

Holmium laser enucleation versus bipolar transurethral resection of the prostate in management of benign prostatic hyperplasia

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ABSTRACT

Objective: To compare the efficacy and safety of Holmium enucleation of the prostate (HoLEP) versus Bipolar transurethral resection of the prostate (BTURP) in the management of benign prostatic hyperplasia. **Methods:** In our randomized controlled trial, 60 patients were allocated into 2 equal groups representing HoLEP and BTURP. Perioperative data were collected regarding the prostate size, post voiding residual urine (PVRU), international prostate symptom score (IPSS), peak urine flow rate (Qmax), and Quality of life affection (QoL). Operative parameters were recorded according to operative, enucleation, and resection time in addition to the volume of resected tissues and intraoperative complication. Patients were followed up at 1 and 12 months postoperative by PVRU, IPSS, Qmax, and QoL assessment. **Results:** Sixty patients finished our follow up period and their data were analyzed. The mean prostate size was 74.23 ± 9.58 ml and 72.6 ± 10.01 ml for HoLEP and BTURP groups respectively. Operative efficacy measures were comparable in both groups. HoLEP was associated with an earlier catheter removal time of 1.07 ± 0.25 days compared to 3.07 ± 0.78 days in the BTURP. Postoperative PSA, IPSS, QoL, PVRU, and Qmax were comparable in both groups and they both showed statistically significant improvement in the aforementioned parameters following treatment. There was no statistically significant difference between both groups regarding the complication rate. **Conclusion:** Both HoLEP and BTURP are safe and effective in the surgical management of benign prostatic hyperplasia. However, HoLEP has an early catheter removal, and shorter hospital stay.

Keywords: Enucleation, prostate, holmium laser, bipolar, endoscopy, lower urinary tract symptoms, prostatic hyperplasia.

1. BACKGROUND

Benign prostatic hyperplasia (BPH) is one of the most common causes of lower urinary tract symptoms (LUTS) in elderly men that affect the quality of life (QoL). Multiple surgical options are available for the management of benign prostatic hyperplasia (BPH) and its associated symptoms. Transurethral resection of the prostate (TURP) and open prostatectomy remains the gold standard surgical management. However, considerable morbidities are associated with both procedures and are mainly related to prostate size (Bach et al., 2012). Holmium laser enucleation of the prostate (HoLEP) is considered one of the most recent modalities in laser prostatectomy. HoLEP is an effective and safe surgical intervention with a very good outcome in comparison with transurethral resection of the prostate (TURP) and open prostatectomy, with shorter hospital stay and catheter removal time (Netsch et al., 2011; Elzayat et al., 2005). HoLEP is an effective size independent procedure, and recently it has been proposed as a new gold standard for the treatment of symptomatic benign prostatic hyperplasia (BPH) currently, all BPH guidelines recommend HoLEP as a surgical treatment of BPH (Kuntz et al., 2004; Novara et al., 2006).

BTURP is the gold standard in the management of BPH according to the European Urological Association. In this technique, the irrigation fluid is converted to a plasma layer when passing between two electrodes (active and passive electrodes) that vaporize tissue on contact (Wendt-Nordahl et al., 2004). The use of saline as an irrigation fluid in bipolar resection has the advantage over the mono-polar as it decreases the risk of TUR syndrome. The difference in terminology in the bipolar prostatectomy as plasma kinetic resection, bipolar TURP, TUR in saline, and plasma kinetic vaporization is due to minor differences in the arrangement of the electrodes and the type of bipolar device used in the procedure (Rassweiler et al., 2006). Few studies compared both techniques, one study was done by Yucong et al. (2019) showing that there was a statistical difference between the two groups regarding catheter removal time and hospital stay. While Xiaoqiang et al. (2017) reported that there was no statistical difference between the two groups.

We aimed through our study to compare these two energy sources in the procedure of the prostatectomy in terms of safety, efficacy, in the management of prostatic adenoma.

2. METHODS

A total number of 60 patients were included in our study from the outpatient clinic of Ain Shams University Hospitals from the period of July 2018 till January 2019 and the data collection was done till January 2020. The inclusion criteria included patients with LUTS secondary to BPH with prostatic volume less than 100 ml, with failed medical treatment, refractory hematuria, recurrent attacks of urine retention, upper urinary tract affection, diverticula, high IPSS with the affection of QoL or recurrent UTI. The exclusion criteria included patients using anticoagulant or antiplatelet medications or those with neurogenic bladder, bladder stones, urethral stricture, prostate cancer diagnosed by TRUS, or previous prostate or urethral surgery, any UTI was probably treated before any intervention. After obtaining informed consent, patients were randomized with a 1:1 ratio by sealed envelope into 2 groups; group 1 represent the HoLEP procedure while group 2 represents the BTURP procedure. Patients were blinded to the type of intervention as well as the data collector and the statistician.

Intervention

Each procedure was done by 2 expert surgeons. In group 1, the HoLEP procedure was done under either general or spinal anesthesia, using a Holmium laser device (Cyber Ho 100-watt, Quanta device, Milano, Italy). We used an 80-watt power, 4 joules, and 20 MHz frequency, A 550 nm flexible laser fiber. Tissue morcellator with reusable blades (Ricard Wolf Inc.) was used to morcellate the enucleated prostatic adenoma. In group 2, the BTURP procedure was done by a Karl Storz device, using a bipolar resection loop.

The technique was done by using a 26 Fr continuous flow resectoscope (Karl Storz, Germany) with saline irrigation. In the HoLEP group the procedure was started by an incision along the deepest prostatic groove using a bilobed technique where each lobe was enucleated separately or a trilobed technique was used to separate a huge median lobe first then to continue as bilobed technique, we performed early apical separation of the prostate to avoid traction on the external sphincter, a mucosal strip was left intact more distal to avoid dissemination of energy to the sphincter, after separation of each lobe we check the ureteric orifices and, adequate hemostasis was done, finally, a morcellator was used to cut down prostatic adenoma into small chips to be removed. In the BTURP group the same resectoscope 26 Fr continuous flow resectoscope (Karl Storz, Germany) with saline as irrigation fluid, if a median lobe is found it is resected first after which a channel is resected either at 5 or 7 o'clock till the surgical capsule is reached. The channel is then widened (usually laterally) and then carried up the lateral walls toward the anterior aspect of the prostate

following the surgical capsule with the depth of resection. Ultimately, the area between the 5 or 7 o'clock positions is then resected at the final stage of the procedure to smooth out the prostatic floor.

After adequate hemostasis, a triple way 22 Fr silicone urethral catheters was introduced with continuous irrigation for 6 hours postoperative, duration was increased according to the demand. Our primary outcome was the catheter removal time and the duration of hospital stay in both techniques. Secondary outcome measures included the volume of resected tissues Operative safety including peri-operative complication and postoperative efficacy including PSA, Qmax, PVRV, IPSS, QoL during 1 month, 12 months follow up period at the out-patient clinic.

Statistical analysis

Data were collected and analyzed using the statistical package for social science (IBM SPSS) version 23. Data were expressed as Mean ± SD for quantitative parametric measures in addition to both number and percentage for categorized data. The Chi-square test was used in comparing qualitative data between groups, and Independent t-test was used in comparing parametric distribution and quantitative data between two independent groups, while Mann-Whitney test was used in data with non-parametric distribution. The Paired t-test was used to compare between two paired groups with parametric distribution and quantitative data. While the comparison between more than two paired groups with quantitative data and parametric distribution was done by using repeated measure ANOVA test. A P-value < 0.05 was considered statistically significant and less than 0.01 was considered highly significant.

Sample size calculation

It was done using STATA program, setting alpha error at 0.05 and power at 90% based on results from the previous study (Enikeev et al., 2018) that showed a mean catheter removal time in the HoLEP group was 1.3 +/-0.6 while in Transurethral resection group was 3.8 +/-1.7 (Qian et al., 2017), based on that, the needed sample is 30 cases per group taking in account 20% drop out rate.

3. RESULTS

A total number of 60 patients were included in our study meeting our inclusion criteria and they were equally distributed into 2 groups, group 1 represented the HoLEP procedure and group 2 represented the BTURP procedure, all the patients completed our study with 12 months follow up period. There was no statistically significant difference in the perioperative parameters including age, complaint, prostate size, IPSS, QoL, PSA, and Qmax (table 1 and figure1 & 2).

Regarding operative efficacy parameters, no statistically significant difference was recorded between both groups. Regarding the volume of resected tissues in the HoLEP group, it was 53.2 ± 8(38-69) compared to 51.6 ± 8.33(37-66) in the BTURP group (P-value 0.451) and also in Hb drop with a mean of 0.98±0.16 (0.8-1.3) and 0.97±0.18 (0.8-1.7) in the HoLEP and BTURP groups respectively.

HoLEP group showed a shorter catheterization time with a highly statistically significant difference with a mean of 1.07±0.25 days compared to 3.07 ±0.78 days in the BTURP group (P-value 0.001), similarly, the hospital stay was statistically significant (P-value 0.04) with a mean of 1±0 days compared to 1.83 ±0.65 days in the HoLEP and BTURP groups respectively as shown in (Table 2, figure 3 & 4). Intraoperative complications as shown in (Table 2) were one case of capsular perforation in the BTURP group. However, they were not statistically significant; no cases of ureteric injury, hemoglobin drop, need to blood transfusion, postoperative urine retention with the need for catheterization up to 12 months follow up or the need to convert to another type of surgery were encountered in our study.

Table 1 Difference in preoperative diameters in the two groups.

		Laser group	Bipolar group	Test value	P-value	Sig.
		No. = 30	No. = 30			
Age	Mean ± SD	67.23 ± 6.84	68.47 ± 6.21	-0.731•	0.468	NS
	Range	55 – 80	55 – 80			
Complaint	Retention	17 (56.7%)	19 (63.3%)	0.364*	0.834	NS
	Elevated IPSS	10 (33.3%)	9 (30.0%)			
	Hematuria	3 (10.0%)	2 (6.7%)			
Prostate size	Mean ± SD	74.23 ± 9.58	72.6 ± 10.01	0.646•	0.521	NS
	Range	55 – 90	50 – 90			

IPSS (preoperative)	Mean ± SD	28.63 ± 2.22	28.8 ± 2.16	-0.295•	0.769	NS
	Range	25 – 32	25 – 32			
PSA (pre)	Mean ± SD	3.61 ± 0.62	3.5 ± 0.83	0.582•	0.563	NS
	Range	2.6 – 4.6	1.1 – 4.7			
Qmax (preoperative)	Median (IQR)	2.5 (0 – 7)	3 (0 – 7)	-0.271≠	0.786	NS
	Range	0 – 10	0 – 10			

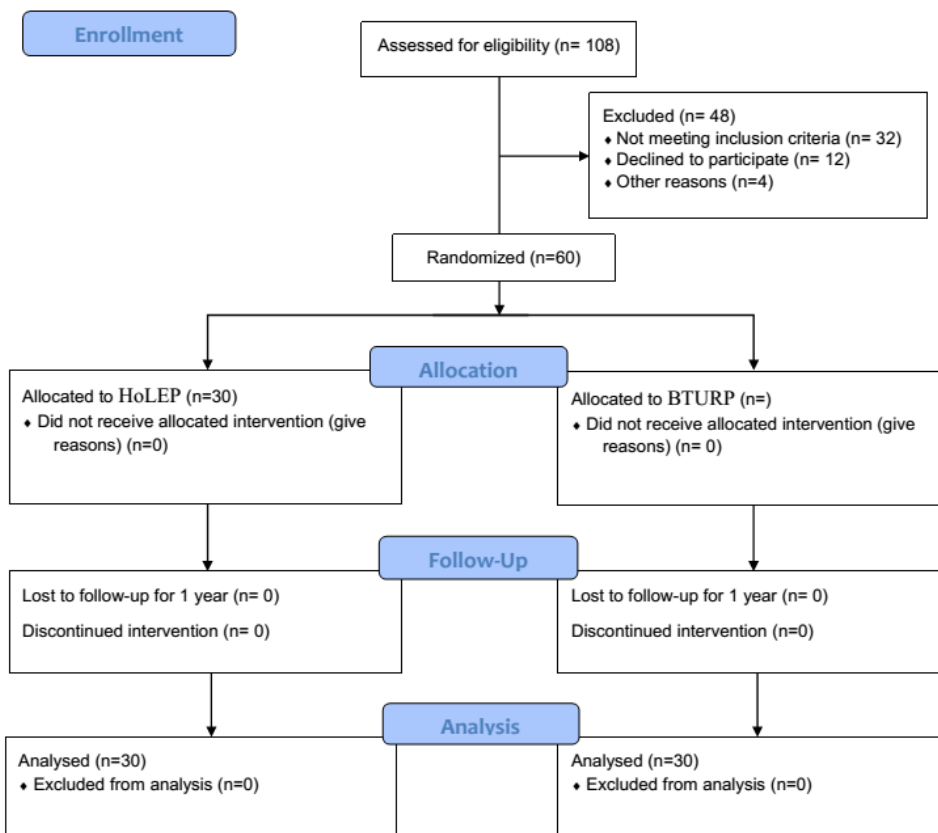


Figure 1 consort flow chart.

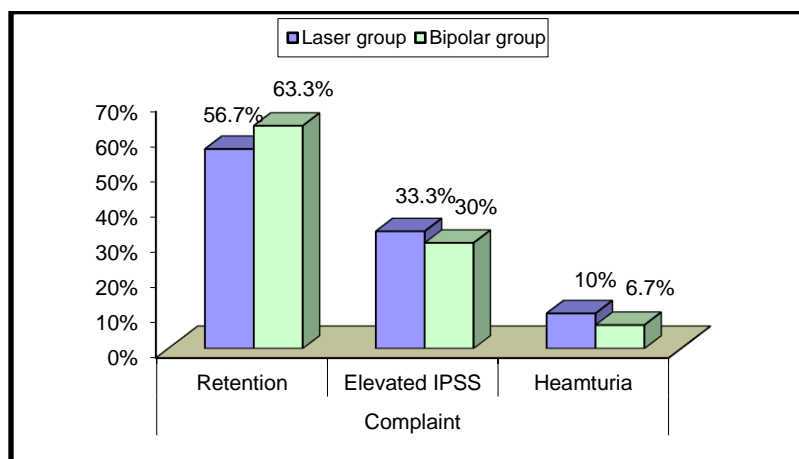


Figure 2 complaints of patients in the two groups

Table 2 Postoperative diameters in the two groups.

		Laser group	Bipolar group	Test value	P-value	Sig.
		No. = 30	No. = 30			
Hb drop	Mean ± SD	0.98 ± 0.16	0.97 ± 0.18	0.307•	0.760	NS
	Range	0.8 – 1.3	0.8 – 1.7			
Resected volume	Mean ± SD	53.2 ± 8	51.6 ± 8.33	0.759•	0.451	NS
	Range	38 – 69	37 – 66			
Post operative catheter time in days	Mean ± SD	1.07 ± 0.25	3.07 ± 0.78	-13.280•	0.000	HS
	Range	1 – 2	2 – 5			
Duration of hospital stay in days	Mean ± SD	1 ± 0	1.83 ± 0.65	-7.047•	0.000	HS
	Range	1 – 1	1 – 3			

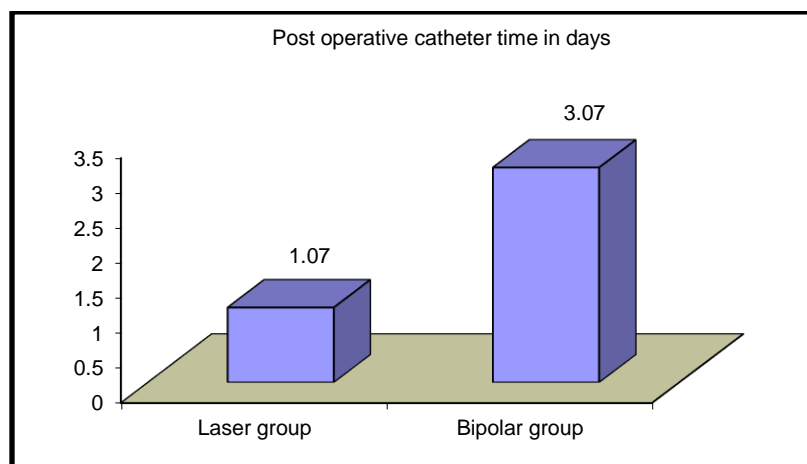


Figure 3 catheter removal time

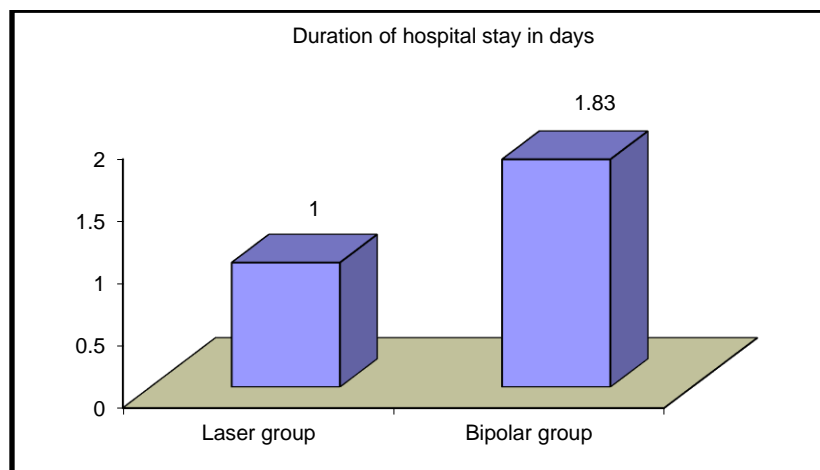


Figure 4 hospital stay

Assessment of the early and delayed postoperative complications, there was no statistically significant differences encountered between groups (table 3) in terms of UTI, stress urinary incontinence (SUI), hematuria, urethral stricture, or bladder neck contracture. 7 cases representing 23.3% of the study population 3 patients in the HoLEP group and 4 patients in the BTURP group developed an early SUI in our study, they showed mild improvement on pelvic floor exercise at the end of our study where only 1 case in the HoLEP group and 2 cases in BTURP group showed no improvement with no statistically significant difference (P-value 0.69). One case only in the HoLEP group developed bladder neck contracture and two in the BTURP group with the need for endoscopic resection, no reported cases of urethral stricture in our study after 12 months of follow up.

Table 3 Complications

		Laser group	Bipolar group	Test value	P-value	Sig.
		No. = 30	No. = 30			
Intra-operative complication	No	30 (100.0%)	29 (96.7%)	1.017*	0.313	NS
	Capsular perforation	0 (0.0%)	1 (3.3%)			
Early complication	No	24 (80.0%)	22 (73.3%)	0.373*	0.830	NS
	UTI	3 (10.0%)	4 (13.3%)			
	Stess incontinence	3 (10.0%)	4 (13.3%)			
Incidence of overall complication	No	24 (80.0%)	22 (73.3%)	0.373*	0.542	NS
	Yes	6 (20.0%)	8 (26.7%)			
Delayed complication	No	28 (93.3%)	26 (86.7%)	0.741*	0.690	NS
	Bladder neck contracture	1 (3.3%)	2 (6.7%)			
	Stress incontinence	1 (3.3%)	2 (6.7%)			

The postoperative efficacy parameters including IPSS, QoL, PVRU, Qmax, prostate size reduction and PSA were evaluated in both groups at 1 month ,and 12months postoperative (Table 4 and figure 5), there was no statistically significant difference between both groups at each interval with comparable results between both groups. A statistically significant difference was documented in both groups in comparison to their preoperative parameters.

The percentage of prostate size reduction in the HoLEP group was 66.6% compared to 68.6% in the BTURP group with no statistically significant difference in between (P-value 0.36), the percentage of PSA reduction was 71.4 % and 68.1% in the HoLEP and BTURP groups respectively with statistically significant difference (P-value 0.01).

Table 4 Difference between pre and postoperative diameters.

		Preoperative	Post 1 month	Post 12 months	Test value	P-value	Sig.
Laser group							
IPSS	Mean ± SD	28.63 ± 2.22	–	5.3 ± 1.12	49.842•	0.000	HS
	Range	25 – 32	–	4 – 7			
Qmax	Median (IQR)	2.5 (0 – 7)	24.5 (24 – 25)	25 (24 – 25)	47.649≠	0.000	HS
	Range	0 – 10	22 – 30	21 – 28			
PSA	Mean ± SD	3.61 ± 0.62	1.13 ± 0.29	1.28 ± 0.32	361.181••	0.000	HS
	Range	2.6 – 4.6	0.5 – 1.6	0.7 – 1.8			
Post voiding	Mean ± SD	–	23.17 ± 18.17	22.67 ± 16.17	0.193•	0.849	NS
	Range	–	0 – 60	0 – 50			
Bipolar group							
IPSS	Mean ± SD	28.8 ± 2.16	–	5.4 ± 1.25	48.659•	0.000	HS
	Range	25 – 32	–	4 – 9			
Qmax	Median (IQR)	3 (0 – 7)	24 (23 – 25)	24.5 (23 – 25)	50.486≠	0.000	HS
	Range	0 – 10	18 – 27	18 – 27			
PSA	Mean ± SD	3.5 ± 0.83	1.06 ± 0.3	1.28 ± 0.32	244.241••	0.000	HS
	Range	1.1 – 4.7	0.4 – 1.5	0.6 – 1.8			
Post voiding	Mean ± SD	–	27.33 ± 18.09	26.33 ± 16.29	0.322•	0.749	NS
	Range	–	0 – 60	0 – 50			

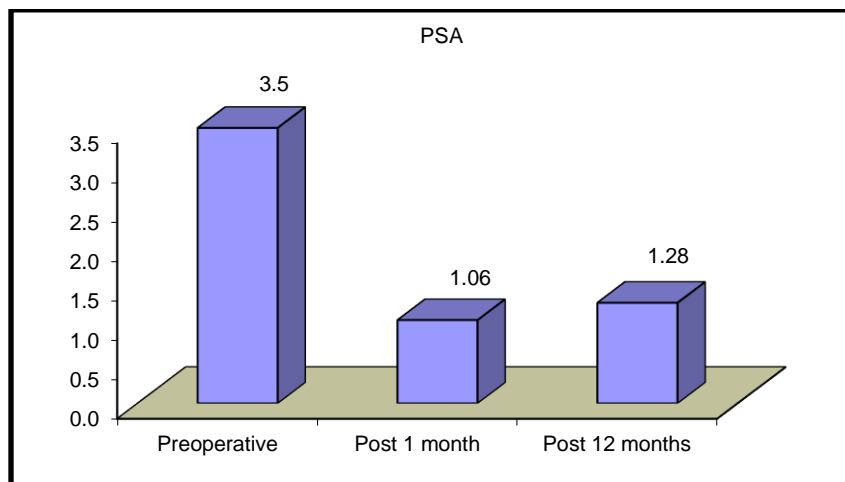


Figure 5 PSA pre and post-operative

4. DISCUSSION

BPH is a common voiding dysfunction that necessitates treatment in 25% to 40% of men between 50 and 80 years with increasing prevalence due to aging (Oesterling, 1996). The main advantage of HoLEP over the conventional bipolar TURP is being more hemostatic with less blood loss. The reason is that resection in HoLEP occurs at the level of the capsule so that the vessels are opened only once, unlike bipolar TURP, in which the same vessels are reopened while the resection is carried down to the capsule. Furthermore, the laser produces deeper coagulation necrosis than the high frequency electric current. These two factors lead to less bleeding and subsequent better visibility and easy identification of important landmarks (Mebust et al., 1989). On the other hand, HoLEP is associated with several difficulties; resection using a straight laser fiber represents a problem in the apical region. Also, most surgeons are accustomed to the antegrade resection of bipolar TURP, while the resection in HoLEP occurs in a retrograde fashion, and resection of the lateral lobes starts at the apical region, which might endanger the sphincter safety. Therefore, it is clear that HoLEP has its own learning curve. In a prospective study, Shah and associates reported that an endourologist who is not familiar with the procedure can achieve outcomes comparable to that of experts with experience of at least 50 cases (Shah et al., 2007). Few studies pointed out comparable outcomes in both HoLEP and BTURP in the management of BPH, we conducted our study to evaluate both techniques in terms of safety and efficacy with catheter removal time and hospital stay as our primary end point.

Our study showed a shorter catheterization time with the HoLEP group with a mean of 1.07 ± 0.25 days compared to 3.07 ± 0.78 in the BTURP group, similarly, a shorter hospital stay with the HoLEP group with a mean of 1 day compared to 1.83 ± 0.65 days in the BTURP group and both results were statistically significant, the previous study performed by Zhang et al. (2019). Habib et al. (2020) showed a catheter removal time in hours $35.80h$ ($43.08, 28.52$) for BTURP compared to $24.34h$ ($35.81, 12.86$) for HoLEP, this slight difference probably due to evaluation in hours rather than days, also a study performed by Qian et al. (2017), reported no difference in catheter time. There was no difference in the volume of resected tissues between both groups with the volume of resected tissues in the HoLEP group was 53.2 ± 8 (38-69) compared to 51.6 ± 8.33 (37-66) in the BTURP group (P-value 0.451), this results were comparable with other studies by Zhang et al. (2019), Habib et al. (2020), Higazy et al. (2020) and the study was done by Qian et al. (2017), and this was reflected on the reduction in PSA level, the percentage of PSA reduction was 71.4 % and 68.1% in the HoLEP and BTURP groups respectively with no statistically significant results between both group while these results were statistically significant compared to the preoperative values in both groups.

Regarding perioperative complications and delayed complications in our study, there was no statistically significant difference between both groups. 7 cases in our study 3 in the HoLEP group and 4 in the BTURP group (23.3% of the study population) developed SUI at the early postoperative period this may be related to the effect of the energy source on the urethral sphincter or mucosal stretch during the enucleation process, the patients showed mild improvement on pelvic floor exercise at the end of our study where only 1 case in HoLEP group and 2 cases in BTURP group showed no improvement with no statistically significant difference, these results were comparable with previous studies done by Zhang et al. (2019).

We reported only 3 cases of UTI or dysuria in the HoLEP group and 4 cases in the BTURP group and they were managed conservatively by antibiotics for 7 to 10 days. Both techniques showed adequate hemostasis with no hemoglobin drop was noted in both groups, no need for blood transfusion or the need to convert to another type of surgeries, these results were comparable to

Zhang et al. (2019) and Qian et al. (2017). Only one case of bladder neck contracture was documented in the HoLEP group and 2 cases in the BTURP group that required an endoscopic resection, this finding is comparable with Zhang et al. (2019) who both reported similar results. In terms of postoperative efficacy parameters in our trial, both HoLEP and BPEP were equivalent in efficacy outcome including Qmax, PVRU, IPSS, and QoL at 1 and 12 months interval with no significant difference between both groups with significant improvement with the preoperative values in both procedures. These results were comparable with the previous studies done by Zhang et al. (2019) and Qian et al. (2017). Recurrence of urine retention following prostatic enucleation may be related to one of the following factors, residual adenoma, meatal stenosis, urethral stricture, or bladder neck contracture, from our study a significant reduction of the prostatic volume was noted in both surgical techniques and no patient required retreatment for BPH, only 3 patients needed an endoscopic intervention for bladder neck contracture in our study.

Our study had a certain limitation in that it did not address the learning curve of both techniques; in addition to that our institute is more experienced with the BTURP procedure compared to the recently introduced HoLEP procedure. Finally, a pressure-flow study could not be performed in our study to assess the voiding dysfunction.

5. CONCLUSION

Both HoLEP and BTURP are safe and effective in the surgical management of benign prostatic hyperplasia. However, HoLEP has a shorter catheterization time, hospital stay compared to BTURP.

Abbreviation

BPH:	Benign Prostatic hyperplasia
LUTS:	Lower urinary tract symptoms
HoLEP:	Holmium laser enucleation of the prostate
BTURP:	Bipolar trans urethral resection of the prostate
EEP:	Endoscopic enucleation of the prostate
UTI:	Urinary tract infection
TRUS:	Transrectal ultra-sound
PSA:	Prostatic Specific Antigen
QoL:	Quality of Life
IPSS:	International prostate Symptoms Score
PVRU:	Post voiding residual urine
Qmax:	Maximum flow rate (ml/sec)
SUI:	Stress urinary incontinence

Ethical considerations

The study was approved by the Medical Ethics Committee of Ain Shams University (ethical approval code: EMASU MD 129/2018).

Consent for participation

Written consent was obtained from all patients before participation.

Competing interest

No competing interests to declare

Funding

We are received no external fund for our study.

Author's contribution

Lotfy, A: Corresponding author, he conducted the study starting from the protocol application, design of the study, data collection and analysis, reviewing of the literature, discussion and conclusion writing

Mohamed S. Mourad: One of the primary surgeons, final revision of the manuscript

Mohamed M. Yassin.: Data interpretation and results formulation in addition to reviewing of the literature

Farouk, A: Study design formulation, methodology section revision, one of the primary surgeons

Data availability

The datasets generated during the current study are available from the corresponding author on reasonable request.

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