

Does Aquablation wash away holmium laser enucleation of the prostate (HoLEP)?: a comparison of the techniques and outcomes

Brian T. Helfand,^{1,2*} Juan Justo Quintas,^{3,4,5} Gerald Park,⁶ Kevin C. Zorn,⁷ Mark Rochester,⁸ Philip J. S. Charlesworth,⁹ Alexander P. Glaser^{1,2}

¹Department of Surgery, Endeavor Health, Evanston, IL, USA

²Section of Urology, University of Chicago, Chicago, IL, USA

³Department of Surgery, Roc Clinic, Madrid, Spain

⁴Department of Urology, HM Hospitales, Madrid, Spain

⁵Department of Urology, HM Hospitales Faculty of Health Sciences, University Camilo José Cela, Madrid, Spain

⁶Kansas City Urology Care, Kansas City, MO, USA

⁷BPH Canada Prostate Surgical Institute, Montreal, QC, Canada

⁸Department of Urology, Norfolk and Norwich University Hospitals, NHS Foundation Trust, Norwich, UK

⁹Department of Urology, The Royal Marsden Hospital, London, UK

HELFAND BT, QUINTAS JJ, PARK G, ZORN KC, ROCHESTER M, CHARLESWORTH PJS, GLASER AP. Does Aquablation wash away holmium laser enucleation of the prostate (HoLEP)?: a comparison of the techniques and outcomes. *Can J Urol* 2026;33(5):1141–1157.

Benign prostatic hyperplasia (BPH) is the most prevalent urological condition in aging men and often requires surgical treatment. While traditional procedures such as open simple prostatectomy (OSP) and transurethral resection of the prostate (TURP) have been widely used, newer modalities, including holmium laser enucleation of the prostate (HoLEP)/anatomic endoscopic enucleation of the prostate (AEEP), initially described in 1997, and Aquablation robotic waterjet therapy (RWT) with FDA approval in 2018, have emerged as modern contenders as a new gold standard. This review study aimed to compare HoLEP and Aquablation RWT across various clinical domains, including symptom relief, quality of life (QoL), sexual function, perioperative outcomes, durability, and learning curves, to guide evidence-based surgical decision-making for BPH treatment. A

comprehensive analysis of published randomized trials, registry data, and institutional experience was conducted and outcomes were compared. Both techniques result in significant improvements in LUTS and QoL. HoLEP remains a durable treatment, especially for large prostates, with <2% retreatment rates; however, it is associated with a steep learning curve, temporary or permanent stress urinary incontinence (SUI), and high rates of ejaculatory dysfunction. In comparison, Aquablation RWT is associated with a shorter learning curve, comparable improvements in LUTS, minimal SUI, and superior preservation of antegrade ejaculatory function. Same-day discharge is feasible for both techniques. Both HoLEP and Aquablation offer superior urinary outcomes compared to TURP for prostates of all volumes. However, given the low learning curve, minimal risk of stress incontinence and ejaculatory function preservation, Aquablation is an increasingly attractive option for both physicians and patients.

Key Words: Aquablation, holmium laser enucleation of the prostate (HoLEP), anatomic endoscopic enucleation of the prostate (AEEP), waterjet, laser, benign prostatic hyperplasia (BPH), outcomes

Received date 19 September 2025

Accepted for publication 19 August 2026

Published online 30 October 2026

*Corresponding Author: Brian T. Helfand.

Email: brian.helfand@endeavorhealth.org

Introduction

Benign prostatic hyperplasia (BPH), a common cause of lower urinary tract symptoms (LUTS), remains the most prevalent urological condition that affects men's quality of life (QoL) and therefore motivates men to seek urologic care in the United States and globally.¹ Notably, BPH ranks as the second leading source of years lived with disease worldwide, contributing to an annual global treatment cost exceeding \$78 billion.² While pharmacological therapy is often prescribed to men as initial therapy, its overall effectiveness and long-term compliance remain low.^{3,4} Therefore, surgery to remove bladder outlet obstruction (BOO) from BPH remains the most definitive and durable treatment for men with moderate to severe LUTS.

Open simple prostatectomy (OSP), as well as laparoscopic and robotic multi- and single-port simple prostatectomy, still play an important role in the surgical treatment of BPH, and, in particular, it is recommended as a standard surgical treatment for large and very large prostates with volume ≥ 80 mL.^{5,6} There are also benefits for concurrent management of large bladder stones and/or those men with large bladder diverticula. OSP has been associated with significant and durable improvements in LUTS in multiple studies techniques.⁷⁻¹⁰ However, it has also been linked to various complications intra-, peri-, and post-operative, even with less invasive laparoscopic or robotic.¹¹⁻¹³

Transurethral resection of prostate (TURP) has offered a more minimally invasive approach to treat BPH,^{14,15} and has been considered the gold standard surgical treatment.^{16,17} However, its association with significant sexual side effects and limited efficacy in larger prostates has prompted the development of alternative procedures with improved safety and broader applicability. Among these, laser enucleation of the prostate (holmium; HoLEP, or thulium; ThuLEP; also sometimes labeled anatomical endoscopic enucleation of the prostate [AEEP] as an energy-source independent name) has emerged as a leading contender, offering comparable or superior outcomes to TURP and OSP with a more favorable safety profile and size-independent applicability.^{18,19} Despite these advantages, HoLEP's technical complexity and steep learning curve, with case volumes of proficiency and expertise reported at 50 and >200 , respectively, have limited its widespread adoption, as reflected in stable, low overall usage rates over the past decade.²⁰⁻²²

In contrast, Aquablation, or robotic waterjet treatment (RWT), represents a novel, ultrasound-guided,

robot-executed technique that utilizes a computer-automated, programmed high-velocity saline jet to precisely remove obstructing prostate adenoma.²³ Gaining momentum in the US and world over the past decade, Aquablation has been associated with comparable symptom relief to TURP, while potentially offering advantages such as reduced sexual dysfunction and incontinence—especially in patients with larger prostate volumes.²³⁻²⁵ In addition, it has been shown to have efficacy among men with intravesical prostatic protrusion/median lobes, bladder stones, prior BPH surgeries, and among men in urinary retention.²⁶⁻³⁰ Though currently recommended for prostates under 80 mL by the European Urology Association and American Urological Association guidelines,^{6,31} clinical data supports use in prostates up to and above 150 mL,³²⁻³⁵ the Canadian Urological Association guidelines support use in prostates up to 150 mL,³⁶ and additional data in large prostates remains forthcoming. As such, Aquablation is a size and shape-independent, efficacious technique for removing BOO secondary to BPH.

Given the increasing demand for individualized treatment selection and shared decision-making, a robust comparison is needed. The results of recent randomized trials comparing these techniques have been presented. In this context, we conducted a comparison of HoLEP/AEEP and Aquablation/RWT, aiming to provide urologists and patients with evidence-based guidance to inform surgical decision-making for BPH treatment.

Comparison of Available Evidence-Based Literature

While HoLEP/AEEP is widely considered a technically superior surgical approach, its evidence base reflects the regulatory era in which it was developed. Unlike modern BPH therapies that require rigorous, centrally adjudicated FDA pivotal trials for market approval, HoLEP was established largely through investigator-initiated research. Consequently, many of these studies are retrospective in nature, lack blinding or standardized methodologies throughout the trial, and/or do not measure continence, limiting applicability in guiding evidence-based practice.³⁷⁻³⁹ Even some of the prospective trials, such as those by Kuntz et al.,⁴⁰ Wilson et al.,⁴¹ and Montorsi et al.,⁴² while valuable, do not consistently meet the standards of contemporary, multi-institutional randomized controlled trials (RCTs), particularly when considering long-term follow-up, standardized outcome reporting, and enrollment across varied practice

settings.^{40–43} Additionally, the literature reflects a limitation in HoLEP studies regarding external validity due to the steep and prolonged learning curve required for surgical proficiency. For example, in the RCT of TURP vs. greenlight vapo-enucleation vs. HoLEP by Elshal et al.,⁴⁴ each surgeon had experience with ≥ 300 cases before the start of the trial. As such, the pool of participating surgeons in trials has often been limited to a small number of high-volume, highly specialized academic centers. Such limitations in surgeon and site diversity somewhat hamper the ability to generalize HoLEP outcomes to broader clinical practice.⁴⁵

In contrast, Aquablation RWT has been subjected to several regulatory studies with a higher level of scientific scrutiny through multiple well-designed, prospective, multi-institutional RCTs, most notably the WATER and WATER II trials.^{23,46} These studies were double-blind, multicenter trials with rigorous inclusion criteria and robust long-term follow-up. The WATER trial, for example, demonstrated not only non-inferior urinary symptom relief compared to TURP at five years but also superiority in some domains such as reduced ejaculatory dysfunction and lower rates of early post-operative complications.

WATER III represents one of the first multi-institutional prospective RCTs evaluating the outcomes of AEEP.⁴⁷ The WATER III trial is a multicenter, prospective, RCT designed to compare Aquablation with AEEP (HoLEP or ThuLEP) for the treatment of men with large prostates (80–180 mL). Conducted across five sites in Germany and the United Kingdom, the study required participating surgeons to have performed a minimum of 30 procedures to ensure baseline proficiency. Primary endpoints included the change in International Prostate Symptom Score (IPSS) and the rate of Clavien-Dindo adverse events at 3 months. Secondary endpoints included changes in QoL scores, sexual function, and urinary flow (Q_{max}), with follow-up extending up to 5 years.

Taken together, HoLEP's status as a "platinum standard" is supported by decades of clinical success, yet its evidence base differs structurally from that of emerging BPH technologies. Because HoLEP predates modern FDA pivotal trial requirements, it was never subjected to the rigorous, multi-center regulatory studies mandated for newer devices. Thus, the dichotomy in the level of evidence between AEEP and RWT should be carefully considered by clinicians and guideline committees when weighing treatment recommendations and should be considered when interpreting data.

Comparison of Surgeon Learning Curve

There have been many variations of techniques that have been developed for HoLEP. Most recently, a majority of surgeons incorporate en-bloc resection techniques with early apical release in an effort to reduce the incidence of incontinence.^{48,49} The number of cases above with a surgeon who can perform HoLEP/AEEP safely with satisfactory efficiency and good outcomes has been estimated at 50 cases, albeit requiring careful case selection.^{50,51} In this learning curve, avoidance of large volume prostate glands or unusual anatomic variants is recommended, coupled with fellowship training or close mentorship during those initial 50–100 cases. Procedures performed during this learning curve have been consistently reported to be associated with longer operative times, higher complication rates, incontinence rates, and re-treatment rates.^{20,51–53} As such, there is a cost to patient outcomes during this period of apprenticeship. Furthermore, more than half of HoLEP trainees reported >50 cases to master laser enucleation.⁵⁴ However, any hard cutoff of a "learning curve" is artificial, as we are continually learning from our patients and experiences. For example, continued learning and efficiency continue to occur during the first 500 HoLEP cases.²¹ In support of this, a report of a single surgeon's HoLEP experience demonstrated a significant decrease in operative time from an average of 64.05 min in the first 100 cases to 42.02 min in the last 100 cases performed. Many experts call for specialized training programs or fellowships to aid in this learning curve, and while independent learning of this technique is possible, it can be challenging.⁵⁴ In addition, the learning curve and associated complications cause many surgeons to abandon performing the procedure, and likely inhibit the widespread adoption of this technique.⁵³ A prospective, multi-center observational study, involving surgeons experienced in TURP and OSP but naïve to HoLEP, evaluated the learning curve of HoLEP. The main judgment criterion was the ability of the surgeon to perform four consecutive successful procedures. The authors concluded that despite mentored training, HoLEP still has a steep learning curve, causing almost half of the programs to abandon or not continue with the technique.⁵³ Therefore, although the prevalence of men with symptomatic LUTS related to BPH is the main motivation for seeking urologic care and spans across all demographics and geographies, until this challenge is overcome via training programs, HoLEP/AEEP surgeons will largely remain at academic institutions centralized

in urban centers, and HoLEP overall will remain utilized infrequently.^{22,55–59}

The Aquablation RWT technique utilizes skillsets that are already a part of the fundamental basis of all urologic training programs and most urologists utilize in their daily practices: cystoscopy and transrectal ultrasound. Because of the familiarity of these basic urologic techniques, most urologists can learn Aquablation RWT rather quickly, with such technologies and automated RWT execution democratizing surgical outcomes. As an example, in the WATER study, most participating study investigators were naïve to Aquablation prior to the trial (average of 0.5 cases/surgeon performed before study initiation).²³ Despite this lack of experience, investigators were able to achieve successful immediate and 5-year outcomes that were non-inferior or superior to TURP.^{23,25,60} A multi-institutional study evaluating the learning curve of 3 naïve Aquablation surgeons demonstrated that surgeons were able to achieve at least a 50% “trifecta” (operative time <60 min, hemoglobin reduction ≤ 2 mg/dL, and no 90 day Clavien-Dindo grade ≥ 2 complications) frequency within 4 cases and a “pentafecta” (the above trifecta + significant improvement in IPSS score and ejaculatory preservation) within 38 cases.⁶¹ This number may have motivated the WATER III study design to require participating investigators to have performed at least 30 Aquablation cases. Our institutional experience of the first 500 cases demonstrates a slight statistical, but not clinically significant, improvement in total operative time with experience. Specifically, the first 100 cases of this series performed were on average 47.5 min, and the last 100 cases were 42.3 min in duration (unpublished data). A query of the past 20 recently graduated urologic trainees reports that all feel comfortable incorporating Aquablation into their future practices without further fellowship training (unpublished data). Furthermore, there are currently no specialized training programs or multi-year fellowships dedicated to learning Aquablation, emphasizing its short learning curve.

Comparison of Operative Times

Both HoLEP and Aquablation procedures require two stages for successful completion. The first stage of HoLEP involves the laser enucleation of the prostate adenoma, whether en-bloc or as enucleation of separate lobes. The second stage involves tissue morcellation of the enucleated adenoma within the bladder. The two stages of Aquablation involve ablation of the adenoma with the waterjet and then

focal bladder neck cautery with either a bipolar or monopolar resectoscope to validate hemostasis.^{62,63}

Operative times for HoLEP are influenced by many factors, including but not limited to surgeon experience, laser type, morcellator type, and size, as well as tissue composition of the prostate gland. Occasional dense stromal nodules may plague the morcellation device and require conversion to a transurethral resection or open retrieval of enucleated tissue. Unintended injury to the bladder has occurred during morcellation and subsequent procedures. Operative times for total HoLEP operative times have ranged from 59 to 135 min.^{64–66} Among these enucleation times range between 40.4 to 80 min.^{65,66} Improved laser technology, including the incorporation of the MOSES 2.0 holmium laser, can improve enucleation times.⁶⁵ Morcellation times can increase total operative time by over 50 min and can range up to 260 min.^{66,67}

Aquablation operative times are less dependent on surgeon experience and prostate volume. Total median (IQR) operative time in the WATER and WATER II clinical trials was 37 (17) and 51 (22), respectively.^{23,46,68} In these two clinical trials, total resection time with the Aquabeam waterjet was on average 3.9 (range 2–11) and 8.0 (range 2.5–17) min, respectively. Additional contributions to total operative time include setup, ultrasound alignment, irrigation, and hemostasis. In a retrospective study of greenlight photovaporization of the prostate (PVP), greenlight enucleation (greenLEP), ThuLEP, HoLEP, Aquablation RWT, procedure time was longest for PVP, intermediate for HoLEP/AEEP, and lowest for Aquablation.⁶⁹

In direct modern comparisons, operative times appear similar between the two modalities. There was no significant difference in operative times in the WATER III trial between Aquablation and HoLEP (58.1 ± 19.6 vs. 61.8 ± 25.8 min, $p = 0.27$), where surgeons had 30–200 case experience compared to >2000 case volume experience, respectively.⁴⁷ Furthermore, in a prospective multi-center non-randomized study of HoLEP vs. Aquablation, Justo Quintas et al.⁷⁰ found no difference in operative times between HoLEP vs. Aquablation (43.9 ± 26.8 min vs. 49.1 ± 15 min; $p = 0.052$).

Transfusion Rate Comparison

The prostate receives its blood supply primarily from the inferior vesical artery, with additional contributions from the middle rectal and internal pudendal arteries. Based upon this robust blood supply, it is

no surprise that many prostate surgeries have been associated with significant blood loss requiring transfusions.

In its early development, Aquablation RWT was associated with clinically significant bleeding rates in the WATER and WATER II (where no prostate cautery was used and only catheter traction devices, such as the continuous traction device, were utilized) trials. Specifically, post-operative bleeding rates requiring peri-operative transfusion varied from 0.9% to 5.9% for prostates 30–80 cc and 80–150 cc, respectively.^{23,24} Unfortunately, because of this, societal guidelines caution about bleeding risk associated with Aquablation. With further experience and introduction of focal bladder neck cautery, Elterman et al.⁶² demonstrated that Aquablation transfusion rates depended on the method of hemostasis and the size of the prostate, ranging from 0.86% to 6.7%. There is ongoing debate and technical refinement with regard to the optimal method for achieving hemostasis in these patients. Options range from standard traction, robust bladder neck traction, balloon tamponade in the prostatic fossa, and selective electrocautery.^{62,63,71,72} However, contemporary data suggest that in men where focal bladder neck cautery was utilized following RWT, transfusion rates were as low as 0.8%.⁶³ Contemporary analysis from the Manufacturer and User Facility Device Experience (MAUDE) database of over 36,000 men who underwent Aquablation demonstrates a transfusion or take-back for fulguration rate of 0.4%.⁷³ MAUDE data should be interpreted with caution, however, as this is a voluntary post-marketing surveillance system, and events could be under-reported. In the International Collaborative Aquablation Research Urology Society (ICARUS) real-world, multi-institutional, international retrospective series of over 2000 patients undergoing Aquablation, the use of focal bladder neck cautery showed an overall transfusion rate of 0.75%.²⁸ For such reasons, the standard operating technique of Aquablation includes at least 2 passes of the Aquabeam RWT, followed by focal bladder cautery.⁷⁴

More recently, in a retrospective comparison study of 167 men undergoing Aquablation RWT *versus* 215 men undergoing HoLEP from Germany, there was no difference in transfusions, postoperative hemoglobin changes, or takebacks for cystoscopy with clot evacuation between groups.⁷⁵ Similarly, in another single-center comparative trial of 75 Aquablations *versus* 75 HoLEPs, the mean post-operative hemoglobin drop was significantly higher in the Aquablation cohort *vs.* HoLEP (2.6 ± 1.33 *vs.* 0.4 ± 0.67 g/dL, $p < 0.001$), however, there was no

difference in clinically significant outcomes, particularly with regard to the need for blood transfusion (1 in each group).⁷⁰ Justo Quintas et al.'s⁷⁰ prospective non-randomized study of Aquablation *vs.* HoLEP showed no difference in transfusion rates between the two procedures. Finally, the results of the WATER III trial also demonstrated no significant difference in bleeding complications or transfusion rates between Aquablation (0%) and HoLEP (2.3%; $p = 0.13$).⁴⁷

Comparison of Outcomes on Anticoagulation and Antiplatelet Therapy

As stated above, LUTS secondary to BPH is common in elderly and aging men. Concomitantly, increasing age is also related to many other chronic conditions, including cardiac and vascular pathologies, which require anti-platelet or anticoagulation medications. Lasers have gained great popularity and interest over the past two decades for such patients.

The holmium laser emits energy at a wavelength (2100 nm) that is strongly absorbed by water. The holmium laser causes coagulation through a photothermal effect, where the laser's energy, highly absorbed by water in tissues, converts to heat, leading to tissue vaporization and superficial coagulation for hemostasis. As mentioned above, HoLEP/AEEP is associated with excellent hemostasis and minimal blood loss, and transfusion rates among men are rare. It therefore, is not surprising that many previous studies have reported the safety and efficacy of HoLEP in men taking anti-platelet medications or anticoagulation.^{76–79} Newer laser technology, including MOSES 2.0, may improve this further.^{65,80} An analysis of factors influencing blood loss among 963 men undergoing HoLEP suggested that prolonged operative time, but not antithrombotic therapy, may influence the risk of bleeding.⁸¹ While procedures can safely be performed on anticoagulation, holding anticoagulants when feasible may be associated with less bleeding, shorter operative times, shorter length of hospital stays, and a higher likelihood of same-day catheter removal.^{82,83} In a retrospective study of 139 men on anticoagulation with clopidogrel, warfarin, or a direct oral anticoagulant (DOAC) undergoing HoLEP, transfusion rates were similar between men who held anticoagulation ($N = 82$, 4.9% transfusion rate) and men who continued anticoagulation ($N = 57$, 5.3%; $p > 0.99$).⁸³

With regards to RWT, one of the contraindications to performing Aquablation would be the inability to stop anticoagulation medications peri-operatively. As mentioned above, in WATER II, no

cautery or hemostasis was performed after treatment with the Aquabeam; rather, only traction was used. This was unsurprisingly associated with a 5.9% transfusion rate in men with prostate volumes of 80–150 cc.⁴⁶ While techniques have been employed (e.g., focal bladder neck cautery) that almost eliminate the risk of significant bleeding, continued use of anticoagulation through the Aquablation procedure has not been reported on in the literature and remains a contraindication for performing such elective surgery. Rather, most men are encouraged to hold their anticoagulation. Sadri et al.⁸⁴ reported the risk of bleeding and post-operative complications among 41 men taking preoperative anticoagulation/antiplatelet medications compared to 75 without use. Most of these patients were on low-dose aspirin only (58%), but 37% were on dual antiplatelet therapy, and 5% were on warfarin, and the anticoagulant/antiplatelet start-stop time was not standardized. Preoperative hemoglobin levels, operative time, and post-operative hemoglobin levels were comparable between the groups. There was no difference in complications, return to the operating room, or blood transfusions (2.4% vs. 0%; $p = 0.35$) between groups. In the more recent ICARUS real-world dataset, there was no significant difference in transfusion rates or cystoscopy/clot evacuation in patients on anticoagulation vs. those not on anticoagulation.⁸⁵ However, in subgroup analysis, men on a DOAC or warfarin had a higher risk of transfusion (6.5% vs. 1.35%; $p = 0.02$) and increased use of cystoscopy with clot evacuation (8.1% vs. 2.1%; $p = 0.05$) compared to men not on anticoagulation. Thus, like in HoLEP, low-dose aspirin seems to have minimal impact, but use of DOAC or warfarin may be associated with a higher risk of bleeding complications. As for any procedure, risk-adjusted shared decision making should be employed, and bleeding risks weighed against potential cardiovascular and thromboembolic events.

Comparison of Indwelling Catheter Time and Same-Day Discharge

Post-operative catheterization, indwelling time, and hospital time are variable and often driven by surgeon and patient preference. Average indwelling catheter times range between 6 and 72 h for each technology, based upon these and other variables. In a non-randomized multicenter study of HoLEP and Aquablation, bladder catheterization time did not differ between the two modalities (32.4 ± 16.5 vs. 39.6 ± 26.2 h, $p = 0.13$).⁷⁰

Same-day discharge (SDD), more specifically the concept of being discharged from the hospital on the same calendar day (leaving the hospital before midnight the same day as the surgery) after surgical management of BPH is increasingly pursued to improve patient recovery experience, reduce health-care costs, and optimize resource use. Both HoLEP and Aquablation have shown feasibility in outpatient settings with SDD, though their pathways and outcomes present some nuanced differences.^{82,86,87}

For HoLEP, recent studies have demonstrated that SDD with same-day catheter removal is both feasible and safe for selected patients. A prospective study by Carvalho et al.⁸⁸ reported a 91.1% success rate for same-day catheter removal and discharge using a 60W holmium laser and en-bloc enucleation techniques. Similarly, Cooley et al.⁸² reported a 90% success rate in a larger cohort of 190 patients, noting that preoperative anticoagulation use was associated with failure of same-day voiding trials. A systematic review by Spinos et al.⁸⁹ further supports these findings, summarizing data from six studies showing same-day catheter removal success rates ranging from 85.5% to 90%, with very low complication and re-catheterization rates. These outcomes suggest that in well-selected patients, with proper selection and perioperative protocols, HoLEP can be routinely performed on an outpatient basis, being discharged with or without an indwelling catheter.

Similarly, Aquablation may also be performed with an SDD protocol, especially in high-efficiency surgical environments such as ambulatory surgery centers (ASCs). In the first global ASC-based cohort study, Zorn et al. reported that 98% of patients undergoing Aquablation RWT for large prostates (mean prostate volume 115 mL) were discharged the same day, with no hospital readmissions, transfusions, or reoperations.⁸⁷ This high success rate was achieved using a standardized Enhanced Recovery After Surgery (ERAS) protocol, meticulous hemostasis via bipolar cautery, and proactive post-op monitoring. Patients reported minimal postoperative pain and hematuria, and outcomes were comparable to inpatient Aquablation procedures in terms of safety, urinary symptom improvement, and sexual function preservation. However, all patients in this Aquablation series were discharged home with an indwelling catheter for an average of 2.8 days.

In summary, both HoLEP and Aquablation are viable for same-day discharge in well-selected patients. HoLEP has demonstrated excellent SDD success in both retrospective and prospective settings, though care must be taken with patients on anticoagulation. Aquablation has shown the potential

for similar high rates of SDD (up to 98%) with a strong safety profile, but there is less published SDD data at this time, and same-day catheter removal has not yet been published. The choice of procedure may ultimately depend on surgeon expertise, institutional protocols, and patient comorbidities, but current evidence supports both techniques as efficient outpatient options for BPH surgery.

Comparison of Improvements in Overall Lower Urinary Tract Symptoms and Quality of Life

Both HoLEP/AEEP and Aquablation/RWT are well-established surgical treatments for relieving LUTS/BPH. Across the literature, both approaches demonstrate substantial improvements in urinary symptom scores and QoL, though they differ slightly in onset, durability, and patient experience.

HoLEP/AEEP has consistently shown marked improvements in voiding and storage symptoms. In a large prospective study by Gurlen et al.⁹⁰, significant reductions were observed in IPSS total, storage, and voiding scores just three months after surgery, with over 85% of patients experiencing at least a 50% reduction in symptom burden. Similarly, a meta-analysis of transurethral procedures (excluding Aquablation) showed that at 1 year, HoLEP was superior to monopolar TURP in terms of IPSS scores, $Q_{\max}$, and PVR, but not with regard to quality of life.¹⁸ Similarly, a meta-analysis by Chen et al.⁹¹ confirmed that HoLEP offers durable improvements in urinary flow rates and symptom relief across a range of prostate sizes, rivaling or surpassing traditional TURP and other enucleation techniques. The long-term efficacy of HoLEP has also been validated in multiple randomized studies showing consistent improvements in IPSS and QoL metrics over time.

Aquablation RWT, while newer, demonstrates equally robust outcomes with the added benefit of a shorter learning curve and preservation of continence and sexual function. The 5-year results from the WATER trial revealed a greater mean reduction in IPSS scores compared to TURP (-14.1 vs. -10.8 ; $p = 0.02$) for men with prostates >50 mL in size.²⁵ A Cochrane systematic review further supports these findings, concluding that Aquablation provides comparable short-term improvements in IPSS and quality of life to TURP, and likely similar to HoLEP, although with less postoperative morbidity and better ejaculatory preservation.⁹² This makes Aquablation particularly appealing to younger men

or those prioritizing both urinary and sexual function outcomes.

Recent clinical trials have reported the results of direct comparisons in regards to improvements in LUTS, QoL, and other clinical variables after HoLEP and Aquablation. Specifically, Justo Quintas et al.⁷⁰ reported no significant difference in IPSS (7.6 ± 6.9 vs. 5.05 ± 4.9 points, $p = 0.11$), IPSS-QoL (1.7 ± 1.6 vs. 1.3 ± 1.6 points, $p = 0.16$), $Q_{\max}$ (28.6 ± 8.8 vs. 23.8 ± 9.3 mL/sec, $p = 0.12$), or PVR (7.2 ± 8.2 vs. 20.3 ± 22.6 mL, $p = 0.19$) between HoLEP and Aquablation. The WATER III randomized clinical trial confirmed these results. In WATER III, there was no difference in postoperative IPSS scores at 1-month or 3-months, and no difference in the change in IPSS (-13.1 ± 7.5 vs. 12.9 ± 6.9 ; $p = 0.745$ between AEEP and Aquablation in men with large prostates (80–180 mL). These improvements translated into significant QoL gains, as patients reported better satisfaction with urinary function and reduced need for reintervention or medication post-surgery. There were also no significant differences in PVR (7.2 ± 8.2 vs. 20.3 ± 22.6 mL, $p = 0.19$) based upon the technique used. $Q_{\max}$ was higher with AEEP (27.5 ± 11.3 vs. 19.8 ± 10.6 mL/sec, $p < 0.0001$). No men reported SUI after Aquablation, while 9.1% reported stress incontinence after HoLEP ($p < 0.05$).⁴⁷

In summary, both AEEP and RWT significantly improve LUTS and QoL in men with BPH. HoLEP offers relief with excellent urinary outcomes, and Aquablation appears to match these improvements while offering preservation of sexual function and urinary continence.

Comparison of Post-Operative Irritative Symptoms and Urge Incontinence

Many men with BPH also experience OAB symptoms, including frequency, nocturia, urgency, and urge urinary incontinence (UUI), mostly due to bladder overactivity (detrusor instability). The results of several studies have suggested that OAB symptoms may be exacerbated after HoLEP.⁹³ The pathophysiology of post-operative OAB symptoms following HoLEP is not well completely understood. Although HoLEP significantly improves OAB symptoms, some patients may require medical treatments or procedures to alleviate their OAB symptoms. In a nationwide database including over 38,000 TURPs and 20,000 HoLEPs, while postoperative use of alpha blockers and 5-alpha reductase inhibitors was higher in the TURP group than the HoLEP group, use of OAB

medications (including anticholinergics and B3 agonists) was more frequently prescribed after HoLEP compared to TURP.⁹³ Specifically, the rate of post-operative OAB medication use was lower in the TURP group than in the HoLEP group at 3 months (8.5% vs. 13.4%, $p < 0.01$), but this difference was not significant after one year (7.4% vs. 7.5%, $p = 0.81$).

Since HoLEP increases urinary storage symptoms among some men after HoLEP, concurrent therapy with intradetrusor onabotulinum toxin A (OTA) has been studied in the setting of HoLEP.⁹⁴ Among 82 men with baseline storage symptoms who underwent HoLEP in this study, 41 received OTA, and 41 served as controls. The authors reported no difference in operative times, rates of same-day trial of void/rates of discharge, or difference in post-operative urinary retention between groups. However, patients who received OTA injections showed a notable decrease in Michigan-Incontinence Symptom Index (M-ISI) scores 3 months postoperatively compared to men who did not get OTA injections (M-ISI -8 [IQR -13 to 0]; $p < 0.0001$ vs. -5 [IQR -8 to -1]; $p = 0.2$).⁹⁴

Elterman et al.²⁷ evaluated the natural history of OAB symptoms and UII among men after Aquablation. This study included men who underwent Aquablation in the WATER, WATER II, FRANCAIS WATER, and Open WATER. Based upon responses to IPSS over time, men demonstrated significant improvements in frequency, urgency, and nocturia over time. Patients were also given the Incontinence Severity Index (ISI), a two-item questionnaire to specifically quantify UII.⁹⁵ Subjects with low baseline ISI scores (4 or less) had modest perioperative rises in ISI score at 1- and 3-months postoperatively, but values reduced back to baseline in subjects with all prostate volumes. In patients with clinically significant baseline UII (ISI > 4), ISI scores improved in men with both small and large prostates.²⁷

In the WATER III RCT of AEEP vs. Aquablation, the rate of UII was not different between AEEP and Aquablation (9.1% vs. 7.2%, $p = 0.70$).⁴⁷

Comparison of Post-Operative Stress Incontinence

Stress urinary incontinence (SUI) is a significant post-operative concern following surgical treatment of BPH. Urinary incontinence is associated with worsened overall urinary symptoms, bother, and quality of life.⁹⁶⁻⁹⁸ As mentioned above, HoLEP and Aquablation stand out as effective techniques for relieving LUTS related to BPH. However, they differ notably in their impact on post-operative incontinence. Many

early studies of AEEP did not measure urinary incontinence with any standardized patient-reported outcome measure, or at all (the frequently-used IPSS has no questions about incontinence).^{39,99} Even some contemporary studies, unfortunately, continue this trend.¹⁰⁰ However, now it is well-known that AEEP is associated with “transient” urinary incontinence up to about three months after surgery. When measured (for example, with M-ISI), approximately 15% of men report “transient” urinary incontinence.^{101,102} Up to 2.5–3% of men will experience permanent SUI at >12 months post-AEEP.^{38,70,103-106} Older age, larger prostate, longer operative times, and preoperative OAB medication use have been associated with a higher risk of postoperative urinary incontinence.^{101,107,108} Preoperative counseling is essential as it helps patients understand the postoperative healing process, leading to a better alignment of expectations regarding incontinence.¹⁰³ However, there is also a risk of permanent urinary incontinence in approximately 1–4% of men.^{38,70,103,104} This leakage is thought to result from traction and mechanical manipulation near the external urinary sphincter.

Aquablation, in contrast, uses a high-pressure robotically-controlled waterjet under imaging guidance, which allows for more consistent preservation of the apical tissue and bladder neck, potentially minimizing trauma to the sphincter complex. Furthermore, the 24F device remains motionless in three-dimensional space during treatment with no fulcrum-like forces at the sphincter complex, the treatment duration is typically shorter than AEEP procedures, and no morcellator equipment is needed (which, in the past and currently at currently at some centers, utilizes a larger 26.5 French offset nephroscope for the required 5 Fr oscillating soft-tissue morcellator unit). As such, there were no reports of SUI following Aquablation in the WATER, WATER II, or WATER III trials. In contrast, 9.1% of patients reported stress urinary incontinence after AEEP in WATER III.⁴⁷ These findings echo those from Justo Quintas et al., who also demonstrated that none of the Aquablation patients required >1 pad/day at six months, compared to 4% in the HoLEP group. It would be expected that the HoLEP rate would be even greater if a strict 0-pad rate definition were utilized.⁷⁰

Comparison of Post-Operative Sexual, Ejaculatory, and Erectile Function

The importance of maintaining all aspects of sexual function after surgeries for BPH has been highlighted

in recent years. The impact of HoLEP and Aquablation on sexual function—particularly ejaculatory function—differs significantly, and this distinction is critical when counseling patients, especially those who are sexually active or concerned about preserving sexual function.

A key point of divergence between the two procedures lies in ejaculatory function. HoLEP has consistently demonstrated a high rate of ejaculatory dysfunction (EjD), with multiple initial studies consistently reporting EjD rates of 75–90%. For instance, Gild et al.³⁸ reported EjD in 92.5% of men following HoLEP, Justo Quintas et al.⁷⁰ reported a 89.3% rate of EjD with HoLEP, and the WATER III trial reported ejaculatory dysfunction in 77.1% of sexually-active patients undergoing AEEP.⁴⁷ In a retrospective study of men undergoing HoLEP who completed the Male Sexual Health Questionnaire-Ejaculatory Dysfunction (MSHQ-EjD), Roper et al.¹⁰⁹ found significant decreases in overall MSHQ-EjD scores after HoLEP, as well as decreases in the quantity of fluid with ejaculation, strength of ejaculation, and frequency of ejaculation. Bebi et al.¹¹⁰ observed higher rates of early postoperative ejaculatory pain and decreased physical pleasure during ejaculation in HoLEP patients compared to other enucleation techniques like bipolar TURP, though these symptoms tended to resolve over time. Although using a non-validated questionnaire, data from Kim et al.¹¹¹ suggests that more than half of patients also experienced decreased orgasmic intensity after HoLEP, further compounding dissatisfaction for those in whom sexual function is a priority. Recent modifications to the HoLEP technique (e.g., en-block and bladder neck preservation technique, verumontanum sparing procedures) may significantly reduce the rate of ejaculatory dysfunction.¹¹² However, these newer techniques are not performed uniformly at most institutions. Although properly counseled men tolerate these effects due to the improvement in voiding symptoms, a subset report significant bother, especially those men who are sexually active with preserved erectile function.

In contrast, Aquablation has emerged as a more favorable option in terms of ejaculatory function preservation. The 5-year results from the WATER trial reported significantly lower rates of EjD with Aquablation compared to TURP (risk difference of –21.9%) and maintained functional outcomes over time.^{23,60} The WATER II study confirmed preservation of ejaculatory dysfunction in larger prostates, and long-term real-world data demonstrate that Aquablation can preserve antegrade ejaculation in 99.6% of men.^{34,113} This remarkable preservation is attributed to Aquablation's precision in avoiding damage to

the ejaculatory ducts with an image-guided robotically executed “butterfly cut”, a distinct advantage over the mechanical enucleation used in HoLEP. In WATER III, only 14% of sexually active men reported ejaculatory dysfunction after Aquablation, in comparison to 77% of men after AEEP ($p < 0.0001$).⁴⁷

Erectile function is generally preserved in both procedures. A recent meta-analysis compared the results of erectile dysfunction following HoLEP or Aquablation RWT.⁴⁵ The results of *de novo* ED at 3 months post-operatively following HoLEP and Aquablation were almost identical in an analysis that was limited to randomized control trials, with Aquablation causing an increase of 0.02 (95% CI: –4.42 to 7.67) compared to HoLEP for IIEF-score improvement at three months. Similarly, at 12 months, HoLEP resulted in an IIEF-score increase of 0.13 points (95% CI: –6.21 to 8.85) compared to Aquablation. In the single-center trial comparing HoLEP to Aquablation, Justo Quintas et al.⁷⁰ reported no significant difference in IIEF-15 at six months in either compared to baseline or between groups. Similarly, results of WATER III demonstrate no *de novo* ED as measured by the IIEF at 3 months. Taken together, the results suggest that neither technique is associated with *de novo* ED.

Comparison of Bladder Neck Contractures and Other Urethral Strictures

Prostate adenoma resective technologies have historically been associated with potential complications, including bladder neck contractures (BNC) and urethral strictures. Reasons for this structuring are thought to occur because of devascularization. Established risk factors are small prostatic size at surgery, inflammation/prostatitis at the time of surgery, increased resection time, and extensive resection at the bladder outlet.^{114,115} Several studies have reported the incidence of post-operative urethral strictures and bladder neck contractures of 1.4–4.3% and 0.28%–3.9% after HoLEP, respectively.^{116–119} The results of a recent registry-based patient cohort study of 3000 men who underwent HoLEP reported a 1.0% incidence rate of urethral stricture and a 0.5% incidence rate of bladder neck contractures at 6 months post-operatively.¹²⁰

The computer-assisted planning of waterjet resection of Aquablation mandates that surgeons perform a more limited resection of the bladder neck. Theoretically, this decreases the risk of vascular disruption and undermines the bladder neck. In support of this, there is a low risk of BNC and other strictures post-Aquablation. Specifically, in the WATER (n = 116) and

WATER II (n = 101) clinical trials, Aquablation therapy was associated with meatal stenosis incidence of 0% and 0.4%, 0% and 0.01% incidence of BNC or adhesions, and 0% and 0.01% risk of urethral stricture at 5 years.¹²¹ A recent single-center series, however, reported a 5.3% rate of stricture after Aquablation, all but one of which were fossa navicularis strictures.¹²² Although unpublished, the rates of our real-world institutional Aquablation database of over 2100 men demonstrate a 0.1% risk of post-operative urethral strictures. All of these are reported as fossa navicularis. In these patients, the median catheter duration was 6.5 days vs. 1 day in men who did not develop a stricture. Although the pathogenesis of urethral strictures is multifactorial and definitive preventive measures remain elusive, minimizing postoperative catheter duration may be advisable.

Comparison of Durability

When comparing the durability of symptom relief and the need for medical or surgical re-treatment, both HoLEP and Aquablation demonstrate strong long-term outcomes, though HoLEP has a longer-established track record. HoLEP has consistently shown low retreatment rates, with numerous studies reporting durable results for up to 10 years or more.^{38,43} Its complete anatomical enucleation of the adenoma minimizes residual tissue and reduces the likelihood of recurrent obstruction, making repeat procedures uncommon. In a large single-institution series, the rate of reoperation after HoLEP was 2% with a median of 52 months of follow-up.³⁸ In a systematic review, He et al. reported an overall 5-year reoperation rate of 6.6% for HoLEP, lower than a 7.7% 5-year rate of reoperation for TURP, 7.1% for greenlight PVP, and 23.8% for prostate artery embolization.¹²³ Retreatments rates over the long-term are best evaluated by large databases that are institution- and surgeon-independent, and in a nationwide database including over 38,000 TURPs and 20,000 HoLEPs, the rate of re-operation was higher in TURP than HoLEP (4.5% vs. 1.27%, $p < 0.01$).⁹³

Aquablation, although a newer technique, has shown impressive durability in medium and large prostates. The WATER 5-year study revealed that Aquablation had a 5% surgical retreatment rate through 5 years of follow-up, but overall, fewer patients required medical or surgical intervention with Aquablation compared to TURP.⁶⁰ Of note, only one Aquabeam pass was performed in the original WATER study, although the current standard is to

perform at least two passes, as this is associated with improved voiding outcomes.⁷⁴ Additionally, the WATER II trial, which included prostates between 80–180 mL, showed no significant difference in re-intervention rates between Aquablation RWT and AEEP at early follow-up, suggesting comparable efficacy in larger glands, although long-term outcomes remain to be seen.

In summary, HoLEP sets the benchmark for long-term durability, with minimal retreatment required over time. Aquablation, though newer, has demonstrated comparable mid-term durability, particularly in the 5-year data, with retreatment rates that are competitive with or even lower than TURP. However, it will be essential to evaluate the long-term 10- and 20-year durability of Aquablation, especially for large prostates and through large claim-based or national datasets.

Comparison of the Frequency of Incidental Prostate Cancer and the Potential to Treat Prostate Cancer

The incidence of prostate cancer is often dependent on pre-operative prostate cancer screening protocols and shared decision-making between patients and providers. However, comparison of cT1a and cT1b prostate cancers has been reported after both HoLEP and Aquablation.¹²⁴ Histopathology revealed incidental prostate tumors in 60 patients (4.6%): 59 (6.03%) after HoLEP and 1 (0.3%) after Aquablation ($p = 0.001$). Of 60 incidental cancers, 11 had a Gleason score ≥ 7 (Aquablation: 1/1 [100%]; HoLEP: 10/59 [16.9%]). The Aquablation and HoLEP study groups differed in patient age, preoperative PSA, and prostate volume. Therefore, matched pairs analysis (Aquablation: 132 patients; HoLEP: 132 patients) was conducted to improve comparability. After matching clinical characteristics, significantly fewer incidental prostate cancers were diagnosed after Aquablation than HoLEP (Aquablation RWT: 0 [0%]; HoLEP: 6 [4.5%]; $p = 0.015$), likely reflecting that most tissue is ablated by the Aquabeam and is not sent for pathologic analysis. Therefore, because Aquablation may miss 4.5% of clinically significant incidental prostate tumors, it is important to screen appropriate patients both pre- and post-operatively.

The surgical capsule is not actually a capsule but rather the potential space that delineates the transition zone of the prostate from the peripheral zone. The vast majority of prostate adenocarcinomas are found within the peripheral zone. The HoLEP technique is most commonly performed by using the

laser to enucleate tissue above the surgical capsule and therefore does not penetrate into the primary location of most adenocarcinomas. In comparison, the waterjet employed in Aquablation RWT has the ability to penetrate into all zones of the prostate based upon the resection used. As such, Aquablation has the potential to resect areas in the peripheral zone and has the potential to treat prostate tumors. As such, several ongoing trials are being conducted to evaluate Aquablation's potential as an image-guided prostate cancer treatment (e.g., NCT06051942, NCT06054867, and NCT06651632: "WATER IV").

Cost Comparison

To date, there are no formally published studies that have performed a comprehensive cost analysis comparing AEEP and Aquablation. Proper analyses would have to account for many factors that include: 1) hospital costs (e.g., technology acquisition and reimbursement, operating room time) 2) physician reimbursement and 3) patient costs (e.g., time off from work, pad use, etc). Aquablation requires a dedicated robotic platform and is associated with substantial upfront capital investment. Similarly, holmium or thulium laser systems, as well as morcellators required for AEEP, also represent significant capital expenditures. However, laser platforms are often multifunctional, allowing institutions to offset costs through their use in other procedures, such as endourologic stone surgery. Both techniques also incur recurring disposable costs, including the handpiece and resection loop for Aquablation and laser fibers for AEEP. Additional important considerations include operating room time and resource utilization. While recent studies suggest comparable operative times between techniques, these metrics are likely influenced by surgeon experience and institutional workflow. Future studies evaluating the full economics of these procedures should be performed.

Summary

BPH is the most common urological condition affecting aging men and a major contributor to LUTS worldwide. HoLEP/AEEP and Aquablation both represent modern, size-independent treatments for BPH with proven efficacy in regard to the relief of bothersome LUTS. Both HoLEP/AEEP and Aquablation have been proven superior to the previously held "gold standard" of TURP, but several differences remain.

A summary comparison of the outcomes of the two procedures is shown in [Table 1](#). Briefly, HoLEP offers proven long-term durability and significant symptom relief, with improved IPSS values, maximum urinary flow rate (Q_{max}), and reduced PVR. However, its widespread adoption is potentially limited by a steep learning curve, with safe and efficient performance typically requiring over 50 cases and refinement continuing beyond this number. HoLEP is also associated with high rates of ejaculatory dysfunction and a modest risk of stress urinary incontinence and irritative symptoms. Same-day discharge and even catheter removal are feasible. While long-term BPH retreatment remains low with AEEP, complications, including BNC and strictures, may be more frequent than with Aquablation.

In contrast, Aquablation, a robotic-assisted, waterjet-based ablative technique, has a shorter and more accessible and reproducible learning curve. Pivotal, multicenter, randomized clinical trials (WATER, WATER II, and WATER III trials) have shown Aquablation RWT provides comparable improvements in IPSS, Q_{max} , and PVR, with significantly better preservation of ejaculatory and sexual function—even in large prostates.^{34,46,47} Transfusion and complication rates are low when hemostasis is achieved with focal bladder neck cautery. In well-trained ambulatory settings, SDD rates approach 100%. While retreatment rates at the 5-year interval for Aquablation appear low, long-term (10-year) follow-up data are pending, and AEEP may have an advantage.

When studied head-to-head, Aquablation and AEEP have similar operative times, transfusion rates, and improvements in IPSS, QoL, and PVR. AEEP has the advantage of a greater improvement in Q_{max} , but is also associated with postoperative SUI, including after 3 months, and is associated with high rates of ejaculatory dysfunction.^{47,70} At 3 months, both are associated with low re-treatment rates. The long term durability of Aquablation remains to be determined in comparison to AEEP.

It is important to note that this review is limited by the heterogeneity and variable quality of the available literature. Reported outcomes for both techniques may differ based on surgeon experience, procedural volume, equipment platforms, and institutional setting (academic versus community-based). Patient-related factors including prostate volume, baseline disease characteristics, comorbidities, and individual goals of care, further contribute to variability across studies.

In conclusion, both HoLEP and Aquablation have demonstrated superiority over the historical

TABLE 1. Summary of comparison between Aquablation and AEEP (Anatomical Endoscopic Enucleation of the Prostate)

Variable	Aquablation	AEEP	Favored technology
Surgeon Learning Curve	Fast learning curve	Long learning curve	Aquablation
Operating Room Time	Consistent time across all prostate sizes	Increased time based upon surgeon experience and prostate volume	Aquablation
Decrease in Hemoglobin	Non-clinically significant decrease in hemoglobin levels	Minimal decrease in hemoglobin levels post-operatively	AEEP
Significant Bleeding Requiring Transfusion	Low rates since the introduction of focal bladder neck cautery hemostasis	Low rates	Equivalent
Ability to Perform Procedure on Anticoagulation	Patient should stop active anticoagulation, excluding low-dose aspirin	Can be performed, although higher rates of complications	AEEP
Ability to Perform and Discharge on Same Day	Yes	Yes	Equivalent
Improvements in Lower Urinary Tract Infections	Significant improvements	Significant improvements	Equivalent
Exacerbation of Irritative Symptoms and UII	Mild increase in Irritative symptoms and UII	Moderate increase in Irritative symptoms and UII	Aquablation
De Novo SUI	None	Temporary and permanent SUI	Aquablation
Urethral Strictures and Bladder Neck Contractures	Rare	Slightly more common	Aquablation
Ejaculatory Dysfunction	Rare	Very common	Aquablation
Ejaculatory Pain/Bother	Rare	More common early postop	Aquablation
Erectile Function	Generally preserved	Generally preserved	Equivalent
Durability/Need for Re-treatment	Low rate of re-treatment in the first 5 years, but 10-year retreatment rates not yet established	Established long-term re-treatment up to 10 years	AEEP

Note. Abbreviations: UII, urge urinary incontinence; SUI, stress urinary incontinence.

“gold standard” of TURP in the surgical management of BPH. In this setting of comparable safety and improvements in voiding outcomes, the treatment decision of AEEP vs. Aquablation should be driven by surgeon familiarity, availability of technology, durability of symptom relief and shared decision making, including additional outcomes such as sexual function, continence, and long-term retreatment rates.

Acknowledgement

All authors have clinical experience with both Aquablation and AEEP.

Funding Statement

The authors received no specific funding for this study.

Author Contributions

Brian T. Helfand and Alexander P. Glaser responsible for initial design, research and manuscript preparation. Juan Justo Quintas, Gerald Park, Kevin C. Zorn, Mark Rochester, Philip J. S. Charlesworth responsible for critical manuscript review and editing. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials

Data obtained from review of PubMed.

Ethics Approval

Not applicable.

Conflicts of Interest

Dr. Helfand is an investigator, advisor and speaker for Procept Biorobotics. Dr. Quintas is an investigator for Procept Biorobotics. Dr. Park is an investigator for Procept Biorobotics. Dr. Zorn is a speaker for Procept Biorobotics. Dr. Glaser is a speaker for Procept Biorobotics. This study was not sponsored

by industry and no funding (internal or external) supported this Review.

References

1. Launer BM, McVary KT, Riche WA, Lloyd GL. The rising worldwide impact of benign prostatic hyperplasia. *BJU Int* 2021;127(6):722–728. doi:10.1111/bju.15286.
2. GBD 2019 Benign Prostatic Hyperplasia Collaborators. The global, regional, and national burden of benign prostatic hyperplasia in 204 countries and territories from 2000 to 2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet Healthy Longev* 2019;3(1):e754–e76. doi:10.1186/s12894-024-01582-w.
3. Cindolo L, Pirozzi L, Fanizza C, et al. Drug adherence and clinical outcomes for patients under pharmacological therapy for lower urinary tract symptoms related to benign prostatic hyperplasia: population-based cohort study. *Eur Urol* 2015;68(3):418–425. doi:10.1016/j.eururo.2014.11.006.
4. Nichol MB, Knight TK, Wu J, Barron R, Penson DF. Evaluating use patterns of and adherence to medications for benign prostatic hyperplasia. *J Urol* 2009;181(5):2214–21; discussion 21-2.
5. Parsons JK, Dahm P, Kohler TS, Lerner LB, Wilt TJ. Surgical management of lower urinary tract symptoms attributed to benign prostatic hyperplasia: AUA guideline amendment 2020. *J Urol* 2020;204(4):799–804. doi:10.1097/ju.0000000000001298.
6. Sandhu JS, Bixler BR, Dahm P, et al. Management of lower urinary tract symptoms attributed to benign prostatic hyperplasia (BPH): AUA guideline amendment 2023. *J Urol* 2024;211(1):11–19. doi:10.1097/JU.0000000000003698.
7. Varkarakis I, Kyriakakis Z, Delis A, Protogerou V, Deliveliotis C. Long-term results of open transvesical prostatectomy from a contemporary series of patients. *Urology* 2004;64(2):306–310. doi:10.1016/j.urology.2004.03.033.
8. Gratzke C, Schlenker B, Seitz M, et al. Complications and early postoperative outcome after open prostatectomy in patients with benign prostatic enlargement: results of a prospective multicenter study. *J Urol* 2007;177(4):1419–1422. doi:10.1016/j.juro.2006.11.062.
9. Serretta V, Morgia G, Fondacaro L, et al. Open prostatectomy for benign prostatic enlargement in southern Europe in the late 1990s: a contemporary series of 1800 interventions. *Urology* 2002;60(4):623–627. doi:10.1016/s0090-4295(02)01860-5.
10. Suer E, Gokce I, Yaman O, Anafarta K, Göğüş O. Open prostatectomy is still a valid option for large prostates: a high-volume, single-center experience. *Urology* 2008;72(1):90–94. doi:10.1016/j.urology.2008.03.015.
11. Autorino R, Zargar H, Mariano MB, et al. Perioperative outcomes of robotic and laparoscopic simple prostatectomy: a European-American multi-institutional analysis. *Eur Urol* 2015;68(1):86–94. doi:10.1016/j.eururo.2014.11.044.
12. Nestler S, Bach T, Herrmann T, et al. Surgical treatment of large volume prostates: a matched pair analysis comparing the open, endoscopic (ThuVEP) and robotic approach. *World J Urol* 2019;37(9):1927–1931. doi:10.1007/s00345-018-2585-z.
13. Haberal HB, Lambertini L, Pacini M, et al. Trifecta of same-day discharge after single-port robotic-assisted simple prostatectomy. *J Endourol* 2025;39(5):477–481. doi:10.1089/end.2024.0930.

14. Tang Y, Li J, Pu C, et al. Bipolar transurethral resection versus monopolar transurethral resection for benign prostatic hyperplasia: a systematic review and meta-analysis. *J Endourol* 2014;28(9):1107–1114. doi:10.1089/end.2014.0188.
15. Taylor BL, Jaffe WI. Electrosurgical transurethral resection of the prostate and transurethral incision of the prostate (monopolar techniques). *Can J Urol* 2015;22 Suppl, 1:24–29.
16. Porto JG, Bhatia AM, Bhat A, et al. Transurethral resection of the prostate across continents: a meta-analysis evaluating quality of gold standard in the twenty-first century. *World J Urol* 2025;43(1):85. doi:10.1007/s00345-024-05439-7.
17. Strebelt RT, Kaplan SA. The state of TURP through a historical lens. *World J Urol* 2021;39(7):2255–2262. doi:10.1007/s00345-021-03607-7.
18. Cornu JN, Ahyai S, Bachmann A, et al. A systematic review and meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic obstruction: an update. *Eur Urol* 2015;67(6):1066–1096. doi:10.1016/j.eururo.2014.06.017.
19. Tan AH, Gilling PJ, Kennett KM, Frampton C, Westenberg AM, Fraundorfer MR. A randomized trial comparing holmium laser enucleation of the prostate with transurethral resection of the prostate for the treatment of bladder outlet obstruction secondary to benign prostatic hyperplasia in large glands (40 to 200 grams). *J Urol* 2003;170:1270–1274. doi:10.1097/01.ju.0000086948.55973.00.
20. Ditonno F, Bianchi A, Fumanelli F, et al. The learning curve for holmium laser enucleation of the prostate: a single-center analysis of surgical and functional outcomes. *J Endourol* 2024;38(11):1226–1233. doi:10.1089/end.2024.0422.
21. Wenk MJ, Hartung FO, Egen L, et al. The long-term learning curve of holmium laser enucleation of the prostate (HoLEP) in the en-bloc technique: a single surgeon series of 500 consecutive cases. *World J Urol* 2024;42(1):436. doi:10.1007/s00345-024-05097-9.
22. National Institute of Diabetes and Digestive and Kidney Diseases. Urologic diseases in America, Annual data report, Benign prostatic hyperplasia and associated lower urinary tract symptoms. Bethesda, MD, USA: NIH/National Institute of Diabetes and Digestive and Kidney Diseases; 2024.
23. Gilling P, Barber N, Bidair M, et al. WATER: a double-blind, randomized, controlled trial of Aquablation[®] vs transurethral resection of the prostate in benign prostatic hyperplasia. *J Urol* 2018;199(2):1252–1261. doi:10.1016/j.eururo.2018.03.026.
24. Desai M, Bidair M, Zorn KC, et al. Aquablation for benign prostatic hyperplasia in large prostates (80–150 mL): 6-month results from the WATER II trial. *BJU Int* 2019;124(4):321–328. doi:10.1097/ju.0000000000001205.
25. Oumedjbeur K, Corsi NJ, Bouhadana D, et al. Aquablation versus TURP: 5-year outcomes of the WATER randomized clinical trial for prostate volumes 50–80 mL. *Can J Urol* 2023;30:11650–11658. doi:10.1016/s0302-2838(23)01169-7.
26. Burton CS, Dobberfuhr AD, Comiter CV. Outcomes of Aquablation in men with acute and chronic urinary retention. *Urology* 2023;180(S2):214–218. doi:10.1016/j.urology.2023.06.028.
27. Elterman D, Gilling P, Roehrborn C, et al. Meta-analysis with individual data of functional outcomes following Aquablation for lower urinary tract symptoms due to BPH in various prostate anatomies. *BMJ Surg Interv Health Technol* 2021;3(1):e000090. doi:10.1136/bmjsit-2021-000090.
28. Foucault R, Bouhadana D, Arezki A, et al. From retention to relief: cohort characteristics and outcomes for men with urinary retention undergoing Aquablation: an analysis of the International Collaborative Aquablation Research Urology Society (ICARUS) database. EAU25 40th Annual EAU Congress. *Eur Urol* 2025;87:S447–S448. doi:10.1016/j.eururo.2025.09.2879.
29. Leathead A, Arezki A, Sadri I, et al. Salvage Aquablation as secondary treatment in recurrent lower urinary tract symptoms: an analysis of the International Collaborative Aquablation Research Urology Society (icarus) database. EAU25 40th annual EAU congress. *Eur Urol* 2025;87:S1646–S1647. doi:10.1016/j.eururo.2025.09.3989.
30. Ohana I, Bouhadana D, Sadri I, et al. Impact of median lobe presence on clinical outcomes following Aquablation: an analysis of the International Collaborative Aquablation Research Urology Society (ICARUS) database. EAU25 40th annual EAU congress. *Eur Urol* 2025;87:S1649–S1650.
31. Gravas S, Cornu JN, Gacci M, et al. EAU guidelines on management of non-neurogenic male lower urinary tract symptoms (LUTS). In: Benign Prostatic Obstruction (BPO)-Update March 2020. Arnhem, The Netherlands: EAU Guidelines; 2020.
32. Helfand BT, Glaser AP, Kasraeian A, et al. Men with lower urinary tract symptoms secondary to BPH undergoing Aquablation with very large prostates (>150 mL). *Can J Urol* 2021;28:10884–10888.
33. Helfand BT, Kasraeian A, Sterious S, et al. How I do it: Aquablation in very large prostates (>150 mL). *Can J Urol* 2022;29:11111–5.
34. Bhojani N, Bidair M, Kramolowsky E, et al. Aquablation therapy in large prostates (80–150 mL) for lower urinary tract symptoms due to benign prostatic hyperplasia: final WATER II 5-year clinical trial results. *J Urol* 2023;210(1):143–153. doi:10.1097/ju.0000000000003483.
35. Ringler R, Gangwish D, Horning P, et al. Does size matter? A single institution's comparison of Aquablation in prostates greater than or less than 150 mL. *Prostate* 2025;85(2):140–147. doi:10.1002/pros.24810.
36. Elterman D, Aube-Peterkin M, Evans H, et al. UPDATE-Canadian urological association guideline: male lower urinary tract symptoms/benign prostatic hyperplasia. *Can Urol Assoc J* 2022;16(8):245–256. doi:10.5489/cuaj.7906.
37. Gilling PJ, Wilson LC, King CJ, Westenberg AM, Frampton CM, Fraundorfer MR. Long-term results of a randomized trial comparing holmium laser enucleation of the prostate and transurethral resection of the prostate: results at 7 years. *BJU Int* 2012;109(3):408–411. doi:10.1111/j.1464-410x.2011.10359.x.
38. Gild P, Vetterlein MW, Daoud I, et al. Which men do or do not achieve long-term symptom relief after holmium laser enucleation of the prostate (HoLEP): 11 years of HoLEP experience. *J Endourol* 2023;37(3):316–322. doi:10.1089/end.2022.0396.
39. Kuntz RM, Lehrich K, Ahyai SA. Holmium laser enucleation of the prostate versus open prostatectomy for prostates greater than 100 grams: 5-year follow-up results of a randomised clinical trial. *Eur Urol* 2008;53(1):160–166. doi:10.1016/j.eururo.2007.08.036.
40. Kuntz RM, Lehrich K, Ahyai S. Transurethral holmium laser enucleation of the prostate compared with transvesical open prostatectomy: 18-month follow-up of a randomized trial. *J Endourol* 2004;18(2):189–191. doi:10.1089/089277904322959851.
41. Wilson LC, Gilling PJ, Williams A, et al. A randomised trial comparing holmium laser enucleation versus transurethral resection in the treatment of prostates larger than 40 grams:

Does aquablation wash away holmium laser enucleation of the prostate (HoLEP)?

- results at 2 years. *Eur Urol* 2006;50:569–573. doi:10.1016/s0084-4071(08)70089-7.
42. Montorsi F, Naspro R, Salonia A, et al. Holmium laser enucleation versus transurethral resection of the prostate: results from a 2-center, prospective, randomized trial in patients with obstructive benign prostatic hyperplasia. *J Urol* 2004;172(5S):1926–1929. doi:10.1016/j.juro.2008.03.143.
 43. Gu M, Chen YB, Liu C, et al. Comparison of holmium laser enucleation and plasmakinetic resection of prostate: a randomized trial with 72-month follow-up. *J Endourol* 2018;32(2):139–143. doi:10.1089/end.2017.0700.
 44. Elshal AM, Soltan M, El-Tabey NA, Laymon M, Nabeeh A. Randomised trial of bipolar resection vs holmium laser enucleation vs Greenlight laser vapo-enucleation of the prostate for treatment of large benign prostate obstruction: 3-years outcomes. *BJU Int* 2020;126(6):731–738. doi:10.1111/bju.15161.
 45. Bhatia A, Titus R, Porto JG, et al. Comparing outcomes of Aquablation versus holmium laser enucleation of prostate in the treatment of benign prostatic hyperplasia: a network meta-analysis. *BJUI Compass* 2024;5(12):1231–1245. doi:10.1002/bco2.454.
 46. Desai M, Bidair M, Bhojani N, et al. WATER II (80–150 mL) procedural outcomes. *BJU Int* 2019;123(1):106–112. doi:10.1111/bju.14360.
 47. Ritter M, Stein J, Barber N, et al. WATER III: Aquablation vs transurethral laser enucleation of large prostates (80–180 mL) for BPH treatment in a randomized trial. In: Proceedings of the EAU25 40th Annual EAU Congress; 2025 Mar 21–24; Madrid, Spain.
 48. Saitta G, Becerra JEA, Del Álamo JF, et al. ‘En Bloc’ HoLEP with early apical release in men with benign prostatic hyperplasia. *World J Urol* 2019;37(11):2451–2458. doi:10.1007/s00345-019-02671-4.
 49. Tuccio A, Grosso AA, Sessa F, et al. En-Bloc holmium laser enucleation of the prostate with early apical release: are we ready for a new paradigm? *J Endourol* 2021;35(11):1675–1683. doi:10.1089/end.2020.1189.
 50. Kampantais S, Dimopoulos P, Tasleem A, Acher P, Gordon K, Young A. Assessing the Learning curve of holmium laser enucleation of prostate (HoLEP). A systematic review. *Urology* 2018;120:9–22. doi:10.1016/j.urology.2018.06.012.
 51. Enikeev D, Morozov A, Taratkin M, et al. Systematic review of the endoscopic enucleation of the prostate learning curve. *World J Urol* 2021;39(7):2427–2438. doi:10.1007/s00345-020-03451-1.
 52. Placer J, Gelabert-Mas A, Vallmanya F, et al. Holmium laser enucleation of prostate: outcome and complications of self-taught learning curve. *Urology* 2009;73(5):1042–1048. doi:10.1016/j.urology.2008.12.052.
 53. Robert G, Cornu JN, Fourmarier M, et al. Multicentre prospective evaluation of the learning curve of holmium laser enucleation of the prostate (HoLEP). *BJU Int* 2016;117(3):495–499. doi:10.1111/bju.13124.
 54. Chavali JSS, Rivera ME, Lingeman JE. HoLEP learning curve-resident perspective: survey of senior residents from high-volume tertiary center. *J Endourol* 2024;38(9):977–981. doi:10.1089/end.2024.0054.
 55. Lee MS, Assmus M, Agarwal D, Large T, Krambeck A. Contemporary practice patterns of transurethral therapies for benign prostate hypertrophy: results of a worldwide survey. *World J Urol* 2021;39(11):4207–4213. doi:10.1007/s00345-021-03760-z.
 56. Guo JN, Mistry NA, Lee MS, Dean NS, Assmus MA, Krambeck AE. Trends of benign prostatic hyperplasia procedures in ambulatory surgery settings. *J Endourol* 2023;37(10):1123–1128. doi:10.1089/end.2023.0154.
 57. Narang G, Moore J, Abdul-Muhsin H, Cheney S, Humphreys M. Travel characteristics and outcomes for patients seeking HoLEP. *Can J Urol* 2022;29:11067–74.
 58. Robles J, Pais V, Miller N. Mind the gaps: adoption and under-utilization of holmium laser enucleation of the prostate in the United States from 2008 to 2014. *J Endourol* 2020;34(7):770–776. doi:10.1089/end.2019.0603.
 59. Abdelaziz A, Bhandari M, Elshabrawy A, et al. Contemporary trends of holmium laser enucleation of the prostate utilization in the United States: a comprehensive analysis using the national surgical quality improvement program database (2011–2020). *J Endourol* 2024;38(5):521–528. doi:10.1089/end.2023.0612.
 60. Gilling PJ, Barber N, Bidair M, et al. Five-year outcomes for Aquablation therapy compared to TURP: results from a double-blind, randomized trial in men with LUTS due to BPH. *Can J Urol* 2022;29:10960–8. doi:10.1016/s2666-1683(20)32809-3.
 61. El Hajj A, Misrai V, Nasrallah AA, Labban ML, Najdi JA, Rijo E. Learning curve in Aquablation: an international multicenter study. *World J Urol* 2022;40(3):773–779. doi:10.1007/s00345-021-03898-w.
 62. Elterman D, Bach T, Rijo E, et al. Transfusion rates after 800 Aquablation procedures using various haemostasis methods. *BJU Int* 2020;125(4):568–572. doi:10.1111/bju.14990.
 63. Elterman DS, Foller S, Ubrig B, et al. Focal bladder neck cautery associated with low rate of post-Aquablation bleeding. *Can J Urol* 2021;28:10610–10613.
 64. Kuo RL, Paterson RF, Kim SC, Siqueira TM Jr, Elhilali MM, Lingeman JE. Holmium laser enucleation of the prostate (HoLEP): a technical update. *World J Surg Oncol* 2003;1(1):6. doi:10.1186/1477-7819-1-6.
 65. Ramadhani MZ, Klopang YP, Rahman IA, Yogiswara N, Renaldo J, Wirjopranoto S. Comparative efficacy and safety of holmium laser enucleation of the prostate (HoLEP) using moses technology and standard HoLEP: a systematic review, meta-analysis, and meta-regression. *Ann Med Surg* 2022;81:104280. doi:10.1016/j.amsu.2022.104280.
 66. Sun F, Yao H, Bao X, et al. The efficacy and safety of holep for benign prostatic hyperplasia with large volume: a systematic review and meta-analysis. *Am J Mens Health* 2022;16(4):15579883221113203. doi:10.1177/15579883221113203.
 67. Monn MF, El Tayeb M, Bhojani N, et al. Predictors of enucleation and morcellation time during holmium laser enucleation of the prostate. *Urology* 2015;86(2):338–342. doi:10.1016/j.urology.2015.04.028.
 68. Nguyen DD, Barber N, Bidair M, et al. Waterjet ablation therapy for endoscopic resection of prostate tissue trial (WATER) vs WATER II: comparing Aquablation therapy for benign prostatic hyperplasia in 30–80 and 80–150 mL prostates. *BJU Int* 2020;125(1):112–122. doi:10.1111/bju.14917.
 69. Nguyen DD, Misrai V, Bach T, et al. Operative time comparison of Aquablation, greenlight PVP, ThuLEP, GreenLEP, and HoLEP. *World J Urol* 2020;38(12):3227–3233. doi:10.1007/s00345-020-03137-8.
 70. Justo Quintas J, García Rojo E, García Gómez B, et al. Aquablation vs. holmium laser enucleation of the prostate for benign prostatic hyperplasia: a 150-patients prospective comparative multicenter study. *Minerva Urol Nephrol* 2025;77(1):111–119. doi:10.23736/s2724-6051.24.05871-3.

71. Aljuri N, Gilling P, Roehrborn C. How I do it: balloon tamponade of prostatic fossa following Aquablation. *Can J Urol* 2017;24:8937–8940.
72. MacRae C, Gilling P. How I do it: Aquablation of the prostate using the AQUABEAM system. *Can J Urol* 2016;23:8590–8593.
73. Elterman D, Chughtai B, Bhojani N, Zorn KC. MP20-03 Aquablation real-world prostate size utilization and reported bleeding events across 5 years. *J Urology* 2024;211(5S):e320. doi:10.1097/01.ju.0001008732.80104.31.03.
74. Bach T, Barber N, Elterman D, et al. Aquablation outcomes in men with LUTS due to BPH following single versus multi-pass treatments. *Urology* 2022;169:167–172. doi:10.1016/j.urology.2022.07.007.
75. Gloger S, Schueller L, Paulics L, Bach T, Ubrig B. Aquablation with subsequent selective bipolar cauterization versus holmium laser enucleation of the prostate (HoLEP) with regard to perioperative bleeding. *Can J Urol* 2021;28(Suppl 3):10685–10690. doi:10.1097/ju.0000000000002007.07.
76. Elzayat E, Habib E, Elhilali M. Holmium laser enucleation of the prostate in patients on anticoagulant therapy or with bleeding disorders. *J Urol* 2006;175(4S):1428–1432. doi:10.1016/s0022-5347(08)61968-0.
77. Westhofen T, Schott M, Keller P, Tamalunas A, Stief CG, Magistro G. Superiority of holmium laser enucleation of the prostate over transurethral resection of the prostate in a matched-pair analysis of bleeding complications under various antithrombotic regimens. *J Endourol* 2021;35(3):328–334. doi:10.1089/end.2020.0321.
78. Rivera M, Krambeck A, Lingeman J. Holmium laser enucleation of the prostate in patients requiring anticoagulation. *Curr Urol Rep* 2017;18(7):77. doi:10.1089/end.2016.0070.
79. Agarwal DK, Large T, Stoughton CL, et al. Real-world experience of holmium laser enucleation of the prostate with patients on anticoagulation therapy. *J Endourol* 2021;35(7):1036–1041. doi:10.1089/end.2020.0886.
80. Elmansy H, Boudreau R, Hodhod A, et al. Second-generation MOSES 2.0 versus MOSES 1.0 pulse-modulation technologies for holmium laser enucleation of the prostate (HoLEP). *World J Urol* 2024;42(1):577. doi:10.1007/s00345-024-05277-7.
81. Romero-Otero J, García-González L, García-Gómez B, et al. Factors influencing intraoperative blood loss in patients undergoing holmium laser enucleation of the prostate (holep) for benign prostatic hyperplasia: a large multicenter analysis. *Urology* 2019;132(Suppl 9):177–182. doi:10.1016/j.urology.2019.06.024.
82. Cooley LF, Assmus M, Ganesh M, Lee M, Helon J, Krambeck AE. Predictors of failed same-day catheter removal after holmium laser enucleation of the prostate. *Urology* 2022;170:168–173. doi:10.1016/j.urology.2022.07.047.
83. Xu P, Dean NS, Tsai K, et al. To hold or continue blood thinners? A retrospective analysis on outcomes of holmium laser enucleation of the prostate in patients who either held or continued antiplatelet/anticoagulation therapy. *Urology* 2025;195:4–12. doi:10.1016/j.urology.2024.08.050.
84. Sadri I, Chakraborty A, Nguyen DD, et al. Aquablation in patients on antithrombotics: assessment of safety, post-operative bleeding rates and clinical outcomes. *Urology* 2023;181:112–118. doi:10.1016/j.urology.2023.08.001.
85. Sioufi J, Bouhadana D, Hamouda A, et al. Evaluating bleeding risk and clinical outcomes with perioperative antithrombotics in Aquablation: an analysis of the International Collaborative Aquablation Research Urology Society (ICARUS) database. EAU25 40th annual EAU congress. *Eur Urol* 2025;87:S1649–S1650. doi:10.1016/j.eururo.2025.09.3992.
86. Slade A, Agarwal D, Large T, Sahm E, Schmidt J, Rivera M. Expanded criteria same day catheter removal after holmium laser enucleation of the prostate. *J Endourol* 2022;36(7):977–981. doi:10.1089/end.2022.0007.
87. Zorn KC, Chakraborty A, Chughtai B, et al. Safety and efficacy of same day discharge for men undergoing contemporary robotic-assisted Aquablation prostate surgery in an ambulatory surgery center setting-first global experience. *Urology* 2025;195(S2):132–138. doi:10.1016/j.urology.2024.08.006.
88. Carvalho BRG, Gabrich PN, de Marins RL, Damião R, Oliveira RV. Same-day catheter removal and hospital discharge after holmium laser enucleation of the prostate: a prospective study. *Urology* 2024;190(6S):78–82. doi:10.1016/j.urology.2024.06.001.
89. Spinos T, Tatanis V, Liatsikos E, Kallidonis P. Same-day catheter removal after holmium laser enucleation of the prostate (HoLEP): a systematic review. *World J Urol* 2023;41(12):3503–3510. doi:10.1007/s00345-023-04655-x.
90. Gurlen G, Aydamirov M, Vuruskan E, Aksay B, Karkin K. Evaluation of lower urinary tract symptoms and sexual functions after holmium laser prostate enucleation. *Ir J Med Sci* 2025;194(1):385–389. doi:10.1007/s11845-024-03854-8.
91. Chen J, Dong W, Gao X, et al. A systematic review and meta-analysis of efficacy and safety comparing holmium laser enucleation of the prostate with transurethral resection of the prostate for patients with prostate volume less than 100 mL or 100 g. *Transl Androl Urol* 2022;11(4):407–420. doi:10.21037/tau-21-1005.
92. Hwang EC, Jung JH, Borofsky M, Kim MH, Dahm P. Aquablation of the prostate for the treatment of lower urinary tract symptoms in men with benign prostatic hyperplasia. *Cochrane Database Syst Rev* 2019;2(2):CD013143. doi:10.1002/14651858.cd013143.pub2.
93. Kim A, Hak AJ, Choi WS, Paick SH, Kim HG, Park H. Comparison of long-term effect and complications between holmium laser enucleation and transurethral resection of prostate: nations-wide health insurance study. *Urology* 2021;154:300–307. doi:10.1016/j.urology.2021.04.019.
94. Huang MM, Dean NS, Assmus MA, Lee MS, Guo JN, Krambeck AE. Intradetrusor onabotulinumtoxin injections at the time of holmium laser enucleation of the prostate for men with severe storage symptoms. *J Endourol* 2023;37(4):801–806. doi:10.1089/end.2023.0074.
95. Sandvik H, Hunskaar S, Seim A, Hermstad R, Vanvik A, Bratt H. Validation of a severity index in female urinary incontinence and its implementation in an epidemiological survey. *J Epidemiol Community Health* 1993;47(6):497–499. doi:10.1136/jech.47.6.497.
96. Glaser AP, Kristof TW, Judge C, et al. The 10-item LURN Symptom Index (LURN SI-10) detects additional symptoms and shows convergent validity with the ipss in men presenting with lower urinary tract symptoms. *Urology* 2023;171:184–189. doi:10.1016/j.urology.2022.10.019.
97. Liu AB, Liu Q, Yang CC, et al. Patient characteristics associated with more bother from lower urinary tract symptoms. *J Urol* 2019;202(3):585–591. doi:10.1097/ju.0000000000000324.
98. Lee YJ, Oh SA, Kim SH, Oh SJ. Patient satisfaction after holmium laser enucleation of the prostate (HoLEP): a prospective cohort study. *PLoS One* 2017;12(8):e0182230. doi:10.1371/journal.pone.0182230.
99. Fayad AS, Sheikh MG, Zakaria T, Elfotth HA, Alsergany R. Holmium laser enucleation versus bipolar resection of the prostate: a prospective randomized study. Which to choose? *J Endourol* 2011;25(8):1347–1352. doi:10.1089/end.2011.0059.

Does aquablation wash away holmium laser enucleation of the prostate (HOLEP)?

100. Lin CH, Wu WJ, Li CC, Ke HL, Jhan JH, Wen SC. Comparison of different en bloc holmium laser enucleation of the prostate techniques to reduce the rate of postoperative transient urinary incontinence. *J Int Med Res* 2021;49(8):3000605211037488. doi:10.1177/03000605211037488.
101. Nam JK, Kim HW, Lee DH, Han JY, Lee JZ, Park SW. Risk factors for transient urinary incontinence after holmium laser enucleation of the prostate. *World J Mens Health* 2015;33(2):88–94. doi:10.5534/wjmh.2015.33.2.88.
102. Houssin V, Olivier J, Brenier M, et al. Predictive factors of urinary incontinence after holmium laser enucleation of the prostate: a multicentric evaluation. *World J Urol* 2021;39(1):143–148. doi:10.1007/s00345-020-03169-0.
103. Assmus MA, Lee MS, Large T, Krambeck AE. Understanding holmium laser enucleation of the prostate (HoLEP) recovery: assessing patient expectations and understanding. *Can Urol Assoc J* 2022;16(1):E25–E31. doi:10.5489/cuaj.7328.
104. Zell MA, Abdul-Muhsin H, Navaratnam A, et al. Holmium laser enucleation of the prostate for very large benign prostatic hyperplasia (≥ 200 cc). *World J Urol* 2021;39(1):129–134. doi:10.1007/s00345-020-03156-5.
105. Hodhod A, Oquendo F, Tablowski T, et al. ‘Top-Down’ holmium laser enucleation of the prostate. Report of initial cases performed by a single surgeon. *Arab J Urol* 2020;19(2):130–136. doi:10.1080/2090598x.2020.1805964.
106. Ye OD, Tadrast A, Di Crocco E, Karsenty G, Toledano H. Urinary incontinence after endoscopic enucleation of the prostate with the Holmium laser: evolutionary aspects and associated predictive factors. *Prog Urol* 2023;33(1):198–206. doi:10.1007/s00345-020-03169-0.
107. Hout M, Gurayah A, Arbelaiez MCS, et al. Incidence and risk factors for postoperative urinary incontinence after various prostate enucleation procedures: systemic review and meta-analysis of PubMed literature from 2000 to 2021. *World J Urol* 2022;40(11):2731–2745. doi:10.1007/s00345-022-04174-1.
108. Elsaqa M, Papaconstantinou H, El Tayeb MM. Preoperative frailty scores predict the early postoperative complications of holmium laser enucleation of prostate. *J Endourol* 2023;37(12):1270–1275. doi:10.1089/end.2023.0196.
109. Roper C, Slade A, Caras R, Shelton T, Rivera M. Ejaculatory and erectile function outcomes following holmium laser enucleation of the prostate. *Prostate* 2024;84(9):791–796. doi:10.1002/pros.24697.
110. Bebi C, Turetti M, Lievore E, et al. Sexual and ejaculatory function after holmium laser enucleation of the prostate and bipolar transurethral enucleation of the prostate: a single-center experience. *Int J Impot Res* 2022;34(1):71–80. doi:10.1038/s41443-020-00366-8.
111. Kim JK, Cho MC, Son H, Ku JH, Oh SJ, Paick JS. Patient perception of ejaculatory volume reduction after holmium laser enucleation of the prostate (HoLEP). *Urology* 2017;99:142–147. doi:10.1016/j.urology.2016.09.037.
112. Press B, Gardezi M, Kim DD, et al. Ejaculatory preserving holmium laser enucleation of the median lobe: preserving sexual function while improving urinary outcomes. *Urology* 2023;173(2s):175–179. doi:10.1016/j.urology.2022.12.035.
113. Omidele OO, Siegal AS, Roshandel R, Te AE, Kaplan SA. Aquablation at 4-years: real world data from the largest single-center study with associated outcomes follow-up. *Urology* 2024;194:216–220. doi:10.1016/j.urology.2024.07.047.
114. Pansadoro V, Emiliozzi P. Iatrogenic prostatic urethral strictures: classification and endoscopic treatment. *Urology* 1999;53(4):784–789. doi:10.1016/s0090-4295(98)00620-7.
115. Kranz J, Reiss PC, Salomon G, Steffens J, Fisch M, Rosenbaum CM. Differences in recurrence rate and *De Novo* incontinence after endoscopic treatment of vesicourethral stenosis and bladder neck stenosis. *Front Surg* 2017;4:44. doi:10.3389/fsurg.2017.00044.
116. Ibrahim A, Alharbi M, Elhilali MM, Aubé M, Carrier S. 18 years of holmium laser enucleation of the prostate: a single center experience. *J Urol* 2019;202(4):795–800. doi:10.1097/ju.000000000000280.
117. Elkoushy MA, Elshal AM, Elhilali MM. Reoperation after holmium laser enucleation of the prostate for management of benign prostatic hyperplasia: assessment of risk factors with time to event analysis. *J Endourol* 2015;29(7):797–804. doi:10.1089/end.2015.0060.
118. Thai KH, Smith JC, Stutz J, Sung J, Shaver C, El Tayeb MM. Urethral complications while using 26F vs 28F resectoscope sheaths in holmium laser enucleation of the prostate: a retrospective observational study. *J Endourol* 2021;35(2):165–170. doi:10.1089/end.2020.0350.
119. Kuo RL, Paterson RF, Siqueira TM Jr., et al. Holmium laser enucleation of the prostate: morbidity in a series of 206 patients. *Urology* 2003;62(1):59–63. doi:10.1016/s0090-4295(03)00124-9.
120. Lee H, So S, Cho MC, Cho SY, Paick JS, Oh SJ. Clinical outcomes of holmium laser enucleation of the prostate: a large prospective registry-based patient cohort study under regular follow-up protocol. *Investig Clin Urol* 2024;65(4):361–367. doi:10.4111/icu.20240080.
121. Berjaoui MB, Nguyen DD, Almousa S, et al. WATER versus WATER II 5-year update: comparing Aquablation therapy for benign prostatic hyperplasia in 30–80-cm³ and 80–150 cm³ prostates. *BJUI Compass* 2024;5:1023–1033. doi:10.1016/j.euros.2021.01.004.
122. Pryor J, Ivan S, Simhan J, Sterious S. Postprocedural urethral strictures after Aquablation. *Urology* 2026;207:212–217. doi:10.1016/j.urology.2025.08.024.
123. He W, Ding T, Niu Z, et al. Reoperation after surgical treatment for benign prostatic hyperplasia: a systematic review. *Front Endocrinol* 2023;14:1287212. doi:10.3389/fendo.2023.1287212.
124. Gloger S, Paulics L, Philippou C, Philippou S, Witt JH, Ubrig B. Perioperative rates of incidental prostate cancer after Aquablation and holmium laser enucleation of the prostate. *Urol Int* 2024;108(5):449–456. doi:10.1159/000539014.