BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

MINIMALLY INVASIVE SURGICAL MANAGEMENT FOR BENIGN PROSTATIC HYPERPLASIA: CURRENT EVIDENCE, CLINICAL OUTCOMES, AND FUTURE DIRECTIONS

Dr Khadka Ravi Roshan,
MBBS, MS
Associate Professor
dr.ravi7209@gmail.com
Faculty of International Students, Asia International University

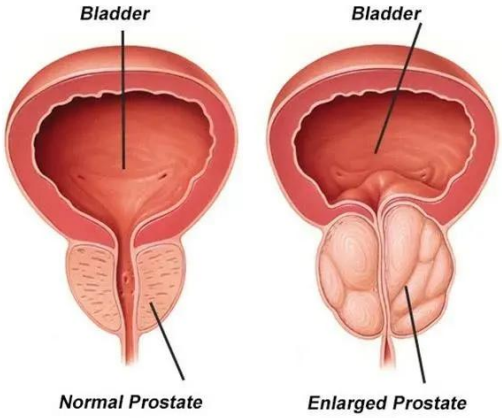
Abstract: Benign prostatic hyperplasia (BPH) is one of the most common urological conditions affecting aging men and a major cause of lower urinary tract symptoms (LUTS). Although transurethral resection of the prostate (TURP) has long been regarded as the gold standard surgical treatment, the last two decades have witnessed significant advances in minimally invasive surgical therapies (MISTs). These techniques aim to provide effective symptom relief while minimizing perioperative morbidity, preserving sexual function, and reducing hospitalization. Emerging procedures such as prostatic urethral lift (PUL), water vapor thermal therapy (Rezūm), prostatic artery embolization (PAE), aquablation, temporary implantable nitinol device (iTind), and laser-based enucleation techniques have expanded treatment options for patients with varying prostate sizes and comorbidities. This review summarizes the current evidence regarding minimally invasive surgical management of BPH, compares clinical outcomes and complications among available modalities, and discusses future directions including personalized treatment selection, technological innovation, and artificial intelligence-assisted surgical planning. MISTs have demonstrated promising efficacy and safety profiles, although long-term comparative data remain limited for several newer technologies.

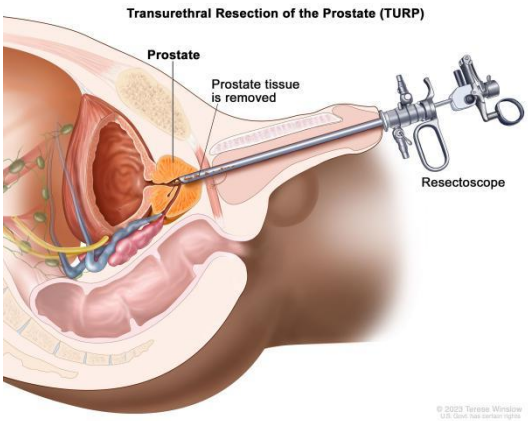
Keywords: Benign prostatic hyperplasia, minimally invasive surgery, lower urinary tract symptoms, aquablation, Rezūm, prostatic urethral lift.

Introduction

Benign prostatic hyperplasia (BPH) is a progressive enlargement of the prostate gland commonly observed in aging men. Histological evidence of BPH is present in approximately 50% of men by the age of 60 years and up to 90% by the age of 85 years (1). BPH frequently results in lower urinary tract symptoms (LUTS), including urinary frequency, urgency, nocturia, hesitancy, weak urinary stream, and incomplete bladder emptying, significantly affecting quality of life (2).

BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL





While medical therapies such as alpha-blockers and 5-alpha reductase inhibitors remain first-line treatment, many patients eventually require surgical intervention due to inadequate symptom control, urinary retention, recurrent infections, bladder stones, or renal dysfunction (3). Traditional TURP has demonstrated excellent outcomes but may be associated with bleeding, prolonged catheterization, retrograde ejaculation, and hospitalization (4). Consequently, minimally invasive surgical therapies (MISTs) have emerged as attractive alternatives.

Evolution of Minimally Invasive Surgical Therapies

The primary goals of MISTs include reducing perioperative morbidity, preserving sexual function, shortening recovery time, and providing durable symptom relief. Recent technological advances have led to the development of various minimally invasive approaches that can often be performed in outpatient settings (5).

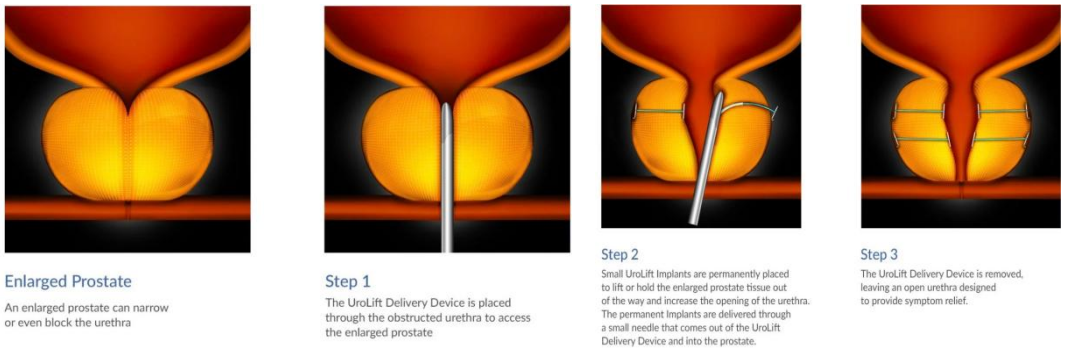
Current MISTs include:

- Prostatic Urethral Lift (PUL/UroLift)
- Water Vapor Thermal Therapy (Rezūm)
- Prostatic Artery Embolization (PAE)
- Aquablation Therapy
- Temporary Implantable Nitinol Device (iTind)
- Holmium Laser Enucleation of the Prostate (HoLEP)
- Thulium Laser Enucleation of the Prostate (ThuLEP)
- Photoselective Vaporization of the Prostate (PVP)

Prostatic Urethral Lift (UroLift)

BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

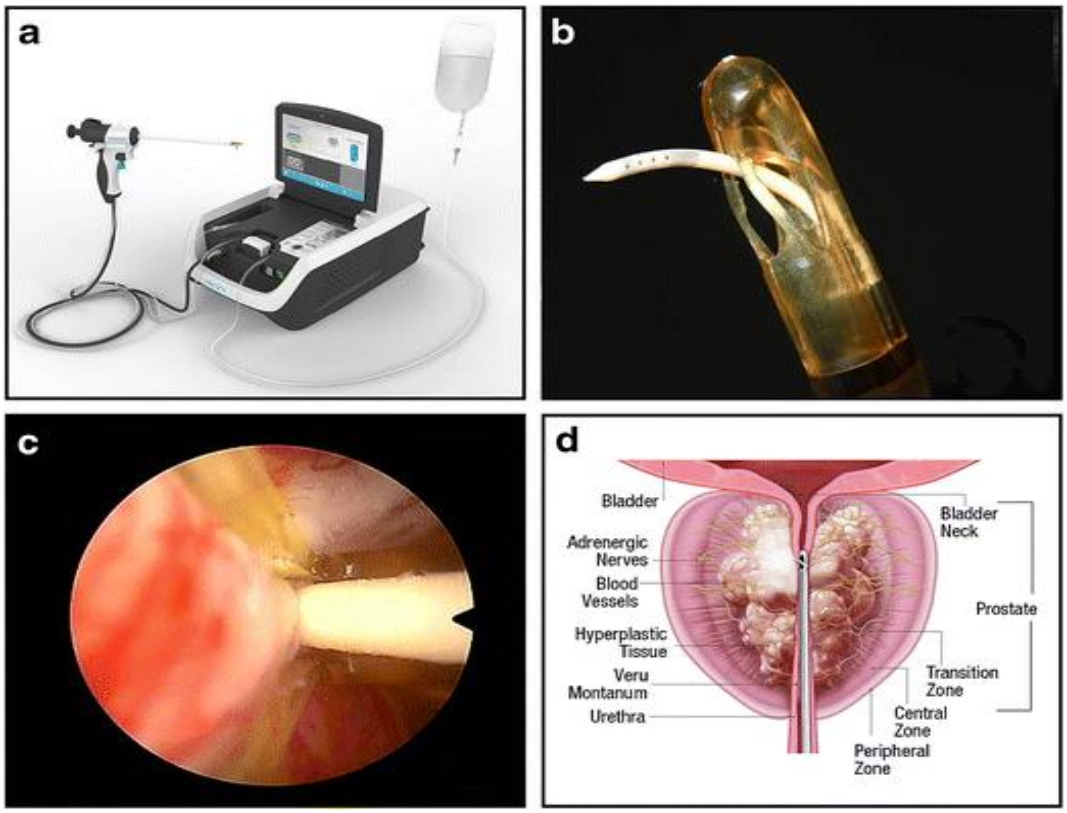
The prostatic urethral lift mechanically retracts obstructing prostatic tissue using permanent implants without tissue removal. The procedure can be performed under local anesthesia and generally preserves erectile and ejaculatory function (6).



Clinical trials have demonstrated significant improvements in International Prostate Symptom Score (IPSS), quality of life, and urinary flow rates. The L.I.F.T. study reported durable symptom improvement up to five years with minimal sexual side effects (7). However, retreatment rates may be higher compared with TURP.

Water Vapor Thermal Therapy (Rezūm)

Rezūm utilizes convective radiofrequency-generated water vapor to induce targeted thermal destruction of prostatic tissue. The procedure is minimally invasive and can be performed in office settings (8).



Several studies have reported significant reductions in LUTS and improvements in urinary flow rates while preserving sexual function. Five-year follow-up data demonstrate sustained efficacy and low retreatment rates (9). Rezūm is particularly attractive for patients wishing to avoid ejaculatory dysfunction.

Prostatic Artery Embolization

PAE is an image-guided procedure performed by interventional radiologists. Embolization of prostatic arteries induces ischemic shrinkage of prostate tissue and subsequent symptom improvement (10).

Meta-analyses suggest that PAE provides meaningful symptom relief and improved quality of life, especially in patients with large prostates or significant surgical risk. Nevertheless, outcomes may be somewhat inferior to TURP in terms of urinary flow improvement (11).

Aquablation Therapy

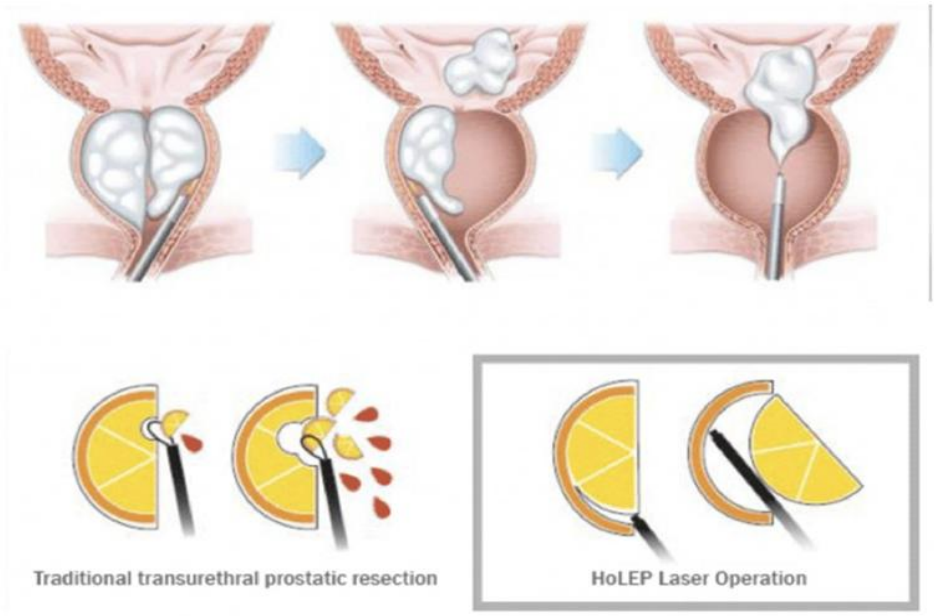
Aquablation combines robotic assistance with high-velocity saline jet ablation under real-time ultrasound guidance. The technique offers precise tissue removal while minimizing thermal injury (12).

Randomized controlled trials have demonstrated comparable symptom relief to TURP with reduced rates of ejaculatory dysfunction. Aquablation appears particularly effective for larger prostates and complex anatomy (13).

Laser-Based Therapies

Holmium Laser Enucleation of the Prostate (HoLEP)

HoLEP has become an increasingly popular minimally invasive alternative to TURP and open prostatectomy. The procedure enables complete anatomical enucleation of adenomatous tissue regardless of prostate size (14).



Numerous studies have demonstrated superior durability, lower bleeding risk, shorter catheterization times, and reduced hospital stay compared with conventional surgery. HoLEP is currently considered one of the most effective surgical options for large prostates.

Photoselective Vaporization of the Prostate (PVP)

PVP utilizes a high-powered potassium-titanyl-phosphate laser to vaporize prostatic tissue. It is particularly useful in anticoagulated patients because of its excellent hemostatic properties (15).

Clinical Outcomes and Comparative Effectiveness

Most MISTs achieve significant improvements in symptom scores, urinary flow rates, and quality of life. HoLEP and aquablation generally provide outcomes comparable to TURP, whereas UroLift and Rezūm prioritize preservation of sexual function and faster recovery.

Procedure	Symptom Relief (IPSS)	Qmax Improvement	Sexual Function Preservation	Hospital Stay	Durability
HoLEP	Excellent	Excellent	Moderate	Short	Excellent
Aquablation	Excellent	Excellent	Good	Short	Very Good
TURP	Excellent	Excellent	Fair	Moderate	Excellent
Rezūm	Good	Good	Excellent	Outpatient	Good
UroLift	Moderate–Good	Moderate	Excellent	Outpatient	Moderate

Challenges and Limitations

Despite encouraging outcomes, several challenges remain. Long-term durability data beyond 10 years are unavailable for many newer therapies. Cost-effectiveness varies considerably between healthcare systems. Additionally, learning curves and equipment costs may limit widespread adoption.Comparative effectiveness studies involving newer technologies remain limited, and treatment selection continues to rely largely on physician experience and institutional resources.

Future Directions

The future of BPH surgery is likely to emphasize personalized treatment strategies. Advances in imaging, artificial intelligence, and predictive analytics may facilitate individualized procedure selection. Emerging technologies such as robotic-assisted enucleation, focal therapy, and next-generation thermal ablation systems are currently under investigation.

Integration of patient-reported outcomes, sexual function preservation, and quality-of-life metrics into treatment algorithms will further enhance patient-centered care. As evidence accumulates, MISTs are expected to become increasingly prominent in BPH management.

Conclusion

Minimally invasive surgical therapies have transformed the management of benign prostatic hyperplasia. Techniques such as UroLift, Rezūm, PAE, aquablation, and laser enucleation provide effective symptom relief with reduced morbidity and improved functional outcomes. While TURP remains an important benchmark, contemporary MISTs offer valuable alternatives tailored to individual patient needs. Continued research, long-term follow-up studies, and technological innovation will further refine the role of these therapies in the evolving management of BPH.

References

1. Berry SJ, Coffey DS, Walsh PC, Ewing LL. The development of human benign prostatic hyperplasia with age. J Urol. 1984;132(3):474-479.

2. McVary KT. BPH: Epidemiology and comorbidities. Am J Manag Care. 2006;12.

3. Gratzke C, Bachmann A, Descazeaud A, Drake MJ, Madersbacher S, Mamoulakis C, et al. EAU Guidelines on BPH. Eur Urol. 2015;67(6):1099-1109.

4. Reich O, Gratzke C, Bachmann A, Seitz M, Schlenker B, Hermanek P, et al. Morbidity, mortality and early outcome of TURP. Eur Urol. 2008;54(5):969-980.

5. Foster HE, Barry MJ, Dahm P, Gandhi MC, Kaplan SA, Kohler TS, et al. Surgical management of LUTS attributed to BPH: AUA Guideline. J Urol. 2019;202(3):592-598.

6. Roehrborn CG. Prostatic urethral lift: Clinical evidence and outcomes. Can J Urol. 2017;24(3):8802-8813.

7. Roehrborn CG, Rukstalis DB, Barkin J, Gange SN, Shore ND, Giddens JL, et al. Five-year results of the L.I.F.T. study. Can J Urol. 2017;24(3):8802-8813.

8. McVary KT, Rogers T, Roehrborn CG. Rezūm water vapor therapy for BPH. J Urol. 2019;201(4):731-742.

9. McVary KT, Rogers T, Roehrborn CG. Final 5-year outcomes of Rezūm therapy. Urology. 2021;148:256-262.

10. Carnevale FC, Iscaife A. Prostatic artery embolization for BPH. Radiology. 2020;295(2):289-301.

11. Ray AF, Powell J, Speakman MJ, Longford NT, DasGupta R, Bryant T, et al. PAE versus TURP for BPH. Lancet. 2018;391(10131):1929-1938.

12. Gilling P, Anderson P, Tan A, Barber N, Bidair M, Bolton D, et al. Aquablation for BPH. J Urol. 2018;199(5):1252-1261.

13. Gilling P, Barber N, Bidair M, Anderson P, Sutton M, Aho T, et al. Five-year outcomes of aquablation. J Urol. 2022;207(4):800-806.

14. Elmansy HM, Krambeck AE, Holmium laser enucleation of the prostate. Eur Urol. 2012;62(5):865-871.

15. Bachmann A, Tubaro A, Barber N, d'Ancona F, Muir G, Witzsch U, et al. 180-W XPS GreenLight laser vaporization outcomes. Eur Urol. 2014;65(5):931-942.