HoLEP techniques – lessons learned

Asaf Shvero, MD,[1,2] Edward Kloniecke, MD,[1] Courtney Capella, MD,[1]
Akhil K. Das, MD[1]

[1]Department of Urology, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA

[2]Department of Urology, Sheba Medical Center, Ramat-Gan, Israel. Affiliated with Tel Aviv University, Tel Aviv, Israel

SHVERO A, KLONIECKE E, CAPELLA C, DAS AK. HoLEP techniques – lessons learned. *Can J Urol* 2021;28(Suppl 2):11-16.

Introduction: *Holmium laser enucleation of the prostate (HoLEP) with mechanical tissue morcellation is one of the most effective surgical modalities for the treatment of symptomatic BPH. HoLEP has many advantages over the historical gold standards open prostatectomy (OP) and transurethral resection of the prostate (TURP). HoLEP is an AUA guideline endorsed surgical treatment for lower urinary tract symptoms (LUTS) due to benign prostatic hyperplasia (BPH), independent of prostate size.*

Materials and methods: *We provide a detailed presentation of our experience in performing HoLEP in a teaching university hospital, with an emphasis on the surgical technique and its evolution.*

Results: *HoLEP is an efficient and durable procedure, although it is very equipment sensitive and has a relatively long learning curve. HoLEP can be performed by several surgical approaches that can be used according to the specific anatomy of the patient. Advances in laser technology, endoscopic morcellators, and surgical technique has improved the HoLEP procedure in efficiency, hemostasis, and safety.*

Conclusions: *The HoLEP procedure, first introduced in 1998, has undergone significant changes including advancements in laser technology, endoscopic morcellation devices, and modifications to the surgical technique. These advancements have made HoLEP a more effective, more efficient, easier to perform, and easier to learn technique for the surgical management of BPH. The modified 2-lobe and the en-bloc techniques are a natural progression from the classic 3-lobe technique.*

Key Words: HoLEP, surgical management of BPH

Introduction

Lower urinary tract symptoms (LUTS) that originate from benign prostatic hyperplasia (BPH) represent a group of chronic urinary conditions, and occur in 15%-60% of men 40 years or older, and 80% of men 70 years or older in the United States. The prevalence of BPH is increasing due to the aging of the population.[1-3] Histological BPH is a proliferation of the glandular elements, smooth muscle, and connective tissue of the transitional zone of the prostate. BPH may progress to benign prostatic enlargement that can either grow outwards from the prostatic urethra or compress the prostatic urethra and eventually lead to bladder outlet obstruction; this, combined with prostatic inflammation, is considered the main cause of LUTS.[4-6] LUTS from BPH is variable, and early symptoms in the course of this disease can often be controlled with medical therapy alone. Patients who continue to suffer from persistent LUTS or develop complications from BPH will eventually require a surgical intervention.

Holmium laser enucleation of the prostate (HoLEP) with mechanical tissue morcellation is one of the most effective surgical modalities for the treatment of symptomatic BPH. HoLEP, according to the

Address correspondence to Dr. Asaf Shvero, Department of Urology, Thomas Jefferson University, 1025 Walnut Street, Suite 1100, Philadelphia, PA 19107 USA

American Urological Association (AUA) guidelines, is a size-independent procedure for prostatic size reduction. This technique can be employed for the treatment of large prostates over 80 grams. Traditional endoscopic procedures like transurethral resection of the prostate (TURP) are limited to glands under 80 grams due to the absorption of hypotonic fluid used for irrigation during the procedure which can lead to TUR syndrome.[7,8] Patients with large prostates, greater than 80 grams, often require a simple prostatectomy involving a skin incision and longer catheter times due to the cystotomy.

HoLEP has several advantages over TURP, such as the absence of potentially fatal TUR syndrome (which was reported to occur in 1.4% of TURP cases), ability to operate on antithrombotic medication with fewer complications, more efficient tissue removal, improved functional outcomes, etc.[9-11] HoLEP has been previously described as the endoscopic equivalent to open prostatectomy (OP) in which the endoscope during the HoLEP procedure functions as the "surgeon's finger" during blunt enucleation during OP.[12,13] Compared to OP, HoLEP avoids a lower abdominal incision and has shorter recovery time, hospital stay, and catheterization time, as well as a lower complication rate.[14] In total, HoLEP does not seem to add any cost to a traditional TURP, and has significantly reduced cost compared to OP.[15,16] But, HoLEP also has some disadvantages including a higher initial cost of surgical equipment (laser generator, laser fiber, and endoscopic soft-tissue morcellator), longer duration of the procedure (especially at the beginning of the learning curve), and most importantly, a longer learning curve of 20-50 cases.[17,18] The relatively long learning curve and the resultant lack of teaching opportunities present an obstacle and ultimately prevent HoLEP from being adopted by many urologists. Here, we present our experience in performing HoLEP in a teaching university hospital, with an emphasis on the surgical technique.

Surgical technique

Holmium laser prostatectomy can refer to any of the following procedures – holmium laser ablation of the prostate (HoLAP),[19] holmium laser resection of the prostate (HoLRP),[20] holmium laser incision of the prostate (HoIP), and HoLEP. HoLEP is the most equipment intensive out of these procedures, and it is imperative that the surgeon is familiar with the specialized equipment while having access to all the proper tools to finish the procedure. There are other variations of holmium enucleation procedures that utilize the same equipment. These procedures include median-lobe-only enucleation, hybrid procedures such as HoLEP combined with open cystotomy for lobe extraction, distal HoLEP combined with open/robotic prostatectomy, HoLEP combined with robotic diverticulectomy, or lateral lobe prostatic urethral lift combined with median-lobe only HoLEP. The choices of holmium enucleation techniques enable the surgeon to tailor the right procedure for the individual patient. For example, in the case of an extremely large prostate, a combined HoLEP/OP can be considered, or in the situation with a patient who desires to preserve antegrade ejaculation – a HoIP or a median lobe HoLEP may be considered if the anatomy is favorable.

There are several variations of HoLEP that have been described in the literature and include classic 3-lobe, modified 2-lobe, and en-bloc enucleation techniques. The choice for the specific technique is dependent on several factors. The first and most important is the comfort level and experience of the surgeon with a specific technique. This can be an important factor in large teaching university centers; frequently residents perform portions of the procedure. In our experience, it has proven easier for a less-experienced surgeon to start with enucleation of the median lobe and go on to the 3-lobe technique. Second, there is always a concern about residual adenoma tissue that has not been completely resected. This factor is dependent on the recognition of the surgical plane between the adenoma and the prostate, which may be challenging at times, especially for larger glands. And third, the technique used in the distal dissection may impact the possibility of transient stress incontinence (SUI) after surgery. To reduce transient SUI, the beak of the endsoscope is always proximal to the sphincter and the external sphincter is minimally manipulated during the enucleation.[21] Several HoLEP techniques have been introduced to address these issues. The enucleation techniques differ from one another in the incisions that are made in the urethral mucosa and down to the surgical capsule, as well as in the direction of dissection. Here, we will describe the classic 3-lobe technique, the modified 2-lobe technique, en-block technique, and bladder neck preserving techniques.

3-lobe technique

The classic technique described previously by Gilling et al is referred to as the "3-lobe technique".[22] Briefly, in this technique, two mucosal incisions are made and carried down to the fibers of the prostatic capsule at 5 and 7 o'clock, and then these are carried distally to the level of the verumontanum on each side. The distal incisions are connected proximal to the verumontanum and enucleation of the median lobe is performed from distal to proximal fashion and the lobe is released it into the bladder. Next, the12 o'clock bladder neck incision is made from the bladder neck to the level of the verumontanum. This incision is then connected distally to the posterior incisions on both sides. Enucleation of the lateral lobes are done one at a time. The 3-lobe technique is possibly the easiest to learn and is helpful since the lateral lobes can either be enucleated or during the process of learning the technique, the lateral lobes can be addressed with a TUR loop. Another factor of the 3-lobe technique that is helpful for surgeon's learning this technique is the irrigation flow improves as the incisions are widened and endoscopic visibility is improved. In addition, the surgeon will get comfortable using the endoscope beak to lift the adenoma off the capsule, an essential part of advancing the surgeon's skills for true anatomic enucleation. Lastly, the surgeon becomes familiar with the rotating movement of the endoscope and allows the surgeon to follow the contour of the prostatic lobes and identify the point of enucleation, and avoid pushing against the external sphincter. After enucleation, meticulous hemostasis is achieved by activating the laser from a distance on the tissue (usually with "coagulation" setting 2J at 30Hz). Finally, tissue morcellation, to be described in depth later, is performed using a soft-tissue morcellator introduced through an offset nephroscope. A 24 French 3-way Foley catheter is inserted and continuous bladder irrigation is initiated.

From a teaching standpoint, the three-lobe technique provides easy division of the case. Trainees can begin learning the nuances of the procedure with enucleation of the median lobe, which is considered less challenging than the lateral lobes.

Modified 2-lobe technique

In this technique, only one posterior incision is needed at either the 5 or the 7 o'clock position, depending on the configuration of the specific prostate, as well as surgeon's preference. In cases where only one sulcus can be identified this approach can prevent undermining of the trigone. The incision is carried proximal to distal fashion and taken to the level of the verumontanum. Next, the incision divides the adenoma into a lateral lobe on one side, and the median lobe en-bloc with the other lateral lobe. The 12 o'clock incision is the same as in the 3-lobe technique and the posterior and anterior incisions are connected on both sides distally. Enucleation is then completed, followed by tissue morcellation. The advantage of this technique includes only one posterior bladder neck incision, which saves time. In a prospective study comparing HoLEP with the 3-lobe, 2-lobe, and en-bloc techniques, enucleation time was significantly longer for the 3-lobe technique by almost 20%, compared with the other two techniques, with no difference in functional outcome.[23] The 2-lobe technique represents a natural progression from the 3-lobe technique. Nonetheless, it adds complexity as it makes identification of the surgical plane more difficult, and so should be performed by an experienced HoLEP surgeon.

En-bloc technique

This technique involves complete detachment of all 3 prostatic lobes in a distal-to-proximal approach.[21,24] There are several en-bloc techniques described in the literature. The techniques differ in the incisions of the urethral mucosa, but all follow the same principle. The procedure starts with the identification of the distal landmarks - external sphincter, distal border of the lateral lobes and the median lobe, and the verumontanum. Two circular incisions are made from both sides of the verumontanum and laterally around the lateral lobes, to meet at 12 o'clock. The two incisions are connected posteriorly just proximal to the verumontanum, to complete a circumferential incision. These incisions are deepened down to the surgical capsule between the adenoma and the prostate and carried proximally in a circumferential fashion towards the bladder neck while using the beak of the scope and the irrigation for blunt dissection together with the laser fiber for hemostasis and delicate dissection. The adenoma is then released to the bladder and tissue morcellation is performed.[25] In a retrospective study that reviewed 1,115 patients who underwent en-bloc or 2-lobe HoLEP, there was no difference in enucleation time or 6-month functional outcome, but morcellation was more efficient in the 2-lobe approach for prostates > 150 cc by about 30%.[26] Others found en-bloc enucleation to be more time-efficient than other techniques by as much as 30%.[27] The surgeon's preference is the main factor in determining the technique to be used.

Bladder neck preservation techniques

One of the most common side effects of HoLEP is retrograde ejaculation occurring in 70%-80% of cases.[28] In young and sexually active patients undergoing treatment of BPH, this side effect may have a negative impact on quality of life and can adversely affect sexual function.[29] In an effort to maintain antegrade ejaculation after surgery, bladder neck preservation techniques have been described.[30] The bladder neck can be preserved in all HoLEP techniques, by sparing the bladder neck when incising the 5 and 7 o'clock incisions and enucleating in the distal-to-proximal approach without performing any incisions in the bladder neck. This requires identification of the fibers of the bladder neck when enucleating the adenoma before going into the bladder at the final stage of enucleation. In a retrospective report, among 213 patients who underwent en-bloc bladder neck sparing HoLEP, 88.3% had antegrade ejaculation after surgery.[30] There are no reports of the results of these techniques with long term follow up, and rates of re-treatment and bladder neck contractures are not known.

Surgical equipment

Most commonly, a 26 French continuous flow endoscope with a 30° lens used with a laser bridge. A 550-micron end-fire laser fiber is inserted through a 7 French laser catheter that has a locking adapter that stabilizes the fiber. The irrigation fluid used is normal saline. We currently use a high-power 120W laser generator with a dual-foot pedal. The laser settings are usually 2J and 50Hz in wide-pulse for enucleation and 2J and 30Hz, wide-pulse mode for hemostasis and apical dissection. The dual-pedals allow easy switching between these two laser settings as needed. Morcellation is done with a 26.5 French offset nephroscope and a 5Fr oscillating soft-tissue morcellator unit with a single-use blade. The nephroscope fits inside the outer sheath of the 26 French continuous flow endoscope with an adapter. The adapter allows us to omit the need for re-introduction of the nephroscope through the urethra. In addition, to maximize visibility and prevent injury to the bladder mucosa by the endoscopic soft-tissue morcellator, both ports of the continuous flow endoscope are used for inflow. The blades of the morcellator have a reciprocating hollow blade with suction and are positioned under the adenoma inside the bladder. The initial morcellator setting is 450 rotations-per-minute (RPM) and is changed if needed.

Energy

HoLEP employs a 2140nm wavelength Ho:YAG laser that is absorbed by water and water-containing soft tissue and has a soft tissue penetration depth of only 0.4 mm, and an incision depth of 2 mm.[31] At a distance of less than 3 mm from the tissue, the laser will achieve hemostasis, and in direct contact with the tissue, it will achieve cutting and/or vaporization of the prostatic tissue. The minimal depth of absorption of holmium laser energy in tissue and the absorption of energy in normal saline allows the surgeon to be more precise in cutting the tissue. The ultimate outcome of the holmium laser on tissue is the "what you see is what you get" effect.[32,33] Pulse width does not affect energy output but delivers the same energy for a longer time. The newer 120 Watt laser has the option for using a wider pulse (longer pulse) which has been shown to lessen fiber degradation during lithotripsy,[34] and have a better coagulation effect, but does not affect the soft-tissue incision depth.[31,35] Recently, a modulated pulsed holmium laser energy used initially at lower settings technology for lithotripsy has been optimized for HoLEP at higher energy settings. This newer and more powerful laser has been shown to reduce enucleation and hemostasis times.[36,37]

Morcellation

The purpose of morcellation is to remove of the enucleated prostatic tissue safely out of the bladder. Electromechanical morcellation of enucleated prostatic tissue was first described in 1998.[38] Newer generations of these devices have made much progress in an effort to enhance efficiency (measured in grams removed per minute) and safety. During morcellation, especially for small-volume bladders, or when bleeding hampers visualization – there is a risk of damaging the bladder wall, mostly the posterior wall or the dome of the bladder.[39] The morcellator is introduced through an offset nephroscope. Once enucleation is completed, just prior to endoscopic soft-tissue removal, it is important to not let the bladder drain completely. The rapid decompression of the bladder may cause bleeding from the bladder lining or prostate capsule which affects visualization. The commonly available morcellators differ in the way their cutting blade moves - the Pirhana (Richard Wolf, Knuittlingen, Germany) has a toothed oscillating blade, DrillCut (Karl Storz, Tuttlingen, Germany) has a toothed rotating blade, and the VersaCut (Lumenis, Santa Clara, CA, USA) has a non-toothed guillotine blade. The morcellator devices have one or two pedals and enable the surgeon to perform suction-only or suction-and-morcellation (either by a different pedal or by pushing the single pedal lightly for suction and forcefully for suction and morcellation). Head-to-head studies have failed to find a significant difference in the efficiency and rate of complications of the different devices.[40,41] A recent review of 26 studies and 5,652 patients assessed the efficiency and safety of the three available morcellators: efficiency was 5.3, 5.29, and 3.95 g/min for the DrillCut, Pirhana, and VersaCut devices respectively. Bladder wall injury was more common with the VersaCut device (5.23%) compared to the Pirhana (1.24%) and DrillCut (1.98%), but VersaCut had the lowest malfunction rates (0.74%) compared to Pirhana (2.07%) and DrillCut (7.86%).[39]

Morcellation can be challenging at times. In situations where it is difficult to collect the tissue pieces via the morcellator (i.e. the "beach-ball" effect, the tissue bounces off the morcellator caused by an indurated nodular adenoma), the RPM of the morcellator is reduced and the adenoma is carried to the prostatic fossa. In this reduced space of the prostatic capsule and decreased morcellator blade speed, the ability to remove difficult adenoma pieces is optimized. Extraction devices such as a basket-grasping device introduced through the nephroscope (a device normally used for nephrolithotomy), or a retrieval loop used with a 26Fr resectoscope bridge can drag large indurated pieces out of the urethra.

Conclusions

HoLEP is an AUA guideline endorsed surgical treatment for LUTS due to BPH, independent of prostate size. HoLEP has a growing body of literature supporting its efficacy, long term durability, and favorable risk profile, with several advantages over other procedures, such as TURP and OP. Still, disadvantages such as a long learning curve and the resulting lack of learning opportunities have prevented its widespread acceptance. HoLEP, first introduced in 1998, has had many advancements in techniques due to improved laser technology, endoscopic mechanical morcellation devices, and modifications to the surgical technique. These advancements have made HoLEP more effective, more efficient, easier to perform, and easier to learn. The modified 2-lobe and the en-bloc techniques are a natural progression from the classic 3-lobe technique. HoLEP is becoming the new gold standard for surgical treatment of BPH. ☐

References

1. Wei JT, Calhoun E, Jacobsen SJ. Urologic diseases in America project: benign prostatic hyperplasia. *J Urol* 2005;173(4):1256-1261.
2. Kupelian V, Wei JT, O'Leary MP et al. Prevalence of lower urinary tract symptoms and effect on quality of life in a racially and ethnically diverse random sample: the Boston Area Community Health (BACH) Survey. *Arch Intern Med* 2006;166(21):2381-2387.
3. Kirby RS. The natural history of benign prostatic hyperplasia: what have we learned in the last decade? *Urology* 2000;56 (5 Suppl 1):3-6.
4. Ficarra V, Rossanese M, Zazzara M et al. The role of inflammation in lower urinary tract symptoms (LUTS) due to benign prostatic hyperplasia (BPH) and its potential impact on medical therapy. *Curr Urol Rep* 2014;15(12):463.
5. Chughtai B, Lee R, Te A et al. Role of inflammation in benign prostatic hyperplasia. *Rev Urol* 2011;13(3):147-150.
6. Abrams P, Cardozo L, Fall M et al. The standardization of terminology of lower urinary tract function: report from the Standardization Sub-committee of the International Continence Society. *Urology* 2003;61(1):37-49.
7. Parsons JK, Dahm P, Köhler TS et al. Surgical management of lower urinary tract symptoms attributed to benign prostatic hyperplasia: AUA Guideline amendment 2020. *J Urol* 2020;204(4):799-804.
8. Gravas S, Cornu JN, Gacci M et al. EAU guidelines on management of non-neurogenic male LUTS, 2021 update. Presented at the EAU Annual Congress Milan 2021.
9. Reich O, Gratzke C, Bachmann A et al. Morbidity, mortality and early outcome of transurethral resection of the prostate: a prospective multicenter evaluation of 10,654 patients. *J Urol* 2008;180(1):246-249.
10. Westhofen T, Schott M, Keller P et al. Superiority of holmium laser enucleation of the prostate over transurethral resection of the prostate in a matched-pair analysis of bleeding complications under various antithrombotic regimens. *J Endourol* 2021;35(3):328-334.
11. 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.
12. Elzayat EA, Elhilali MM. Holmium laser enucleation of the prostate (HoLEP): the endourologic alternative to open prostatectomy. *Eur Urol* 2006;49(1):87-91.
13. Gilling PJ, Kennett KM, Fraundorfer MR. Holmium laser enucleation of the prostate for glands larger than 100 g: an endourologic alternative to open prostatectomy. *J Endourol* 2000;14(6):529-531.
14. Cornu JN, Ahyai S, Bachmann A et al. A systematic review and meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic obstruction: an update. *Eur Urol* 2015;67(6):1066-1096.
15. Schiavina R, Bianchi L, Giampaoli M et al. Holmium laser prostatectomy in a tertiary Italian center: a prospective cost analysis in comparison with bipolar TURP and open prostatectomy. *Arch Ital Urol Androl* 2020;92(2):82-88.
16. Salonia A, Suardi N, Naspro R et al. Holmium laser enucleation versus open prostatectomy for benign prostatic hyperplasia: an inpatient cost analysis. *Urology* 2006;68(2):302-306.
17. Enikeev D, Morozov A, Taratkin M et al. Systematic review of the endoscopic enucleation of the prostate learning curve. *World J Urol* 2020;39(7):2427-2438.
18. 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.
19. Tan AH, Gilling PJ, Kennett KM et al. Long-term results of high-power holmium laser vaporization (ablation) of the prostate. *BJU Int* 2003;92(7):707-709.
20. Gilling PJ, Cass CB, Cresswell MD et al. Holmium laser resection of the prostate: preliminary results of a new method for the treatment of benign prostatic hyperplasia. *Urology* 1996;47(1):48-51.
21. 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(11):2451-2458.
22. Gilling PJ, Kennett K, Das AK et al. Holmium laser enucleation of the prostate (HoLEP) combined with transurethral tissue morcellation: an update on the early clinical experience. *J Endourol* 1998;12(5):457-459.

23. Rücker F, Lehrich K, Böhme A et al. A call for HoLEP: en-bloc vs. two-lobe vs. three-lobe. *World J Urol* 2021;39(7):2337-2345.
24. Scoffone CM, Cracco CM. The en-bloc no-touch holmium laser enucleation of the prostate (HoLEP) technique. *World J Urol* 2016;34(8):1175-1181.
25. Tuccio A, Grosso AA, Sessa F et al. En-bloc holmium laser enucleation of the prostate with early apical release: are we ready for a new paradigm? *J Endourol* 2021; Online ahead of print.
26. Enikeev D, Taratkin M, Laukhtina E et al. En bloc and two-lobe techniques for laser endoscopic enucleation of the prostate: retrospective comparative analysis of peri- and postoperative outcomes. *Int Urol Nephrol* 2019;51(11):1969-1974.
27. Whiting D, Penev B, Ijaaz A et al. En bloc enucleation technique during holmium laser enucleation of the prostate: An analysis of its efficiency. *Low Urin Tract Symptoms* 2021;13(3)372-376.
28. Placer J, Salvador C, Planas J et al. Effects of holmium laser enucleation of the prostate on sexual function. *J Endourol* 2015;29(3):332-339.
29. Becher EF, McVary KT. Surgical procedures for BPH/LUTS: impact on male sexual health. *Sex Med Rev* 2014;2(1):47-55.
30. Li P, Wang C, Tang M et al. Holmium laser enucleation of prostate by using en-bloc and bladder neck preservation technique: technical consideration and influence on functional outcomes. *Transl Androl Urol* 2021;10(1):134-142.
31. Emiliani E, Talso M, Haddad M et al. The true ablation effect of holmium YAG laser on soft tissue. *J Endourol* 2018;32(3):230-235.
32. Kahokehr AA, Gilling PJ. Which laser works best for benign prostatic hyperplasia? *Curr Urol Rep* 2013;14(6):614-619.
33. Abedi A, Razzaghi MR, Rahavian A et al. Is holmium laser enucleation of the prostate a good surgical alternative in benign prostatic hyperplasia management? A review article. *J Lasers Med Sci* 2020;11(2):197-203.
34. Finley DS, Petersen J, Abdelshehid C et al. Effect of holmium:YAG laser pulse width on lithotripsy retropulsion in vitro. *J Endourol* 2005;19(8):1041-1044.
35. Pan S, Smith AD, Motamedinia O. Minimally invasive therapy for upper tract urothelial cell cancer. *J Endourol* 2017;31(3):238-245.
36. Elhilali MM, Badaan S, Ibrahim A et al. Use of the Moses technology to improve holmium laser lithotripsy outcomes: a preclinical study. *J Endourol* 2017;31(6):598-604.
37. Large T, Nottingham C, Stoughton C et al. Comparative study of holmium laser enucleation of the prostate with MOSES enabled pulsed laser modulation. *Urology* 2020;136:196-201.
38. Fraundorfer MR, Gilling PJ. Holmium:YAG laser enucleation of the prostate combined with mechanical morcellation: preliminary results. *Eur Urol* 1998;33(1):69-72.
39. Franz J Suarez-Ibarrola R, Pütz P et al. Morcellation after endoscopic enucleation of the prostate: efficiency and safety of currently available devices. *Eur Urol Focus* 2021;S2405-4569(21).
40. Ibrahim A, Elhilali MM, Elkoushy MA et al. DrillCut™ vs. VersaCut™ prostate tissue morcellation devices after holmium laser enucleation: A prospective, randomized controlled trial. *Can Urol Assoc J* 2019;13(8):266-270.
41. El Tayeb MM, Borofsky MS, Paonessa JE et al. Wolf Piranha versus Lumenis VersaCut prostate morcellation devices: a prospective randomized trial. *J Urol* 2016;195(2):413-417.