HoLEP: Implementing the Technique and Initial Report of the First 100 Cases

Roxana-Andra Coman[1,2*], Bogdan Petruț[1,2]

[1] 1Department of Urology, "Iuliu Haţieganu" University of Medicine and Pharmacy, 400012 Cluj-Napoca, Romania
[2] Department of Urology, Medicover Hospital, 407062, Cluj, Romania

ABSTRACT

Introduction and objectives: To report our experience and analyze the surgical and functional parameters of the first 100 cases of Holmium laser enucleation of the prostate (HoLEP) performed by a single surgeon in a single center.

Materials and Methods : A total of 100 cases of HoLEP were performed between June 2022 and November 2023. The mean age of the patients was 68.10 ± 9.00 (range 47-85) years. There was no limit for prostate size, with a mean prostate size of 86.48 ± 52.11 (range 25-330) g. Follow-up was performed regularly at 1, 3, 6, and 12 months by assessing Qmax, PVR, IPSS, and QoL.

Results : The weight of prostate chips retrieved after morcellation was 49.86 ± 18.29 (10-220) g, with an enucleation time of 63.74 ± 12.7 (45-120) min and a morcellation time of 13.14 ± 5.08 (5-25) min, resulting in an estimated efficiency rate of 0.54 g/min. 57.65% of the estimated preoperative prostate volume was removed. At 1 month, mean Qmax increased from 10.55 to 20.82 ml/s (P 0.001), while mean PVR decreased from 102.10 to 40.3 ml (P 0.001), with an improvement in mean IPSS score from 23.17 to 9.17 (P < 0.001) over the same period. These improvements were maintained throughout the 12-month follow-up period. Transient irritative voiding symptoms were reported in 23 patients (23%) and were self-limited and controlled with anticholinergics and non-steroidal anti-inflammatory drugs. None of the patients developed TUR syndrome. There was no need for reintervention.

Conclusions: HoLEP appears to be a good alternative to the gold standard treatment for BPH regardless of adenoma size with a low incidence of complications. It is not an easy procedure, but good results can be achieved by inexperienced surgeons after a short training period.

Keywords: BPH, HoLEP, Holmium laser, laser enucleation, LUTS.

Correspondence to:
Roxana-Andra Coman, MD, FEBU.
Medicover Hospital, Strada Principala, nr. 323T, Suceagu 407062, Cluj, Romania
tel: +40743133087
e-mail: dr.roxanacoman@yahoo.com

Introduction and objectives

Benign prostatic hyperplasia (BPH) is an age-related benign neoplasm affecting 8% of the male population in the 4th decade and approximately 90% in the 9th decade. It refers to an increase in prostate volume that causes lower urinary tract symptoms - LUTS (irritative, obstructive or mixed) - which can affect the patient's quality of life [1].

Surgical treatment of BPH has evolved over the last decade. Transurethral resection of the prostate (TUR-P) and open prostatectomy (OP) have been the gold standard treatments for the last 30 years, despite the potential complications of blood transfusion, TUR syndrome, urinary retention, dysuria, frequency, urgency, and overactive bladder [2].

Holmium laser ablation of the prostate was first reported by Gilling et al (1995) [3]. Holmium laser enucleation of the prostate (HoLEP) is the next step in laser prostatectomy. Optimization of the surgical technique and use of a mechanical tissue morcellator resulted in anatomical enucleation of prostate adenomas of any size [4,5]. Several studies have suggested that HoLEP is a minimally invasive and efficient procedure for functional outcomes, similar to TURP and surgery, with lower morbidity rates and shorter hospital stay [6,7]. Recently, Shvero et al. reported that HoLEP is the new gold standard for surgical treatment of BPH [8].

In this study, we present the implementation of this technique in our hospital and the initial report of the first 100 cases with a 12-month follow-up.

Materials and Methods

We performed a prospective analysis of 100 patients with LUTS due to BPH who underwent HoLEP between June 2022 and November 2023. All patients had BPH-related obstructive voiding symptoms. Transrectal ultrasound biopsies were performed in patients with elevated prostate-specific antigen (PSA) levels and/or abnormal digital rectal examination and/or MRI PI-RADS score ≥ 3 concurrent with or before HoLEP. Patients with prostate cancer who had undergone radical prostatectomy, urethral stricture, neurogenic bladder, previous bladder neck or urethral surgery were excluded. There was no restriction on prostate size.

This observational study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and received ethical approval from the local ethics committee (No 201/02.05.2022). Informed consent was waived for this prospective analysis.

All patients underwent routine preoperative assessment, including International Prostate Symptom Score (IPSS), Quality of Life (QoL) index, maximum urinary flow rate (Qmax), and postvoid residual urine (PVR) volume. Abdominal ultrasound to measure prostate volume, PVR measurement, and uroflowmetry were performed in all patients. The duration of catheterization and hospital stay and any peri- or post-operative adverse events were recorded. Mean Qmax rate, PVR, and IPSS were evaluated at 1, 3, 6, and 12 months after HoLEP. Total operative time including enucleation and morcellation time was also recorded and histological results were reviewed.

All HoLEP procedures were performed by a single surgeon (B.P.) with > 10 years of experience performing TUR-P but who had never performed HoLEP. The surgeon first attended a fellowship at the referral center. He then underwent proctoring of six cases.

The HoLEP procedure involves blunt dissection using a resectoscope to cut and detach the adenoma from the surgical capsule of the prostate. This procedure is called enucleation because it is believed that the transitional zone of the prostate is removed in the same way as in OP, with excellent hemostasis provided by the Holmium laser. The verumontanum and ureteral orifices were visualized before the procedure.

Our equipment consisted of a 100W MultiPulse Ho Plus (Jena Surgical) with a 550 µm laser fiber, a 26F continuous flow Storz resectoscope sheath with laser bridge, and an integrated morcellation module. The morcellator was inserted through the nephroscope for tissue harvest. Normal saline was used for irrigation during the procedure. Enucleation was performed using laser settings of 2J and 45 Hz.?

A three-lobe technique was used, starting with two incisions at the 5 and 7 o'clock positions. Each incision was started at the bladder neck on either side of the verumontanum and deepened to the level of the surgical capsule. Enucleation of the

median lobe began at the verumontanum. Using blunt and sharp dissection, the median lobe is then enucleated in a retrograde fashion towards the bladder neck and released into the bladder. The next step of the operation is to move towards the lateral lobes by developing the plane lateral to the verumontanum at the apex of the adenoma. The resection was continued circumferentially to the 3 and 9 o'clock positions (Fig 1.). The resectoscope was then rotated to begin the 12 o'clock incision to open the plane for enucleation of the superior aspect of the lateral lobes. The lateral lobes were then released into the bladder (Fig 2.). After proper hemostasis is achieved, the resectoscope is changed to a nephroscope. All three lobes were morcellated and suctioned.(Fig 3.) The bladder was distended to avoid bladder wall injury during morcellation. Hemostasis was achieved using a monopolar roller ball. At the end of the surgery, a 3-way 22F silicone catheter was placed, and continuous bladder irrigation was initiated



Fig 1. Enucleation of the right lateral lobe using the Holmium laser fiber – the adenomatous tissue is located in the upper part of the image and the surgical capsule in the lower part.



Fig 2. The final aspect of the prostatic capsule

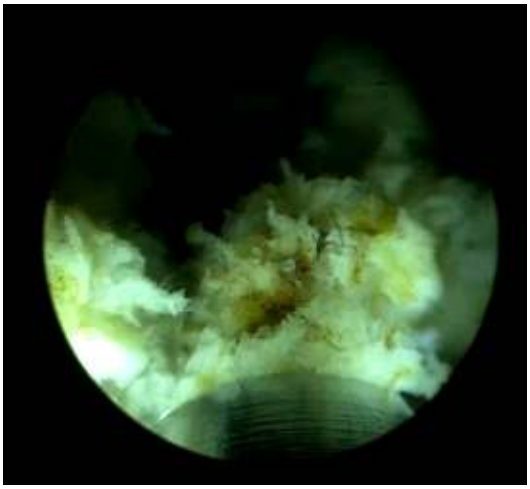


Fig 3. The enucleated prostate tissue is morcellated into smaller pieces, that are suctioned out of the bladder

Results

Table 1. Patients' demographic and preoperative data

	Mean ± SD (Range)
Age	68.10 ± 9.00 (47-85)
Associated conditions	
Hypertension	53
Ischaemic heart disease	16
Diabetes mellitus	12
Chronic renal failure	7
Bladder stones	1
Bladder tumor	1
Patients on anticoagulant or antiplatelet therapy	19
Indication of surgery	
Urinary retention	15 (15%)
Failure of medical management	67 (67%)
Bladder calculi	1 (1%)
Refusal of medical management	17 (17%)
Preoperative	
IPSS symptom score	23.17 (6-35)
QoL	4.76 (3-6)
Prostate weight (g)	86.48 ± 52.11 (25-330)
Qmax (ml/s)	10.55 ± 4.32 (3.2-23.9)
PVR (ml)	102.10 ± 94.29 (33-330)
PSA (ng/ml)	6.91 ± (0.15-59)

Table 2. Operative data

	Mean ± SD (Range)
HoLEP time (min)	83.11 ±20.62 (60-145)
Enucleation time (min)	63.74 ±12.7 (45-120)
Morcellation time (min)	13.14 ± 5.08 (5-25)
Weight enucleated (g)	49.86 ± 18.29 (10-220)
Enucleation efficiency (g/min)	0.54 ± 0.06 (0.2-0.81)
Morcellation efficiency (g/min)	3.11 ± 0.04 (0.5-6.22)
Catether time (d)	7.25 ± 2.01 (4-14)
Hospital stay (d)	2.47 ± 1.16 (1-7)

Table 3. Preoperative and postoperative parameters

	preoperative	1 Mo	3 Mo	6 Mo	12 Mo
No patients	85	96	78	59	41
IPSS	23.17 (6-35)	9.17 (4-33)	7.44 (2-21)	6.16 (0-12)	5.82 (0-12)
QoL	4.76 (3-6)	2.1 (1-3)	1.9 (0-3)	1.8 (0-3)	1.5 (0-2)
Qmax (mean)	10.55 ± 4.32 (3.2-23.9)	20.82 ± 4.62 (9.8-45.7)	19.68 ± 4.54 (9.3-39.5)	18.94 ± 4.68 (10.3-34.9)	19.42 ± 4.42 (9.6-29.8)
PVR (mean)	102.10 ± 94.29 (33-330)	40.3 ± 22.19 (0-100)	25.5 ± 21.36 (0-85)	30.8 ± 18.32 (0-70)	19.8 ± 15.64 (0-60)

Table 4. Complications

blood transfusions	5
TUR syndrome	0
superficial bladder mucosal injury	3
capsular perforation	11
catheterization	0
transient urinary incontinence	14
permanent urinary incontinence	0
urinary tract infections	4
epididymitis	2
clot evacuation	2
urethral stricture	1
meatal/submeatal stenosis	2

Patient demographics and perioperative data are shown in Table 1. HoLEP was successfully performed using the 3-lobe technique in 92 patients and the 2-lobe technique in eight patients. There were no conversions to TUR-P.

Bladder stone lithotripsy was performed in the same session in one patient with 2 associated bladder stones (2.57 and 2.17 cm) using Holmium laser prior to HoLEP. In one case we also performed a resection of the bladder tumour and one patient underwent circumcision.

Operative data are presented in Table 2. We were able to remove 57.65% of the estimated preoperative prostate volume (86.48 g before HoLEP vs. 49.86 g for retrieved prostate tissue) with an estimated efficiency rate of 0.54 g/min for enucleation and 3.11 g/min for morcellation.

The follow-up is illustrated in Table 3. At 1 month, mean Qmax increased from 10.55 to 20.82 ml/s (P 0.001), while mean PVR decreased from 102.10 to 40.3 ml (P 0.001), with an improvement in mean IPSS score from 23.17 to 9.17 (P 0.001) over the same period. These improvements were maintained throughout the 12-month follow-up period.

Capsular perforation was the most common complication during HoLEP, occurring in 11% of patients (Table 4). Most of these perforations did not require any change in patient management. Two patients had a subtrigonal perforation. The first subtrigonal perforation occurred in the first patient who underwent HoLEP and two drains were placed suprapubically for extraperitoneal extravasation. The second perforation was performed by accidentally inserting a silicone catheter in the subtrigonal plane at the end of the procedure. The catheter was then removed and reinserted into the guidewire.

None of the patients developed TUR syndrome due to HoLEP. Five patients required blood transfusion after HoLEP and three patients also received platelets. Six patients developed severe haematuria

and in one case blood clots had to be evacuated. No re-intervention was required.
Transient irritative voiding symptoms were reported in 23 patients (23%) and were self-limited and controlled with anticholinergics and non-steroidal anti-inflammatory drugs. These symptoms resolved in 14 patients after 1 month, in six patients after 3 months, and in only three patients they persisted for 6 months. A further seven patients (7%) experienced stress urinary incontinence, all of which was transient and resolved 3 months after surgery.

Discussion

HoLEP with mechanical morcellation is increasingly used worldwide as a therapeutic option for BPH. In OP, the surgeon uses the index finger to mechanically enucleate the adenoma from the prostate capsule, but in HoLEP the laser is considered the surgeon's finger and the morcellator is used to remove the prostate adenoma from the bladder [9].
Although surgery is the most invasive procedure for BPH, involving a lower abdominal incision, longer recovery time, significant risk of complications and cost [10], it provides a high rate of symptomatic improvement, durable results, and a low rate of treatment failure [11]. Robotic-assisted simple prostatectomy was associated with lower morbidity, shorter catheterization times, and shorter hospital stays compared with open surgery, but higher costs. Functional outcomes were similar [12].
In the 1990s, minimally invasive treatment, TUR-P, became the new gold standard for surgical treatment of BPH because it offered a lower complication rate and shorter hospital stay. It was an effective and safe procedure but had some limitations for patients with large prostates and an increased risk of bleeding [13]. These limitations led to the introduction of other minimally invasive techniques.
Several studies have shown that HoLEP is as effective as TURP or surgery in improving subjective symptoms and urodynamic results in patients with BPH and has a low morbidity rate [6, 7]. The results of our study showed a significant improvement in post-operative IPSS, Qmax, PVR and QoL index compared to baseline. We demonstrated that the HoLEP surgical technique can effectively relieve obstruction caused by BPH. There were 15 patients with urinary retention in our study, and we found that despite their high PVR, they did not have difficulty voiding but had an increased rate of iritative symptoms.
By using the Holmium laser, a hemostatic scalpel that cuts and coagulates the vessels, less blood loss is reported with the HoLEP procedure compared to TUR-P and OP [7,14]. Another explanation for the reduced blood loss is that in HoLEP the blood vessels are cut once from the capsule during enucleation, whereas in TURP the vessels are cut repeatedly until the prostate capsule is reached. Blood transfusion rates are low with HoLEP, even in large prostates [15].
An important advantage of HoLEP is the use of normal saline during enucleation and morcellation, which allows us to extend the operating time without worrying about dilutional hyponatremia. The Holmium laser also reduces the absorption of irrigation fluid by sealing the venous vessels [16]. No patient developed TUR syndrome.
Capsular perforation is more common early in the learning curve and in smaller prostates [17]. In smaller prostates, the tissue is more fibrotic and the surgical capsule is more difficult to identify and dissection is more challenging than in larger prostates where peripheral compression results in a more easily identifiable surgical plane [18]. Most capsular perforations can be managed conservatively with urethral catheter drainage [19].
Three patients had injuries to the bladder mucosa. These were superficial and did not require further surgery. The patients were cured by 7-10 days of catheterization. Bladder injury can occur during morcellation. The bladder mucosa collapses into the morcellator blades due to insufficient bladder filling. This complication can be avoided by good hemostasis and proper distension of the bladder prior to morcellation [20].
Transient urinary incontinence was common, especially in the early cases. Early incontinence can be common, but late iatrogenic stress incontinence is rare. Early incontinence is usually represented by irritative symptoms secondary to the laser energy applied to the capsule, possibly associated with urinary tract infection or detrusor instability caused

by long-standing BPH. The higher incidence of transient incontinence can be explained by the complete removal of the adenoma and the closed resection to the external sphincter [21]. To avoid damage to the external sphincter, the apical incision should be made carefully at the 12 o'clock position so as not to be distal to the verumontanum. Most symptoms respond to anticholinergic treatment and resolve in 1 to 6 months [17]. Vavassori et al showed that 23% of mild to severe irritative symptoms respond to non-steroidal anti-inflammatory drugs [19].

Complications, including bladder injury during morcellation, capsular perforation and transient urinary incontinence, were more common in the first 20 patients but decreased with increasing surgeon experience.

In terms of operative time, some authors have reported a longer operative time with HoLEP compared with conventional surgery, which is considered a major disadvantage [22]. On the other hand, it is considered a more efficient technique if we calculate the amount of tissue removed per unit of time [23]. In the early cases, we also reported longer operative times, but with increasing experience, both enucleation and morcellation times have been reduced.

HoLEP has been compared with TUR-P in many trials and the results were better independent of prostate volume in terms of catheterization time, hospital stay, and risk of bleeding and also in large-volume prostates in long-term follow-up improved Qmax, PSA, and QoL. This could lead to the HoLEP procedure becoming the best choice for the treatment of large-volume prostates [24].

t is difficult to define how many cases are needed to master the HoLEP procedure. Some authors suggest that 20-30 procedures are sufficient to achieve good results [23], but without proper instruction, approximately 50 cases are required to master the technique [21]. The learning curve can be shortened if there is a minimum period of expert supervision and the first cases are properly selected. In our experience, the surgeon became confident with the HoLEP technique after about 15 procedures. He also benefited from the supervision of an expert who provided valuable information for the first six cases. We also believe that the experience with TUR-P has facilitated the learning curve.

Conclusion

In conclusion, this study revealed a low incidence of complications using the HoLEP technique. Most complications were minor and could be managed conservatively. HoLEP appears to be a good alternative to the gold standard treatment for BPH irrespective of the adenoma size. It is not a simple procedure, but good results can be achieved if previous fellowships and proctorship steps are passed. Considering the fact that the Holmium enucleation technique completely eliminates the adenoma - at the limit with the normal prostate - we postulate a possible shift of the indication for surgery in the early stages of the adenoma, in order to minimize the deterioration of the micturition physiology.

References

Langan RC. Benign Prostatic Hyperplasia. Prim Care (2019) Jun;46(2):223-232. doi: 10.1016/j.pop.2019.02.003. Epub 2019 Apr 1.

Marien T, Kadihasanoglu M, Miller NL. Holmium laser enucleation of the prostate: patient selection and perspectives. Res Rep Urol (2016) Oct 21;8:181-192. doi: 10.2147/RRU.S100245. eCollection 2016.

Gilling PJ, Cass CB, Malcolm AR, Fraundorfer MR. Combination holmium and Nd:YAG laser ablation of the prostate: initial clinical experience. J Endourol (1995) Apr;9(2):151-3. doi: 10.1089/end.1995.9.151.

Kuntz RM, Lehrich K, Ahyai S. Does perioperative outcome of transurethral holmium laser enucleation of the prostate depend on prostate size? J Endourol (2004) Mar;18(2):183-8. doi: 10.1089/089277904322959842.

Kuntz RM. Current role of lasers in the treatment of benign prostatic hyperplasia (BPH). Eur Urol (2006) Jun;49(6):961-9. doi: 10.1016/j.eururo.2006.03.028. Epub 2006 Mar 31.

Mavuduru RM, Mandal AK, Singh SK, et al. Comparison of HoLEP and TURP in terms of efficacy in the early postoperative period and perioperative morbidity. Urol Int (2009);82(2):130-5. doi: 10.1159/000200786. Epub 2009 Mar 19.

Naspro R, Suardi N, Salonia A, et al. Holmium laser enucleation of the prostate versus open

prostatectomy for prostates >70 g: 24-month follow-up. Eur Urol (2006) Sep;50(3):563-8. doi: 10.1016/j.eururo.2006.04.003. Epub 2006 May 2.

Shvero A, Calio B, Humphreys MR, Das AK. HoLEP: the new gold standard for surgical treatment of benign prostatic hyperplasia. Can J Urol (2021) Aug;28(S2):6-10.

Elzayat EA, Elhilali MM. Holmium laser enucleation of the prostate (HoLEP): the endourologic alternative to open prostatectomy. Eur Urol (2006) Jan;49(1):87-91. doi: 10.1016/j.eururo.2005.08.015. Epub 2005 Nov 2.

Gratzke C, Schlenker B, Seitz M, Karl A, Hermanek P, Lack N. Complications and early postoperative outcome after open prostatectomy in patients with benign prostatic enlargement: results of a prospective multicenter study. J Urol (2007) Apr;177(4):1419-22. doi: 10.1016/j.juro.2006.11.062.

Salonia A, Suardi N, Naspro R, et al. Holmium laser enucleation versus open prostatectomy for benign prostatic hyperplasia: an inpatient cost analysis. Urology (2006) Aug;68(2):302-6. doi: 10.1016/j.urology.2006.02.007.

Benarroche D, Paladini A, Grobet-Jeandin E, et al. Robotic versus open simple prostatectomy for benign prostatic hyperplasia in large glands: single-centre study. World J Urol (2022) Dec;40(12):3001-3006. doi: 10.1007/s00345-022-04176-z. Epub 2022 Oct 14.

Tubaro A. BPH treatment: a paradigm shift. Eur Urol (2006) Jun;49(6):939-41. doi: 10.1016/j.eururo.2006.03.055. Epub 2006 Apr 7.

Kuntz RM, Ahyai S, Lehrich K, Fayad A. Transurethral holmium laser enucleation of the prostate versus transurethral electrocautery resection of the prostate: a randomized prospective trial in 200 patients. J Urol (2004) Sep;172(3):1012-6. doi: 10.1097/01.ju.0000136218.11998.9e.

Matlaga BR, Kim SC, Kuo RL, Watkins SL, Lingeman JE. Holmium laser enucleation of the prostate for prostates of >125 mL. BJU Int (2006) Jan;97(1):81-4. doi: 10.1111/j.1464-410X.2006.05898.x.

Hochreiter WW, Thalmann GN, Burkhard FC, Studer UE. Holmium laser enucleation of the prostate combined with electrocautery resection: the mushroom technique. J Urol (2002) Oct;168(4 Pt 1):1470-4. doi: 10.1016/S0022-5347(05)64476-X.

Elzayat EA, Habib EI, Elhilali MM. Holmium laser enucleation of the prostate: a size-independent new "gold standard". Urology (2005) Nov;66(5 Suppl):108-13. doi: 10.1016/j.urology.2005.06.006.

Aho TF, Gilling PJ, Kennett KM, Westenberg AM, Fraundorfer MR, Frampton CM. Holmium laser bladder neck incision versus holmium enucleation of the prostate as outpatient procedures for prostates less than 40 grams: a randomized trial. J Urol (2005) Jul;174(1):210-4. doi: 10.1097/01.ju.0000161610.68204.ee.

Vavassori I, Hurle R, Vismara A, Manzetti A, Valenti S. Holmium laser enucleation of the prostate combined with mechanical morcellation: two years of experience with 196 patients. J Endourol (2004) Feb;18(1):109-12. doi: 10.1089/089277904322836767.

Hurle R, Vavassori I, Piccinelli A, Manzetti A, Valenti S, Vismara A. Holmium laser enucleation of the prostate combined with mechanical morcellation in 155 patients with benign prostatic hyperplasia. Urology (2002) Sep;60(3):449-53. doi: 10.1016/s0090-4295(02)01812-5.

Seki N, Mochida O, Kinukawa N, Sagiyama K, Naito S. Holmium laser enucleation for prostatic adenoma: analysis of learning curve over the course of 70 consecutive cases. J Urol (2003) Nov;170(5):1847-50. doi: 10.1097/01.ju.0000092035.16351.9d.

Kuntz RM, Lehrich K. Transurethral holmium laser enucleation versus transvesical open enucleation for prostate adenoma greater than 100 gm.:: a randomized prospective trial of 120 patients. J Urol (2002) Oct;168(4 Pt 1):1465-9. doi: 10.1016/S0022-5347(05)64475-8.

Montorsi F, Naspro R, Salonia A, et al. Holmium laser enucleation versus transurethral resection of the prostate: results from a 2-center, prospective, randomized trial in patients with obstructive benign prostatic hyperplasia. J Urol (2004) Nov;172(5 Pt 1):1926-9. doi: 10.1097/01.ju.0000140501.68841.a1.

Sun F, Yao H, Bao X, et al. The Efficacy and Safety of HoLEP for Benign Prostatic Hyperplasia With Large Volume: A Systematic Review and Meta-Analysis. Am J Mens Health (2022) Jul-Aug;16(4):15579883221113203. doi: 10.1177/15579883221113203.