

Body Mass Index Along Multifactor Predictors of Ventral Hernia Recurrence

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Abstract

Background: Patients who underwent ventral hernias repair had a recurrence rate of up to 40%. A ventral hernia protrudes the peritoneum through the defective abdominal wall. Several risk factors increase the likelihood of hernia recurrence. One of the most critical risk factors is obesity, translated according to the world health organization as increased body mass index (BMI). Limited studies are exploring the effect of BMI on hernia recurrence. therefore, we aimed to investigate the role of increased BMI concerning hernia recurrence in conjunction with various risk factors such as age, gender, type of hernia, the time elapsed between the first and the second operations, complications of hernia, and procedure method.

Method: This retrospective cohort study was held at King Abdulaziz University Hospital (KAUH). Involves all the patients who have been admitted in 2015-2022. 1676 medical records were obtained from all patients who underwent hernia repair more than once or were diagnosed with a recurrent hernia during the study period.

Result: Our study revealed a weak correlation between high BMI and the recurrence of inguinal hernias, predominantly indirect hernias. Furthermore, overweight and obese patients experience a longer interval between the first and second hernia repair. Interestingly, all patients with inguinal and umbilical hernias had the same diagnosis at the second presentation, highlighting the importance of surgical technique and experience.

Other critical findings include a significant increase in umbilical hernias in individuals with high BMI and higher recurrence rates among male patients with inguinal hernias.

Conclusion: High BMI increases recurrence rates for umbilical and incisional hernias but lowers it for inguinal hernias. Female gender increases the risk of recurrence, while male gender, mesh repair, and obstruction presentation are associated with inguinal hernia recurrence. Treatment should consider these factors.

Categories: General Surgery

Keywords: surgical repair, type of hernia, obesity, body-mass index, hernia recurrence

Introduction

Worldwide, patients who underwent ventral hernias repair had a recurrence rate of up to 40% [1]-a ventral hernia protrusion of the peritoneum through the defective abdominal wall. Including various types, yet the most frequently seen are inguinal, incisional, and umbilical [1]. Moreover, it has been demonstrated that several risk factors increase the likelihood of hernia recurrence: First, hernia-related factors like the hernia's diameter or location. Second, factors related to the surgery itself, like the type of anesthesia used, the type of suture used, the type of repair made, the likelihood of postoperative infection, and hematoma, third, patient-related factors like gender, weight, genetics, lifestyle factors, medications, elevated intra-abdominal pressure, immunosuppression, and other comorbidities [2-4]. Additionally, one of the most critical risk factors is obesity, which is translated according to the world health organization (WHO) as body mass index (BMI). It is an anthropometric measurement to categorize individuals into sub-classes [5]. Obesity is

considered a risk factor for the recurrence rate of hernias [6]. Meanwhile, it is a growing health issue in modern societies [7]. Several studies suggest obesity, as a single factor, is a significant risk factor for hernia recurrence [8-11].

In contrast, an American study showed the opposite results [9]. However, as far as we reach, limited studies are exploring the effect of BMI on factors such as age, gender, type of hernia, surgical repair, and the period between the first operation and the second in hernia recurrence. Even though recurrent hernias subject patients to multiple operations regardless of the hernia repair procedure, exposing patients to a higher risk of surgical complications [12]. Therefore, we aimed to investigate the role of BMI concerning hernia recurrence in conjunction with various factors such as age, gender, type of hernia, the interval between the first and second operations, complications of hernia, and procedure method.

Materials And Methods

Study design

This retrospective cohort study was held at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia. Involves all the patients who have been admitted 2015-2022 to undergo hernia repair. This study was approved by the KAUH Ethical Committee (reference number 527-22). Data for the study were obtained from the Hospital Health Informatics department, collected using a data collection sheet, and interpreted in a Microsoft Excel spreadsheet.

Patients and participants

The medical records of 1676 patients were initially reviewed. All patients who underwent hernia repair more than once or were diagnosed with a recurrent hernia at (KAUH) during the study period were included. In comparison, those who aged less than two years were excluded from the study.

The patients' demographics included age at the time of operation, sex, and Body Mass Index (BMI) at the first and second operation or diagnosis. Data regarding the type of hernia, as inguinal, umbilical, femoral or incisional, obstruction, treated with mesh or not, date of operations or diagnoses were collected.

Patients are classified according to age into pediatrics if aged <16 years old, adults aged 16-50 years old, and elderly aged > 50 years old. Additionally, regarding BMI, if were ≥ 25 kg/m² were identified as overweight and obese, and < 25 as normal weight.

Statistical analysis

Statistical analysis was carried out using RStudio (R version 4.1.1). Categorical variables were expressed using frequencies and percentages, whereas numerical variables were presented using median and interquartile range (IQR). Statistical differences between different groups were assessed using a Pearson's Chi-squared test or a Fisher's exact test for categorical data, or a Wilcoxon rank sum test for continuous data. Changes in the type of hernia overtime were assessed using a McNemar's Chi-squared test with continuity correction.

Results

Demographic and hernia-related characteristics

In the current study, we analysed data of 98 patients who had recurrent hernias. More than two-thirds of patients (67.3%) were males. More than a half of patients aged > 50 years (51.0%), whereas 37.8% and 11.2% of them aged 16 to 50 and < 16 years, respectively. At the time of the first intervention, inguinal hernia was the most common type of hernia (72.4%), while 18.4% and 9.2% of patients had umbilical and incisional hernias, respectively. Obstructed hernia was prevalent among 25.5%, and mesh repair was performed among 68.4% of patients (Table 1).

Baseline differences based on BMI groups.

At the time of the first presentation, a total of 69 patients (70.4%) were overweight or obese (had a BMI of ≥ 25 kg/m²). A significantly higher proportion of patients with high BMI levels (≥ 25 kg/m²) aged > 50 years (55.1% vs 41.4% had BMI <25 kg/m², $p < 0.001$). Additionally, patients with high BMI levels (≥ 25 kg/m²) had a significantly higher rate of umbilical hernia (24.6% vs 3.4%, $p = 0.013$), as well as lower rates of inguinal hernia (62.3% vs 96.6%, $p < 0.001$) and indirect hernia (31.9% vs 69.0%, $p < 0.001$, Table 1).

Changes in the type of hernias over time

The median time between first and second interventions for hernia repair was 23.2 months (13.6, 59.5). Overweight and obese patients had a significantly longer time between first and second interventions (median = 35.0 months, IQR = 15.8 to 72.2) compared to other patients (median = 19.8 months, IQR = 11.2 to 24.3, $p = 0.006$, Figure 1). The majority of patients who had umbilical and inguinal hernias at the first intervention had the same diagnosis at the second intervention (94.4% for both types of hernias), whereas all the patients who had baseline incisional hernias had the same diagnosis at the second presentation. There were no significant differences in the type of hernias over time (from the first to second interventions, Table 2).

Factors associated with the incidence of a recurrent hernia.

The incidence of a recurrent umbilical hernia was significantly higher among females (89.5% vs 19.0%, $p < 0.001$), as well as those with a BMI of ≥ 25 kg/m² (89.5% vs 62.0%, $p = 0.022$) and a previous umbilical hernia at the first presentation (89.5% vs 1.3%, $p < 0.001$); however, it was significantly lower among those who had an obstructed hernia (5.3% vs 30.4%, $p = 0.037$). A recurrent hernia at the inguinal region was significantly higher among males (89.7% vs 16.7%, $p < 0.001$), those with an obstructed hernia at the first surgery (32.4% vs 10.0%, $p = 0.019$), and those who underwent a mesh surgery at the first surgery (75.0% vs 53.3%, $p = 0.030$). Nevertheless, overweight and obese patients had lower rates of inguinal hernias (55.9% vs 93.3%, $p < 0.001$). Additionally, having a recurrent incisional hernia was significantly associated with the female gender (72.7% vs 27.6%, $p = 0.005$), having a BMI of ≥ 25 kg/m² (100% vs 63.2%, $p = 0.014$) and undergoing a non-mesh herniorrhaphy at the first intervention (45.5% vs 28.7%, $p = 0.045$, Table 5).

Parameter	Category	Umbilical Hernia			Inguinal Hernia			Incisional Hernia		
		No, N = 79	Yes, N = 19	p-value	No, N = 30	Yes, N = 68	p-value	No, N = 87	Yes, N = 11	p-value
Gender	Male	64 (81.0%)	2 (10.5%)	<0.001	5 (16.7%)	61 (89.7%)	<0.001	63 (72.4%)	3 (27.3%)	0.005
	Female	15 (19.0%)	17 (89.5%)		25 (83.3%)	7 (10.3%)		24 (27.6%)	8 (72.7%)	
Age at second surgery	< 16 y	9 (11.4%)	1 (5.3%)	0.246	1 (3.3%)	9 (13.2%)	0.210	10 (11.5%)	0 (0.0%)	0.644
	16 to 50 y	21 (26.6%)	9 (47.4%)		12 (40.0%)	18 (26.5%)		27 (31.0%)	3 (27.3%)	
	> 50 y	49 (62.0%)	9 (47.4%)		17 (56.7%)	41 (60.3%)		50 (57.5%)	8 (72.7%)	
Obstructed	Yes	24 (30.4%)	1 (5.3%)	0.037	3 (10.0%)	22 (32.4%)	0.019	23 (26.4%)	2 (18.2%)	0.724
	Mesh	56 (70.9%)	11 (57.9%)	0.415	16 (53.3%)	51 (75.0%)	0.030	62 (71.3%)	5 (45.5%)	0.045
	Non-mesh herniorrhaphy	22 (27.8%)	8 (42.1%)		13 (43.3%)	17 (25.0%)		25 (28.7%)	5 (45.5%)	
Type of surgical repair at the first operation	Not specified	1 (1.3%)	0 (0.0%)		1 (3.3%)	0 (0.0%)		0 (0.0%)	1 (9.1%)	
BMI at second surgery	BMI < 25	30 (38.0%)	2 (10.5%)	0.022	2 (6.7%)	30 (44.1%)	<0.001	32 (36.8%)	0 (0.0%)	0.014
	BMI 25 or more	49 (62.0%)	17 (89.5%)		28 (93.3%)	38 (55.9%)		55 (63.2%)	11 (100.0%)	
Time between surgeries	Months	24.5 (14.0, 60.0)	17.6 (11.1, 54.5)	0.486	22.2 (14.9, 54.5)	23.9 (12.4, 59.8)	0.982	22.9 (12.4, 59.1)	35.0 (17.2, 55.5)	0.362

TABLE 1: Factors associated with the incidence of a recurrent hernia

Hernia at the first intervention	Hernia at the second intervention		p
Umbilical hernia	No, N = 79	Yes, N = 19	
No	78 (97.5%)	2 (2.5%)	>0.999
Yes	1 (5.6%)	17 (94.4%)	
Inguinal hernia	No, N = 30	Yes, N = 68	
No	26 (96.3%)	1 (3.7%)	0.371
Yes	4 (5.6%)	67 (94.4%)	
Incisional hernia	No, N = 87	Yes, N = 11	
No	87 (97.8%)	2 (2.2%)	0.480
Yes	0 (0.0%)	9 (100.0%)	

TABLE 2: Temporal changes in the type of hernias

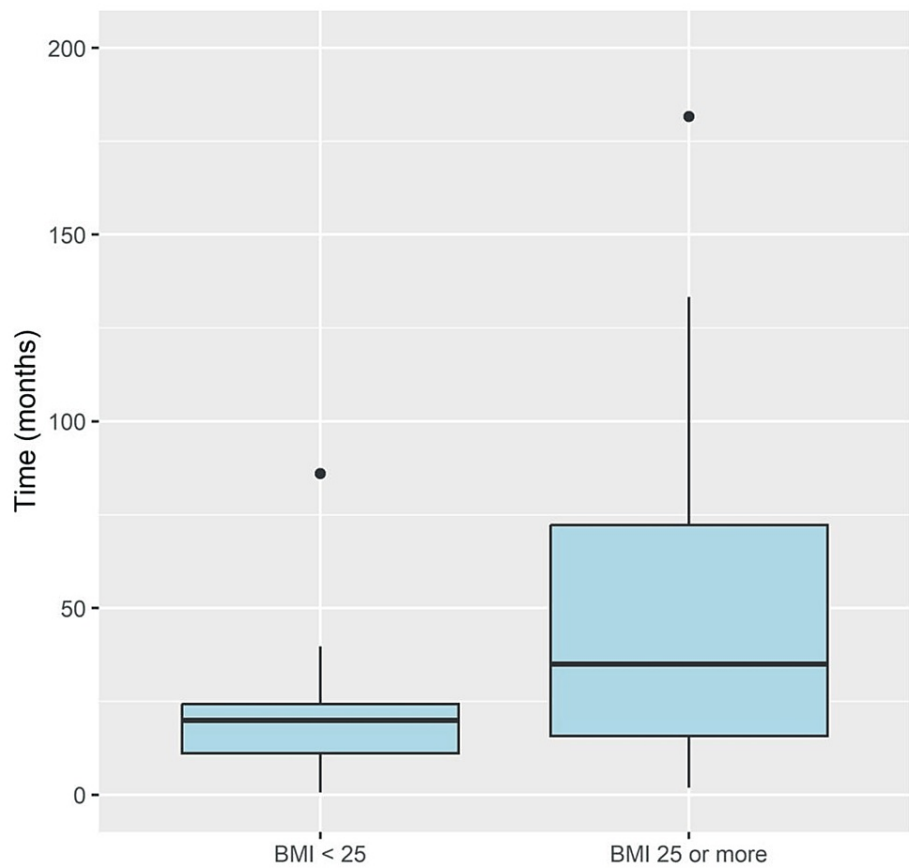


FIGURE 1: Changes in the type of hernias over time

Parameter	Category	Overall, N = 98	BMI < 25, N = 29	BMI 25 or more, N = 69	p-value
Gender	Male	66 (67.3%)	22 (75.9%)	44 (63.8%)	0.244
	Female	32 (32.7%)	7 (24.1%)	25 (36.2%)	
Age (years)	< 16 y	11 (11.2%)	11 (37.9%)	0 (0.0%)	<0.001
	16 to 50 y	37 (37.8%)	6 (20.7%)	31 (44.9%)	
	> 50 y	50 (51.0%)	12 (41.4%)	38 (55.1%)	
Type of hernia	Umbilical hernia	18 (18.4%)	1 (3.4%)	17 (24.6%)	0.013
	Inguinal hernia	71 (72.4%)	28 (96.6%)	43 (62.3%)	<0.001
	Incisional hernia	9 (9.2%)	0 (0.0%)	9 (13.0%)	0.054
Direct or indirect hernia	Direct hernia	43 (43.9%)	15 (51.7%)	28 (40.6%)	0.310
	Indirect hernia	42 (42.9%)	20 (69.0%)	22 (31.9%)	<0.001
Obstructed	Yes	25 (25.5%)	9 (31.0%)	16 (23.2%)	0.416
Type of surgical repair	Mesh	67 (68.4%)	17 (58.6%)	50 (72.5%)	
	Non-mesh herniorrhaphy	30 (30.6%)	12 (41.4%)	18 (26.1%)	
	Not specified	1 (1.0%)	0 (0.0%)	1 (1.4%)	
Time between surgeries	Months	23.2 (13.6, 59.3)	19.8 (11.2, 24.3)	35.0 (15.8, 72.2)	0.006

TABLE 3: Demographic and hernia-related characteristics at the time of the first intervention.

Discussion

Baseline differences based on BMI groups

Our analysis found a weak relation between high BMI and recurrence of inguinal hernia, especially indirect hernia. This finding is consistent with Burcharth J et al. and Zendejas B et al. finding that BMI did not impact the risk of inguinal hernia recurrence [13, 14]. This could be explained by the fact that excessive fat accumulation within the intra-abdominal space can confer a barrier effect by serving as a physical obstruction to impede the protrusion of abdominal contents, thus mimicking the properties of a plug [14].

Changes in the type of hernias over time

Also, our research found that overweight and obese patients have a longer time between the first and second interventions for hernia repair than other patients. This could be explained by the fact that overweight and obese patients are advised medically or surgically to reduce their weight for the second optimum intervention. The current evidence suggests that patients with obesity and hernias may experience better outcomes if they undergo bariatric surgery before or in concomitant to ventral hernia repair. Several studies have reported higher rates of complications and recurrence in patients with obesity who undergo hernia repair alone. A retrospective analysis of 106 successive patients who underwent simultaneous bariatric surgery and ventral hernia repair showed they were at a lower risk of recurrence [Krivan et al., 2013] [15]. Another retrospective study of 156 patients reported that bariatric surgery concomitant with mesh ventral hernia repair resulted in fewer complications and lower recurrence rates due to weight loss [Raj et al., 2019] [16]. Therefore, patients with obesity and hernias should consider bariatric surgery before undergoing hernia repair to reduce the likelihood of adverse outcomes. Hernia repair at lower BMIs seems suitable, and delaying therapy to lose weight before surgery is probably not advantageous [17]. This result may lead to a longer time between the first and second interventions for hernia repair in overweight and obese patients.

In addition, the study also found that all patients with inguinal and umbilical hernias had the same diagnosis at the second presentation. This might be related to poor surgical technique, including surgeon inexperience, ineffective dissection, insufficient prosthesis size, inadequate prosthesis overlaps of hernia defects, incorrect fixation, prosthesis bending, overlooked hernias, or mesh lifting as a result of hematoma development are all examples of factors that can contribute to poor results Lowham et al. [17] Also, a study done in Arar city in Saudi Arabia found that umbilical and inguinal hernias are the commonest type of hernia in the Saudi population, consecutively Alenazi et al. [18].

The lack of significant differences in the type of hernias over time is also essential. It suggests that the risk factors and underlying mechanisms contributing to hernia development and recurrence are likely consistent across different types of hernias. Overall, this research offers insightful information about the persistence and recurrence of different types of hernias and emphasizes the significance of continuous observation and follow-up care for patients who have undergone hernia repair.

Factors associated with the incidence of a recurrent hernia

Another finding about high BMI is significantly increasing the rate of umbilical hernia. These results reflect those of Shankar DA et al., who also found that BMI is a Factor associated with the development of an umbilical hernia. It posits that individuals with higher BMIs may be at greater risk for hernia recurrence, potentially due to the additional strain that excess weight places on the abdominal muscles and the stress on the abdominal wall during the surgery [19]. We find that the recurrence rate was significantly lower among those who had an obstructed hernia. This finding contradicts the previous one by Lau B, which suggested that a BMI greater than 40 kg/m² showed an increased chance of recurrent hernia obstruction [20].

It appears likely that these outcomes are caused by obstructed hernia is more likely to develop in more minor abdominal defects, which may prevent future recurrence. Moreover, Recurrent inguinal hernias are higher among male patients. This is compatible with Guillaumes S et al. [21]; generally, inguinal hernias are more common in males than females. Our paper found that an increased incidence of recurrence in a patient having mesh repair is consistent with Yu JF et al. [22] following a patient with mesh repair. This might be explained by the increased prevalence of mesh repair instead of other procedures. Furthermore, females and obese patients are at higher risk of developing incisional hernia recurrence; this result aligns with Parker et al. [1] due to poor surgical suturing technique, increased intraabdominal pressure, weakened abdominal wall, and multiple pregnancies.

Incisional hernia is less likely to recur in mesh repair rather than in other types of hernia repair, which is consistent with Romain B et al. [23]; when the mesh is used and placed ideally minimizes the risk of recurrence and complication.

Limitation

Despite its valuable contribution, this research is not unrestricted. The retrospective design, which relies on medical records, may introduce incomplete or inaccurate data. In addition, including only patients who have been repaired with a hernia may lead to selection biases that may underestimate the incidence of a hernia recurrence in the broader population. Another limitation is the absence of consideration for possible confounding factors [such as smoking and comorbidity] that may affect the risk of hernia recurrence. Finally, the single institutional setting of the study may restrict the applicability of the findings to other populations or settings.

Conclusions

Our study observed that high BMI (>25kg/m) significantly increases the rate of recurrence of umbilical and incisional hernia, on the other hand high BMI is associated with lower rate of inguinal hernia recurrence. Therefore, we advise weight loss or bariatric surgery for patients with umbilical and incisional hernia only. However, more studies are required to consolidate our findings.

Being female is a risk factor for recurrence of both umbilical and incisional hernia. Moreover, umbilical hernia has a high potential of recurrence of the same type unless being obstructed. While incisional hernias tend to recur after non-mesh herniorrhaphy. Male gender, mesh hernioplasty and presentation with obstruction are risk factors for recurrence of inguinal hernia. These factors must be taken into account while treating patients who have hernia.

Additional Information

Disclosures

Human subjects: All authors have confirmed that this study did not involve human participants or tissue.

Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue.

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no

other relationships or activities that could appear to have influenced the submitted work.

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