



# Risk Factors for Transient Urinary Incontinence after Holmium Laser Enucleation of the Prostate

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**Purpose:** To investigate the factors associated with the occurrence of and recovery from transient urinary incontinence (TUI) after holmium laser enucleation of the prostate (HoLEP).

**Materials and Methods:** From March 2009 to December 2012, 391 consecutive patients treated with HoLEP for benign prostatic hyperplasia were enrolled. Information regarding age, prostate volume, International Prostate Symptom Score, Overactive Bladder Symptom Score, peak urinary flow rate, postvoid residual urine, and operation time was collected. TUI was defined as a patient complaint of urine leakage, regardless of type. Logistic regression was used to investigate the factors associated with the occurrence of TUI, and the Kaplan-Meier test was used to analyze the TUI recovery period.

**Results:** TUI after HoLEP occurred in 65 patients (16.6%), 52 patients of whom (80.0%) showed recovery within three months. Stress and urge urinary incontinence and postvoid dribbling occurred in 16 patients (4.1%), 29 patients (7.4%), and 33 patients (8.4%), respectively. Age (odds ratio [OR] = 3.494; 95% confidence interval [CI] = 1.565 ~ 7.803;  $p=0.002$ ) and total operation time (OR = 3.849; 95% CI = 1.613 ~ 9.185;  $p=0.002$ ) were factors that significantly affected the occurrence of TUI.

**Conclusions:** TUI, defined as any type of urine leakage, occurred after HoLEP in some patients, most of whom recovered within three months. Stress urinary incontinence occurred in only 4% of patients after HoLEP. Age and total operation time were associated with the occurrence of postoperative TUI.

**Key Words:** Lasers; Prostatic hyperplasia; Urinary incontinence

## INTRODUCTION

Holmium laser enucleation of the prostate (HoLEP), which was introduced to clinical practice by Gilling et al [1] in 1998, has been proven to be a safe, efficient, and pros-

tate-size-independent procedure for treating benign prostatic hyperplasia (BPH) with a low complication rate [2-5]. The postoperative outcomes of HoLEP, such as urinary stream and patient satisfaction, are comparable to those of transurethral resection of the prostate, which has been a

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standard therapeutic option for BPH [6-8]. Moreover, studies have proved that HoLEP provides not only a significant reduction in perioperative morbidity, reoperation rate, catheter time, and hospital stay compared with transurethral resection of the prostate, but also equal suitability for small and large prostate glands, even up to a size exceeding 100 g, with clinical outcomes comparable to those of open prostatectomy [2,6,9-12]. Thus, based on all these benefits, HoLEP has become an excellent therapeutic option for BPH surgery and has gained increasing popularity [3].

However, postoperative transient urinary incontinence (TUI) has been observed as a bothersome complication of HoLEP in a small number of patients, occurring in a range of 1.3% to 10.7% of reported cases [4,13-15]. Although most cases with TUI recover spontaneously within three months, it remains one of the most troublesome complications of this procedure, as it decreases the patients' quality of life [16]. This has led to a loss of interest in adopting HoLEP, both by surgeons and patients, despite the many advantages that have been demonstrated [2,7,14].

Although many urologists agree with the seriousness of TUI after HoLEP, only a few studies have attempted to identify the factors that affect its occurrence. Therefore, we tried to identify factors that predict TUI after HoLEP, and investigated the association between the duration of TUI and the factors that affected its recovery period concomitantly.

## MATERIALS AND METHODS

After Pusan National University Yangsan Hospital Institutional Review Board approval, a retrospective review of 391 consecutive patients treated with HoLEP for BPH was performed. All patients were treated by a single surgeon from March 2009 to December 2012 and were followed-up for at least three months. Preoperative evaluation included the collection of the patient's age, International Prostate Symptom Score, and Overactive Bladder Symptom Score. Additional objective parameters, such as prostate volume, maximal flow rate, and postvoid residual urine volume, were also measured. Prostatic biopsy preceded HoLEP if serum prostate-specific antigen level and/or digital rectal examination yielded suspicious results. Urinary incontinence was defined according to the

guidelines of the International Continence Society as involuntary loss of urine that represents a hygienic or social problem to the individual, as well as by the answer to the question "Do you have involuntary loss of urine?" [17]. The occurrence of TUI was evaluated at two weeks postoperatively. In the patients with TUI, recovery of continence was evaluated every month thereafter. The operation time was calculated based only on the time of endoscope use, including enucleation and morcellation time.

An endoscope modified for HoLEP with a 26 Fr Storz continuous irrigation system was used, through which a laser bridge adapter and a SlimLine™ 550 m end-firing laser fiber (Lumenis Inc., Yokneam, Israel) were inserted. The VersaPulse® PowerSuite™ Holmium laser (Lumenis Inc.) was used with settings of 2.0 J and 40 Hz. A nephroscope and a VersaCut® morcellator (Lumenis Inc.) were used for subsequent morcellation. We used an inverse (downward) technique to prevent injury of the bladder mucosa. A three-way 18 Fr urethral catheter was inserted after the surgery, and was generally removed two days later.

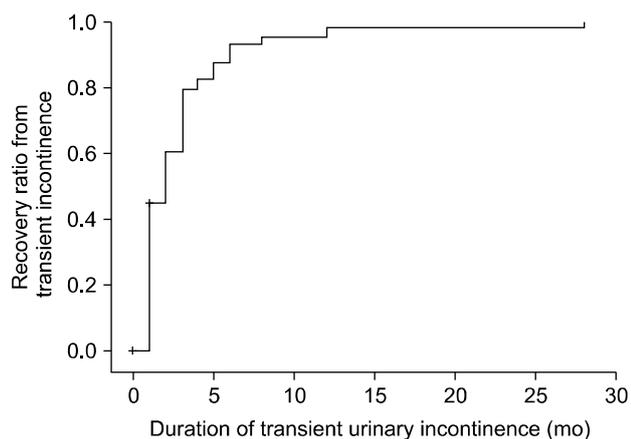
Differences in variables between the groups of patients with and without postoperative TUI were compared and analyzed using Student's t-test. A logistic regression test was used to investigate the factors associated with the occurrence of postoperative TUI, and the Kaplan-Meier test was used to analyze the postoperative TUI recovery period. Factors that affected the postoperative TUI recovery period were investigated using the Cox regression test. p values less than 0.05 were considered significant. All statistical analyses were computed using PASW Statistics ver. 18 (IBM Co., Armonk, NY, USA).

## RESULTS

Postoperative TUI occurred during the second postoperative week in 65 patients (16.6%) of the 391 BPH patients who underwent HoLEP, 52 patients of whom (80.0%) showed recovery within three months from the date of the surgery (Fig. 1). Only one patient (0.3%) complained of TUI extending until one year after surgery. Stress and urge urinary incontinence, and postvoid dribbling occurred in 16 patients (4.1%), 29 patients (7.4%), and 33 patients (8.4%), respectively. Table 1 lists the preoperative and intraoperative parameters of all patients, as

well as a comparison of these parameters between the two groups of patients (with and without postoperative TUI). Age, International Prostate Symptom Score, postvoid residual urine volume, and total operation time were significantly different between the two groups.

Among the variables analyzed, age (odds ratio [OR]=3.494; 95% confidence interval [CI]=1.565~7.803;



**Fig. 1.** Recovery ratio of transient urinary incontinence depending on its duration. Eighty percent of the patients who complained transient urinary incontinence after holmium laser enucleation of the prostate showed recovery within 3 months from the date of the surgery (n=65).

p=0.002) and total operation time (OR=3.849; 95% CI=1.613~9.185; p=0.002) were factors that had a significant impact on the occurrence of postoperative TUI (Table 2). These results showed that age above 65 years and a total operation time longer than 65 minutes tended to be associated with the occurrence of postoperative TUI.

Few other peri- and postoperative complications, other than TUI, were observed. Urethral stricture needing surgical intervention, bladder neck contracture, regrowing adenoma, bladder mucosal injury during morcellation, and acute urinary retention managed with recatheterization occurred in three patients (0.8%), two patients (0.5%), one patients (0.3%), one patients (0.3%), and nine patients (2.3%), respectively. Five patients (1.3%) were diagnosed as having prostate adenocarcinoma based on the final pathological report.

## DISCUSSION

TUI is one of the most bothersome postoperative complications of HoLEP, both for patients and clinicians [2,7,14]. Involuntary loss of urine with a hygienic or social problem decreases the quality of life of patients significantly, and the complaints of the symptoms of incon-

**Table 1.** Baseline characteristics and perioperative data

Variable	Patients without TUI (n=326)	Patients with TUI (n=65)	p value
Baseline characteristic			
Age (yr)	65.3±7.2	68.8±6.5	<0.001
Diabetes	65	14	0.764
Prostate volume (mL)	54.1±25.2	50.7±20.1	0.307
International Prostate Symptom Score			
Voiding symptoms	10.4±5.4	12.9±5.0	0.007
Storage symptoms	6.8±3.8	8.1±3.6	0.051
Total score	17.2±8.4	21.0±7.6	0.009
Quality of life score	3.9±1.3	4.5±1.4	0.019
Overactive Bladder Symptom Score	5.6±3.3	7.1±3.3	0.074
Max flow rate (mL/s)	12.9±14.5	10.2±5.2	0.211
Postvoid residual urine (mL)	60.1±67.9	95.7±148.5	0.013
Serum PSA (ng/mL)	5.3±10.6	4.5±5.3	0.545
Perioperative data			
Total operation time (min)	59.1±36.0	81.7±50.9	<0.001
Morcellation time (min)	14.9±16.2	19.7±21.5	0.040
Resected volume (mL)	23.1±20.0	25.6±18.4	0.352

Values are presented as mean±standard deviation or number only. TUI: transient urinary incontinence, PSA: prostate-specific antigen.

**Table 2.** Univariate and multivariate predictors of postoperative transient incontinence

Variable	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value
Age (<65 vs. ≥65), yr	2.85 (1.55~5.21)	0.001	3.49 (1.57~7.80)	0.002
Prostate volume (<50 vs. ≥50), g	0.98 (0.53~1.80)	0.940	0.89 (0.49~1.25)	0.489
International Prostate Symptom Score (<17 vs. ≥17)	1.98 (1.00~3.98)	0.047	1.61 (0.74~3.46)	0.228
Overactive Bladder Symptom Score (<5 vs. ≥5)	1.73 (0.57~5.25)	0.330	–	–
Max flow rate (<13 vs. ≥13), mL/s	0.64 (0.31~1.34)	0.644	–	–
Postvoid residual urine (<70 vs. ≥70), mL	1.45 (0.71~2.94)	0.299	–	–
Total operation time (<65 vs. ≥65), min	2.17 (1.26~3.72)	0.005	3.85 (1.61~9.19)	0.002

CI: confidence interval.

tinence can be very stressful to clinicians.

In several studies, TUI after HoLEP was shown to occur in up to 20% of patients, most of whom recovered within one year [2,7,14,16]. Shah et al [4] reported postoperative TUI in 10.7% of their sample; all but two of the patients showed improvement after a mean duration of 42.3 days (range, 1~110 days). In the present study, postoperative TUI occurred in 16.6% of all patients, 80.0% of whom showed recovery within three months. As shown above, the occurrence of postoperative TUI varied widely across studies. The main cause of these differences may have been the variation in the definition of postoperative TUI in each study. We defined any involuntary urine leak as TUI, including stress or urge urinary incontinence and postvoid dribbling. However, many other authors defined TUI exclusively as a complaint of stress urinary incontinence. Because postvoid dribbling can also disturb the lives of patients, our definition of TUI (including any kind of urine leak) seems to be more appropriate.

In the present study, the main predicting factors of the occurrence of TUI after HoLEP were the age of the patient and the total operation time. Older age and a longer operation time seemed to cause postoperative TUI more often, as well as delays in the recovery from this complication. We suggest that these factors are associated with urethral sphincter damage because of its compression, stretching, and tearing by the resectoscope during the operation. Older patients may have more fragile and sparse sphincteric tissue compared with younger ones; this may lead to increased susceptibility to damage caused by forcing the tissue.

Longer operation time implies a longer time during which the resectoscope is moving in the urethra; thus, the

sphincter is exposed for a longer period to a force that may cause damage, leading to an increased chance of sphincter damage. Lerner et al [18] reported that even though operation time was not significantly related to postoperative TUI in their study, this factor was the most likely to affect TUI after HoLEP, because the analysis of total operation time in their study was fraught with confounding issues. Those authors were not able to determine how much time was actually spent in the operation, because much of the operation time involved equipment set-up, equipment delays, teaching and demonstrating, etc. Therefore, no valuable information was collected from that dataset. Recently, Elmansy et al [15] reported that the presence of diabetes mellitus, large prostate volume (greater than 81 g), and a greater reduction in postoperative prostate-specific antigen (greater than 84% remained) were statistically significant predictive factors of the development of stress urinary incontinence ( $p < 0.001$ ,  $p = 0.02$ , and  $p = 0.006$ , respectively). Their explanations for the two predictive factors of postoperative TUI, diabetes mellitus and prostate volume, were as follows. First, diabetes mellitus is a chronic disease that can affect the bladder, urethral sphincter, or the nerves involved in micturition functions in a variety of ways; consequently, diabetes mellitus may compromise the nerve supply of the external sphincter. Second, a large prostate size is associated with longer operation time and longer time of manipulation of the sheath located across the external sphincter, which may lead to greater sphincter damage. There are many confounding factors for the relationship between larger prostate size and longer operation time. Although larger prostate size tends to cause longer operation time, large prostates with well-encapsu-

lated adenoma do not require a longer operation time. Therefore, the present data suggest that mean longer operation times should not presuppose a larger prostate size, and that only longer operation time will cause TUI after HoLEP. The investigation of the association between diabetes mellitus and TUI will be the subject of our future studies.

Similarly, many authors have proposed that external sphincter damage caused by the resection of adenoma tissue close to the external sphincter may damage the continence mechanisms temporarily [14,19,20]. Endo et al [19] reported that the anteroposterior dissection technique, which dissects from the bladder neck to the apex, does not stretch this inner layer of the external sphincter. Those authors reported a reduction in postoperative TUI occurrence when using this technique compared with conventional retrograde dissection (2.7% vs. 25.2%). However, it has been debated whether anteroposterior dissection is suitable for large prostates [15,19]. We focused on techniques aimed at reducing postoperative TUI by shortening the operation time, which would consequently lessen the exposure to forces that cause urethral sphincter damage, rather than on anatomic methods, such as anteroposterior dissection. Unlike the conventional 'three-lobe technique,' which enucleates the median and both lateral lobes in each piece, we performed a 'two-lobe technique,' which enucleates via two steps; the left lateral lobe primarily, followed by the median, which is incorporated into the right lateral lobe as a piece [21,22]. This two-lobe technique reduced our operation time considerably; however, the precise data on this were not investigated.

Regarding TUI, sphincteric dysfunction does not represent the whole problem; in addition, several mechanisms are proposed. Various studies have suggested that early postoperative incontinence is usually a symptomatic urge caused by the healing of the fossa or is associated with urinary tract infection, detrusor instability caused by long-lasting benign prostatic hyperplasia, or thermal injury of the prostatic capsule by holmium laser exposure [4,7,23]. Radical removal of adenoma can be one of the causes of TUI after HoLEP, because a large prostatic fossa leads to urine trapping and leakage with stress maneuvers in the short term [24]. The type of postoperative incontinence may vary individually, and urodynamic studies would be helpful in determining the types of postoperative inconti-

nence. However, the invasive nature of this technique, with a risk of side effects, may render it controversial, especially if most cases of postoperative incontinence last only for a transient period.

The learning curve must affect the incidence of TUI after HoLEP because of longer operation time, inappropriate enucleation, and frequent complications in the early phase [13,18]. One study has reported a significant decrease in the incidence of TUI in patients in their late 50s (6%) compared with patients in their early 50s (28%) [25]. These results showed that an improvement in the learning curve had the direct effect of decreasing complications. Operation time will also be reduced as the learning curve improves. Moreover, the operation will be performed with less resectoscope movement and smaller force during manipulation as the learning curve improves, which ultimately reduces urethral sphincter damage and prevents postoperative TUI.

During the management of TUI after HoLEP, pelvic-floor muscle exercise might quicken the improvement of postoperative TUI, particularly during the immediate early postoperative period [4,26]. As the internal urethral sphincter is damaged after HoLEP, continence relies on a competent external urethral sphincter, which is reinforced by pelvic-floor musculature [26]. Medications such as anticholinergic or anti-inflammatory agents would be effective in the management of postoperative urge incontinence [4,8,23]. We have also used anticholinergic agents, anti-inflammatory agents, and antibiotic treatments and recommend pelvic-floor muscle exercises for patients complaining from dysuria, urgency, frequency, and TUI after HoLEP. However, detailed investigations regarding the management of these patients were not performed in the present study. Further studies of the association between the duration of postoperative TUI recovery and the management of these patients are required.

There are several limitations to our study. In our study, data collection was done retrospectively. In addition, there were no objective measurements, such as a pad test or voiding diary. Moreover, there was no urodynamic study to exclude cases with detrusor overactivity or sphincter disorders. The regression analysis lacks important variables which could predict stress urinary incontinence, such as presence of diabetes, and prostate specifi-

ic antigen levels, as previously reported [15].

## CONCLUSIONS

TUI, defined as any type of urine leakage, occurred after HoLEP in some patients (16.6%). However, most of these recovered within three months. Stress urinary incontinence occurred in only 4% patients after HoLEP. The age of the patients and endoscopic operation time were associated with the occurrence of postoperative TUI. We suggest that a decrease in the occurrence of postoperative TUI is possible by considering age in preoperative candidate selection, and also by reducing the operation time based on the development of operative skills and know-how.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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