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Comparative Analysis of the Effectiveness of Modern Endoscopic Methods of Treatment of BPH

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ABSTRACT

Lower urinary tract symptoms caused by benign prostatic hyperplasia are the most common urological problem among men, affecting about a third of men over the age of 50

Of all surgical treatments, monopolar transurethral resection of the prostate (TURP), in which enlarged prostate tissue is resected piece by piece using a monopolar electrode, has been the standard method since the 1970s. It can significantly improve maximum flow rate (Qmax), urination-related symptoms (based on the International Prostate Symptom Assessment Scale (IPSS)), and health-related quality of life with long-term efficacy compared to medications or other minimally invasive treatments [4].

Since the 2000s, new energy systems for surgery for benign prostatic hyperplasia have rapidly become popular, including systems using bipolar energy and various laser systems such as holmium laser, potassium titanyl phosphate (KTP) laser, thulium laser and diode laser Over the past 10 years, the trend in the surgical treatment of benign prostatic hyperplasia has shifted from monopolar TURP to laser therapy and bipolar TURP. Based on the data on the effectiveness of the HoLEP technique, it becomes clear that HoLEP is ready to replace all these methods as a new standard, based on almost two decades of data that consistently demonstrate its better results and lower complication rate. This review summarizes the available literature by comparing HoLEP and traditional BPH treatments that are widely used and have long-term efficacy data.

Despite the fact that there is such a wide arsenal of surgical treatment of BPH, each of these methods has its own advantages and disadvantages. This review article contains a significant portion of the best randomized data directly comparing HoLEP with alternative surgical treatments.

KEYWORDS: Lower urinary tract symptoms, holmium enucleation of the prostate, transurethral resection of the prostate, comparative analysis, results.

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a common disease in older men and is a significant social problem. The clinical manifestations of BPH have significant negative consequences for the quality of life. Although many men with BPH never see a doctor and do not need treatment for this disease [1]. Increasingly, prostate adenoma is becoming a cause leading to serious manifestations of lower urinary tract syndrome (LUTS), which forces patients to seek medical help. LUTS is the preferred terminology for describing symptoms potentially caused by multiple conditions, including symptoms associated with urinary bladder function and difficulty emptying, such as increased urgency, urinary frequency, poor urine flow, and urinary incontinence [2].

Lower urinary tract symptoms caused by benign prostatic hyperplasia are the most common urological problem among men, affecting about a third of men over 50 [3]. Of all surgical treatments, monopolar transurethral resection of the prostate (TURP), in which the enlarged prostate tissue is resected piece by piece with a monopolar electrode, has been the standard technique since the 1970s. It can significantly improve maximum flow rate (Qmax), urinary symptoms (based on the International Prostate Symptom Scale (IPSS) and health-related quality of life, with long-term efficacy compared to drugs or other minimally invasive treatments [4].

New energy systems for benign prostatic hyperplasia surgery have rapidly become popular since the 2000s,

including systems using bipolar energy and various laser systems such as holmium laser, potassium titanyl phosphate (PTP) laser, thulium laser and diode laser. [5,6] over the past 10 years, the trend in the surgical treatment of benign prostatic hyperplasia has shifted from monopolar TURP to laser therapy and bipolar TURP. Bipolar energy can be used to cut, resect and vaporize prostate tissue using a variety of electrodes. Holmium and thulium laser beams are primarily absorbed by water and act as incisal lasers. PTP- laser is selectively absorbed by hemoglobin and destroys prostate tissue by vaporization.

THE MAIN FINDINGS AND RESULTS

Based on data on the effectiveness of the HoLEP technique, it is clear that HoLEP is poised to replace all of these techniques as a new standard based on nearly two decades of data that consistently show better results and lower complication rates. This review summarizes the available literature comparing HoLEP and conventional BPH treatments that are widely used and have long-term evidence of efficacy.

Despite the existence of such a wide arsenal of surgical treatment for BPH, each of these methods has its own advantages and disadvantages. This review article contains much of the best randomized data directly comparing HoLEP with alternative surgical treatments. And so we will consider the analysis of the results of the main surgical methods in comparison with the HoLEP method.

Comparative analysis of HoLEP and TURP.

TURP is the historic gold standard against which all surgical treatments for BPH are compared. HoLEP is poised to replace TURP as the standard based on long-term data that consistently show equivalent or superior results with fewer postoperative complications and better long-term outcomes based on reoperation rates [7].

There is a wealth of data directly comparing outcomes and complications for HoLEP and TURP. Ahyai et al. [8] performed a meta-analysis of 23 randomized trials comparing monopolar TURP, bipolar TURP, open prostatectomy, HoLEP, and PVP in a total of 2245 patients. HoLEP showed statistically significant improvement over TURP in IPSS ($p = 0.005$) and postoperative Qmax ($p = 0.012$), it was the only endoscopic procedure that did not require reoperation due to adenoma growth within 5 years. The argument against HoLEP is that the uptime is significantly longer than using TURP. However, Ahyai [8] also found that the mean tissue resection rate (g / min) for HoLEP and TURP was statistically similar (0.52 g / min versus 0.57 g / min), making them equally time efficient. Postoperative complications are usually lower for HoLEP compared to TURP; TURP syndrome after HoLEP was not observed in any case, even for adenomas hundreds of grams in size [8].

In 2013, Yin et. al. [9] published a meta-analysis comparing six randomized clinical trials of HoLEP and TURP. HoLEP outperformed TURP in both Qmax and IPSS scores within one year ($p < 0.0001$ and $p = 0.01$, respectively). In addition, HoLEP patients had lower intraoperative blood loss ($p = 0.001$), shorter catheterization time ($p < 0.001$), shorter hospital stay ($p = 0.001$), and lower blood transfusion rates ($p = 0.04$). However, HoLEP procedures required a longer operative time ($p = 0.001$).

Gilling et al. [10] reported the results of the data after prospective studies over a period of 92 months. They reported that HoLEP, on average, led to an increase in the amount of tissue removed, a decrease in catheterization time and a decrease in hospitalization time, all statistically significant ($P < 0.05$). In addition, patients who underwent HoLEP had a greater decrease in IPSS and a greater improvement in postoperative Qmax compared to preoperative.

Like other authors, Gilling also reported similar results for erectile function, sexual desire, between the HoLEP and TURP cohorts. Finally, no patient in the HoLEP group required reoperation for enlarged prostate adenoma, while in the TURP group the rate was 18%.

Similar comparative studies were also performed by the teams of authors Hamouda A, et al 2016 [22] and Jhanwar A, et al. 2017 [23] These comparative studies also showed the advantages of the HOLEP method in all compared indicators: catheterization time, volume of removed tissue, changes in Q-max, IPSS. The main difference was the duration of the operation, which was statistically longer for HOLEP.

Details of the results of the studies carried out can be found in table 1.

Table 1. Comparative evaluation of the direct results of the HoLEP and TURP application.

	Kuntz, et al 2004		Gilling, et al 2012		Montorsi et al 2004		Gupta et al 2006		Hamouda A, et al 2016		Jhanwar A, Et al. 2017	
	HoLEP	TURP	HoLEP	TURP	HoLEP	TURP	HoLEP	TURP	HoLEP	TURP	HoLEP	TURP
Length of hospital stay (days)	2.2	3.6	1.2	2.1	2.5	3.6	-	-	36.400 ± 19.9 (hours)	85.5 ± 18.9 (hours)	41.81± 9.17 (ч)	54.58± 12.36 (h)
	p ≤ 0.001		*p ≤ 0.001*		*p =0.001*				*p ≤ 0.001*		*p =0.0001*	
Catheterization time (days)	1.1	1.8	0.7	1.9	1.3	2.4	1.2	1.9	24.000 ±0.000 (hours)	59.200± 15.09 (hours)	30.94± 5.49 (h)	48.06± 13.36 (h)
	p ≤ 0.001		*p ≤ 0.001*		*p =0.001*		*p =0.001*		*p ≤ 0.001*		*p =0.0001*	
The amount of tissue removed (g)	32.6	37.2	40.4	24.7	36.1	25.4	17.2	24.2	46.033± 17.655	35.733± 13.577	48.49± 10.87	44.80± 9.87
	-		p ≤ 0.05		p ≤ 0.05		p ≤ 0.004		p ≤ 0.014		*p =0.03*	
Operation time (min)	94.6	73.8	62.1	33.1	74	57	75.4	62.6	89.500±32.01	74.833±9.36	89± 13.81	73± 10.49
	p = 0.001		p = 0.001		p ≤ 0.05		p ≤ 0.001		p ≤ 0.044		*p =0.0001*	
Changes in Qmax	+20.2	+21.8	+13,8	+9,5	+16.9	+15.9	+19.9	+19.2	+ 12,5	+ 11,9	+15,6	+15,1
IPSS changes	-19.9	-17.7	- 18,4	-13,4	-17,5	-19	-18.2	-17.7	-11,7	- 12,6	-19,54	-18,86

Comparative analysis of HoLEP and open prostatectomy (OP)

HoLEP is size-independent, i.e. this type of surgical treatment can be used regardless of the size of the prostate gland. As a consequence, it is expected that HoLEP will eventually turn the OP into an almost historic operation, even for the largest prostate sizes. HoLEP has been successfully used to enucleate adenomas up to 800 g in size [7]. Numerous studies have shown that HoLEP results, catheterization time and length of hospital stay are independent of prostate volume. Lingeman et al. [11] retrospectively reviewed 507 patients who were stratified into three groups based on preoperative TRUS measurements - <75 g, 75-125 g, and> 125 g. They found no significant difference in hospitalization, catheterization time, postoperative IPSS and postoperative Q max. between the three groups. Likewise, Kuntz et al. [12] prospectively followed 389 patients who were stratified into three subgroups (<40 g, 40-79 g and> 80 g). They found no differences in catheterization time, length of hospital stay, complication rate, or postoperative symptom scores across the cohorts. In addition, the transfusion rate was 0% in all three subgroups.

HoLEP and OP results have been directly compared in several large RCTs. Kuntz [13] demonstrated that HoLEP can be used to resect adenomas larger than 100 g with the same efficacy as OP, but with significant reductions in hospital stay, catheterization time, blood loss, and blood transfusion rate. Naspro et al. [14] conducted a similar randomized prospective study comparing HoLEP with OP in 80 patients with a prostate volume> 70 g after 2 years of follow-up. They found lower transfusion rates (4% versus 17.9%), shorter catheterization times (1.5 versus 4.1 days), and shorter hospitalization times (2.7 versus 5.4 days) in patients undergoing HoLEP. against the OP, respectively. Moody and Lingeman et al [15] retrospectively compared HoLEP with OP in patients with a prostate volume greater than 100 g and found that patients undergoing HoLEP benefited from a minimal change in postoperative hemoglobin (1.3 versus 2.9 g / dL), more short length of stay (2.1 versus 6.1 days) and more resected adenoma (151 versus 106 g). Moreover, the effectiveness of the operation was not compromised; the duration of the procedure and the improvement in AUA-SS (American Urological Association - Symptom Score) between the two cohorts were equivalent.

Table 2. Shows the staggering reductions in hospital stay, catheterization time, and blood transfusion rate in HoLEP patients.

	Kuntz, et al 2008 (RCTs)		Naspro, et al 2006 (RCTs)	
	HoLEP	ОП	HoLEP	ОП
Length of hospital stay (days)	2.9	10	12,7	5,4
	P ≤ 0.0001		*p ≤ 0.0001*	
Catheterization time (days)	1.3	8.1	1.5	4.1
	P ≤ 0.0001		*P ≤ 0.001*	
The amount of tissue removed (g)	93,7	96,4	59.3	87.9
			p = 0.005	
Operation time (min)	135,9	90,6	72.1	58.3
	p = 0.001		p = 0.0001	
Frequency of blood transfusions	0	13,3	4	17,9
	p = 0.003		p ≤ 0.007	
Loss of hemoglobin g / Dl	1.9	2,8	2,1	3,1
	p ≤ 0.0001		p ≤ 0.007	
RV volume (g)	> 100	> 100	> 70	> 70
Changes in Qmax	+20.6	+20.7	+11,4	+11,8
Changes in IPSS	-19	-18	-12,2	-13,5

Comparative analysis of HoLEP and PKRP, ThuLEP, PVP

In addition to HoLEP and TURP, there are numerous other minimally invasive treatments for symptomatic BPH, including Greenlight PVP, ThuLEP, and PKRP. There are only a few studies that directly compare HoLEP to these alternative methods.

Greenlight PVP is the most well-proven laser alternative to traditional transurethral resection of the prostate gland, which quickly and efficiently vaporizes prostate adenoma. Recent advances in the PVP laser have made it possible to treat larger adenomas [16]. Elmansy et al. [17] conducted the only RCT comparing HoLEP to PVP. The mean preoperative transrectal ultrasound volume was 91.3 g and 89.3 g in the HoLEP and PVP groups, respectively. Significantly higher postoperative Qmax and lower residual urine volume (PVR) were noted in the HoLEP cohort at one year of follow-up (p = 0.02). There was no significant

difference in IPSS, quality of life, or sexual function over one year. However, 22% of patients undergoing PVP required either HoLEP or TURP conversion; the authors attributed this to visual impairment due to bleeding, which could not be controlled with a PVP laser. They also noted that ~ 33% of PVP cases required multiple laser fibers to complete the operation and required higher energy settings than HoLEP procedures.

PKRP is similar to bipolar transurethral resection of the prostate. Chen, et al [18] compared HoLEP and PKRP in RCTs and found that HoLEP procedures had significantly more resected tissue and shorter hospitalization and catheterization times. HoLEP treatments averaged 86.6 minutes versus 60.4 minutes for PKRP. Chen concluded that compared to PKRP, HoLEP is applicable regardless of prostate size and has a lower risk of blood loss and intraoperative bleeding, with reduced need for postoperative bladder irrigation and reduced catheterization time and hospital stay. Neill et al [19] randomized 40 patients to either HoLEP or PKRP. They found a reduction in operative time (43.6 versus 60.5 minutes) and a decrease in the need for bladder irrigation (5% versus 35%) for HoLEP. All other functional outcomes were statistically similar.

Thylium laser: YAG (ThuLEP) operates at 2013 nm in continuous wave mode and boasts excellent vaporization and hemostatic capabilities with outcomes and complication rates similar to those of HoLEP. However, as a pulsed laser, the HoLEP offers great opportunities for the urologist; Patients undergoing endoscopic enucleation of BPH often require cystolitolapaxy, stricture ablation, or tumor removal during the procedure, all of which can be done with a holmium laser. Zhang et al. [20] compared HoLEP and ThuLEP in RCTs and found similar functional objective results with significantly reduced operative time for HoLEP, but more blood loss, both of which they found clinically insignificant.

In a study comparing ThuLEP and TUR by the team of authors Bozzini G, et al 2017 [24], it was shown that both ThuLEP and TUR are very effective in stopping LBWT with a high degree of efficacy and safety. ThuLEP has shown much better results in terms of time to catheterization, volume of tissue removed and reduced hospital stay. However, procedures were not significantly different in Qmax, IPSS, after 3 months of follow-up.

Another study comparing PKRP and ThuLEP [25] by Yang Z, et al. 2016, showed PKRP and ThuLEP are safe and effective treatments for patients with symptomatic BPH. Compared to PKRP, ThuLEP offers advantages in intraoperative safety, minimal blood loss, shorter catheterization and shorter hospital stays, but requires a longer operative time. Medium- and long-term follow-up showed no difference in IPSS and Q-max.

More details on the data of the above studies can be found in Table 3.

Index	Elmansy, et al 2012 [17] RCT		Chen, et al 2013 [18] RCT		Zhang, et al 2012 [20] RCT		Neill et al 2006 [19] RCT		Bozzini G, et al 2017		Yang Z, et al. 2016	
	HoLEP	PVP	HoLEP	PKRP	HoLEP	ThuLEP	HoLEP	PKEP	ThuLEP	TUR	PKRP	ThuLEP
Length of hospital stay (days)	-	-	3.55 p ≤ 0.01	4,37	-	-	1,4	1,3	1,7 ± 2,73	5,2 ± 3,98	4.6 ± 1.4 (3–6)	2.5 ± 1.4 (3–6)
Catheterization time (days)	1.2	1.4	3.3 p ≤ 0.05	3.5	2.5	2.4	1.0	1.0	1,3 ± 2,55	4,8 ± 3,81	3.5 ± 1.2 (0.50 – 4.00)	2.1 ± 0.8 (0.50–3.00)
The amount of tissue removed (g)	-	-	48.5 p ≤ 0.01	41.1	40.4	37.6	21.7	20	51,13 ± 23,14	48,84 ± 18,23	-	-

Operation time (min)	107	110	86.6	60.4 $p \leq 0.01$	61.5 $p = 0.03$	72.4	43.6 $p \leq 0.05$	60.5	53,69 ± 31,44	61,66 ± 18,70	47.4 ± 15.9 (35–75)	65.4 ± 22.2 (47–85)
Frequency of blood transfusions	0	0	0	0	0	0	0	0	0	3	-	-
RV volume (g)	91.3	89.3	56.7	60.3	43.5	46.6	57.0	51.0	89,7	81,9	72,4	69,20
Changes in Qmax	+22.4 $p = 0.02$	+20.3	+16	+15.8	+16.7	+16.2	+11.6	+14.6	22,14 ± 10,23	19,87 ± 9,70	8,7	9,1
Changes in AUASS/IPSS	-19	-18	-15.4	-15.2	-16.6	-19.4	-18.2	-13,8	- 12,8	18,6	-18,8	-17,5

Several studies of HoLEP outcomes over 5 to 10 years have reported a reoperation rate of less than 1%. It should be noted that these findings are in stark contrast to TURP with an average re-operation rate of 7.4% and PVP with a re-operation rate of 5-6% [5]. In RCTs HoLEP versus TURP, Gilling et al [21] reported a reoperation rate of 0% versus 18% at 7 years in the HoLEP and TURP cohorts, respectively. Of particular note is the fact that in this study the volume of the prostate gland in patients varied from 40 to 200 ml, which suggests that the long-term results of HoLEP are independent of size.

Kuntz et al in 2008 also reported a 0% reoperation rate within 5 years in men with prostate volume> 100 g who underwent HoLEP. In a retrospective review of 507 patients undergoing HoLEP, Lingeman et al reported a stricture rate of 2.2%, significantly lower than the 7.4% reported for TURP [11].

CONCLUSION

Based on all available evidence, HoLEP offers patients a safer, more effective, and at least as effective, if not more effective, treatment for lower urinary tract LUTS syndrome associated with prostate adenoma compared to other surgical treatments. Compared to TURP, the currently reference gold standard, HoLEP patients benefit from shorter catheterization times, shorter hospitalization times, and fewer complications. In centers where HoLEP is available, OP is an unnecessary and historic operation, fraught with high blood transfusion rates, long hospital stays, and long catheterization times. Despite the well-documented superiority of HoLEP over more traditional therapies, widespread adoption remains to be seen. The standard argument that HoLEP is too laborious or too difficult to learn is not reflected in the literature.

These benefits make HoLEP the treatment of choice for men with BPH today.

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