Original Article - Lower Urinary Tract Dysfunction

Investig Clin Urol 2023;64:31-40.
https://doi.org/10.4111/icu.20220232
pISSN 2466-0493 • eISSN 2466-054X

INVESTIGATIVE AND CLINICAL UROLOGY
ICUROLOGY

Effect of urinary retention on the surgical outcome of holmium laser enucleation of the benign prostatic hyperplasia

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Purpose: To evaluate the effect of urinary retention (UR) on holmium laser enucleation of the prostate (HoLEP) in patients with benign prostatic hyperplasia (BPH) and lower urinary tract symptoms.

Materials and Methods: A retrospective analysis of a prospective cohort of patients who underwent HoLEP between January 2010 and December 2016 was performed. The perioperative factors, including the International Prostate Symptom Score, Overactive Bladder Symptom Score, prostate-specific antigen, urodynamic study results, uroflowmetry results, transrectal ultrasound prostate volume, operative time, morcellation time, enucleation weight, and complications, were evaluated. Postoperative evaluation was performed at 2, 3, and 6 months.

Results: Overall, 903 patients were identified. The mean age and follow-up were 68.3 years and 6 months, respectively. Among the patients, 135 (15.0%) patients had a history of acute UR (AUR), and 36 patients (4.0%) had chronic UR (CUR). The mean detrusor pressures at maximum flow were 64.4, 74.3, and 77.7 cmH_2O ($p<0.001$). The mean maximum flow rates (Qmax) were 7.6, 6.6, and 4.8 mL/s ($p<0.001$). Additionally, the mean bladder outlet obstruction indices were 49.5, 61.1, and 69.4 ($p<0.001$). The postoperative Qmax improved in all three groups. The mean postvoid residual volumes (PVRs) were 55, 75, and 333 mL preoperatively; 20, 29, and 66 mL at 2 weeks; 16, 23, and 45 mL at 3 months; and 15, 22, and 52 mL at 6 months ($p<0.001$).

Conclusions: Voiding symptoms, PVR, and Qmax of BPH patients with preoperative AUR and CUR significantly improved after HoLEP, similar to those without preoperative UR.

Keywords: Benign prostatic hyperplasia; Holmium laser; Prostate; Prostatectomy; Transurethral resection of prostate

INTRODUCTION

Benign prostatic hyperplasia (BPH), related lower urinary tract symptoms (LUTS), and urinary symptoms are the most common urinary problems that have a major effect on the quality of life of older men [1]. There are several treatment options for BPH, depending on the severity of the disease [1]. If the disease severity is low, watchful waiting or pharmacotherapy is recommended, and surgical treatment is recommended if the disease severity is high [1]. Bladder contraction and bladder outlet opening processes are combined during the process of urination [2]. BPH may cause bladder outlet obstruction, which affects outlet opening; thus, bladder outlet obstruction may cause urinary overdistention.

Received: 12 July, 2022 • **Revised:** 3 November, 2022 • **Accepted:** 13 November, 2022 • **Published online:** 15 December, 2022
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Moreover, bladder overdistention can reduce blood flow, causing bladder tissue ischemia and hypoxic damage [2]. Holmium laser enucleation of the prostate (HoLEP) is a technique that uses a laser to remove prostate tissue that blocks urine flow. Recently, the standard treatment of surgery has been shifted from transurethral resection of the prostate (TURP) to HoLEP, a surgical therapy for the treatment of BPH, and is recommended by the American Urological Association [3-5]. The efficacy and safety of HoLEP surgery have already been confirmed in several randomized trials [6-9], which showed similar or better results in resolving bladder outlet obstruction (BOO) compared to other BPH surgeries [6-9].

Previous studies have demonstrated that several patients have improved LUTS after BPH surgery; however, in patients with preoperative urinary retention (UR), the postoperative results are unsatisfactory [10,11]. However, there are limited studies and detailed analyses on this subject. Therefore, this study aimed to evaluate the effect of UR on HoLEP in patients with LUTS.

MATERIALS AND METHODS

This retrospective prospective cohort study was approved by the Institutional Review Board of Seoul National University Hospital (IRB no. 2111-181-1277). Informed consent was obtained from all patients for the prospective cohort study. The study protocol and contents followed the guidelines of the Declaration of Helsinki. A prospective cohort of patients with LUTS/BPH who underwent HoLEP between January 2010 and December 2016 was enrolled in this study. The inclusion criteria were patients of age >50 years, patients diagnosed with BPH based on clinical symptoms and related tests, and patients who underwent HoLEP surgery. Patients with genitourinary cancer, previous pelvic surgical history, or neurogenic bladder were excluded.

The baseline evaluation included careful history taking, underlying disease, and medication use, digital rectal examination, International Prostate Symptom Score (IPSS), Overactive Bladder Symptom Score (OABSS), 72-hour voiding diary, level of serum prostate antigen (PSA), cystourethroscopy, uroflowmetry, postvoid residual volume (PVR) measurement, urodynamic study (UDS), and the prostate volume measured by transrectal ultrasonography.

The timing of measurement of the preoperative PVR and IPSS in acute UR (AUR) patients is not the time of the AUR event but preoperatively. Therefore, most patients with AUR were converted to clean intermittent catheterization (CIC) from an indwelling Foley catheter; additionally, IPSS, OABSS, and UDS were performed whenever patients could void spontaneously. The surgery was planned after confirming the recovery of bladder contraction in UDS. The criterion for the recovery of bladder contraction is that the contractile force of the detrusor muscle is seen in the UDS performed when at least partial self-voiding is observed.

The UDS procedures were performed according to the guidelines of the International Continence Society (2002). The UDS procedure was as follows: 1) The free yaw flow was measured; 2) A filled bladder measurement was performed in the first designated position using physiological saline mixed with contrast medium at a filling rate of 50 mL/min at room temperature. Then, a sterile double-lumen 6-French catheter (Medtronic Inc., Skovlunde, Denmark) was inserted to measure the bladder pressure and inject fluids; 3) A rectal balloon catheter system (Medical Measurement System) was inserted into the rectum to measure the abdominal pressure, and a pressure flow study was performed; 4) After the second bladder filling measurement was performed in the second designated position, a pressure flow study was performed; and 5) Finally, the urethral pressure was measured [12].

The preoperative antibiotic used was second-generation cephalosporin. Under spinal or general anesthesia, HoLEP was performed with the patient placed in the lithotomy position. Enucleation was performed using three- or four-lobe techniques in an 80-W (2 J×40 Hz) setting of holmium:YAG laser with a 550-mm endfire laser fiber, followed by morcellation of adenomas using a morcellator. Continuous bladder irrigation was performed using normal saline. The intraoperative parameters included the total operative time, morcellation time, enucleation weight, energy use, and intraoperative complications. The intraoperative complications included bladder injury and perforation of the prostate capsule. Typically, the Foley catheter was removed on postoperative day 1. After removal of the Foley catheter, the PVR was measured, and the urination pattern was observed twice. Antibiotics were not administered on postoperative day 1. A postoperative evaluation was performed at 2, 3, and 6 months. Two weeks postoperatively, IPSS, OABSS, uroflowmetry, 72-h voiding diary, and urine analysis were performed. At 3 and 6 months postoperatively, IPSS, OABSS, uroflowmetry, 72-h voiding diary, urine analysis, and PSA levels were evaluated. The postoperative complications included urinary incontinence, urgency, re-continuous bladder irrigation, transfusion, transurethral coagulation, re-insertion of the urethral catheter due to retention, urethral stricture, and bladder neck contracture for 6 months.

In this study, the same study protocol was applied to all

https://doi.org/10.4111/icu.20220232

the surgical patients after 2009 in terms of the timing and follow-up evaluation for both baseline and 6 months postoperatively. In addition, we applied the same electronic medical record-based designated pre-orders to all the patients for the purpose of patient treatment optimization. Therefore, we performed a retrospective analysis of the clinical results of a prospective patient cohort using a prospectively designed study design that had been accumulated since 2009.

The patients were categorized into three groups: the non-UR, AUR, and chronic UR (CUR) groups; additionally, the clinical parameters were compared between these groups. AUR was defined as a sudden spontaneous onset of inability to pass urine and use of an indwelling Foley catheter or a clean intermittent catheter, and CUR was defined as a non-transient voiding difficulty with a PVR of more than 300 mL [13].

All the statistical tests were performed using IBM SPSS Statistics version 22.0 (IBM, Armonk, NY, USA). Mean values with standard deviations were used for the analysis of continuous variables. Categorical variables were analyzed using the ratio of events (%). Categorical variables were analyzed with the χ^2-test for the comparison of postoperative changes, and ANOVA was used for the analysis of continuous variables. The Kolmogorov–Smirnov test and quantile–quantile plot were performed for the normality test. A power test was conducted with a significance level of 0.05 and a power of 0.8. The sample size of this study was 252 [14,15]. The Bonferroni correction was used to adjust for multiple comparisons. All the statistical tests were two-sided, and the statistical significance was set at a p-value of ≤0.05.

RESULTS

The data prospectively collected from 903 patients who underwent HoLEP between January 2010 and December 2016 were retrospectively analyzed. Of these, 732 patients had no UR, 135 patients had preoperative AUR, and 36 patients had CUR. All the patients were followed up for up to 6 months postoperatively. The baseline patient characteristics are presented in Table 1. In the case of AUR, CIC was more frequent than indwelling Foley catheterization for treating UR. Of the 135 patients with AUR, 95 patients underwent CIC, 30 patients underwent indwelling Foley catheterization, and 10 patients underwent indwelling Foley catheterization and CIC. The mean duration of Foley indwelling catheterization was 5.1 days, and the mean CIC duration was 2.2 days. In the case of CUR, the ratio of CIC to indwelling Foley catheterization was comparable. Of the 36 patients with AUR, 12 underwent CIC, 9 underwent indwelling Foley catheterization, and 1 underwent indwelling Foley catheterization and CIC. There was no significant difference in age between the three groups. The mean indwelling Foley catheterization duration was 3.5 days, and the mean CIC duration was 13.2 days.

The perioperative outcomes are presented in Table 2. All the patients underwent preoperative prostate ultrasonography to measure the prostate size, and all patients underwent preoperative UDS. The UR group had a larger prostate size than that in the non-UR group. In the UDS, the detrusor pressure at the mean maximum urinary flow (Pdet Qmax) was significantly higher in the UR group. However, Qmax was lower in the UR group. In addition, the mean BOO index was significantly higher in the UR group. Detrusor overactivity and bladder compliance decrease were rare in all the groups. Underactive detrusor was higher in the AUR and CUR groups than in the non-UR group; however, the difference was not statistically significant.

The incidence of the most common postoperative complications was not significantly different among the three groups (Table 3). There was no significant difference in the incidence of short-term complications within 2 weeks postoperatively and long-term complications within 6 months after HoLEP. In the short-term postoperative period, one patient (0.7%) in the AUR group and one patient (0.1%) in the non-UR group presented with Clavien–Dindo grade 3 complications requiring intervention. Furthermore, in the long-term postoperative period, approximately 0.6% to 3.7% of the patients showed complications requiring intervention, and there was no difference between the groups. The urgency was significantly higher in the non-UR group than in the other groups; however, there was no difference between the groups at postoperative 6 months.

The mean preoperative Qmax was significantly lower in the AUR and CUR groups than that in the non-UR group. However, there was no significant difference between the groups during the follow-up period at 6 months postoperatively. The mean preoperative PVR was highest in the CUR group, followed by the AUR and non-UR groups, with significant differences. The postoperative PVR was still significantly higher in the CUR and AUR groups than in the non-UR group. The difference in urine volume was approximately 30–40 mL between the CUR and non-UR groups. The mean PVR was less than 60 in all groups (Fig. 1). The preoperative mean IPSS and OABSS were not significantly different among the three groups. Moreover, at 3 and 6 months postoperatively, the mean IPSS and OABSS were not significantly different (Fig. 2).

In comparison between the AUR and CUR groups, there

Table 1. Baseline patient characteristics

Variable	Non-UR (n=732)	AUR (n=135)	CUR (n=36)	p-value
Age (y)	68.6±7.7	70.6±6.9	68.4±8.3	0.139
Body mass index (kg/m^2)	24.1±3.0	23.6±3.0	24.8±2.7	0.780
Comorbidities				
Diabetes	131 (17.9)	19 (14.1)	12 (33.3)	0.028
Hypertension	311 (42.5)	54 (40.0)	16 (44.4)	0.832
Cardiovascular diseases	60 (8.2)	10 (7.4)	2 (5.6)	0.821
Chronic kidney disease	8 (1.1)	6 (4.4)	2 (5.6)	0.005*
Cerebrovascular accidents	14 (1.9)	2 (1.5)	2 (5.6)	0.280
Neurologic diseases	78 (10.7)	9 (6.7)	5 (13.9)	0.280
Duration of LUTS (mo)	54.3±54.6	47.3±61.4	42.6±43.5	0.083
Previous BPH operation	35 (4.8)	8 (5.9)	3 (8.3)	0.570
Medical treatment				
Alpha blockers	452 (61.7)	107 (79.3)	23 (63.9)	<0.001*
Anticholinergics	30 (4.1)	2 (1.5)	3 (8.3)	0.129
Five alpha reductase	162 (22.1)	44 (32.6)	13 (36.1)	0.008*
Desmopressin	17 (2.3)	2 (1.5)	2 (5.6)	0.354
Initial visit status				<0.001*
LUTS	732 (100.0)	100 (74.1)	27 (75.0)	
On CIC	0 (0.0)	4 (3.0)	6 (16.7)	
On indwelling urethral catheter	0 (0.0)	22 (16.3)	1 (2.8)	
Unable to void	0 (0.0)	9 (6.7)	2 (5.6)	
Treatment for UR				<0.001*
None	732 (100.0)	0 (0.0)	14 (38.9)	
CIC	0 (0.0)	95 (70.4)	12 (33.3)	
Urethral catheter	0 (0.0)	30 (22.2)	9 (25.0)	
CIC+urethral catheter	0 (0.0)	10 (7.4)	1 (2.8)	
Catheter duration of UR (d)	0.0±0.0	5.1±16.6	3.5±10.0	<0.001*
CIC duration of UR (d)	0.0±0.0	2.2±6.8	13.2±38.0	<0.001*

Data are presented as mean±standard deviation or number (%).
UR, urinary retention; AUR, acute urinary retention; CUR, chronic urinary retention; LUTS, low urinary tract symptoms; BPH, benign prostatic hyperplasia; CIC, clean intermittent catheterization.
*Statistically significant p≤0.05.

was no significant difference in the Qmax between the two groups. The PVR was significantly lower in the AUR group than in the CUR group 2 weeks after surgery; however, there was no significant difference at 3 months and 6 months after surgery (Supplementary Fig. 1) before the surgery. There was no significant difference in the mean IPSS and OABSS scores at 3 and 6 months after surgery (Supplementary Fig. 2).

A detailed analysis was performed by dividing patients with UR into those with repeated UR once and those with repeated UR twice or more. There were no significant differences in the Qmax and PVR between the two groups at 2 weeks, 3 months, and 6 months after surgery (Fig. 3). Also, there was no significant difference in the mean IPSS and OABSS scores at 3 and 6 months after surgery (Fig. 4).

DISCUSSION

Chronic BOO reduces the bladder blood flow, and this decrease in blood flow can impair bladder function [16]. Bladder overdistention also induces ischemic injury by reducing bladder perfusion [17]. Additionally, reperfusion damage may also occur during reperfusion after decompression of the overdistended bladder [17].

In a retrospective study of 1,242 AUR patients, 9.2% of the patients who had preoperative UR still had UR after an open prostatectomy [18]. Moreover, the greater the risk of prostate enlargement, the greater the risk of postoperative voiding symptoms [18]. In a prospective study of 388 patients with TURP, preoperative CUR patients were more likely to have a worse general health status. Additionally, preoperative AUR patients may have morbidity, such as heart prob-

https://doi.org/10.4111/icu.20220232

Table 2. Perioperative outcomes of non-UR, AUR and CUR groups

Variable	Non-UR (n=732)	AUR (n=135)	CUR (n=36)	p-value
Preoperative parameters				
Prostate volume (mL)	66.1±31.5	89.9±44.8	85.3±38.1	<0.001*
Underactive detrusor	28 (3.8)	11 (8.1)	2 (5.6)	0.082
Pdet Qmax (cmH_2O)	64.4±25.4	74.3±31.0	77.7±42.0	<0.001*
Qmax (mL/s)	7.6±4.9	6.6±6.8	4.8±3.8	<0.001*
Bladder Contractility Index	102.0±28.5	107.5±46.7	103.8±43.6	0.157
BOOI	49.5±28.0	61.1±33.4	69.4±43.0	<0.001*
BOOI >40	432 (59.0)	96 (71.1)	25 (69.4)	0.018*
Intraoperative parameters				
Morcellation time (min)	9.7±9.0	12.9±9.5	12.1±10.2	0.001*
Total operation time (min)	54.0±27.9	68.5±32.9	68.7±31.7	<0.001*
Enucleation weight (g)	20.7±17.0	35.0±25.6	34.1±25.3	<0.001*
Energy used (kJ)	139.5±759.4	96.9±75.8	83.1±45.6	0.446
Intraoperative bladder injury	6 (0.8)	1 (0.7)	1 (2.8)	0.464
Intraoperative bleeding event	32 (4.4)	4 (3.0)	2 (5.6)	0.822
Interoperative capsule perforation	5 (0.7)	1 (0.7)	0 (0.0)	0.880
Immediate postoperative parameters				
Postoperative urethral catheter duration (d)	1.6±2.0	1.9±2.9	1.7±2.4	0.241
Additional continuous bladder irrigation	18 (2.5)	16 (11.9)	1 (2.8)	<0.001*
Duration of additional CBI (d)				<0.001*
1	16 (2.2)	13 (9.6)	1 (2.8)	
2	1 (0.1)	1 (0.7)	0 (0.0)	
≥3	1 (0.1)	2 (1.5)	0 (0.0)	
Hospitalization (d)				<0.001*
1	646 (88.3)	91 (67.4)	34 (94.4)	
2	77 (10.5)	37 (27.4)	2 (5.6)	
≥3	9 (1.2)	7 (5.2)	0 (0.0)	
Immediate postoperative medical treatment				<0.001*
Anticholinergics	10 (1.4)	9 (6.7)	3 (8.3)	
Cholinergics	0 (0.0)	0 (0.0)	1 (2.8)	
Imipramine	0 (0.0)	1 (0.7)	0 (0.0)	

Data are presented as mean±standard deviation or number (%).
UR, urinary retention; AUR, acute urinary retention; CUR, chronic urinary retention; Pdet Qmax, the detrusor pressure at the mean maximum urinary flow; BOOI, Bladder Outlet Obstruction Index; CBI, continuous bladder irrigation.
*Statistically significant p≤0.05.

lems or infection, and the postoperative urinary symptoms were more severe [19]. In another retrospective study of 3,885 TURP patients, the preoperative AUR was reported to be one of the factors that increased postoperative morbidity. Moreover, 11% of patients who had preoperative UR still had UR after TURP. Furthermore, the prevalence of infection after TURP in patients with preoperative AUR was approximately three times higher than that in patients without UR [20]. However, a prospective study comparing the effects of CIC and TURP in 41 patients with CUR reported that TURP is effective in the treatment of CUR patients [21]. IPSS significantly increased, and the voiding pressure significantly decreased in UDS at postoperative 6 months [21].

In a retrospective study of 164 HoLEP patients, only one patient with preoperative UR required postoperative retreatment; however, no complications were reported [10]. A recent retrospective study of 95 patients with UR reported that the risk of UR after HoLEP did not increase, even if preoperative UR was present. Additionally, patients with preoperative UR showed improved urination-related indicators after HoLEP [22].

However, most previous studies have differed from ours. The surgical techniques used in previous studies were conventional TURP and open prostatectomy, but not HoLEP. In most large or prospective studies, open prostatectomy or TURP was the most common surgical method, not HoLEP,

Table 3. Postoperative complications of non-UR, AUR and CUR groups

Variable	Non-UR (n=732)	AUR (n=135)	CUR (n=36)	p-value
Postoperative 2 wk				
Urinary incontinence	127 (17.3)	19 (14.1)	5 (13.9)	0.570
Urgency	154 (21.0)	19 (14.1)	2 (5.6)	0.016*
Transfusion	0 (0.0)	2 (1.5)	0 (0.0)	0.003*
Recatheterization	39 (5.3)	11 (8.1)	2 (5.6)	0.438
Continuous bladder irrigation	9 (1.2)	3 (2.2)	0 (0.0)	0.506
Bleeding need for TUC	1 (0.1)	1 (0.7)	0 (0.0)	0.374
Postoperative 3 mo				
Stress urinary incontinence	44 (6.0)	5 (3.7)	2 (5.6)	0.566
Urgency urinary incontinence	59 (8.1)	7 (5.2)	3 (8.3)	0.507
Urgency	139 (19.0)	37 (27.4)	4 (11.1)	0.032*
Urethral stricture	4 (0.5)	1 (0.7)	0 (0.0)	0.866
Bladder neck contracture	1 (0.1)	0 (0.0)	0 (0.0)	0.625
Postoperative 6 mo				
Stress urinary incontinence	13 (1.8)	3 (2.2)	0 (0.0)	0.668
Urgency urinary incontinence	11 (1.5)	2 (1.5)	0 (0.0)	0.311
Urgency	22 (3.0)	4 (3.0)	0 (0.0)	0.573
Urethral stricture	4 (0.5)	3 (2.2)	1 (2.8)	0.564
Bladder neck contracture	1 (0.1)	2 (1.5)	0 (0.0)	0.760

Data are presented as number (%).
UR, urinary retention; AUR, acute urinary retention; CUR, chronic urinary retention; TUC, transurethral coagulation.
*Statistically significant p≤0.05.

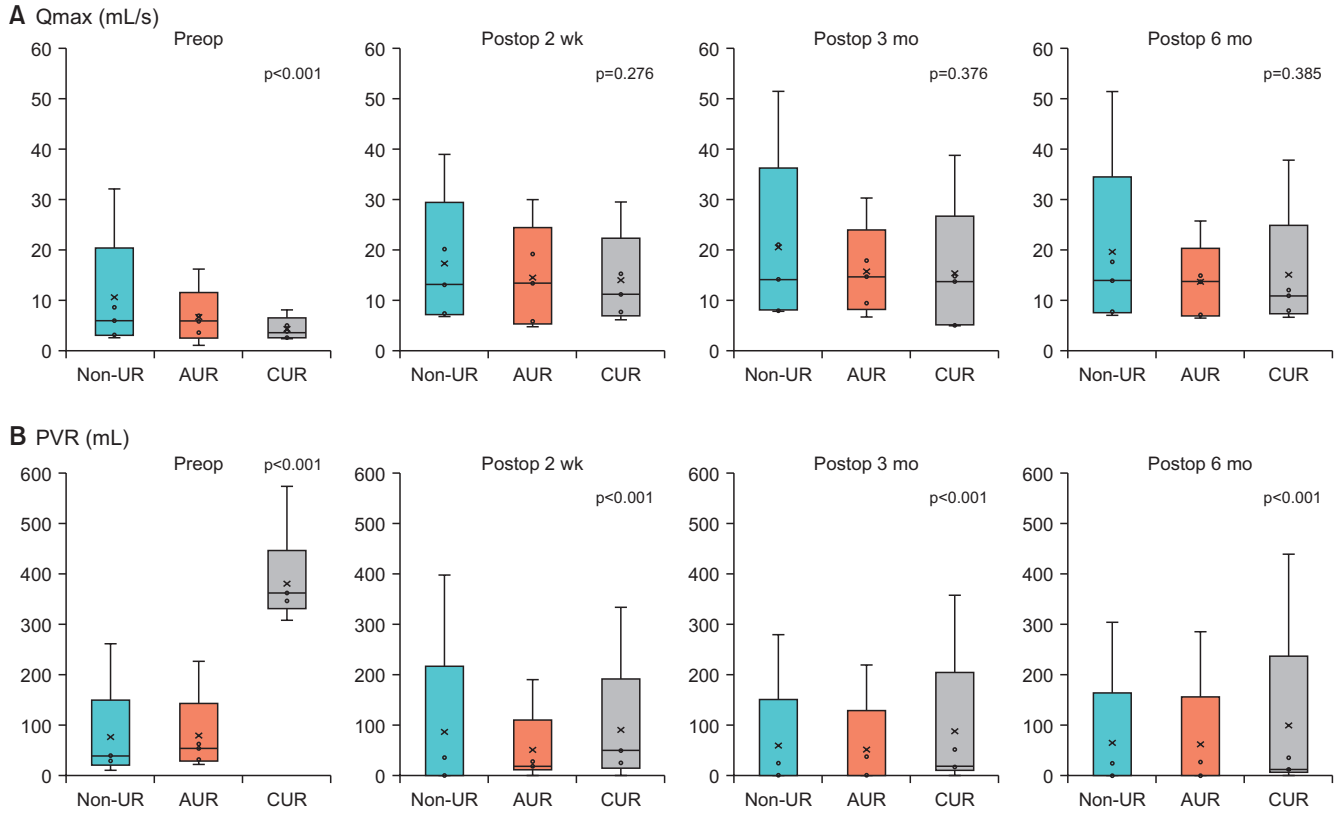

Fig. 1. Voiding parameters of the non-urinary retention (UR), acute UR (AUR), and chronic UR (CUR) groups. Qmax, the mean maximum urinary flow; PVR, postvoid residual volume; preop, preoperative; postop, postoprerative.

https://doi.org/10.4111/icu.20220232

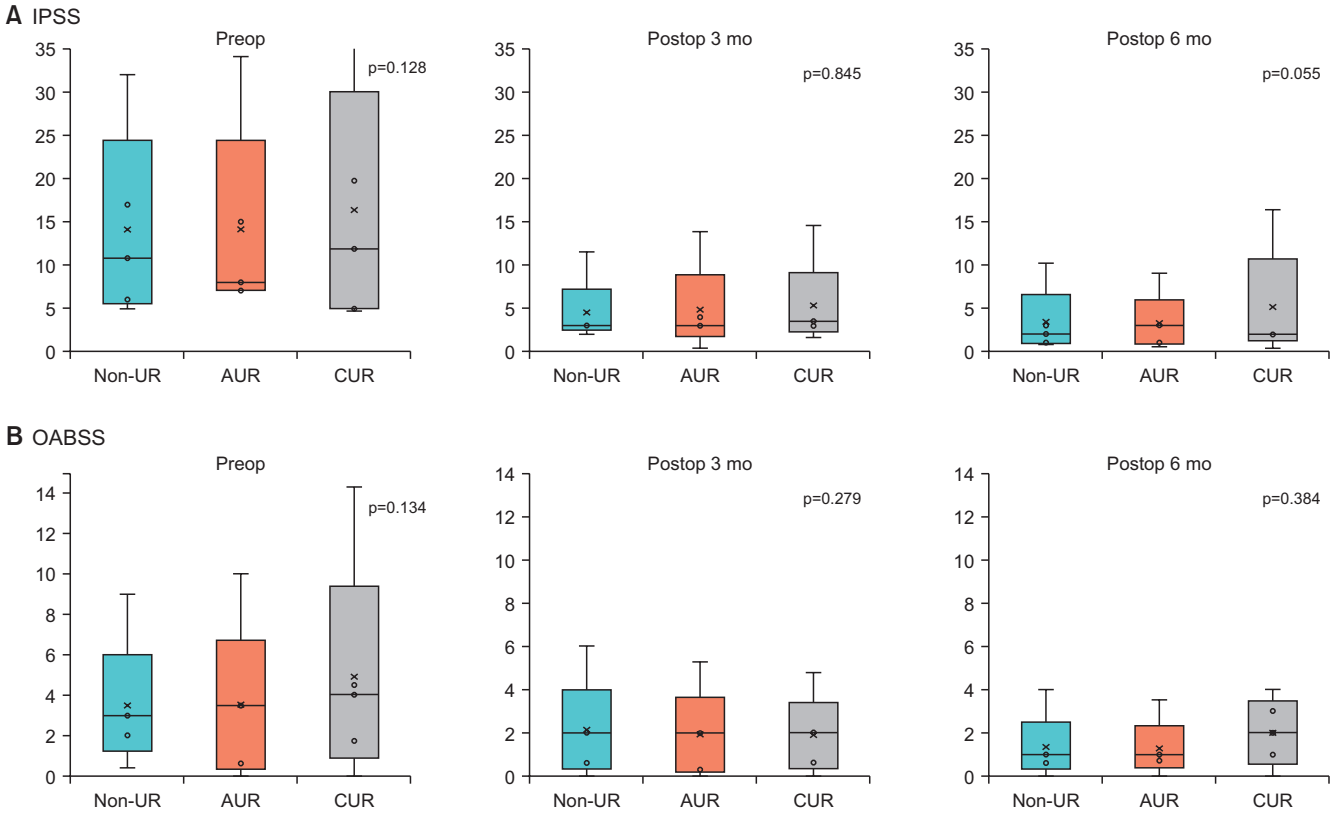

Fig. 2. Symptoms scores of the non-urinary retention (UR), acute UR (AUR), and chronic UR (CUR) groups. IPSS, International Prostate Symptom Score; OABSS, Overactive Bladder Symptom Score; preop, preoperative; postop, postoprerative.

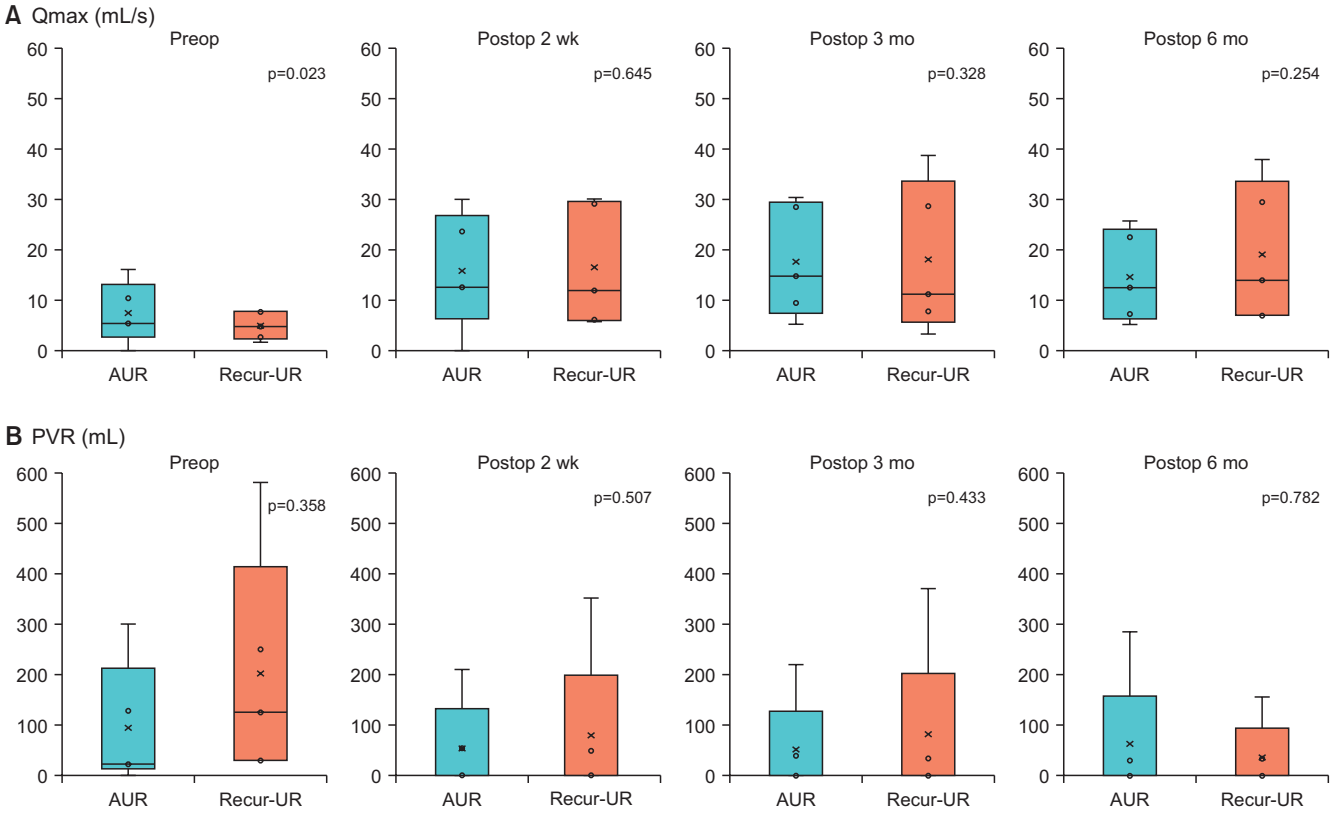

Fig. 3. Voiding parameters of the acute urinary retention (AUR) and recur-UR groups. Qmax, the mean maximum urinary flow; PVR, postvoid residual volume; preop, preoperative; postop, postoprerative.

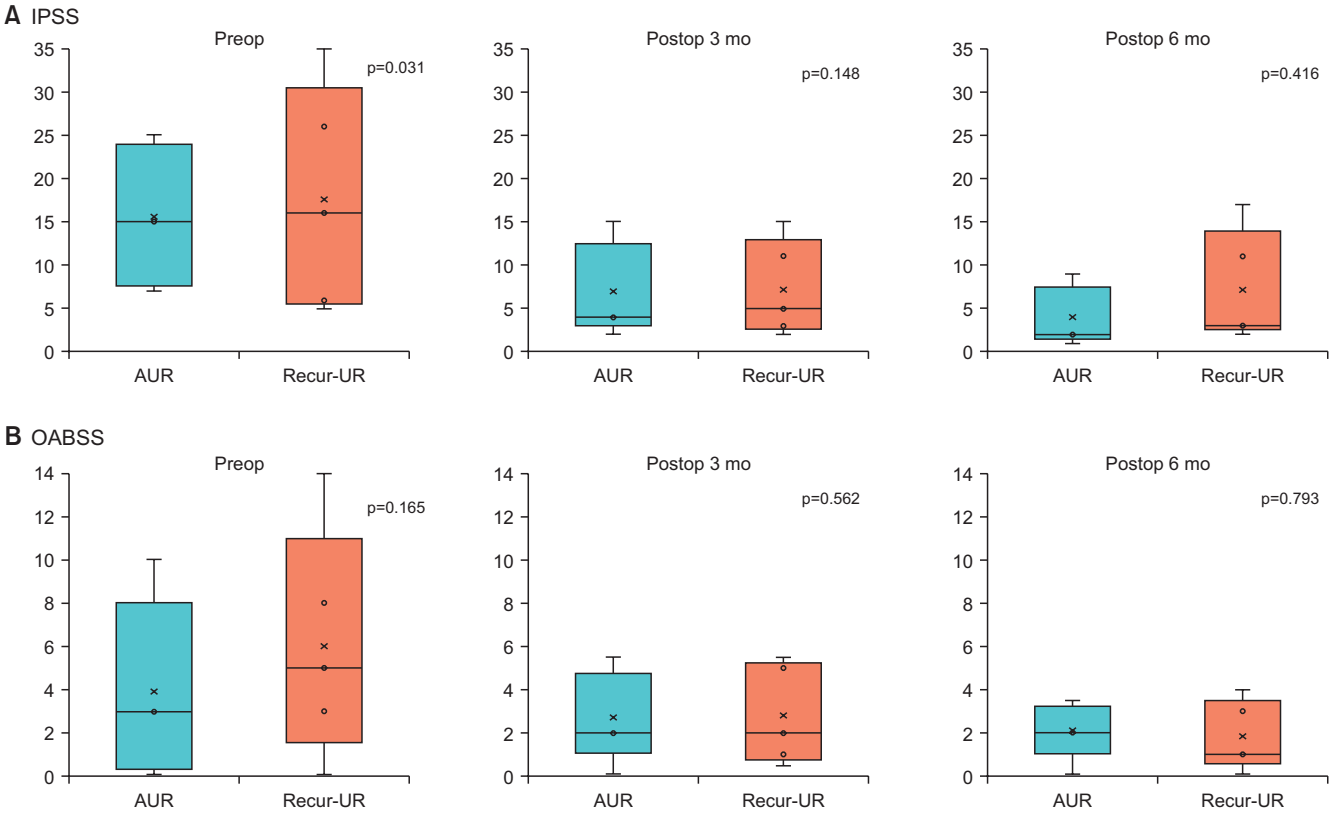

Fig. 4. Symptom scores of the acute urinary retention (AUR) and recur-UR groups. IPSS, International Prostate Symptom Score; OABSS, Overactive Bladder Symptom Score; preop, preoperative; postop, postoprerative.

and most of the studies on HoLEP and UR were retrospective studies. Our study is the only large prospective cohort study on this topic, and our results demonstrate that HoLEP is an effective and safe surgical treatment for BPH patients with preoperative AUR or CUR.

A subanalysis was performed by dividing the patients into preoperative AUR and CUR groups. The patients with AUR and CUR had a larger prostate and more severe BOO than those without non-UR patients, which may have resulted in longer operation and morcellation times in patients with UR. Nevertheless, our results showed no significant differences in postoperative voiding symptoms or complications between the non-UR and UR groups. Further, no significant difference was observed in the incidence of intraoperative complications. The Qmax was significantly lower before HoLEP; however, there was no difference after HoLEP. Only a few PVRs remained in the patients with AUR and CUR preoperatively. At postoperative 6 months, the PVR was approximately 1.5 times higher in the AUR group and approximately three times higher in the CUR group than in the UR group. However, the maximum difference in the PVR volume was approximately 30 mL, assuming clinical care. Although the postoperative PVR in patients with AUR and CUR remains small compared to patients without preoperative UR, clinically, it does not become a problem at all.

Furthermore, the AUR and CUR groups showed a higher BOO index and Pdet Qmax than the non-UR group. However, despite the high Pdet Qmax, the Qmax was lower. The BOO index was higher in patients with AUR or CUR than in non-UR patients due to the relatively large prostate and retention. Patients with AUR and CUR before HoLEP had an average of approximately 30% to 35% larger than that of non-UR patients in our study. BPH is associated with the irregular proliferation of the prostate glandular epithelium, smooth muscles, and connective tissue [23]. BPH compresses the prostatic urethra, resulting in BOO that interferes with urine flow through the urethra [24]. BOO is caused by static components, such as BPH, and dynamic components, such as stromal smooth muscle tone. These stromal smooth muscle tones are associated with UR [25]. In UDS, when BOO is present, outlet obstruction causes the pressure of the detrusor to increase when the urine exits the bladder. However, the urine flow is weak compared to the detrusor pressure [26]. In our study, because of increased BOO, the AUR and CUR groups had higher detrusor muscle pressures during urination than the non-UR group. However, the urine flow was not improved.

https://doi.org/10.4111/icu.20220232

Our study had a few limitations. Patients who were lost to follow-up were excluded from the analysis. The follow-up loss rate was 10.1%, 11.1%, and 13.9% in the non-UR, AUR, and CUR groups, respectively. Since most patients are followed up for up to 6 months according to our protocol, there are limited long-term follow-up results, such as regrowth of the prostate gland, recurrent retention after 6 months, long-term voiding parameters, and complications. Patients who were not followed up could have acted as a selection bias. However, according to the personal experiences of the authors, almost all the patients who were not followed up after surgery had favorable postoperative outcomes. As BPH is a benign disease in nature, there is a very high tendency for patients who have relatively mild symptoms and minimal subjective discomfort to not return to the clinic after surgery. Patients almost always return to the clinic when they present with bothersome symptoms. Therefore, patients lost to follow-up are presumed to be a group of patients with selection bias toward those with minimal symptoms.

As described, the preoperative and postoperative follow-up in this study was performed by applying the same prospectively designed protocol to all patients. Some patients who had significant events during the postoperative follow-up followed the above protocol and were followed up during the postoperative interim period. Follow-up in all patients after surgery was expected to be terminated 6 months after surgery. However, in the few patients who showed abnormal findings at 6 months postoperatively, the follow-up was extended by individualization. A disadvantage of a typical prospective patient registry study is that patients who do not agree to preoperative enrollment will be excluded from the analysis. Alternately, this study has the advantage that the possibility of selection bias is minimized because data from almost all relevant patients were included.

CONCLUSIONS

In conclusion, the baseline history of AUR and CUR did not adversely affect the postoperative outcomes of HoLEP, nor did these conditions increase the incidence of postoperative complications. The voiding symptoms, PVR, and Qmax of BPH patients with preoperative AUR and CUR were observed to significantly improve after HoLEP, similar to those without preoperative UR. Further research is required in this regard.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

FUNDING

None.

AUTHORS' CONTRIBUTIONS

Research conception and design: Seung-June Oh. Data acquisition: all authors. Statistical analysis: Hyeong Dong Yuk. Data analysis and interpretation: all authors. Drafting of the manuscript: all authors. Critical revision of the manuscript: all authors. Administrative, technical, or material support: all authors. Supervision: Seung-June Oh. Approval of the final manuscript: all authors.

SUPPLEMENTARY MATERIALS

Supplementary materials can be found via https://doi.org/10.4111/icu.20220232.

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https://doi.org/10.4111/icu.20220232