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ARTICLE

The new gold standard for surgical management of BPH: an institutional experience with 1000 HoLEPs

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Introduction: *Holmium Laser Enucleation of the Prostate (HoLEP) is a size-independent, endoscopic management option for benign prostatic hyperplasia (BPH). HoLEP offers a distinct advantage for patients who are at high-risk for bleeding whilst preserving prostatic tissue for pathology analysis, unlike photoselective vaporization. Further, HoLEP avoids the need for cystotomy, unlike simple open and robotic prostatectomy, by using intravesical morcellation. We report our experience with the first 1000 HoLEP procedures at our institution.*

Materials and Methods: *We performed a retrospective review of all HoLEP procedures performed at our institution from 2013–2021 to capture patient demographics, procedure details, and outcomes. Unpaired two sample t-tests were used to compare outcomes, $p < 0.05$ considered statistically significant.*

Results: *The average patient age and BMI were 71.1 y (±8.1 y) and 27.9 kg/m² (±4.9 kg/m²), respectively. 69.4% of patients were on an alpha blocker and 33.3% of patients were on a 5-alpha reductase inhibitor preoperatively. 11.2% of cases were redo outlet procedures including after prior Urolift®. Average prostate volume was 108.0 mL (±66.5 mL) and average enucleation time was 119.7 min (±56 min). On average, 65 g (±53.2 g) prostate tissue was resected. Pre-operative and post-operative flow, post-void residual (PVR), AUA symptom score (AUA-SS), and quality of life (QoL) score showed notable improvement. Complication rates remained low, with the most common including blood transfusion (2.8%), urethral stricture (1.9%), and persistent stress urinary incontinence (1.3%).*

Conclusions: *HoLEP is emerging as the new surgical gold standard for BPH. A steep learning curve remains for urologists. Nonetheless, this procedure holds great promise in improving patient experiences with BPH.*

Key Words: benign prostatic hyperplasia, holmium enucleation of the prostate, surgical outcomes

Introduction

Benign prostatic hyperplasia (BPH) remains highly common and often inevitable in aging men, with prevalence exceeding 60–80% in males aged 65–80.[1,2] This condition, arising from a nonmalignant proliferation of glandular epithelial and fibromuscular tissue, typically results in bladder outlet obstruction. This may significantly affect the patient's quality of life, causing progressive lower urinary tract symptoms and voiding concerns, and ultimately leading to acute urinary retention without treatment.

Although conservative and medical treatments are available, they may result in unacceptable adverse effects or poor adherence to treatment, and patient symptoms may be refractory to such treatment. Unmanaged BPH may eventually lead to lower and

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upper urinary tract infection or renal insufficiency; as such, early surgical intervention has slowly gained interest, as a large portion of patients may ultimately require invasive treatment for BPH.[3]

Holmium laser enucleation of the prostate (HoLEP) has emerged as a leading treatment option for BPH. HoLEP involves the use of laser technology to remove obstructive prostate tissue. The entire adenoma is removed from the prostatic capsule, reducing rates of recurrence and reoperation, in contrast with transurethral resection of the prostate (TURP), which is currently considered the standard of care.[1] The endoscopic nature of this procedure allows significant morbidity benefit for patients when compared with simple prostatectomy (SP). Perhaps most importantly, this treatment modality has already been recommended as first-line by American Urological Association (AUA) guidelines in patients who are at higher risk of bleeding.[1]

We aimed to analyze institutional outcomes and experiences surrounding HoLEP procedures conducted largely by a single surgeon, offering insight into the practical implementation and efficacy of this evolving modality.

Materials and Methods

We retrospectively reviewed 1000 consecutive HoLEP procedures performed at our tertiary care center from 2013–2021. These procedures were largely performed by a single surgeon. Variables of interest included patient demographics and body mass index (BMI), preoperative prostate volume, and preoperative BPH treatment regimen. Additionally, we captured pre- and post-procedural data on post-void residual volume, AUA symptom score, and quality of life rating. Finally, we investigated complication rates for common post-BPH treatment and post-surgical occurrences including urethral strictures (requiring subsequent surgical treatment), blood transfusion, persistent stress urinary incontinence (SUI) beyond six months and mortality.

Statistical Analysis

All statistical testing was performed using Prism 7 (GraphPad, San Diego, CA, USA). Unpaired two sample *t*-tests were performed to compare outcomes, $p < 0.05$ considered significant.

Results

Demographic information is shown in Table 1. Mean patient age was 71.1 y (±8.1 y). Patients had an average BMI of 27.9 kg/m^2 (±4.9 kg/m^2). Before their HoLEP procedure, 71.4% of patients received an alpha blocker while 41.0% received a 5-alpha reductase inhibitor (Table 2A,B). 11.2% of cases were reoperations following outlet procedures including TURP and Urolift®.

Average prostate volume was 108.0 mL (±66.5 mL). Average enucleation time was 119.7 min (±56 min). Mean resection weight was 65 g (±53.2 g). Overall, patients reported notable improvements in symptom scores and apparent satisfaction from the procedure. Pre-operative and post-operative flow, post-void residual (PVR), AUA symptom score (AUA-SS), and quality of life (QoL) score showed notable improvement, as shown in Table 3.

Peri- and post-procedural morbidity appeared limited. The most common complications included receipt of blood transfusion (2.8%), urethral stricture (1.9%), and persistent SUI (1.3%).

Discussion

Overall, our single institutional experience demonstrates excellent efficacy and limited risks to the use of HoLEP for BPH in older men. We demonstrated subjective and objective improvement in this condition, including reduced urinary retention and LUTS, along with apparent patient-reported quality of life.

As HoLEP gains popularity, there is an increased interest amongst junior urologists and trainees in learning and adopting this procedure into their clinical practice. HoLEP became the second-most common BPH ambulatory surgery in 2019.[4] However, overall adoption still remains low in comparison to other treatment options that have been shown as subpar in the literature.[5] It is likely that this discrepancy may be explained by the steep learning curve, as well as limited access to specialized instruments required to perform the procedure.

Poorly managed BPH can significantly worsen a man's quality of life through urgency, pain, and leakage, along with mental health effects. Moreover, progression can result in urinary tract infections, acute retention, and subsequent sudden deterioration with systemic manifestations.[6] While there are a wide variety of diverse treatment options, outside of the AUA guidelines using prostate size to narrow down surgical options, treatment decision-making remains unclear.

TABLE 1. **Patient demographics**

		Racial breakdown					
Average Age +/− SD	**Average BMI +/− SD**	**White**	**Black**	**Asian**	**Latino**	**Indian**	**Unknown**
71.12 +/− 8.443	27.92 +/− 4.92	81.45%	9.96%	5.05%	1.23%	0.82%	1.50%

TABLE 2. **(A): Pre-operative medication status (Alpha blockers). (B): Pre-operative medication status (Androgen receptor inhibitors)**

(A)						
Alfuzosin	**Tamsulosin**	**Terazosin**	**Silodosin**	**Doxazosin**	**Total**	**None**
4.94%	60.49%	1.85%	3.09%	0.99%	71.36%	28.64%

(B)			
Finasteride	**Dutasteride**	**Total**	**None**
33.17%	7.80%	40.97%	59.03%

TABLE 3. **Pre-operative and post-operative outcomes**

		Pre-operative	**Post-operative**
Peak flow (mL/s)	Mean values +/− Standard deviation	9.766 +/− 18.17	22.85 +/− 16.81
	t, degrees of freedom	t = 11.55, df = 975	
	p-value	$p < 0.0001$	
Mean flow (mL/s)	Mean values +/− Standard deviation	3.568 +/− 2.578	6.417 +/− 5.433
	t, degrees of freedom	t = 8.361, df = 609	
	p-value	$p < 0.0001$	
PVR (mL)	Mean values +/− Standard deviation	241.4 +/− 253.3	61.76 +/− 96.42
	t, degrees of freedom	T = 15.66, df = 1159	
	p-value	$p < 0.0001$	
AUA-SS	Mean values +/− Standard deviation	18.99 +/− 8.228	7.295 +/− 6.558
	t, degrees of freedom	T = 17.07, df = 528	
	p-value	$p < 0.0001$	
QoL score (1 = best, 6 = worst)	Mean values +/− Standard deviation	3.539 +/− 1.518	1.367 +/− 1.590
	t, degrees of freedom	T = 13.24, df = 367	
	p-value	$p < 0.0001$	

TURP is the most commonly performed surgical treatment for BPH, though it offers notable limitations in patients with especially large adenomas and those at high risk of complications related to bleeding. Additionally, BPH recurrence rates following TURP remain high. While SP was previously the gold standard for large prostates, namely those exceeding 80 mL, this is a highly invasive surgery that carries significant surgical morbidities, such as bleeding and subsequent need for blood transfusions, as well as prolonged catheter times and length of stay. As endoscopic techniques improved, laser enucleation appears to provide similar efficacy while reducing morbidity.

Increased adoption of endoscopic BPH treatment promises significant improvement in quality metrics. Additionally, reoperation, length of stay, cost, and bleeding risk should all decrease.[4] There remains a need for prospective studies comparing HoLEP with other minimally invasive techniques including water vapor therapy, prostate artery embolization, and photoselective vaporization.[7,8] Particularly, while symptomatic improvement and quality of life change have been studied, there remain fewer studies reporting the effects of these various treatments on sexual function and long-term recurrence.[3] Future directions may include the development of guidelines that recommend particular endoscopic techniques based on patient-specific comorbidities and long-term goals.

Recent literature suggests that the most common peri-operative complications are postoperative urinary retention (0.2%), hematuria and clot retention (2.6%), and cystoscopy for clot evacuation (0.7%), while the most common post-procedural morbidities are dysuria (7.5%), stress (4.0%), urge (1.8%), transient (7%) and permanent (1.3%) urinary incontinence, urethral stricture (2%) and bladder neck contracture (1%).[9] The rates of most common complications from our database, receipt of blood transfusion (2.8%), urethral stricture (1.9%), and persistent SUI well beyond the procedure (1.3%), are largely comparable to those found in current literature; however, urethral stricture rates from our dataset are higher than those reported. Further studies and multi-variate analysis are indicated to better elucidate the statistical and clinical significance of this disparity in urethral stricture rates.

This study has several limitations inherent to its retrospective, single-institutional design. While we included a large cohort of patients, techniques and outcomes may have evolved from 2013 to present day. Additionally, these procedures were largely performed by a single surgeon, and experiences may vary based on training level and individual technique.

Conclusions

As our patient population ages, BPH will be a major focus of urologic care. Given the increasing need for safe, long-lasting BPH treatments, laser enucleation offers significant promise. Further development of this technology and understanding of its efficacy will allow better training and increased adoption across community and academic sites, ultimately improving accessibility for patients.

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Author Contributions

The authors confirm contribution to the paper as follows:

- Study conception and design: Yash B. Shah, Mihir S. Shah, Akhil K. Das
- Data collection: Yash B. Shah, Brian H. Im, Aaron R. Hochberg
- Analysis and interpretation of results: Yash B. Shah, Brian H. Im, Aaron R. Hochberg, Mihir S. Shah, Akhil K. Das
- Draft manuscript preparation: Yash B. Shah, Brian H. Im, Mihir S. Shah Elliott P. Freudenburg, James Jiang, Bruce M. Gao, Akhil K. Das

All authors reviewed the results and approved the final version of the manuscript.

Availability of Data and Materials

Data will be made available upon reasonable request.

Ethics Approval

Ethical approval was obtained from the Jefferson Office of Human Research Protection Institutional Review Board (IRB), and the study was conducted in compliance with the ethical standards of the Declaration of Helsinki. The IRB approval number is **12D.50**. Due to the retrospective nature of this study, the requirement for informed consent was waived by the IRB.

Conflicts of Interest

The authors declare no conflicts of interest to report regarding the present study.

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