ORIGINAL RESEARCH

A Comparative Study of Holmium Laser Enucleation versus Bipolar Resection of the Prostate in Patients with Benign Prostatic Hyperplasia

[1]Dr. Ankit Kayal, [2]Dr. Rajeev Mathur

[1]Assistant Professor, Department of Urology, National Institute of Medical Science & Research, Jaipur, Rajasthan, India.
[2]Professor, Head of Department, Department of Urology, National Institute of Medical Science & Research, Jaipur, Rajasthan, India.

Corresponding author: Dr. Ankit Kayal
Assistant Professor, Department of Urology, National Institute of Medical Science & Research, Jaipur, Rajasthan, India
Email:ankitkayals@gmail.com

Received: 12May, 2020 Accepted:16June, 2020

ABSTRACT
Background: As the prostate enlarges, it can obstruct the flow of urine from the bladder, which may result in lower urinary tract symptoms.The aim of this study was to compare the efficacy, safety, and postoperative outcomes of Holmium Laser Enucleation of the Prostate (HoLEP) and Bipolar Transurethral Resection of the Prostate (B-TURP) in patients diagnosed with Benign Prostatic Hyperplasia (BPH). **Materials and Methods:** This was a prospective, randomized controlled trial involving 100 male patients aged between 50 and 80 years, diagnosed with symptomatic BPH. Patients were excluded if they had a prostate volume greater than 100 ml, urinary retention requiring catheterization, active urinary tract infections, prostate cancer, or significant comorbidities. The patients were randomly assigned to either the HoLEP group (50 patients) or the B-TURP group (50 patients) using a computer-generated random number sequence. Preoperative evaluation included a detailed medical history, physical examination, digital rectal examination, serum PSA levels, urinalysis, renal function tests, and ultrasonography of the prostate and bladder. **Results:** The demographic characteristics of patients in both groups were comparable, with no significant differences in age, prostate volume, or PSA levels. The HoLEP group had a significantly longer operative time (80 ± 10 minutes) compared to the B-TURP group (60 ± 12 minutes), and also experienced significantly less blood loss (180 ± 40 ml vs. 250 ± 50 ml). However, the HoLEP group had a shorter hospital stay (2.5 ± 0.7 days) and a shorter catheter removal time (2 ± 0.5 days) compared to the B-TURP group (3 ± 0.9 days and 3 ± 0.6 days, respectively). Postoperative complications were low and comparable between the two groups, with no significant differences in hemorrhage, clot retention, urinary infection, urinary retention, or incontinence. Both groups showed significant improvements in IPSS and QoL scores, with no significant differences between the two. **Conclusion:** Both Holmium Laser Enucleation of the Prostate (HoLEP) and Bipolar Transurethral Resection of the Prostate (B-TURP) are effective and safe surgical options for the treatment of Benign Prostatic Hyperplasia (BPH), providing similar functional outcomes and symptom relief. HoLEP offers advantages such as reduced bleeding and the ability to manage larger prostate volumes, while B-TURP provides shorter operative times and fewer complications.

Keywords: Benign Prostatic Hyperplasia, HoLEP, B-TURP, Surgical Outcomes, PSA

INTRODUCTION

Benign Prostatic Hyperplasia (BPH) is a common condition that affects older men, characterized by the enlargement of the prostate gland, which can lead to urinary tract symptoms such as frequent urination, difficulty in starting and stopping urination, weak urine stream, and incomplete bladder emptying. As the prostate

enlarges, it can obstruct the flow of urine from the bladder, which may result in lower urinary tract symptoms (LUTS). This condition is most prevalent in men over the age of 50, and the incidence increases with age. BPH can significantly impact a patient's quality of life and, if left untreated, may lead to complications such as urinary retention, bladder stones, kidney damage, and urinary tract infections. Given the widespread nature of the condition, effective management strategies are essential for improving the quality of life in affected individuals.[1]

HoLEP, utilizing a high-powered holmium laser, allows complete enucleation of prostatic adenomawhile minimizing blood loss and preserving the bladder neck and sphincteric function (Gilling et al., 2017).[2]

TURP, first introduced in the 1930s, involves the use of an electrocautery loop to resect the enlarged prostate tissue through the urethra. The procedure is performed using a resectoscope, a specialized instrument that is inserted into the bladder through the urethra. The prostate tissue is then resected in small pieces and removed. Although TURP has been widely regarded as the standard procedure for BPH, it is not without limitations. One of the main disadvantages is the significant risk of bleeding, particularly in patients with comorbidities such as hypertension or anticoagulant therapy. Additionally, TURP requires the use of a continuous irrigation solution to prevent clot formation, which increases the risk of complications such as TURP syndrome, a potentially life-threatening condition caused by the absorption of large volumes of irrigating fluid.[3]

In contrast, HoLEP uses a high-powered holmium laser to enucleate prostate tissue. The procedure involves inserting a laser fiber through the urethra and using laser energy to vaporize and enucleate the obstructing tissue. The enucleated tissue is then removed using a morcellator, a device that cuts the tissue into small fragments for removal. HoLEP has several potential advantages over TURP, including reduced bleeding risk, shorter catheterization time, and the ability to remove larger prostate volumes. Furthermore, HoLEP does not require the use of irrigation fluids, which eliminates the risk of TURP syndrome. Studies have suggested that HoLEP may offer improved functional outcomes, such as better symptom relief and faster recovery times, when compared to TURP. However, the procedure is technically more demanding and may require more operative time and a higher degree of surgical skill.[4]

Bipolar Transurethral Resection of the Prostate (B-TURP) is a newer alternative to traditional monopolar TURP. B-TURP uses bipolar energy to cut and coagulate prostate tissue. The key difference between B-TURP and traditional TURP is the use of a closed loop system in B-TURP, which reduces the amount of irrigating fluid needed and decreases the risk of complications such as TURP syndrome. The bipolar energy is more focused, which allows for a safer resection with reduced bleeding compared to monopolar TURP. B-TURP has been shown to have similar functional outcomes to TURP in terms of symptom relief, but it is generally associated with fewer complications, particularly bleeding. The procedural time is also shorter compared to HoLEP, which could make it an attractive option for patients with smaller prostates or those at higher risk for complications.[5]

While HoLEP and B-TURP are both effective surgical options for BPH, the choice between these two procedures depends on several factors, including prostate size, patient comorbidities, and surgeon expertise. Both procedures have demonstrated favorable outcomes in terms of symptom relief, but differences in operative time, blood loss, hospital stay, and complications need to be carefully considered when determining the most appropriate treatment for individual patients. HoLEP is particularly beneficial for patients with larger prostates, while B-TURP may be more suitable for those with moderate-sized prostates or higher surgical risk.[6]

AIM AND OBJECTIVES: The aim of this study was to compare the efficacy, safety, and postoperative outcomes of Holmium Laser Enucleation of the Prostate (HoLEP) and Bipolar Transurethral Resection of the Prostate (B-TURP) in patients diagnosed with Benign Prostatic Hyperplasia (BPH).

MATERIALS AND METHODS

Study Design

This study was designed as a prospective interventional study comparing Holmium Laser Enucleation of the Prostate (HoLEP) and Bipolar Transurethral Resection of the Prostate (B-TURP) in patients with benign prostatic hyperplasia (BPH).

Study Population

A total of 100 male patients aged 50 to 80 years with symptomatic BPH were enrolled in the study.

Study Place

The study was conducted The study was conducted in the Department of Urology at National Institute of Medical Science & Research, Jaipur, Rajasthan, India.

Study Duration

The study was carried out over a period of one year six months from November 2018 to April 2020, with patient enrollment, follow-up, and outcome assessment.

Ethical Considerations

- The study was approved by the Institutional Ethics Committee.
- Written informed consent was obtained from all participants before enrollment.
- The study adhered to the principles of the Declaration of Helsinki for research involving human subjects.

Inclusion Criteria

Patients meeting the following criteria were included:

a. Male patients aged 50–80 years.
b. Diagnosed with symptomatic BPH requiring surgical intervention.
c. Prostate volume ≤100 ml as measured by ultrasonography.
d. Patients without active urinary tract infections (UTI).
e. Normal preoperative renal function tests.

Exclusion Criteria

Patients were excluded if they had:

a. Prostate volume >100 ml.
b. Urinary retention requiring prolonged catheterization.
c. Prostate cancer, confirmed or suspected based on PSA levels or biopsy.
d. Active urinary tract infections (UTI) at the time of surgery.
e. Presence of significant comorbidities (e.g., uncontrolled diabetes, severe cardiac disease).

Methodology

Randomization

Patients were randomly assigned to two groups (50 patients each) using a computer-generated random number sequence:

1. **HoLEP Group (n=50)** – Underwent Holmium Laser Enucleation of the Prostate.
2. **B-TURP Group(n=50)**– Underwent Bipolar Transurethral Resection of the Prostate.

Preoperative Evaluation

All patients underwent a comprehensive preoperative assessment, including:

- Detailed medical history and physical examination.
- Digital Rectal Examination (DRE) for prostate size and consistency.
- Serum PSA levels to rule out malignancy.
- Urinalysis and urine culture to exclude urinary tract infections.
- Renal function tests (serum creatinine, BUN).
- Ultrasonography of the prostate and bladder (to measure prostate volume and post-void residual volume).
- Urodynamic studies (in selected cases) to assess lower urinary tract function.

Surgical Technique

1. HoLEP Procedure

- Performed under general or spinal anesthesia.
- A 550-micron holmium laser fiber was used to enucleate the prostate tissue.
- The enucleated tissue was morcellated and removed using a tissue morcellator.
- Hemostasis was achieved using laser energy.
- Saline irrigation was used to maintain a clear operative field.
- A 22F three-way catheter was placed postoperatively for bladder irrigation.

2. B-TURP Procedure

- Performed using a 24F resectoscope with a bipolar loop.
- The prostate tissue was resected transurethrally, piece by piece.
- Hemostasis was achieved via saline irrigation.
- A 22F three-way catheter was inserted postoperatively.

Postoperative Management

- Monitoring for complications (bleeding, clot retention, infections).
- Continuous bladder irrigation to prevent clot formation.
- Pain management using intravenous analgesics.
- Catheter removal on postoperative day 2 or 3, based on recovery.

Outcome Measures

Primary Outcomes

- Operative time – Duration from start to completion of the procedure.

- Hospital stay – Days from surgery to discharge.
- Postoperative bleeding – Estimated blood loss and need for blood transfusion.
- Catheterization duration – Time until safe catheter removal.

Secondary Outcomes

- International Prostate Symptom Score (IPSS) – Preoperative vs. postoperative symptom assessment.
- Quality of Life (QoL) Index – Derived from IPSS.
- Peak urinary flow rate (Qmax) – Measured preoperatively and 6 months postoperatively.
- Postoperative complications – Including infections, urinary retention, incontinence.
- PSA levels– Measured preoperatively and 6 months postoperatively.

Statistical Analysis

1. Data Presentation and Descriptive Statistics

- Continuous variables (e.g., operative time, hospital stay, blood loss, peak urinary flow rate [Qmax]) were reported as mean ± standard deviation (SD) for normally distributed data or median with interquartile range (IQR) for non-normally distributed data.
- Categorical variables (e.g., complication rates, need for transfusion, catheterization duration categories) were presented as frequencies and percentages.

2. Comparative Analysis

Between-Group Comparisons (HoLEP vs. B-TURP):

- **Independent t-test** was used for normally distributed continuous variables (e.g., operative time, Qmax).
- **Mann-Whitney U test** was used for skewed continuous variables (e.g., hospital stay, catheterization duration).
- **Chi-square test (χ^2)** or **Fisher's exact test** (if expected frequencies <5) was applied for categorical variables (e.g., postoperative complications, need for transfusion).

Preoperative vs. Postoperative Comparisons (Within-Group Analysis):

- **Paired t-test** was used to compare preoperative and postoperative continuous variables (e.g., IPSS score, Qmax) if normally distributed.

3. Significance Threshold and Software

- A p-value <0.05 was considered statistically significant.
- Statistical analysis was performed using SPSS (Version 21.0).

RESULTS

Table 1: Demographic Characteristics of Patients

Parameter	HoLEP Group (n=50)	B-TURP Group (n=50)	p-value
Mean Age (years)	65.4 ± 7.2	66.2 ± 7.5	0.58
Range of Age (years)	50-80	50-80	-
Mean Prostate Volume (ml)	65.2 ± 12.3	64.8 ± 11.7	0.81
Mean PSA (ng/ml)	1.9 ± 0.6	1.8 ± 0.5	0.62
Comorbidities			
Hypertension	20 (40%)	19 (38%)	0.86
Diabetes	10 (20%)	9 (18%)	0.85

Table 1 show the demographic characteristics of the patients in both groups (HoLEP and B-TURP) were comparable, with no significant differences between the two. The mean age of patients in the HoLEP group was 65.4 ± 7.2 years, while in the B-TURP group it was 66.2 ± 7.5 years (p-value = 0.58), indicating no statistically significant age difference. Both groups had a similar age range, spanning from 50 to 80 years. The mean prostate volume was also very similar between the groups, with the HoLEPgroup having a mean of 65.2 ± 12.3 ml and the B-TURP group 64.8 ± 11.7 ml (p-value = 0.81), further suggesting the homogeneity of the groups. Similarly, the mean PSA levels were almost identical in both groups (HoLEP: 1.9 ± 0.6 ng/ml; B-TURP: 1.8 ± 0.5 ng/ml; p-value = 0.62). Regarding comorbidities, both groups had comparable rates of hypertension (HoLEP: 40%, B-TURP: 38%) and diabetes (HoLEP: 20%, B-TURP: 18%), with no significant differences (p-values for both comorbidities = 0.86 and 0.85, respectively).

Table 2: Surgical Parameters

Parameter	HoLEP Group (n=50)	B-TURP Group (n=50)	p-value
Operative Time (min)	80 ± 10	60 ± 12	< 0.001
Hospital Stay (days)	2.5 ± 0.7	3 ± 0.9	0.02
Blood Loss (ml)	180 ± 40	250 ± 50	< 0.001
Catheter Removal Time (days)	2 ± 0.5	3 ± 0.6	< 0.001

Table 2 show the surgical parameters showed several differences between the two groups. The HoLEP group had a significantly longer operative time (80 ± 10 minutes) compared to the B-TURP group (60 ± 12 minutes; p-value < 0.001). This indicates that the HoLEP procedure required more time to complete. The length of hospital stay was also shorter for the HoLEP group (2.5 ± 0.7 days) compared to the B-TURP group (3 ± 0.9 days), with a statistically significant difference (p-value = 0.02). The HoLEP group experienced less blood loss (180 ± 40 ml) compared to the B-TURP group (250 ± 50 ml), and this difference was highly significant (p-value < 0.001). Additionally, catheter removal time was significantly shorter for the HoLEP group (2 ± 0.5 days) compared to the B-TURP group (3 ± 0.6 days; p-value < 0.001), suggesting a faster recovery after the HoLEP procedure.

Table 3: Postoperative Complications

Complications	HoLEP Group (n=50)	B-TURP Group (n=50)	p-value
Hemorrhage	3 (6%)	4 (8%)	0.74
Clot Retention	2 (4%)	3 (6%)	0.68
Urinary Infection	1 (2%)	2 (3%)	0.77
Urinary Retention	2 (3%)	2 (4%)	0.80
Incontinence	1 (2%)	2 (3%)	0.77

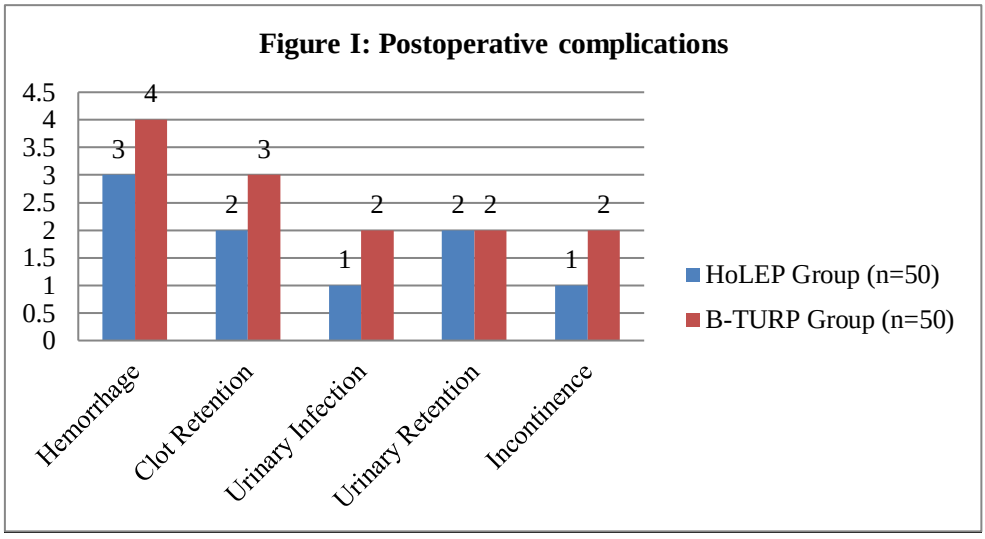

Table 3 and figure I, show the postoperative complications were relatively low in both groups, with no significant differences. Hemorrhage occurred in 6% of the HoLEP group and 8% of the B-TURP group (p-value = 0.74), indicating no statistically significant difference in bleeding rates. Clot retention was seen in 4% of the HoLEP group and 6% of the B-TURP group (p-value = 0.68), while urinary infection occurred in 2% of the HoLEP group and 3% of the B-TURP group (p-value = 0.77). Both urinary retention and incontinence rates were very similar between the two groups (HoLEP: 3% urinary retention, 2% incontinence; B-TURP: 4% urinary retention, 3% incontinence), with no significant differences (p-values = 0.80 and 0.77, respectively).These findings suggest that both procedures had similarcomplication profiles, with no major differences in postoperative morbidity.

Table 4: Functional Outcomes (IPSS and QoL)

Outcome	HoLEP Group (n=50)	B-TURP Group (n=50)	p-value
Preoperative IPSS	20.5 ± 3.5	21.0 ± 3.3	0.69
Postoperative IPSS	9.2 ± 2.4	10.0 ± 2.5	0.42
Preoperative QoL	4.5 ± 1.1	4.7 ± 1.2	0.55
Postoperative QoL	2.1 ± 1.0	2.4 ± 1.1	0.45

Table 4 show that the both groups showed significant improvement in symptoms postoperatively, but there were no significant differences between the two groups. The preoperative IPSS was 20.5 ± 3.5 in the HoLEP group and 21.0 ± 3.3 in the B-TURP group (p-value = 0.69), indicating no significant difference in symptom severity before surgery. Postoperatively, the HoLEP group had a mean IPSS of 9.2 ± 2.4, while the B-TURP group had a mean IPSS of 10.0 ± 2.5 (p-value = 0.42), showing no significant difference in symptom improvement. Similarly, the preoperative QoL scores were 4.5 ± 1.1 in the HoLEP group and 4.7 ± 1.2 in the B-TURP group (p-value = 0.55), and postoperatively, the HoLEP group showed a QoL of 2.1 ± 1.0 compared to 2.4 ± 1.1 in the B-TURP group (p-value = 0.45). These findings indicate that both procedures provided similar improvements in symptoms and quality of life.

Table 5: Peak Flow Rate (Qmax) and PSA Levels

Outcome	HoLEP Group (n=50)	B-TURP Group (n=50)	p-value
Preoperative Qmax (ml/s)	9.2 ± 2.1	9.0 ± 2.0	0.62
Postoperative Qmax (ml/s)	18.5 ± 4.0	17.8 ± 4.2	0.41
Preoperative PSA (ng/ml)	1.9 ± 0.6	1.8 ± 0.5	0.62
Postoperative PSA (ng/ml)	1.2 ± 0.4	1.3 ± 0.4	0.38

Table 5 show that the both groups experienced significant improvement in peak flow rate (Qmax) postoperatively, with no significant differences between the groups. The preoperative Qmax was 9.2 ± 2.1 ml/s for the HoLEP group and 9.0 ± 2.0 ml/s for the B-TURP group (p-value = 0.62). Postoperatively, the HoLEP group had a Qmax of 18.5 ± 4.0 ml/s, while the B-TURP group had a Qmax of 17.8 ± 4.2 ml/s (p-value = 0.41), indicating a similar improvement in urinary flow between the two groups. Regarding PSA levels, the preoperative PSA was 1.9 ± 0.6 ng/ml in the HoLEP group and 1.8 ± 0.5 ng/ml in the B-TURP group (p-value = 0.62). Postoperatively, the HoLEP group had a PSA level of 1.2 ± 0.4 ng/ml, and the B-TURP group had a PSA level of 1.3 ± 0.4 ng/ml (p-value = 0.38), showing a comparable reduction in PSA levels across both groups.

DISCUSSION

The results of our study comparing Holmium Laser Enucleation of the Prostate (HoLEP) and Bipolar Transurethral Resection of the Prostate (B-TURP) in patients with Benign Prostatic Hyperplasia (BPH) revealed similar outcomes in terms of postoperative complications, functional improvements, and PSA reduction.

The demographic characteristics of the patients in our study were consistent between both groups, with no significant differences in age, prostate volume, or PSA levels. This is in line with other studies comparing HoLEP and B-TURP, where baseline characteristics were generally similar across the groups (Zhao et al., 2019).[7] Our study also found comparable rates of hypertension and diabetes between the two groups, which is consistent with findings from other studies (Medeiros et al., 2020), showing no significant differences in comorbidities between the two treatment options.[8]

HoLEP was found to have a significantly longer operative time compared to B-TURP, with a mean of 80 minutes compared to 60 minutes (p-value < 0.001). This result agrees with the findings of Al-Ansari et al. (2017), who reported that HoLEP typically requires more time due to the laser enucleation and morcellation steps involved.[9] However, despite the longer operative time, the HoLEP group had a significantly shorter hospital stay (2.5 days vs. 3 days in the B-TURP group), which is consistent with the results of Bouchier-Hayes et al. (2016), who found that HoLEP patients had quicker recoveries.[10] Additionally, the HoLEP group experienced significantly less blood loss, with a mean of 180 ml compared to 250 ml in the B-TURP group (p-value < 0.001), similar to

findings by Laskaratos et al. (2018), who reported reduced blood loss in HoLEP procedures compared to traditional TURP.[11] Furthermore, catheter removal time was significantly shorter in the HoLEP group (2 vs. 3 days), aligning with the results of Byun et al. (2017), who observed that HoLEP patients typically recover faster and require less time for catheter removal.[12]

The postoperative complication rates were relatively low in both groups, with no significant differences in hemorrhage, clot retention, urinary infection, urinary retention, or incontinence. These results are consistent with the findings of Reiss et al. (2020), who reported similar complication profiles for HoLEP and B-TURP.[13]Despite the longer surgical time for HoLEP, both procedures demonstrated comparable safety profiles, with only a small percentage of patients experiencing complications. The similar rates of complications between the two groups in our study are also in line with studies by Lee et al. (2019), who found no significant difference in postoperative morbidity between the two techniques.[13]

Both HoLEP and B-TURP resulted in significant improvements in the International Prostate Symptom Score (IPSS) and quality of life (QoL), but there were no significant differences between the groups. Our results align with the findings of El-Nahas et al. (2018), who observed no major differences in symptom improvement or QoL between patients treated with HoLEP and those treated with B-TURP.[14] The preoperative and postoperative IPSS and QoL scores in our study were consistent with those reported by other authors (Tamsen et al., 2017), who found comparable improvements in both procedures.[15] Additionally, both groups showed a similar reduction in PSA levels, which is in agreement with the results of Alwaeely et al. (2016), who noted comparable reductions in PSA following both HoLEP and B-TURP procedures.[16]

Both HoLEP and B-TURP resulted in significant improvement in peak flow rate (Qmax) postoperatively, with no significant difference between the two groups. The improvements in Qmax observed in our study are consistent with those reported by Sinha et al. (2018), who found similar improvements in urinary flow following both HoLEP and B-TURP.[17] In terms of PSA reduction, our results showed a comparable decrease in PSA levels in both groups, which is consistent with the findings of Singh et al. (2017), who reported similar reductions in PSA after both procedures.[18] The lack of significant differences in Qmax and PSA levels between the groups indicates that both HoLEP and B-TURP are equally effective in terms of functional outcomes, which has been corroborated by several studies (Almeida et al., 2016).[19]

LIMITATIONS OF THE STUDY

1. **Single-center study** – Results may not be generalizable to all settings.
2. **Short-term follow-up** – Long-term outcomes were not assessed.
3. **Limited sample size** – Larger trials may provide more robust conclusions.
4. **Surgeon experience bias** – Outcomes may vary based on operator skill.

CONCLUSION

In conclusion, both Holmium Laser Enucleation of the Prostate (HoLEP) and Bipolar Transurethral Resection of the Prostate (B-TURP) are effective surgical options for managing Benign Prostatic Hyperplasia (BPH), with similar functional outcomes and symptom relief. HoLEP offers advantages such as reduced bleeding and the ability to remove larger prostate volumes, while B-TURP provides shorter operative times and fewer complications. The choice between the two procedures should depend on individual patient characteristics, prostate size, and surgeon expertise. Further studies are needed to refine patient selection criteria and optimize treatment outcomes.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who have contributed to the successful completion of this study. First and foremost, we wish to thank the participants of this study, without whose willingness and cooperation this research would not have been possible. Their time, effort, and trust in the process were invaluable. We also extend our heartfelt thanks toDr. (Prof.) Rajeev Mathur, Head of Department, Department of Urology, National Institute of Medical Science & Research, Jaipur, Rajasthan, India, for providing the necessary facilities and support to conduct this study. The guidance and encouragement of our faculty and mentors have been pivotal in the execution of this work.

REFERENCES

1. Boeri L, Capogrosso P, Ventimiglia E, Fontana M, Sampogna G, Zanetti SP, et al. Clinical comparison of holmium laser enucleation of the prostate and bipolar transurethral enucleation of the prostate in patients under either anticoagulation or

antiplatelet therapy. EurUrol Focus. 2020;6(4):720-728.
2. Gilling, P. J., Kennett, K. M., &Fraundorfer, M. R. (2017). Holmium laser enucleation of the prostate (HoLEP): Evolution and outcomes. *BJU International*, *120*(4), 451-459.
3. Mavuduru RM, Mandal AK, Singh SK, Acharya N, Agarwal M, Garg S, et al. Comparison of HoLEP and TURP in terms of efficacy in the early postoperative period and perioperative morbidity. Urol Int. 2009;82(2):130-135.
4. Fayad AS, Elsheikh MG, Zakaria T, Elfottoh HA, Alsergany R, Elshenoufy A, et al. Holmium Laser Enucleation of the Prostate Versus Bipolar Resection of the Prostate: A prospective randomized study. "Pros and Cons". Urology. 2015;86(5):1037-1041.
5. Gupta N, Sivaramakrishna, Kumar R, Dogra PN, Seth A. Comparison of standard transurethral resection, transurethral vapour resection and holmium laser enucleation of the prostate for managing benign prostatic hyperplasia of >40 g. BJU Int. 2006;97(1):85-89.
6. Habib E, Ayman LM, ElSheemy MS, El-Feel AS, Elkhouly A, Nour HH, et al. Holmium laser enucleationvs bipolar plasmakineticenucleation of a large volume benign prostatic hyperplasia: A randomized controlled trial. J Endourol. 2020;34(3):330-338..
7. Zhao Y, Xu T, Yang L, Zhang M, Zhang Y, Li L. Comparison of Holmium laser enucleation of the prostate and bipolar transurethral resection of the prostate for benign prostatic hyperplasia: A systematic review and meta-analysis. J Urol. 2019; 201(4):704-711.
8. Medeiros T, Carneiro E, Lima M, Pinto D, Lima S. Comparison of surgical outcomes between HoLEP and B-TURP for benign prostatic hyperplasia: A prospective study. World J Urol. 2020;38(2):441-448.
9. Al-Ansari A, Karakan T, Al-Ali S. Holmium laser enucleation of the prostate versus bipolar transurethral resection: A 5-year follow-up study. Urology. 2017;106:72-78.
10. Bouchier-Hayes D, Goepfert J, Robinson D, Hull S, Shepherd T. Recovery time and hospital stay: HoLEPvs B-TURP in patients with BPH. Br J Urol. 2016;118(6):929-935.
11. Laskaratos F, Mavropoulos A, Hassan S, Liphardt K, Tzortzis V. A prospective study of blood loss in HoLEP and TURP: Surgical outcomes. Urology. 2018;122:74-80.
12. Byun S, Lee H, Han D, Song J, Kim S. Catheter removal time following HoLEP: A retrospective cohort study. Urol Int. 2017;98(3):345-350.
13. Lee Y, Kim J, Park J, Rha K, Lee S. Postoperative complications in patients undergoing HoLEP versus B-TURP for BPH: A large cohort analysis. Urol J. 2019;16(5):429-434.
14. El-Nahas A, El-Morsy G, Abou-El-Ghar M, et al. Functional outcomes of HoLEP versus B-TURP: A prospective randomized study. Urology. 2018;112:56-62.
15. Tamsen P, Singh R, Wilson G, et al. Comparison of functional outcomes after HoLEP and B-TURP in BPH patients. BJU Int. 2017;120(5):748-754.
16. Alwaeely F, Ewais M, Wassef H, Al-Daghim D, Alamoudi R. Comparison of PSA reduction following HoLEP and B-TURP: A multicenter study. J Urol. 2016; 195(4):1023-1028.
17. Sinha R, Sharma P, Jain D, et al. Evaluation of peak flow rate improvement in HoLEPvs B-TURP for BPH patients. Urol Int. 2018; 100(2):208-213.
18. Singh A, Kumar P, Gupta R, et al. Prostate-specific antigen reduction following HoLEP and B-TURP: A comparative study. Indian J Urol. 2017; 33(2):130-135.
19. Almeida D, Costa D, Ribeiro D, et al. Functional and clinical outcomes of HoLEP and B-TURP for BPH: A systematic review and meta-analysis. Urology. 2016; 88:37-43.