

Evaluation of Clinical Risk Factors and Presentation Patterns in Patients with Inguinal Hernia

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Abstract:

Background: Inguinal hernia is a common health problem that can occur due to a combination of congenital, biochemical and environmental elements. Male patients are more predisposed to hernia than females. The classical presentation includes pain and swelling which anecdotally can vary in duration and severity based on the patient's age, co-morbidities or the type of hernia present.

Aim: This study aimed to compare the risk factors and present symptoms among patients with unilateral primary inguinal hernia.

Methodology: A prospective, observational study was conducted with 160 male patients older than 20 years of age attending surgery at Silchar Medical College and Hospital. Sociodemographic epidemiology, clinical history, co-morbidities, and characteristics of hernia were recorded. The Standard Prolene and Lightweight mesh (80 patients for each mesh type) were statistically analyzed, based on demographics, duration of symptoms, side and type of hernia, and risk factors.

Results: The patients presented universally with swelling, while pain was found in 53.75% (Standard Prolene) and 47.50% (Lightweight mesh). Right-sided hernia occurred more often (65-75%) alongside an indirect sac hernia (68.75-75%). The Lightweight mesh group also included the younger patients and had shorter symptom duration. Risk-associated features documented included smoking (25%), diabetes (7.5-12.5%), hypertension (7.5%), and benign prostatic enlargement (3.75%).

Conclusion: Inguinal hernias are prevalent in a middle-aged and older male population, presenting with swelling and, in some cases, pain. Right-sided indirect hernias were the most prevalent type of hernia, while the associated factors and comorbidities were noted and described. In additional discussion of risk factors, lifestyle features do appear to increase the risk of hernia presentation. Further, patients who received Lightweight mesh had shorter symptom duration upon presentation to care, compared to Prolene hernia repair.

Keywords: Inguinal Hernia, Clinical Risk Factors, Hernia Presentation, Swelling, Pain, Mesh Repair.

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Introduction

The inguinal region represents a complex part of the anterior abdominal wall both structurally and functionally, which is designed to permit certain physiological processes while maintaining resistance against herniation. The inguinal canal is one of the key elements of the region, representing the pathway through which the testes descend during fetal development. It creates a weak point that may later become the site of hernia development. The canal develops in both sexes due to the indifferent morphological stage of sexual differentiation, though it has an obvious anatomical and physiological meaning in males. During the processes of embryogenesis, as the mesonephros degenerates, the gubernaculum-a fibrous cord-passes obliquely through the developing anterior abdominal wall at the site destined for

the inguinal canal. The gubernaculum attaches caudally to the internal surface of the labioscrotal swellings, which later differentiate into the scrotum in males and the labia majora in females [1].

In the process, the parietal peritoneum gives rise to the processus vaginalis-a peritoneal diverticulum that forms an important structure through which the testes descend in the male fetus. This diverticulum pierces the layers of the anterior abdominal wall to form the inguinal canal and to allow the migration of the testes into the scrotum [2]. In its descent, the processus vaginalis carries with it prolongations of the layers of the abdominal wall, which eventually form the coverings of the spermatic cord and testes. The deep inguinal ring is created anatomically by an

opening in the transversalis fascia, while the superficial inguinal ring is derived from an aperture in the external oblique aponeurosis [3].

Failure of obliteration of the processus vaginalis results in a persistent connection between the peritoneal cavity and the inguinal canal, with the potential for herniation. A patent processus vaginalis is the major etiological factor in the development of indirect inguinal hernias, especially in infants and children. However, a patent processus vaginalis is not sufficient to cause herniation, suggesting that other factors are also important in the pathogenesis of inguinal hernias [4]. The descent of the testes as well as closure of the processus vaginalis are controlled both hormonally and neurologically. Calcitonin gene-related peptide (CGRP), produced by the genitofemoral nerve under the influence of fetal androgens, represents one of the important neuroanatomical mediators of both testicle descent and closure of the processus vaginalis. Abnormalities of such mechanisms may thus lead to persistent patency and hernia.

A familial predisposition to inguinal hernia has been documented, supporting a genetic component in its pathogenesis. A study conducted among 280 Chinese families with congenital indirect inguinal hernias demonstrated an autosomal dominant pattern of inheritance with incomplete penetrance, and a preferential paternal influence. The hernia occurred more frequently on the right side, corresponding with the typically delayed descent of the right testis. Moreover, the increased incidence among premature infants suggests that delayed maturation and developmental immaturity contribute significantly to the risk of herniation [5].

In addition to embryological and genetic factors, the basis for the integrity of the abdominal wall involves biochemical abnormalities in connective tissue composition. Collagen comprises approximately 80% of the rectus sheath and provides tensile strength and resiliency. Biochemistry studies have shown that patients with hernias have a decreased hydroxyproline concentration that quantitatively represents collagen quality and cross-linking ability. Defective collagen has changed salt sensitivity, decreased hydroxylation, and diminished quantities of mature insoluble polymeric forms. Fibroblast cultures from hernia patients demonstrated both slower rates of proliferation and lower radioactive proline incorporation, adding support to the theory of systemic connective tissue disorder. Electron microscopy ultrastructural studies demonstrated abnormalities of collagen fibril periodicity with variable thickness, indicative of compromised collagen fiber synthesis or post-translational modification.

The fascia transversalis is a significant structural barrier in the groin and relies on an intact collagen matrix for resistance to intraabdominal pressure

changes. Indeed, biochemical studies have demonstrated decreased hydroxyproline and lysine concentrations in direct inguinal hernias, implicating defective collagen metabolism as a contributor to abdominal wall weakness. Systemic connective tissue disorders, such as Marfan's syndrome, Ehlers-Danlos syndrome, Hurler-Hunter syndrome, and other mesenchymal disorders will similarly predispose to groin hernias due to structural defects of collagen and elastin [6].

In addition to congenital and metabolic factors, environmental and lifestyle factors contribute significantly to the risk of herniation. Cigarette smoking is recognized as an established cause of chronic pulmonary emphysema, which may initiate a chronic neutrophil-macrophage inflammatory response accompanied by the release of proteolytic enzymes such as elastase and collagenase. These enzymes degrade the structural elements of the lung parenchyma and can subsequently degrade collagen and elastin in the rectus sheath and fascia transversalis through the systemic circulation, leading to progressive attenuation of the connective tissue and a loss of tensile strength. Progressive systemic degradation of connective tissue together with increased intra-abdominal pressure from chronic cough presents a potent risk factor in the development of inguinal hernia.

Considering the multifactorial basis of inguinal hernia that is embryological, genetic, biochemical, mechanical and environmentally based, clinical risk factors and patterns of presentation should be examined and characterized in specific patient populations. This is done in order to understand the relative contributions of systemic and local mechanisms in hernia pathogenesis, to identify subgroups at high risk, and to facilitate the development of both preventive and therapeutic strategies.

The current study therefore aimed to evaluate clinical risk factors and presentation characteristics in patients with inguinal hernias, with a particular emphasis on the interaction of congenital predisposition, connective tissue integrity and acquired environmental factors. By systematically re-evaluating patient demographics, comorbidities and clinical manifestations, the ongoing research work aims to elucidate the multifactorial pathophysiological mechanisms behind this hernia type to develop progressively more sophisticated preventative and management strategies.

Methodology

Study Design: We conducted a prospective observational study conducted in the hospital setting to assess clinical risk factors and presentation patterns in patients diagnosed with unilateral primary inguinal hernia.

Study Area: The research was conducted in the Department of General Surgery, Silchar Medical College and Hospital, Assam, India.

Study Duration: The study was conducted over a period of 12 months from January 2023 to December 2023

Study Population: The research sample was represented by patients who were admitted to the Department of General Surgery with unilateral primary inguinal hernia diagnosis.

Sample Size: A total of 160 patients (80 patients per group) meeting our inclusion and exclusion criteria were enrolled in the study. In line with the goals of this prospective study, the number of cases was determined based on the number of eligible patients admitted into the Division of General Surgery during our study interval.

Inclusion Criteria

- Male patients aged 20 years or older diagnosed with unilateral primary inguinal hernia.
- Patients who provided informed consent to participate in the study and undergo surgical management.

Exclusion Criteria

- Female patients.
- Patients with recurrent hernias.
- Patients are present with bowel obstruction, strangulation, peritonitis, or perforation.
- Patients with associated femoral hernia.
- Patients undergo orchidectomy during the same procedure.
- Patients are medically unfit for surgery.
- Patients who refused investigations or declined surgical procedures.

Data Collection: Data collection was carried out utilizing a standardized proforma with clinical history, demographics, occupation, duration of symptoms, side of hernia, reducibility, and comorbidities. Diagnosis was made by a history of reducible groin swelling in addition to clinical examination. Investigations that were relevant for fitness for surgery were performed, including:

- Random Blood Sugar
- Blood Urea and Serum Creatinine
- Electrocardiogram (ECG)
- Hemoglobin percentage
- Routine Urine Analysis (sugar, albumin, microscopy)
- Chest X-ray
- Ultrasound abdomen (to rule out associated pathology)

Patients with any medical contraindication to surgery were appropriately managed and re-evaluated before inclusion.

Procedure: All surgical repair of the inguinal hernia was performed under spinal anesthetic (3 ml, 2% bupivacaine - Sensorcaine), and all the surgical intervention and intraoperative findings were logged in detail. The postoperative course, any complications, and recovery were all noted and followed up until discharge.

Statistical Analysis: Data entered into Microsoft Excel was analyzed using Statistical Package for the Social Sciences (SPSS) software, Version 27.0. Descriptive statistics (mean, standard deviation, percentages) were performed to summarize quantitative data. Categorical variables were evaluated using Chi-square or Fisher's exact test, as appropriate. A p-value of less than 0.05 is deemed statistically significant."

Result

Table 1 displays the distribution of cases according to age for the two mesh categories (N=80 for each study group). In the Standard Prolene mesh study group, approximately 23.75% of patients in the study group, and 26.25% were between the ages of 50-59 years and 60-69 years; whereas the Lightweight mesh group had the largest percentage of patients in the 20-29 age category (33.75%). The other age categories were all fairly similar or had lower proportionate distributions, however there were equal total numbers of patients in both study groups (80) in all age variables tested.

Age group (yrs)	Standard Prolene mesh n (%)	Lightweight mesh n (%)
20-29	9 (11.25%)	27 (33.75%)
30-39	9 (11.25%)	9 (11.25%)
40-49	11 (13.75%)	6 (7.50%)
50-59	19 (23.75%)	10 (12.50%)
60-69	21 (26.25%)	19 (23.75%)
70+	11 (13.75%)	9 (11.25%)
Total	80 (100.00%)	80 (100.00%)

Table 2 compares the associated symptoms in patients receiving Standard Prolene versus Lightweight mesh (N = 80 per group). Swelling was universal in both groups (100%), while pain was slightly more common in the Standard Prolene

group (53.75%) compared with the Lightweight mesh group (47.50%), indicating that both mesh types are similarly associated with swelling, with marginally higher pain reported in the Standard Prolene group.

Table 2: Comparison of associated symptoms (N = 80 per group)

Symptoms	Standard Prolene mesh n (%)	Lightweight mesh n (%)	Symptoms	Standard Prolene mesh n (%)	Lightweight mesh n (%)
Swelling	80 (100.00%)	80 (100.00%)	Swelling	80 (100.00%)	80 (100.00%)
Pain	43 (53.75%)	38 (47.50%)	Pain	43 (53.75%)	38 (47.50%)

Table 3a details the duration of swelling in patients with Standard Prolene and Lightweight mesh (N = 80 per group). In the Standard Prolene group, swelling persisted for 1–6 months in 40%, 12 months–2 years in 16.25%, and over 2 years in 40% of patients, with no cases under 1 month. In contrast, the

Lightweight mesh group had 43.75% experiencing swelling for 1–6 months, 27.5% for 12 months–2 years, 20% for over 2 years, and 5% for less than 1 month. Overall, swelling tended to resolve sooner in the Lightweight mesh group compared with the Standard Prolene group.

Table 3a: Duration of swelling (N = 80 per group)

Duration	Standard Prolene mesh n (%)	Lightweight mesh n (%)
< 1 month	0 (0.00%)	4 (5.00%)
1–6 months	32 (40.00%)	35 (43.75%)
6–12 months	3 (3.75%)	3 (3.75%)
12 months–2 years	13 (16.25%)	22 (27.50%)
2 years +	32 (40.00%)	16 (20.00%)
Total	80 (100.00%)	80 (100.00%)

Table 3b presents the duration of pain among patients reporting pain in the Standard Prolene (n = 43) and Lightweight mesh (n = 38) groups. In the Standard Prolene group, pain persisted 1–6 months in 46.5%, 6–12 months in 23.3%, 12 months–2 years in 14%, and over 2 years in 14%, with only 2.3% experiencing pain for less than 1 month. In contrast,

the Lightweight mesh group had most pain cases resolve quickly: 68.4% reported pain for 1–6 months, 23.7% for less than 1 month, and only 7.9% for over 2 years, with no cases in the 6–24 month range. This indicates faster pain resolution in the Lightweight mesh group compared with Standard Prolene.

Table 3b: Duration of pain

Duration	Standard Prolene mesh n (% of pain n=43)	Lightweight mesh n (% of pain n=38)
< 1 month	1 (2.33% of pain)	9 (23.68% of pain)
1–6 months	20 (46.51% of pain)	26 (68.42% of pain)
6–12 months	10 (23.26% of pain)	0 (0.00% of pain)
12 months–2 years	6 (13.95% of pain)	0 (0.00% of pain)
2 years +	6 (13.95% of pain)	3 (7.89% of pain)
Total (pain cases)	43	38

Table 4(a) shows the side of hernia repair in patients with Standard Prolene and Lightweight mesh (N = 80 per group). In the Standard Prolene group, the right side was affected in 65% of cases and the left side in 35%. In the Lightweight mesh group, the

right side predominated even more at 75%, with the left side accounting for 25%. Overall, right-sided hernias were more common in both groups, particularly in the Lightweight mesh group.

Table 4(a): Side affected (N = 80 per group)

Side	Standard Prolene mesh n (%)	Lightweight mesh n (%)
Right	52 (65.00%)	60 (75.00%)
Left	28 (35.00%)	20 (25.00%)
Total	80 (100.00%)	80 (100.00%)

Table 4(b) summarizes the type of hernia sac in patients receiving Standard Prolene and Lightweight mesh (N = 80 per group). In the Standard Prolene group, direct sacs were observed in 31.25% and indirect sacs in 68.75% of cases. In the Lightweight

mesh group, direct sacs accounted for 25%, while indirect sacs were more common at 75%. This indicates that indirect hernia sacs predominated in both groups, slightly more so in the Lightweight mesh group.

Table 4(b): Direct / Indirect sac (N = 80 per group)		
Type	Standard Prolene mesh n (%)	Lightweight mesh n (%)
Direct	25 (31.25%)	20 (25.00%)
Indirect	55 (68.75%)	60 (75.00%)
Total	80 (100.00%)	80 (100.00%)

Table 5 presents the associated comorbid factors among patients receiving Standard Prolene and Lightweight mesh (N = 80 per group). In both groups, smoking was present in 25% of patients, and benign enlargement of prostate (BEP) in 3.75%. Diabetes mellitus was slightly higher in the Lightweight mesh group (12.5%) compared with Standard Prolene (7.5%). Other conditions, including bronchial asthma, HTN + BEP, and smoker with

urethral stricture, detailed in Table 3, were only seen in the Lightweight mesh group at the 3.75% each. There was a greater percentage of patients in the Standard Prolene group (52.5%) who did not have any associated factors, compared to (36.25%) in the Lightweight mesh group indicating that patients with Lightweight mesh had more comorbidities than those in the Standard Prolene group.

Table 5: Associated factors (N = 80 per group)		
Associated factors	Standard Prolene mesh n (%)	Lightweight mesh n (%)
Smoker (Sm)	20 (25.00%)	20 (25.00%)
Benign enlargement of prostate (BEP)	3 (3.75%)	3 (3.75%)
Bronchitis + BEP (Br+BEP)	3 (3.75%)	3 (3.75%)
Diabetes Mellitus (DM)	6 (7.50%)	10 (12.50%)
Hypertension (HTN)	6 (7.50%)	6 (7.50%)
Bronchial Asthma (BA)	0 (0.00%)	3 (3.75%)
HTN + BEP	0 (0.00%)	3 (3.75%)
Smoker + Urethral stricture (Sm+US)	0 (0.00%)	3 (3.75%)
NIL	42 (52.50%)	29 (36.25%)
Total	80 (100.00%)	80(100.00%)

Discussion

The current analysis shows distinct differences in age distribution, with patients in the Standard Prolene mesh group being characterized as older (60–69 years), whereas there is a greater percentage of younger (20–29 years) patients in the Lightweight mesh group. This supports literature from a study by Abrahamson (1998) [7], which identified that direct inguinal hernias were more commonly treated among older adults, whereas indirect hernias were more common in younger individuals, as described by natural epidemiological patterns of development of hernias”.

Schofield (2000) [8] noted similar observations, maintaining again, a higher incidence in younger males with indirect inguinal hernias; this supports the demographic distribution we have noted in our Lightweight mesh study group. The age demographic could also reflect increased physical activity in younger patients, as this is a well-known risk factor for indirect hernia development as introduced by Read (2002) [9].

More than half of the patients in the Standard Prolene mesh group reported pain, although it is less by some measure in the Lightweight mesh group, as to demonstrate a trend for either older patients or those with more chronic hernias experiencing greater pain. This is consistent with previous studies suggesting that chronicity and tissue stiffness are responsible for prolonged pain in hernia patients. The rather shorter duration of pain observed after the Lightweight mesh may also relate to the characteristics of the mesh itself since there are reports of reduced foreign body sensation with lightweight meshes and improved comfort after surgery (Kingsnorth & Bennet, 2008) [10].

With regard to symptom duration, our results showed that Standard Prolene mesh patients suffered from swelling for a longer duration, with 40% of symptoms persisting beyond two years, whereas the Lightweight mesh group generally had symptoms for shorter durations. This agrees with the reports by Quinn (2002) and Kux (2002) [1,2], where it was observed that older patients, or those with predisposing factors, tend to present late, hence longer symptom duration, while younger patients or those

who have lighter meshes recover sooner due to less tissue remodeling and quicker resumption of daily activity.

In both groups, the right side was more often affected, and the indirect type of hernia predominated. This agrees well with previous anatomical and clinical reports that demonstrated the right-sided predisposition due to delayed descent of the right testis and the presence of a patent processus vaginalis (Quinn, 2002; Last, 1994) [1,3]. The predominance of the indirect type in younger patients, especially in the Lightweight mesh group, agrees with the literature emphasizing male predominance and higher incidence of indirect hernias in early adulthood (Schofield, 2000) [8].

Examination of the associated factors involved in the patients' conditions showed that smoking, diabetes, hypertension, and chronic respiratory conditions were all relevant to a certain extent. Interestingly, diabetes was more prevalent among the Lightweight mesh group, while hypertension and bronchial asthma were present exclusively in this group. This agrees with the assumption that comorbidities may be associated with hernia presentation and complications, as Abrahamson (1998) [7] emphasized systemic diseases as factors contributing to abdominal wall weakness. The presence of more patients with no associated risk factors in the Standard Prolene mesh group would tend to support the assertion by Read (2002) [9] that age-related tissue degeneration may be a major determinant of herniation in elderly patients rather than the presence of comorbid conditions.

The research further underscores the significance of clinical evaluation, particularly in the erect position, for evaluating hernia attributes and associated pain, as noted by Boffard (1986) [4]. It is sensible to reason that the pain characteristics shown in our study, where pain predated swelling in some cases and decreased once hernia was fully formed, are classic clinical presentations of hernia causing pain, and so backs the surgical literature of Madden et al. (1971) [5] who reported that conservative management of hernias was appropriate. These further supports using age, duration of symptoms, and other comorbid factors, as the basis for an individualized decision to intervene operatively.

The distinction between clinical presentation and risk factors between the two groups could also extend to implications for postoperative outcomes. As expected, lightweight mesh was correlated with less overall pain and younger age. This could provide advantages from the standpoint of early mobilization and decreased morbidity after surgery, which aligns with the current surgical community's preference to implement tension-free lightweight mesh technique for hernia repair and to minimize chronic pain due to hernias and facilitate early recovery (Kingsnorth

& Bennet, 2008) [10]. Meanwhile, the standard proline mesh group was older and symptomatic for longer, however it was again noted that the established utility of traditional mesh repair using standard MMA in double layer repairs protects against recurrent hernias, thus with all patient factors considered, surgical technique is also highly relevant.

Overall, the present findings corroborated the literature concerning epidemiology, risk factors, and clinical presentation of inguinal hernias while providing enriched details on outcomes related to mesh. Young patients and patients given lightweight mesh had shorter durations of symptom duration and less chronic pain, whereas older patients with standard mesh represented the classic demographic and clinical pattern observed in prior literature. The findings suggest that clinical assessment and mesh selection should be matched to the patient for optimal recovery and long-term outcome.

Conclusion

The assessment of clinical risk factors and presentation patterns in patients with inguinal hernia indicated that the typical age of presenting patients was among the middle-aged and elderly group, however, there was a noticeable incidence of specimens of male gender as well. The most common presenting symptom was swelling, which was frequently associated with pain, which may have been of varying duration. The reported swelling and pain related to symptoms suggested chronicity for the majority of patients, whereas others presented sooner as part of the lightweight mesh cohort. Additionally, it was noted that right-sided and indirect hernia with a female bias were more frequent. The most common associated risk factors were identified as smoking, once reported as diabetes, hypertension, and benign prostatic enlargement. Many patients indicated no identifiable risk factors. In summary, this data suggests that contributing factors to the incidence and presentation of inguinal hernia in this population included age-related weakness of underlying tissue, chronicity of co-morbidities, and lifestyle factors.

References

1. Quinn TH. Anatomy of the Groin: A view from the Anatomist. Chapter 6. In: Fitzgibbons R, Greenberg G, editors. Nyhus and Condon's Hernia: Philadelphia USA: Lippincott Williams and Wilkins, 2002, 55.
2. Kux M. Anatomy of the Groin: A view from the surgeon. Chapter 5 in: Fitzgibbons R, Greenberg G, editors. Nyhus and Condon's Hernia: Philadelphia USA: Lippincott Williams and Wilkins, 2002, 45
3. Last RJ. The anterior abdominal wall. In: McMinn RMH, Editor, Last's Anatomy Regional and Applied 9th edition London. Churchill Livingstone, 1994.

4. Boffard KD. The Groin and Scrotum. In: Decker GAG, du Plessis DJ. Lee McGregor's Synopsis of Surgical Anatomy, Bristol, Great Britain: John Wright and Sons Limited, 1986, 118-137.
5. Madden JL, Hakim S, Agrorogianuis AB. The Anatomy and Repair of Inguinal Hernias. Surg Clin N Am. 1971; 51(6):1269-1292
6. Read RC. Why do Human Beings Develop Groin Hernias? Chapter 1: In Fitzgibbons R, Greenberg G, editors. Nyhus and Condon's Hernia: Philadelphia USA: Lippincott Williams and Wilkins, 2002, 3.
7. Abrahamson J. Etiology and pathophysiology of primary and recurrent groin hernia formation. Surg Clin North Am. 1998; 78(6):953.
8. Schofield PF. Inguinal Hernia: Medicolegal Implications. Ann R Coll Surg Engl. 2000; 82:109-110.
9. Read RC. Why do Human Beings Develop Groin Hernias? Chapter 1: In Fitzgibbons R, Greenberg G, editors. Nyhus and Condon's Hernia: Philadelphia USA: Lippincott Williams and Wilkins, 2002, 3.
10. Kingsnorth AN, Bennet DH. Hernias, Umbilicus and abdominal wall. Chapter 73; in Russell RCG, Williams NS and Bulstrode CJK, editors: Bailey and Love's Short Practice of Surgery, 25th edn. London: Arnold, 2008, 968.