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Original Article

Watt matters: Safety and efficacy of using a 140-W high-powered holmium laser for enucleation of the prostate (HoLEP)

Ali Yıldız[1], Serkan Akdemir[2], Hakan Anıl[3], Murat Arslan[1]

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ABSTRACT

Objective: This study aimed to assess the perioperative and the 12-month efficacy and safety of 140 W high-powered holmium laser for enucleation of the prostate (HP-HoLEP) for the treatment of benign prostatic obstruction.

Material and methods: The data of 540 patients who underwent HoLEP by a single surgeon were analyzed retrospectively. Preoperative evaluation included a physical examination with a digital rectal examination, measurement of maximum urinary flow rate (Q_{max}), postvoid residual volume (PVR) and prostate volume by transabdominal ultrasonography, serum prostate-specific antigen (PSA), international prostate symptom score (I-PSS) and international index of erectile function-5 (IIEF-5) questionnaires, and urine analysis. Morcellation, enucleation, and operation efficiencies were calculated with the resected weight divided by morcellation, enucleation, and operative times, respectively. The patients were reassessed at 1, 3, 6, and 12 months after surgery by I-PSS, IIEF-5, Q_{max}, PSA, and the occurrence of complications.

Results: The mean operative time was 65.2±20.9 minutes. The mean enucleation time and efficiency were 53±15.1 minutes and 1.72±0.4 g/min, respectively. The mean morcellation time and efficiency were 12.3±15.1 minutes and 7.4±3.2 g/min respectively. Clavien grade 1 complications were observed in 102 (18.9%) patients, Clavien grade 2 complications in 20 (3.7%) patients, and Clavien grade 3b complications in 23 (5.4%) patients. I-PSS, Q_{max}, and IIEF-5 at postoperative 1, 3, 6, and 12 months were significantly better than baseline results.

Conclusion: Our study demonstrated that 140 W HP-HoLEP can be performed with high enucleation efficiency, low perioperative and postoperative complication rates, and excellent functional results.

Keywords: Holmium laser for enucleation of the prostate; 140 watt, high power, benign prostate hyperplasia; efficacy

[1]Department of Urology, Okan University Hospital, Faculty of Medicine, İstanbul, Turkey
[2]Department of Urology, Private Tınaztepe Hospital, İzmir, Turkey
[3]Department of Urology, Adana City Training and Research Hospital, Adana, Turkey

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Corresponding Author: Hakan Anıl
E-mail: dr.hakananil@gmail.com

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Introduction

Holmium laser enucleation of the prostate (HoLEP) has recently gained momentum in terms of safety, efficacy, and durability and has become a reliable method for all prostate sizes.[1-4] Holmium:Yttrium Aluminum Garnet laser (holmium) with a wavelength of 2140 nm, is the first laser to be used in soft tissue and urinary tract (specifically for benign prostatic hyperplasia [BPH]).[5] The standard HoLEP technique was described by Gilling using high-energy holmium laser platforms (100 or 120 W) and end-firing 550 micron laser fiber.[6] Since the initial description of the HoLEP technique, many techniques have been defined, and ≤80 W holmium lasers have been used in most of these techniques.[7-9] In the last few years, numerous technological and procedural advances have been made to increase the effectiveness and efficiency of the procedure, including new morcellators, compatibility with multiple scope manufacturers, changes in the technique to allow more people to learn the technique. Besides, the power of the newly produced laser platforms is gradually increasing. We believe that as the power of the laser platforms increases, enucleation efficiency too will increase without changing the complication rates.

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To the best of our knowledge, there is no published study assessing the efficacy and safety of 140 W high-powered HoLEP (HP-HoLEP) for the treatment of benign prostatic obstruction thus far. Therefore, this study aimed to report the perioperative safety and the 12-month efficacy of 140 W HP-HoLEP.

Material and methods

Patient selection and preoperative assessment

After the local institutional review board approval (number:2020/986), patients who met the inclusion criteria between January 2017 and July 2020 were reviewed retrospectively. Written informed consent was obtained from patients who participated in this study. The inclusion criteria were patients with low urinary tract symptoms (LUTS) and poor response to medical therapy, maximum urinary flow rate (Q_{max}) of <15 mL/s, complications of BPH. Patients with previous prostate or urethral surgery, urethral strictures, and urodynamically diagnosed neurogenic bladder were excluded. Preoperative evaluation included a physical examination with digital rectal examination, TRUS, biopsy whenever indicated, measurement of Q_{max}, postvoid residual volume (PVR), prostate volume by transabdominal ultrasonography, serum prostate specific antigen (PSA), international prostate symptom score (I-PSS), international index of erectile function-5 (IIEF-5) questionnaire, and urine analysis. Comorbidities of preoperative patients were assessed according to the Charlson comorbidity index.[10,11]

Surgical technique and equipment

All the procedures were performed by a single surgeon with an appreciable HoLEP experience (MA). HP-HoLEP using 140 W multipulse HoPLUS laser (Jena Surgical/Asclepion Laser, Jena, Germany) and 550 nm bare ended, reusable laser fiber (Jena Surgical) was performed in all the patients under general or spinal anesthesia. A three-lobe technique was performed in all the patients by a single surgeon (MA). A 26-F continuous flow resectoscope (Karl Storz, Tuttlingen, Germany) and rigid nephroscope with a 5 mm working channel (Karl Storz) were used in all the procedures.

Main Points:

- Although there are many studies regarding HoLEP in the literature; so far there is no published study that is assessing the efficacy and safety of 140-W high-powered HoLEP (HP-HoLEP) for the treatment of benign prostatic obstruction (BPO).
- In our study, the mean enucleation efficiency was 1.72±0.4. This is one of the highest enucleation efficiency in the literature.
- Our findings in our study demonstrated that 140-W HP-HoLEP can be performed with high enucleation efficiency, low perioperative and postoperative complication rates, and excellent functional results.

Energy settings were entered separately for each pedal preoperatively. Power settings were 140 W (4 J energy, 35 Hz frequency) for the left (for enucleation) and 60 W (2 J energy, 30 Hz frequency) for the right pedal (for coagulation). Multicut integrated tissue morcellator (Jena Surgical) was used for morcellation. The blade was changed after every 300 g of morcellated tissue according to the manufacturer's recommendation. All the procedures were carried out using normal saline as irrigation fluid. At the end of the surgery, a 22F three-way Foley catheter was inserted. Perioperative antibiotic therapy was administered to all the patients, and they were routinely discharged on the first postoperative day.

Perioperative evaluation and follow-up

Morcellation, enucleation, and operation efficiencies were calculated with the resected weight divided by morcellation, enucleation, and operation times, respectively. The patients were reassessed at 1, 3, 6, and 12 months after surgery by I-PSS, IIEF-5, Q_{max}, PSA, and the occurrence of complications. Of the 540 patients, 426 had a 12-month follow-up. Complications in the first month were evaluated in 540 patients, whereas 12-month results were evaluated in 426 patients. Perioperative and postoperative complications were recorded according to the modified Clavien-Dindo System.[12,13]

Statistical analysis

The data analyses were performed using the IBM Statistical Package for Social Sciences, version 21.0, software (IBM SSPS Corp., Armonk, NY, USA). Continuous variables were expressed as mean±standard deviation, and categorical variables were expressed as percentages. Analysis of normality was performed with the Kolmogorov-Smirnov test. Differences in 2 different time measures were analyzed by repeated measures of ANOVA. A p value ≤0.05 was considered statistically significant.

Results

Baseline characteristics

A total of 540 patients were included in this retrospective study. The mean age was 69.3±8.9 years. Table 1 shows the baseline characteristics of the patients.

Perioperative results and complications

Tables 2 and 3[14-20] list the perioperative data. All the procedures were performed successfully. Mean operative time was 65.2±20.9 minutes. The mean enucleation time and efficiency were 53±15.1 minutes and 1.72±0.4 g/min, respectively. The mean morcellation time and efficiency were 12.3±15.1 minutes and 7.44±3.2 g/min, respectively.

Table 4 lists the detailed frequencies of all the complications according to Clavien-Dindo grading and treatment modalities

Table 1. Patient demographics and preoperative data (n=540)

Age (years)	69.3±8.9
BMI (kg/m^2)	23.90±2.6
Charlson comorbidity score	3 (0–7)
Preoperative urinary retention n (%)	140 (26)
Previous prostate biopsy n (%)	198 (36.7)
Previous prostate surgery n (%)	10 (1.8)
Bipolar TURP	3 (0.6)
PVP	3 (0.6)
Monopolar TURP	3 (0.6)
PSA (ng/mL)	6.5±14.7
Prostate volume (mL)	97.2±42.5
I-PSS	28.8±4.5
Q_{max} (mL/sn)	6.8±8.50*
PVR (mL)	152.9±85.1*
IIEF-5 score	14.8±6.6
Patients using anticoagulant therapy n (%)	239 (44.3)

Data are presented as n (%) or mean±standard deviation or median (range).
*Except those in urinary retention
HoLEP: holmium laser enucleation of the prostate; BMI: body mass index; TURP: transurethral resection of prostate; PVP: photoselective vaporization of the prostate; PSA: prostate-specific antigen; I-PSS: International prostate symptom score; Qmax: maximum urinary flow rate; PVR: postvoiding residual urine; IIEF-5: International index of erectile function-5

Table 2. Perioperative results (n=540)

	mean±SD
Operation time[1] (min)	65.2±20.9
Enucleation time[2] (min)	53.0±15.1
Morcellation time (min)	12.3±6.7
Morcellation efficiency[3] (g/min)	7.4±3.2
Enucleation efficiency[4] (g/min)	1.72±0.4
Operation efficiency[5] (g/min)	1.4±0.3
Resected weight (g)	91.6±40.4
Hemoglobin decrease (g/dL)	0.8±0.6
Catheter time (days)	2.9±0.5
Postoperative stay (days)	1.02±0.2

SD: standard deviation. [1]Measured from insertion until removal of the resectoscope, [2]Measured from the insertion of the laser fiber until removal, [3]Resected weight/morcellation time, [4]Resected weight/enucleation time, [5]Resected weight/operation time

Table 3. Enucleation efficiency in contemporary HoLEP series

Study	Laser power (W)	Enucleation efficiency (g/min) (mean)
Khan et al. 2017[17]*	50	0.91 (95% CI, 0.56–1.09)
Scoffone et al.[15]*	40	1.64±0.8
	100	1.7±1
Rassweiler et al.[9]*	25	0.45
	40	0.71
Dusing et al. 2010[18]*	100	1 (0.1–5.1)
Elshal et al. 2012[19]* (McGill series)	100	0.7
Minagawa et al. 2017[20]*	30	1.14
Stern et al.[14]*	120	0.84
	100	0.89
Elshal et al. 2018 [16]	50	1.42±0.6
	100	1.47±0.6
Present study	140	1.72±0.4

HoLEP: holmium laser enucleation of the prostate; CI: confidence interval
*Cited by Elshal et al.[16]

Table 4. Perioperative and postoperative complications

Complication	Treatment	Clavien grade	n (%)
Complications within 30-day period (n=540)			
Transient incontinence	Functional training	1	42 (7.7)
Capsular perforation	No treatment	1	28 (5.2)
Urinary retention after catheter removal	Bedside recatheterization	1	24 (4.4)
Bladder mucosal injury	No treatment	1	8 (1.4)
Postoperative hematuria	Bladder irrigation and transfusion	2	8 (1.4)
Urinary tract infection	Antibiotics	2	12 (2.2)
12-month follow-up complication (n=426)			
Urethral stricture	Internal urethrotomy	3b	8 (1.8)
Meatal/submeatal stenosis	Meatotomy	3b	10 (2.3)
Bladder-neck contracture	Bladder-neck incision	3b	5 (1.1)

which occurred during the first 30 postoperative days and postoperative 12-month follow-up. Clavien grade 1 complications were observed in 102/540 (18.9%) patients. Clavien grade 2 complications were observed in 20/540 (3.7%) patients. Clavien grade 3b complications were observed in 23/426 (5.4%) patients.

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Table 5. Patient follow-up data

Follow-up parameters	Preop (n=426)	1-month (n=426)	3-month (n=426)	6-month (n=426)	12-month (n=426)
I-PSS	28.7±4.0	5.6±1.9*	5.2±1.9*	5.0±1.5*	4.7±1.5*
Q_{max} (mL/s)	7.54±9.45	37.73±9.66*	36.84±9.03*	35.59±8.87*	35.61±8.94*
PSA (μg/dL)	4.76±4.66	0.64±0.52*	0.63±0.51*	0.59±0.44*	0.58±0.41*
IIEF-5	15.83±6.40	16.45±6.95**	16.41±6.81**	16.54±6.90**	16.30±6.77**

**p<0.01. *p<0.001 compared with baseline. I-PSS: international prostate symptom score; Qmax: maximum urinary flow rate; PSA: prostate-specific antigen; IIEF-5: international index of erectile function-5

Follow-up results

Table 5 lists the changes in I-PSS, Q_{max}, PSA, and IIEF-5 score at 1, 3, 6, and 12 months after the operation. The 12-month follow-up results of 426 patients could be recorded. The reason for the loss of data during follow-up was the patients who did not expire at the 12th month control period at the time of writing this manuscript. I-PSS, $Q_{max,}$ and IIEF-5 at postoperative 1, 3, 6, and 12 months were significantly better than baseline results. BPH occurred in 522 (96.7%) patients and Gleason 3+3 adenocarcinoma in 18 (3.3%) patients.

Discussion

For years, HoLEP has been typically described by reference centers as a procedure that is performed by high-power holmium laser (80–100 W).[21,22] To the best of our knowledge, this is the first study regarding HoLEP using 140 W high-power energy with a 12-month follow-up period.

The enucleation efficiency in the contemporary HoLEP series is compared in Table 3. Thus far, the highest energy we have seen in HoLEP studies in the literature was 120 Stern et al.[14] have published the results of patients who underwent HP-HoLEP (100 W and 120 W) in 2017. The mean enucleation efficiency was 0.89 and 0.84 g/min, respectively. A study by Rassweiler et al.[9] that retrospectively analyzed the results of patients who underwent LP-HoLEP (25 W and 40 W), the mean enucleation efficiency was 0.45 and 0.71 g/min, respectively. A study by Scoffone et al.[15] in 2017 has compared the results of LP-HoLEP and HP-HoLEP. The mean enucleation efficiency was 1.64 and 1.7 g/min, respectively. In our study, the mean enucleation efficiency was 1.72±0.4 g/min. Therefore, our study is one of the studies with the highest enucleation efficiency in the literature. We believe that the reason for this high efficiency could be that all the procedures were performed using a high-powered holmium laser platform by a single experienced surgeon.

When we evaluated our 12-month follow-up results, we observed a significant relief of symptoms in patients with LUTS. We noted momentous improvement in all urinary outcome measures after HP-HoLEP at 12-month follow-up. This improvement is comparable with the other HoLEP study in the literature.[2,23] Tinmouth et al.[24] have reported that PSA reduction could be a marker of complete removal of the adenoma. Zhang et al.[25] have presented a study which compared HoLEP and thulium enucleation of the prostate. The mean PSA reduction 18 months after surgery in this study was 83.5% and 81.9%, respectively. In our study, the mean PSA reduction after 12 months HP-HoLEP is 87.8%, and this result also confirms complete removal of the adenoma.

In our study, the rates of perioperative and medium-term postoperative complications were very low and comparable with the HoLEP series in the literature.[2,23-29] The most common perioperative complication was transient incontinence. Although the immediate incontinence rate was 7.7% at the 1-month follow-up, the rate dropped to 0 at the 12-month follow-up similar to other HoLEP series, transurethral resection of the prostate, and open prostatectomy.[2,23,26,28,29] In our study, the number of patients treated with anticoagulant was 239 (44.3%). All these patients received bridging therapy with heparin after cardiology consultation when undergoing HoLEP. Although the rate of patients receiving anticoagulant therapy was high, the perioperative transfusion/irrigation rate was 1.4%, in line with other HoLEP series.[2,26,30] This could be owing to the fact that the 140 W laser platform has a better hemostasis potential because of its ability to widen the pulse width. Although we performed HoLEP using high energy, there was no significant increase in complication rates as we performed all the procedures with the "no-touch" approach that Scoffone et al.[15] have previously defined. The "no-touch" approach seems to deliver less energy directly to the capsule, one of the reasons for postoperative storage symptoms and capsular perforation.[26,31]

Using a high-power laser platform might harm erectile function owing to increased penetration depth. In a prospective study evaluating the effect of HoLEP on the overall erectile function, it was observed that the overall IIEF score increased compared with the baseline. However, a negative effect on erectile function has occurred in patients with preoperative normal erectile function.[32] Our study also demonstrated that the mean IIEF-5 scores after HP-HoLEP were significantly increased compared with those at baseline.

Our study had a few potential limitations, one of which was that this study was designed retrospectively. Another limitation was the lack of an LP-HoLEP arm that could be used for comparison. We also included cases on the learning curve. However, this was the first study that presented the data of 140 W HP-HoLEP at 12-month follow-up.

In conclusion, our study demonstrated that 140 W HP-HoLEP could be performed with high enucleation efficiency, low perioperative and postoperative complication rates, and excellent functional results. We believe that increased operation and enucleation efficiency can also facilitate the learning process by reducing the operation time. However, the 140 W HP-HoLEP results need to be evaluated in prospective randomized controlled studies.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Istanbul Okan University (Approval No: 2020/986).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Project Development – A.Y., M.A.; Data Collection – S.A., H.A.; Data Analysis – S.A., H.A.; Manuscript Writing/ Editing – A.Y., M.A., H.A.

Conflict of Interest: The authors have no conflicts of interest to declare.

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