Experience With More Than 1,000 Holmium Laser Prostate Enucleations for Benign Prostatic Hyperplasia

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Purpose: Holmium laser prostate enucleation is a contemporary treatment for benign prostatic hyperplasia. We report our experience with more than 1,000 procedures.

Materials and Methods: From June 1998 to March 2009 we performed 1,065 holmium laser prostate enucleations. After receiving institutional review board approval we retrospectively reviewed the database. Reported short-term, intermediate term and long-term results are 0 to 6, 6 to 12 and greater than 12 months, respectively.

Results: Bladder stones were present in 50 patients (4.7%) and 87 of the 717 (12.1%) with laboratory studies available had renal insufficiency. Preoperative urinary retention was present in 411 cases (38.7%). Significant preoperative stress and urge incontinence was noted in 8 and 16 patients, respectively. Mean transrectal ultrasound prostate volume was 99.3 gm (range 9 to 391). Mean preoperative American Urological Association symptom score was 20.3 (range 1 to 35) and maximum urinary flow was 8.4 cc per second (range 1.1 to 39.3). Intraoperative or postoperative complications occurred in 24 cases (2.3%). Mean followup was 287 days (range 6 to 3,571). At short-term, intermediate term and long-term followup the mean symptom score was 8.7, 5.9 and 5.3, and maximum urinary flow was 17.9, 19.5 and 22.7 cc per second, respectively. At the most recent followup 3 patients (0.3%) were in urinary retention. One patient with maximum urinary flow 20 cc per second required a second procedure for bleeding prostatic regrowth. Urethral stricture was noted in 9 (0.9%), 11 (1.3%), 4 (1.3%) and 0 patients, and bladder neck contracture was found in 0, 7 (0.8%), 4 (1.3%) and 5 (6.0%) at short-term, intermediate term, long-term and greater than 5-year followup, respectively. At the most recent followup significant stress and urge incontinence was noted in 9 and 6 patients, respectively.

Conclusions: Holmium laser prostate enucleation is safe and effective for benign prostatic hyperplasia. The complication rate is low, and incontinence and the need for ancillary procedures are rare for holmium laser prostate enucleation with durable long-term results.

Key Words: prostate, laser therapy, prostatic hyperplasia, prostatectomy, transurethral resection of prostate

Abbreviations and Acronyms

AUA = American Urological Association

BPH = benign prostatic hyperplasia

HoLEP = holmium laser enucleation of the prostate

PSA = prostate specific antigen

Qmax = maximum urinary flow

TURP = transurethral prostate resection

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HOLMIUM laser enucleation of the prostate has emerged as an effective transurethral treatment option in patients with symptomatic BPH of any size.[1] Several single center and multicenter series have documented HoLEP efficacy and safety.[1–16] In the last 10 years this minimally invasive surgical technique has been the most rigorously studied of any BPH therapy with multiple randomized clinical trials comparing efficacy to

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that of classic TURP[4–8,16] and open simple prostatectomy.[2,4,13] To date HoLEP is the only endourological procedure to provide superior relief of bladder outlet obstruction compared to TURP on urodynamic measures.[7]

There is evidence that of all the new technologies proposed for BPH HoLEP may be the most cost-effective. The multifunctional nature of the holmium laser, reusable fibers, low complication rate and short hospital stay make it a cost-effective treatment option. Only HoLEP has the potential to save more costs in the long term compared to TURP and the benefit is greatest if only 1 HoLEP procedure is necessary in a lifetime.[17]

Recent evidence suggests that 1 HoLEP procedure can produce long-term control of BPH symptoms. Elzayat and Elhilali reported their 4-year experience with HoLEP with a 4.2% re-treatment rate, and an association between re-treatment and the HoLEP learning curve.[15] Gilling et al reported on 38 patients with 6-year followup studied urodynamically before and after HoLEP, noting durable long-term HoLEP results with less than a 2% re-treatment rate.[9] We evaluated all patients treated with HoLEP at our institution, where the procedure has been done more than 10 years, to assess short-term and long-term benefits of the procedure.

MATERIALS AND METHODS

After receiving institutional review board approval we retrospectively reviewed our prospectively collected HoLEP database. The database, initiated with the first HoLEP performed at our institution in 1998, contains all patients who consented to the use of their medical records for research purposes. We identified 1,065 consecutive patients who underwent HoLEP between June 1998 and March 2009 at our hospital.

The AUA symptom index, BPH index score and urine flow rate were not documented before surgery in patients in urinary retention, defined as an indwelling urinary catheter or intermittent catheterization for bladder drainage. Although HoLEP can be done successfully in anticoagulated cases,[14] it is our practice to discontinue all anticoagulants other than low dose aspirin. Of all HoLEP procedures 850 (80%) were done by 1 surgeon (JEL), as previously described.[18] The remainder were done by a total of 7 surgeons. Equipment used for enucleation included a 100 W holmium:YAG laser with a 550 μ end fire laser fiber, a 28Fr continuous flow resectoscope with a laser bridge housing a 7Fr stabilizing catheter and normal saline irrigant. The enucleated adenoma was removed from the bladder using a rigid offset 27Fr nephroscope with a 5 mm working channel placed through the laser resectoscope sheath and a tissue morcellator. Enucleated prostate tissue weight was provided by the pathologist and recorded in gm.

Typically the urethral catheter was removed early on postoperative day 1 and the patient was discharged home within 24 hours of the procedure. In certain patients the procedure was done on an outpatient basis and they were discharged home the same day. Pain medication was not administered unless a concurrent procedure was done.

Postoperative results are reported as short-term (0 to 6 months after the surgery date), intermediate term (6 to 12 months), long-term (greater than 12 months to 5 years) and greater than 5-year results. Renal insufficiency was defined as serum creatinine 1.6 mg/dl or greater. Significant urinary incontinence was considered a patient self-report of stress or urge incontinence all or most of the time.

RESULTS

Table 1 lists patient information. Mean age at HoLEP was 75 years (range 40 to 95). Prior BPH procedures were done in 97 patients (9.1%), of whom 11 underwent 2 prior surgeries each (total 108). Significant incontinence was noted preoperatively in 24 patients (2.3%), including 8 (0.8%) with stress and 16 (1.5%) with urge incontinence. Preoperatively urinary retention was present in 411 cases (38.7%). Mean preoperative AUA symptom score was 20.3 (range 1 to 35), mean BPH Index score was 7.2 (range 0 to 30) and mean Qmax was 8.4 cc per second (range 1.1 to 39). Known preoperative prostate cancer was present in 36 patients (3.4%). Mean American Society of Anesthesiologists score in the entire cohort was 2.5 (range 1 to 4).

Intraoperatively perineal urethrostomy was required in 4 patients (0.4%) in whom the resectoscope was not long enough to reach the bladder and it was

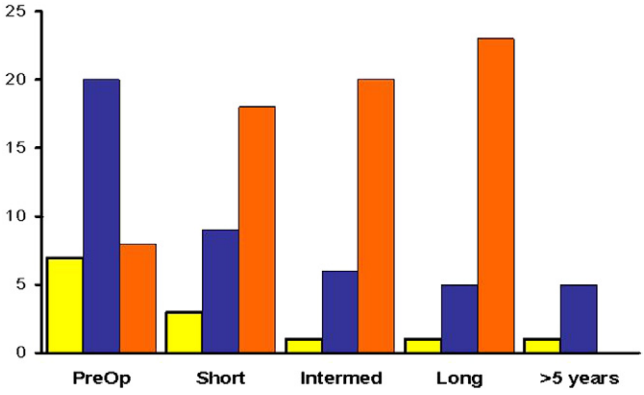
Table 1. *Preoperative, intraoperative and postoperative demographics in 1,065 patients who underwent HoLEP for BPH*

Mean mg/dl preop PSA (range)	7.2 (0.47–26.8)	
No. prior prostate procedure (%):	108	
TURP	39	(36.1)
Transurethral microwave therapy	39	(36.1)
KTP or holmium ablation	21	(19.4)
Transurethral needle ablation	7	(6.5)
Indigo laser ablation	2	(1.9)
No. bladder calculus (%)	50	(4.7)
No. renal insufficiency (%)	87	(12.1)
No. concurrent procedure (%):	31	(2.9)
Transurethral resection/bladder tumor fulguration	10	(32)
Ureteroscopy	6	(19)
Scrotal procedure	4	(13)
Circumcision	2	(6)
Percutaneous nephrolithotomy	2	(6)
da Vinci® bladder diverticulectomy	1	(3)
Urethral stricture dilation	1	(3)
Leg hematoma evacuation	1	(3)
Shock wave lithotripsy	1	(3)
Mean gm specimen wt (range)	76	(0.4–532.2)
Mean hrs catheterization (range)	19.1	(1–310)
Mean hrs hospitalization (range)	32	(2–600)

not possible to perform the procedure without perineal access. Excluding bladder stone removal, 31 patients (2.9%) also underwent a concurrent procedure at HoLEP (table 1). Intraoperative or postoperative complications occurred in 24 patients (2.3%), including clot retention in 7, significant hematuria prolonging hospitalization in 5, open cystotomy to remove adenoma in 3, myocardial infarction in 3, and atrial fibrillation requiring cardioversion, morcellator bladder injury, cerebral vascular accident and sepsis in 1 each. One patient required open cystotomy due to morcellation equipment malfunction and in 2 adenoma tissue was so dense that it could not be morcellated by currently available equipment. Superficial, inconsequential bladder trauma is not uncommon at morcellation but the patient with bladder injury had a full-thickness wall defect, which healed with 1 week of postoperative catheterization. Pathological evaluation of adenoma tissue retrieved at HoLEP revealed evidence of malignancy in 106 patients (10.0%).

Mean followup in the entire cohort was 287 days (range 6 to 3,571). A total of 83 patients (7.8%) had more than 5-year followup with a mean observation period of 7 years (range 5 to 10). At most recent followup mean AUA symptom score, BPH Index and Qmax were 5.3, 1 and 22.7 cc per second, respectively (table 2 and see figure). At the most recent followup all except 3 patients (0.3%) voided spontaneously, including 2 in urinary retention with a documented atonic bladder and 1 who voided spontaneously until spinal cord surgery resulted in a neurogenic bladder. In the 83 patients with more than 5 years of followup the most recent mean PSA was 0.95 mg/dl (range 0.029 to 8.13) at more than 5 years from the surgery date. Only 1 patient (0.1%) in whom 99.6 gm were originally enucleated required repeat HoLEP for bleeding nodular regrowth 6 years after the date of original surgery. Qmax at the repeat procedure was 20 cc per second. At most recent followup 9 (0.8%) and 6 patients (0.6%) had stress and urge incontinence, respectively, and in 106 (10.1%) prostate cancer was diagnosed at HoLEP.

At short-term, intermediate term, long-term and greater than 5-year followup urethral stricture requiring office dilation was noted in 9 of 971 (0.9%), 11 of 837 (1.3%), 4 of 314 (1.3%) and 0 of 83 patients, and bladder neck contracture was noted in 0 of 971, 7 of 837 (0.8%), 4 of 314 (1.3%) and 5 of 83 (6.0%), respectively. Mean enucleated specimen size in patients with postoperative bladder neck contracture was 38.5 gm (range 1 to 160.8). At short-term, intermediate term, long-term and greater than 5-year followup significant stress incontinence was noted in 12.5% (60 of 477), 3.4% (13 of 378), 1.8% (5 of 267) and 4.8% (4 of 83) of patients with completed incontinence questionnaires and significant urge incontinence was identified in 11.5% (56 of 477), 3.1% (13 of 378), 1.5% (4 of 267) and 2.2% (2 of 83), respectively. To our knowledge no patients were treated with a urinary sphincter or male sling but 2 patients received urethral collagen injections.



Preoperative (*PreOp*), short-term (*Short*), intermediate term (*Intermed*), long-term (*Long*) and greater than 5-year BPH index (yellow bars), AUA symptom score (blue bars) and Qmax (red bars) for 1,065 patients undergoing HoLEP for BPH. Urinary flow rates were not routinely obtained for the 83 patients with greater than 5 years of followup and are therefore not reported.

DISCUSSION

Many studies support HoLEP safety and efficacy for small and large gland BPH[1–16,18] even in the presence of bleeding diatheses and anticoagulation.[14] HoLEP is as effective as TURP[4–8,16] and open suprapubic prostatectomy[2,4,13] for obstructive BPH and it has lower morbidity. HoLEP efficacy lies in its excel-

Table 2. *Followup AUA symptom score, BPH Index and Qmax*

	AUA Symptom Score		BPH Index		Qmax (cc/sec)*	
	No. Pts	Mean (range)	No. Pts	Mean (range)	No. Pts	Mean (range)
1 Mo	578	8.7 (0–33)	508	3.3 (0–19)	221	17.9 (2.8–55.1)
6 Mos	425	5.9 (0–28)	398	1.4 (0–13)	108	19.6 (1–54.8)
12 Mos or greater	313	5.3 (0–31)	284	0.9 (0–12)	40	22.7 (6.9–52.6)
Greater than 5 yrs	79	5.1 (0–25)	79	1.07 (0–7)	—	—

* Not routinely measured after 1 year.

lent tissue debulking capability. Large case series show that HoLEP reduces prostate volume and PSA 60% to 90%.[3,10–12,15] HoLEP may be done on an outpatient basis with catheter removal within 24 hours of surgery. Compared to contemporary ablative procedures HoLEP has the advantage of actual tissue removal for pathological specimen examination, greater prostate volume reduction and durable long-term results while maintaining low morbidity.[19]

In a randomized clinical study HoLEP was more cost-effective than TURP.[16] Using economic modeling HoLEP has the potential to be more cost effective than TURP or other current ablative therapies if 1 HoLEP procedure provides long-term relief of BPH symptoms.[17] Despite the obvious benefits of HoLEP it has been slow to gain widespread acceptance among urologists. Initial cost of the 100 W holmium laser and the steep learning curve have been cited as reasons for its slow acceptance.[13] Thus, although HoLEP was introduced more than 10 years ago, few large volume studies have been published.

In our 10-year experience with performing HoLEP we have treated more than 1,000 patients, of whom 83 have more than 5-year followup. Operative and postoperative complications were rare, occurring in 2.3% of the patients. Hospital stay and catheterization duration were less than 36 and 24 hours, respectively. Of the patients 53 (5%) were treated on an outpatient basis and discharged home within 12 hours of the procedure. Mean PSA remained less than 1 mg/dl even 5 years after treatment. Only 1 patient (0.1%) required a repeat BPH procedure for bleeding adenomatous regrowth, not obstruction. Urethral stricture and bladder neck contracture were also rare, occurring at some point in 24 (2.3%) and 16 patients (1.5%), respectively. Urinary stress and urge incontinence were not uncommon immediately postoperatively but were present in fewer than 2% of patients at 12 months or more of followup.

Our study provides further evidence to support HoLEP long-term efficacy. Kuntz et al reported their series of 42 patients treated with HoLEP and followed 5 years.[13] Their 5-year results were similar to those in 32 patients treated with open suprapubic prostatectomy and no patient required re-treatment for BPH. Elzayat and Elhilali also reported on 118 patients treated with HoLEP with greater than 4-year followup.[15] Re-treatment for BPH was done in 4.2% of patients and it was positively associated with the procedure learning curve. Gilling et al have since reported on 38 patients with greater than 6-year followup and noted only 1 (1.4%) who required repeat HoLEP for BPH.[9] Mean followup in our series was 9.6 months and 83 patients had followup greater than 5 years (mean 7, maximum 10). Only 3 men were in urinary retention, of whom all had a documented or suspected neurogenic atonic bladder. No patient had recurrent obstructive BPH symptoms.

HoLEP long-term successes are difficult to compare to currently available ablative procedures, on which long-term data are limited. Malek et al reported their 5-year experience with KTP laser prostate ablation in 94 men, of whom 14 had 5-year outcome data available.[20] During followup they noted a 32% initial decrease in serum PSA but a slow PSA increase was noted after 1 year. They also noted a 2% bladder neck contracture rate, a 3% gross hematuria rate, 1 patient in urinary retention and no incontinence or reoperations. These initial findings are promising for ablative therapy but further large cohort studies are needed for an accurate comparison between prostate laser ablation and enucleation.

In our study the urinary urge and stress incontinence rate was significant at greater than 10% in month 1 after surgery. By 1 year postoperatively the incontinence rate had decreased to less than 2%, similar to the preoperative rate. The high early incontinence rate may be considered a postoperative complication but we believe that it reflects the radical de-obstruction achieved by HoLEP. We counsel all patients that transient urinary incontinence is expected in the immediate postoperative setting and it will improve in days to weeks. Improved incontinence by 1 year most likely reflects bladder and sphincter retraining after adaptation to the urinary de-obstruction produced by HoLEP. The low urethral stricture and bladder neck contracture rates were comparable to the less than 2% rate at long-term followup in the literature.[9,13,15] We observed a positive correlation between gland size and postoperative bladder neck contracture. Based on these data we now routinely incise the bladder neck after HoLEP on most glands less than 40 gm. In more than 1,000 cases only 1 bladder morcellation injury (0.01%) occurred. It was treated with 1 week of catheter drainage without prolonged adverse sequelae. Thus, if proper technique is used, morcellation injury should not be a significant deterrent limiting widespread HoLEP use.

The current study has 2 limitations. 1) Most procedures were performed by 1 surgeon but a total of 8 surgeons were incorporated into the study. Differences in technique and training level may produce variability in outcomes. 2) Due to the referral nature of our practice not all patients were followed at our hospital. To adjust for followup variability outcomes are shown as the percent of patients available for followup. Despite these limitations to our knowledge this study rep-

resents the initial experience with HoLEP in the United States and it is the largest reported series of patients treated with the procedure to date.

With multiple large cohort studies now supporting HoLEP long-term efficacy and safety HoLEP may continue as the contemporary gold standard for BPH in a gland of any size. However, with the recent introduction and rapid dissemination of more invasive techniques such as laparoscopic and robotic suprapubic prostatectomy one must question whether HoLEP will gain widespread acceptance. The development of appropriate training models and simulators, and surgeon mentoring programs is necessary to assist surgeons new to the procedure to overcome the learning curve.

CONCLUSIONS

This series of more than 1,000 HoLEP procedures at a single institution provides substantial supporting evidence for its safety and efficacy for BPH. In our study 99.7% of patients spontaneously urinated postoperatively, although more than a third presented in urinary retention. Immediate and long-term complications were rare with only 1 patient requiring repeat HoLEP for hematuria. AUA symptom score, BPH Index and urinary flow improved immediately postoperatively and continued to improve at long-term followup. Bladder neck contracture, urethral stricture and incontinence risks remained low. Based on these data we recommend HoLEP for symptomatic BPH in a gland of any size.

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