ORIGINAL RESEARCH

Predictors of postoperative urinary tract infection following holmium laser enucleation of the prostate

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ABSTRACT

INTRODUCTION: Storage urinary symptoms and urinary tract infection (UTI) are among the most common complications following holmium laser enucleation of the prostate (HoLEP). We aimed to study the incidence and risk factors for storage urinary symptoms and early UTI following HoLEP.

METHODS: A prospectively maintained database was reviewed for patients who underwent HoLEP over a five-year period at a single tertiary center. Patient demographics, preoperative, operative, and postoperative characteristics, as well as infection rates, were obtained and analyzed using the appropriate statistical methods.

RESULTS: Of a total 514 patients who underwent HoLEP, 473 patients with complete followup data were included. Mean (± standard deviation) age and median (interquartile range) prostate volume were 72±9.1 years and 89 (68–126) g, respectively. Preoperative positive urine culture and urine retention were seen in 28.5% (n=135) and 23.46 % (n=111) of patients, respectively. At six-week followup, irritative urinary symptoms were seen in 32.3% (n=153) of patients, while 13.5% (n= 64) of patients had positive urine culture. Bivariate and multivariate analysis showed that factors associated with significant higher rate of postoperative UTI at six weeks were high body mass index (BMI) (p= 0.023), weak grip strength within preoperative frailty assessment (p=0.042), positive preoperative urine culture (p=0.025), and postoperative incontinence (p=0.002).

CONCLUSIONS: Storage urinary symptoms are common complaints post-HoLEP; however, it may be caused by an inflammatory rather than infective process in a significant percentage of patients. Possible predictors of UTI after HoLEP are high BMI, preoperative positive urine culture, higher frailty scale, and postoperative urinary incontinence.

INTRODUCTION

Holmium laser enucleation of the prostate (HoLEP) combined with mechanical morcellation has been a steadily growing surgical option for management of benign prostatic hyperplasia (BPH). HoLEP has shown low overall complication rate, durable symptom relief, very low reoperation rate, and high patient satisfaction rate.[1,2] HoLEP has become an effective and safe alternative for managing variable size prostates rivaling transurethral resection of prostate (TURP) or simple prostatectomy.[3-5]

The most common complications related to HoLEP include retrograde ejaculation, transient storage voiding symptoms, postoperative urinary tract infection (UTI), and transient urinary incontinence.[6,7] Storage voiding symptoms are consistently a main complaint early following HoLEP. Studies have reported that 17–34% of patients had transient postoperative storage voiding complaints that may extend to three months following HoLEP. Storage symptoms are sometimes difficult to distinguish from UTI in the postoperative setting.[7-10]

Different scoring scales, such as BPH surgical scoring (BPHSS) system, have demonstrated modalities to predict perioperative outcomes of HoLEP; however, few studies have evaluated risk factors for postoperative UTI. Preoperative high postvoid residual (PVR), use of intermittent or indwelling catheterization, and diabetes mellitus (DM) have been proposed as predictors of UTI fol-

KEY MESSAGES

- Irritative voiding symptoms are consistently a main complaint post-HoLEP and are sometimes difficult to distinguish from postoperative UTI.
- In our study, irritative urinary symptoms were seen in 32.3% of patients, while 13.5% of patients had true postoperative UTI.
- UTI risk factors identified were preoperative UTI, obesity, weak grip strength within preoperative frailty assessment, and postoperative incontinence.

lowing transurethral prostate surgery.[11,12]

We aimed to study the incidence and risk factors for early storage urinary symptoms and postoperative UTI post-HoLEP in an attempt to decrease unnecessary postoperative antibiotic use and to identify high-risk patient populations for UTI.

METHODS

A prospectively maintained database for patients undergoing HoLEP over five years was retrospectively reviewed. Study data were collected and managed using REDCap electronic data capture tool hosted at our institution.[13] The study protocol was approved by our institutional review board. Patients without complete followup data at six weeks were excluded. Patients' demographics and preoperative characteristics, as well as operative and postoperative followup data, were obtained and analyzed. Postoperative UTI was defined by postoperative storage urinary symptoms with positive urine culture of >1000 CFU/ml with identification of pathogenic organism.[14] Grip strength in association with hemoglobin level in last 30 days and the American Society of Anesthesiologists (ASA) physical status score were used for assessment of patient frailty through Modified Hopkins frailty score adopted at our institution.[15,16]

HoLEP protocol

All HoLEP procedures were performed by a single surgeon (MET). Lumenis Pulse™ 120 H laser system and 550-micron laser fiber were used with energy settings of 80 and 40 W at a power setting of 2 J and frequency of 40 and 20 HZ, respectively. The protocol generally adopted for HoLEP procedures included preoperative urine culture for all the patients. Patients with preoperative positive urine culture were treated with appropriate antibodies for 7–10 days without repeating the urine culture routinely after antibiotic use. Patients with indwelling urinary catheter were prescribed preoperative antibiotics only with positive urine culture. A single-dose intravenous antibiotic (third-generation cephalosporin) was administered prior to anesthesia induction and prophylactic postoperative oral antibiotics (sulfamethoxazole-trimethoprim, nitrofurantoin, cephalexin, or ciprofloxacin) were given for three days to all patients. A voiding trial was usually performed on postoperative day 1. Patients were mostly discharged on a postoperative day 1 after passing the voiding trial. Patients who failed the voiding trial were discharged with an indwelling catheter and had a repeat voiding trial after three days in the outpatient clinic. During a six-week postoperative followup, clean catch midstream urine culture was ordered only for patients with suspected UTI. In the case of positive culture, antibiotics were prescribed according to culture and sensitivity results.

Statistical analysis

Sample characteristics were described using descriptive statistics. Frequencies and percentages were used to describe categorical variables. Means and standard deviations (or medians and ranges where appropriate) were used to describe continuous variables. Statistical analysis was performed using SAS 9.4. Logistic regression models were used to assess the association of different possible predictors to postoperative UTIs. The significance level was set to $p<0.05$.

RESULTS

Of total 514 patients identified; 41 patients were excluded due to incomplete data. The data of 473 patients were included for analysis. Results of patient preoperative demographics are summarized in Table 1. Preoperative urine culture was positive in 135 (28.5%) patients. Patients were prescribed a preoperative fluoroquinolone (60%), amoxicillin (17%), sulfamethoxazole/trimethoprim (15%), or nitrofurantoin (13%) to treat their preoperative positive urine culture. Around 81% of the patients had an ASA score of 2 or 3.

HoLEP was performed for 111 (23.4%) patients with retention at the time of surgery; 37 (7.8%) and 74 (15.6%) patients used clean intermittent catheterization and indwelling catheter, respectively.

Successful voiding trial and hospital discharge on

Table 1. Patient demographics and preoperative characteristics

Variable	Patients (N=473)
Age, mean (SD)	71.69 (9.09)
BMI, median (IQR)	28.96 (6.42)
Prostate volume, gm, median (IQR)	89 (68–126)
PSA, ng/ml, median (IQR)	3.9 (1.75–7.6)
Retention at time of surgery, n (%)	111 (23.4%)
Duration of urine retention, days, median, (IQR)	60 (90)
CIC preop, n (%)	37 (7.8%)
Indwelling catheter, n (%)	74 (15.6%)
Diabetes mellitus, n, (%)	126 (26.63%)
Positive preop urine culture	135 (28.5)
PVR, ml, median (IQR)	135 (269)
Grip strength, PSI, median (IQR)	36 (14)
ASA score, n (%)	
1	61(12.8%)
2	191(40.38%)
3	190 (40.16%)
4	31(6.55%)

ASA: American Society of Anesthesiologists; BMI: body mass index; CIC: clean intermittent catheterization; IQR: interquartile range; PSA: prostate-specific antigen; PSI: pounds per square inch; PVR: postvoid residual.

Table 2. Perioperative and 6-week postoperative followup data

Variable	Patients
Operative time, min, median (IQR)	65 (57–89)
Intraoperative complications, n (%)	17 (3.59%)
Pathological weight, median (IQR)	46 (52)
Catheterization time, days, mean (SD)	1.78 (2.2)
Failed 1st voiding trial, n (%)	36 (7.61%)
Hospital-stay, days, mean (SD)	1.26 (1.38)
Immediate PVR, ml, median (IQR)	35 (19–75)
6-week IPSS score, median (IQR)	7 (4–11)
6-week QoL, median (IQR)	1 (0–3)
6-week storage urinary symptoms, n (%)	153 (32.3%)
6-week urinary tract infection, n (%)	64 (13.5%)
6-week urinary incontinence, n (%)	159 (33.61%)
6-week PVR, ml, median (IQR)	27 (63)

IPSS: International Prostate Symptom Score; IQR: interquartile range; PVR: postvoid residual; QoL: quality of life; SD: standard deviation.

Table 3. The organism detected at postoperative urine culture

Organism	Result, n (%)
Enterococci faecalis	15 (23.4%)
Escherichia coli	13 (20.3%)
Staphylococci (*aureus*, coagulase negative)	11 (17.1%)
Pseudomonas aeruginosa	8 (12.5%)
Streptococci (*viridians, anginosus*)	7 (10.9%)
Proteus	3 (4.6%)
Other (*Enterobacter, Corynebacterium*, Mixed, Candida)	7 (10.9%)

postoperative day 1 was observed in 82% of the patients. Perioperative outcome data are shown in Table 2. Intraoperative complications were reported in 17 (3.59%) patients in the form of urethral injury (no=7), ureteric orifice injury (no=4), and bladder mucosal injury during morcellation (no=6). Up to six-week postoperative followup, 159 (33.61%) patients reported urinary incontinence; differentially, 67 (14.1%), 65 (13.7%), and 27 (5.7%) have stress, urge, and mixed-type, respectively. Storage urinary symptoms were reported in 153 (32.3%) patients, all of whom had urine culture analysis. Within the patients with storage symptoms, they were associated with fever in 19 (12.42 %) patients and resulted in early clinic visits, emergency department visits, and readmission in 47 (30.72 %), 32 (20.92%), and 12 (7.84%) patients, respectively. Among the patients who had urine culture, only 64 (13.5%) had positive postoperative urine culture. Table 3 shows the types of organism detected with urine culture in patients with postoperative UTI. Of note, changing the definition of UTI to the historic cutoff value for positive urine culture (>100 000 CFU/ml) would decrease the number of patients with postoperative positive urine culture to 57 (12%) instead of 64 (13.5%) patients.

With bivariate analysis, patients with postoperative UTI showed significantly higher body mass index (BMI) (p=0.023), reduced grip strength at preoperative frailty assessment (p=0.042), positive preoperative urine culture (p=0.025), and postoperative urinary incontinence (p=0.002) (Table 4). Multivariate regression analysis model using multiple variables again showed that high BMI (hazard ratio [HR] 2.02, confidence interval [CI]

1.36–2.58, p=0.034), preoperative positive urine culture (HR 1.92, CI 1.3–3.38, p=0.019), and postoperative incontinence (HR 2.82, CI 1.8–5.67, p=0.015) were associated with statistically significant risk of positive urine within the first six weeks post-HoLEP.

Table 4. Analysis of predictors for postoperative UTI after HoLEP

Variable	PO UTI (no=64)	No PO UTI (no=409)	p
Age, mean, SD	70.95 (9.48)	72.1 7(8.78)	0.315
BMI, median (IQR)	29 (8.02)	27.88 (6.35)	0.023
Retention at time of surgery, n (%)	23 (35.9%)	130 (31.78%)	0.228
Urine retention duration, days, median (IQR)	70 (85)	60 (95)	0.871
CIC, n (%)	12 (18.75%)	67 (16.38%)	0.810
Diabetes mellitus, no (%)	22 (34.38%)	104 (25.4%)	0.158
Preop UTI, no (%)	22 (34.37%)	89(21.76%)	0.025
Intraoperative calculi, n (%)	3 (4.69%)	28 (6.94%)	0.508
Weight morcellated, gm, median (SD)	42 (50)	46 (52)	0.332
Catheterization time, mean (SD)	1.55 (1.56)	1.79 (2.05)	0.369
Postoperative incontinence, no (%)	35 (54.68%)	124 (30.3%)	0.002
6 weeks PVR, ml, median (IGR)	23 (69)	28 (61)	0.387
Grip strength, median (IQR)	34 (15)	39 (16)	0.042
ASA score, n (%)			
1	6 (9.37)	56 (13.69)	0.783
2	26 (40.6)	157 (38.39)	
3	29 (45.31)	164 (40.09)	
4	3 (4.68)	32 (7.82)	

ASA: American Society of Anesthesiologists; BMI: body mass index; CIC: clean intermittent catheterization; IQR: interquartile range; PVR: postvoid residual; SD: standard deviation; UTI: urinary tract infection

DISCUSSION

Storage urinary symptoms continue to be a common postoperative complaint in the first three months following HoLEP. The reported incidence of storage urinary symptoms varies from 17–35%.[7-10] Differentiation of postoperative storage symptoms from UTI is usually difficult. Our results showed postoperative storage symptoms incidence of 32.3%, while UTI (positive urine culture) was observed in only 41% of these patients. This reiterates that patients are more likely to have transient complaints rather than infective processes. In the current study, we used the updated definition of the positive urine culture as >1000 CFU/mL of a single bacteria in a urine culture in presence of new urinary tract symptoms instead of the historic cutoff value of >100 000 CFU/mL; however, it may be prudent to consider using the >100 000 CFU/mL threshold in the setting of the postoperative period to minimize the use of antibiotics considering the abundance of lower urinary symptoms, as shown in the current results.

Hwang et al, in their prospective study, reported UTI incidence rate after transurethral prostate surgery of 34.9%, with association to prolonged operation time and DM. They also documented that the type of prophylactic antibiotic or length of antibiotic dose does not alter the postoperative infectious complication rate.[17] Kikuchi et al reported preoperative and postoperative incidence of UTI with HoLEP at 41% and 23%, respectively. They showed that the risk of postoperative bacteriuria was lower with the use of perioperative prophylactic antibiotics and preoperative use of dutasteride. They could not identify risk factors for postoperative infectious complications.[12]

In the current study, possible predictors of postoperative UTI include higher BMI, lessened grip strength, and positive preoperative urine culture. There is also a significant association between urinary incontinence and UTI at six weeks. Although there are no guideline recommendations or literature regarding the indications of postoperative urine culture post-HoLEP, we recommend that these variables may help guide clinical decision-making postoperatively to decrease the number of routine urine cultures. Multiple recent studies have shown correlation of the handgrip strength to the perioperative outcome of different surgeries in frail patients.[18,19] Surprisingly, some proposed clinical risk factors for UTI, such as intermittent or indwelling catheterization, DM, and high PVR, were not statistically linked to postoperative UTI in our patients. This may be attributed to more careful treatment of patients with a higher risk for UTI in the preoperative setting, preventing persistence of their UTI postoperatively.

Generally, guidelines currently recommend the use of single-dose antibiotic prophylaxis prior to all transurethral procedures for the treatment of enlarged prostate, including HoLEP.[20,21] Recent prospective, randomized studies have shown that preoperative prophylactic antibiotics can be safely omitted in patients without preoperative pyuria and a preoperative indwelling catheter undergoing TURP.[22] Currently, there are no clear evidence-based recommendations to guide the use of prophylactic postoperative antibiotics after HoLEP. Nevertheless, most surgeons performing HoLEP usually extend the antibiotics prophylaxis up to 3–7 days after

HoLEP to avoid the incidence of UTI.[23,24]

The current article represents a novel work that has not been previously addressed in the growing field of HoLEP. The limitation of the study is its retrospective nature. Future directed studies targeted to pre-and postoperative antibiotic use may elucidate further information on improvement on postoperative UTI rates and patient selection for urine culture post-HoLEP.

CONCLUSIONS

It is key to have a high clinical suspicion for UTI post-HoLEP; however, it is equally important to keep in mind that more patients will present with transient complaints rather than UTIs. Storage symptoms can be associated with overtreatment by empirical antibiotics. Possible predictors of UTI after HoLEP are high BMI, preoperative positive urine culture, high frailty score, and postoperative urinary incontinence.

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