

Original Article

Surgical outcomes of Holmium laser enucleation of the prostate (HoLEP) versus bipolar transurethral enucleation of the prostate (B-TUEP) in benign prostatic hyperplasia patients

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Keywords:

HoLEP, bipolar transurethral enucleation of the prostate, benign prostatic hyperplasia

Abstract

Objective: To evaluate the outcomes and safety of the surgical technique Holmium laser enucleation of the prostate (HoLEP) in comparison to bipolar transurethral enucleation of the prostate (B-TUEP) in patients with benign prostatic hyperplasia (BPH) for whom surgery was advised by a single surgeon.

Materials and Methods: Data was collected from 36 patients who underwent HoLEP between January 2021 and June 2022 and 36 patients who underwent B-TUEP between January 2023 and August 2024 in Rajavithi Hospital. Demographic characteristics, perioperative results, complications, and functional outcomes of surgery were compared between the two groups.

Results: There was no significant difference between the groups in terms of age, blood loss, resected tissue volume, complications and pathology. The operative time, the catheterization time and the length of stay were significantly longer in the HoLEP group. There was significant postoperative improvement in international prostate symptom score (IPSS), quality of life score (QoL), peak flow rate (Q-max), post-void residual urine volume (PVR) and prostate-specific antigen (PSA) in both groups. However, the improvement in the IPSS was significantly better in the B-TUEP group.

Conclusions: The outcomes of HoLEP and B-TUEP are comparable regarding safety and efficacy for the treatment of BPH patients. However, HoLEP required a longer operative time, catheterization time and length of stay than B-TUEP.

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Introduction

Benign prostatic hyperplasia (BPH) is the most common pathology affecting bladder outlet obstruction in men, the incidence of BPH increas-

ing by 50% in the last 60 years.¹ Transurethral resection of the prostate (TURP) is still the gold standard in the endoscopic surgical treatment of BPH. Currently, bipolar-TURP is being in-

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creasingly used in comparison to the long-established monopolar-TURP due to the lower risk of hyponatremia, TUR syndrome, and blood loss.² Bipolar transurethral enucleation of the prostate (B-TUEP) was implemented as a safe, effective, and durable procedure for BPH patients, and it has been shown to have superior outcomes at both short- and long-term follow-up in comparison with TURP.³ Holmium laser enucleation of the prostate (HoLEP) has been used as alternative treatment for BPH, first being described in 1995 by Gillig et al.⁴ The recent guidelines published by the European Association of Urology (EAU) recommend B-TUEP and HoLEP as surgical treatments for BPH when the gland is larger than 30 ml.^{5,6} American Urology Association (AUA) guidelines recommend HoLEP as the surgical treatment for all sizes of BPH especially in the case of patients who use anticoagulant and antiplatelet therapy.⁷ However, in the majority of hospitals of Thailand there remains a lack of laser equipment for BPH surgery. For these reasons B-TUEP has been considered as a suitable option for all patients in Thailand. Thus, the purpose of this study was to compare the perioperative data, complications and functional outcomes between HoLEP and B-TUEP in the same hospital by single surgeon.

Materials and Methods

A total of 36 patients underwent HoLEP between January 2021 and June 2022 and 36 patients underwent B-TUEP between January 2023 and August 2024 in Rajavithi Hospital for BPH surgical conditions. The study was approved by the Research Ethics Committee of Rajavithi Hospital (protocol number: 66042). In this study was cystoscopy had been carried out in every patient before either the HoLEP or B-TUEP procedure to evaluate the prostate anatomy and exclude other causes of lower urinary tract symptoms.

Data were recorded including underlying disease, mean age, operative time, tissue weight removed, catheterization time, length of hospital stay (LOS), pathologic results and complications in both groups. The data collected included the international prostate symptom score (IPSS), quality of life score (QoL), prostate-specific antigen (PSA), peak flow rate (Q-max), and post-void residual urine volume (PVR). Data were collected pre-operatively and compared with results from 1 month postoperatively. Pre-post operative hema-

tocrit (Hct) readings were also compared. Patients were monitored for complications for one month postoperatively, with follow-up continuing until the patient exhibited normal urination. Additional follow-up was conducted at three months.

Data analyses were performed using SPSS, version 22.0 (SPSS Inc., Chicago, IL, USA). The categorical variables are presented as number and percentages, whereas the continuous variables are represented by mean \pm standard deviation (SD). Comparisons between the two groups were analyzed using the chi-squared test or Fisher's exact test. Student's t-test or Mann-Whitney U test were used to compare continuous variables between two groups. Preoperative versus postoperative results in each group were compared using a Paired-t test or Wilcoxon signed rank test. A p-value less than 0.05 was statistically significant.

Whilst carrying out the HoLEP procedure, the author performed the three-lobe technique in all patients. The instrument was a 26 Fr laser resectoscope with 30-degree lens (Wolf brand). The laser device was Holmium-YAG laser 120-watt (Lumenis brand) with 550 microns of laser fiber. The laser power setting was 2J and 50Hz for cutting, with 1J and 20Hz for coagulation. The morcellator was PIRANHA (Wolf brand) connected with a 0-degree nephroscope for removal of prostatic adenoma. The irrigating fluid used was normal saline. Patients were put in the lithotomy position after general or spinal anesthesia, a 26 Fr laser resectoscope and sheath were inserted then the bladder was evaluated, and ureteric orifices, bladder neck and verumontanum were identified. The author inserted the resectoscope with an obturator lens (Wolf brand) without dilating the urethra but in the narrow urethral lumen cases we used a metal dilator before inserting the resectoscope. Firstly, the author made the inverted-U shape incision by laser around the verumontanum to identify the surgical capsule of the median lobe. Then the incision was made at 5 and 7 o'clock deep to reach the surgical capsule. After that the median lobe was enucleated to the bladder in a retrograde fashion. The left lateral lobe enucleation was initiated by mucosal incision from 5 to the 12 o'clock position at the apex of the prostate to release the adenoma tissue from the urethral sphincter then an incision was made at the anterior commissure of the prostate. The left lateral lobe was enucleated in a retrograde fashion towards the bladder. The

right lateral lobe enucleation was initiated by mucosal incision from the 7 to the 12 o'clock position at the apex of the prostate then the right lateral lobe was enucleated in a retrograde fashion to the bladder in a similar way to the left lobe. After completing enucleation of the three lobes of the prostate, the author used the laser to stop any bleeding of the prostatic fossa before morcellation. The nephroscope was changed to the same sheath and a morcellator was used to remove the floating adenoma from the bladder. At the end of operation, the author inserted a 22 Fr three-way urethral catheter with 30 mL of balloon with continuous bladder irrigation with normal saline. Urethral traction was carried out in some cases if the urine became red.

In the case of the B-TUEP procedure, the author performed the three-lobe technique in all patients. The instrument used was a 26 Fr bipolar loop resectoscope with a 30-degree lens (Wolf brand). The electrosurgery unit (Martin brand) was set to 180 watts at grade 3. The morcellator was PIRANHA (Wolf brand) connected to a 0-degree nephroscope for removal of prostatic adenoma. The operation was begun in the same way as the HoLEP procedure. Firstly, the urethral mucosa was split deep to the surgical capsule from the 5 to 3 o'clock position near the verumontanum to identify the correct surgical capsule. Then, the median lobe was enucleated retrogradely at 5 and 7 o'clock to the bladder neck using the resectoscope beak. An electrode loop was used to ensure coagulation at bleeding points. The median lobe was separated from the surgical

capsule and both lateral lobes, then the median lobe was pushed into the bladder. The 12 o'clock position of the mucosa of the prostate was resected to split the left and right lobes of the prostate. The left lateral lobe enucleation was initiated from the 5 to 12 o'clock position in a retrograde fashion then the adenoma was pushed into the bladder. The right lateral lobe was enucleated in the same fashion from the 7 to 12 o'clock position toward the bladder neck. After enucleation of three lobes of the prostate was completed, the author used the bipolar electrode loop to arrest any bleeding from the prostatic fossa before morcellation. The nephroscope was used with the morcellator to remove prostatic adenoma in the same way as HoLEP. At the end of operation, the author implanted a 22 Fr three-way urethral catheter with 30 mL of balloon with continuous bladder irrigation by normal saline. Urethral traction was carried out in some cases if the urine became red.

Both HoLEP and B-TUEP were performed by a single surgeon who only has previous experience in standard TURP.

Results

The demographic data and preoperative parameters of the patients who underwent HoLEP and B-TUEP are shown in Table 1. The postoperative outcomes of the patients are shown in Table 2. There were no significant differences between the groups with regard to age, blood loss (estimated by anesthesiologist which may lead to some inaccuracy), resected tissue volume, complications and pathology. Underlying diseases

Table 1. Demographic data and preoperative parameters of the patients

Data	HoLEP (n =36)	TUEP (n = 36)	P-value
Age (year)	72.08±7.81	69.11±7.75	0.110 ^A
Underlying disease	21.0 (58.3)	30.0 (83.3)	0.020 ^B
Hct Preoperative (%)	40.71±5.60	39.87±5.50	0.526 ^A
PSA Preoperative (ng/ml)	5.3 (2.2-9.5)	3.9 (1.6-10.1)	0.441 ^C
IPSS Preoperative	22.8±6.65	25.25±5.54	0.228 ^A
QOL Preoperative	5.0 (4.0-5.0)	5.0 (5.0-5.8)	0.401 ^C
Q-max Preoperative (ml/sec)	8.2 (5.0-12.7)	8.1 (6.3-12.7)	0.664 ^C
PVR Preoperative (ml)	159.70±148.60	120.50±109.11	0.375 ^C

Results shown as mean ± SD, n (%) and median (IQR), * = statistically significant at p ≤ 0.05
^A = The p-value by Student's t-test, ^B = The p-value by Chi-squared test, ^C = The p-value by Mann-Whitney U test

Hct = hematocrit, PSA = prostate-specific antigen, IPSS = International Prostate Symptom Score, QOL = Quality of Life Score, Q-max = peak flow rate, PVR = post-voided residual urine volume.

Table 2. Postoperative outcomes of the patients.

Data	HoLEP (n = 36)	TUEP (n = 36)	P-value
Hct (%)	38.80±4.90	37.58±4.81	0.296 ^A
Hct loss	1.9 (0.3-3.2)	2.1 (0.7-4.1)	0.331 ^C
% Hct loss	4.6 (0.8-8.8)	6.1 (1.8-9.7)	0.265 ^C
PSA (ng/ml)	1.1 (0.6-1.6)	0.8 (0.4-1.9)	0.441 ^C
PSA decline (ng/ml)	3.8 (1.2-9.0)	3.1 (0.7-10.0)	0.479 ^C
%PSA decline	78.0 (56.8-90.8)	81.2 (48.8-89.3)	0.945 ^C
IPSS	6.35±4.05	2.85±2.46	<0.001 ^{*A}
IPSS improvement	15.55±7.23	21.50±5.19	0.027 ^{*A}
%IPSS improvement	66.82±22.25	87.43±10.54	0.009 ^{*A}
QOL	0.0 (0.0-2.0)	0.0 (0.0-1.0)	0.121 ^C
QOL improvement	4.0 (2.8-5.0)	4.5 (3.8-5.0)	0.137 ^C
%QOL improvement	81.7 (55.0-100.0)	81.7 (75.0-100.0)	0.782 ^C
Q-max (ml/sec)	17.8 (12.2-26.7)	20.4 (14.5-34.7)	0.264 ^C
Q-max Improvement (ml/sec)	11.4 (0.5-18.7)	9.4 (5.7-27.5)	0.431 ^C
%Q-max Improvement	64.1 (5.3-78.9)	60.0 (48.1-66.4)	0.928 ^C
PVR (ml)	29.0 (17.5-55.8)	32.0 (9.8-80.8)	0.965 ^C
PVR decline (ml)	50.5 (13.3-215.0)	47.0 (8.5-159.0)	0.502 ^C
%PVR decline	63.4 (39.2-93.1)	79.1 (7.0-100.0)	0.860 ^C
Operative time (minutes)	150.0 (120.0-217.5)	90.0 (60.0-150.0)	<0.001 ^{*C}
Blood loss (ml)	200.0 (62.5-300.0)	100.0 (50.0-200.0)	0.080 ^C
Catheterization (days)	2.31±0.53	1.92±0.28	<0.001 ^{*A}
Length of stay (days)	2.42±0.69	1.94±0.23	<0.001 ^{*A}
Resected tissue volume (g)	43.5 (16.3-59.8)	29.0 (11.0-49.8)	0.213 ^C
Complications	6 (16.7)	5 (13.9)	0.743 ^B
Pathology			1.000 ^B
BPH	34 (94.4)	35 (97.2)	
Prostate cancer	2 (5.6)	1 (2.8)	

Results shown as mean ± SD, n (%) and median (IQR), * = statistically significant at p ≤ 0.05

^A = The p-value by Student's t-test, ^B = The p-value by Chi-squared test, ^C = The p-value by Mann-Whitney U test

Hct = hematocrit, PSA = prostate-specific antigen, IPSS = International Prostate Symptom Score, QOL = Quality of Life Score, Q-max = peak flow rate, PVR = post-voided residual urine volume, BPH = benign prostate hyperplasia.

such as hypertension, diabetes, chronic kidney disease and cardiovascular disease were noted. All patients who took an antiplatelet or anticoagulant drug were asked to discontinue the medication before surgery. Twelve out of 36 patients in the HoLEP group and 19 out of the 36 patients in the B-TUEP group had an indwelling urethral catheter before surgery due to urinary retention. The median operative time was significantly longer in the HoLEP group, 150.0 (120.0-217.5) minutes vs 90.0 (60.0-150.0) minutes, (p < 0.001). The mean catheterization time was significantly longer in the HoLEP group, 2.31±0.53 days vs 1.92±0.28

days, (p < 0.001). The length of stay was also significantly longer in the HoLEP group, 2.42±0.69 days vs 1.94±0.23, (p < 0.001).

Preoperative and postoperative data are compared in Table 2 and Table 3. There were statistically significant differences between mean preoperative versus postoperative Hct in the HoLEP group, 40.71±5.60 % vs 38.80±4.90 %, (p < 0.001) and in the B-TUEP group, 39.87±5.50 % vs 37.58±4.81 %, (p < 0.001). However, there was no significant difference in the Hct loss between the two groups. Only 1 patient in each group required 1 unit of blood transfusion. There was

Table 3. Comparison between the preoperative and postoperative parameters.

Data	Preoperative	Postoperative	P-value
Hct (%) HoLEP	40.71±5.60	38.80±4.90	<0.001*
Hct (%) TUEP	39.87±5.50	37.58±4.81	<0.001*
PSA (ng/ml) HoLEP	5.3 (2.2-9.5)	1.1 (0.6-1.6)	<0.001*
PSA (ng/ml) TUEP	3.9 (1.6-10.1)	0.8 (0.4-1.9)	<0.001*
IPSS HoLEP	22.8±6.65	6.35±4.05	<0.001*
IPSS TUEP	25.25±5.54	2.85±2.46	0.005*
QOL HoLEP	5.0 (4.0-5.0)	0.0 (0.0-2.0)	<0.001*
QOL TUEP	5.0 (5.0-5.8)	0.0 (0.0-1.0)	0.007*
Q-max (ml/sec) HoLEP	8.2 (5.0-12.7)	17.8 (12.2-26.7)	0.006*
Q-max (ml/sec) TUEP	8.1 (6.3-12.7)	20.4 (14.5-34.7)	0.003*
PVR (ml) HoLEP	104.0 (34.0-238.0)	29.0 (17.5-55.8)	0.001*
PVR (ml) TUEP	88.0 (35.8-188.3)	32.0 (9.8-80.8)	0.037*

Results shown as mean ± SD and median (IQR), * = statistically significant at $p \leq 0.05$

The p-value from paired t-tests

Hct = hematocrit, HoLEP = holmium laser enucleation of the prostate, TUEP = bipolar transurethral enucleation of prostate, PSA = prostate-specific antigen, IPSS = International Prostate Symptom Score, QOL = Quality of Life Score, Q-max = peak flow rate, PVR = post-voided residual urine volume, BPH = benign prostate hyperplasia.

significant postoperative improvement in PSA, IPSS, QoL, Q-max and PVR in each group. The IPSS improvement was significantly higher in the B-TUEP than the HoLEP group, 21.50±5.19 vs 15.55±7.23, ($p = 0.027$).

Pathological results of the tissue removed showed mostly BPH with the exception of 2 of the HoLEP group who were found to have prostate cancer adenocarcinoma Gleason 3+4 and adenocarcinoma Gleason 3+3, and 1 in the B-TUEP group who was found to have prostate cancer adenocarcinoma Gleason 3+3.

There were no serious complications or TUR syndrome in any patients in either group. The total rate of complications in the HoLEP group was 16.7% (6 of 36 patients), 1 patient (2.78%) required a blood transfusion of one unit, 1 patient (2.78%) had capsular perforation needing prolonged urethral catheterization, 1 patient (2.78%) had overflow incontinence from a prior neurogenic bladder, 1 patient (2.78%) had post operative bleeding after discharge for 1 week (he was readmitted for urethral traction and continuous bladder irrigation), and 2 patients (5.56%) had contracture of bladder neck at the 3 month follow up, necessitating transurethral incision of the bladder neck. Total complications in the B-TUEP group was 13.9% (5 out of 36 patients). One patient (2.78%) required one unit of blood

transfusion, 1 patient (2.78%) had post operative bleeding after discharge for 1 week (he was readmitted for transurethral fulguration at the prostatic fossa), 1 patient (2.78%) had contracture of bladder neck at the 3 month follow-up necessitating urethral dilation, and 2 patients (5.56%) had postoperative stress incontinence at the 2 week follow-up (full recovery was established at the 3 month follow-up).

Discussion

Many investigations have resulted in the emergence of various new transurethral surgical therapies including vaporization, aquablation⁸, laser and bipolar enucleation, hence the surgical treatment of BPH has diversified. A recent study has shown that HoLEP is the most common modality for enucleation, but Bipolar TURP is the most common modality for prostate resection.⁹ HoLEP was introduced in 1995 by Gilling et al.⁴ Many publications supported the effectiveness, safety, and durability of the technology involved in this treatment and HoLEP has been recommended as the surgical treatment for all sizes of BPH in American Urology Association (AUA) guidelines. However, HoLEP necessitates a steep learning curve and incurs great expense.^{10,11} A combination of bipolar energy used in TURP and the enucleation technique have resulted in

B-TUEP. B-TUEP has been reported as being a safe and effective alternative to TURP or open prostatectomy.¹²

In B-TUEP, the adenoma is completely dissected along the surgical capsule plane in the same manner to the index finger of the surgeon during open prostatectomy, which is equivalent to HoLEP and is also considered an anatomic enucleation technique.¹³

Elsaqa et al.¹⁴ reported the outcomes of a prospective trial of HoLEP versus B-TUEP in bladder outlet obstruction patients with a prostate volume more than 80 g. Seventy patients underwent HoLEP and 31 patients underwent B-TUEP. The enucleation rate in g/min was significantly higher in the HoLEP patients than in the B-TUEP group (1.9 ± 1 vs 1.1 ± 0.4 , $p < 0.001$), meaning that HoLEP was associated with a shorter operative time. Catheterization time (days) and length of hospitalization (days) were also significantly lower in the HoLEP group (1 (1–2) vs 2 (2–3), $p = 0.012$, 1.2 ± 0.7 VS 1.9 ± 0.6 , $p < 0.001$ respectively). The complication rate, drop in hemoglobin, and readmission rate were comparable between the groups.

Higazy et al.¹⁵ reported on a randomized controlled trial of the outcome of HoLEP versus B-TUEP in 120 patients. The prostate volume was 135.2 ± 34.8 ml and 125 ± 26.9 ml for HoLEP and B-TUEP, respectively. The HoLEP patients had shorter operative time of 83.43 ± 6.92 min compared with 94.7 ± 12.2 min in the B-TUEP group. HoLEP was associated with an earlier catheter removal time compared with B-TUEP (1 ± 0.23 vs 1.79 ± 1.6 days, $p = 0.02$) and shorter hospital stay (1 ± 0.24 vs 1.49 ± 0.6 days, $p = 0.01$) respectively. Postoperative IPSS, QoL, Q-max, PVR, PSA, prostate volume reduction and perioperative complications were comparable between both groups. In the cost analysis, HoLEP was more cost-effective than B-TUEP.

Li et al.¹⁶ carried out a meta-analysis of the outcome in HoLEP versus B-TUEP from 10 studies (1,725 patients). HoLEP had a significantly lower operative time ($p = 0.03$), shorter catheterization time ($p = 0.007$), lower bladder irrigation time ($p = 0.01$), and higher enucleation weight ($p = 0.01$) compared with B-TUEP. Length of stay, drop in hemoglobin, transfusion rates and complications were comparable between the two techniques. There were no statistically significant

differences in postoperative outcomes between HoLEP and B-TUEP regarding IPSS, Q-max, QoL and PVR at 1, 3, 6, 12 and 24 months.

In this present study, both HoLEP and B-TUEP showed significant improvement post-operatively in all parameters without serious complications or incidence of TUR syndrome. However, there was a significantly longer operative time, catheterization time, and length of stay in the HoLEP group which contrasted to other literature. In the author's opinion, the reason might be that using a Holmium laser to stop bleeding differs from using a bipolar loop. When compared to the conventional TURP the author needed additional bladder traction on post-op day 0, continuous bladder irrigation on day 1, stopping bladder irrigation on day 2 and removal of the urethral catheter on day 3. Thus, the mean catheterization time of HoLEP and B-TUEP might be shorter than conventional TURP. The results of this present study could differ from other studies due to the hospitals not having access to a Holmium laser for BPH surgery due to the cost of laser machine. They might perform B-TUEP instead of HoLEP for BPH patients to good effect because the surgical outcomes of the two techniques were comparable.

The limitations of this study are the relative inexperience in the carrying out of both techniques and also the relatively low number of patients. To improve the study further randomized controlled trial data would increase the generalization of the findings.

Conclusion

HoLEP and B-TUEP are equally safe and effective methods for the treatment of BPH patients who have paused anticoagulant and anti-platelet medications prior to operation. However, in this study HoLEP required a longer operative time, catheterization time and length of stay than B-TUEP.

Conflict of Interest

The authors declare no conflicts of interest.

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