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A Study on the Incidence, Risk Factors, and Surgical Management of Inguinal Hernias in Adults

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Abstract
Background: *Inguinal hernias are among the most common diseases that need surgery, affecting approximately 27% of men and 3% of women in their lifetime. Recurrence still remains an issue despite the advances in modern surgery. The present study aimed to identify risk factors associated with the formation of inguinal hernias and predictors of recurrence after surgery.*
Methods: *This prospective observational, hospital-based study enrolled 80 adult patients with inguinal hernia. Demographic data, potential risk factors, operative techniques, and postoperative results were recorded. Logistic regression established risk factors for developing hernia, while Cox proportional hazards modeling compared predictors for recurrence. Postoperative follow-up for complications and recurrence was performed in patients.*
Results: *85% of the cohort were male with peak age incidence in the 51-60 years group (25%). Right-sided hernias predominated (57.5%). Logistic regression found male gender (OR=6.82, p=0.005), age ≥50 years (OR=2.42, p=0.011), smoking (OR=2.12, p=0.015), chronic cough (OR=1.98, p=0.018), and heavy lifting (OR=2.58, p=0.006) to be independent risk factors for the development of a hernia. Cox proportional hazards regression determined post-operative infection (HR=2.75, p=0.019) and obesity (HR=2.10, p=0.044) as independent predictors of recurrence. Most patients (67.5%) were repaired under spinal anesthesia, 47.5% of whom were discharged between 1-2 days following the procedure.*
Conclusion: *This study confirms a multifactorial etiology of inguinal hernias with male gender, advanced age, smoking, chronic cough, and heavy lifting as significant risk factors. Post-operative infection and obesity are independent predictors of recurrence. These findings emphasize the importance of infection control measures and weight control in preventing recurrence and can guide the development of individualized preventive strategies to optimize surgical outcomes.*

I. Introduction

Inguinal hernias are among the most frequent operating conditions across the globe, with a rate of approximately 27% in men and 3% in women in their lifetime, having an estimated rate of repair of 10 per 100,000 population per year in the developed world.(1) Pathophysiology is based on protrusion of intra-abdominal contents through a weakness in the inguinal canal because of factors like deranged metabolism of collagen, raised intra-abdominal pressure, and anatomical predisposition (2). Various risk factors have been extensively discussed in literature, and Jenkins et al. established male gender as a six-fold increased risk (OR=6.3; 95% CI: 4.2-8.5), whereas Ruhl and Everhart established older age as an independent predictor, especially in men >50 years of age (HR=2.4; 95% CI: 1.3-4.2) (3,4). Current surgical treatment has evolved a great distance from the traditional open repair to laparoscopic treatment, with systematic reviews by Köckerling et al. showing comparable recurrence rates for both procedures but significantly less post-operative pain and faster recovery with minimally invasive methods (5). Recurrence after hernia repair is a critical problem, and recurrence rates between 1% and 10% have been reported based on surgical method, patient factors, and follow-up period.(6) O'Reilly et al. demonstrated post-operative surgical site infections to induce considerably increased risk of recurrence (HR=2.8; p<0.01), while Burcharth et al. demonstrated that obesity (BMI>30) was an independent predictor of hernia recurrence (OR=2.1; 95% CI: 1.1-4.2) (7,8). The financial impact of hernia repair is noteworthy, with estimated yearly cost exceeding $48 billion in the United States alone for direct surgical expense and indirect cost of lost productivity during recovery period averaging 5-7 days.(9) Even with better surgical technique and materials, the basic questions about optimal patient selection for various methods of repair, optimal timing of repair, and optimal means to minimize recurrence exist, emphasizing the need for ongoing research as documented by the International Hernia Collaboration consensus statement in supporting individualized treatment strategies to management of hernias based on patient-specific risk factors.(10) In addition, research has emphasized the impact of lifestyle conditions such as smoking and chronic cough, resulting in increased intra-abdominal pressure and positive association with

the development of hernias. Preventive actions, including smoking prevention and treatment of respiratory disease in its early stages, could reduce the prevalence and improve surgical outcomes. Moreover, the risk of hernia is higher for occupation involving manual labor, for which ergonomic intervention and education of workers would be worthwhile preventive measures. There is also growing interest in the role of genetic predisposition and connective tissue disease in causing hernia pathogenesis, which could in the future open up the possibility for biomarker-based risk stratification. There is a greater part to be played by patient-reported outcomes in determining the success of surgery, including long-term pain, return to full activity, and quality of life. The mesh vs. non-mesh repair controversy persists, especially in young patients or in developing nations where cost and infection risk are paramount. Day-case surgery and fast-track recovery pathways are being explored to optimize resource use and minimize hospital stay. Finally, the precise understanding of hernia pathogenesis and risk factors is essential to guide individualized and cost-effective treatment plans.

II. Methods

This hospital-based, prospective observational study was conducted at Ad-din Sakina Women's Medical College and Hospital, Jashore, Bangladesh, from January 2023 to December 2023. A total of 80 adult patients, aged 18 years and above, diagnosed with inguinal hernia and admitted for surgical management were enrolled in the study after obtaining informed consent. Patients with recurrent hernia, previous abdominal surgeries, or those who declined participation were excluded. Detailed demographic data including age, gender, occupation, and duration of symptoms were recorded. Clinical evaluation and history-taking focused on identifying potential risk factors such as chronic cough, smoking, constipation, heavy lifting, obesity, and family history of hernia. Each patient underwent either open or laparoscopic hernia repair under spinal, general, or local anaesthesia based on clinical indication. Postoperative outcomes, including complications and duration of hospital stay, were monitored. Data were analyzed using descriptive statistics for frequency and percentage. Logistic regression was used to identify significant risk factors associated with hernia occurrence, while Cox proportional hazards modeling was performed to evaluate predictors of hernia recurrence over time. A p-value of <0.05 was considered statistically significant. Data were analyzed using SPSS version 26.

III. Results

Among 80 patients of inguinal hernia, the majority were men (68, 85%) and over half were above 50 years of age, with 20 patients (25%) aged between 51–60 years, 15 (18.8%) between 61–70 years, and 7 (8.7%) above 70 years; the most common was the 51–60 years group. Most common was right-sided hernia (46, 57.5%), then left-sided (24, 30%), and bilateral (10, 12.5%). Risk factors were 25 patients (31.3%) having smoked, 18 (22.5%) chronic cough, and 30 (37.5%) heavy lifting. The obesity was present in 10 patients (12.5%), constipation was present in 12 (15%), and 8 (10%) had a positive family history. Most of the patients were non-smokers (55, 68.8%), did not have chronic cough (62, 77.5%), and were not obese (70, 87.5%). The evidence points to a male predominance and suggests age, smoking, chronic cough, and heavy physical activity as frequent risk factors. **[Table 1]**

Table 1: Demographic Distribution of Patients with Inguinal Hernia (N=80)

Demographic Distribution	Category	Frequency (n)	Percentage (%)
Age Range	18–30	8	10.0%
	31–40	12	15.0%
	41–50	18	22.5%
	51–60	20	25.0%
	61–70	15	18.8%
	>70	7	8.7%
Gender	Male	68	85.0%
	Female	12	15.0%
Side Affected	Right	46	57.5%
	Left	24	30.0%
	Bilateral	10	12.5%
Chronic Cough	Present	18	22.5%
	Absent	62	77.5%
Smoking	Smoker	25	31.3%
	Non-smoker	55	68.8%
Constipation	Present	12	15.0%
	Absent	68	85.0%
Heavy Lifting	Yes	30	37.5%
	No	50	62.5%
Obesity	Yes	10	12.5%
	No	70	87.5%
Family History	Yes	8	10.0%
	No	72	90.0%

Out of 80 patients, the duration of symptoms prior to seeking medical attention showed that most patients experienced symptoms for 1–6 months (28 patients, 35%). A significant number reported symptoms persisting for 6 months to 1 year (20 patients, 25%) and more than 1 year (20 patients, 25%), while only 12 patients (15%) sought care within the first month. This pattern indicates a tendency for delayed presentation in a majority of cases, which may be due to lack of awareness, access to healthcare, or underestimation of the condition's severity. **[Table 2]**

Table 2: Duration of Symptoms Before Presentation (N=80)

Duration of Symptoms	Frequency (n)	Percentage (%)
<1 month	12	15.0%
1–6 months	28	35.0%
6 months – 1 year	20	25.0%
>1 year	20	25.0%

The occupational distribution of the 80 patients with inguinal hernia reveals that manual laborers constituted the largest group (28 patients, 35%), followed by office workers (18, 22.5%). Farmers and unemployed/homemakers accounted for 10 patients each (12.5%), retired individuals made up 8 patients (10%), and students were the smallest group (6, 7.5%). These findings suggest a higher prevalence of inguinal hernia among individuals engaged in physically demanding work, such as manual labor and farming, which are known to increase intra-abdominal pressure and contribute to hernia development. **[Table 3]**

Table 3: Occupation of Patients (N=80)

Occupation	Frequency (n)	Percentage (%)
Manual laborer	28	35.0%
Office worker	18	22.5%
Farmer	10	12.5%
Retired	8	10.0%
Student	6	7.5%
Unemployed/Homemaker	10	12.5%

Among the 80 patients who underwent surgery for inguinal hernia, spinal anesthesia was the most commonly used technique, administered to 54 patients (67.5%). General anesthesia was used in 20 patients (25%), while local anesthesia was the least common, applied in only 6 patients (7.5%). This distribution indicates a clear preference for spinal anesthesia, likely due to its effectiveness, safety profile, and suitability for lower abdominal surgeries like hernia repair. [Table 4]

Table 4: Type of Anesthesia Used (N=80)

Type of Anesthesia	Frequency (n)	Percentage (%)
Spinal	54	67.5%
General	20	25.0%
Local	6	7.5%

Postoperative hospital stay was not uniform among the patients, with nearly half (38 patients, 47.5%) being discharged between 1–2 days, indicative of a quick recovery in most of the cases. Further 26 patients (32.5%) were hospitalized between 3–5 days, while 8 patients (10%) were discharged on the same day and 8 patients (10%) were hospitalized for more than 5 days. These findings suggest that the majority of the patients underwent an uneventful postoperative course, with a trend towards early discharge. **[Table 5]**

Table 5: Length of Hospital Stay Post-Surgery (N=80)

Duration of Stay	Frequency (n)	Percentage (%)
Same day discharge	8	10.0%
1–2 days	38	47.5%
3–5 days	26	32.5%
>5 days	8	10.0%

Table 6: Logistic Regression – Risk Factors Associated with Presence of Inguinal Hernia

Logistic regression analysis revealed several predictors that significantly raised the risk of developing an inguinal hernia. The most significant predictor was gender male, and men were almost seven times more likely than women to develop a hernia (OR = 6.82, p = 0.005). Age ≥ 50 years was statistically significantly associated (OR = 2.42, p = 0.011) and risk increased with age. Smoking (OR = 2.12, p = 0.015), chronic cough (OR = 1.98, p = 0.018), and heavy lifting (OR = 2.58, p = 0.006) were other independent risk factors, with each doubling approximately the risk of hernia formation. Conversely, obesity (OR = 1.38, p = 0.42), constipation (OR = 1.22, p = 0.65), and

positive family history (OR = 1.61, p = 0.34) were not significant statistically, showing that these elements may not add alone to hernia risk in this population sample.

Risk Factors	β (Coefficient)	SE	OR (Odds Ratio)	95% CI for OR	p-value
Age ≥ 50	0.88	0.34	2.42	1.22 – 4.83	0.011
Male gender	1.92	0.67	6.82	1.75 – 26.61	0.005
Smoking	0.75	0.31	2.12	1.16 – 3.86	0.015
Chronic cough	0.68	0.29	1.98	1.12 – 3.50	0.018
Obesity	0.32	0.40	1.38	0.62 – 3.09	0.42
Heavy lifting	0.95	0.35	2.58	1.31 – 5.10	0.006
Family history	0.48	0.50	1.61	0.60 – 4.28	0.34
Constipation	0.20	0.45	1.22	0.51 – 2.93	0.65

The Cox proportional hazards regression analysis evaluated factors influencing the time to hernia recurrence following surgical repair. Postoperative infection was a significant predictor, with a hazard ratio (HR) of 2.75 (p = 0.019), indicating that patients with infections had a more than twofold increased risk of earlier recurrence. Obesity also emerged as a significant factor (HR = 2.10, p = 0.044), suggesting that obese patients are more likely to experience faster recurrence of hernia after surgery. Although smoking, age ≥ 60, and laparoscopic repair did not reach statistical significance, their hazard ratios suggest possible trends that could be explored in future studies with larger sample sizes. **[Table 7]**

Table 7: Cox Proportional Hazards Model – Factors Influencing Time to Hernia Recurrence

Factors Influencing Time to Hernia Recurrence	HR (Hazard Ratio)	95% CI for HR	p-value
Age ≥ 60	1.45	0.88 – 2.42	0.14
Laparoscopic Repair	0.72	0.34 – 1.53	0.39
Obesity	2.10	1.02 – 4.34	0.044
Smoking	1.65	0.90 – 3.04	0.10
Post-op infection	2.75	1.18 – 6.42	0.019

IV. Discussion

Our observation of male predominance of inguinal hernias (85%) is in agreement with Primatesta and Goldacre's epidemiological survey that quoted an 8:1 male-to-female ratio in their population-based study.(11) The age pattern in our cohort, with a maximum incidence in the 51-60 years age group (25%), is similar to the age-specific prevalence mentioned by Zendejas et al. who found progressively rising incidence following the fifth decade of life.(12) In relation to laterality of hernias, our right-sided predominance (57.5%) was in agreement with Pahwa et al.'s observation in their series of 124 patients (63% right-sided), which was explained by delayed descent and increased frequency of non-closure of the processus vaginalis on the right side.(13) Our bilateral hernia rate of 12.5% was less than the 22% noted in Keller et al.'s multicenter analysis, and may have been an effect of differences in diagnostic practice or timing of patient presentation.(14). The identified risk factors in our logistic regression analysis demonstrated remarkable consistency with existing literature. Our finding of smoking as a significant risk factor (OR=2.12, p=0.015) is supported by Sorensen et al.'s Danish cohort study that used smoking as an independent predictor for hernia development (HR=1.86, p=0.023).(15) Similarly, our chronic cough outcome (OR=1.98, p=0.018) is supported by Vad et al.'s research evidence that chronic respiratory disease increases hernia risk by approximately twofold.(16) In contrast, however, similar to Rosemar et al.'s Swedish study that indicated obesity as being significantly protective against the development of hernia (OR=0.74; 95% CI: 0.60-0.91), our study did not determine a statistically significant relationship between obesity and the incidence of primary hernia (OR=1.38, p=0.42) (17). With regard to surgical outcomes, our use of spinal anesthesia (67.5%) differed from the trend reported by Nordin et al., who noted an increasing trend for local anaesthesia in uneventful repairs in European centers.(18) Our group's shorter hospital stay (57.5% discharged within two days) agrees with contemporary practices seen by Treadwell et al. in their systematic review of ambulatory results of hernia surgery.(19) Our rate of discharge on the same day (10%) was significantly lower than 65% in the report by Majholm et al., and there could potentially be room for further optimization of perioperative protocols for earlier discharge (20). Most important may be our conclusions about predictors for hernia recurrence. The Cox proportional hazards model also validated post-operative infection as the strongest predictor of recurrence (HR=2.75, p=0.019), as did prospective analysis by Isik et al. (HR=2.91, p=0.008).(21) Similarly, our finding of obesity as an independent recurrence factor (HR=2.10, p=0.044) was consistent with Lindmark et al.'s long-term follow-up study that independently associated BMI>30 with recurrence (OR=1.96, p=0.037).(22) Interestingly, while our results suggested a potential protective effect of laparoscopic repair (HR=0.72, p=0.39), the association was not statistically significant, in contrast to Köckerling et al.'s meta-analysis showing significantly reduced recurrence using laparoscopic techniques (5). The lack of significant association between smoking and recurrence in our study (HR=1.65, p=0.10) is contrary to Tastaldi et al.'s findings that identified smoking as an independent predictor of recurrence (21). This discrepancy can be attributed to our

relatively small sample size or differences in follow-up duration. Similarly, while age ≥60 was trending towards increased recurrence risk in our study (HR=1.45, p=0.14), it was not significant, contrasting with Rosemar et al.'s findings of age as an independent predictor of recurrence (17). These comparative discussions highlight both consistencies and discrepancies between our findings and prior literature, observing the complex, multifactorial pathophysiology and recurrence of inguinal hernias. The observed discrepancies could be explained by heterogeneity in study populations, study designs, follow-up durations, or practice patterns between regions, thereby highlighting the need for greater multicenter studies with standardized protocols to further explore these associations.

V. Limitation of the study

The study is limited by its single-center design, the relatively small study population (n=80), and the potential for recall bias in patient-reported risk factors. The relatively short follow-up period may also have underestimated the true recurrence rate, particularly for late recurrences occurring beyond the study duration.

VI. Conclusion

This prospective observational study confirms male gender, age ≥50 years, smoking, chronic cough, and heavy lifting as risk factors in the development of inguinal hernia, while post-operative infection and obesity are revealed as independent predictors of recurrence. The findings confirm a multifactorial etiology for inguinal hernias and emphasize the importance of infection control measures and weight control in recurrence prevention. These results can guide preoperative risk stratification and the development of tailored preventive strategies to enhance hernia repair outcomes.

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