.78	2.72	24	36	31

Table 5: Association between Seroma: Grade

Seroma Status	Grade 1	Grade 2	Grade 3	Total
1 Month	1 (7.10%)	18 (22.80%)	8 (27.60%)	27 (22.10%)
6 Months	0 (0.00%)	1 (1.30%)	4 (13.80%)	5 (4.10%)
Absent After 1 Year	13 (92.90%)	60 (75.90%)	17 (58.60%)	90 (73.80%)
Total	14 (100%)	79 (100%)	29 (100%)	122 (100%)
Chi-square		12.2417		
p-value		0.0156		

Table 6: Association between S S I: Grade

SSI Status	Grade 1	Grade 2	Grade 3	Total
1 Month	1 (7.10%)	7 (8.90%)	8 (27.60%)	16 (13.10%)
Absent After 1 Year	13 (92.90%)	72 (91.10%)	21 (72.40%)	106 (86.90%)
Total	14 (100%)	79 (100%)	29 (100%)	122 (100%)
Chi-square		7.0227		
p-value		0.0299		

Table 7: Association between Infected Mesh: Grade

Sinus/Fistula Tract Status	Grade 1	Grade 2	Grade 3	Total
6 Months	0 (0.00%)	0 (0.00%)	3 (10.3%)	1 (2.5%)
Absent After 1 Year	14 (100.00%)	79 (100.00%)	26 (89.7%)	121 (97.5%)
Total	14 (100%)	79 (100%)	29 (100%)	122 (100%)
Chi-square		9.8632		
p-value		0.0072		

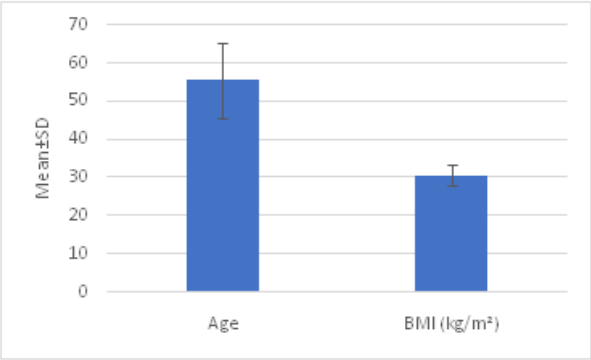

Figure 1: Distribution of Mean Statistics of Age and BMI in Study Population

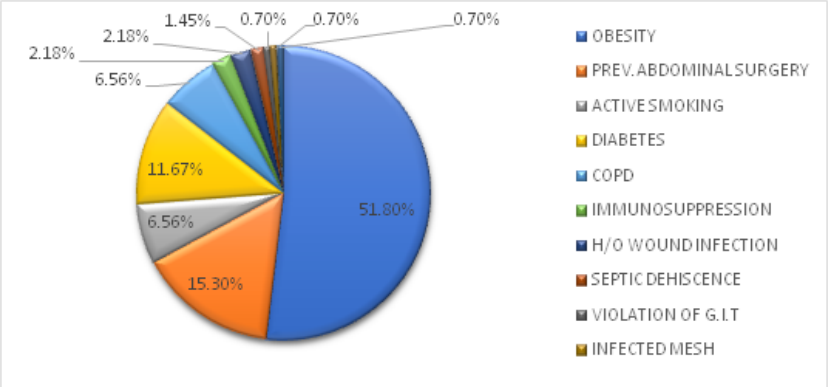

Figure 2: Distribution of Co-morbidities in study population

In this study, the majority of participants were female, accounting for 76.2% (93 out of 122) of the total population, while males comprised 23.8% (29 out of 122). Regarding age distribution, the largest group of participants fell within the 51 to 60 years age range, representing 42.6% of the study population. This was followed by the 41 to 50 years group at 25.4%, the 61 to 70 years group at 20.5%, and the 71 to 80 years group at 8.2%. The smallest age group was 31 to 40 years, constituting only 3.3% of the participants. The study included 122 participants with a mean age of 55.55 years (SD =

9.87), ranging from 32 to 76 years, and a median age of 54 years. The mean Body Mass Index (BMI) was 30.78 kg/m² (SD = 2.72), with values ranging from 24 to 36 kg/m² and a median BMI of 31 kg/m². In this study, obesity was the most common comorbidity (51.8%), followed by previous abdominal surgery (15.3%) and diabetes (11.7%). Surgical procedures were evenly divided between laparoscopic and open methods (50% each). Postoperative complications were low, with 13.1% experiencing surgical site infections at 1 month and most patients free of complications like sinus/fistula tract, infected mesh, wound dehiscence, and recurrence after 1 year.

Seroma formation showed a statistically significant association with seroma grade. At 1 month, seroma was more frequently observed in higher grades, particularly Grade 3 (27.6%) compared to Grade 2 (22.8%) and Grade 1 (7.1%). By 6 months, persistent seroma was uncommon overall but remained proportionally higher in Grade 3 (13.8%) than in Grade 2 (1.3%) and Grade 1 (0%). At 1 year, seroma had resolved in the majority of patients across all grades; however, resolution was lower in Grade 3 (58.6%) compared to Grade 2 (75.9%) and Grade 1 (92.9%). The difference in seroma status across grades was statistically significant ($\chi^2 = 12.24$, $p = 0.0156$).

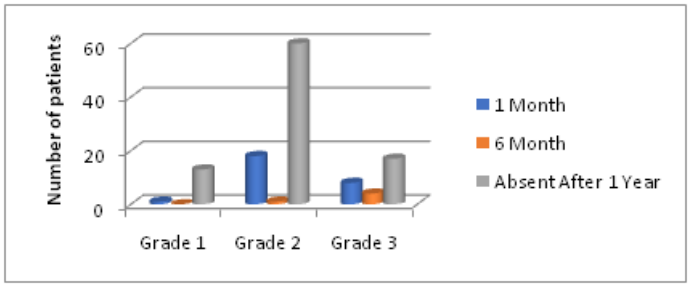

Figure 3: Association of Seroma with Grade

Surgical site infection (SSI) status demonstrated a significant association with SSI grade. At 1 month, SSI was more frequently observed in higher grades, with Grade 3 showing the highest proportion (27.6%) compared to Grade 2 (8.9%) and Grade 1 (7.1%).

By 1 year, SSI had resolved in most patients across all grades; however, persistence was higher in Grade 3 (27.6% unresolved) compared to Grade 2 (8.9%) and Grade 1 (7.1%). The difference in SSI status across grades was statistically significant ($\chi^2 = 7.02$, $p = 0.0299$).

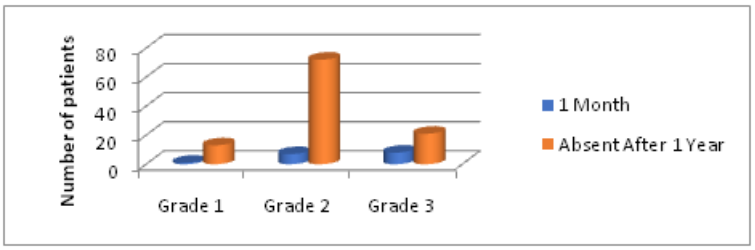

Figure 4: Association of SSI with Grade

In this study, infected Mesh at 6 months shows that 100% of the cases are in Grade 3 (3 cases, 10.3%). In contrast, for those Absent after 1 Year, 11.8% are in Grade 1 (14 cases), 66.4% in Grade 2 (79 cases), and 21.8% in Grade 3 (26 cases). The p-value of 0.0072 indicates that statistically significant difference in occurrence of Mesh infection with higher group.

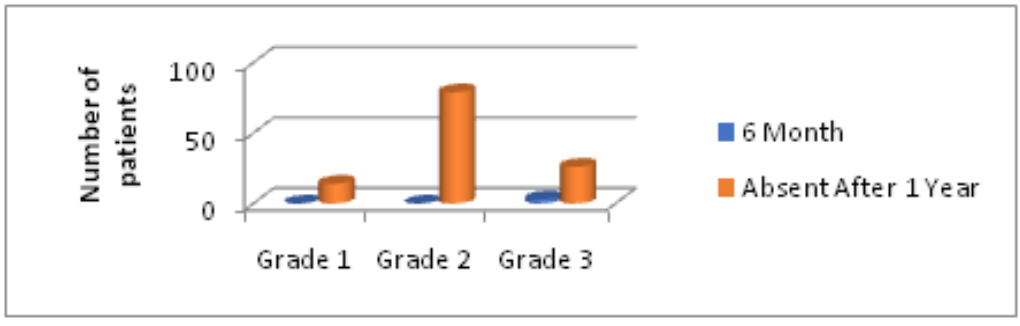

Figure 5: Association between Infected Mesh: Grade

In our study, the occurrence of Sinus/ Fistula tract formation, Wound dehiscence, Recurrence were only 1 in each group and they were not statistically significant.

Discussion

In the present study, females constituted the majority of patients (76.2%), with the peak age group being 51–60 years and a mean age of 55.55 years, findings that are comparable to several previous studies reporting a predominance of middle-aged and elderly patients undergoing abdominal wall hernia surgery [11–13,16]. While many earlier reports describe male predominance, recent literature has noted an increasing female representation, likely related to higher rates of obesity, prior abdominal surgeries, and improved healthcare access among women [14,15]. Obesity was the most frequent comorbidity in our cohort (51.8%), consistent with earlier studies identifying it as a major risk factor for hernia development and postoperative complications, including seroma and surgical site infection (SSI) [12,17,18]. The incidence of SSI at 1 month in our study (13.1%) falls within the range reported by other authors (10–15%), with a significant association observed between SSI and higher grade according to modified VHWG, a trend similarly documented in previous studies [11,15,19]. Seroma formation also demonstrated a significant grade-dependent pattern, with higher grades showing increased early incidence and delayed resolution, especially in Grade 3 patients, aligning with reports that link extensive dissection, higher disease severity, and obesity to prolonged seroma formation [16,18,20].Mesh infection was also reported to have occurred exclusively in Grade 3 patients and showed statistically significant relation between Infected mesh and higher grade as consistent with previous studies[11,15.20] In contrast, Sinus or fistula tract formation, Wound dehiscence, Recurrence were rare and showed no significant association with grade, a finding consistent with existing literature describing this complication as uncommon and usually confined to severe infections or mesh-related issues [11,17]. Overall, the demographic profile, comorbidity distribution, and postoperative outcomes in our study closely mirror those reported in earlier studies, reinforcing the predictive value of grading systems in anticipating postoperative complications and highlighting the impact of obesity and higher grades on early postoperative morbidity [11–20].

Conclusion

According to our study, development of post-operative complications like Seroma, Surgical site infection, Infected mesh increases with rising grade according to modified Ventral Hernia Working Group classification system. Although the development of Sinus or Fistula tract, Wound dehiscence and Recurrence according to the grading system was statistically not significant but they were found only in Grade 3 patients .This study demonstrates the validity of Modified ventral hernia working group classification system in predicting the post operative outcomes based on previous risk factors .Analysis of the risk factors also showed Obesity(B.M.I > 30) to be the most important factor in the development of Ventral hernia. Overall, the findings emphasize the importance of preoperative risk stratification, meticulous surgical technique, and vigilant postoperative follow-up, especially in patients with higher grades and comorbidities, to minimize complications and optimize long-term outcomes.

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