Holmium laser enucleation of the prostate vs monopolar transurethral resection of the prostate in management of benign prostatic hyperplasia

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Objective
The aim was to compare the efficacy, safety, and cost-effectiveness of holmium laser enucleation of the prostate (HoLEP) vs monopolar transurethral resection of the prostate (TURP) in the management of benign prostatic hyperplasia.
Materials and methods
Between February 2018 and February 2020, 70 patients who underwent surgical treatment for benign prostatic hyperplasia were randomized into two equal groups, representing HoLEP and monopolar TURP. All the patients were assessed preoperatively and followed up for 12 months postoperatively. The primary preoperative and postoperative parameters were the international prostate symptom score (IPSS) and maximum urine flow rate (Qmax), whereas the secondary parameters were operative time, resected volume, postoperative drop in hemoglobin level, postoperative change in sodium level, postoperative catheterization time, duration of hospital stay, and postvoiding residual urine. All complications were recorded. Cost analysis was evaluated.
Results
A total of 60 patients (30 HoLEP and 30 TURP) of the initial 70 patients completed our study. Mean baseline prostate sizes were similar in both groups. HoLEP group had longer operative time of 80 min compared with 60 min in the TURP group. HoLEP was associated with shorter postoperative catheter time and hospital stay compared with those of TURP group. There were no statistically significant differences between both groups regarding perioperative parameters such as resected volume, hemoglobin drop, and sodium level drop. Moreover, postoperative international prostate symptom score, Qmax, postvoiding residual urine, prostatic specific antigen, and quality of life were comparable in both groups. There was no statistically significant difference between both groups regarding postoperative complications. Regarding cost analysis, HoLEP was more cost-effective than TURP.
Conclusion
Both HoLEP and monopolar TURP are safe and effective. However, HoLEP has shorter catheterization time and hospital stay and was more cost-effectiveness but had longer operative time than monopolar TURP.

Keywords:
Holmium laser enucleation of the prostate, prostate, prostatic hyperplasia, transurethral resection of the prostate

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Introduction

Benign prostatic hyperplasia (BPH) has a significant effect on men, as it affects 70% of men older than 70 years [1].

Lower urinary tract symptoms (LUTS) in old men are mainly related to an enlarged prostate; the actual links between an enlarged prostate and the onset of symptoms are multifactorial [2].

Lower urinary tract symptoms include both irritative symptoms in the form of urgency, frequency, nocturnal enuresis, and urge incontinence as well as obstructive symptoms comprising hesitancy, weak interrupted stream of urine, and incomplete voiding, which eventually affect the quality of life (QoL); the main goal of treatment is to resolve these symptoms [3].

Multiple surgical options are available for management of BPH and its associated symptoms. Transurethral resection of the prostate (TURP) and open prostatectomy remain the gold standard surgical management. However, considerable morbidities are associated with both procedures and mainly related to the prostate size [4].

These complications may be either patient or surgically related. The complications that are patient related include myocardial infarction, cardiac arrhythmia, exacerbation of previous respiratory disease, deep venous thrombosis, pulmonary embolism, and death. The complications that are surgically related include capsular perforation, bleeding, urosepsis, urinary incontinence, conversion to open surgery, bladder neck stenosis, redo surgery, and transurethral resection syndrome [5,6].

There is a wide gap between simple medical treatment and TURP. This wide gap needed a less morbid alternative to TURP, so various less-invasive therapy techniques emerged, among which was laser-based minimally invasive procedure.

Modern laser-based procedures have many advantages over monopolar TURP, including less blood loss, minimal changes in serum electrolytes level, fewer cardiovascular complications, shorter catheter time, decreased hospital stay, and the ability to operate while the patient is on anticoagulation [7].

Owing to these advantages, urologists have turned to the use of laser procedures that accounted for 57% of surgical management for BPH in 2005, in comparison with TURP that accounted for only 39% [8].

The most recent technique of prostatectomy using holmium laser is holmium laser enucleation of the prostate (HoLEP). HoLEP procedure is safe and effective and has comparable results to TURP and open prostatectomy, with less morbidity and complications and shorter hospital stay [9].

HoLEP procedure is suitable for all sizes of prostate gland, and now it is proposed as a new gold standard for surgical management of BPH [10,11]. Recently, BPH guidelines recommend HoLEP as a surgical management of BPH [12].

To consider a procedure as gold standard, it should have low rate of morbidity, effective results, and durable outcomes. HoLEP procedure has scanty data regarding its role in Egyptian population and if it can replace TURP to be the gold standard.

To our best knowledge, no one has estimated the cost-effectiveness between the two techniques in a developing country.

Our study aimed to compare the efficacy, safety, and cost effectiveness of HoLEP vs monopolar TURP in the management of BPH in a developing country.

Materials and methods

Between February 2018 and February 2020, 70 patients who underwent surgical management for BPH and presented to Ain Shams University Hospitals in Cairo, Egypt, were selected.

Our inclusion criteria included patients with LUTS due to BPH who are fit for surgery with prostate volume less than 80 ml, with high international prostate symptom score (IPSS) more than 19, affecting QoL, recurrent urine retention with failure of medical treatment, recurrent urinary tract infection (UTI), affection of upper urinary tract, refractory hematuria, bladder stones, and diverticula. Exclusion criteria were patients with neurogenic bladder, patients with previous urethral or prostatic surgeries, patients with urethral stricture, patients with prostatic cancer diagnosed by TRUS biopsy, and patients with prostate volume more than 80 ml.

Patients were randomly allocated by ratio 1 : 1 into one of two groups by random number tables: group A represents the HoLEP procedure, whereas group B represents the monopolar TURP procedure.

Intervention: Patients were operated in lithotomy position under either general or spinal anesthesia. In group A, the HoLEP procedure was done using a Holmium laser device (Cyber Ho 100-Watt, Quanta Device, Milano, Italy). We used a 50 W power, 2 J, and 25 MHz frequency. A 550 nm flexible end firing laser fiber was used. Dissection of the middle and lateral prostatic lobes off the surgical capsule was done in a retrograde manner from the prostate apex toward the bladder. The laser fiber was moved in the same plane as the surgeon's index finger does in open prostatectomy. Then, fragmentation of the lobes was performed by morcellator (VersaCut, Lumenis, Germany). During HoLEP, normal saline solution irrigation was used.

In group B, on the contrary, monopolar TURP was performed with ERBE ICC 300 using the standard tungsten wire loop; the cutting current of 120 W and the coagulation of 80 W were used and distilled water for irrigation.

In both groups, all retrieved tissues were collected and examined histologically. After adequate hemostasis was checked, a triple-way 22-Fr silicone urethral catheter was inserted, and postoperative bladder irrigation was used as necessary until the efflux became sufficiently clear to remove the catheter.

All the patients were assessed preoperatively and followed at 1 and 12 months postoperatively. The primary preoperative and postoperative parameters were IPSS and Qmax, whereas the secondary parameters were operative time, resected volume, postoperative drop in hemoglobin level, postoperative change in sodium level, postoperative catheterization time, duration of hospital stay, postvoiding residual urine (PVRU), and ultrasound assessed prostate volume. All complications were recorded, and the early postoperative complications that occurred during the first postoperative month were analyzed using the modified Clavien-Dindo classification system (Table 1). Cost analysis was assessed with special concern on the running cost of the laser fibers, monopolar resection loops, irrigation fluids, hospital stay.

The recruitment and handling of the study population during the study is shown in the flow diagram according to the CONSORT (CONsoildated Standards of Reporting Trials) 2010 guidelines (Fig. 1).

Ethical considerations

Approval was obtained from the Research Ethical Committee at Faculty of Medicine Ain shams University with approval number FWA000017585. All patients signed a comprehensive informed consent before participation in the study.

Results

A total of 70 patients who met our inclusion criteria were included in our study and were randomly allocated in two equal groups. A total of 30 patients in HoLEP group and 30 patients in monopolar TURP group completed our study, with a follow-up period of 12 months. The mean age was 67 (55–80) and 68 years (55–80), respectively. Regarding the preoperative parameters they were not statistically different between the two groups, including age, prostate size, IPSS, QoL, PVRU volume, prostatic specific antigen (PSA), and Qmax, as shown in Table 2, confirming the homogeneity between both groups.

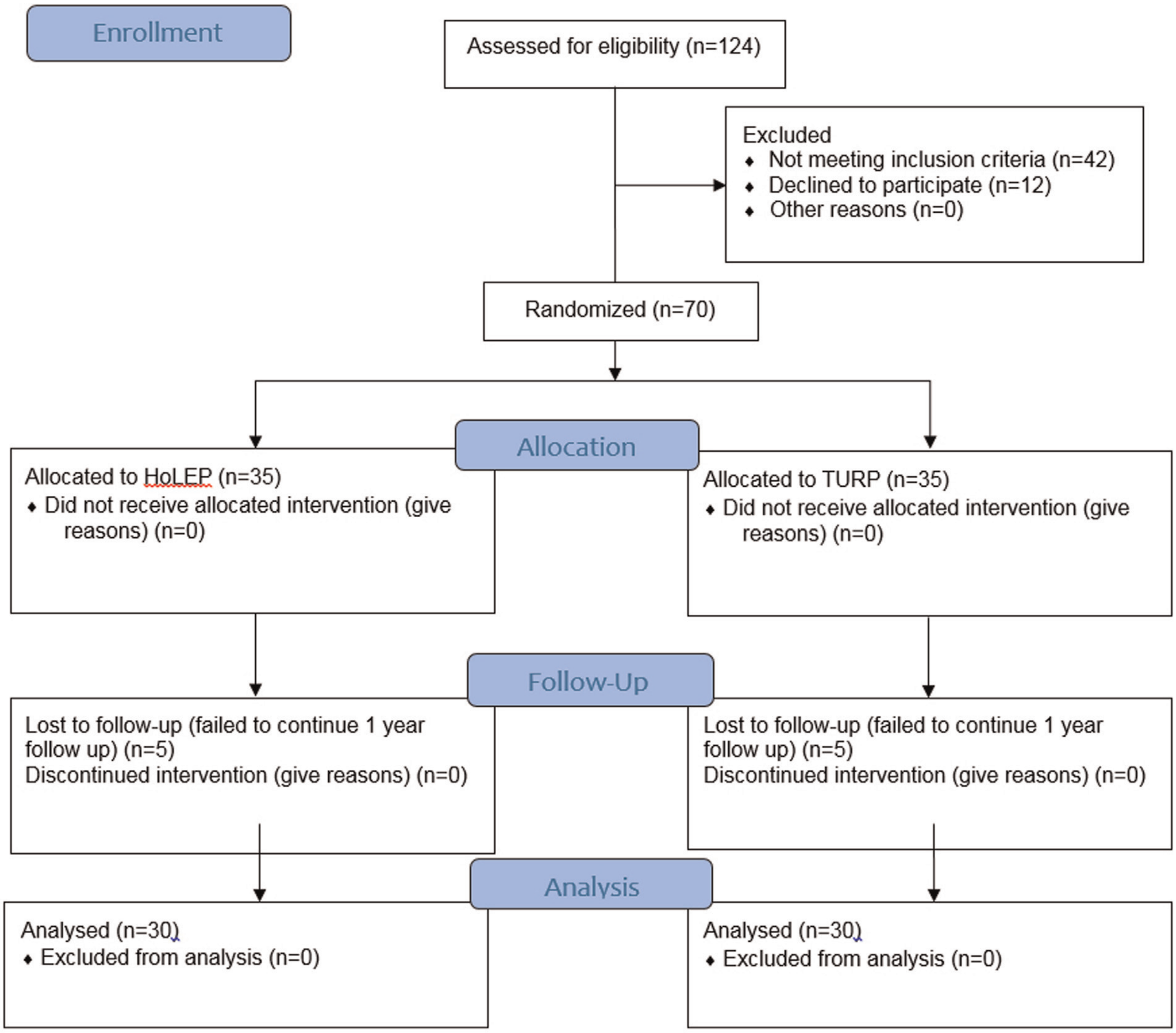
Regarding the operative parameters, operative time was longer in HoLEP group; it was 80.17±9.87 min in HoLEP group and 60.00±10.75 min in TURP group, with P value less than 0.001, which was statistically highly significant. Regarding resected

Table 1 Classification of surgical complications based on the modified Clavien-Dindo classification system [13]

Grades	Subgrade	Definition
I		Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions. Allowed therapeutic regimens are drugs such as antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside. Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions. Allowed therapeutic regimens are drugs such as antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside
II		Complications requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included complications requiring pharmacological treatment with drugs other than such allowed for grade I complications. blood transfusions and total parenteral nutrition are also included complications requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included complications requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included complications requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included complications requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included
III		Complications requiring surgical, endoscopic or radiological intervention
	a	Intervention not under general anesthesia
	b	Intervention under general anesthesia
IV		Life-threatening complications (including CNS complications) requiring IC/ICU management
	a	Single organ dysfunction (including dialysis)
	b	Multiorgan dysfunction
V		Death
Suffix 'd'		If the patient suffers from a complication at the time of discharge, the suffix 'd' (for disability) is added to the respective grade of complication. This label indicates the need for a follow-up to fully evaluate the complication

CNS, central nervous system.

Figure 1



CONsoildated Standards of Reporting Trials 2010 flow diagram showing the recruitment and handling of the study population during the course of the study.

volume, there was no statistical difference between both groups, with 47.70±7.97 g resected in HoLEP group and 46.60±8.33 g resected in TURP group, with *P* value of 0.6 (Table 3).

The hospital stay had statistically significant difference, with 1 day in HoLEP group and 1.83±0.65 days in TURP group, with *P* value less than 0.001, and the postoperative catheter time also had statistically significant difference ($P<0.001$), representing 1.10 ±0.31 days compared with 3.07±0.78 days in HoLEP and TURP groups, respectively (Table 4).

Regarding intraoperative complications, we reported only one case of capsular perforation in the TURP group, with no statistically significant difference between the two groups, with no cases of ureteric injury, bladder mucosal injury, or the need to convert to another type of surgery (Table 5).

Regarding early postoperative complications such as hemoglobin drop, sodium level drop, TUR syndrome, hematuria, UTI (whether it was low UTI or UTI with signs of bacteremia and fever >38.5°C), and stress incontinence, there was no statistically significant difference between the two groups.

Hemoglobin drop was mostly similar in the two groups with 0.98±0.16 g drop in HoLEP group and 0.97 ±0.18 g drop in TURP group (P=0.8), with no need for blood transfusion in both groups.

Regarding sodium level drop and TUR syndrome, it happened in one patient only in TURP group, whereas in HoLEP group, it did not happen in any patient, with *P* value 0.3, which was not significant.

No cases of hematuria were reported in both groups in our study. UTI happened in 10% and 13.3% of patients

Table 2 Comparison between study groups regarding preoperative parameters

	HoLEP *N*=30	TURP *N*=30	*P* value	Significance
Age				
Mean±SD	67.13±6.85	68.47±6.21	0.433	NS
Range	55–80	55–80		
Prostate size (preoperative)				
Mean±SD	63.90±9.54	62.60±10.01	0.609	NS
Range	45–80	40–80		
IPSS (preoperative)				
Mean±SD	28.57±2.18	28.80±2.16	0.678	NS
Range	25–32	25–32		
Postvoiding residual volume (preoperative)				
Median (IQR)	150 (150–212.5)	170 (140–225)	0.466	NS
Range	75–225	75–225		
PSA (preoperative)				
Mean±SD	3.62±0.61	3.50±0.83	0.515	NS
Range	2.6–4.6	1.1–4.7		
Qmax (preoperative)				
Mean±SD	3.27±3.45	3.63±3.22	0.672	NS
Range	0–10	0–10		
QoL (preoperative)				
Mean±SD	4.40±0.50	4.40±0.50	1.000	NS
Range	4–5	4–5		

HoLEP, Holmium laser enucleation of the prostate; IPSS, international prostate symptom score; IQR, interquartile range; PSA, prostatic specific antigen; QoL, quality of life; TURP, transurethral resection of the prostate. $P>0.05$, nonsignificant. $P<0.05$, significant. $P<0.01$, highly significant.

Table 3 Comparison between study groups regarding operative time and resected volume

	HoLEP *N*=30	TURP *N*=30	*P* value	Significance
Operative time				
Mean±SD	80.17±9.87	60.00±10.75	<0.001	HS
Range	70–100	45–75		
Resected volume				
Mean±SD	47.70±7.97	46.60±8.33	0.603	NS
Range	33–64	32–61		

HoLEP, Holmium laser enucleation of the prostate; HS, highly significant; TURP, transurethral resection of the prostate. $P>0.05$, nonsignificant. $P<0.05$, significant. $P<0.01$, highly significant.

Table 4 Comparison between study groups regarding postoperative catheter time and hospital stay duration

	HOLEP *N*=30	TURP *N*=30	*P* value	Significance
Postoperative catheter time in days				
Mean±SD	1.10±0.31	3.07±0.78	<0.001	HS
Range	1–2	2–5		
Duration of hospital stay in days				
Mean±SD	1.00±0.00	1.83±0.65	<0.001	HS
Range	1–1	1–3		

HoLEP, Holmium laser enucleation of the prostate; HS, highly significant; TURP, transurethral resection of the prostate. $P>0.05$, nonsignificant. $P<0.05$, significant. $P<0.01$, highly significant.

in HoLEP and TURP groups, respectively, with *P* value of 0.69. Overall, 10% of patients of HoLEP group and 13.3% of patients in TURP group showed early SUI in our study; they showed improvement on pelvic floor exercises at the end of our study, where only 3.3% of cases in HoLEP group and 6.7% of cases in TURP group showed no improvement, with no statistically significant difference (P=0.55) (Table 5).

Classifying the 15 early postoperative complications in our study according to Clavien-Dindo classification

Table 5 Comparison between study groups regarding incidence of intraoperative and postoperative complications

	HOLEP N=30	TURP N=30	P value	Significance
Intraoperative complications				
No	30 (100.0)	29 (96.7)	0.313	NS
Capsular perforation	0	1 (3.3)		
Early postoperative complications				
No	24 (80.0)	21 (70.0)	0.371	NS
Sodium level drop and TUR syndrome	0	1 (3.3)	0.313	NS
UTI	3 (10.0)	4 (13.3)	0.687	NS
Stress incontinence	3 (10.0)	4 (13.3)	0.687	NS
Hematuria	0	0	–	–
Delayed postoperative complications				
No	27 (90.0)	26 (86.7)	0.687	NS
Urethral stricture	0	0	–	–
Bladder neck contractor	2 (6.7)	2 (6.7)	1.000	NS
Stress incontinence	1 (3.3)	2 (6.7)	0.554	NS

HoLEP, Holmium laser enucleation of the prostate; HS, highly significant; TURP, transurethral resection of the prostate; UTI, urinary tract infection. $P>0.05$, nonsignificant. $P<0.05$, significant. $P<0.01$, highly significant.

showed that the majority of the complications were classified as grade I and grade II, where 7 of 15 complications (46.67%) were stress incontinence, classified as grade I because most of them improved on pelvic floor exercises, and also 7 of 15 complications (46.67%) were UTI, classified as grade II, requiring antibiotics for improvement, whereas only 1 of 15 complications (6.67%) was TUR syndrome, classified as grade IVb requiring ICU admission.

Regarding late postoperative complications such as bladder neck contracture and urethral stricture, there was no statistically significant difference between both groups. No cases of urethral stricture were reported in both groups in our study. In each group, 2 cases of bladder neck contracture were reported that required an endoscopic resection, with *P* value 1 (Table 5).

The postoperative efficacy parameters including IPSS, PSA, Qmax, PVRU, prostate size reduction, and QoL were assessed in both groups at 1 month and 12 months postoperatively, as shown in Tables 6 and 7. There was no statistically significant difference between the groups at each interval in these parameters. On the contrary, there was a statistically significant difference in each group in comparison with its preoperative baseline parameters.

On assessment after 12 months, all cases of the two groups were satisfied with both procedures and the mean IPSS was 5, with postoperative 23 points IPSS reduction in both groups. Qmax has risen to 24.57 ±1.74 ml/s in HoLEP group and to 24.1±1.84 ml/s in TURP group (P=0.32), with postoperative raising of 21.3±4.13 ml/s in HoLEP group and 20.47±3.88 ml/s in TURP (P=0.43).

The percentage of prostate size reduction was 58 and 57.3% in the HoLEP and TURP groups, respectively, with no statistical difference between them (P=0.55).

The percentage of PSA reduction was 64.4 and 63.4% in the HoLEP and TURP groups, respectively, with no statistically significant difference (P=0.58).

Cost analysis can be classified into two main categories: the capital cost and the running cost. The capital cost includes the devices of Holmium laser, morcellator device, and the monopolar electrocautery. However, the running cost includes laser fibers, monopolar resection loops, irrigation fluids, and hospital stay.

In our study, cost analysis depended on the running cost rather than the capital cost. We considered the devices as one of the essential logistics of the hospital, and also each device can be used in other surgeries not only prostatectomy, such as stone laser lithotripsy with the laser device, and the monopolar electrocautery can be used in TURT and other different surgical procedures; thus, the cost analysis will be affected by the number of cases done rather than the individual cost of each surgery.

Regarding the running cost in our study, we consumed three laser fibers, and each fiber was used for 10 patients; regarding the monopolar resection loops, we consumed 30 loops, and each loop was used for one patient. Cost of irrigation fluids was estimated by the price of 1 unit multiplied by the total units consumed including intraoperative and the maintenance irrigation fluid used overnight. The hospital stay cost was calculated by the price of one night multiplied by the nights of hospital stay for each group.

Table 6 Comparison between study groups regarding postoperative parameters at intervals of 1 and 6 months

	HOLEP *N*=30	TURP *N*=30	*P* value	Significance
IPSS post 1 month				
Mean±SD	5.70±1.12	5.97±1.59	0.455	NS
Range	4–7	4–9		
PSA post 6 months				
Mean±SD	1.14±0.29	1.06±0.30	0.280	NS
Range	0.5–1.6	0.4–1.5		
Qmax post 1 month				
Mean±SD	24.60±1.89	23.93±1.84	0.171	NS
Range	22–30	18–27		
Postvoiding residual volume post 1 month				
Median (IQR)	27.5 (0–30)	30 (20–30)	0.391	NS
Range	0–60	0–60		

HoLEP, Holmium laser enucleation of the prostate; IQR, interquartile range; IPSS, international prostate symptom score; PSA, prostatic specific antigen; TURP, transurethral resection of the prostate. $P>0.05$, nonsignificant. $P<0.05$, significant. $P<0.01$, highly significant.

Table 7 Comparison between study groups regarding postoperative parameters after 1 year follow up

	HOLEP *N*=30	TURP *N*=30	*P* value	Significance
IPSS post 12 months				
Mean±SD	5.30±1.12	5.40±1.25	0.745	NS
Range	4–7	4–9		
PSA post 12 months				
Mean±SD	1.29±0.31	1.28±0.32	0.871	NS
Range	0.7–1.8	0.6–1.8		
Qmax post 12 months				
Mean±SD	24.57±1.74	24.10±1.84	0.317	NS
Range	21–28	18–27		
Postvoiding residual volume post 12 months				
Median (IQR)	20 (10–30)	20 (20–40)	0.406	NS
Range	0–50	0–50		
Prostate size by ultrasound after 1 year				
Mean±SD	26.83±4.51	26.70±4.35	0.908	NS
Range	20–35	20–35		
Qol after 1 year				
Mean±SD	1.43±0.50	1.40±0.50	0.798	NS
Range	1–2	1–2		

HoLEP, Holmium laser enucleation of the prostate; IQR, interquartile range; IPSS, international prostate symptom score; PSA, prostatic specific antigen; TURP, transurethral resection of the prostate. $P>0.05$, nonsignificant. $P<0.05$, significant. $P<0.01$, highly significant.

In our study, HoLEP was more cost-effective than TURP, where total cost of a case is 3390.5 Egyptian pounds (EGP) in HoLEP group and 4282 EGP in TURP group, with statistically significant difference ($P<0.001$). (Table 8).

Discussion

Our study showed longer mean operative time in HoLEP group (80 min) than TURP group (60 min), which was statistically significant. This is reasonable because of the extra time of morcellation, and also this difference may be attributed to the more experience with the TURP technique in our hospital compared with the recently introduced HoLEP technique. A previous study performed by Barboza *et al*. [14] also showed longer mean operative time in HoLEP group (85 min) than TURP group (60 min), with *P* value 0.02, and also Gilling *et al*. [15] reported longer mean operative time in HoLEP group (62 min) than TURP group (33 min), with *P* value less than 0.001; both results were statistically significant. This is unlike the study performed by Eltabey *et al*. [16] which showed no significant difference in operating times between the two groups.

In our study, we reported a shorter catheterization time in HoLEP group (1.10±0.31 days) than in TURP group (3.07±0.78 days), and similarly, a shorter hospital stay in HoLEP group (1 day) compared

Table 8 Comparison between study groups regarding cost analysis

Running cost of materials in EGP	HoLEP (average price/ case)	TURP (average price/ case)	P value	Significance
LASER Fiber (1 fiber=8375)/monopolar loop (1 loop=700)	837.5 (1 fiber per 10 cases)	700 (1 loop per 1 case)		
Irrigation fluids (1 unit=30)	1353	1386		
Hospital stay (1 day=1200)	1200	2196		
Total in EGP	3390.5±100	4282±100	<0.001	Highly significant

with TURP group (1.83±0.65 days); both results were statistically significant. These findings agree with those of Gilling *et al*. [15] who reported significantly shorter catheterization time and hospital stay in HoLEP group than TURP group, with catheterization time of 17.7 ±0.7 vs 44.9±10.1 h and hospital stay of, 27.6±2.7 vs 49.9±5.6 h in HoLEP and TURP groups, respectively. Moreover, Eltabey *et al*. [16] reported significantly less bladder irrigation, with shorter catheterization time (1.5 vs 2.1 days; $P<0.001$) and shorter hospital stay (2.6 vs 3.8 days; $P<0.001$) in HoLEP group than TURP group; they attributed this to the excellent hemostatic characteristics of HoLEP.

In our study, there was no statistical difference in the volume of resected tissues and the percentage of prostate size reduction between the two groups with reduction percentage of 58 and 57.3% in the HoLEP and TURP groups, respectively. These results were comparable with those reported in the study by Eltabey *et al*. [16], and this was reflected on PSA level reduction, which showed a reduction of 64.4% in HoLEP group vs 63.4% in TURP group, with no statistically significant difference between the two groups/ On the contrary, these results showed statistically significant difference compared with the preoperative baseline values in each group.

Tan *et al*. [17] showed that more prostatic tissue is removed at HoLEP group than at TURP group in matched prostates. Reduction in postoperative prostate sizes was higher in HoLEP technique, and also postoperative PSA reduction was higher denoting adequate tissue removal.

Regarding intraoperative complications, we reported only one case of capsular perforation in the TURP group that was managed conservatively, with no statistically significant difference between the two groups, with no cases of ureteric injury, bladder mucosal injury, or the need to convert to another type of surgery. Barboza *et al*. [14] reported bladder mucosal injury during morcellation in six patients in HoLEP group.

Moreover, hemoglobin drop was mostly similar in the two groups in our study, with 0.98±0.16 g drop in HoLEP group and 0.97±0.18 g drop in TURP group (P=0.8), with no need for blood transfusion in both groups. Barboza *et al*. [14] also reported no need for blood transfusion in both groups. However, Eltabey *et al*. [16] reported more hemoglobin loss in TURP group and three (7.5%) patients required blood transfusion in TURP group vs no patients required blood transfusion in HoLEP group, with P value less than 0.007, which was statistically significant.

Regarding sodium level drop and TUR syndrome, we reported it in one patient only in TURP group, whereas in HoLEP group, it did not happen in any patient, with P value 0.3, which was not significant. These results are comparable with the study done by Barboza *et al*. [14], which showed no statistically significant difference in post-procedure sodium levels.

In our study, there were no statistically significant differences between the two groups regarding early and late postoperative complications such as UTI, hematuria, stress incontinence, bladder neck contracture, and urethral stricture. No cases of hematuria or urethral stricture were reported in both groups in our study. UTI happened in 10 and 13.3% of patients in HoLEP and TURP groups, respectively, with P value 0.69. In each group, 2 cases of bladder neck contracture were reported that required an endoscopic resection. Overall, 10% of patients of HoLEP group and 13.3% of patients in TURP group showed early SUI in our study; they showed improvement on pelvic floor exercises at the end of our study, where only 3.3% of cases in HoLEP group and 6.7% of cases in TURP group showed no improvement, with no statistically significant difference (P value 0.55).

These results are comparable with the study done by Barboza *et al*. [14]. Moreover, Eltabey and colleagues showed similar results, with no statistically significant difference between the two groups in postoperative complications, where urinary incontinence occurred in 20 and 30% of patients in HoLEP and TURP groups, respectively (*P*=0.08); these were temporary.

Urethral stricture was reported in three cases (one in HoLEP group vs two in TURP group); they were all short strictures that were treated with visual internal urethrotomy [16].

Gilling *et al*. [15] after 7 years of follow-up noticed that none of the patients needed re-operation for recurrent BPH in the HoLEP group, whereas three needed re-operation in the TURP group. The three patients of TURP group who required re-operation underwent HoLEP for prostatic regrowth.

We reported a similar efficacy between both groups, with no statistically significant difference in postoperative efficacy parameters, including Qmax, IPSS, Qol, and PVRU at 1- and 12-month interval, with significant improvement with the preoperative baseline values in each procedure. These results were comparable with the previous studies done by Barboza *et al*., Gilling *et al*., and Tan *et al*. [14,15,17].

Eltabey *et al*. [16] showed statistically significant improvements from baseline in IPSS, PVR urine volume and Qmax in both groups. The IPSS and PVR urine volumes were significantly better in the HoLEP group than in the TURP group. But Qmax was comparable in both groups.

In our study, HoLEP procedure was considered more cost-effective than TURP in terms of running cost after exclusion the capital cost of both devices from our assessment. A previous study showed that HoLEP technique is more cost-effective than TURP technique, as it can spare the costs of higher early morbidity with TURP [18]. Moreover, holmium laser can be used in another uses such as to treat stones; this advantage further more improves its cost-effectiveness. Holmium laser has a 93% success rate in treatment of ureteric stones [19].

The main disadvantage of HoLEP technique is the steep learning curve. This learning curve can be minimized with a short period of structured supervision and proper case selection. In general, after performing transurethral surgery on about 20–30 cases, a surgeon will be able to do HoLEP on prostates ranging from 30 to 100 grams, especially because of the anatomical nature of enucleation that makes HoLEP easier than TURP [20].

Conclusion

Both HoLEP and monopolar TURP are safe and effective in the surgical management of BPH. However, HoLEP has shorter catheterization time and hospital stay and more cost effectiveness but longer operative time than monopolar TURP.

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Conflicts of interest

There are no conflicts of interest.

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