How I Do It: Teaching holmium laser enucleation of the prostate (HoLEP)

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Holmium laser enucleation of the prostate (HoLEP) is considered a size-independent technique to treat benign prostatic hyperplasia. This safe and effective procedure is increasingly being adopted in urology training programs worldwide, yet limited teaching strategies have been described. Endoscopic handling during HoLEP allows for a simultaneous interaction between the surgeon and trainee, facilitating a guided teaching strategy with increasing difficulty as experience grows. In this article, we describe our stepwise approach for teaching HoLEP as part of a structured surgical training curriculum. We also evaluate the association of our method with intraoperative efficiency parameters and immediate postoperative surgical outcomes of 200 HoLEP procedures.

Key Words: HoLEP, benign prostatic hyperplasia, surgical education, training

Introduction

Holmium laser enucleation of the prostate (HoLEP) is a procedure with low complication rates and durable results, considered a size-independent technique to treat benign prostatic hyperplasia (BPH).[1] Despite this, HoLEP remains underutilized, accounting for only 7.6% of surgical interventions to treat BPH in the United States.[2] Widespread implementation of HoLEP has been hampered by the assumption of being a technique with a steep learning curve that requires advanced and specialized training, allowing limited teaching opportunities.[3]

The adoption of a technically challenging procedure in training programs is also hampered by cost-effectiveness issues arising from the negative impact that trainee involvement could have on surgical efficiency, as supported by evidence from other fields.[4] While diverse HoLEP surgical techniques have been introduced and technological advancements have been implemented to minimize the learning curve, there are few teaching strategies described. Furthermore, the impact of trainee involvement on HoLEP operative efficiency is unknown.

In this study, we describe our approach to teaching HoLEP as part of a structured surgical training curriculum and evaluate the impact of this method on HoLEP intraoperative efficiency parameters and immediate postoperative safety.

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A video clip is available online at www.canjurol.com

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Materials and methods

Study cohort

After obtaining Institutional Review Board (IRB) approval, we retrospectively identified men who underwent HoLEP at our institution between 2020 and 2022. Procedures were divided into two groups according to the presence or absence of trainees. All trainees involved were instructed using the technique described herein and all procedures were performed by the same attending surgeon.

Clinical and surgical features

Clinicopathological variables were abstracted from electronic health records included: age, baseline international prostate symptom score (IPSS), baseline prostate-specific antigen (PSA), prostate size, history of anticoagulation, prior urinary retention, and prior urinary tract infection. Surgical efficiency outcomes from each enucleation included: operative time, total laser energy and energy density. Trainee presence was recorded for each case and trainees were subdivided as Juniors (PGY 1 and 2) and Seniors (PGY 3, 4, 5 and fellows). Case order, postoperative discharge day, surgical pathology, and 90-day complication rates were also recorded.

Statistical analysis

Baseline characteristics were summarized using means and standard deviations for continuous variables or frequencies and percentages for categorical variables and compared between groups using t-tests and Fisher exact tests, respectively. The effect of our teaching strategy and trainee involvement on surgical efficiency parameters was evaluated using multivariable linear regression models including all clinically relevant covariates. Statistical analyses were performed using Stata (Version 17, College Station, TX, USA, StataCorp LLC).

Surgical technique and teaching strategy

All procedures were performed using high power 100-W MOSES pulse-modulated holmium laser unit (Lumenis, Yoknaem, Israel) utilizing an "en bloc" approach with early apical release as described by Gómez Sancha et al.[5] Briefly, the operation begins by demarcating the apical extent of the adenoma by incising the mucosa circumferentially proximal to the urethral sphincter. The posterior plane is entered on each side of the verumontanum and then the mucosal strip and fibromuscular tissue over the verumontanum is divided creating a unified posterior plane of dissection. Before continuing the dissection, the fibro-muscular complex connecting the apex of the transitional zone to the urethral sphincter complex is divided circumferentially liberating the apex of the prostate from the sphincter complex.

The dissection is continued from apex to bladder neck in an en-bloc fashion. The bladder is entered anteriorly, and then all remaining attachments between the surgical capsule and the adenoma are divided and the prostate adenoma is delivered into the bladder. A Piranha morcellator (Richard Wolf, Knittlingen, Germany) is used to remove enucleated prostatic tissue. This feasible and reproducible technique provides a systematic approach to the surgical procedure, facilitating trainee involvement.

In our training curriculum, prior to engaging in the procedure, the trainee learns the steps of the procedure, principles of endoscope navigation and laser-tissue interaction for which simulation-based training strategies and video review can be beneficial. Pinpoint lasing to achieve hemostasis during dissection or prior to morcellation is an ideal step of the procedure for trainee to gain competence in this initial skill set. After this, the "active help" phase begins, with sequential and simultaneous handling of the scope as trainees' ability and comfort improves. Initially, the trainee places their hands over the surgeon's hands holding the endoscope, using the "hand over hand" maneuver, Figure 1. This allows the trainee to experience the range of movement and tension/traction forces utilized during the energy and mechanical dissection portion of the case.

After gaining experience with three-dimensional movement within prostatic fossa and plane dissection, the "adjustment" phase begins, in which the trainee holds the scope primarily and carries on the dissection, while the surgeon's hands are placed over the trainee's hands to provide real-time feedback regarding movement and force as the surgeon can observe and guide the dissection, Figures 2 and 3. As the trainee's experience grows, it is only necessary for the surgeon to provide minor adjustments to trainee's endoscope movements which can be accomplished by manipulating the scope via the light cord or the camera in the "passive help" phase, Figure 4. Finally, the surgeon supervises the trainee and provides minor guidance, Figure 5.

Results

A total of 200 HoLEP procedures were performed, of which 136 had trainee involvement, Table 1. Mean age at surgery was 70.7 ± 9.2 years, mean baseline IPSS score was 18.5 ± 6.7, mean prostatic volume was 113.5 grams and mean baseline preoperative PSA was 8.7 ±

Figure 1. Hand over hand maneuver.

Figure 2. Adjustment phase 1.
*trainee is shown wearing green gloves

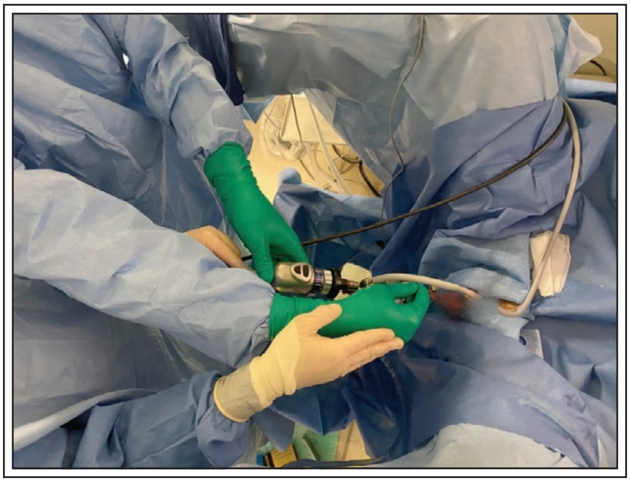

Figure 3. Adjustment phase 2.

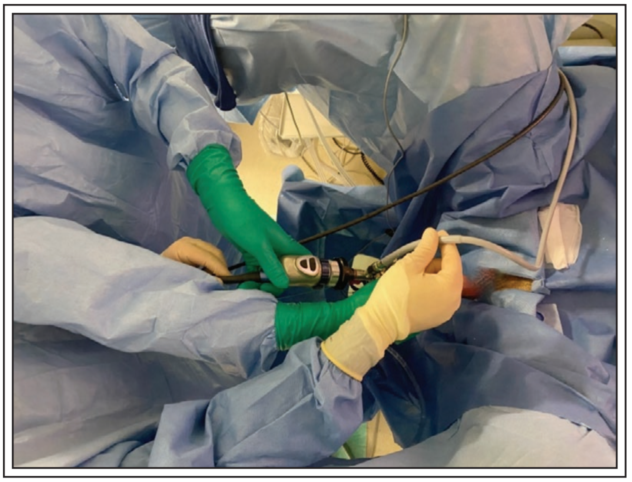

Figure 4. Passive help phase.

26.3 ng/dL. There were no statistically significant differences among groups on baseline characteristics. Cases involving a trainee were performed earlier in the morning ($p = 0.01$). Operative efficiency parameters for each group are summarized in Table 2. On multivariable analysis, trainee presence was not associated with increase in operative time (β: 17.2; $p = 0.08$), total laser energy (β: -3.3; $p = 0.8$), or energy density (β: -0,01; $p = 0.9$) as shown in Table 3. Similarly, trainee level was not associated with efficiency parameters on multivariable regression.

Neither discharge day ($p = 0.53$) nor 90-day complication rate (6.6% vs. 10.6%, $p = 0.4$) differed between groups. The most frequent complication presented was postoperative urinary retention, Table 4.

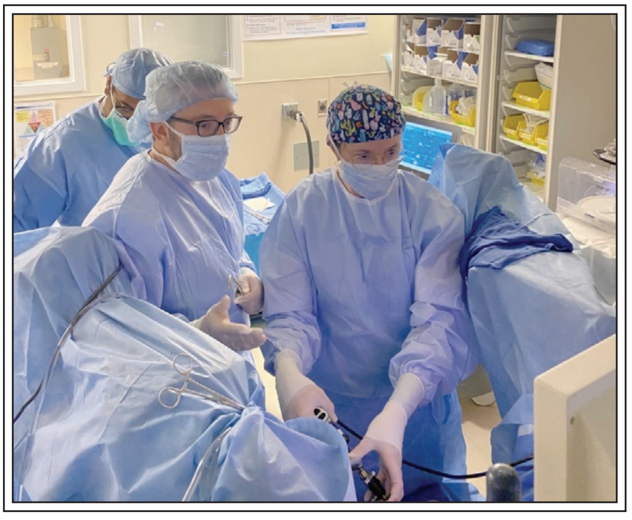

Figure 5. Supervision and minor guidance.

TABLE 1. **Baseline characteristics***

Characteristic	**Trainee presence**		**p value**
	Yes (136)	**No (64)**	
Age, years	70.5 ± 9.6	71.1 ± 8.2	0.6
Baseline IPSS	18.5 ± 6.7	18.7 ± 7.1	0.9
Baseline PSA	7.3 ± 6.4	11.6 ± 45.8	0.3
Baseline urinary retention	77 (56.6)	45 (70.3)	0.09
Baseline urinary tract infection	42 (31.1)	22 (34.4)	0.7
Anticoagulation			
Preoperative anticoagulation	9 (6.8)	10 (15.9)	0.07
Anticoagulation held	6 (66.7)	9 (90.0)	0.3
ASA			0.4
I	1 (0.7)	1 (1.6)	
II	73 (53.7)	34 (53.1)	
III	61 (44.9)	27 (42.2)	
IV	1 (0.74)	2 (3.1)	
Prostate size (grams)	119.1 ± 55.5	114.1 ± 47.1	0.5
Case order			0.02
1	81 (59.6)	47 (77.1)	
2	33 (24.3)	12 (19.7)	
3	22 (16.2)	2 (3.3)	

*continuous variables presented as mean ± SD, categorical variables presented as n (%)

TABLE 2. **Operative characteristics by the presence of trainee***

Characteristic	**Trainee presence**		**p value**
	Yes	**No**	**(unadjusted)**
Total energy (kJ)	219.7 ± 112.3	212.5 ± 89.7	0.7
Energy density (kJ/g)	2.07 ± 1.1	1.98 ± 0.69	0.7
OR time (min)	168.3 ± 69.3	166.5 ± 63.1	0.8

*continuous variables presented as mean ± SD

TABLE 3. **Multivariable linear regression model***

Characteristic	**Coefficient**	**95 % CI**	**p value**
Total energy (kJ)	-3.4	(-33.9, 37.1)	0.8
Energy density (kJ/g)	-0.2	(-0.34, 0.3)	0.3
OR time (min)	17.2	(-1.9, 36.2)	0.08

*variables not shown: age, case order, preoperative anticoagulation, ASA score, baseline UTI, baseline urinary retention

TABLE 4. **Postoperative characteristics***

Characteristic	Trainee presence Yes (136)	No (64)	p value
Postoperative discharge day			0.5
0	54 (40.0)	31 (48.5)	
1	56 (41.5)	26 (40.9)	
2	20 (14.8)	6 (9.1)	
> 2	5 (3.7)	1 (1.5)	
Any complication n (%)	9 (6.5)	7 (10.6)	0.4
Complication type			0.3
Urinary retention	6 (66.7)	2 (28.6)	
Urinary tract infection	0 (0)	2 (28.6)	
Hematuria	3 (33.3)	2 (28.6)	

*categorical variables presented as n (%)

Discussion

Trainee involvement under supervision is one of the mainstays of surgical teaching, yet there are few procedures that allow safe simultaneous participation of the surgeon and trainee. Endoscopic procedures such as HoLEP allow a safe and dynamic trainee engagement facilitating the learning experience. Prior studies have supported that trainee participation in a controlled training environment does not affect perioperative and functional outcomes of HoLEP. Early reports showed that HoLEP was a safe procedure to be taught with good functional outcomes under the supervision of an experienced urologist, although surgical efficiency was not assessed.[6] In a more recent study, length of stay, catheterization time, and 1-year intermediate functional outcomes were not affected by the participation of junior and senior trainees, with a significant increase in operative time noticed in procedures with trainee presence.[7]

In contrast, our findings suggest that trainee involvement is not associated with operative time, and additional efficiency parameters, including laser energy and energy density, as a measure of energy used per gram of prostatic tissue. The nature of the teaching technique presented contributes to the maintenance of surgical efficiency as it allows for a gradual increase in trainee involvement and an adaptative transition to more challenging steps of the procedure. This is relevant considering that recent literature has shown HoLEP to be one of the most cost-effective surgical options for benign prostatic hyperplasia when compared to other minimally invasive procedures.[8] Although some studies have reported up to 60 cases to reach a plateau in HoLEP learning curve,[9] the adoption of stepwise teaching strategies to achieve trainee independence could potentially minimize this achieving safe adoption in practice.[10]

Even though our technique has been implemented for the "en bloc" approach, it is applicable to all HoLEP surgical techniques as it allows the trainee to understand forces and laser tissue interactions that are relevant to all endoscopic procedures. Our study is not without limitations, including a retrospective design and short term outcome ascertainment. Further studies are required to determine this technique's effect on long-term safety and functional outcomes.

Conclusion

The use of a stepwise technique with simultaneous endoscope handling is a safe and efficient strategy to teach HoLEP in a post-graduate training setting. This approach can help ease the learning curve and achieve metrics for incorporating HoLEP into clinical practice. ☐

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