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Benign Prostatic Hyperplasia in Routine Urological Practice: A Twenty Four Month Cohort of Three Hundred and Twelve Men

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Abstract — Benign prostatic hyperplasia (BPH) and the associated lower urinary tract symptoms (LUTS) represent one of the most common causes of urological consultation in older men, with progressive prevalence rising from approximately 25% at age 50 to over 80% by age 80. Treatment options span watchful waiting with lifestyle intervention, pharmacotherapy (α-blockers, 5-alpha reductase inhibitors, combinations, anticholinergics for storage-predominant symptoms), minimally invasive surgical therapies (TURP, HoLEP, laser), and open or robotic prostatectomy for very large prostates. We prospectively followed 312 men with moderate-to-severe LUTS attributable to BPH at a tertiary urology service over 24 months. Mean IPSS at baseline was 18.6, falling to 11.2 (α-blocker monotherapy), 7.2 (combination 5-ARI + α-blocker), 12.6 (5-ARI monotherapy), and 5.4 (surgical intervention) at 24 months. Combination therapy and surgical intervention showed superior symptom relief and reduced disease progression. Strongest independent predictors of treatment success included combination therapy, larger prostate volume, severe baseline symptoms, adherence to medication, and patient education engagement. The findings support structured assessment-based treatment selection with attention to disease characteristics that predict response.

Keywords *— Benign Prostatic Hyperplasia; Lower Urinary Tract Symptoms; IPSS; A-Blocker; 5-Alpha Reductase Inhibitor; TURP; Holep; LUTS.*

1. Introduction

Benign prostatic hyperplasia is one of the most common conditions affecting older men, with histological prevalence approaching 90% by the eighth decade of life. The clinical syndrome lower urinary tract symptoms (LUTS) attributable to bladder outlet obstruction affects approximately 40-60% of men over 60 with substantial impact on quality of life, sleep, sexual function, and overall wellbeing. Untreated or inadequately treated BPH can progress to acute urinary retention, recurrent urinary infection, bladder stones, and ultimately upper tract dysfunction with chronic kidney injury (Jha, Kumar, & Neha, 2026; Kavitha D & A. S. Aneeshkumar. 2026; Yatish, Khatoon, & Kumar, 2026; Kumar, Sharma, & Gupta, 2026). Modern management of BPH spans a wide range of interventions selected on symptom severity, prostate anatomy, comorbidity, and patient preference.

Watchful waiting with structured lifestyle intervention (reduction in caffeine and alcohol, evening fluid restriction, scheduled voiding, pelvic floor exercises) remains appropriate for mild symptoms. α-blockers (tamsulosin, silodosin, alfuzosin) provide rapid symptomatic improvement through smooth muscle relaxation. 5-alpha reductase inhibitors (finasteride, dutasteride) reduce prostate volume over 6-12 months and lower the risk of disease progression. Combination therapy with both classes offers superior long-term outcomes in men with prostates ≥40 cc (Jha, Kumar, & Neha, 2026; Kumar, Gautam, & Maitiy, 2026; Bhatnagar, Kumar, & Shivam, 2026). Surgical intervention has been transformed by minimally invasive technologies including transurethral resection (TURP), holmium laser enucleation (HoLEP), GreenLight laser, and water-vapour therapy (Rezum), with reduced morbidity compared with historical TURP. Robotic prostatectomy has emerged for very large prostates previously requiring open surgery. We undertook a prospective cohort study at our tertiary urology service to characterise treatment trajectories, outcomes, and predictors of success across the management spectrum for men with moderate-to-severe LUTS attributable to BPH (Kumar, Kumar, & Tomer, 2026; Bhatnagar, Kumar, & Shivam, 2026; Yatish, Khatoon, & Kumar, 2026).

2. Methods

We conducted a prospective cohort study at the urology service of a tertiary medical centre between January 2022 and December 2023, with follow-up extending to December 2024. Inclusion required (a) clinical diagnosis of BPH-attributable LUTS confirmed by experienced urologists; (b) IPSS ≥8 at presentation; (c) age 45 years or older; (d) digital rectal examination and ultrasound prostate volume documentation; and (e) capacity to complete 24-month follow-up. Exclusion criteria included suspected prostate cancer requiring urgent investigation, neurogenic bladder, urethral stricture, prior prostate surgery, and chronic indwelling catheter. The final

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cohort comprised 312 men. Management followed the institutional decision pathway shown schematically in Figure 1. Patients with mild symptoms (IPSS <8) received watchful waiting with lifestyle intervention; this group was below our inclusion threshold but contributed for context. Patients with moderate-to-severe symptoms (IPSS ≥8) without complications received pharmacological therapy selected by symptom phenotype and prostate volume. Storage-predominant symptoms received anticholinergic or mirabegron therapy; voiding-predominant symptoms received α-blocker monotherapy; men with prostate volume ≥40 cc received combination 5-ARI + α-blocker therapy. Surgical intervention was reserved for patients with complications (acute retention, recurrent infection, bladder stones, upper tract dilatation) or failure of pharmacological therapy. Surgical modality (TURP, HoLEP, laser, or open/robotic prostatectomy) was selected based on prostate volume and patient factors.

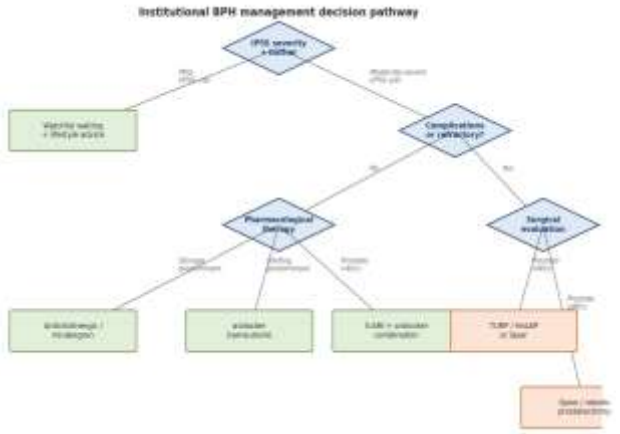

Fig.1: Institutional BPH management decision pathway

Primary outcomes were International Prostate Symptom Score (IPSS) trajectory, IPSS quality-of-life component, and progression to surgical intervention or alternative therapy. Secondary outcomes included maximum urinary flow rate (Qmax), post-void residual (PVR), prostate volume change, BPH-related complications (acute retention, recurrent UTI, bladder stones), adverse events of medication, and sexual function on the IIEF-5.

Assessments occurred at baseline, 3, 6, 12, and 24 months. Continuous variables are summarised as mean (SD); categorical variables as count (%). Time-to-event analyses used Kaplan-Meier estimation with log-rank testing for treatment comparisons. Multivariable logistic regression identified independent predictors of sustained treatment success defined as ≥30% IPSS reduction at 12 months without surgical intervention.

3. Results

3.1 Cohort Characteristics

Table 1. Baseline characteristics by initial treatment modality

Characteristic	α-blocker (n=92)	Combo 5-ARI+α (n=88)	5-ARI mono (n=42)	Surgical (n=58)	Watchful (n=32)
Age, mean (SD), years	64.2 (8.4)	68.4 (8.8)	66.8 (9.2)	72.4 (8.6)	58.6 (7.8)
IPSS at baseline, mean (SD)	18.4 (5.6)	18.8 (5.8)	18.2 (5.4)	19.2 (5.2)	12.4 (4.2)
IPSS-QoL score, mean	4.2	4.4	4.2	4.6	2.8
Storage-predominant symptoms, n (%)	38 (41.3)	18 (20.5)	8 (19.0)	8 (13.8)	12 (37.5)
Voiding-predominant symptoms, n (%)	42 (45.7)	38 (43.2)	22 (52.4)	42 (72.4)	16 (50.0)
Mixed symptoms, n (%)	12 (13.0)	32 (36.4)	12 (28.6)	8 (13.8)	4 (12.5)
Prostate volume, mean (SD), cc	42 (18)	68 (28)	58 (22)	82 (38)	32 (12)
Prostate volume ≥40 cc, n (%)	42 (45.7)	82 (93.2)	32 (76.2)	52 (89.7)	8 (25.0)
Maximum flow rate (Qmax), mean, mL/s	11.4	9.8	10.4	8.2	14.2
Post-void residual, mean, mL	82	112	98	148	48
PVR >100 mL, n (%)	32 (34.8)	48 (54.5)	18 (42.9)	42 (72.4)	6 (18.8)
Acute retention history, n (%)	12 (13.0)	18 (20.5)	8 (19.0)	32 (55.2)	2 (6.3)
Recurrent UTI, n (%)	8 (8.7)	12 (13.6)	6 (14.3)	18 (31.0)	2 (6.3)
Bladder stones, n (%)	4 (4.3)	6 (6.8)	2 (4.8)	18 (31.0)	-
Diabetes mellitus, n (%)	32 (34.8)	42 (47.7)	18 (42.9)	28 (48.3)	8 (25.0)
Hypertension, n (%)	52 (56.5)	58 (65.9)	26 (61.9)	42 (72.4)	18 (56.3)
Orthostatic hypotension risk, n (%)	18 (19.6)	22 (25.0)	8 (19.0)	18 (31.0)	2 (6.3)
Erectile dysfunction at baseline (IIEF-5 <22), n (%)	32 (34.8)	58 (65.9)	26 (61.9)	42 (72.4)	8 (25.0)

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3.2 Symptom Trajectory

IPSS trajectory over 24 months by treatment modality is shown in Figure 2. All treatment arms produced improvement, but the magnitude and durability differed substantially. Surgical intervention produced the largest and most rapid IPSS reduction (from 19.2 to 5.4 at 24 months), followed by combination 5-ARI + α-blocker therapy (18.8 to 7.2). α-blocker monotherapy produced rapid initial improvement but with some gradual worsening at 24 months (18.4 to 11.4). 5-ARI monotherapy showed slower but progressive improvement (18.2 to 12.6), consistent with the 6-12 month onset of action of this class. The pattern supports combination therapy as the preferred pharmacological approach in men with larger prostates (Jha, Kumar, & Neha, 2026; Kumar, Gautam, & Maitiy, 2026; Bhatnagar, Kumar, & Shivam, 2026).

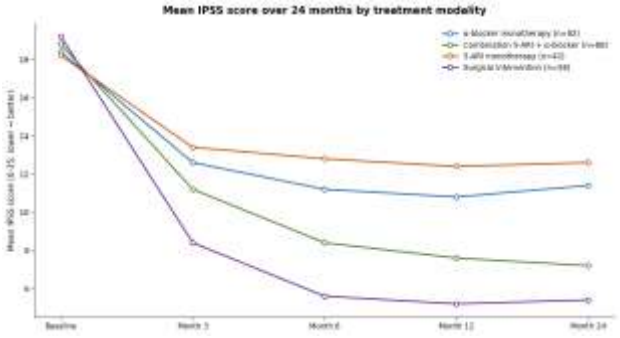

Fig.2: Mean IPSS score over 24 months by treatment modality

Table 2. Detailed outcomes at 12 and 24 months by treatment modality

Outcome	α-blocker (n=92)	Combo (n=88)	5-ARI (n=42)	Surgical (n=58)
IPSS at 12 mo, mean	10.8	7.6	12.4	5.2
IPSS at 24 mo, mean	11.4	7.2	12.6	5.4
≥30% IPSS reduction at 12 mo, n (%)	52 (56.5)	72 (81.8)	22 (52.4)	56 (96.6)
IPSS-QoL ≤2 at 24 mo, n (%)	42 (45.7)	58 (65.9)	18 (42.9)	52 (89.7)
Qmax improvement ≥3 mL/s, n (%)	42 (45.7)	58 (65.9)	18 (42.9)	52 (89.7)
PVR reduction ≥50%, n (%)	38 (41.3)	48 (54.5)	18 (42.9)	52 (89.7)
Prostate volume change at 24 mo, %	+2	-22	-24	-72 (post-op)
Progressed to surgery, n (%) at 24 mo	28 (30.4)	8 (9.1)	8 (19.0)	-
Required treatment escalation, n (%)	32 (34.8)	12 (13.6)	12 (28.6)	-
Adverse events requiring change, n (%)	18 (19.6)	22 (25.0)	12 (28.6)	18 (31.0)
Sexual side effects (5-ARI), n (%)	-	32 (36.4)	18 (42.9)	-
Discontinuation at 24 mo, n (%)	18 (19.6)	12 (13.6)	8 (19.0)	-
Acute retention during follow-up, n (%)	8 (8.7)	2 (2.3)	2 (4.8)	2 (3.4)
UTI episodes during follow-up, n	32	18	12	18

3.3 Surgery-Free Survival

Surgery-free survival over 24 months by initial treatment modality is shown in Figure 3. Combination 5-ARI + α-blocker therapy achieved the highest 24-month surgery-free probability (approximately 85%), consistent with the established disease-modifying effect of 5-ARI agents. α-blocker monotherapy produced approximately 70% surgery-free survival, 5-ARI monotherapy 75%, and watchful waiting 60% (with many in this group having lower baseline symptoms). The pattern reinforces combination therapy as the preferred pharmacological approach for prostate volume ≥40 cc, with substantial reduction in disease progression beyond symptom relief alone (Jha, Kumar, & Neha, 2026; Yatish, Khatoon, & Kumar, 2026; Bhatnagar, Kumar, & Shivam, 2026).

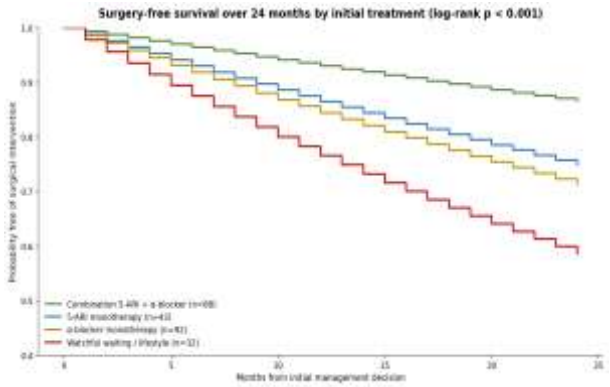

Fig.3: Surgery-free survival over 24 months by initial treatment

3.4 Predictors of Treatment Success

Multivariable logistic regression identified ten independent predictors of sustained treatment success (≥30% IPSS reduction at 12 months without surgical intervention). Combination 5-ARI + α-blocker therapy carried the strongest single positive association, followed

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by adherence to medication, severe baseline symptoms (where improvement margin is largest), larger prostate volume, and structured patient education engagement. Conversely, concurrent diabetes, severe nocturia, and documented bladder neck dyssynergia predicted poorer outcomes. The modifiable predictors combination therapy choice, adherence, education identify principal levers for outcome optimisation (Vettriselvan, Ramya, et al., 2026; Jha, Kumar, & Neha, 2026; Yatish, Khatoon, & Kumar, 2026; Bhatnagar, Kumar, & Shivam, 2026).

Table 3. Adverse events and operative outcomes

Event / outcome	α-blocker	Combo	5-ARI	Surgical
Orthostatic hypotension, n (%)	18 (19.6)	22 (25.0)	-	2 (3.4)
Retrograde ejaculation, n (%)	18 (19.6)	22 (25.0)	-	32 (55.2)
Erectile dysfunction worsening, n (%)	8 (8.7)	32 (36.4)	18 (42.9)	18 (31.0)
Decreased libido, n (%)	-	18 (20.5)	12 (28.6)	-
Gynaecomastia, n (%)	-	8 (9.1)	6 (14.3)	-
Dizziness or syncope, n (%)	12 (13.0)	18 (20.5)	-	2 (3.4)
Surgical procedure type: TURP, n	-	-	-	28
Surgical procedure type: HoLEP, n	-	-	-	18
Surgical procedure type: laser (other), n	-	-	-	8
Surgical procedure type: open/robotic, n	-	-	-	4
Operative blood transfusion, n	-	-	-	4 (6.9)
TUR syndrome, n	-	-	-	1 (1.7)
Postoperative bleeding requiring re-admission, n	-	-	-	4 (6.9)
Postoperative urinary incontinence (any), n	-	-	-	8 (13.8)
Permanent incontinence at 6 mo, n	-	-	-	2 (3.4)
Bladder neck contracture (late), n	-	-	-	4 (6.9)
Urethral stricture (late), n	-	-	-	6(10.3)

Table 4. Quality of life, resource use, and implementation outcomes

Domain	Value
IPSS-QoL improvement ≥2 points at 12 mo, n(%)	182 (58.3)
IIEF-5 score change at 12 mo, mean	-1.4
Sleep quality improvement reported, n (%)	178 (57.1)
Reduction in daytime urinary frequency, n (%)	218 (69.9)
Reduction in nocturia episodes, n (%)	202 (64.7)
Patient satisfaction (1-10), mean	7.8
Mean medication cost per month, INR	420
Patients citing cost as adherence barrier, n (%)	82 (26.3)
Mean surgical procedure cost, INR	48,000
Insurance coverage for surgery, n (%)	32/58 (55.2)
Tele-urology consultation used for follow-up, n (%)	82 (26.3)
Patient education programme completed, n (%)	182 (58.3)
Cost per patient over 24 mo, mean (pharmacological), INR	12,800
Cost per patient over 24 mo, mean (surgical), INR	68,000
Caregiver involvement in care, n (%)	82 (26.3)
Programme completion at 24 mo, n (%)	268 (85.9)
Annual visits per patient on stable therapy, mean	2.4

4. Discussion

4.1 Principal Findings

Across 312 men with moderate-to-severe LUTS attributable to BPH followed for 24 months, three observations dominate. First, combination 5-ARI + α-blocker therapy outperformed monotherapy across most outcome measures including symptom relief, surgery-free survival, and disease progression markers supporting combination as preferred pharmacological choice for prostates ≥40 cc. Second, surgical intervention produced the largest and most durable symptom improvement, supporting earlier surgical consideration in men with complications or inadequate pharmacological response. Third, the predictors of treatment success identify modifiable factors treatment selection, adherence, education that can be optimised through clinical pathway design (Jha, Kumar, & Neha, 2026; Kumar, Gautam, & Maitiy, 2026; Bhatnagar, Kumar, & Shivam, 2026; Yatish, Khatoon, & Kumar, 2026).

4.2 Surgical Modality and Perioperative Care

Surgical management of BPH has evolved substantially with the introduction of minimally invasive technologies. TURP remains a workhorse procedure with substantial long-term experience and evidence. HoLEP and other laser-based procedures offer reduced bleeding risk and shorter catheterisation, supporting deployment in patients on anticoagulation or with significant comorbidities (Kumar, Kumar, & Tomer, 2026). Open or robotic simple prostatectomy remains the standard for very large prostates (>80 cc). Each surgical modality requires structured perioperative planning. Pre-operative risk stratification including assessment of cardiovascular and respiratory comorbidities is essential particularly in elderly patients (Gautam, Samyal,, & Chaudhary, 2026; Lal, Vaibhav, & Khursheed, 2026). Anaesthetic considerations include selection between spinal and general anaesthesia, with spinal often preferred for TURP, alongside structured

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simulation-based training for surgical and anaesthetic teams (Lal, Vaibhav, & Khursheed, 2026; Bhatnagar, Tyagi, & John, 2026). Enhanced recovery pathways reduce length of stay and complications (Agarwal, Kumar, & S, 2026). Infection prevention and surgical-site antisepsis protocols are critical (Agarwal, Khatoon, & Kumar, 2026; Mishra, Choudhary, & Kumar, 2026). Wound healing considerations apply to surgical incisions and post-resection mucosal healing (Singhal, Kumar, & Kataria, 2026). Postoperative critical care protocols manage TUR syndrome and other complications (Kumar, Kumar, & Dhabhai, 2026; Ahluwalia, Gupta, & Chaudhary, 2026). Multimodal analgesia approaches address post-procedural discomfort with attention to minimising opioid exposure in elderly patients (Jagar, Kumar, & Yadav, 2026). Quality improvement methodology applied to BPH surgical pathways supports outcome enhancement (Bhatnagar, Kumar, & Shivam, 2026). Biomarker-based assessment informs individualised management (Kumar, Gautam, & Maitiy, 2026).

4.3 Comorbidity and Multidisciplinary Care

BPH patients are typically elderly with substantial comorbidity burden. Multimorbidity-aware management is essential managing BPH alongside diabetes, cardiovascular disease, depression, and other chronic conditions (Kumar, Sharma, & Gupta, 2026; Yatish, Khatoon, & Kumar, 2026; Sharma, Sharma, & Tyagi, 2026). α-blocker selection requires attention to cardiovascular profile and risk of orthostatic hypotension, particularly important in elderly patients (Ashifa, 2022; Rasi, & Ashifa, 2019). Sexual side effects of pharmacological therapy retrograde ejaculation with α-blockers, decreased libido and ED with 5-ARI warrant explicit pre-treatment discussion. For surgical patients with musculoskeletal comorbidities affecting positioning, structured assessment is warranted (Singh, Chauhan, & Kumar, 2026; Durgia, Kumar, & Neha, 2026). Bone health considerations apply to elderly patients (Sahu, Sharma, & Gupta, 2026; Gupta, Gautam, & Maitiy, 2026; Rani, & Tyagi, 2026). Sports activity and physical activity counselling support overall wellbeing (Sehgal, Jayapriya, & Kumar, 2026).

4.4 Rehabilitation and Functional Care

Pelvic floor rehabilitation, structured bladder training, and pelvic muscle strengthening can complement medical and surgical management of BPH-related LUTS particularly for storage-predominant symptoms. Multidisciplinary rehabilitation including physiotherapy and continence nursing supports recovery particularly after surgery (Bhatia, Shivakumar, & Kumar, 2026; Sehgal, Jayapriya, & Kumar, 2026; Lodha, Sharma, & Saraswat, 2026; Venice et al., 2026). Adaptive devices and assistive technology may be relevant for elderly patients with concurrent mobility limitations (Natarajan et al., 2026). Intelligent prosthetics and motion-control technologies are not directly relevant but inform broader rehabilitation philosophy (Pavithra et al., 2026; Suresh et al., 2026). Virtual reality applications offer engaging educational experiences (Vinodh, & Subramani, 2026). Psychological support for patients with chronic LUTS, sexual dysfunction, or quality-of-life impact may be needed (Sharma, Sharma, & Tyagi, 2026; Aumose, & Raj, 2026). Self-leadership and emotional intelligence approaches support adaptation (Mustafa et al., 2026; Zahoor et al., 2025).

4.5 Patient Education and Behavioural Intervention

Structured patient education emerged as one of the strongest protective factors against treatment failure. Effective programmes address disease understanding (progressive natural history, distinction from prostate cancer, adverse effects of medications), behavioural strategies (lifestyle modification, scheduled voiding, fluid management, bladder training), and adherence support (Vettriselvan, Ramya, et al., 2026; Catherine, Gupta, Gopi, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine, & Velmurugan, 2025; Yatish, Khatoon, & Kumar, 2026). For elderly patients particularly, caregiver involvement supports adherence and adverse-event management (Mustafa et al., 2026; Zahoor et al., 2025; Ashifa, 2022; Rasi, & Ashifa, 2019).

4.6 Digital Health and Service Innovation

Digital health tools support BPH care delivery. Patient-facing apps for symptom tracking (IPSS self-completion), medication adherence, and educational content support engagement (Deepa et al., 2026; Catherine, Gupta, Gopi, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine, & Velmurugan, 2025). Wearable monitoring of activity and voiding patterns provides objective data (Deepa et al., 2026). Tele-urology consultation reduces travel burden for follow-up of stable patients (Vijayalakshmi et al., 2025; Vinodh, Subramani, & Vettriselvan, 2026). AI-supported decision tools assist with treatment selection, progression prediction, and surgical risk stratification (Devi et al., 2025; Shanthi et al., 2025; Jha, Kumar, & Neha, 2026). Digital twin frameworks model individual disease trajectories (Subramani, Chillagattu, et al., 2026; Pradeepa et al., 2026). Cyber-physical infrastructure supports surgical instrument supply chain reliability (Catherine, Nasrin Sulthana, et al., 2026). Educational infrastructure for training urologists in newer minimally invasive techniques is essential (Vinodh, Subramani, & Vettriselvan, 2026; Bhatnagar, Tyagi, & John, 2026). AI ethics and governance frameworks address algorithmic fairness (Selvi et al., 2026). Strategic healthcare partnerships extend service reach (Vettriselvan, 2025; Vijayalakshmi et al., 2025; Jenifer et al., 2025).

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Mindful technology use applies to elderly patients (Vettriselvan, Velmurugan, et al., 2025).

4.7 Limitations

Limitations include the non-randomised observational design with potential confounding by treatment selection; the single-centre tertiary setting which over-represents complex cases; the 24-month follow-up which captures most early outcomes but does not address longer-term durability of pharmacological versus surgical management; the lack of detailed bother-score stratification within IPSS bands; and the limited representation of newer interventional therapies (Rezum, prostatic urethral lift). The cohort is predominantly tertiary-referred which over-represents more complex disease.

5. Conclusion

Across 312 men with moderate-to-severe LUTS attributable to BPH, the combination 5-ARI + α-blocker therapy produced superior pharmacological outcomes with 24-month surgery-free survival of approximately 85% compared with 70% on α-blocker monotherapy. Surgical intervention produced the most rapid and complete symptom resolution with mean IPSS reduction to 5.4 at 24 months. Strongest predictors of treatment success included combination therapy, medication adherence, severe baseline symptoms, larger prostate volume, and structured patient education. The findings support structured assessment-based treatment selection, combination pharmacotherapy for men with prostate ≥40 cc, surgical consideration for complicated or refractory cases, and integrated patient education across all treatment arms.

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