Ambulatory surgery for Moses™ holmium laser enucleation of the prostate: A prospective, real-practice study from a single center

Alexandre Morin, Stéphanie Boulet, Samuel Lagabrielle
Department of Urology, Sherbrooke University Hospital Center (CHUS), Sherbrooke, QC, Canada

Acknowledgments: *The authors would like to thank Samuel Lemaire-Paquette and Catherine Allard, statisticians from the Centre de recherche du CHUS, for their support in the development of statistics and contribution to the elaboration of the statistical analysis subsection of the article. The authors would also like to express gratitude to the nurses of our surgical department, Mathieu Simard and Diane Rodrigue, for helping out and making these HoLEP procedures possible in our institution.*

Cite as: Morin A, Boulet S, Lagabrielle S. Methods to increase equity, inclusion, and diversity in Canadian urology programs. Ambulatory surgery for Moses™ holmium laser enucleation of the prostate: A prospective, real-practice study from a single center. *Can Urol Assoc J* 2023 May 30; Epub ahead of print. http://dx.doi.org/10.5489/cuaj.8229

Published online May 30 2023

Corresponding author: Dr. Alexandre Morin, Department of Urology, Sherbrooke University Hospital Center (CHUS), Sherbrooke, QC, Canada; alexandre.morin4@usherbrooke.ca

***

ABSTRACT

Introduction: Use of ambulatory holmium laser enucleation of the prostate (HoLEP) is uncommon among Canadian urologists. Our objectives were to determine the feasibility (ambulatory success rate) and safety (early complication rate) of ambulatory HoLEP in a Canadian population.

Methods: We prospectively evaluated consecutive patients from June 2020 to May 2022 presenting for ambulatory HoLEP using Moses™ technology at our institution (MoLEP). Ambulatory success was defined as no hospital admission within 48 hours following the procedure. Thirty-day adverse events were also identified and graded according to the Clavien-Dindo (CD) classification. All procedures were planned to be ambulatory regardless of prostate size or anticoagulant treatment. We generated a logistic regression model to identify factors associated with ambulatory failure.

KEY MESSAGES

- Using Moses™ technology for ambulatory holmium laser enucleation of the prostate (MoLEP), success rate was high (87%).
- The ambulatory MoLEP major complication rate (Clavien-Dindo classification score ≥3) was low (6%).
- Hematuria was the sole cause of ambulatory failure.

© 2023 Canadian Urological Association

Results: A total of 61 patients underwent MoLEP, 52 of whom met the eligibility criteria. The mean age was 71.0 years (standard deviation 6.2). Most patients (67%, 35/52) were catheter or self-catheterization-dependent. The ambulatory success rate was 87% (45/52), 6/52 (11.5%) required hospitalization following MoLEP, and one patient (2%) was re-admitted within 48 hours of the procedure. Hematuria was the sole cause of ambulatory failure. Thirty-day major complication rate (CD ≥3) was 6% (3/52) and the minor complication rate (CD <3) was 37% (19/52). The identified adverse events included hematuria (10/52), urinary retention (6/52), and cystitis (4/52). Based on univariate analysis, we did not identify factors significantly associated with ambulatory failure.
Conclusions: The MoLEP ambulatory success rate is high, and the 30-day major adverse event rate is low. In this small, Canadian cohort, ambulatory MoLEP seems feasible and safe.

INTRODUCTION

Benign prostate hyperplasia (BPH) affects up to 60% of the male population by the age of 60 years[1]. Holmium laser enucleation of the prostate (HoLEP) is a minimally invasive surgical procedure for BPH. It can be performed on a prostate of any size[2–4]. Although the technique is associated with a steep learning curve, its efficacy is well proven[5–7]. The efficacy and safety of HoLEP are comparable or superior to transurethral resection of prostate (TURP) independent of prostate size[8,9]. With the development of a new generation of holmium laser (Moses Effect™), "MoLEP" has resulted in shorter operative time and reduction in blood loss, positioning HoLEP as more favorable for ambulatory surgery[10,11].

Given the benefits of laser enucleation, some experts have assessed the feasibility and safety of this minimally invasive procedure in an ambulatory setting[12–19]. Ambulatory surgery (or day-case surgery) was initially strictly described by Comat et al.[15], in a prospective study, as a hospital stay of less than 12 hours and no medical assistance for the first 48 hours. According to a meta-analysis by Salciccia et al.[20], the pooled ambulatory failure rate of HoLEP is 11.8% (95% confidence interval [CI] 7–16.7) and the complication rate is similar to inpatient HoLEP.

Since the start of COVID-19 pandemic, many BPH procedures requiring hospitalization have been postponed. As suggested by Medina-Polo et al.[21], BPH procedures with the lowest complication rate and the shortest hospital stay should be encouraged during the COVID-19 crisis. Ambulatory HoLEP does seem to meet these criteria. Endoscopic BPH laser procedures have been gaining in popularity among Canadian urologists[22,23]. Recently, a group of Canadian urologists showed that, for selected patients, same-day catheter removal is a safe option[12]. However, more data are needed in Canada regarding the possible management of laser enucleation procedures, particularly in an ambulatory setting. Therefore, this study aimed to confirm the feasibility (ambulatory success rate) and safety (early complication rate) of ambulatory MoLEP in a prospective Canadian cohort. The secondary objectives of this study

© 2023 Canadian Urological Association

were to identify potential clinical factors associated with MoLEP ambulatory failure and to assess functional outcomes.

METHODS

Study design and population

We performed a prospective observational study on all consecutive patients who presented for MoLEP procedure from June 2020 to May 2022 at our university-affiliated hospital center. All procedures were planned to be ambulatory regardless of prostate size or anticoagulant treatment, unless the preoperative internal medicine team's evaluation suggested unstable medical comorbidities requiring hospitalization, if patients were unaccompanied the night of the operation, or if they lived more than a 1-hour drive away from any hospital center. Patients were excluded from the study if they had had a past prostate surgery affecting the prostate capsular dissection plan (i.e., transurethral needle ablation), if they had sole median lobe enucleation, or if they lacked the capacity to give informed consent. The study protocol was approved by our institutional review board (databank 2021-3909).

Ambulatory success was defined as an hospital stay of less than 12 hours and no hospital admission within 48 hours following the procedure[15]. In our institution, MoLEP is essentially performed on prostates greater than 80 grams (patients referred from colleagues and from non-university hospitals in the region). We also included patients with smaller prostates enlisted by the surgeon.

Data collection

Prior to MoLEP, patients were assessed with a full history and physical exam, including digital rectal exam, the International Prostate Symptom Score (IPSS), uroflow studies, post-void residual (PVR), blood count, kidney function, and prostate-specific antigen (PSA). Preoperative prostate volume was assessed via transrectal ultrasound. Perioperative data were also collected. In the month following the procedure, any emergency consultations or hospitalizations were documented. All adverse events were graded according to the Clavien-Dindo classification and counter-verified with the patient at the 1-month follow-up[24]. Uroflow studies, blood work and IPSS questionnaire were repeated at the 3-month follow-up. All data were prospectively collected in our databank.

Preoperative evaluation

During the preoperative consultation, patients were briefed about the ambulatory MoLEP procedure and received documentation describing the surgery and possible complications. Urine cultures were collected 1 week prior to MoLEP. Patients were treated with a 72-hour course of adapted antibiotics (48 hours pre-MoLEP and 24 hours post-MoLEP) if the urine culture was positive and/or if they were catheter dependent. Antiplatelet and anticoagulant therapies were suspended before surgery and re-started 48 hours postoperatively.

© 2023 Canadian Urological Association

Perioperative care and technique

The day of the surgery, HoLEP was performed using an "en bloc" technique with a holmium Lumenis® Moses pulse 120W laser[25]. All procedures were performed by the same surgeon (experience of 100–150 cases after a dedicated fellowship) during the morning operative period. The type of anesthesia was determined by the attending anesthesiologist. Single-dose intravenous cefazoline was given to all patients at induction. Tobramycin or vancomycin was given if patients had a known penicillin allergy. A 550 μm laser fiber was used with a 26F Storz® endoscope for all cases. The laser settings were 2 J at 45 Hz for enucleation and 1 J at 20 Hz for coagulation. A Storz® morcellator was used for prostate tissue morcellation. Meticulous hemostasis was obtained with the holmium laser before insertion of a 20F three-way catheter inflated to 40 mL. Continuous bladder irrigation was administered for 3–4 hours after the operation, followed by a single 20 mg intravenous furosemide dose. If hematuria was minimal (hematuria score of ≤ 4 without continuous bladder irrigation[13]), the patient was discharged with the catheter. All patients were advised to properly self-hydrate and to consult our institution's emergency room in case of any adverse events. The day after MoLEP, the urinary catheter was removed in the morning, and voiding trials were overseen by local community care centers.

Statistical analysis

We performed a descriptive analysis of the pre- and postoperative patient characteristics, as well as ambulatory success and complication rates. We sub-stratified the data into two categories: MoLEP ambulatory success patients and MoLEP ambulatory failure patients. We compared the groups using Fisher's exact test and the Mann–Whitney U test. We used a penalized logistic regression model to assess potential risk factors for failure. We performed univariate analysis for each of the variables collected and present the results as odds ratios (ORs) with 95% confidence intervals (CIs). We set the threshold of significance at $p < 0.05$. We used SPSS Statistics Version 28 (IBM Corp., Armonk, NY) and R version 4.0.2 (R Core Team, Vienna, Austria) for analyses.

RESULTS

A total of 61 patients underwent MoLEP. As shown in Figure 1, 52 patients met the eligibility criteria and we included them in our analysis. The median age was 71.0 years (standard deviation [SD] 6.2). Thirty-five (67.3%) patients were catheter or self-catheterization dependant for an average of 9.9 months (SD 5.9) prior to the operation. In total, 4 patients had undergone prior TURP, 12 were on antiplatelet therapy, and 5 were on anticoagulant therapy. The type of anesthesia was variable: 21/52 (40%) patients had spinal anesthesia, 16/52 (31%) patients had laryngeal mask airway anesthesia, and 15/52 (29%) patients were intubated. The mean postoperative time to discharge was 9.8 hours (SD 11.7), and the mean time to postoperative catheter removal was 1.1 days (SD 0.3).

The ambulatory success rate was 87% (45/52). As shown in Figure 1, 6 patients were hospitalized following MoLEP and 1 patient was readmitted after consulting the emergency room within 48 hours of the operation. Hematuria was the sole cause of ambulatory failure.

© 2023 Canadian Urological Association

Hospitalizations occurring between postoperative days 3 and 30 included 2 patients requiring re-morcellation and 1 patient requiring re-operation for hemostasis. All other patients that presented with a postoperative complication were handled by general practitioners (outpatient care). Complications classified according to their time of occurrence within or after 48 hours are depicted in Figure 2.

The overall 30-day complication rate was 42% (22/52); major complications (Clavien-Dindo ≥ 3) accounted for 6% (3/52). A total of 10 patients had hematuria, 9 requiring continuous bladder irrigation (Clavien-Dindo 1) and 1 requiring re-operation for hemostasis post operative day 16 (Clavien-Dindo 3A). No patient required blood transfusions. Four patients presented symptoms of cystitis and had a positive urine culture, which required oral antibiotics (Clavien-Dindo 2). There was no urinary sepsis. Six patients had urinary retentions (Clavien-Dindo 1). Of these urinary retentions, 2 were caused by blood clots, 2 were later diagnosed with acontractile bladder, and 2 were caused by residual intravesical prostate adenoma obstructing the bladder outlet. The last 2 patients required re-morcellation of the remaining intravesical prostate adenoma tissue (Clavien-Dindo 3B).

Demographic and pre-, peri-, and postoperative data are summarized and sub-stratified into two groups in Tables 1 and 2. There were few significant differences in the variables between the MoLEP ambulatory success and the MoLEP ambulatory failure groups. The operative time was longer in the failure group compared with the success group (126.1 ± 47.5 vs. 97.4 ± 30.4 minutes, p = 0.046). Postoperative hemoglobin levels were lower in the failure group (120.5 ± 16.6 vs. 142.8 ± 12.2 g/L, p = 0.002). Patients in the ambulatory failure group had higher morcellated prostate volumes (72.1 ± 35.7 vs. 55.3 ± 22.4 cm^3, p = 0.3) and catheter dependence (85.7% vs. 64.4%; p = 0.6) than in the ambulatory success group, although these differences were not significant.

The factors associated with MoLEP ambulatory failure (univariate analysis) are listed in Table 3. Although operative time was significantly longer in the ambulatory failure group (p = 0.046), it was not significantly associated with ambulatory failure (OR 1.02, 95% CI 0.99–1.05, p = 0.07). The prostate volume and morcellated volume also tended to be associated with ambulatory failure, although not significantly (respectively: OR 1.02, 95% CI 1.00–1.04, p = 0.11 and OR 1.02, 95% CI 0.99–1.06, p = 0.12). Antiplatelet and anticoagulant therapies were not associated with ambulatory failure (respectively: OR 1.54, 95% CI 0.18–7.66, p = 0.62 and OR 0.49, 95% CI 0.0–5.20, p = 0.67).

Table 4 presents data regarding the functional outcomes at 3 months. There were clinically significant changes from baseline in IPSS (-11.3, SD 8.2), IPSS quality of life (-2.7, SD 2.3), PVR volume (-177.4, SD 147.5), and peak urinary flow (QMax; +16.0, SD 12.5) at the 3-months post-MoLEP follow-up. Most importantly, the number of catheter- or self-catheterization-dependent patients dropped from 67.3% (35/52) to 3.8% (2/52) after MoLEP.

© 2023 Canadian Urological Association

DISCUSSION

This study aiming to assess the feasibility and safety of ambulatory MoLEP procedures represents the second series in a Canadian population[12]. Our ambulatory success rate was high (87%) and concordant with most of the literature. Salciccia et al.[20] reported, in a meta-analysis on outpatient management of BPH procedures, a variable HoLEP ambulatory failure rate ranging from 2.5% to 51.1%. The pooled failure rate was 11.8% (95% CI 7–16.7). This is also in line with a recent large prospective series by Agarwal et al.[14] (n = 207), with a successful HoLEP same-day discharge of 87.4%. The ambulatory success rate may vary according to its definition. Compared with Comat and colleagues, who also used a strict 48-hour window to define ambulatory failure but used a 100 W holmium laser, the success rate was 80% in 2015[15] and improved to 87% in 2019[26], showing that the experience gained by the surgeon and also the team over time plays an important role in increasing ambulatory success. It also highlights that such ambulatory success rates (87%) are achievable with less experience (our institution) and that the laser technology might not be a determining factor, as shown in the meta-analysis by Gauhar et al.[11]. Indeed, in that review, the length of postoperative stay did not significantly favor MoLEP over HoLEP.

Regarding the specific advantages when using Moses™ technology, studies have found shorter operative time and reduction in blood loss[10,11]. Day-case MoLEP has not been as well documented as standard HoLEP. Nottingham and colleagues had a rate of same day discharge of 69%[27]. However, they had recently transitioned to an ambulatory setting three months prior, which may explain the lower rate of success. This may also reinforce the importance of ambulatory protocols and teamwork, considering the two surgeons were highly experienced (≥ 200 procedures). On a more promising note, Assmus et al. showed that 86% of patients (32 out of 37) undergoing MoLEP and using anticoagulation or antiplatelet medications could be discharge the same day, and that less than 2% were re-admitted within 90 days[28].

Our inclusion criteria were liberal: We included all prostate volumes, patients with indwelling catheters, patients with past TURP or past prostate embolization, and patients on antiplatelet and/or anticoagulant therapy. This renders ambulatory HoLEP more accessible but is also at risk for increasing the ambulatory failure and complication rates. Mouton et al.[19] identified age, the American Society of Anaesthesiology (ASA) score, anticoagulant therapy, the surgeon's experience, and operative time as factors associated with ambulatory HoLEP early complications. This overlaps with the findings of Comat et al.[15] who identified age and the ASA score as risk factors for ambulatory failure in a multivariate analysis. On the other hand, Lee at al.[17] found that small prostates (≤ 40 g) and morning operations had a higher rate of successful day-case HoLEP.

Our data partly correlate with the above findings; MoLEP ambulatory failure patients who were hospitalized had significantly longer operative times. Although not significant, the ambulatory failure group had larger preoperative prostate volumes and higher morcellated prostate volumes. Larger prostates led to longer operative times and hypothetically increased the chance of complications, therefore increasing the risk of day-case surgery failure. We also noted

© 2023 Canadian Urological Association

that patients who depended on catheters or on self-catheterization had higher ambulatory failure rates compared with the ambulatory success group, but this was not significant. We hypothesize that these indwelling catheters lead to inflammatory and well-vascularized prostates, making HoLEP operations technically challenging. Gross hematuria was the most common post-MoLEP complication and can solely explain the lower postoperative hemoglobin in the day-case surgery failure group. In our univariate analysis, we did not identify factors associated with MoLEP ambulatory failure, certainly due to our low rate of failure (7 out of 52 patients).

The reported complication rates of ambulatory HoLEP can be highly variable, from 12.8% to 56.7% [20]. Nonetheless, our 30-day major complications (Clavien-Dindo ≥ 3) rate was low at 6% (3/52), and the overall complication rate was 42%. This is consistent with the findings reported by Comat et al.[15], who reported a 37% rate of overall complications on 90 consecutive patients. Gross hematuria has been reported as the predominant factor leading to ambulatory failure (the cause of failure in 25%–87% of cases), while urinary infections and acute urinary retentions seem to be more prevalent within the first postoperative month[13,15,17,29]. Hematuria was the sole cause of ambulatory failure in our cohort, reinforcing our appropriate preoperative planning because no patients refused to leave for social/anxiety reasons. Abdul-Muhsin et al.[13] reported an 8.5% ambulatory failure rate for these reasons. Urinary retentions were attributable to blood clots, residual adenoma, or acontractile bladders. No patient experienced urinary retention due to a failure to alleviate prostatic urethra obstruction, which further reinforces the efficacy of HoLEP. Kim et al.[30] found that 35% of urinary retentions following HoLEP were not caused by a blood clot. In addition, 2 of our patients experienced urinary obstruction secondary to residual intravesical prostatic adenoma and required re-morcellation (Clavien-Dindo 3). These findings further stress the importance of adequate per-operative hemostasis to allow proper intravesical visibility and therefore, to achieve complete prostatic adenoma morcellation.

The complication rate of ambulatory MoLEP we found is similar to that of inpatient HoLEP [20,31]. Agarwal et al.[14] did not find any differences in the 90-day complication rate and the Clavien-Dindo ≥ 3 complication rate between planned inpatient HoLEP, unplanned inpatient HoLEP, and ambulatory HoLEP, even though this was not their primary objective.

Proper HoLEP technique, aggressive hemostasis with the holmium laser, and adequate antibiotic prophylaxis contributed to our relatively low major complication rates. By doing so and with the support of local community care centers for catheter removal, we could perform day-case MoLEP during the COVID-19 pandemic. Since the start of this pandemic, many Canadian hospitals have been restricting operations requiring hospitalisation, mostly because of the limited number of available hospital beds and human resources. The advantages of avoiding most hospitalizations with day-case MoLEP operations include increasing the availability of human resources, maintaining accessibility to BPH procedures in the COVID-19 era, and reducing medical expenses[13,18,32]. Moreover, because our functional outcomes are comparable to that of inpatient procedures[5,6], accessible MoLEP during the COVID-19 crisis permitted our patients to attain better quality of life in a reasonable amount of time.

© 2023 Canadian Urological Association

This series represents a prospective study in a Canadian population in a health care system strained by the COVID-19 pandemic, further supporting the feasibility of an ambulatory HoLEP setting. This study does have a few limitations. The cohort is relatively small and limited to a single center with a surgeon who had performed 100–150 procedures after a dedicated fellowship. However, these results are consistent with studies from more experienced surgeons (> 250 patients[12,26]), showing that great success rates in ambulatory HoLEP can be achieved before reaching such experience. The improvement in the ambulatory success rate over time has recently been shown by Klein et al.[26], who reported 70% ambulatory success for the first 88 patients and 87% after more than 178 patients. There is also a possibility of inherent selection bias. Peaks of COVID-19 outbreaks restrained our access to the operating room for urological functional surgeries and limited patient recruitment for this study. Therefore, our statistical analysis was limited to univariate penalized logistic regressions. In addition, the low rate of failure (only 7 out of 52 patients) certainly explains the lack of independent variables associated with ambulatory failure. Finally, patient discharge was subjective according to the attending urologist. Even though all MoLEP surgeries were performed and patients were evaluated by the same urologist, discharge criteria could have been variable.

CONCLUSIONS

Ambulatory MoLEP is both safe and feasible. The successful same day discharge rate was high (87%) and the 30-day major complication rate was low (6%) when performed by an experienced surgeon and nursing team and in collaboration with internists to assess and manage the bleeding risk. Adverse events can, for the most, be managed on an outpatient basis. We did not identify factors associated with ambulatory failure. However, the operative time and hemoglobin drop were significantly higher in the ambulatory failure group. Given its many benefits, widespread adoption of ambulatory HoLEP should be considered across Canada.

DRAFT

© 2023 Canadian Urological Association

REFERENCES

1. Lerner LB, McVary KT, Barry MJ, et al: Management of Lower Urinary Tract Symptoms Attributed to Benign Prostatic Hyperplasia: AUA GUIDELINE PART I-Initial Work-up and Medical Management. J Urol 2021; 206: 806–817.
2. Lerner LB, McVary KT, Barry MJ, et al: Management of Lower Urinary Tract Symptoms Attributed to Benign Prostatic Hyperplasia: AUA GUIDELINE PART II-Surgical Evaluation and Treatment. J Urol 2021; 206: 818–826.
3. Kuntz RM, Lehrich K and Ahyai SA: Holmium laser enucleation of the prostate versus open prostatectomy for prostates greater than 100 grams: 5-year follow-up results of a randomised clinical trial. Eur Urol 2008; 53: 160–166.
4. Krambeck AE, Handa SE and Lingeman JE: Holmium laser enucleation of the prostate for prostates larger than 175 grams. J Endourol 2010; 24: 433–437.
5. Elzayat EA and Elhilali MM: Holmium laser enucleation of the prostate (HoLEP): long-term results, reoperation rate, and possible impact of the learning curve. Eur Urol 2007; 52: 1465–1471.
6. Fallara G, Capogrosso P, Schifano N, et al: Ten-year Follow-up Results After Holmium Laser Enucleation of the Prostate. Eur Urol Focus 2020.
7. Romero-Otero J, García-Gómez B, García-González L, et al: Critical analysis of a multicentric experience with holmium laser enucleation of the prostate for benign prostatic hyperplasia: outcomes and complications of 10 years of routine clinical practice. BJU Int 2020; 126: 177–182.
8. Das AK, Han TM and Hardacker TJ: Holmium laser enucleation of the prostate (HoLEP): size-independent gold standard for surgical management of benign prostatic hyperplasia. Can J Urol 2020; 27: 44–50.
9. Magistro G, Schott M, Keller P, et al: Enucleation vs. Resection: A Matched-pair Analysis of TURP, HoLEP and Bipolar TUEP in Medium-sized Prostates. Urology 2021; 154: 221–226.
10. Kavoussi NL, Nimmagadda N, Robles J, et al: MOSESTM Technology for Holmium Laser Enucleation of the Prostate: A Prospective Double-Blind Randomized Controlled Trial. J Urol 2021; 206: 104–108.
11. Gauhar V, Gilling P, Pirola GM, et al: Does MOSES Technology Enhance the Efficiency and Outcomes of Standard Holmium Laser Enucleation of the Prostate? Results of a Systematic Review and Meta-analysis of Comparative Studies. Eur Urol Focus 2022; 8: 1362–1369.
12. Noureldin Y, Gupta A, Hodhod A, et al: Same-day trial of void and discharge following standard vs. MOSESTM holmium laser enucleation of the prostate: A single-center experience. Can Urol Assoc J 2022.
13. Abdul-Muhsin H, Critchlow W, Navaratnam A, et al: Feasibility of holmium laser enucleation of the prostate as a 1-day surgery. World J Urol 2020; 38: 1017–1025.
14. Agarwal DK, Large T, Tong Y, et al: Same Day Discharge is a Successful Approach for the Majority of Patients Undergoing Holmium Laser Enucleation of the Prostate. Eur Urol Focus 2022; 8: 228–234.
15. Comat V, Marquette T, Sutter W, et al: Day-Case Holmium Laser Enucleation of the Prostate: Prospective Evaluation of 90 Consecutive Cases. J Endourol 2017; 31: 1056–1061.

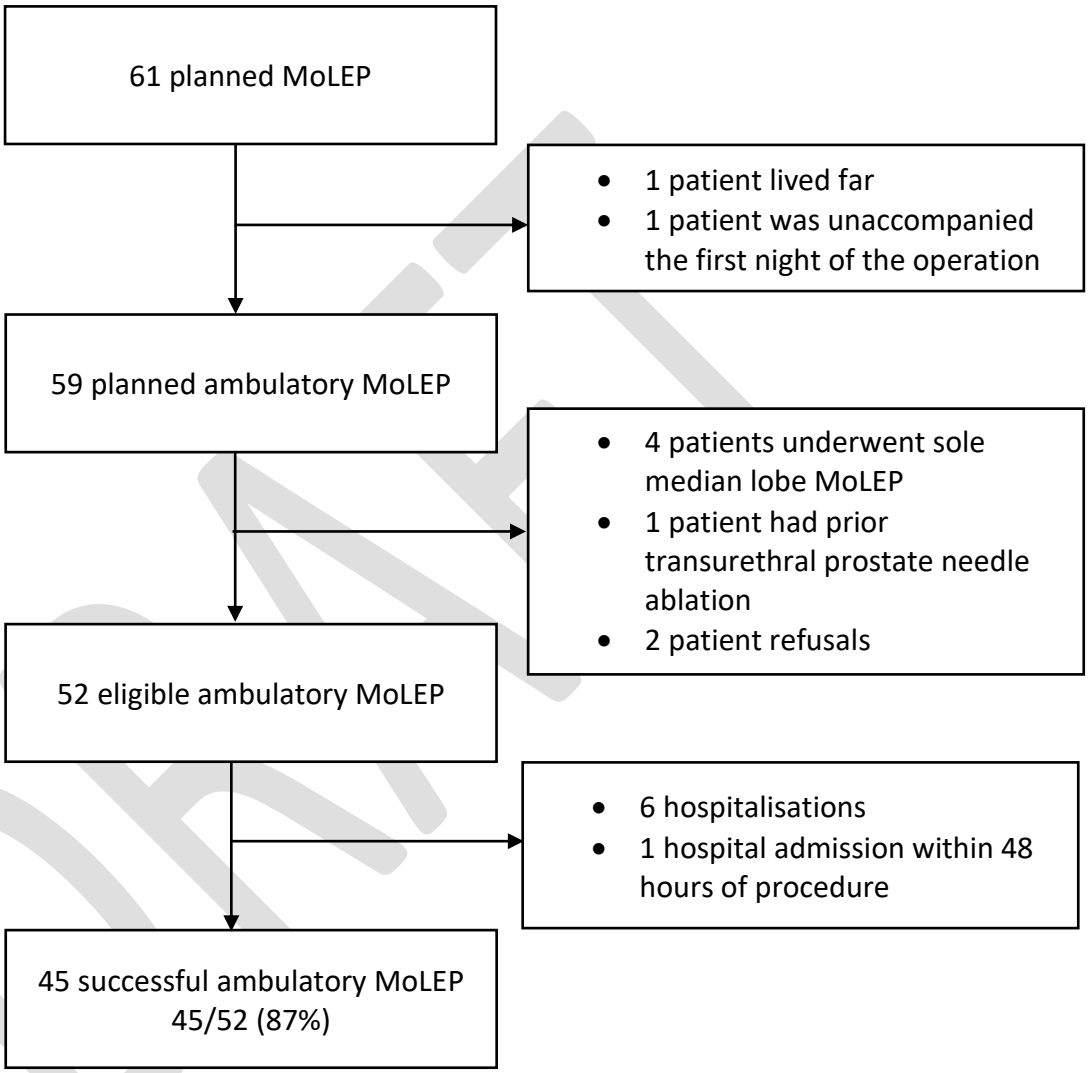
© 2023 Canadian Urological Association

16. Gabbay G, Bernhard J-C, Renard O, et al: [Holmium laser enucleation of the prostate as a day case surgery: prospective evaluation of the first 30 patients]. Prog Urol 2015; 25: 34–39.
17. Lee S-M, Gordon K, McMillan R, et al: Day-case holmium laser enucleation of the prostate: feasibility, safety and predictive factors. Ann R Coll Surg Engl 2018; 100: 475–479.
18. Lwin AA, Zeng J, Evans P, et al: Holmium Laser Enucleation of the Prostate Is Safe and Feasible as a Same Day Surgery. Urology 2020; 138: 119–124.
19. Mouton M, Michel C, Bourgi A, et al: [Holmium laser enucleation of the prostate: Analysis of early complications. Patient selection for day-case surgery]. Prog Urol 2020; 30: 89–96.
20. Salciccia S, Del Giudice F, Maggi M, et al: Safety and Feasibility of Outpatient Surgery in Benign Prostatic Hyperplasia: a Systematic Review and Meta-Analysis. J Endourol 2021; 35: 395–408.
21. Medina-Polo J, Téigell Tobar J, Romero-Otero J, et al: [Benign prostatic hyperplasia management during COVID-19 pandemia.]. Arch Esp Urol 2020; 73: 405–412.
22. Hueber P-A and Zorn KC: Canadian trend in surgical management of benign prostatic hyperplasia and laser therapy from 2007-2008 to 2011-2012. Can Urol Assoc J 2013; 7: E582-586.
23. LaBossiere JR, Wallis CJD, Herschorn S, et al: Surgical management of benign prostatic obstruction: 20-year population-level trends. Can Urol Assoc J 2020; 14: 252–257.
24. Mitropoulos D, Artibani W, Biyani CS, et al: Validation of the Clavien-Dindo Grading System in Urology by the European Association of Urology Guidelines Ad Hoc Panel. Eur Urol Focus 2018; 4: 608–613.
25. Saitta G, Becerra JEA, Del Álamo JF, et al: "En Bloc" HoLEP with early apical release in men with benign prostatic hyperplasia. World J Urol 2019; 37: 2451–2458.
26. Klein C, Marquette T, Comat V, et al: Evolution of Day-Case Holmium Laser Enucleation of the Prostate Success Rate Over Time. J Endourol 2021; 35: 342–348.
27. Nottingham CU, Large T, Agarwal DK, et al: Comparison of Newly Optimized Moses Technology vs Standard Holmium:YAG for Endoscopic Laser Enucleation of the Prostate. J Endourol 2021; 35: 1393–1399.
28. Assmus MA, Lee MS and Krambeck AE: Moses laser enucleation of the prostate (MoLEP). Urology Video Journal 2022; 13: 100123.
29. Cynk M, Georgiadis G, Moore E, et al: Day-case holmium laser enucleation of the prostate. Journal of Clinical Urology 2015; 8: 268–273.
30. Kim SH, Yoo C, Choo M, et al: Factors affecting de novo urinary retention after Holmium laser enucleation of the prostate. PLoS One 2014; 9: e84938.
31. Kampantais S, Dimopoulos P, Tasleem A, et al: Assessing the Learning Curve of Holmium Laser Enucleation of Prostate (HoLEP). A Systematic Review. Urology 2018; 120: 9–22.
32. Larner TRG, Agarwal D and Costello AJ: Day-case holmium laser enucleation of the prostate for gland volumes of < 60 mL: early experience. BJU Int 2003; 91: 61–64.

© 2023 Canadian Urological Association

FIGURES AND TABLES

Figure 1. Study flow chart. MoLEP: Moses™ technology for ambulatory holmium laser enucleation of the prostate.



© 2023 Canadian Urological Association

Figure 2. Thirty-day postoperative complications' timeline according to the Clavien-Dindo score (CD). Hematuria required continuous bladder irrigations. Re-fulguration and re-morcellation were performed under general anesthesia. UTI: urinary tract infection.

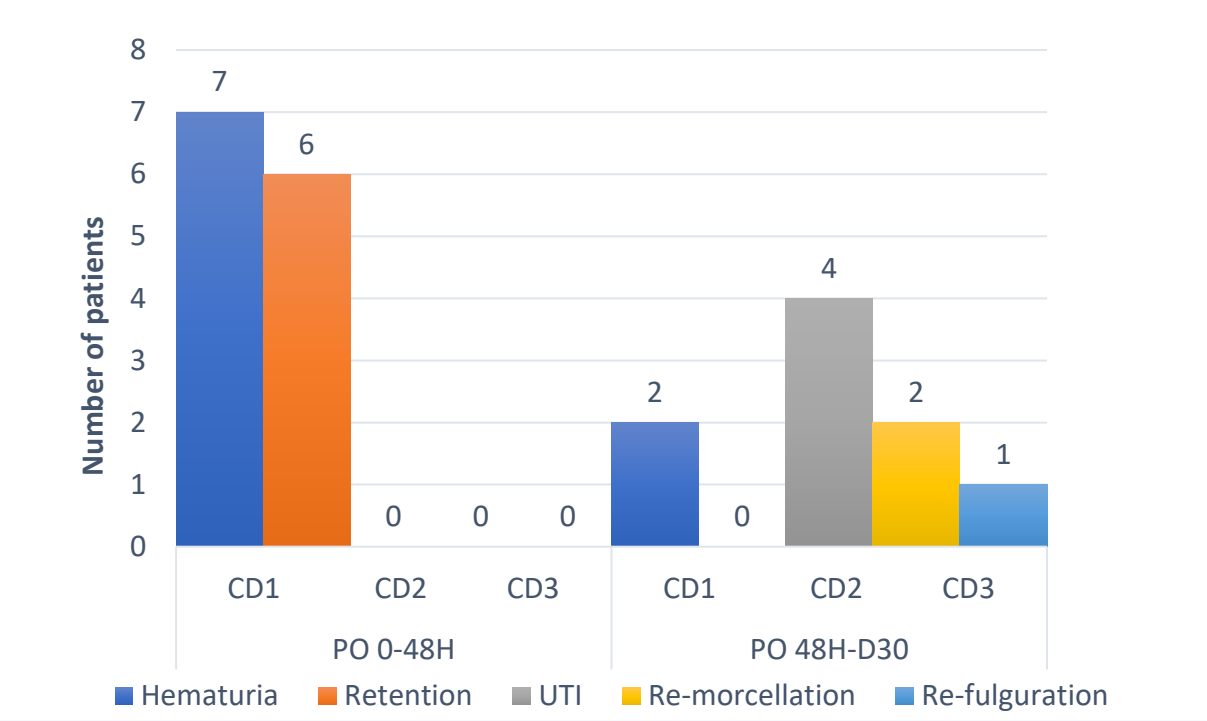


Table 1. Demographic and preoperative data				
	Ambulatory success (n=45)	**Ambulatory failure (n=7)**	**Total (n=52)**	**p**
Age, yr Mean (SD) Median Range	 70.6 (5.8) 70.8 (54.8–83.8)	 73.5 (8.3) 74.6 (61.2–83.7)	 71.0 (6.2) 71.0 (54.8–83.8)	0.355
Prior TURP surgery, n (%)	3 (6.7)	1 (14.3)	4 (7.7)	0.450
Prior prostate embolization, n (%)	4 (8.9)	0 (0)	4 (7.7)	1.000
Prior abdominal surgery, n (%)	14 (31.1)	1 (14.3)	15 (28.8)	0.658
Diabetes, n (%)	6 (13.3)	0 (0)	6 (11.5)	0.580
Known prostate cancer under active surveillance protocol, n (%)	5 (11.1)	0 (0)	5 (9.6)	1.000
Antiplatelet therapy, n (%)	10 (22.2)	2 (28.6)	12 (23.1)	0.656
Anticoagulant therapy, n (%)	5 (11.1)	0 (0)	5 (9.6)	1.000

© 2023 Canadian Urological Association

α-blocker use, n (%)	38 (84.4)	6 (85.7)	44 (84.6)	1.000
5-α reductase inhibitor use, n (%)	26 (57.8)	5 (71.4)	31 (59.6)	0.687
Urinary retention total, n (%) Catheter dependent retention, n (%) Self-catheterization dependent retention, n (%)	29 (64.4) 16 (35.6) 13 (28.9)	6 (85.7) 3 (42.9) 3 (42.9)	35 (67.3) 19 (36.5) 16 (30.8)	0.601
Time of catheter or self-catheterization dependence (months) Mean (SD) Median Range	 10.7 (6.3) 9.0 (2–26)	8.0 (1.8) 7.5 (6–11)	10.2 (5.9) 9.0 (2–26)	0.442
Hemoglobin (g/L) Mean (SD) Median Range	 143.6 (16.4) 144.0 (62.0–176.0)	 139.6 (11.4) 140.0 (118.0–151.0)	 143.0 (15.8) 144.0 (62.0–176.0)	0.324
Prostatic-specific antigen (ng/mL) Mean (SD) Median Range	 6.6 (5.4) 5.1 (0.9–26.0)	7.0 (7.4) 4.2 (0.8–22.9)	6.6 (5.7) 4.9 (0.8–26.0)	0.820
Serum creatinine (micromole/L) Mean (SD) Median Range	 92.4 (24.8) 84.0 (63.0–183.0)	 85.0 (20.1) 79.0 (56.0–117.0)	 91.4 (24.2) 84.0 (56.0–183.0)	0.494
Prostate volume (cm^3) Mean (SD) Median Range	 106.9 (43.3) 104.0 (41.8–200.0)	 138.0 (44.5) 131.0 (92.3–221.0)	 111.1 (44.3) 107.5 (41.8–221.0)	0.108

SD: standard deviation; TURP: transurethral resection of the prostate.

© 2023 Canadian Urological Association

Table 2. Perioperative and postoperative data				
	Ambulatory success (n=45)	**Ambulatory failure (n=7)**	**Total (n=52)**	**p**
ASA score ≥3, n (%)	10 (22.2)	0 (0)	10 (19.2)	0.322
Anesthetic type, n (%) Spinal Laryngeal mask airway Intubation	 17 (37.8) 14 (31.1) 14 (31.1)	 4 (57.1) 2 (28.6) 1 (14.3)	 21 (40.4) 16 (30.8) 15 (28.8)	0.613
Surgery time (min) Mean (SD) Median Range	 97.4 (30.4) 90.0 (56.0–202.0)	 126.1 (47.5) 109.0 (88.0–225.0)	 101.3 (34.1) 91.0 (53.0–225.0)	**0.046**
Delivered energy (J) Mean (SD) Median Range	 93.1 (26.4) 86.6 (38.9–140.2)	 83.0 (10.4) 80.9 (72.6–97.4)	 92.2 (25.4) 84.6 (38.9–140.2)	0.604
Morcellated prostate volume (g) Mean (SD) Median Range	 55.3 (22.4) 53.0 (20.0–111.5)	 72.1 (35.7) 72.0 (31.5–127.5)	 57.5 (24.9) 53.5 (20.0–127.5)	0.302
Benign pathology, n (%)	37 (82.2)	7 (100.0)	44 (84.6)	0.578
Hemoglobin (g/L) Mean (SD) Median Range Change from baseline (SD)	 142.8 (12.2) 143.0 (118.0–170.0) -6.9 (8.3)	 120.5 (16.6) 126.5 (92.0–136.0) -19.2 (17.4)	 137.2 (16.3) 138.5 (92.0–170.0) -10.4 (12.5)	**0.002**
Prostatic-specific antigen (ng/mL) Mean (SD) Median Range Change from baseline (SD)	 0.8 (0.8) 0.6 (0.1–2.9) -6.3 (5.5)	 1.1 (1.8) 0.5 (<0.1–4.7) -3.3 (2.1)	 0.8 (0.9) 0.6 (<0.1–4.7) -5.7 (5.3)	0.543
Serum creatinine (micromole/L) Mean (SD) Median Range Change from baseline (SD)	 91.3 (20.4) 88.5 (65.0–155.0) 0.7 (13.3)	 81.0 (22.5) 78.0 (46.0–115.0) -4.0 (10.0)	 89.8 (20.8) 88.0 (46.0–155.0) 0.0 (12.9)	0.346

ASA: American Society of Anesthesiologists; SD: standard deviation

© 2023 Canadian Urological Association

Table 3. Strength of association between risk factors and ambulatory failure according to univariable penalized logistic regression		
	OR (95% confidence interval)	**p**
Preoperative		
Age	1.08 (0.95–1.30)	0.27
Prior TURP surgery	2.80 (0.11–22.05)	0.38
Prior prostate embolization	0.61 (0.00–6.80)	0.78
Prior abdominal surgery	0.50 (0.02–2.71)	0.48
Diabetes	0.41 (0.00–4.10)	0.58
Known prostate cancer under active surveillance protocol	0.49 (0.00–5.20)	0.67
Antiplatelet therapy	1.54 (0.18–7.66)	0.62
Anticoagulant therapy	0.49 (0.00–5.20)	0.67
α-blocker use	0.84 (0.14–22.53)	0.87
5-α reductase inhibitor use	1.62 (0.35–13.70)	0.56
Urinary retention total Catheter dependent retention Self-catheterization dependent retention	 2.33 (0.34–64.27) 2.85 (0.41–79.66)	 0.43 0.33
Time of catheter or self-catheterization dependence	0.93 (0.68–1.10)	0.44
Prostatic-specific antigen	1.03 (0.86–1.15)	0.68
Prostate volume	1.02 (1.00–1.04)	0.11
ASA score ≥3	0.23 (0.00–2.13)	0.34
Per-operative		
Anesthetic type Laryngeal mask airway Intubation	 0.67 (0.08–3.60) 0.40 (0.02–2.49)	 0.65 0.38
Surgery time	1.02 (0.99–1.05)	0.07
Delivered energy	0.99 (0.93–1.00)	0.51
Morcellated prostate volume	1.02 (0.99–1.06)	0.12
Postoperative		
Benign pathology	3.40 (0.35–inf.)	0.44
Prostatic-specific antigen	1.41 (0.54–2.98)	0.37

© 2023 Canadian Urological Association

Table 4. Three months postoperative functional outcomes		
	Preoperative (n=45)	**3 months postoperative (n=45)**
IPSS*		
Mean (SD)	18.1/35 (7.6/35)	6.7/35 (4.3/35)
Median	19.0/35	6.0/35
Range	(0/35–30/35)	(0/35–18/35)
Change from baseline (SD)	/	-11.3 (8.2)
IPSS quality of life*		
Mean (SD)	4.5/6 (1.6/6)	1.7/6 (1.8/6)
Median	4.5/6	1.0/6
Range	(0/6–6/6)	(0/6–6/6)
Change from baseline (SD)	/	-2.7 (2.3)
Postvoid residual volume (ml)*		
Mean (SD)	219.1 (148.9)	75.0 (71.3)
Median	167.0	44.0
Range	(60.0–600.0)	(0–259.0)
Change from baseline (SD)*	/	-177.4 (147.5)
Qmax (mL/second)**		
Mean (SD)	4.1 (6.5)	19.8 (11.2)
Median	0.0	17.0
Range	(0.0–36.0)	(3.5–49.0)
Change from baseline (SD)*	/	+16.0 (12.5)
Catheter or self-catheterization dependent, n (%)	35 (67.3)	2 (3.8)

*Only applies to patients non-catheter or self-catheterization-dependent. **Patients who were catheter or self-catheterization-dependent were considered to have a Qmax of 0. IPSS: International Prostate Symptom Score; SD: standard deviation; Qmax: maximum urinary flow rate.

© 2023 Canadian Urological Association