Holmium laser ablation and enucleation of the prostate: a pilot study of the hybrid technique

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Objectives: *To report the initial clinical experience using a hybrid technique combining holmium laser ablation of the prostate (HoLAP) and holmium laser enucleation of the prostate (HoLEP) for the treatment of lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH).*
Methods: *A total of 18 patients with documented moderate to severe LUTS underwent the hybrid technique. Baseline characteristics were documented for all patients. Operative and resection times, as well as intra and perioperative complications, were recorded. Additionally, changes in American Urological Association symptom index (AUA-SI) and quality of life (QoL) scores and serum prostate-specific antigen (PSA) values were recorded both pre and postoperatively.*
Results: *All patients experienced significant improvements in their AUA-SI and QoL scores, with a mean decrease in PSA of 74.6% postoperatively. There were no reported complications with this technique and the average resection time (48.2 min) was decreased in comparison to those reported for HoLAP or HoLEP monotherapies.*
Conclusions: *This is the first report of surgical therapy for BPH involving two different holmium laser therapies. This hybrid technique offers tissue for pathologic analysis in comparison to HoLAP, and an improved learning curve and decreased complication rate in comparison to HoLEP. Additional studies are warranted to validate this data.*

Key Words: benign prostatic hyperplasia, holmium laser, enucleation, ablation

Introduction

Bladder outlet obstruction (BOO) relating to benign prostatic hyperplasia (BPH) is a common problem for older men associated with significant morbidities and a large healthcare burden.[1] Transurethral resection of the prostate (TURP) has long been the gold standard surgical intervention for lower urinary tract symptoms (LUTS) secondary to BPH. However, there has been a concerted effort to find alternatives that reduce hospital stay length as well as offer the same clinical outcomes as TURP but without the associated morbidities.[2] In the last decade, various laser technologies have been introduced to remove obstructing prostate adenoma tissue including the Neodymium:Yttrium Aluminum Garnet (Holmium:YAG) and the potassium titanyl phosphate (KTP) laser.[3]

The holmium laser is a pulse, solid-state laser with a 2140 nm wavelength that has excellent hemostatic

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properties.[4] Based on these abilities, the holmium laser has been used in prostate tissue ablation, incision, resection and enucleation. The vaporization technique, also known as holmium laser ablation of the prostate (HoLAP), involves focusing a side-firing laser on periurethral prostatic tissue to destroy the prostate adenoma. This technique was initially positively received because it provided early and long lasting symptom relief without an extended learning curve.[3] However, HoLAP and all laser wavelengths require a longer operative time when treating large prostates.[5] Holmium laser resection of the prostate (HoLRP) involves piecemeal incisional resection down to the surgical capsule. While operative times are improved compared to HoLAP, this procedure still requires ~20%-30% longer operative times than standard TURP due to the time spent incising lateral lobe fragments small enough for safe urethral extraction.[5] Because of the desire for increased efficiency, holmium laser enucleation of the prostate (HoLEP) was developed which involves subcapsular enucleation of the three prostate lobes.[6] After hemostasis is achieved, a transurethral tissue morcellator is used to extract the tissue. However, this procedure has a significant learning curve as well as morbidities associated with the morcellation process including bladder and urethral injuries.

We have employed a novel technique at our institution, which combines principles of HoLAP and HoLEP. In our hybrid approach, laser enucleation of the median lobe of the prostate is performed to remove obstructing adenoma using the side firing fiber. The remaining prostate tissue is then vaporized using the HoLAP method with the 100W holmium laser. This combined HoLAP/HoLEP technique offers significant LUTS improvement, decreased surgical time, tissue for pathologic analysis, and no requirement for tissue morcellation.

Patients and methods

This study received institutional review board approval. The surgical selection for the HoLAP/HoLEP technique included patients with moderate to severe LUTS secondary to BPH who failed medical management, who had acute urinary retention secondary BPH and/or patient preference. Patients were evaluated preoperatively by history and physical examination and by the American Urological Association symptom index (AUA-SI) and quality of life (QoL) questionnaire forms. Patients also completed AUA-SI and QoL questionnaire forms at follow up visits up to 24 months postoperatively. Serum PSA values were determined at regular intervals both pre and postoperatively. When appropriate, these levels were corrected for 5-alpha reductase inhibitor use by doubling PSA values.[7] To remove additional variability, only patients with documented 5-alpha reductase inhibitor use for greater than 1 year were included in this study. Transrectal ultrasound (TRUS) was used to assess prostate size and TRUS-guided biopsy was used to exclude prostate cancer for patients when appropriate. Patients with biopsy proven prostate cancer were excluded from this study. The total amount of energy used [kilojoules(kj)], the number of fibers used, the total operative time (minutes), total resection time (minutes), time to catheter removal (days), duration of hospital stay (days) and the need for recatheterization were recorded.

Surgical technique

Patients are placed in the dorsal lithotomy position and are prepped and draped in the usual sterile fashion. A cystourethroscopy is performed using a 26 F Storz rigid cystoscope with both the 30 and 70 degree lenses using 0.9% saline irrigation. Next, the ACMI Elite continuous flow 27.9 F resectoscope is introduced per urethra using the Timberlake obturator. The laser adaptor and side firing laser fiber (Laser Duotome, 550µm, Boston Scientific, Natick, MA) are then inserted into the sheath. The dual wavelength VersaPulse Select holmium laser (Lumenis, VersaPulse PowerSuite, Santa Clara, CA) generating a maximum average power of 100W in a pulsed mode is used. The energy level is set at 3.2 Joules at a frequency of 30 pulses per second.

The HoLEP portion of the procedure is initiated by making two incisions along the median lobe at the 5 and 7 o'clock positions to the depth of the surgical capsule from the bladder neck to the proximal portion of the verumontanum, Figures 1a-1b. The capsule can be easily distinguished from the overlying BPH tissue by the presence of the transverse capsular fibers. Using our method, the grooves are undermined and widened to separate the median lobe from the lateral lobes. Additionally, this provides and improves visualization allowing definitive identification of the surgical capsule as it maximizes irrigation flow through the prostate. Evidence from open simple prostatectomy suggest that removal of all BPH tissue down to the capsule leads to improved outcomes as measured by AUA-SI results, duration of symptom improvement, reduced rate of BPH/LUTS recurrence, and persistence of reduced postoperative PSA.[8]

After making the bilateral incisions, the holmium laser is then placed at the proximal end of the 5 o'clock groove near the bladder neck at the level of the

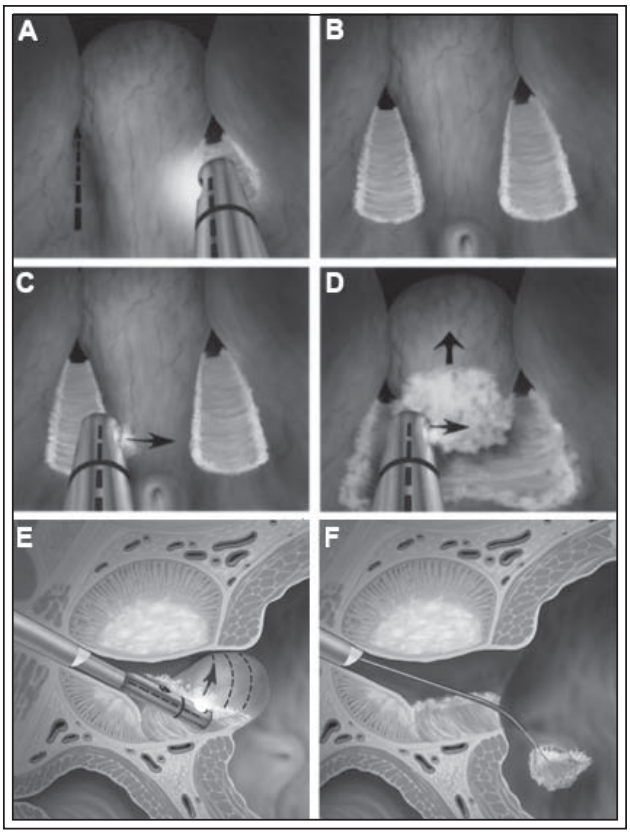

Figure 1. Enucleation of the median lobe of the prostate using the holmium laser side firing fiber. The HoLEP portion of the procedure is initiated by making two incisions along the median lobe at the 5 and 7 o'clock positions to the depth of the surgical capsule from the bladder neck to the proximal portion of the verumontanum **(a, b)**. After making bilateral incisions, the laser fiber is then used to make a lateral incision underneath the median lobe which is extended medially **(c-e)**. Subsequently, the entire middle lobe is enucleated in one piece **(d)**. Finally, the prostatic piece floats into the bladder and can be subsequently retrieved using a flexible endoscopic stone basket **(f)**.

surgical capsule. With the laser as close to the surgical capsule as possible, a lateral incision is made underneath the median lobe which is then extended medially towards the initial 7 o'clock incision, Figures 1c-1e. The same steps are taken starting at the initial 7 o'clock incision and extended medially towards the 5 o'clock position until both grooves are connected in the midline. Subsequently, the entire middle lobe is enucleated in one piece and floats into the bladder for later retrieval, Figures 1d-1f. Care must be taken during this step not to penetrate the surgical capsule, as the prostatic vascular bed lies deep to this structure. The holmium laser wavelength is useful in this regard as the 0.2 mm-0.4 mm depth of penetration allows for identification of the capsule. Hemostasis is achieved periodically throughout the procedure by directing the laser beam in a slightly unfocused fashion to the surrounding tissue.

Often, the median lobe specimen will spontaneously evacuate with the fluid and can be sent for pathologic examination. If the specimen is not easily removed from the resectoscope sheath, it can be retrieved using one of two methods: 1) re-insertion of the resectoscope using the inactive laser fiber to pin the specimen to the sheath as the scope is cautiously withdrawn, or 2) passing a 4.5F 4-wire stone basket through the resectoscope, entrapping the adenoma therein, Figure 1f. An alternate involves a modification of the "mushroom technique" described by Hochreiter et al.[9] The middle lobe is enucleated with the laser and left attached at the bladder neck by a narrow pedicle to prevent its release into the bladder. At this point the vascular supply is almost completely interrupted and the lobe can easily be fragmented with the laser fiber, or even with a conventional resection loop, into smaller pieces. In larger middle lobes which may be too big to extract through the sheath, the "mushroom technique" is used to divide the tissue into a more manageable size while still attached to the surgical capsule.

The analogous technique can also be applied to the lateral lobe provided there is sufficient tissue bulk. Otherwise, once hemostasis from the median lobe enucleation is complete, the HoLAP portion of the combined technique is used to complete the prostatectomy. Using the initial bladder neck incisions and the surgical capsular fibers as a guide, the initial 5 o'clock incision is then extended laterally toward the 1 o'clock position and the left lateral lobe is ablated. Similarly, the right lateral lobe is ablated by extending the original 7 o'clock incision towards the 11 o'clock position, progressing from base to apex. Once ablation is complete and hemostasis is fully achieved, the bladder is drained and the resectoscope is removed. A 20F, latex catheter is placed and removed after 24 hours.

Results

A total of 18 patients who presented with moderate to severe LUTS and demonstrable median lobes on cystoscopy underwent combined HoLAP/HoLEP between April 2005 and July 2008. None of the patients had prior transurethral surgery. The preoperative characteristics are listed in Table 1. Briefly, the mean age was 67.7 years (range 48 to 84). Additionally, TRUS revealed a mean prostate volume of 69.1 cc ± 25.8 cc.

TABLE 1. **Pre and postoperative characteristics of 18 men who underwent the hybrid technique**

Preoperative	
Mean age	67.7 ± 10.3
Mean TRUS prostate volume (g)	69.1 ± 25.8
Mean AUA-SI	21.6 ± 11.0
Mean QOL	4.5 ± 1.4
Mean PSA value	4.8 ± 4.8
Adjusted mean PSA value*	7.1 ± 9.4
Percentage on BPH meds	70.6
Percentage on 5-alpha reductase inhibitors	29.4
Postoperative	
Mean follow up time (months)	9.0 ± 10.5
Mean hospital stay (hours)	35.3 ± 14.9
Mean AUA-SI	10.5 ± 6.7
Mean QoL	2.1 ± 1.4
Percent change AUA-SI	51.6
Percent change QoL score	49.4
Mean PSA value at 3 months	1.3 ± 0.7
Adjusted mean PSA value*	1.8 ± 1.0

*adjusted for 5-alpha reductase inhibitor usage

The average preoperative PSA value (corrected for 5-alpha reductase inhibitors) for all patients in this study was 7.1 ± 9.4, Table 1.

The total operative time (spent in operating room) for the HoLAP/HoLEP procedure was 119.7 minutes (range 50 to 180), and the mean resection time was 48.2 minutes (range 32 to 125 minutes). The average total energy used was 167.0 kJ (range 65 to 304) and a mean number of 1.2 laser fibers were used. No patient required a blood transfusion or had significant alterations in blood chemistry or hematocrit. The average weight of prostate tissue (obtained from the median lobe) which was sent for pathologic analysis was 10.8 g (range 0.8 g to 28.0 g). There was one reported case (5.6%) of incidental Gleason 3+3 prostate cancer diagnosed.

All patients were discharged within 24 hours of the procedure on their home medications. All patients were successfully decatheterized by postoperative day #2 (average 1.3 ± 0.5 days) and had documented low postvoid residuals prior to discharge. There were no cases of subsequent urinary retention requiring recatheterization in this series.

The postoperative AUA-SI and QoL scores are presented in Table 1. On average patients experienced a 51.6% and 49.4% improvement in the AUA-SI and QoL scores, respectively. These significant improvements were maintained for up to 24 months postoperatively. Furthermore, all patients experienced a significant decrease in serum PSA values by 3 months postoperatively ($p < 0.001$).

Discussion

The advantages of holmium laser therapies over traditional TURP include decreased blood loss, shorter hospitalization and decreased catheterization times. However, many of the published holmium laser techniques require increased operative times due to either the tedious nature of prostate vaporization or transurethral morcellation. Our technique combining HoLAP and HoLEP offers significant patient improvements of LUTS, provides tissue for pathologic diagnosis, and potentially decreases the morbidities in comparison to HoLEP.

Since its description by Gilling et al, HoLEP has become an increasingly popular choice for the surgical treatment of BOO related to BPH.[10] However, this technique has been criticized for its significant learning curve as well as potential for morcellator-related bladder injury(~1-8%).[11, 12] Our hybrid technique may provide advantages over "monotherapy" HoLEP or HoLAP as tissue is enucleated which is easily irrigated through the resectoscope sheath without needing tissue morcellation and is available for pathological examination. We believe that the elimination of tissue morcellation alleviates potential injuries and significantly improves the learning curve. In fact, this may be a technique that can facilitate or act as a transition to learning the HoLEP technique. Additionally, although we do not have a direct comparison to either monotherapy, our combined technique may significantly reduce operative time.

Some limitations of our study deserve mention. We did not record operative times specific for removal of the median lobe. Therefore, we cannot make any meaningful comparisons in operative times between pure laser ablation versus our combined technique for removal of the median lobe. However, we believe that enucleation decreases operative length by alleviating the ablation of median lobe. It should be noted that this may be at an additional cost. While none of the men included in the present study had additional therapy in the same setting with either a bipolar cautery loop or a HoLEP laser fiber, it is possible that these loops or fibers could be required if the case is failing to progress. In these circumstances, the holmium laser fiber used for this hybrid technique would create additional cost and operative time for the patient.

While HoLAP has been successfully used on patients with large prostate volumes,[13] it can significantly prolong operative times. In addition, the lack of tissue obtained during this procedure is associated with a potential for false negative prostate cancer diagnoses. We believe these shortcomings are resolved through the hybrid technique as enucleation of the median prostatic lobe provides a specimen for histological examination. While the precise frequency and prognosis of prostate cancer that is limited exclusively to the median lobe is currently unknown, it has been reported that prostate cancer extending into the central zone is associated with a worse prognosis.[14] Therefore, we feel that providing tissue for pathologic analyses from the median lobe could diagnose potentially lethal cancer. While this tissue does not replace postoperative PSA screening, it could detect disease that may otherwise be missed.

Conclusion

The initial results of the combined HoLAP/HoLEP technique are promising. To date, there have been no intra or postoperative adverse events (e.g. urine retention, blood transfusion, bladder injury) associated with this technique. All of the patients included in this study demonstrated significant improvements in AUA-SI and QoL scores. These reports are consistent with results of HoLAP and HoLEP monotherapies.[13,15] In addition, our operative times may be consistent with reports for either monotherapy,[16,17] but our times were not standardized for prostate size. We believe that efficiency can be achieved to overcome the learning curve of this combined technique, and attention then turned to removing larger portions of adenoma.

This study suggests that the combined HoLAP/HoLEP method is safe and associated with similar results to those of either HoLAP or HoLEP alone. In addition, it is associated with significantly less blood loss, and shorter catheterization and hospitalization times than conventional TURP. Moreover, the overall rate of complications appears lower compared to either TURP or HoLEP. Nevertheless, the conclusions of this study are limited by the relatively short follow up time period and small sample size. Future studies examining the long term outcomes of this technique are required. □

References

1. Wei JT, Calhoun E, Jacobsen SJ. Urologic diseases in America project: benign prostatic hyperplasia. *J Urol* 2008;179(5 Suppl): S75-S80.
2. McVary KT. BPH: epidemiology and comorbidities. *Am J Manag Care* 2006;12(5 Suppl):S122-S128.
3. Seki N, Naito S. Holmium laser for benign prostatic hyperplasia. *Curr Opin Urol* 2008;18(1):41-45.
4. Montorsi F, Naspro R, Salonia A, Suardi N, Briganti A, Zanoni M, Valenti S, Vavassori I, Rigatti P. 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(5 Pt 1): 1926-1929.
5. Tan AH, Gilling PJ. Holmium laser prostatectomy: current techniques. *Urology* 2002;60(1):152-156.
6. Kuo RL, Paterson RF, Kim SC, Siqueira Jr TM, Elhilali MM, Lingeman JE. Holmium laser enucleation of the prostate (HoLEP): a technical update. *World J Surg Oncol* 2003;1(1):6.
7. Thompson IM, Pauler Ankerst D, Chi C, Goodman PJ, Tangen CM, Lippman SM, Lucia MS, Parnes HL, Coltman CA Jr. Prediction of prostate cancer for patients receiving finasteride: results from the Prostate Cancer Prevention Trial. *J Clin Oncol* 2007; 25(21):3076-3081.
8. Helfand B, Mouli S, Dedhia R, McVary KT. Management of lower urinary tract symptoms secondary to benign prostatic hyperplasia with open prostatectomy: results of a contemporary series. *J Urol* 2006;176(6 Pt 1):2557-2561; discussion 2561.
9. Hochreiter WW, Muller RM. Lasers for lower urinary tract symptoms secondary to benign prostatic hyperplasia: when is the fuss worth it? *Curr Urol Rep* 2005;6(4):257-262.
10. Gilling PJ, Mackey M, Cresswell M, Kennett K, Kabalin JN, Fraundorfer MR. Holmium laser versus transurethral resection of the prostate: a randomized prospective trial with 1-year follow up. *J Urol* 1999;162(5):1640-1644.
11. Elzayat EA, Elhilali MM. Holmium laser enucleation of the prostate (HoLEP): long-term results, reoperation rate, and possible impact of the learning curve. *Eur Urol* 2007;52(5):1465-1471.
12. Vavassori I, Hurle R, Vismara A, Manzetti A, Valenti S. Holmium laser enucleation of the prostate combined with mechanical morcellation: two years of experience with 196 patients. *J Endourol* 2004;18(1):109-112.
13. Kumar SM. Rapid communication: holmium laser ablation of large prostate glands: an endourologic alternative to open prostatectomy. *J Endourol* 2007;21(6):659-662.
14. Cohen RJ, Shannon BA, Phillips M, Moorin RE, Wheeler TM, Garrett KL. Central zone carcinoma of the prostate gland: a distinct tumor type with poor prognostic features. *J Urol* 2008; 179(5):1762-1767; discussion 1767.
15. Kuo RL, Kim SC, Lingeman JE, Paterson RF, Watkins SL, Simmons GR, Steele RE. Holmium laser enucleation of prostate (HoLEP): the Methodist Hospital experience with greater than 75 gram enucleations. *J Urol* 2003;170(1):149-152.
16. Kim SC, Matlaga BR, Kuo RL, Watkins SL, Kennett KM, Gilling PJ, Lingeman JE. Holmium laser enucleation of the prostate: a comparison of efficiency measures at two institutions. *J Endourol* 2005;19(5):555-558.
17. Rigatti L, Naspro R, Salonia A, Centemero A, Ghezzi M, Guazzoni G, Briganti A, Rigatti P, Montorsi F. Urodynamics after TURP and HoLEP in urodynamically obstructed patients: are there any differences at 1 year of follow-up? *Urology* 2006; 67(6):1193-1198.