Holmium laser transurethral incision of the prostate: Can prostate size predict the long-term outcome?

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Abstract

Introduction: We determine the impact of prostate size on the long-term outcome of holmium laser transurethral incision of the prostate (Ho-TUIP) for bladder outlet obstruction (BOO) secondary to benign prostate enlargement (BPE).

Methods: A retrospective review of prospectively collected data was performed for patients undergoing Ho-TUIP by a single surgeon for patients presenting with lower urinary tract symptoms (LUTS) secondary to BOO. Patients were stratified into 2 groups: Group 1 included patients with prostate ≤30 cc and Group 2 included patients with prostate >30 cc. Demographic, operative and follow-up data were recorded and analyzed. In addition, intraoperative and long-term adverse events were included.

Results: In total, 82 patients underwent surgery between March 1998 and March 2013, including 9 (11%) reoperated patients. Only prostate size independently predicted reoperation after Ho-TUIP (adjusted odds ratio [aOR], 95% confidence interval [CI] 7.12 [2.92–9.14], $p = 0.01$). The receiver operating characteristic (ROC) analysis showed an optimal cutoff value of prostate volume of 29 cc to characterize long-term reoperation after TUIP, with area under the curve (AUC) of 0.96, sensitivity of 89.7 and specificity of 88.9. Group 1 included 51 patients and Group 2 included 31 patients. The international prostate symptoms score (IPSS) and peak flow rate (Qmax) significantly improved in both groups at different follow-up points. At the 12-month follow-up, the percent change in IPSS and Qmax were comparable between both groups. However, after 12 months, the degree of improvement in all voiding parameters was significantly higher in Group 1 ($p < 0.001$ at all points of follow-up). After a median follow-up of 5.3 years (range: 1–13), both groups had comparable early and late adverse events with significantly higher reoperation rate in Group 2 (3.9% vs. 22.6%, $p = 0.02$). Overall retrograde ejaculation was detected in 25.6% of sexually active men and it was comparable between both groups (23.5% vs. 29%, $p = 0.61$). On multivariable analysis, patients with prostate volume >30 cc were associated with significantly higher reoperation for BOO (aOR 95% CI 5.72 [2.83–8.14], $p = 0.02$), significantly higher IPSS (aOR 1.72), higher quality of life index (aOR 1.72) and lower Qmax (aOR 0.28).

Conclusion: Ho-TUIP is a durable, safe and efficient treatment of BOO secondary to a small-sized prostate. The long-term outcome could be improved and the re-operation rate could be minimized with appropriate selection of cases, with prostate glands no bigger than 30 cc.

Introduction

Transurethral incision of the prostate (TUIP) is a well-established treatment for bladder outlet obstruction (BOO) secondary to small-size benign prostate enlargement (BPE). The choice of TUIP was originally introduced to treat small fibrous prostates with an elevated bladder neck that became wide open after 1 or 2 incisions, without removing prostate tissue.

Systematic reviews and meta-analyses confirm that TUIP has equivalent symptomatic improvement for men with prostate glands ± 30 mL, with the advantages of less morbidity, less bleeding and less sexual dysfunction than TURP.[1,2] Nevertheless, TUIP is underused due to its questionable long-term efficacy and lack of data. Without considering the prostate size limit, redo TURP was needed after a mean 16 months in 23.3% of patients who underwent TUIP.[3] To avoid this high failure rate, Li and colleagues recommended selective TURP in combination with transurethral incision of the bladder neck in patients with small obstructing prostate.[4]

However, in the era of laser prostatectomy, holmium laser energy is an excellent alternative to incise the prostate due its satisfactory cutting effect and superior visibility than electrocautery. Moreover, it has a minimal tissue penetration depth of 0.4 mm, with less probability of scarring.[5] Therefore, the previously mentioned adhesions between the prostatic lobes and excessive healing of the incisions,[3,6] responsible for impairment of the results after TUIP, could be avoided.

Furthermore, there is debate about the proper management of small-size prostates. The controversy is whether to relieve the obstruction with an incision with a higher risk of reoperation for residual tissue up to 20%,[7] or to remove the adenoma with a growing evidence of increased risk of bladder neck contracture.[8,9]

Holmium TUIP (Ho-TUIP) has been used safely and effectively for small prostates even in high-risk anti-coagulated patients.[7,10] It provides symptom reduction equivalent to that of green laser vaporization of the prostate at different follow-up points with less cost and shorter operating time, catheter time, and hospital stay.[10] After Ho-TUIP, 80% of patients who needed redo procedure had prostates larger than 30 cc.[7] Therefore, size limitations and the long-term durability of success are the main concerns. We sought to determine the impact of prostate size on the long-term outcome of holmium laser TUIP.

Methods

A retrospective review of a prospectively collected database was performed for patients undergoing Ho-TUIP for BOO secondary to BPE. All procedures were performed or supervised by a single surgeon (MME).

The decision of performing TUIP was made purely on the anatomical appearance at the preoperative cystoscopy and the wide open cavity after the initial incision. Prostate size per se was not an exclusion criterion, except for the presence of middle lobe or significant large adenoma. Therefore, even though the prostate size was measured, it was not used to select the procedure. Due to differences in outcome among patients over the long term, a post-hoc comparison was done to detect the factors which might affect the long-term outcomes of patients who underwent TUIP.

Hospital records and charts were comprehensively reviewed for perioperative and follow-up data, including demographic, operative and follow-up data. In addition, postoperative adverse events and long-term complications were recorded and analyzed.

Patients with a history of prostate surgery or history of concomitant urethral stricture were excluded (Fig. 1). Baseline and follow-up data were compared both subjectively and objectively in terms of the International Prostate Symptoms Score (IPSS), quality of life (QoL), peak flow rate (Qmax) (mL/sec), and post-void residual urine volume (PVR) (mL). These parameters were compared at different follow-up visits at 1, 6, and 12 months and then annually. Adverse events were graded using the modified Clavien Classification System.

Procedure

We used a modified continuous flow 26Fr resectoscope, with a distal bridge to stabilize the laser fibre, continuous saline irrigation, and a video camera. Ho-TUIP was performed using a 100-Watt holmium: YAG laser (Versa Pulse Power Suite) and a 550 um end firing fibre (SlimLine 550, Inc.). The bladder neck was deeply incised at 5 and or 7 o'clock just distal to each ureteral orifice using laser energy

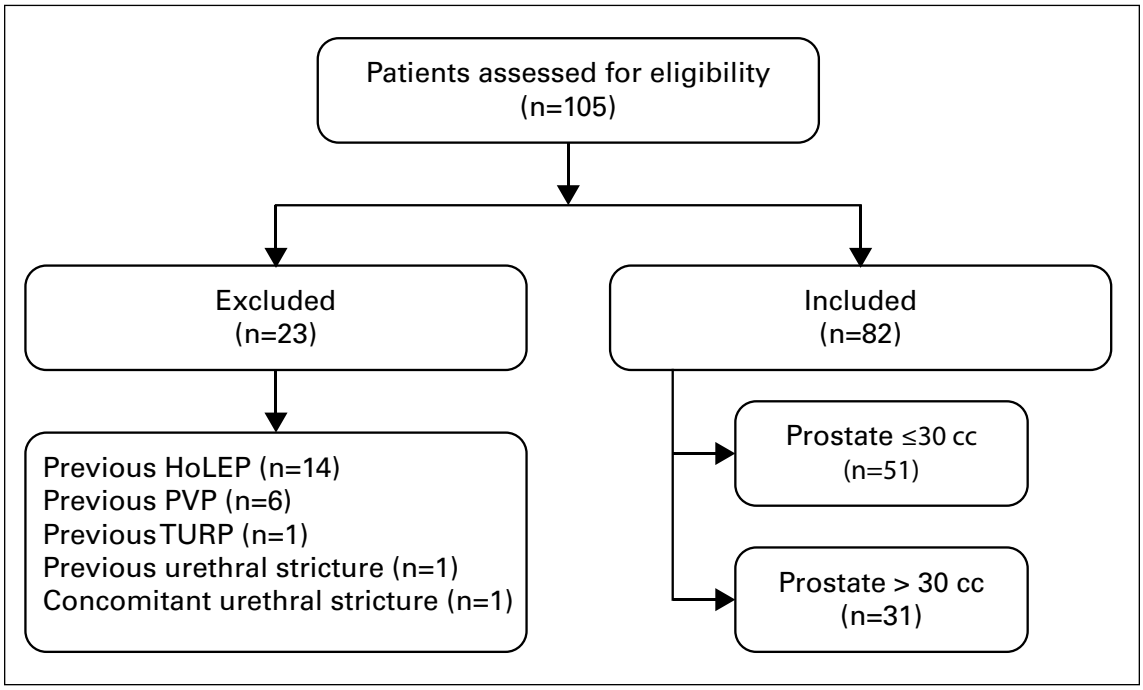

Fig. 1. Patients' enrollment and exclusions. HoLEP: Holmium laser enucleation of the prostate; PVP: Greenlight photoselective vaporization of the prostate; TURP: transurethral resection of the prostate.

to create a trough down to the true capsule of fat to either side of the verumontanum (laser energy of 2 KJ and rate of 50 Hz). A 2-way 22Fr Foley catheter was inserted and connected to straight drainage. The patient was discharged once the urine was clear and the patient was able to void adequately without a catheter.

Statistical analysis

Data were analyzed using Statistical Package for Social Sciences for windows, version 20 (IBM© SPSS, Armonk, NY). The receiver operating characteristic (ROC) was used to determine the optimal cutoff value of prostate volume, which characterize long-term reoperation after TUIP. Descriptive statistics were presented in terms of numbers and percentages or means and standard deviations for categorical and continuous variables, respectively. Changes from baseline data for the same group were compared using the paired *t*-test while between groups comparison was done by the Fisher exact test for categorical variables and Mann Whitney-U test for continuous variables. A multivariate logistic regression model was used to assess the independent effect of prostate volume on the different outcomes after adjusting for all possible perioperative parameters and reoperation for BOO. A critical two-sided *p* value of less than 0.05 was considered statistically significant.

Results

In total, 82 patients underwent surgery between March 1998 and March 2013, including 9 (11%) reoperated patients. Re-operated patients after Ho-TUIP had significantly larger prostate volume (36.8 ± 8.9 vs. 27.6 ± 5.1 mL, $p < 0.001$), longer operative time, and more patients with urethral catheter than those who were not re-operated (Table 1). However, after adjusting for possible confounders in a multivariate regression model, only prostate size independently predicted re-operation after Ho-TUIP (adjusted odds ratio [aOR] 95% confidence interval [CI] 7.12 (2.92–9.14), $p = 0.01$).

The ROC analysis showed an optimal cutoff value of prostate volume of 29 cc to characterize long-term reoperation after TUIP, with area under the curve (AUC) of 0.96, sensitivity of 89.7 and specificity of 88.9. Therefore, patients were stratified into 2 groups: Group 1 included 51 patients with prostate ≤30 cc and Group 2 included 31 patients with prostate >30 cc.

Apart from the significantly larger prostate size in Group 2 (37.9 ± 10.6 vs. 22.6 ± 4.9 mL, $p < 0.001$), both groups were comparable in all preoperative parameters (Table 2). We also compared perioperative data and adverse events between both groups (Table 3). Postoperatively, no patient needed pharmacological therapy for BOO. However, comparable numbers of patients in Group 1 and Group 2 needed α-adrenergic blockers during their long-term follow-up (8 [15.7%] vs. 10 [32.3%], $p = 0.10$, respectively).

IPSS, QoL, Qmax and PVR significantly improved in both groups compared to their baseline measurements at all

Table 1. Factors affecting long-term reoperation after Holmium laser TUIP

Variable		Non re-operated n = 73	Re-operated n = 9	*p* value
Age (years ± SD)				
Presentation	LUTs	64 (87.7)	5 (55.6)	0.03
	Retention	8 (11.0)	4 (44.4)	
	Hematuria	1 (1.4)	0 (0)	
ASA score ≥2		22 (30.1)	4 (44.4)	0.45
Preoperative prostate medications		47 (64.4)	6 (66.7)	1.00
Patients with diabetes mellitus		10 (13.4)	2 (22.2)	0.61
Preoperative anticoagulants		7 (9.5)	2 (22.2)	0.26
Preoperative IPSS		17.2 ± 5.4	16.8 ± 6.3	0.84
Preoperative QoL		3.2 ± 1.3	3.4 ± 1.2	0.66
Preoperative Qmax		8.2 ± 3.4	7.6 ± 2.8	0.21
Preoperative PVR		122.6 ± 68	102 ± 74	0.40
Mean PSA (ng/mL ± SD)		2.8 ± 4.2	3.8 ± 6.4	0.53
Mean TRUS volume of the gland (mL ± SD)		27.6 ± 5.1	36.8 ± 8.9	<0.001
Mean operative time (min)		25.8 ± 14.7	38.2 ± 28.9	0.04
Mean energy utilized (KJ ± SD)		49.4 ± 28.9	68.7 ± 34.3	0.06
Mean catheterization time (days ± SD)		1.3 ± 2.1	1.8 ± 1.9	0.49
Mean hospital stay (days ± SD)		0.92 ± 0.32	1.1 ± 0.46	0.17

Data are presented as means ± SD or numbers (%) which appropriate. ASA: American Society of Anesthesiologists; SD: standard deviation; LUTS: lower urinary tract symptoms; IPSS: International Prostate Symptoms Score; TRUS: transrectal ultrasound; PSA: prostatic specific antigen; TUIP: transurethral incision of the prostate; QoL: quality of life; Qmax: peak flow rate; PVR: post-void residual urine volume.

Table 2. Comparison of demographic and operative data of patients with different prostate size and undergoing Holmium laser TUIP

Variable		Group I Prostate ≤30 cc n = 51	Group II Prostate >30 cc n = 31	*p* value
Age (years +SD)		72.5 ± 17	73.3 ± 8	
Indications for surgery	LUTs	46 (90.2)	23 (74.2)	0.49
	Retention	4 (7.8)	8 (25.8)	
	Hematuria	1 (2.0)	0 (0)	
ASA score	I	35 (68.6)	21 (67.7)	0.60
	II	10 (19.6)	9 (29.0)	
	III	6 (11.8)	1 (3.2)	
Preoperative prostate medications	None	19 (37.3)	10 (32.2)	0.82
	Alpha blockers	30 (58.8)	19 (61.3)	
	Combination therapy	2 (3.9)	2 (6.5)	
Concomitant procedures	None	47 (92.2)	25 (80.6)	0.27
	Cystolitholapaxy	2 (3.9)	5 (16.1)	
	Bladder biopsy/tumour resection	2 (3.9)	1 (3.2)	
Diabetes mellitus		6 (11.8)	6 (19.4)	0.36
Preoperative anticoagulants		4 (7.8)	5 (16.1)	0.29
Preoperative IPSS		16.0 ± 6.2	16.4 ± 6.8	0.84
Preoperative QOL		3.4 ± 1.2	3.3 ± 1.1	0.64
Preoperative Qmax		8.1 ± 3.9	7.9 ± 3.8	0.96
Preoperative PVR		118.6 ± 139	92.9 ± 149	0.66
Mean PSA (ng/mL ± SD)		2.6 ± 4.6	3.8 ± 7.9	0.45
Mean TRUS volume of the gland (mL ± SD)		22.6 ± 4.9	37.9 ± 10.6	<0.001

Data are presented as means ± SD or numbers (%) which appropriate. SD: standard deviation; ASA: American Society of Anesthesiologists; LUTS: lower urinary tract symptoms; IPSS: International Prostate Symptoms Score, QoL: quality of Life; Qmax: peak flow rate; PVR: post-void residual urine volume; TRUS: transrectal ultrasound; TUIP: transurethral incision of the prostate; PSA: prostatic-specific antigen.

follow-up visits (Fig. 2). Similarly, both groups were comparable in subjective and objective voiding parameters within the first 12 months postoperatively. The percent changes in IPSS and QoL were 63.7% vs. 61.6%, p=0.83 and 55.9% vs. 42.8%, $p = 0.11$ in Groups 1 and 2, respectively. The percent changes in Qmax and PVR were 118.5% vs. 100%, $p = 0.62$ and 46.2% vs. 28%, $p = 0.08$ in Groups 1 and 2, respectively (Fig. 2).

However, after 12 months follow-up, the degree of improvement in all voiding parameters was significantly higher in patients undergoing TUIP for prostate ≤30 cc compared to those with larger prostates ($p < 0.001$ at all periods

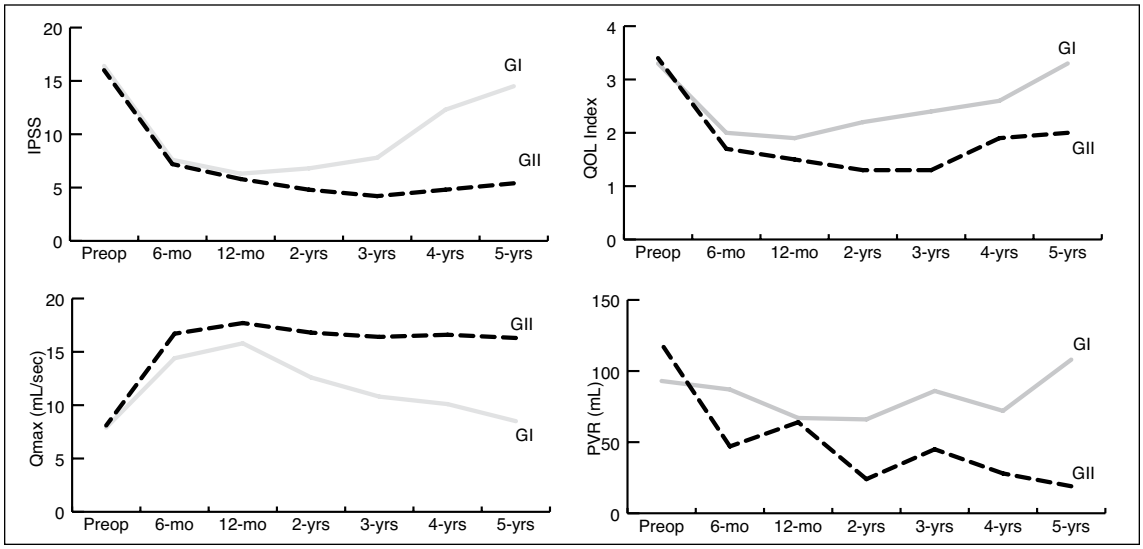

Fig. 2. Outcome parameters and number of evaluable patients who underwent Holmium TUIP for both groups at different follow-up points. *$p < 0.001$. IPSS: International Prostate Symptoms Score; TUIP: transurethral incision of the prostate; QoL: quality of life; Qmax: peak flow rate; PVR: post-void residual urine volume.

Table 3. Perioperative data of patients with different prostate size and undergoing Holmium laser transurethral incision of the prostate

Variable		Group 1 n= 53	Group 2 n= 31	*p* value
Mean operative time (min)		26.1 ± 16.6	37.6 ± 33.0	0.16
Mean energy utilized (KJ ± SD)		50.3 ± 26.1	61.2 ± 38.3	0.18
Mean catheterization time (days ± SD)		1.7 ± 2.8	2.2 ± 3.9	0.71
Mean hospital stay (days ± SD)		0.86 ± 0.34	0.89 ± 0.33	0.82
Failed trial of voiding/early retention		0 (0)	1	0.34
Postoperative complications				
Low grade Clavien I-II	Failed TOV	1 (2.0)	0 (0)	
	Retrograde ejaculation	15 (29.4)	11 (35.5)	
	Recurrent UTI	2 (3.9)	1 (3.2)	0.11
High grade Clavien ≥III	Reoperation for BOO	2 (3.8)	7 (22.6)	
	Urethral stricture	1 (1.9)	1 (3.2)	

SD: standard deviation; TOV: trial of voiding; UTI: urinary tract infection; BOO: bladder outlet obstruction.

of follow-up) (Fig. 2). After a median follow-up of 5.3 years (range: 1–13), Group 1 patients had more improvement in the percent change of IPSS (59.3% vs. 14%, $p = 0.03$) and Qmax (65% vs. 17%, $p = 0.02$) than Group 2 patients, respectively. The overall percent change in QoL was 41.2% in Group 1 patients, while the QoL of those operated for prostate volume >30 cc showed a 10% deterioration than its baseline values (Fig. 3).

Both groups were comparable in terms of early and late adverse events (Table 2). Only 1 patient in Group 2 failed to void adequately after catheter removal. Postoperative urine incontinence was not reported by any patient.

Overall reoperation rate was 11%, which was significantly higher in Group 2 (3.9% vs. 22.6%, $p = 0.02$). Two patients in Group 1 (3.9%) were re-operated: 1 patient developed urethral strictures after 13 months and the other patient needed holmium laser enucleation of the prostate (HoLEP) for progression of adenoma after 9 years follow-up. Seven patients in Group 2 (22.6%) needed reoperation: 1 developed urethral stricture after 15 months, and 6 required re-operation for recurrent bothersome lower urinary tract symptoms (LUTS). Of these 6 patients, 2 underwent HoLEP after 2 and 4 years post-TUIP, 3 patients needed a second green light HPS photoselective vaporization of the prostate after a mean follow-up of 18 months, and the last patient needed a second bladder neck incision after 9 months. Overall retrograde ejaculation was detected in 25.6% of sexually active men and it was comparable between groups (23.5% vs. 29%, $p = 0.61$).

After correcting for possible confounders on multivariable analysis, we associated patients with prostate volume >30 cc with significantly higher re-operation for BOO (aOR 95% CI 5.72 [2.83–8.14], $p = 0.02$), significantly higher IPSS (aOR 1.72 [1.37–1.94], $p < 0.001$), higher QoL index (aOR 1.72 [1.37–1.94], $p < 0.001$) and lower Qmax (aOR 0.28 [0.16–0.42], $p < 0.001$).

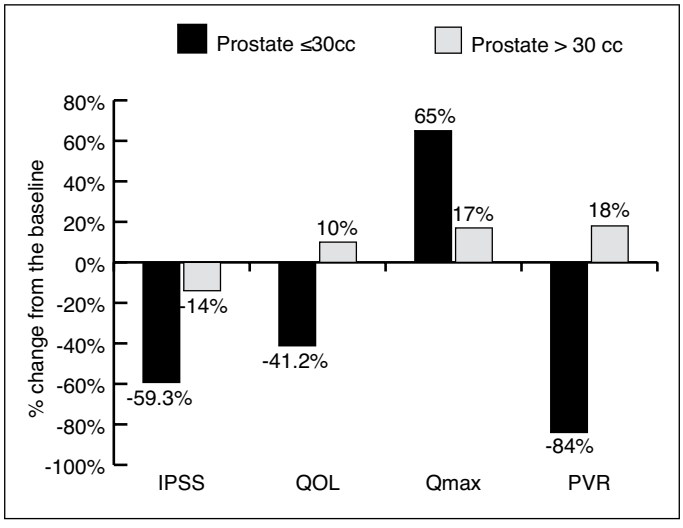

Fig. 3. Percent reduction of IPSS, QoL and Qmax at the most recent follow-up in patients undergoing Holmium TUIP for prostate ≤30 cc or larger than 30 cc. IPSS: International Prostate Symptoms Score; QoL: quality of life; Qmax: peak flow rate; PVR: post-void residual urine volume.

Discussion

Ho-TUIP is a feasible, minimally invasive outpatient procedure in patients with small prostates. It is faster than HoLEP with equivalent functional outcomes and lower rates of early stress urinary incontinence.[7] However, there is no data which characterize those patients who might obtain long-term benefit from TUIP.

TUIP was comparable to TURP in terms of functional outcomes within the first 12 months after surgery, apart from Qmax that was more significantly improved with resection.[2] However, TUIP has significantly shorter operative time and hospital stay than TURP.[11-14] Nevertheless, there is little evidence on long-term effectiveness and there is no clear cutoff prostate size that achieves long-term favourable outcomes after TUIP. Prostate size was found to correlate with BOO

in patients with a prostate volume ≥30 g, a finding which was not seen in patients with smaller prostates.[4] Therefore, other contributing BOO pathophysiological factors could play a role, whereas prostate size seems to correlate with TUIP outcomes. Consequently, it would seem logical not only to evaluate the outcome of TUIP using the new era of laser management for infravesical obstruction, but also to determine the predictors of success for this minimally invasive simple procedure.

In the present study, all subjective and objective voiding parameters, including IPSS, QoL, Qmax and PVR, significantly improved within groups. Similar comparable improvement was detected between both groups within the first 12-months after TUIP. However, further follow-up supported the more significant improvement of patients managed for prostate smaller than 30 cc than those with larger prostates. In addition, after a median follow-up of 5.3 years, Group 1 had favourable long-term follow-up in IPSS and Qmax. QoL even deteriorated in comparison with its baseline values in patents with prostates larger than 30 cc. These differences were maintained in the multivariate regression model, after correcting for all possible perioperative confounders.

Aho and colleagues found no significant differences between Ho-TUIP and HoLEP for small prostates in IPSS, QoL, and Qmax at any time during the 12-month follow-up. Moreover, both groups showed significant improvements from baseline in these outcome measures.[7] However, no long-term data were available about the functional outcomes after Ho-TUIP. Only two earlier studies reported a comparable symptomatic benefit of TUIP with TURP which persisted for up to 5 years.[3,15] Otherwise, meta-analysis and systematic reviews failed to detect improvement in symptom score after TUIP at 12 months compared to TURP.[1,2] This might be due to the high drop-out rates and the inconsistent patterns of evaluation of effectiveness.

In a randomized prospective study, the objective results were better after TURP than TUIP due to the frequent formation of complex adhesions or synechiae observed within 24 months between the prostatic lobes and the excessive scarring of the incisions in 5/21 patients that further deteriorated the flow rate with time. The comparable Qmax between both groups in the latter study after 60 months could be attributed to the fewer number of evaluable patients after 5 years, in addition to the fact that a quarter of patients needed TURP after TUIP for progressive symptoms.[3] In a concomitant study, Qmax improvement was maintained above 15 mL/sec in 78% of patients at the most recent follow-up.[15] This encouraged the authors to conclude that sustainable urodynamic and subjective improvement after bladder neck incision were maintained long term.

In terms of complications, our patients were comparable in the early and late adverse events. Moreover, there was no significant bleeding complication, which is consistent with previous reports.[7] In contrast, significant bleeding was reported in 4.3% of patients undergoing TUIP using electrocautery, including the need in 0.9% of patients for blood transfusion.[16]

The overall re-operation rate in our patients was 11%, which was lower than that previously observed in a meta-analysis of 6 previous studies (18.4%), and slightly higher than the 7.2% re-operation rate reported after TURP.[1] In a randomized controlled study, despite the small sample size and the short follow-up after holmium TUIP, 20% re-operation rate has been reported for residual adenoma.[7] However, 4 of the 5 patients in whom holmium bladder neck incision failed in the latter study had prostate size greater than 30 cc, which is consistent with our results. Of interest, re-operation after TUIP for the management of LUTS secondary to BPE was mostly needed after 12 months.[3,17] This highlights the importance of prolonged follow-up to fully evaluate the reoperation rate after this procedure. The significantly higher re-operation rate for prostate larger than 30 cc in our patients may indicate that the re-operation rate could be improved with appropriate selection of patients with smaller prostates.

The findings of this study highlight the importance of long-term follow-up; our findings also warn clinicians not to be satisfied with 12-month data when evaluating surgical options, particularly minimally invasive procedures.

Overall retrograde ejaculation was detected in 25.6% of our sexually active men, which was consistent with the 27.6% reported in a systematic review of randomized controlled trials.[1] Moreover, a significantly lower risk for retrograde ejaculation was reported in men undergoing TUIP than after TURP (27.6% vs. 51.8%, RR 0.54, $p < 0.001$).[1] The 80% retrograde ejaculation which has been previously reported after Ho-TUIP may be due to the lower number of evaluable patients (12/20) at 12 months. In addition, the number of patients who were able to comment on ejaculation was not mentioned, as described by the authors.[7]

This study is limited by its retrospective nature and the disparity in sample size between both groups. Lack of urodynamic studies might represent another limitation.[18] Nevertheless, the current cohort presented the long-term outcome available to date for patients undergoing Ho-TUIP and highlighted the impact of prostate size on the outcome of the procedure.

Conclusion

Ho-TUIP is a durable, safe and efficient procedure to treat BOO secondary to a small-sized prostate. Long-term outcome could be improved and the reoperation rate could be minimized with appropriate selection of cases, with prostate glands no larger than 30 cc.

Competing interests: The authors all declare no competing financial or personal interests.

This paper has been peer-reviewed.

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