

Clinical Presentation, Risk Factors, Surgical Management, and Postoperative Complications of Patients with Inguinal Hernia: A Prospective Observational Study.

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ABSTRACT

Background:

Inguinal hernia is a common surgical condition with substantial variation in presentation, contributing risk factors, operative approach, and postoperative recovery.

Objectives:

This study evaluated the clinical presentation, associated risk factors, surgical management, and early postoperative complications among patients undergoing inguinal hernia repair.

Methods:

This prospective, single-centre observational cohort study included 80 adults with inguinal hernia who underwent surgery at Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India, from January to December 2025. Consecutive eligible patients were enrolled. Demographic characteristics, associated risk factors, clinical presentation, hernia characteristics, operative details, hospital stay, and postoperative complications were recorded and analysed.

Results:

The mean age was 49.6 ± 15.2 years, and 74 patients (92.5%) were male. Groin swelling was present in all patients, while 46 (57.5%) reported pain or a dragging sensation. Right-sided (51.3%), indirect (61.3%), and reducible (68.8%) hernias predominated. Smoking (32.5%), heavy physical work or weight lifting (26.3%), chronic cough (21.3%), and chronic constipation (16.3%) were frequently associated factors. Elective surgery was performed in 86.3%; open mesh hernioplasty was the most common procedure (65.0%), followed by laparoscopic repair (21.3%). Eighteen patients (22.5%) developed at least one postoperative complication. Acute pain requiring additional analgesia (10.0%), seroma (7.5%), surgical-site infection (5.0%), and scrotal oedema or haematoma (5.0%) were the principal events. Complications were more frequent among older patients, smokers, emergency procedures, and complicated hernias. No postoperative death occurred.

Conclusion:

Inguinal hernia predominantly affected middle-aged and older men and commonly presented as a unilateral reducible swelling. Mesh-based elective repair produced favourable short-term outcomes, whereas emergency presentation and selected patient-related factors were associated with greater postoperative morbidity.

Recommendations:

Early surgical evaluation, modification of relevant risk factors, and timely elective repair should be encouraged to reduce emergency presentations and postoperative complications.

Keywords: Inguinal Hernia; Risk Factors; Hernioplasty; Laparoscopic Repair; Postoperative Complications

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INTRODUCTION

Inguinal hernia is among the most frequent disorders encountered in general surgical practice and remains a major source of elective operative workload worldwide. A systematic review of population-based studies estimated a pooled prevalence of 7.7%, with a substantially higher burden among men than women.¹ The condition results from protrusion of intra-abdominal contents through a weakness in the groin, most often involving the inguinal canal. Its clinical importance extends beyond the presence of a groin swelling because pain, impaired physical activity, incarceration, intestinal obstruction, and strangulation can alter both timing and complexity of treatment.²

Age and male sex are consistently recognized determinants of inguinal hernia. Long-term population data have also linked hernia occurrence to several constitutional and clinical characteristics, although associations with smoking, body mass index, physical activity, chronic cough, and other causes of increased intra-abdominal pressure vary across populations.³ In the Rotterdam Study, incidence rose with advancing age, while overweight and obesity were inversely associated with hernia development.⁴ Indian observational data have described a marked male predominance and frequent histories of heavy weight lifting, altered bowel habits, and respiratory disease among patients presenting for repair.⁵ Sex-related differences in groin hernia characteristics and postoperative outcomes have also been demonstrated in contemporary evidence, reinforcing the importance of describing local patient profiles.⁶

Diagnosis is primarily clinical, based on a groin bulge or cough impulse that changes with posture or straining. The hernia can be unilateral or bilateral, direct or indirect, reducible or complicated by irreducibility, obstruction, or strangulation. Current international guidance supports mesh-based repair for most adults requiring surgery, with open anterior and laparo-endoscopic approaches selected according to patient factors, hernia characteristics, surgeon expertise, available resources, and shared decision-making.^{7,8} Evidence comparing laparoscopic and open repair suggests broadly similar recurrence outcomes, with laparo-endoscopic approaches offering lower rates of chronic groin pain in appropriately selected patients.⁹

Emergency groin hernia surgery carries greater clinical risk than elective repair, particularly when bowel compromise necessitates resection.¹⁰ Postoperative outcomes are influenced by age, comorbidity, smoking, mode of admission, operative technique, and the complexity of the hernia.¹¹ Chronic postoperative inguinal pain remains an important patient-centred outcome even when recurrence and major surgical complications are uncommon.¹² Describing these features in a defined tertiary-care

population provides practical information for counselling, operative planning, and prevention of avoidable emergency presentation. Therefore, the objectives of the present study were to characterize the demographic and clinical presentation of patients with inguinal hernia, identify commonly associated risk factors, describe patterns of surgical management, determine postoperative complications and short-term outcomes, and examine selected factors associated with postoperative morbidity.

METHODOLOGY

Study design and setting

This was a prospective, single-centre, hospital-based observational cohort study conducted in the Department of General Surgery at Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India. The institution functions as a tertiary-care teaching centre serving patients from Vizianagaram and surrounding areas. Patient recruitment was undertaken from January to December 2025, and postoperative outcomes were recorded prospectively after surgical treatment. The study findings were prepared in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement¹³.

Study participants and sampling

Adults aged 18 years or older with a clinical diagnosis of inguinal hernia who underwent operative treatment during the study period were eligible. Primary, recurrent, unilateral, bilateral, reducible, irreducible, obstructed, and strangulated inguinal hernias were considered. Patients who did not undergo surgery during the study period, declined participation, had a groin hernia other than an inguinal hernia as the principal diagnosis, or had incomplete perioperative information were excluded. Consecutive eligible patients were approached for enrolment. Eighty patients who fulfilled the criteria and completed the required perioperative assessment constituted the final study sample.

Study size

The study size was determined using a census-based consecutive enrolment approach over the prespecified 12-month recruitment period rather than a hypothesis-driven sample-size calculation. All eligible adults undergoing operative treatment for inguinal hernia during the study period were approached. Of 86 patients assessed for eligibility, six were excluded, and 80 completed the required perioperative assessment and postoperative follow-up, constituting the final study sample. This approach was selected because the study was primarily descriptive and

aimed to characterize the spectrum of surgically managed inguinal hernia cases encountered during the defined study period.

Bias

Potential sources of bias were addressed through consecutive enrolment of eligible patients, predefined inclusion and exclusion criteria, and prospective data collection using a structured case-record form. Clinical and operative characteristics were documented from direct assessment and operative records using the same variables for all participants. Complete postoperative outcome data were available for all included patients, reducing the risk of attrition bias. Treatment-selection bias could not be eliminated because the operative approach was determined by the treating surgical team rather than by random allocation; therefore, comparative findings were interpreted as descriptive and exploratory, without causal inference.

Clinical assessment and data collection

A structured case-record form was used to document age, sex, body mass index, smoking history, occupation involving heavy physical work or weight lifting, chronic cough, chronic constipation, lower urinary tract symptoms or benign prostatic hyperplasia, family history of inguinal hernia, and previous contralateral hernia surgery. Presenting symptoms, side of hernia, anatomical type, reducibility, recurrent status, and features of obstruction or strangulation were recorded after clinical evaluation. Relevant laboratory and imaging investigations were performed according to routine clinical indications rather than as mandatory research procedures.

Surgical management and outcome assessment

The decision for elective or emergency surgery and the choice of open mesh, laparo-endoscopic, non-mesh tissue repair, or emergency exploration were made by the treating surgical team according to the clinical condition and operative findings. Operative duration, bowel viability, requirement for resection and anastomosis, and intraoperative complications were documented.

Postoperative follow-up included duration of hospital stay and occurrence of acute pain requiring additional analgesia, seroma, surgical-site infection, scrotal oedema or haematoma, urinary retention, wound haematoma, persistent groin pain during follow-up, early recurrence, mesh infection requiring removal, and death.

Statistical analysis

Data were summarized using frequencies and percentages for categorical variables and mean $\pm$ standard deviation for continuous variables. Associations between selected clinical factors and postoperative complications were assessed using categorical comparison tests, with a two-sided p-value <0.05 considered statistically significant. The analysis was descriptive and exploratory; no causal inference was intended.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee of Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India, before participant recruitment. Necessary administrative permissions were obtained before starting the study. Written informed consent was obtained from each participant before inclusion. Patient information was handled confidentially, and study records were used only for the stated research purpose.

RESULTS

Participant recruitment and baseline characteristics

During the study period, 86 patients with clinically suspected inguinal hernia were assessed for eligibility. Six patients were excluded: three did not undergo operative treatment during the study period, two declined participation, and one had incomplete perioperative information. The remaining 80 patients underwent surgical management and were included in the final analysis. Complete postoperative outcome data were available for all included patients. Participant flow is shown in Figure 1.

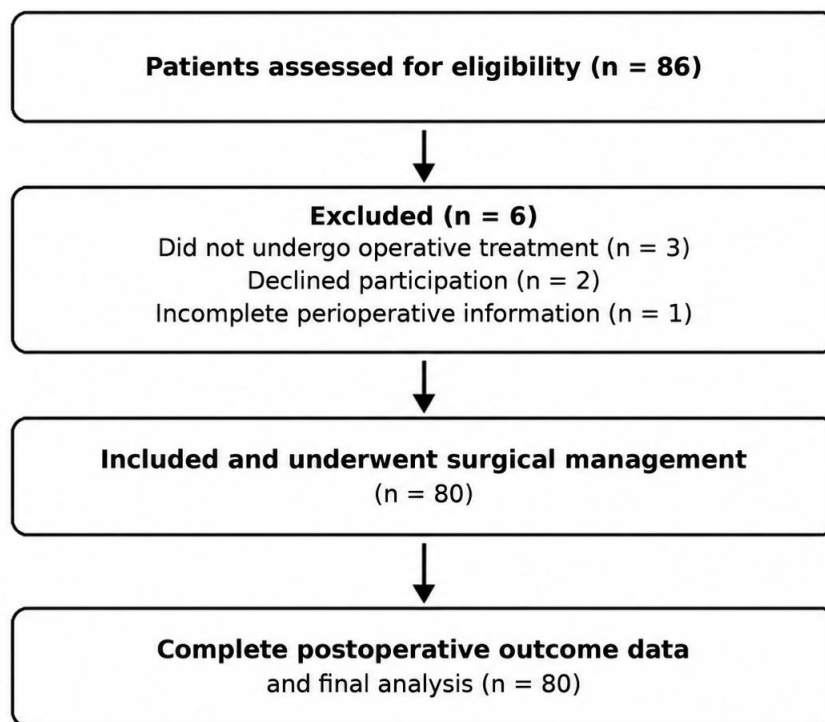


Figure 1. Participant flow through the study.

The mean age of the study population was 49.6 ± 15.2 years, with a range of 18-78 years. Patients aged 41-60 years represented the largest group (38.8%), followed by those aged >60 years (28.8%). Seventy-four participants (92.5%) were male, and six (7.5%) were female, yielding a male-to-female ratio of approximately 12.3:1. The mean body mass

index was 24.8 ± 3.4 kg/m². Smoking history was recorded in 26 patients (32.5%), heavy physical work or weight lifting in 21 (26.3%), chronic cough in 17 (21.3%), chronic constipation in 13 (16.3%), lower urinary tract symptoms or benign prostatic hyperplasia in 10 (12.5%), and a family history of inguinal hernia in seven (8.8%) (Table 1).

Table 1: Demographic Characteristics and Risk Factors of the Study Population

Characteristic	Frequency, n (%) or mean $\pm$ SD
Total participants	80
Age, years	49.6 ± 15.2
18-40 years	26 (32.5%)
41-60 years	31 (38.8%)
>60 years	23 (28.8%)
Male	74 (92.5%)
Female	6 (7.5%)
BMI, kg/m ²	24.8 ± 3.4
Smoking history	26 (32.5%)

Characteristic	Frequency, n (%) or mean $\pm$ SD
Heavy physical work/weight lifting	21 (26.3%)
Chronic cough	17 (21.3%)
Chronic constipation	13 (16.3%)
Lower urinary tract symptoms/BPH	10 (12.5%)
Family history of inguinal hernia	7 (8.8%)
Previous contralateral hernia surgery	5 (6.3%)

Clinical presentation and characteristics of hernia

Groin swelling was present in all 80 patients (100%). Pain or a dragging sensation was reported by 46 patients (57.5%), and 19 (23.8%) described discomfort that increased with coughing, prolonged standing, or strenuous activity. Six patients (7.5%) presented with symptoms suggestive of intestinal obstruction. The hernia was right-sided in 41

patients (51.3%), left-sided in 30 (37.5%), and bilateral in nine (11.3%). Indirect inguinal hernia was the predominant anatomical type, affecting 49 patients (61.3%), followed by direct hernia in 24 (30.0%) and pantaloon or combined hernia in seven (8.8%). Fifty-five hernias (68.8%) were reducible; 11 (13.8%) were irreducible, six (7.5%) were obstructed, and three (3.8%) were strangulated. Recurrent inguinal hernia was documented in five patients (6.3%) (Table 2).

Table 2: Clinical Presentation and Hernia Characteristics

Variable	n (%)
Groin swelling	80 (100%)
Groin pain/dragging sensation	46 (57.5%)
Discomfort on coughing/straining	19 (23.8%)
Symptoms of intestinal obstruction	6 (7.5%)
Right-sided hernia	41 (51.3%)
Left-sided hernia	30 (37.5%)
Bilateral hernia	9 (11.3%)
Indirect hernia	49 (61.3%)
Direct hernia	24 (30.0%)
Pantaloon/combined hernia	7 (8.8%)
Reducible hernia	55 (68.8%)
Irreducible hernia	11 (13.8%)
Obstructed hernia	6 (7.5%)
Strangulated hernia	3 (3.8%)
Recurrent hernia	5 (6.3%)

Surgical management

Elective surgery was performed in 69 patients (86.3%), whereas 11 (13.8%) required emergency operative intervention. Open mesh hernioplasty was the most frequent procedure and was performed in 52 patients (65.0%). Seventeen patients (21.3%) underwent laparoscopic repair using a transabdominal preperitoneal or totally extraperitoneal approach according to clinical suitability

and surgeon preference. Non-mesh tissue repair was undertaken in five patients (6.3%). Six patients (7.5%) required emergency exploration with hernia repair, and three of these patients underwent bowel resection and anastomosis because of non-viable bowel. Mean operative duration was 63.4 ± 18.7 minutes. Intraoperative complications were recorded in four patients (5.0%) (Table 3).

Table 3: Surgical Management and Operative Characteristics

Surgical variable	n (%) or mean $\pm$ SD
Elective surgery	69 (86.3%)
Emergency surgery	11 (13.8%)
Open mesh hernioplasty	52 (65.0%)
Laparoscopic hernia repair	17 (21.3%)
Non-mesh tissue repair	5 (6.3%)
Emergency exploration with hernia repair	6 (7.5%)
Bowel resection and anastomosis	3 (3.8%)
Operative duration, minutes	63.4 ± 18.7
Intraoperative complications	4 (5.0%)

Postoperative outcomes and complications

The mean postoperative hospital stay was 3.1 ± 1.9 days. Patients undergoing uncomplicated elective repair generally had shorter hospitalization, whereas those with obstruction, strangulation, or bowel resection required longer inpatient care. At least one postoperative complication was documented in 18 patients (22.5%). Acute postoperative pain requiring additional analgesia beyond the routine

protocol was the most frequent event, occurring in eight patients (10.0%). Seroma developed in six (7.5%), surgical-site infection in four (5.0%), scrotal oedema or haematoma in four (5.0%), urinary retention in three (3.8%), and wound haematoma in two (2.5%). During follow-up, persistent groin pain was reported by three patients (3.8%), and one patient (1.3%) developed early recurrence. No mesh infection requiring removal and no postoperative mortality were observed (Table 4).

Table 4: Postoperative Outcomes and Complications

Outcome/complication	n (%) or mean $\pm$ SD
Postoperative hospital stay, days	3.1 ± 1.9
Any postoperative complication	18 (22.5%)
Acute postoperative pain requiring additional analgesia	8 (10.0%)
Seroma	6 (7.5%)
Surgical-site infection	4 (5.0%)
Scrotal oedema/haematoma	4 (5.0%)
Urinary retention	3 (3.8%)

Outcome/complication	n (%) or mean $\pm$ SD
Wound haematoma	2 (2.5%)
Persistent/chronic groin pain during follow-up	3 (3.8%)
Early recurrence	1 (1.3%)
Mesh infection requiring removal	0
Postoperative mortality	0

Factors associated with postoperative complications

Postoperative complications were more frequent in patients undergoing emergency surgery than in those treated electively (45.5% versus 18.8%). Complications were also more frequent among patients aged >60 years, smokers, and those presenting with complicated hernias. Nine of 23 patients aged >60 years (39.1%) experienced a complication compared with nine of 57 patients aged $\leq$ 60 years (15.8%;

$p=0.024$). Complications occurred in 10 of 26 patients with a smoking history (38.5%) and eight of 54 non-smokers (14.8%; $p=0.018$). Five of 11 patients undergoing emergency surgery (45.5%) had postoperative complications compared with 13 of 69 elective cases (18.8%; $p=0.048$). Similarly, complications occurred in eight of 20 patients with complicated hernias (40.0%) and 10 of 60 patients with uncomplicated hernias (16.7%; $p=0.021$) (Table 5).

Table 5: Association of Selected Clinical Factors With Postoperative Complications

Factor	Complication present, n/N (%)	p-value
Age >60 years	9/23 (39.1%)	0.024
Age $\leq$ 60 years	9/57 (15.8%)	
Smoking history	10/26 (38.5%)	0.018
No smoking history	8/54 (14.8%)	
Emergency surgery	5/11 (45.5%)	0.048
Elective surgery	13/69 (18.8%)	
Complicated hernia at presentation*	8/20 (40.0%)	0.021
Uncomplicated hernia	10/60 (16.7%)	

Note. Complicated hernia included irreducible, obstructed, or strangulated presentations.

Overall, the observed pattern was characterized by a predominantly male study population, frequent right-sided and indirect hernias, and a high proportion of elective mesh-based repairs. Short-term postoperative outcomes were favourable in most patients, while postoperative morbidity clustered among older patients, smokers, emergency cases, and complicated presentations.

Discussion

The present study describes 80 adults undergoing inguinal hernia surgery at a tertiary-care teaching institution. The mean age was 49.6 years and 92.5% were men, a pattern consistent with population studies showing marked male

predominance and increasing occurrence with age^{1,3,4}. The concentration of cases among middle-aged and older men indicates that the local operative workload reflects the established age- and sex-related distribution of inguinal hernia; however, because only surgically treated patients were enrolled, these proportions should not be interpreted as population prevalence. Agarwal reported 97.3% male participants in an Indian prospective series and similarly found a substantial proportion of older patients⁵. Contemporary evidence also confirms important sex-related differences in groin hernia epidemiology and outcomes⁶. Smoking was the most frequently recorded associated factor, followed by heavy physical work or weight lifting,

chronic cough, and chronic constipation. These findings show that exposures related to repeated increases in intra-abdominal pressure and potentially modifiable patient characteristics are common among patients presenting for surgery. Nevertheless, the absence of a hernia-free comparison group means that these frequencies cannot establish determinants of hernia development. Ruhl and Everhart demonstrated strong age-related effects, whereas the Rotterdam cohort reported an inverse association between body mass index and incident hernia^{3,4}. Agarwal identified heavy weight lifting, altered bowel habits, and respiratory disease as prominent accompanying factors⁵. Thus, the present findings should be interpreted as associated characteristics rather than evidence of causation. Right-sided hernia (51.3%), indirect anatomy (61.3%), and reducibility (68.8%) predominated, resembling prior Indian observations.⁵ The predominance of reducible hernias together with an 86.3% elective surgery rate indicates that most patients reached operative care before obstruction or strangulation developed. Open mesh hernioplasty was the commonest repair, a pattern compatible with international guidance supporting mesh-based repair for most adults^{7,8}. Laparoscopic repair was used in 21.3%, reflecting selective use according to clinical suitability, surgeon expertise, and available resources. Reviews comparing open and laparoscopic techniques report broadly similar recurrence outcomes, with less chronic postoperative pain after laparoscopic repair in appropriately selected patients and experienced hands^{9,14}.

Postoperative complications occurred in 22.5%, although the composite included minor events such as additional analgesic requirement, seroma, and scrotal oedema. Surgical-site infection occurred in 5.0%, persistent groin pain in 3.8%, and early recurrence in 1.3%. Chronic postoperative inguinal pain remains an important patient-centred outcome after repair¹². The higher complication frequency among patients aged over 60 years, smokers, emergency cases, and complicated hernias suggests that baseline vulnerability and acute disease complexity are useful clinical markers for closer perioperative surveillance and optimization. This pattern is directionally consistent with reported perioperative risk factors¹¹. Emergency groin hernia surgery has substantially greater morbidity and mortality than elective repair, particularly when bowel resection is required¹⁰. Three patients in this series required bowel resection, but no postoperative deaths occurred.

Generalizability

These findings are most applicable to adults undergoing operative management of inguinal hernia in comparable tertiary-care surgical units in India, particularly settings

where open mesh repair remains the predominant technique and emergency presentations continue to occur. Direct extrapolation to community populations, high-volume specialist hernia centres, or health systems with substantially greater use of laparoscopic repair is limited by the single-centre design, local referral patterns, surgeon preferences, and the small number of women included. Nonetheless, the observed clinical and perioperative patterns are broadly consistent with established epidemiological and surgical evidence.

Conclusion

In this prospective observational study, inguinal hernia predominantly affected middle-aged and older men and most often presented as a unilateral, right-sided, reducible swelling with indirect anatomy. Smoking, heavy physical work, chronic cough, and constipation were frequently associated factors. Most patients underwent elective surgery, with open mesh hernioplasty as the principal operative technique. Short-term outcomes were generally favourable, although postoperative morbidity was greater among older patients, smokers, emergency cases, and those with complicated hernias. Timely assessment and elective repair of appropriate symptomatic patients can reduce the clinical burden associated with obstruction, strangulation, bowel resection, and prolonged postoperative recovery. Continued follow-up is important for evaluating persistent pain and recurrence.

Limitations

This study was conducted at a single tertiary-care centre with a modest sample of 80 patients, limiting precision for uncommon complications and subgroup comparisons. The follow-up period was insufficient for robust assessment of long-term recurrence and chronic pain. Risk-factor information such as smoking, occupational strain, cough, and constipation relied partly on patient history. Surgical approach was determined clinically rather than through random allocation, introducing treatment-selection differences.

Recommendations

Patients with symptomatic inguinal hernia should receive early surgical assessment so that repair can be planned before obstruction or strangulation develops. Smoking cessation, treatment of chronic cough and constipation, and evaluation of lower urinary tract symptoms should form part of preoperative optimization. Elective mesh-based repair should remain the preferred strategy when clinically appropriate, while laparo-endoscopic techniques should be

offered where expertise and resources are available. Emergency cases require prompt resuscitation, assessment of bowel viability, and timely surgery. Standardized postoperative surveillance should document wound events, seroma, persistent groin pain, and recurrence. Larger multicentre studies with longer follow-up are recommended to define independent predictors of complications and recurrence.

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Abbreviations

BMI: Body Mass Index; BPH: Benign Prostatic Hyperplasia; SD: Standard Deviation; SSI: Surgical-Site Infection; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology; TAPP: Transabdominal Preperitoneal Repair; TEP: Totally Extraperitoneal Repair.

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

V.S. contributed to study conception and design, clinical investigation, data curation, and drafting of the manuscript. **B.K.B.** contributed to methodology, data interpretation, literature review, and critical revision of the manuscript. **T.K.** contributed to perioperative data assessment, clinical interpretation, and critical revision of the manuscript.

Data availability

De-identified data supporting the findings of this study are available

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