World Journal of Urology (2023) 41:1613–1619
https://doi.org/10.1007/s00345-023-04410-2

ORIGINAL ARTICLE

The outcomes of same-day discharge following holmium laser enucleation of the prostate (HoLEP) surgeries: our experience during the COVID-19 pandemic

Jad Badreddine[1] · Helen Sun[1] · Kimberly Tay[1] · Stephen Rhodes[1] · Daniel Chen[2] · Michael Zell[1] · Irina Jaeger[1] · Amihay Nevo[1,3]

Received: 7 February 2023 / Accepted: 11 April 2023 / Published online: 9 May 2023

Abstract

Objective To describe the outcomes of Same-Day Discharge (SDD) following Holmium Laser Enucleation of the Prostate (HoLEP) in patients during the COVID-19 pandemic.

Methods A retrospective review of HoLEP surgeries at a single institution between January 2021 and March 2022 was performed. Patient demographic and operative data were collected, and postoperative outcomes were evaluated in terms of safety and efficacy and compared in both groups using a *t*-test and chi-square test. Logistic regression was also performed to identify factors that correlate with the failure of SDD.

Results A total of 155 patients were identified; 135 patients were successfully discharged on the same day and 20 were admitted (87% SDD rate). Admitted HoLEP patients had a significantly higher median prostate-specific antigen (5.7 vs 3.9 ng/dL, $P<0.001$), prostate volume (152.3 vs 100.6 mL, $P<0.001$), and enucleated tissue weight (90.3 vs 56.9 g, $P=0.04$) compared to the SDD group. The SDD group had a 2.9% ($n=4$) readmission rate and a 5.2% ($n=7$) Emergency Department (ED) visit rate. There was no significant difference in the rate of postoperative ED visits ($P=0.64$), readmissions ($P=0.98$), complications, and catheterization time ($P=0.98$) between both groups. Preoperative predictors of SDD failure included prostate gland volume > 150 mL (OR = 7.17; CI 2.01–25.67; $P<0.01$) and history of antiplatelet/anticoagulation use (OR = 6.59; CI 2.00–21.67; $P<0.01$).

Conclusion Same-day discharge following HoLEP is a safe and effective approach that can be performed in most patients using a liberal discharge criteria and relying on postoperative findings only.

Keywords Lower urinary tract symptoms · Prostatic hyperplasia · Urologic surgical procedures

✉ Amihay Nevo
Amihaynevo@gmail.com

Jad Badreddine
Jad.Badreddine@UHhospitals.org

Helen Sun
Helen.Sun2@UHhospitals.org

Kimberly Tay
Kimberly.Tay@UHhospitals.org

Stephen Rhodes
Stephen.Rhodes@UHhospitals.org

Daniel Chen
Daniel.Chen@UHhospitals.org

Michael Zell
Michael.Zell@UHhospitals.org

Irina Jaeger
Irina.Jaeger@UHhospitals.org

[1] Urology Institute, University Hospitals Cleveland Medical Center, Cleveland, OH, USA

[2] Case Western Reserve University School of Medicine, Cleveland, OH, USA

[3] Department of Urology, Tel-Aviv Sourasky Medical Center, Sackler School of Medicine, Tel-Aviv University, Tel-Aviv, Israel

Introduction

A myriad of novel surgical treatments for benign prostatic hyperplasia (BPH) have emerged in recent years with the advent of innovative technology and techniques [1]. With the goal of reducing costs and hospital stays, minimally invasive procedures in particular such as HoLEP have gained popularity over the last decade [2]. HoLEP has been regarded as the gold standard treatment for BPH with its highly favorable safety and efficacy profile. When compared to other surgical therapies like transurethral resection of the prostate (TURP) and simple prostatectomy, HoLEP has demonstrated superior functional outcomes [3–5].

HoLEP traditionally requires overnight hospital admission to closely monitor acute complications such as postoperative hematuria and urinary retention [6, 7]. However, newer techniques and improved laser platforms such as pulse-modulated lasers have enabled improved hemostasis and postoperative recovery. This has made SDD following HoLEP a feasible option for some patients [8]. Previous studies evaluating SDD post-HoLEP are difficult to compare due to inconsistent patient inclusion criteria. Moreover, most of these cohorts were characterized by relatively small glands and minimal patient comorbidities [8–10].

The COVID-19 pandemic greatly impacted multiple aspects of surgical practice including staffing, procedural prioritization, and perioperative evaluation [11, 12]. Substantial changes were introduced to surgical practices, resulting in limited hospital bed availability [13]. A study exploring the impact of the pandemic on urologic practices in the United States (US) showed a 20% decline in urologic operative volume compared to the baseline before the pandemic due to the restrictions imposed by hospitals [14]. This strain on the US health system subsequently drove strategies to improve cost-efficacy and promote early discharge following selected surgeries [15].

As with many other institutions during the COVID-19 pandemic, inpatient hospital beds at our institution were not routinely available for elective surgeries such as BPH treatments. This posed a challenge and opportunity to implement strict admission criteria within our hospital for HoLEP patients, in which only patients with hematuria requiring continuous bladder irrigation (CBI) were admitted, regardless of preoperative or intraoperative factors. We aim to demonstrate feasibility of SDD with liberal discharge criteria in HoLEP patients during the COVID-19 pandemic.

Methods

After obtaining institutional review board approval, we retrospectively reviewed the records of all patients that underwent HoLEP between January 2021 and March 2022 at our institution. All patients were planned for SDD regardless of their age, prostate volume, and comorbidities. All HoLEP patients were counseled on perioperative expectations of SDD to coordinate appropriate care. Hospital admissions were limited to patients that required overnight observation for acute postoperative hematuria. The risk of thrombosis for each patient was assessed individually after communicating with the patient's cardiologist regarding the indication for anticoagulation and the timing of the reintroduction of treatment. Patients on antiplatelet/anticoagulant pharmacotherapy were asked to hold their medications for an appropriate period prior to surgery. Patients were informed that it is common to experience low-grade hematuria for several weeks after surgery if they are taking anticoagulants for their condition. All HoLEP surgeries were performed by two experienced endourologists (AN and IJ) using an early apical release en-bloc technique as previously described [16]. We used a MOSES pulse-modulated 120-W (Lumenis, Yoknaem, Israel) or Quanta 100-W laser platform (Quanta Systems, Samarate, Italy) for all procedures. Laser settings for enucleation using MOSES were 2 J and 50 Hz; for Quanta, 2 J and 40 Hz was used for cutting, and 1 J and 20 Hz for coagulation. A Piranha morcellator (Richard Wolf, Knittlingen, Germany) was used for all cases. At the end of every procedure, a 22 or 24 Fr three-way Foley catheter was inserted with the balloon inflated to 40–50 mL and CBI was initiated in the operating room. Patients were monitored in the post-anesthesia care unit (PACU) by an anesthesiologist and PACU nursing staff. After 1 h of CBI, irrigation was clamped and urine color was visually assessed after 30 min. Evaluation of hematuria was based on the surgeon's clinical judgment postoperatively. The nursing staff was trained to perform routine monitoring and continuous or manual irrigation. However, the decision to admit or discharged patients was determined by the surgeon based on their condition. The patient was deemed eligible for discharge if the urine color was light pink to red without clots and if they met standard PACU discharge criteria. The catheter was removed the next business day in clinic. If the urine color remained unacceptable, patients were admitted for overnight observation and CBI.

Patient demographics including age, body mass index (BMI), ASA score, comorbidities, and medications were recorded. Perioperative data and postoperative outcomes at 1-month follow-up were retrospectively collected. Prostate gland volumes were reported as measured by an MRI

or transrectal ultrasound preoperatively. The total operative time reported in this study was calculated from the induction of anesthesia till the conclusion of anesthesia as the actual operative time was not reported. Chi-squared and t tests were performed to compare categorical and continuous variables, respectively, between the SDD and admission groups. Continuous and nominal variables were reported using median with range and frequency, respectively. Multivariable logistic regression was performed to identify perioperative factors associated with SDD failure defined as prolonged hospitalizations, ED visits, and postoperative readmissions.

Results

A total of 155 patients underwent HoLEP between January 2021 and March 2022 at our institution. From this cohort, 135 (87.1%) patients were successfully discharged home from the PACU and 20 (13%) were admitted for CBI and monitoring of hematuria. Patient demographics are described in Table 1. Mean age was 71.5 ± 7.1 years, and median preoperative prostate volume was 103 mL (range 52–350). The median preoperative peak urinary flow, American Urological Association (AUA) symptom score, and Post-Void Residual (PVR) volume were 8 mL/sec (range 3–25 mL/sec), 17 (range 6–14), and 105 mL (range 0–3,000 mL), respectively. The admission group had a significantly higher median prostate volume (152 vs 100 mL, $p < 0.01$) and prostate-specific antigen (5.7 vs 3.9 ng/dL, $p < 0.01$) than the SDD group. There were no other significant differences between the two groups, as shown in Table 1.

Prostate characteristics and acute outcomes are summarized in Table 2. Our cohort's average total operative time was 2.84 ± 0.7 h with no significant difference between patients who were discharged on the same day and those who were admitted ($p = 0.15$). 72% ($n = 111$) of the total cases were performed in the morning and 28% ($n = 44$) were performed in the afternoon, with both groups having approximately the same distribution of morning/afternoon surgeries ($p = 0.99$), Table 2. The weight of enucleated tissue was higher in the admission group compared to the SDD group (90.3 vs 56.9 g, $p = 0.04$). At follow-up, a similar improvement in postoperative peak urinary flow (13.25 mL/sec for SDD vs 10.4 mL/sec for admitted, $p = 0.56$) and AUA symptom score (6 for SDD vs 6.5 for admitted, $p = 0.95$) was noted in both groups. In addition, postoperative reduction in PVR was similar between patients who were SDD and admitted ($p = 0.63$). The median catheterization time was

Table 1 Demographic and preoperative characteristics of patients undergoing HoLEP

	Patient Characteristic	All Patients ($n = 155$)	SDD ($n = 135$)	Unplanned Admission ($n = 20$)	*P*-value
	Age (years), mean (SD)	71.5 ± 7.1	71.2 (7.1)	69.5 (7.5)	0.72
Race/Ethnicity	Caucasian, *n*(%)	118 (76.1%)	106 (78.5%)	12 (60%)	**0.02**
	Black/African American, *n*(%)	32 (20.6%)	27 (20%)	5 (25%)	
	Other, *n*(%)	6 (3.8%)	3 (0.5%)	3 (15%)	
	Body mass index (Kg/m^2), median (range)	29.3 (20.62–45)	29.4 (20.62–45)	29.5 (23.26–40)	0.99
	Prostate specific antigen (ng/dL), median (range)	4.68 (0.16–13.9)	3.9 (0.16–10.4)	5.7 (0.9–13.9)	**< 0.001**
	Prostate volume (mL), median (range)	103 (52–350)	100 (52–350)	152 (60–310)	**< 0.001**
	History of urinary retention, *n*(%)	65 (42%)	55 (40.7%)	10 (50%)	0.59
	History of recurrent urinary tract infections, *n*(%)	36 (23.2%)	31 (23%)	5 (25%)	0.99
	History of bladder stones, *n*(%)	29 (18.7%)	25 (18.5%)	4 (20%)	0.99
	Antiplatelet drug, *n*(%)	57 (36.7%)	46 (34.1%)	11 (55%)	0.12
	Anticoagulant drug, *n*(%)	21 (13.5%)	17 (12.6%)	4 (20%)	0.58
	Alpha blocker drug, *n*(%)	130 (83.8%)	114 (84.5%)	16 (80%)	0.86
	5-alpha reductase Inhibitor drug, *n*(%)	36 (23.2%)	34 (25.2%)	2 (10%)	0.22
	Beta-3 agonist, *n*(%)	9 (6.7%)	9 (6.7%)	0	0.50
	Hemoglobin (g/dL), median (range)	13.9 (9.2–18.3)	14 (9.2–18.3)	13.6 (10.9–15.8)	0.72
	Serum creatinine (mg/dL), median (range)	1.08 (0.64–2.14)	1.08 (0.64–2.14)	1.06 (0.71–2.01)	0.79
	Post-void residual volume (mL), median (range)	105 (0–3,000)	103.5 (0–3,000)	124 (1—534)	0.63
	AUA score, median (range)	17 (6–34)	17 (12–34)	18 (6—26)	0.92
	Peak urinary velocity (mL/sec), median (range)	8 (3–25)	8 (4.8–22.6)	9.4 (3–25)	0.89
	Previous surgery for BPH, *n*(%)	33 (21.2%)	29 (21.5%)	4 (20%)	0.99

AUA American Urological Association, *SDD* Same-day discharge, *SD* Standard Deviation

Table 2 Perioperative characteristics and outcomes of patients undergoing HoLEP

	Intraoperative/Postoperative Characteristics	All Patients ($n=155$)	SDD ($n=135$)	Unplanned Admission ($n=20$)	*P*-value
	ASA score, median (range)	3 (1–4)	3 (1–4)	3 (2–4)	0.92
	Total operative time (hrs), mean (SD)	2.84 (0.7)	2.9 (0.8)	2.5 (0.7)	0.15
Timing of surgery during the day	Morning, *n*(%)	111 (72%)	97 (72%)	14 (70%)	0.99
	Afternoon, *n*(%)	44 (28%)	38 (28%)	6 (30%)	0.99
Pathology Result	Weight of enucleated tissue (grams), median (range)	59.7 (16.8–223)	56.9 (16.8–223)	90.3 (18.3–174)	**.04**
	Benign prostatic hyperplasia, *n*(%)	150 (98%)	131 (97%)	19 (95%)	0.99
	Prostate adenocarcinoma, *n*(%)	17 (11%)	15 (11.1%)	2 (10%)	0.99
	Other, *n*(%)	2 (1.2%)	2 (1.5%)	0	0.99
	Estimated blood loss (mL), median (range)	30 (5 – 250)	30 (10—100)	40 (5—250)	0.10
	Readmission, *n*(%)	4 (2.6%)	4 (2.9%)	0	0.98
	Emergency department visit, *n*(%)	7 (4.5%)	7 (5.2%)	0	0.64
	Indwelling catheterization time (days)	1 (1 – 3)	1 (1—3)	1 (1—2)	0.98
	Peak urinary velocity (mL/sec), median (range)	12.1 (2.3 – 33.9)	13.25 (7.1 – 33.9)	10.4 (2.3—16.3)	0.56
	Post-void residual volume (mL), median (range)	7 (0—450)	7 (0—450)	7 (0—40)	0.63
	AUA score, median (range)	6 (1 – 20)	6 (1—20)	6.5 (2.5—15)	0.95
	Prostate specific antigen (ng/dL), median (range)	0.6 (0.14 – 3.91)	0.6 (0.14—3.91)	0.6 (0.18—2.19)	0.53
30-Day Complications	Overall complications, *n*(%)	21 (13.5%)	18 (13.3%)	3 (15%)	0.20
	Complication on POD0 or POD1	7	5	2	0.41
	Complication after POD1	14	13	1	
	Urinary tract infections, n(%)	7 (4.5%)	5 (3.7%)	2 (10%)	0.49
	Gross hematuria, n(%)	9 (5.8%)	8 (5.9%)	1 (5%)	0.99
	Urinary retention, n(%)	5 (3.2%)	5 (3.7%)	0	0.84
	None, n(%)	134 (86.4%)	117 (86.7%)	17 (85%)	0.72
Clavien Dindo Classification	Grade I, n(%)	13 (61.9%)	11 (61.1%)	2 (67%)	0.77
	Grade II, n(%)	7 (31.8%)	6 (33.3%)	1 (33%)	
	Grade III, n(%)	1 (4.5%)	1 (5.5%)	0	

ASA American Society of Anesthesiologists, *AUA* American Urological Association, *SDD* Same-day discharge, *POD* postoperative day, *SD* Standard Deviation

1 day in both groups ($p=0.98$). Our cohort had a total of 17 (11%) cases of incidental carcinoma. Thirteen of these cases had a Gleason score of 6 and four cases had a Gleason score of 7 (3 + 4). Our cohort also had 20 (13%) patients with a prostate gland ≥ 200 mL, 12 (60%) of which were successfully discharged on the same day.

A total of 21 (13.5%) complications were reported in our cohort, comprising 18 (13.3%) in the SDD group and 3 (15%) in the admission group ($p=0.2$). The most common complication was gross hematuria ($n=9$, 5.8%) followed by urinary tract infection (UTI) ($n=7$, 4.5%) and urinary retention ($n=5$, 3.2%). Fourteen (67%) complications occurred after postoperative day 1 and 7 (33%) occurred within 24 h of surgery. All complications in the SDD group were Clavien Dindo grade I ($n=11$, 61.1%) and grade II ($n=6$, 33.3%) except for one case (grade III) that was a postoperative hemorrhage requiring an urgent cystourethroscopy with clot evacuation and subsequent admission. There were seven (4.5%) ED visits and four (2.6%) readmissions in the SDD group with none documented in the admission group (Table 2).

Multivariable regression on features associated with SDD failure is shown in Table 3. Patients with prostate volumes ≥ 150 mL were more than six times more likely to fail SDD (OR = 6.7; 95% CI 1.86–24.16, $p<0.01$). In addition, despite instructions to hold antiplatelet/anticoagulant therapy perioperatively, patients using these medications were at a significantly higher risk of failing SDD (OR = 6.01; 95% CI 1.84–19.62, $p<0.01$). We found that each additional hour of surgery is associated with an increase of 1.47 in the odds

Table 3 Multivariate analysis of perioperative factors associated with SDD failure

Variable	OR	CI lower	CI upper	*P*-value
Age	1.04	0.96	1.11	0.34
Prostate volume ≥ 150 mL	**6.7**	**1.86**	**24.16**	**< 0.01**
History of urinary retention	0.94	0.33	2.70	0.91
History of recurrent UTIs	1.58	0.55	4.53	0.40
History of bladder stones	0.78	0.24	2.54	0.68
Enucleated tissue weight (g)	0.68	0.15	3.05	0.62
Antiplatelet/anticoagulation use	**6.01**	**1.84**	**19.62**	**< 0.01**
Post-void residual volume (mL)	1.02	0.90	1.17	0.71
Total operative time (hrs)	1.47	0.69	3.15	0.31

CI confidence interval, *OR* odds ratio, *UTI* urinary tract infection

of SDD failure, however, the association was not significant (OR 1.47; CI 0.69–3.15; $p = 0.31$). Other factors such as age, history of recurrent UTIs, history of bladder stones, or being previously dependent on an indwelling catheter were not associated with SDD failure.

Discussion

Our study demonstrates the outcomes of SDD after HoLEP in patients during the COVID-19 pandemic regardless of their demographics and perioperative factors. Our data show the overall safety and feasibility of this approach in the setting of significant healthcare constraints. In our cohort of 155 patients, we had an 87% successful SDD rate.

It is clear that great variability exists among exclusion criteria for SDD in the literature. Supplemental Table 1 summarizes previous studies that evaluated outcomes of SDD HoLEP procedures. Larner et al. reported one of the earliest series evaluating the safety and feasibility of SDD after HoLEP [17]. Their cohort was limited to younger patients (age < 75 years) with small prostate volumes (< 60 mL) and incorporated frequent nursing care [17]. Another study by Abdul-Muhsin et al. demonstrated a 16% SDD rate ($n = 28$) in a cohort of 179 HoLEP patients while excluding those with age > 75 years, prostate volume > 200 mL, ASA > 3, and prostate cancer [18]. Comat et al. selected 90 patients with a median prostate volume of 65 g for SDD in a cohort of 211 patients (43% SDD rate). Gabbay et al. successfully discharged 30 patients after exclusion of unstable cardiovascular diseases and anticoagulation therapy [9]. Other studies that used less stringent exclusion criteria such as Lee et al. successfully discharged 74 (35.3%) out of 210 HoLEP patients on the same day [19].

The two largest SDD after HoLEP series reported by Aggarwal et al. and Lwin et al. demonstrated successful SDD rates of 38% ($n = 181$) and 52% ($n = 199$), respectively, with a mean prostate volume of 83–88 mL [10, 20]. Unlike many of these studies, our cohort did not involve any preoperatively planned inpatient admissions as all patients were readily considered for SDD without restrictions on age, comorbidities, or prostate size. In addition, our study reports one of the highest prostate volumes in an SDD cohort with a median volume of 100 mL.

Our study had an overall 30-day complication rate of 13.5% ($n = 21$) with no significant difference between the two groups (13.3% for SDD vs 15% for admitted group, $P = 0.20$). This is comparable to previously reported complication rates in other SDD after HoLEP series, which range from 16 to 36% [8, 10, 20]. Importantly, 17/18 (94.5%) of the complications in our SDD group were Clavien grade I or II with gross hematuria being the most common complication (5.9%). In addition, the readmission rate of our SDD cohort (2.9%) is analogous to those reported in similar studies ranging from 2.5 to 17.8% [8, 20]. It is notable that most complications in the SDD cohort occurred late in the postoperative course with 5/18 (27.8%) occurring in the first 24 h postoperatively. This suggests that admission for overnight observation may not prevent the majority of complications. Furthermore, only one patient (0.75%) presented for urinary retention and two patients (1.5%) presented with gross hematuria requiring CBI within the first 24 h postoperatively. It is possible that once patients started to ambulate at home, they were more likely to bleed, hence contributing to late presentations of hematuria. This finding challenges the notion that all HoLEP patients must be admitted overnight to prevent urinary retention and gross hematuria.

Our multivariable analysis revealed that prostate volumes > 150 mL and a history of antiplatelet/anticoagulation use were predictive of SDD failure such as requiring prolonged hospitalizations, readmissions, or ED visits. Agarwal et al. and Abdul-Muhsin et al. were not able to identify any perioperative factors associated with SDD failure [10, 18]. Comat et al. found that increased age and lower ASA scores were significantly associated with SDD failure using multivariate analysis [8]. Total operative duration and timing of surgery during the day were not found to predict SDD failure in our cohort. In addition, even though antiplatelet/anticoagulation therapy was held before the surgery, these patients experienced a higher postoperative risk of bleeding after resuming therapy. Furthermore, operating on patients with large prostate glands may confer significant risks as it involves handling challenging anatomy with longer enucleation and morcellation time. While we acknowledge the risks accompanied with larger prostate glands and the use of blood thinners, we do not believe they should be exclusion factors for SDD. More than 30% of the patients in our SDD cohort were taking blood thinners. Also, 60% ($n = 12$) of those had a prostate gland volume > 200 mL were successfully discharged

on the same day. This is comparable to the 69% ($n = 38$) successful SDD rate reported by Assmus et al. in a cohort of 55 patients with large prostate glands (≥ 175 mL) [21].

These results can be partially attributed to our surgical technique and laser platforms being used. Most previous cohorts included patients treated with two or three lobes' technique for enucleation, while we used an en-bloc technique exclusively [8, 20, 21]. We believe that operating in the space between the adenoma and the capsule allows better irrigation and visibility and reduces bleeding, as we avoid cutting through the adenoma [22]. Additionally, we only used pulsed modulated lasers (Moses 2.0 or Quanta Cyber Ho) which have been shown to be more hemostatic than non-pulse-modulated lasers [23].

This study has several limitations. Our single institution experience and retrospective nature of the study limit its generalizability. Further, it is possible that some patients were lost to follow-up or may have presented to other hospitals postoperatively, and hence some complications might have been missed. In addition, there remains a subjective component in patient assessment in the PACU for discharge, based on hematuria and recovery from anesthesia. Lastly, SDD after HoLEP was possible during the pandemic as our institution is a tertiary care center with significant HoLEP volume and experience. Surgical centers with less experience and low HoLEP volume may choose to exercise caution before adopting this approach.

Conclusion

This study demonstrates the outcomes of SDD after HoLEP in patients regardless of their demographic and perioperative factors. We showed that SDD after HoLEP is safe and effective even with liberal discharge criteria. This approach was instrumental for adapting during the pandemic and treating BPH patients without compromising the quality of care.

Author contributions JB: data collection, manuscript writing. HS: manuscript writing. KT: manuscript editing. SR: data analysis. DC: data management. MZ: project development. IJ: project development, manuscript editing. AN: project development, manuscript editing.

Data availability The data that support the findings of this study are available from the corresponding author. Amihay Nevo, upon reasonable request.

Declarations

Conflict of interest No funding was received to assist with the preparation of this manuscript. The authors have no competing interests to declare that are relevant to the content of this article.

Research involving human participants and/or animals This research study was conducted retrospectively from data obtained for clinical purposes. We consulted extensively with the IRB of University Hospitals who determined that our study did not need ethical approval.

Informed consent Given the de-identified nature of the data, the University Hospitals institutional review board determined that this retrospective study was thus exempted from the need for informed consent, in accordance with 45 CFR §46.

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