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ThuLEP technique for managing benign prostatic hyperplasia: Intraoperative and postoperative complications in a series of 42 consecutive cases

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Ethics Committee Approval
This study was approved by the Ethics Committee of Atlas University Hospital (institution review board number, E-22686390-050.99-42447, received date: April 22, 2024).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Data from the first series of 42 patients diagnosed with benign prostatic hyperplasia (BPH) who underwent Thulium laser prostate enucleation (ThuLEP) surgery at our clinic were retrospectively reviewed. The procedures were performed by a single physician with 10 years of endoscopic surgery experience. The purpose of this retrospective study was to add our results, which highlight potential complications during and after ThuLEP surgery, to the already reported ThuLEP results in the literature.
Methods: Data from 42 patients with BPH who underwent ThuLEP surgery at Atlas University Hospital between January 2020 and January 2024 were retrospectively analyzed. Patients with a high international prostate symptom score (IPSS>7), a low quality of life score (QoL<3), a prostate volume ≥ 50 cc according to urinary ultrasonography, a peak urine flow rate (Q_{max}) ≤ 15 ml/s on uroflowmetry, a total serum prostate-specific antigen (tPSA) <4 ng/mL, and a negative biopsy tPSA ≥ 4 ng/mL were included in the study. All patients underwent pre-operative evaluations that included urinalysis, urine culture, tPSA, uroflowmetry, IPSS, QoL, urinary ultrasonography, prostate volume, postvoid residual urine volume (PVR), and sexual function (IIEF). ThuLEP surgery was performed en bloc using the "Omega Sign" technique in all patients.
Results: Mean enucleation and morcellation times were 110±40 and 25±18 min, respectively. Mean resected prostate tissue weight was 40±25 g. Mean hospital stay and catheterization time were 40±12 and 36±10 h, respectively. Significant improvements were observed in post-operative IPSS, IIEF, QoL, Q_{max}, and PVR (P<0.05). Q_{max} increased, whereas PVR decreased. Post-operative hemoglobin values decreased initially (P<0.05) but returned to baseline at six months (P>0.05). Intra-operative complications included superficial bladder mucosal injury in two patients (4.76%), major capsular perforation in one patient (2.38%), and major perforation below the bladder neck between the five and seven o'clock positions in one patient (2.38%). Complications that developed in the first six months after surgery included urinary retention in one patient (2.38%), stress incontinence in two patients (4.76%), and urethral stricture in one patient (2.38%).
Conclusion: Due to the steep learning curve for surgeons, ThuLEP surgery can initially cause complications, which are manageable. Despite these complications, current reports support its safety and effectiveness across a variety of prostate sizes. The ThuLEP technique offers patients several advantages, such as shorter hospital stays, shorter catheterization times, and fewer complications.

Keywords: ThuLEP, benign prostatic enlargement, transurethral resection

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Introduction

Prostate enucleation surgery (PES) techniques have gained significant popularity among urologists as a common approach for managing benign prostatic hypertrophy (BPH). The main purpose of these endoscopic surgical techniques is to remove the prostate lobules from the surgical capsule using enucleation. In comparison to transurethral resection of the prostate (TURP), which is the established standard for BPH treatment, PES has become increasingly favored by urologists for its benefits that include shorter hospital stays, a reduction in complications, and effectiveness in managing large-volume prostates [1–3]. With advancements in laser technology, Holmium:YAG was initially used for ablation and later for complete enucleation in BPH treatment [1].

The fundamental principles of PES techniques and their emergence as the benchmark treatment for BPH were established primarily through holmium laser enucleation of the prostate (HoLEP) [1,2]. Thulium laser, which consists of a different type of energy, has a slightly shorter wavelength than holmium lasers. This type of system provides a continuous wave output that enhances vaporization while limiting the depth of penetration into prostate tissue. These characteristics, along with rapid advances in laser technologies, have brought minimally invasive surgical approaches to the forefront and are influencing current urological practice [3]. Compared to TURP and HoLEP, advantages of PES, such as better intra-operative bleeding control, a shorter learning curve, and similar results across prostate sizes, have been reported. However, it has been reported that complications occur at varying rates as surgeons gain experience.

The European Association of Urology (EAU) guidelines emphasize that ThuLEP offers a strong alternative to TURP and HoLEP for patients with moderate to severe lower urinary tract symptoms and has yielded clinical improvements in the short to medium term. Although randomized controlled trials on ThuLEP are limited, this technique is becoming more widely accepted as the preferred surgical option and a viable alternative to TURP and HoLEP.

The primary objective of our study was to review our results in light of the available evidence regarding thulium enucleation techniques. Our study aimed to inform urologists who had newly adopting the ThuLEP method about potential intra- and post-operative complications during the first six months and to discuss the early safety and efficacy results of the method in terms of the literature.

Materials and methods

Results from 42 patients who underwent ThuLEP surgical technique at Atlas University Hospital between January 2020 and January 2024 were retrospectively analyzed. The study was approved by the Ethics Committee of Atlas University Hospital (institutional review board number: E-22686390-050.99-42447; approval date: April 22, 2024). The study was conducted in accordance with the principles of the Declaration of Helsinki, and written informed consent was obtained from all participants.

Patients with a high international prostate symptom score (IPSS>7), a low quality of life score (QoL<3), a prostate volume ≥ 50 cc according to urinary ultrasonography, a peak urine flow rate (Q_{max}) ≤15 ml/s on uroflowmetry, a total serum prostate-specific antigen (tPSA) <4 ng/mL, and a negative tPSA ≥4 ng/mL on biopsy were included in the study. Exclusion criteria included patients with prostate cancer, neurogenic bladder dysfunction as detected by urodynamic testing, and those who had previously undergone lower urinary tract surgery (TURP).

All patients underwent pre-operative evaluations that included urinalysis, urine culture, tPSA, uroflowmetry, IPSS, QoL, urinary ultrasonography, prostate volume, postvoid residual urine volume (PVR), and sexual function scores (IIEF).

The ThuLEP procedure was performed by a single surgeon who had 10 years of extensive experience in endourological surgery, including endoscopic treatments, such as TURP, for BPH. Most patients underwent spinal anesthesia, while a few patients underwent general anesthesia when spinal anesthesia proved ineffective.

All surgical procedures were performed using the "Omega Sign" technique for en bloc prostate enucleation. Enucleation was performed using a Thulium:YAG laser using a 550 µm fiber (CyberTM 200W; Quanta System) in conjunction with a 26 Fr continuous-flow resectoscope. Power settings of the thulium laser were controlled at 60 W for the left pedal and 40 W for the right pedal. A Hawk Jaws tissue disruptor (Hawk, Minitech Co.) and a 26 Fr nephroscope were used to remove the enucleated prostate tissue.

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) for Windows version 11.5.1 (SPSS Inc., Chicago, IL, USA). Paired-samples t-tests were applied to compare pre- and post-operative values in addition to 6-month follow-up values of functional and laboratory parameters. A *P*-value of <0.05 was considered statistically significant. Descriptive statistics are presented as mean±standard deviation and range

Results

Demographic and pre-operative clinical characteristics of the 42 study patients are shown in Table 1. The mean enucleation time was 110±40 min (range: 40–180 min), while the mean morcellation time was 25±18 min (range: 10–40 min). The mean weight of the enucleated prostate tissue was 40±25 g (range: 35–180 g).

When pre-operative data were compared with discharge and 6-month post-operative data, statistically significant improvements were observed in IPSS, IIEF, Q_{max}, PVR, and QoL scores (P<0.05). Changes in IPSS, IIEF, QoL, Q_{max}, PVR, tPSA levels, and hemoglobin (Hb) values are summarized in Table 2. The mean hospital stay was 40±12 h (range: 24–72 h), and the mean catheter removal time was 36±10 h (range: 24–168 h). Other peri-operative data are presented in Table 3. Although a significant decrease (P<0.05), in post-operative Hb levels was noted (no significant change in Hb was observed at six months (P>0.05). Complications that developed during surgery and in the first six months after surgery are summarized in Table 4. One patient with a perforation below the bladder neck underwent open prostatectomy due to uncontrolled bleeding and injury depth. A blood transfusion was performed only in this case, whereas the other patients did not require such transfusions. One patient

developed both urinary tract infection and urethral stricture while another patient developed both prostate capsule perforation and bladder mucosal damage.

Table 1: Baseline characteristics of patients and pre-operative data

n=42	Mean, SD (range)
Age (years)	63.9±6.2 (50 –79)
BMI	26.7±5.8 (19.5–31.1)
Prostate volume (cm^3)	60±35 (50-230)
PSA (ng/mL)	4.7±3.9 (0.8–15.0)
PVR (mL)	153±80 (0–300)
Qmax	8.3±2.7 (5.1–13.8)
IPSS	20.4±3.6 (17–30)
IIEF	16.6±5.8 (15–26)
QoL score	3.9±1.5 (3–5)
Hb level (g/dL)	13.8±1.9 (11.4–17.5)

BMI: Body Mass Index, PSA: prostate-specific antigen, Q_{max}: maximum urine flow rate, IPSS: International Prostate Symptom Score, IIEF: International Index of Erectile Function, QoL: Quality of Life, PVR: Post Voiding Residual Volume, Hb: Hemoglobin, SD: standard deviation

Table 2: Pre- and post-operative follow-up findings from the patients

Variables Mean, SD (range)	Preoperative	Postoperative	6-month follow-up	*P*-value (Pre-op vs Post-op)	*P*-value (Pre-op vs 6-Month)
IPSS score	20.4±3.6 (17–30)	4.2±2.2 (1–9)	3.8±2.5 (0–10)	0.021	0.020
IIEF score	16.6±5.8 (15–26)	-	20.2±6.4 (18–29)	-	0.038
QoL score	3.9±1.5 (3–5)	-	1.8±0.6 (0–3)	-	0.041
PSA (ng/mL)	4.7±3.9 (0.8–15)	1.1±2.3 (0.1–4.9)	1.3±2.4 (0.1–5.2)	0.018	0.020
Qmax (mL/sn)	8.3±2.7 (5.1–13.8)	29.3±10.6 (21.6–48)	30.5±11 (22–50)	0.015	0.013
PVR (mL)	153±80 (0–300)	20±8 (0–30)	25±10 (0–35)	0.018	0.020
Hb level (g/dL)	13.8±1.9 (11.4–17.5)	11.6±2.2 (8.3–15.7)	12.9±3.1 (10.4–16.8)	0.042	0.061

IPSS: International Prostate Symptom Score, IIEF: International Index of Erectile Function, QoL: Quality of Life, PSA: prostate-specific antigen, Q_{max}: maximum urine flow rate, PVR: Post voiding residual, Hb: hemoglobin

Table 3: Peri-operative data

n=42	Mean, SD (range)
Enucleation Time (min)	110±40 (40–180)
Morcellation Time (min)	25±18 (10–40)
Weight of Prostate Tissue Removed (g)	40±25 (35–180)
Hospital Stay Duration (h)	40±12 (24–72)
Catheter Withdrawal Time (h)	36±10 (24–168)

Table 4: Intraoperative and postoperative complications

Complications	n=42 (100%)	Assessment
Intra-operative		
Bladder mucosal injury	2 (4.76%)	72 h of catheterization
Prostate capsule perforation	1 (2.38%)	72 h of catheterization
Perforation at the sub-o'clock level of the bladder neck	1 (2.38%)	Open surgical repair
Post-operative (0–6 month)		
Urinary retention	1 (2.38%)	72 h of catheterization and NSAID
Stress incontinence	2 (4.76%)	Continence after 8 weeks
Urethral stricture	1 (2.38%)	Internal urethrotomy
Urinary tract infection	1 (2.38%)	Intravenous antibiotic therapy
Retrograde ejaculation	35 (83.33%)	-

NSAID: non-steroidal anti-inflammatory drug. Note: Urinary tract infection and urethral stricture occurred in one patient. Prostate capsule perforation and bladder mucosal injury occurred another patient.

Discussion

This retrospective analysis evaluated the clinical outcomes and complications in a series of 42 patients who underwent ThuLEP surgery for BPH by a single physician.

The surgical technical parameters of the study, namely mean enucleation time, morcellation time, hospital stay, and catheterization time, were found to be comparable with ThuLEP data in the literature [3,4].

The ThuLEP technique offers significant patient advantages over conventional TURP, particularly in terms of shorter hospital stays and urethral catheterization times. These advantages have been clearly documented in various comparative studies and demonstrate that ThuLEP surgery is a safe and effective treatment option, even for large-volume prostates [5,6].

Post-operative clinical evaluations revealed significant improvements in excretory parameters such as IPSS, QoL, Q_{max}, and PVR in addition to a significant increase in IIEF scores. These findings highlight the effectiveness of the surgical technique not only on symptoms but also on QoL and IIEF. While the impact of laser prostate enucleation surgery on sexual function is unclear in the literature, some studies have reported positive improvements in IIEF scores after surgery [7–12]. Our results are consistent with these findings.

Although the post-operative hemoglobin decrease was significant, only one patient required a blood transfusion. Based on both our clinical experience and results in the literature, blood loss is less compared to TURP and open prostatectomy (AP) [13].

Intra-operative complications were mostly limited to superficial bladder mucosa injuries and capsule perforations, except in one patient. Superficial bladder mucosa damage occurred during tissue morcellation in two patients. This complication was attributed to continuing morcellation without recognition of the decrease in that the irrigation fluid, which led to inadequate bladder filling. Therefore, morcellation with a full bladder and adequate irrigation fluid will help prevent further complications.

All of these occurred in the first 20 cases and coincided with the early learning curve. No such complications were observed in subsequent cases. We believe that the ThuLEP surgical technique is a learnable technique and that its safety increases with additional endoscopic surgical experience. This clinical experience is consistent with studies in the literature and demonstrates that surgeons can safely and effectively perform the ThuLEP technique after performing 15–20 supervised cases [14].

Post-operative complications, such as urinary tract infections, urinary retention, urethral strictures, and stress incontinence were observed at low rates and were transient. These findings were important in supporting the favorable safety profile of the ThuLEP technique. A review of studies in the literature reveals that these complications are generally minimal, self-limiting, and manageable with conservative approaches [15,16].

Stress incontinence has generally been shown to resolve spontaneously within 6–8 weeks post-operatively, whereas persistent incontinence is very rare [15]. In this respect, our results are consistent with those in the literature.

The most common post-operative complication in our series was retrograde ejaculation. This complication is a proven consequence of both endoscopic resection and laser enucleation techniques and is often a consideration for patients considering surgery [17]. Similar rates have been reported in previous studies, thereby supporting the consistency of our findings [18].

The guidelines for the surgical management of lower urinary tract symptoms related to BPH have recently been revised. The 2023 American Urological Association guidelines suggest that laser enucleation procedures can be considered a treatment option regardless of prostate size and are contingent upon the surgeon's level of experience [19].

Study limitations

This study has several limitations. Primarily, ThuLEP was not directly compared to standard TURP or other endoscopic laser surgical techniques. Additional limitations include the absence of a control group and a relatively small sample size.

Additionally, the retrospective study design, which was conducted in a single center and performed by a single surgeon in addition to possible selection bias, may be considered study limitations.

Conclusion

Our results support the safety, efficacy, and practicality of the ThuLEP technique for the surgical treatment of BPH. The technique yielded significant post-operative improvements as demonstrated by statistically significant changes in IPSS, Q_{max}, PVR, QoL, and IIEF scores. Intra- and post-operative complication rates were low and mostly mild or transient, thus supporting the technique's favorable safety profile. Notably, all intra-operative complications occurred within the first 20 cases and serve to highlight the steep but adaptable learning curve that is associated with the ThuLEP technique. With appropriate training and surgeon experience, ThuLEP can be safely performed and can be a strong alternative to conventional TURP or open prostatectomy, particularly for patients with large prostate volumes.

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