

Coexistence and Clinical Characteristics of Benign Prostatic Hyperplasia Among Men Presenting with Inguinal Hernia: A Prospective Cross-sectional Study

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Abstract

Background and objectives: Inguinal hernia and benign prostatic hyperplasia (BPH) are common in elderly males. Chronic straining during micturition may cause increased intra-abdominal pressure and hernia formation. However, the relationship between both conditions is not yet clear. This research aims to assess the prevalence of

coexisting BPH in men presenting with inguinal hernia and compare their demographic and clinical characteristics.

Methodology: After obtaining the Institutional Ethics Committee (IEC) approval, a prospective cross sectional study was conducted among 180 male of age more than 40 years with inguinal hernia. Assessments of the

participants were done using International Prostate Symptom Score (IPSS), ultrasonographic estimation of prostate volume, uroflowmetry, and hernia evaluated by clinical examination and ultrasonography. Participants were divided into a hernia-only group and a hernia-with-BPH group and demographic, urinary and hernia-related parameters were compared between these two groups.

Results: Eighty-six participants (47.78%) had coexisting BPH and 94 participants (52.22%) had hernia without BPH. The BPH group was significantly older (71.35 ± 5.75 vs 52.71 ± 7.78 years) and had larger prostate volumes (40.34 ± 5.46 vs 23.64 ± 3.82 mL, both $p < 0.01$). BPH status was significantly associated with IPSS severity. Prostate volume was positively correlated with hernia defect size ($r = 0.63$, $p < 0.01$). All three uroflowmetry parameters (Qmax, post-void residual volume and voided volume) were also differed significantly between both groups (all p value < 0.01)

Conclusion: Almost half of the men presenting with inguinal hernia had coexisting BPH. These participants were older, with larger prostate volumes and altered urinary parameters. The observed associations suggest possible positive relationship between BPH-related urinary dysfunction and inguinal hernia, but the lack of a non-hernia control group, significant differences in age, and the cross-sectional design preclude conclusions about causality. In elderly men presenting with an inguinal hernia, assessment of lower urinary tract symptoms may be useful, but the role of routine urological screening requires further investigation.

Keywords: Inguinal hernia, benign prostatic hyperplasia (BPH), lower urinary tract symptoms, International Prostate Symptom Score (IPSS), prostate volume, uroflowmetry.

Introduction

Inguinal hernia is one of the most common surgical diseases of adult males and accounts for a significant proportion of abdominal wall hernias worldwide. The lifetime risk of inguinal hernia is substantially higher in men than in women, and its incidence increases with advancing age. The pathogenesis of inguinal hernia is multifactorial, resulting from the interaction of anatomical predisposition, age-related changes in connective tissue, and factors that increase intra-abdominal pressure^{1,2}.

The inguinal canal is a potential area of weakness in the lower abdominal wall. Its anatomical configuration permits passage of the spermatic cord in men but also creates a region susceptible to herniation when abdominal-wall integrity is compromised³. Both congenital and acquired factors contribute to inguinal hernia. Increasing age, chronic cough, constipation, heavy physical exertion, smoking, and other conditions associated with repeated increases in intra-abdominal pressure have been proposed as contributing factors^{1,2}. Indian hospital-based data mirror this pattern, with inguinal hernias accounting for 70-80% of abdominal wall hernias and a marked predominance among men over 40 years, particularly those in physically demanding occupations⁴.

Benign prostatic hyperplasia (BPH) becomes increasingly common with advancing age^{5,6}. Histological prostate enlargement may be associated with lower urinary tract symptoms (LUTS), including urinary frequency, nocturia, hesitancy, weak urinary stream, intermittency, incomplete emptying, urgency, and straining during micturition. LUTS prevalence and severity vary considerably among older men⁷. Metabolic syndrome and obesity have also been associated with

larger prostate volumes and some measures of BPH progression⁸.

The coexistence of inguinal hernia and BPH has attracted clinical interest because urinary obstruction and associated straining during micturition may theoretically increase intra-abdominal pressure⁹. Research has documented changes in intra-abdominal pressure during normal activities and Valsalva-type manoeuvres in healthy adults¹⁰. In men with BPH, repeated straining during voiding could therefore provide a plausible mechanical link between urinary symptoms and hernia formation, although this hypothesis does not establish causality.

However, the relationship is complex. Both BPH and inguinal hernia become more common with advancing age, and age itself may therefore explain at least part of their observed coexistence^{11,12}. Other factors, including chronic cough, constipation, smoking, occupation, physical exertion and age-related connective tissue changes, may also contribute to hernia formation. Consequently, the presence of both conditions in an older male population does not necessarily establish a direct causal relationship¹³.

The relationship between BPH-related LUTS and inguinal hernia remains unclear. Some evidence suggests an association between the two conditions¹⁴, whereas other studies have not demonstrated significant differences in LUTS severity or BPH prevalence between men with and without hernia^{15,16}. More recently, a large population-based cohort demonstrated that men with LUTS due to BPH carried a significantly higher long-term risk of developing inguinal hernia¹⁷. Urinary straining, prostate enlargement, and postoperative urinary outcomes have also been investigated, but the available evidence remains heterogeneous.

This issue has clinical implications in addition to pathophysiology. Recognition of LUTS in men presenting for inguinal hernia surgery may impact perioperative assessment, evaluation of urinary obstruction, risk of postoperative urinary retention, and timing of urological management. There is currently limited evidence to support routine urologic evaluation of all men with an inguinal hernia. Hence, a cross-sectional study was conducted to determine the proportion of men presenting with inguinal hernia who have coexisting BPH and to compare selected demographic, urinary and clinical characteristics between participants with and without BPH. The study also aimed to determine the severity of LUTS using the International Prostate Symptom Score (IPSS), to compare prostate volume and uroflowmetry parameters between the two groups, and to evaluate the correlations between prostate volume, post-void residual volume and selected hernia-related characteristics.

Materials and Methods

A prospective cross-sectional study was conducted in the Departments of General Surgery at Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India. The study was carried out between May, 01, 2024 and October, 31, 2025, after approval by the Institutional Research Review Committee (IRRC) and the Human Research Ethics Committee (HREC) with Reference no. GU/HREC/EC/2024/2456. Written informed consent was obtained from all participants before enrolment. The aim of the study was to assess the prevalence of coexisting BPH in men presenting with inguinal hernia and compare their demographic and clinical characteristics.

This study included 180 male patients over 40 years of age, who were diagnosed with an inguinal hernia and admitted to the Department of General Surgery. Participants were recruited using a convenience sampling method during the study period. Patients who were medically unfit for surgery, had coexisting urethral pathology, presented with complicated inguinal hernia (complicated inguinal hernia is defined as inguinal hernia in which the herniated contents become irreducible, obstructed, or strangulated) or refused to participate in study were excluded. All participants provided written informed consent before enrolment.

A detailed clinical history and examination was performed, and study data were collected. All participants underwent general physical examination and local examination of the inguinal region, together with relevant routine preoperative investigations. Variables used in the present analysis included age, body mass index (BMI), comorbidities, smoking status, presenting urinary complaints, ultrasonographic hernia defect size, International Prostate Symptom Score (IPSS), prostate volume, and uroflowmetry parameters. In this analysis, the hernia characteristic assessed was ultrasonographic defect size, categorized as <2 cm, 2-4 cm, or >4 cm.

Lower urinary tract symptoms (LUTS) were assessed using the IPSS seven questions related to symptoms related to BPH (created in 1992 by the American Urological Association)²¹, which evaluates incomplete emptying, frequency, intermittency, urgency, weak urinary stream, straining, and nocturia. Based on the total IPSS, symptoms were categorized as mild (0-7), moderate (8-19), or severe (20-35). Prostate volume was estimated by ultrasonography and recorded in millilitres. Uroflowmetry was performed in all participants, and

peak urinary flow rate (Qmax), post-void residual (PVR) urine volume and voided volume were recorded.

Participants were classified into two groups: a hernia-only group and a hernia-with-BPH group. BPH was defined based on the presence of at least two of the following criteria: prostate volume ≥ 30 mL on ultrasonography, IPSS ≥ 8 , Qmax <15 mL/s, and PVR volume ≥ 50 mL[29]. The primary outcome was the proportion of participants with inguinal hernia who were classified as having coexisting BPH. Secondary outcomes included comparison of age, prostate volume, IPSS severity and uroflowmetry parameters between groups, and assessment of the relationships between prostate volume and hernia defect size and between PVR volume and BPH status.

Data were entered into Microsoft Excel and analysed using SPSS software version 26.0. Continuous variables were expressed as mean $\pm$ standard deviation and compared using the unpaired Student's t-test, while categorical variables were presented as frequencies and percentages and compared using the chi-square test. Pearson's correlation coefficient was used to assess linear relationships between selected continuous variables. A p-value <0.05 was considered statistically significant.

Results

Demographic and Anthropometric Characteristics

A total of 180 participants were analysed. The majority belonged to the 51–60 year and 61–70-year age groups, with 56 (31.11%) participants in each group. This was followed by the 71–80-year age group with 33 (18.33%) participants, the 40–50-year group with 29 (16.11%) participants, and aged over 80 years were 6 (3.33%) participants. The overall mean age was 61.84 ± 10.86 years, and the mean BMI was 23.30 ± 5.02 kg/m². Of the

180 participants, 94 (52.22%) had hernia without BPH and 86 (47.78%) had coexisting inguinal hernia and BPH. Participants with coexisting BPH were significantly older than those with hernia alone (Table 1).

Table 1: Demographic and Clinical Overview of Study Participants(n=180)

Variable	Category	n (%)	Mean $\pm$ SD	p-value
Age group	40–50 years	29 (16.11)	—	-
Age group	51–60 years	56 (31.11)	-	-
Age group	61–70 years	56 (31.11)	-	-
Age group	71–80 years	33 (18.33)	-	-
Age group	>80 years	06 (3.33)	-	-
Overall age	-	-	61.84 $\pm$ 10.86 years	-
Overall BMI	-	-	23.30 $\pm$ 5.02 kg/m ²	-
Mean age by BPH status	Hernia only group	-	52.71 $\pm$ 7.78 years	<0.01
Mean age by BPH status	Hernia + BPH group	-	71.35 $\pm$ 5.75 years	-
BPH status	Hernia only	94 (52.22)	-	-
BPH status	Hernia + BPH	86 (47.78)	-	-

Comorbidities and Smoking History

Among the documented medical conditions, COPD was reported in 20 (11.11%) participants and chronic constipation in 16 (8.89%). Bronchial asthma was present in 4 (2.22%) participants, while diabetes mellitus and hypertension were each reported in 3(1.67%) participants, the remaining 134 (74.44%) participants, had no documented comorbidity (Table 2).

Table 2: Comorbidities of Study Participants(n=180)

Comorbidity	Frequency(n)	Percentage(%)
Bronchial Asthma	4	2.22
Chronic Constipation	16	8.89
COPD	20	11.11
Diabetes Mellitus	3	1.67
Hypertension	3	1.67
None	134	74.44
Total	180	100.00

Regarding personal history, 60 (33.33%) participants reported smoking, while 120 (66.67%) were nonsmoker.

Presenting Complaints

The most common presenting complaint was groin swelling, reported by 152 (84.44%) participants, followed by pain over the swelling in 108 (60.00%) and dragging sensation in the groin in 48 (26.67%).

Urinary complaints included nocturia in 65 (36.11%) participants, increased frequency of micturition in 43 (23.89%), sensation of incomplete bladder emptying in 33 (18.33%), straining during micturition in 29 (16.11%), poor urinary stream in 27 (15.00%), hesitancy in 10 (5.56%), and acute urinary retention in 6 (3.33%) (Table 3).

Because participants could report more than one complaint, percentages do not sum to 100%.

Table 3: Presenting Complaints(n=180)

Presenting Complaint	Frequency (n)	Percentage (%)
Groin swelling	152	84.44
Pain over swelling	108	60.00
Dragging sensation in groin	48	26.67
Nocturia	65	36.11
Increased frequency of micturition	43	23.89
Incomplete bladder emptying	33	18.33
Straining during micturition	29	16.11
Poor urinary stream	27	15.00
Hesitancy	10	5.56
Acute urinary retention	6	3.33

Hernia Defect Size

Ultrasonography showed a hernia defect size of <2 cm in 72 (40.00%) participants, 2-4 cm in 102 (56.67%), and >4 cm in 6 (3.33%) (Table 4). The relationship between prostate volume and hernia defect size was further evaluated using correlation analysis.

Table 4: Distribution of Participants According to Ultrasonographic Hernia Defect Size(n=180)

Ultrasonographic hernia defect size	Frequency (n)	Percentage (%)
<2 cm	72	40.00
2-4 cm	102	56.67
>4 cm	6	3.33
Total	180	100.00

Prostate Volume and Uroflowmetry Findings

Mean prostate volume was significantly greater in the hernia-with-BPH group than in the hernia-only group (40.34 ± 5.46 mL vs 23.64 ± 3.82 mL, $p < 0.01$). All three uroflowmetry parameters also differed significantly between groups: mean Qmax was 14.45 ± 4.29 versus 20.99 ± 2.58 mL/s, mean post-void residual volume was 99.23 ± 13.14 versus 44.26 ± 6.47 mL, and mean voided volume was 216.09 ± 14.33 versus 287.18 ± 13.79 mL in the hernia-with-BPH and hernia-only groups, respectively (all $p < 0.01$) (Table 5).

Table 5: Comparison of Prostate Volume and Uroflowmetry Findings Between Groups

Parameter	Hernia Only (mean $\pm$ SD)	Hernia + BPH (mean $\pm$ SD)	p-value
Prostate volume (mL)	23.64 ± 3.82	40.34 ± 5.46	<0.01
Qmax (mL/s)	20.99 ± 2.58	14.45 ± 4.29	<0.01
PVR (mL)	44.26 ± 6.47	99.23 ± 13.14	<0.01
Voided volume (mL)	287.18 ± 13.79	216.09 ± 14.33	<0.01

Correlation Analysis

A positive correlation was observed between prostate volume and hernia defect size ($r = 0.63$, $p < 0.01$). A positive association was also observed between post-void residual volume and BPH status ($r = 0.18$, $p = 0.015$) (Table 6).

Table 6: Correlation Analysis

Variables	r value	p-value
Prostate volume vs hernia defect size	0.63	<0.01
PVR vs BPH occurrence	0.18	0.015

IPSS Category Distribution and Association with BPH Status

Overall, 80 (44.44%) participants had mild symptoms, 72 (40.00%) had moderate symptoms. Thus, 152 (84.44%) of the participants had mild or moderate symptoms, while 28 (15.56%) had severe symptoms. The distribution of IPSS severity categories according to BPH status is presented in Table 7.

Table 7: IPSS Category Distribution and Association with BPH Status (n=180)

BPH Status	Mild (0-7) n(%)	Moderate (8-19) n(%)	Severe (20-35) n(%)	Total (n=180)
Present	28 (32.6%)	35 (40.7%)	23 (26.7%)	86
Absent	52 (55.3%)	37 (39.4%)	5 (5.3%)	94
Total	80 (44.4%)	72 (40.0%)	28 (15.6%)	180

$$\chi^2 = 18.49, df = 2, p < 0.001$$

Discussion

The coexistence of benign prostatic hyperplasia (BPH), lower urinary tract symptoms (LUTS), and inguinal hernia in older men is biologically plausible, but the present findings should be interpreted mainly as evidence of coexistence rather than causation. Age is a particularly important alternative explanation because both BPH and inguinal hernia become more frequent with advancing age, and the study groups were not age-

matched. This limitation is consistent with previous work showing age as an important determinant of both prostate enlargement and inguinal hernia risk.¹¹

Previous studies have reported mixed findings regarding LUTS/BPH and inguinal hernia. Reis et al. described greater LUTS severity among men with inguinal hernia, whereas Sentürk et al. did not find evidence that the presence of a hernia independently worsened LUTS in men with BPH¹⁴⁻¹⁵. Parthiban and Durairaj likewise cautioned against considering BPH an independent hernia risk factor, while the population-based study by Wu et al. reported an increased subsequent risk of inguinal hernia among men with LUTS/BPH^{13,17}. The present study therefore fits within a literature that supports an association in some populations but does not establish a uniform causal relationship.

A proposed biological explanation is that bladder outlet obstruction can lead to repeated straining during voiding and transient increases in intra-abdominal pressure^{9-10,18}. This mechanism is plausible but is not specific to BPH, because chronic cough, constipation, occupational exertion, connective-tissue susceptibility, family history, and other factors can also influence hernia formation^{2,12,19-20}. Contemporary groin-hernia guidance recognizes age, male sex, family history, abnormal collagen metabolism, and previous prostatectomy among established or proposed risk factors, emphasizing the multifactorial nature of inguinal hernia¹⁹.

BPH status was significantly associated with IPSS severity in the present cohort ($\chi^2 = 18.49$, $df = 2$, $p < 0.001$). Among participants with BPH, 28 (32.6%) had mild, 35 (40.7%) had moderate, and 23 (26.7%) had severe symptoms; among those without BPH, the corresponding numbers were 52 (55.3%), 37 (39.4%), and 5 (5.3%). Thus, moderate-to-severe LUTS were

more frequent among participants classified as having BPH. Reis et al. reported greater LUTS severity among men with inguinal hernia, whereas Sentürk et al. and C Jina Priya et al. did not demonstrate a comparable difference in their respective comparison groups [14-16]. These studies used different comparison frameworks, and the present finding should therefore be interpreted as an association between BPH classification and symptom burden within a hernia cohort, not as evidence that BPH causes inguinal hernia. IPSS is a validated measure of symptom burden, but symptom severity does not correspond perfectly to prostate size or objective voiding measures^{21,22}. Population-based studies also demonstrate that LUTS severity spans a broad spectrum among ageing men²³.

Metabolic and systemic factors may further complicate the relationship. Systematic reviews have associated metabolic syndrome with larger prostate volume and some measures of BPH progression, although associations with symptom scores are less consistent^{8,24}. At the same time, studies of abdominal-wall hernia biology describe altered collagen composition and turnover in some patients, suggesting that connective-tissue vulnerability may coexist with mechanical stress rather than result from it alone²⁰. Therefore, future studies should assess urinary obstruction together with age, BMI, smoking, chronic respiratory disease, constipation, physical activity, metabolic factors, and other relevant covariates.

From a perioperative perspective, identifying clinically important LUTS remains relevant because older age and a history of BPH have been associated with postoperative urinary retention after inguinal hernia repair²⁵. Current LUTS/BPH guidance supports structured symptom assessment, clinical evaluation, and

selective use of uroflowmetry, residual urine measurement, PSA testing, and imaging according to the clinical context²⁶⁻²⁸. However, these recommendations do not imply that every man with an inguinal hernia requires routine urological screening. Prospective controlled studies with age-matched comparison groups and multivariable analysis are needed to determine whether targeted LUTS/BPH assessment changes hernia-related or perioperative outcomes.

Clinical Implications

The findings support attention to clinically relevant urinary symptoms in older men presenting with inguinal hernia. A brief LUTS history and, where indicated, use of the IPSS may help identify patients who warrant further urological assessment. However, the present study does not demonstrate that universal screening with IPSS, prostate ultrasonography or uroflowmetry improves surgical outcomes, prevents recurrence or is cost-effective.

Thus, the results do not justify systematic screening of urinary symptoms in all men, but rather targeted evaluation of urinary symptoms, especially in older men or those with significant LUTS.

Strengths and Limitations

Strengths

The design provided a structured approach to gathering clinical and demographic information. The study employed the IPSS questionnaire, which has been validated, and objective measures, such as prostate volume estimation and uroflowmetry. Correlation between urinary and hernia related parameters was also investigated.

Limitations

This study has limited assessment of association between BPH and inguinal hernia as there is no non-

hernia control group. Due to the single-centre cross sectional study design, generalisability can be restricted and conclusions cannot be drawn with regard to causality. The large age variation of the groups is an important potential confounder. Further, transabdominal ultrasonography may not be as accurate for assessing prostate size and the definition of BPH may need more specificity.

Conclusion

This study shows a high prevalence of coexisting BPH and hernia in men above 40 years, there is no statistically significant association between the two. Furthermore, hernia with BPH participants were significantly older than the hernia only group, thus reconfirming the coexistence of these two conditions as an age dependent phenomenon. There was a statistically significant correlation between the prostate volume and the hernial defect size, between the status of BPH and the IPSS severity, and in the uroflowmetry parameters. This together support a clinically relevant relationship between hernia and BPH, likely mediated through chronic straining and increased intra-abdominal pressure. These results highlight the importance of routine urological evaluation, including IPSS, prostate volume and uroflowmetry, in the preoperative evaluation of men over 40 years of age presenting with inguinal hernia, for the detection of occult lower urinary tract dysfunction and optimisation of perioperative management strategies.

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