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HOLMIUM LASER ENUCLEATION OF THE PROSTATE (HoLEP): THE METHODIST HOSPITAL EXPERIENCE WITH GREATER THAN 75 GRAM ENUCLEATIONS

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ABSTRACT

Purpose: Holmium laser enucleation of the prostate (HoLEP) effectively removes obstructive prostate tissue in minimally invasive fashion. We present our large enucleation outcomes (greater than 75 gm retrieved). We examined post-procedural prostate specific antigen (PSA) and transrectal ultrasound (TRUS) volume changes to assess tissue removal completeness.

Materials and Methods: We retrospectively reviewed HoLEPs performed from April 1, 1999 through September 30, 2002 to identify all enucleations greater than 75 gm. Demographic, laboratory, operative and pathological data were obtained. Patients were surveyed to document longer term complications.

Results: The cohort of 108 patients had a mean age and specimen weight of 71.5 years (range 53 to 90) and 120.6 gm (range 75.3 to 376), respectively. Average procedural time and hospital stay were 166.8 minutes (range 75 to 473) and 1.2 days (range 0 to 4), respectively. No deaths or episodes of transurethral resection syndrome occurred. Postoperative complications included transfusion in 2 cases, a clot retention episode in 3, capsular perforation in 2, morcellator blade malfunction in 4, minor bladder mucosal injury in 1 and bladder neck contracture in 1. American Urological Association symptom scores reassessed in 53 patients without chronic retention an average $\pm$ SD of 10.6 $\pm$ 7.1 months postoperatively showed a mean decrease from 20.3 $\pm$ 6.4 to 4.7 $\pm$ 3.8. PSA in 48 patients a mean of 5.0 $\pm$ 4.1 months postoperatively had decreased an average of 91.7%. In 10 patients TRUS data revealed a mean post-procedural volume decrease of 85.9%.

Conclusions: HoLEP can be performed on extremely large prostates with minimal risk or need for secondary interventions. Most patients are discharged home after an overnight stay. Postoperative decreases in PSA and TRUS volumes support the completeness of enucleation that can be achieved.

KEY WORDS: prostate; holmium, lasers; prostatic hyperplasia; surgical procedures, minimally invasive

The holmium laser is a versatile instrument that has multiple applications in the field of urology. It effectively fragments calculi of all compositions and has also been used to ablate soft tissue pathology in the urinary tract.[1,2] At higher power settings the laser is capable of cutting tissue, while producing a hemostatic effect that results in minimal bleeding after resection.[3]

Most recently the holmium laser has been used as a minimally invasive option for benign prostatic hyperplasia.[4] This laser is well suited to prostatic applications not only because of its hemostatic effect, but also because its limited tissue penetration (0.4 mm) results in much less tissue inflammation and edema than other lasers, such as the neodymium: YAG laser.[5] As a result, catheterization time and irritative voiding symptoms are minimized.

Initially holmium energy was used simply to ablate obstructive prostate tissue, creating a wider channel through the prostatic fossa.[6] Unfortunately tissue ablation can be time-consuming and cumbersome, especially in larger glands. In 1996 Gilling et al developed the first holmium resection technique for the prostate, in which the median and lateral lobes are progressively dissected free and released into the bladder.[7] However, larger lobes had to be systematically cut into smaller pieces during resection to facilitate removal with a modified resectoscope loop.

The advent of the transurethral morcellator eliminated the tedious process of sectioning prostate tissue because complete lobes could now be removed.[4] This latest technique refinement, termed holmium laser enucleation of the prostate (HoLEP), combined with mechanical morcellation, allows treatment of even the largest glands that would have required an open surgical procedure in the past. It is our hypothesis that HoLEP of large glands results in minimal morbidity, while enabling a degree of tissue removal that is unsurpassed by any other ablative modality.

To support our hypothesis we reviewed and documented the outcomes and complications of all large enucleations performed in our practice, in which greater than 75 gm of tissue were retrieved. In particular we used the changes between available preoperative and postoperative prostate specific antigen (PSA) values, and transrectal ultrasound (TRUS) prostate volumes as objective indicators of the completeness of adenoma resection in our patient population.

METHODS

We retrospectively reviewed all HoLEPs from April 1, 1999 to September 30, 2002. Patients with an enucleation weight of greater than 75 gm were selected. Study exclusion criteria were a previous diagnosis of prostate adenocarcinoma or

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HoLEP after hospital admission for problems unrelated to the urinary tract. Office and hospital records were reviewed to obtain demographic data, and the results of preoperative and postoperative patient evaluations, including American Urological Association (AUA) symptom scores, PSA and TRUS volumes. In addition, operative times (including enucleation and morcellation), specimen weights, specimen pathology and hospital stays were recorded.

When patient followup was performed by referring physicians, the respective offices were contacted for postoperative PSA values and AUA symptom scores. When this information was not available from physician records, attempts were made to contact the respective patients by telephone. Patients were also asked to provide information about long-term complications (bladder neck contracture and urethral stricture) through telephone surveys or mailed questionnaires. Data are presented as the mean ± SD. Comparisons between mean preoperative and postoperative outcomes were analyzed statistically by Student's paired t test with $p < 0.05$ considered significant. All HoLEP cases were performed by 1 of 3 surgeons (JEL, RES or GRS). Technical details have been previously documented in the literature.[8–10]

Briefly, our preferred energy source consists of a 100 W holmium:YAG laser with a 550 μ end firing laser fiber (Lumens, Santa Clara, California). A 28Fr continuous flow resectoscope (Karl Storz Endoscopy, Culver City, California) is used with a laser bridge using normal saline as the irrigant. The patient's urethra is calibrated with sounds to 30Fr prior to resectoscope insertion. A urethrotome may be used when the urethra is tight to minimize the incidence of urethral stricture.

The laser fiber is placed into a 7Fr stabilizing catheter, (Cook Urological, Spencer, Indiana) which in turn is inserted into the laser bridge. This bridge incorporates a stabilizing ring at its distal end that holds the laser catheter/fiber combination securely. Because of the high power settings required to perform HoLEP successfully, a video camera based system remains mandatory for the optical safety of the surgeon.

We perform the majority of the enucleation process using a laser setting of 2 J and 50 Hz, changing to 2 J and 40 Hz during dissection of the lateral lobe apex to protect sphincter integrity. After enucleation is completed the surgical capsule is carefully inspected. Any bleeding points are treated by defocusing the laser over targeted areas and using settings of 2.5 J and 40 Hz for coagulation.

A VersaCut (Lumenis, Santa Clara, California) morcellator is used to remove enucleated prostate tissue. An offset rigid nephroscope is placed into the resectoscope sheath with the morcellator blades inserted into the working channel. Morcellation should begin only when the surgeon is satisfied with field clarity to ensure proper tissue visualization. It is crucial to maintain adequate bladder distention during the morcellation process to avoid engaging the bladder wall. As such, it is our practice to run saline irrigant through the 2 inflow ports. Following completion of the procedure a 2-way 20Fr Foley catheter is placed and the patient is given 20 mg furosemide intravenously.

RESULTS

The cohort consisted of a total of 108 patients with a mean age of 71.5 ± 7.9 years (range 53 to 90). A total of 34 patients were in chronic urinary retention prior to the procedure, requiring an indwelling Foley catheter or a clean intermittent catheterization regimen. Table 1 lists perioperative data. Pathological tissue analysis revealed benign prostatic hypertrophy in 101 patients (93.5%). Overall 87% of the patients were discharged home on postoperative day (POD) 1 or earlier after successful voiding trials. Two local patients were discharged home the day of surgery without a catheter.

Table 1. *Perioperative data*

	Mean ± SD (range)
Total operative time (mins)	166.8 ± 62.3 (75–473)
Enucleated tissue wt (gm)	120.6 ± 48.7 (75.3–376)
Hospital stay (days)	1.2 ± 0.6 (0–4)

Table 2 lists outcome data, consisting of comparisons between preoperative and postoperative AUA symptom scores, PSA and TRUS volumes as well as the mean followup periods for these parameters. Postoperative values of these data points were recorded from office, hospital, and referring physician records as well as from patient interviews. All outcome parameters showed significant decreases postoperatively with PSA and TRUS volumes decreasing an average of 91.7% and 85.9%, respectively. Of the 67 patients with available postoperative AUA symptom scores 14 had a history of chronic retention and were not included in the comparison population because the preoperative score could not be accurately assessed. In these 14 patients the average followup symptom score recorded a mean of 12.7 ± 7.4 months postoperatively was 1.9 ± 1.5.

Two patients required additional surgical interventions to complete HoLEP. A patient who had an extremely large prostate gland required small open cystotomy to facilitate removal of the enucleated tissue. In this case the prostatic lobes completely filled the bladder after they were freed. As a result, the bladder could not accommodate sufficient amounts of irrigant through the offset rigid nephroscope, making it impossible to optimize the endoscopic field of vision and safely perform morcellation. The final weight of the enucleated adenoma was 376 gm. The patient was discharged home voiding on POD 2 after an uneventful hospital course. Another patient with a total of 284 gm enucleated tissue required perineal urethrostomy to enable endoscopic access to the prostate as well as open cystotomy for tissue removal. This patient was discharged home on POD 3 without a catheter.

Table 3 shows the complications that occurred in the cohort. Five patients experienced intraoperative morcellator related complications, of which 4 involved blade malfunctions that resulted in retained tissue. The first patient also experienced bleeding that resolved after morcellation completion later that day. Another patient who had undergone a prior transurethral needle ablation procedure, required multiple sets of blades with additional laser resection of the enucleated tissue to enable endoscopic removal of the resected adenoma. Similarly in a third patient a firm portion of adenoma could not be engaged efficiently with the morcellator blades. The retained tissue was laser resected into smaller pieces, which were then removed with a large stone basket (Olympus, Melville, New York). The fourth patient was admitted to the hospital overnight and underwent successful morcellation with new blades the following day. The last complication was a minor bladder mucosal injury during the morcellation process, which was cauterized with the holmium laser. No bladder wall perforation occurred and the patient was discharged home after catheter removal on POD 1. Two other intraoperative complications consisted of episodes of capsular perforation during the enucleation process. One patient was discharged home on POD 1 without a catheter and the other was discharged home on POD 1 with an indwelling catheter for 3 days.

There were no deaths in this series. In addition, no patients had a myocardial infarction, pulmonary embolism or transurethral resection (TUR) syndrome. Two patients (1.9%) required transfusions during the immediate postoperative period. An 81-year-old male had a baseline hemoglobin of 8.0 gm/dl (Cook Urological, Spencer, Indiana). Following HoLEP hemoglobin decreased to 7.0, which was most likely a

TABLE 2. *Outcome parameters*

	AUA Symptom Score	PSA (ng/ml)	TRUS Vol (cc)
No. pts	53	48	10
Mean preop ± SD (range)	20.3 ± 6.4 (6–35)	9.5 ± 6.4 (2.6–26.8)	163.8 ± 70.5 (84.7 ± 309.5)
Mean postop ± SD (range)	4.7 ± 3.8 (0–16)	0.6 ± 0.5 (0.04–2.6)	21.8 ± 8.2 (11.9 ± 38)
Mean mos followup ± SD	10.6 ± 7.1	5.0 ± 4.1	18.6 ± 13.1

Differences among all outcome patients were statistically significant (p <0.001).

TABLE 3. *Overall complications*

Complication	No. Pts (%)
Transfusion	2 (1.9)
Capsular perforation	2 (1.9)
Morcellator blade malfunction	4 (3.7)
Bladder mucosal injury	1 (0.9)
Bladder neck contracture	1 (0.9)
Clot retention	3 (2.8)
Nausea/constipation	1 (0.9)

There were no deaths, myocardial infarctions, TUR syndrome episodes or urethral strictures.

dilutional effect of hydration. Because of advanced age, the patient was given 1 U packed red cells. As mentioned, the other patient had retained tissue following morcellator malfunction and was admitted to the hospital while replacement equipment was acquired. This patient experienced bleeding from capsular sinuses, which were likely unable to coapt in the presence of the retained tissue. He required 6 U packed red cells and morcellation was completed later that day. Following removal of the retained adenoma and laser cauterization of the capsular bleeding points the patient had no further problems.

Of the 108 patients in this series 71 provided information on longer term complications an average of 16.9 ± 7.7 months after surgery. Long-term complications included bladder neck contracture in 1 patient, which was treated successfully with urethral sound dilation in the office. Three patients had clot retention with 1 episode occurring in the immediate postoperative period. The other 2 patients required readmission to the hospital 2 and 4 weeks postoperatively. Two cases were cleared with manual clot evacuation and continuous bladder irrigation. The third patient, who had late onset bleeding a month after surgery, required cystoscopy to facilitate clot evacuation, followed by 24 hours of continuous bladder irrigation. In addition, 1 patient required a 3-day hospital readmission for severe constipation and nausea, which was treated successfully with intravenous hydration and enemas. No patient contacted during followup had a urethral stricture after HoLEP.

DISCUSSION

As technology has advanced, endoscopic surgical alternatives for benign prostatic hypertrophy have expanded from the gold standard of transurethral resection of the prostate (TURP) to other options, such as transurethral vaporization of the prostate, microwave thermotherapy, transurethral needle ablation, interstitial laser coagulation and water induced thermotherapy. A common disadvantage of these newer treatment modalities is that they become increasingly ineffective with larger prostate sizes.

Until the advent of HoLEP patients with a large prostate were limited to staged TURP or open simple prostatectomy since only these procedures could provide effective removal of large amounts of obstructing adenoma. Unfortunately these 2 options can be associated with significant morbidity, especially bleeding. The risk level associated with large TURPs may be higher than in the past because urologists today have had progressively less exposure to the procedure during training. It has a negative impact on resection times, especially for large glands, and increases the chance of related complications. Mebust et al reviewed the outcome of 3,885 TURP procedures and found that the incidence of intraoperative bleeding and the TUR syndrome significantly increased when resection time was greater than 90 minutes.[11]

HoLEP provides distinct advantages over TURP when treating large prostate glands. The hemostatic action of the homium laser results in a clear visual field during the enucleation process and minimizes the risk of postoperative transfusions. Although 2 patients (1.9%) in our series required blood, this rate is extremely favorable considering that a similar percent in the TURP series of Mebust et al also required transfusion despite significantly smaller prostate sizes (mean resected weight 22 gm).[11] In addition, the risk of dilutional hyponatremia (TUR syndrome) is eliminated with HoLEP since normal saline can be used as the irrigant throughout the procedure.

In regard to simple open prostatectomy Moody and Lingeman compared a group of patients who underwent HoLEP with matched patients who had undergone open prostatectomy for a greater than 100 gm prostate gland.[9] Outcomes in the patients who underwent HoLEP were comparable to those in patients who underwent the open procedure with significantly decreased blood loss and hospital stay. With time the hospital stay following HoLEP for large prostate glands is expected to shorten even further, as seen by the decrease in mean hospital stay from 2.1 days in the series of Moody and Lingeman[9] to 1.2 days in the current series.

Overall our results revealed dramatic improvements in patient symptom scores with only minor complications. This finding parallels the conclusions in other, smaller contemporary series in which HoLEP was performed to treat large prostate glands.[9,12] The incidence of bladder neck contracture and urethral stricture was essentially nonexistent in this population after an average of 1.5 years of followup which attests to the minimal morbidity associated with HoLEP but requires longer-term data to substantiate. Complications related to the processes of enucleation and morcellation, such as capsular perforation and bladder mucosal injury, can be attributed to the learning curve.

When preoperative and postoperative PSA values were compared, we found that patients had a 91.7% average decrease in the level following HoLEP. Other groups have analyzed PSA responses after treatment with TURP, transurethral vaporization of the prostate and visual laser ablation of the prostate.[13–15] None of these series showed a PSA response as dramatic as that seen after HoLEP. Importantly, the TURP series of Aus et al, which consisted of 190 patients, showed a only a 70% mean decrease in PSA.[14] When correlated with the 85.9% mean decrease in TRUS volumes in a subset of our cohort, the PSA data in this series strongly support the completeness of adenoma removal that can be achieved through HoLEP.

Although the learning curve for HoLEP is steep, its inherent advantages firmly secure its place for the surgical treatment of large prostates. Potential improvements can still be made in the area of morcellation, in which increased efficiency would help decrease overall operative time and the possibility of complications due to retained tissue.

CONCLUSION

HoLEP is an effective surgical technique for relieving obstructive symptoms in even the largest of prostates. Associated complications are minor and the completeness of adenoma removal is unparalleled by any other endoscopic approach. This procedure offers distinct advantages over TURP or open simple prostatectomy for larger prostate glands. As a result, HoLEP should be strongly considered to treat patients presenting with a large, obstructing prostate.

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