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Impact of Obesity on Clinical Presentation and Surgical Outcomes in Patients with Benign Prostate Hyperplasia Receiving Greenlight Laser Prostatectomy

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Video Abstract

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Objective: To investigate the impact of body mass index (BMI) on preoperative characteristics, lower urinary tract symptoms (LUTS), intraoperative variables, surgical outcomes and postoperative complications.

Methods: This is a retrospective observational study including 891 benign prostate hyperplasia (BPH) patients who underwent GreenLight Laser photoselective vaporization of the prostate (PVP) between 2014 and 2020. Clinical characteristics, uroflowmetry parameters, and surgery related parameters were extracted from electronic health records. Patients were categorized into different weight groups based on Taiwanese populations' BMI criteria. Statistical analyses, involving descriptive statistics, correlation analyses, and independent *t*-tests, were employed to examine associations between BMI and relevant variables.

Results: Pearson's correlation analysis indicated a negative correlation between BMI ($r = -0.172$, $p < 0.001$) and age, and positive correlations with total prostate volume (TPV) ($r = 0.123$, $p < 0.001$) and transition zone volume (TZV) ($r = 0.083$, $p = 0.017$). Obese patients were found to be younger ($p=0.007$) and have larger TPVs ($p=0.010$) but showed no significant differences in International Prostate Symptom Scores (IPSS) scores when compared to non-obese patients. Notably, obese patients had lower preoperative and postoperative post-void residual (PVR), whereas non-obese patients exhibited a more significant PVR reduction post-surgery. BMI did not significantly affect surgical parameters or postoperative complications.

Conclusion: In BPH patients treated with PVP, obese individuals were younger with larger prostates but had similar IPSS scores compared to non-obese patients. Obese patients had lower pre and post-surgery PVR, while non-obese patients saw greater PVR improvements. BMI plays a nuanced role BPH patients' characteristics.

Keywords: benign prostate hyperplasia, body mass index, functional study, GreenLight Laser, photoselective vaporization of the prostate, urodynamic study

Introduction

Benign prostate hyperplasia (BPH) is a condition characterized by the proliferation of smooth muscle and epithelial cells in the prostate's transition zone. Its increasing prevalence leads to troubling lower urinary tract symptoms (LUTS) in

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elderly males, including obstructive, irritative symptoms, and post-micturition issues. When symptoms are not sufficiently relieved by conservative or medical treatments, surgical interventions become necessary.[1] Among these, GreenLight Laser photoselective vaporization of the prostate (PVP) stands out as a minimally invasive technique that matches the effectiveness of the traditional Transurethral Resection of the Prostate (TURP). PVP offers several benefits, including a lower risk of bleeding, reduced need for catheterization, and shorter hospital stays, positioning it as an attractive surgical option.[2,3]

Obesity, defined by the World Health Organization (WHO), is characterized by abnormal or excessive fat accumulation posing a risk to health.[4] The global prevalence of obesity has significantly increased over the past decades, impacting public health in various regions worldwide.[5,6] WHO recommends using Body Mass Index (BMI), calculated as weight/height^2, to categorize individuals into underweight, normal weight, overweight, and obesity based on criteria specific to different regions.[4] Due to the higher prevalence of abdominal fat distribution in Asian populations compared to Caucasians, leading to an increased risk of metabolic syndrome, WHO suggested in 2000 that countries in the Asian-Pacific region adopt different BMI ranges for weight classification.[7] Taking into account the unique ethnic mix of the population, Taiwan's Ministry of Health and Welfare introduced population-specific criteria in 2002, defining overweight as BMI 24.0–26.9 and obese as BMI ≥ 27.0.[8] Considering the relevance to health risks, using Taiwan criteria to define overweight and obesity is most appropriate for the Taiwanese population.

While previous studies have explored the association between BMI and total prostate volume (TPV), as well as the severity of LUTS in BPH patients, few have focused on BPH patients who underwent procedural intervention. Additionally, most studies use the International Prostate Symptom Score (IPSS) to assess the severity of LUTS, with few employing objective uroflowmetric parameters as outcome measures for evaluating disease severity. Furthermore, there is a lack of empirical evidence on whether obesity affects perioperative parameters such as operative time and laser energy use, with only a few studies analyzing the impact of BMI on the surgery and prognosis of these patients. Central obesity, often measured by waist circumference, has been linked to less improvement in storage LUTS among BPH patients following surgery.[9,10] Given the potential influence of BMI on both surgery and prognosis, it is important to explore whether BMI similarly affects LUTS. The purpose of this study is to investigate the correlation between BMI and preoperative patient characteristics, symptoms, intraoperative variables, outcomes and postoperative complications in BPH patients undergoing PVP.

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Materials and Methods

Study Design

This study employed a retrospective cohort design to investigate the association between BMI and clinical factors, LUTS-related parameters, and surgery-related parameters and postoperative complications over a specified time period.

Study Population

The study comprised 843 individuals (aged between 49–95 years) who had undergone GreenLight Laser PVP by multiple surgeons at a single medical center between 2016 and 2020. Inclusion criteria included patients with moderate to severe LUTS undergoing PVP; while those with prostate cancer, lower urinary tract infections (UTI), or neurologic bladder conditions were excluded (Supplementary Figure 1). Patients were stratified into four weight groups based on Taiwan criteria: underweight (BMI < 18.5), normal weight (18.5 ≤ BMI < 24), overweight (24 ≤ BMI < 27), and obese (BMI ≥ 27).

Data Source

Patient data were extracted from the electronic health records (EHR) of a single medical center. The surgeries were performed by 11 expert surgeons, each with experience in over 100 TURP and 100 GreenLight laser PVP procedures. Variables of interest included preoperative physical status (height, age, weight, BMI), history of anticoagulant use, preoperative hemoglobin level, platelet count, initial prostate-specific antigen (PSA). Prostate dimensions (length, width, height) were measured using Transrectal Ultrasound of the Prostate (TRUS), and TPV was calculated using the formula Length x Width x Height x π/6. PSA density (ng/mL²) was calculated as PSA/Volume. The Chinese version of the IPSS was used to assess preoperative urinary tract symptoms. Uroflowmetric parameters pre and post-surgery, including peak flow rate (PFR), average flow rate (AVR), voided volume (VV), and post-void residual (PVR), were measured through uroflowmetry. Total laser energy use was recorded by the GreenLight XPS™ Laser Therapy System. Intraoperative parameters such as operation time, laser energy use, and related variables and postoperative complications such as the need for manual irrigation, postoperative emergency room visits, and the occurrence of a second operation were recorded.

Outcomes

Primary endpoints between BMI groups included preoperative characteristics such as TPV, transition zone volume (TZV), PSA, PSA density, preoperative severity of LUTS (measured by IPSS), and changes in pre and postoperative uroflowmetric parameters. Secondary outcomes included differences in intraoperative parameters and postoperative complications among different BMI groups. Details of postoperative complications were classified using the Clavien-Dindo classification.[11]

Statistical Analysis

Statistical analysis was conducted using IBM SPSS, version 25 (IBM Corp, Armonk, NY, USA). Descriptive statistics summarized the demographic characteristics, and Pearson's correlation coefficient was used for univariate analysis to test linear relationships. Independent t-tests examined differences in means between groups for continuous measurements. A value of $P < 0.05$ was considered to indicate statistical significance.

Ethical Considerations

This study received approval from the Institutional Review Board (IRB) of a single medical center. Due to the retrospective nature, a waiver of informed consent was obtained, and the study adhered to ethical standards and guidelines.

Result

Descriptive Statistics

This study involved 891 BPH patients treated with GreenLight Laser PVP, with 843 successfully enrolled (Table 1). Patients' average age was 70.9 ± 8.8 years (range 49–95), with an average BMI of 25 ± 3.3 kg/cm² (range 15.7–39.3). Preoperative TPV and TZV averaged 60.6 ± 26.6 gm and 31.0 ± 18.6 gm, respectively, with a PSA density of 0.2 ± 1.2 ng/mL². Among them, 597 had analyzable IPSS, averaging 23.6 ± 4.4. Preoperative and postoperative measurements included PFR, AVR, VV, and PVR. Surgical data revealed an average operation time of 116.4 ± 45.6 mins, with laser energy use averaging 175,601.5 ± 127,075.3 joules, and energy per TPV and TZV averaging 3,115.9 ± 2,134.1 and 6,872.3 ± 5,291.7 joules/gm, respectively.

Correlation Analysis

Table 2 reveals a significant but weak correlation between BMI and certain parameters through Pearson correlation analysis. BMI negatively correlates with age ($r = -0.172$, $p < 0.001$) and has a positive, weak correlation with TPV ($r = 0.123$, $p < 0.001$) and TZV ($r = 0.083$, $p = 0.017$). No correlation exists with preoperative PSA levels, but a weak negative correlation was found with PSA density ($r = -0.118$, $p = 0.026$). Between BMI and the IPSS, only nocturia showed a negative correlation ($r = -0.099$, $p = 0.017$). Positive correlations were seen with preoperative PFR ($r = 0.115$, $p = 0.012$), AVR ($r = 0.101$, $p = 0.028$), VV ($r = 0.098$, $p = 0.032$), postoperative PFR ($r = 0.152$, $p = 0.002$), and AVR ($r = 0.131$, $p = 0.009$), while a negative correlation was found with preoperative PVR ($r = -0.089$, $p = 0.046$). No significant correlations were observed between BMI and postoperative VV and PVR or with surgery-related parameters, including operation time, laser energy, energy per TPV, and TZV, nor with changes in PFR and PVR. Furthermore, BMI did not significantly correlate with postoperative

Table 1 Descriptive Characteristics of the Participants

Variables	Mean/Number	SD	Range/Percentage	
Total Number	843			
Age	70.9	8.8	49–95	Year-old
Height	164.9	6.1	148–197	cm
Weight	68.1	10.2	41–119	kilograms
BMI	25.0	3.3	15.7–39.3	kg/cm^2
Anticoagulant			11.0%	
Pre-OP platelet count	217.1	65.1	89–677	1000/uL
Pre-OP Hb	13.6	1.8	7.5–18.2	g/dL
PSA	12.9	76.7	0.2–1430.9	ng/mL
TPV	60.6	26.6	16.3–229.9	gm
TZV	31.0	18.6	4.74–149.8	gm
PSA density	0.2	1.2	0.00–21.83	ng/ml^2
GFR	79.4	25.1	7.3–171.0	
LUTS Related Parameters				
IPSS total score	23.6	4.4	2–35	
Frequency	3.7	1.1	0–5	
Urgency	2.8	1.4	0–5	
Nocturia	3.4	1.3	0–5	
Weak stream	3.8	1.0	0–5	
Intermittency	3.2	1.2	0–5	
Straining	3.2	1.2	0–5	
Incomplete emptying	3.3	1.2	0–5	
Pre-PFR	8.7	4.9	1–36	mL/s
Pre-AVR	3.6	2.1	0–11	mL/s
Pre-VV	165.8	107.0	0–597	mL
Pre-PVR	121.0	146.1	0–967	mL
Post-PFR	14.1	8.1	0–46	mL/s
Post-AVR	6.4	3.8	0–21	mL/s
Post-VV	191.6	123.8	0–693	mL
Post-PVR	41.8	64.4	0–644	mL

(Continued)

Table 1 (Continued).

Variables	Mean/Number	SD	Range/Percentage	
Surgery Related Parameters				
Operation time	116.4	45.6	36–361	mins
Laser energy	175601.5	127,075.3	7438–1231845	Joule
Energy per TPV	3115.9	2134.1	150.1–19,643.6	Joule/gm
Energy per TZV	6872.3	5291.7	278.7–43,661.8	Joule/gm

Abbreviations: BMI, body mass index; OP, operation; HB, hemoglobin; PSA, prostate-specific antigen; TPV, total prostate volume; TZV, transition zone volume; GFR, glomerular filtration rate; TZV, transition zone volume; GFR, glomerular filtration rate; IPSS, international prostate symptom score; pre, preoperative; post, postoperative; PFR, peak flow rate; AFR, average flow rate; VV, voided volume; PVR, post-void residual.

Table 2 Correlation Analysis Between BMI and Clinical Factors

Variables	Pearson Correlation	*p* value
Age	−0.172	<0.001***
TPV	0.123	<0.001***
TZV	0.083	0.017*
PSA	−0.096	0.069
PSA density	−0.118	0.026*
LUTS Related Parameters		
IPSS total score	−0.033	0.409
Frequency	0.019	0.648
Urgency	−0.013	0.749
Nocturia	−0.099	0.017*
Weak stream	−0.028	0.506
Intermittency	−0.004	0.918
Straining	0.051	0.224
Incomplete emptying	−0.033	0.434
Pre-PFR	0.115	0.012*
Pre-AVR	0.101	0.028*
Pre-VV	0.098	0.032*
Pre-PVR	−0.089	0.046*
Post-PFR	0.152	0.002**
Post-AVR	0.131	0.009**
Post-VV	0.023	0.655
Post-PVR	−0.040	0.377

(*Continued*)

Table 2 (Continued).

Variables	Pearson Correlation	p value
Surgery Related Parameters		
Operation time	0.227	0.050
Laser energy	0.043	0.209
Energy per TPV	−0.033	0.335
Energy per TZV	−0.024	0.491
PFR change	0.065	0.247
PVR change	−0.079	0.113
Postoperative Complication		
Manual irrigation	−0.091	0.251
Manual irrigation times	−0.075	0.456
Post-incontinence	−0.031	0.771
P3M ER visit	−0.061	0.529
P12M ER visit	−0.041	0.676
P3M second operation	0.077	0.575
P12M second operation	−0.048	0.725

Notes: *p value< 0.05, **p value<0.01, ***p value<0.001.
Abbreviations: ABMI, body mass index; TPV, total prostate volume; TZV, transition zone volume; PSA, prostate-specific antigen; IPSS, international prostate system score; Pre, preoperative; Post, postoperative; PFR, peak flow rate; AFR, average flow rate; VV, voided volume; PVR, post-void residual; P3M, 3-month postoperatively; P12M, 12-month postoperatively; ER, emergency room.

complications like manual irrigation for blood clot evacuation, frequency of manual irrigation during hospital stay, post-operative incontinence, emergency room visits, or the occurrence of a second operation within 3 and 12 months after surgery.

Comparison Between Obesity and Non-Obesity Groups

In Table 3, we compare non-obese (BMI < 27.0) and obese (BMI ≥ 27.0) patients using t-tests. Obese patients were younger and had larger total TPV than non-obese patients, with significant differences in age ($p = 0.007$) and TPV ($p = -0.010$). No significant differences were observed in TZV, PSA levels, or PSA density. For LUTS, both groups showed similar IPSS and components. However, obese patients had significantly lower preoperative and postoperative PVR compared to non-obese patients in Figure 1 ($p = 0.005$ and $p = 0.015$, respectively), with no significant differences in preoperative and postoperative PFR, AVR, VV, or surgery-related parameters, except for a significantly higher PVR change in non-obese patients ($p = 0.002$).

Subgroup Analysis

Subgroup analysis visualized TPV among the four weight groups (underweight, normal weight, overweight, and obesity) in Supplementary Figure 2. The mean ± standard deviation of TPV in the underweight, normal weight, overweight, and obesity groups were 50.51 ± 21.48 kg/m², 58.72 ± 30.10 kg/m², 59.93 ± 22.94 kg/m², and 64.50 ± 26.28 kg/m², respectively. Independent sample t-tests revealed significant differences in TPV between the obesity group and the normal weight group ($p = 0.024$) and between the obesity group and the overweight group ($p = 0.037$).

Table 3 Difference Analysis Between Non-Obesity and Obesity Patients

	Univariate Analysis				
	Non-Obesity (BMI<27)		Obesity (BMI>27)		*p* value
	n=630		n=213		
	Mean(n)	Std	Mean(n)	Std	
Age	70.91	8.57	69.11	8.12	0.007**
TPV	59.01	26.70	64.50	26.28	0.01*
TZV	30.34	18.68	32.40	18.10	0.163
PSA	9.67	27.41	7.60	9.39	0.463
PSA density	0.17	0.64	0.12	0.18	0.402
LUTS Related Parameters					
IPSS total score	23.61	4.37	23.36	4.74	0.556
Frequency	3.71	1.01	3.71	1.05	0.970
Urgency	2.80	1.39	2.87	1.37	0.561
Nocturia	3.43	1.26	3.21	1.22	0.084
Weak stream	3.82	1.00	3.69	1.00	0.182
Intermittency	3.24	1.18	3.13	1.02	0.367
Straining	3.23	1.23	3.21	1.20	0.882
Incomplete emptying	3.34	1.23	3.38	1.11	0.780
Pre-PFR	8.64	4.75	9.22	5.36	0.258
Pre-AVR	3.54	2.12	3.74	2.03	0.370
Pre-VV	165.35	105.36	177.98	112.11	0.262
Pre-PVR	130.98	159.88	89.77	89.66	0.005**
Post-PFR	13.85	8.14	15.59	7.92	0.065
Post-AVR	6.28	3.90	6.91	3.70	0.159
Post-VV	195.48	127.45	188.04	115.33	0.607
Post-PVR	45.51	69.88	29.15	40.77	0.015*
Surgery Related Parameters					
Operation time	114.00	49.46	124.57	43.59	0.370
Laser energy	172980.46	125,870.71	183,057.96	134,523.02	0.321
Energy per TPV	3140.12	2101.98	3066.89	2261.61	0.667
Energy per TZV	6933.39	5312.07	6765.45	5293.89	0.691
PFR change	5.50	8.32	6.10	6.98	0.559
PVR change	94.18	163.06	57.44	72.85	0.002**

Notes: *p value< 0.05, **p value<0.01.
Abbreviations: TPV, total prostate volume; TZV, transition zone volume; PSA, prostate-specific antigen; IPSS, international prostate system score; Pre, preoperative; Post, postoperative; PFR, peak flow rate; AFR, average flow rate; VV, voided volume; PVR, post-void residual.

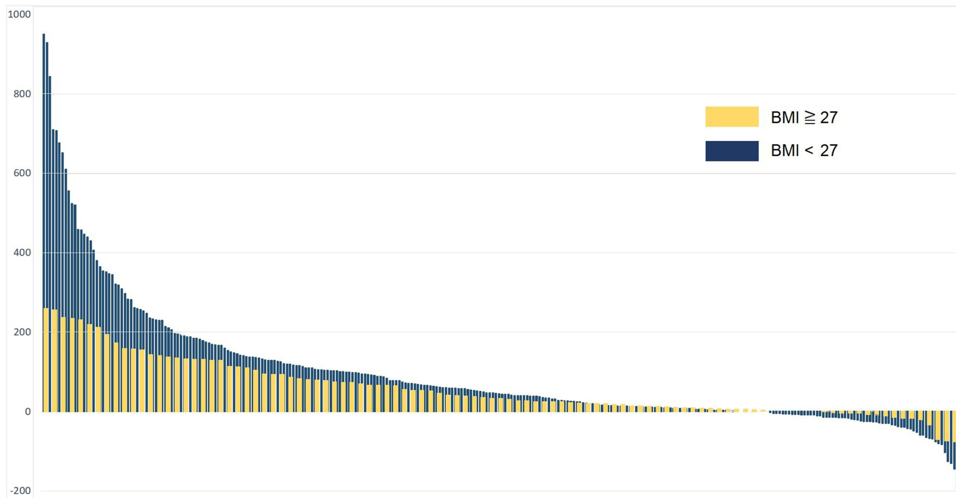

Figure 1 Post-voiding residual change after surgery of all participants.

Postoperative Complications in Detail

As shown in Table 4, a total of 75 patients (75/843, 8.9%) in the cohort experienced at least one perioperative complication. In the non-obesity group, 56 patients (56/630, 8.9%) experienced complications, with 32, 5, 17, and 2 patients having grade I, II,

Table 4 Postoperative Complications Classified by Clavien-Dindo System

	Non-Obesity (BMI<27) n=630	Obesity (BMI>27) n=213	p value
Overall AEs; n (%)	56 (8.9%)	19 (8.9%)	0.989
Clavien-Dindo I	32 (5.1%)	12 (5.6%)	
Clavien-Dindo II	5 (0.8%)	1 (0.5%)	
Clavien-Dindo III	17 (2.7%)	5 (2.3%)	
Clavien-Dindo IV	2 (0.3%)	1 (0.5%)	
Clavien-Dindo V	0 (0.0%)	0 (0.0%)	
Grade	**Complication**	**Management**	
I	Acute urinary retention (n=25)	Foley catheter insertion	
	Hematuria ± blood clot retention (n=19)	Manual irrigation	
II	Urinary tract infection (n=4)	Antibiotics treatment	
	Pneumonia (n=1)	Antibiotics treatment	
	Epididymo-orchitis (n=1)	Antibiotics treatment	
III	Acute urinary retention or hematuria (n=16)	Cystoscopy	
	Bladder neck stricture (n=3)	TUIP	
	Prostate enlargement (n=3)	TURP	
IV	Urosepsis (n=3)	Admission to ICU	

Abbreviations: AE, adverse events; BMI, body mass index; TUIP, transurethral incision of the prostate; TURP, transurethral resection of the prostate.

III, and IV complications, respectively. In the obesity group, 19 patients (19/213, 8.9%) experienced complications, with 12, 1, 5, and 1 patients having grade I, II, III, and IV complications, respectively. No grade V complications were observed in the cohort. The overall complication rate did not significantly differ between the groups (p=0.989), and there were no significant intergroup differences in the rates of grade I, II, III, or IV complications.

Discussion

Several studies have established a link between BMI and prostate volume (PV) in patients with BPH. Li, B. H. et al observed a significant linear relationship between BMI and the risk of having a larger PV in Chinese patients with BPH.[12] In a similar vein, Batai, K.et al conducted research on patients undergoing holmium enucleation for benign prostatic obstruction (BPO), finding a notable positive correlation between BMI and PV. This study also identified a correlation between the expressions of TGFB3 and A2M with both BMI and PV.[13] These findings are consistent with the results of our study, which showed that individuals in the obesity group had significantly larger TPVs than those in the normal weight and overweight groups. The lack of significant differences in TPV among the underweight group, which comprised only 18 patients, might be due to the small sample size.

Additionally, our analysis revealed a positive linear relationship between BMI and transitional zone volume (TZV), although no significant difference in TZV was observed between the obesity and non-obesity groups. Interestingly, our research also found that patients with obesity were significantly younger on average than those without obesity (mean age: 69.11 years versus 70.91 years, p=0.007). This age difference, coupled with a positive association between BMI and the rate of prostate growth, suggests that obesity may contribute to a faster prostate growth rate,[14] potentially necessitating earlier surgical intervention. Previous research, including a study by Park, J.et al supports this, showing a higher annual change rate in PV among Korean patients with a BMI ≥ 25 kg/m^2.[15] The accelerated prostate growth in obese patients is thought to be driven by chronic inflammation[16] or the increased conversion of testosterone into estrogen due to higher adiposity levels.[17] Although weight loss has been indicated to reduce the prostate growth rate,[18] further studies are needed to determine if weight loss could indeed delay the requirement for BPH surgery, as our findings suggest.

Earlier research has delved into the relationship between BMI and both PSA levels and IPSS in patients with Benign Prostatic Hyperplasia (BPH). Yin, Z.et al uncovered a significant positive link between BMI and IPSS among Chinese men undergoing routine health check-ups.[19] Conversely, Seo, D.H. et al found a slight negative correlation between BMI and both PSA and IPSS in South Korean men being screened for prostate issues.[20] Furthermore, Kim, J.M.et al identified contrasting correlations of BMI with PSA levels (negative) and IPSS (positive) in BPH patients with LUTS.[21] However, our findings diverge from these patterns; we did not observe a significant linear relationship between BMI and PSA levels (p=0.069), nor did we find a notable difference in PSA levels between non-obese and obese groups (p=0.463). Similarly, apart from nocturia, we found no linear correlation between BMI and total IPSS or its subscores, with no significant differences in IPSS scores, including nocturia, across groups. This discrepancy may stem from the fact that our study subjects, requiring surgical intervention, presented with more severe BPH symptoms unresponsive to non-surgical treatments, irrespective of their obesity status. We also suggest that the observed differences in PSA density between groups could be due to variations in PV.

Limited research has explored the association between obesity and uroflowmetric variables. Yin, Z.et al found a significant positive correlation between BMI and PVR in Chinese men receiving routine health care.[19] Another study on newly diagnosed BPH patients in China found no significant differences in PVR >50 among underweight, overweight, and obese patients compared to the normal-weight reference group.[12] Pierce, H. et al suggested that patients of normal weight, overweight, and obese categories undergoing 180W Greenlight PVP showed significant improvements in PVR and PFR postoperatively, with no significant differences in the magnitude of improvement among the three groups.[22] However, this differs from our results. In our study, BMI showed a significant positive linear correlation with preoperative PFR, AVR, and VV, as well as a significant negative correlation with preoperative PVR. Postoperatively, only PFR and AVR exhibited significant positive correlations with BMI. Despite no differences in PFR, AVR, and VV, non-obese patients had consistently higher PVR both pre- and postoperatively compared to obese patients. Obesity is associated with increased intra-abdominal pressure,[23,24] which may contribute to the smaller PVR in obese patients. However, this hypothesis requires further investigation. Notably, non-obese patients had a larger PVR change, indicating that these patients had a higher preoperative PVR, allowing for greater improvement postoperatively. In summary, both obese and non-obese patients demonstrated significant improvements in PVR postoperatively, with non-obese patients exhibiting greater PVR improvement and obese patients having lower postoperative PVR.

The influence of obesity on storage symptoms in patients with BPH remains a subject of ongoing debate. Khan et al reported that obese men in later life were 25% more likely to experience nocturia compared to men with normal body weight.[25] However, the effect of obesity on treatment outcomes in these patients remains controversial. For instance, Singam et al demonstrated that increasing BMI did not significantly impact the medical treatment outcomes of nocturia,[26] while Lv et al similarly found no significant correlation between BMI or waist circumference and postoperative improvement in nocturia.[27] In contrast, Gacci et al observed that a waist circumference of ≥102 cm was associated with a higher risk of incomplete recovery of both total and storage IPSS after prostatectomy compared to men with a waist circumference <102 cm.[9,10] Due to the retrospective design of our study, we were unable to collect postoperative IPSS scores. Further research is warranted to explore whether obesity, defined by BMI or waist circumference, affects storage symptoms following surgical treatment for BPH.

In our research, we observed no association between BMI and perioperative parameters, including operation duration, total laser energy used, and energy consumption per TPV or TZV. Similarly, when comparing groups based on BMI, no significant differences in these perioperative metrics were identified. This finding contrasts with Pierce, H. et al who noted that overweight patients with BPH undergoing PVP required longer operation times, more lasing time, and higher energy usage compared to their normal-weight counterparts. Additionally, in this literature, these differences became insignificant when patients with a history of TURP or 5-alpha-reductase inhibitor (5-ARI) usage were excluded from the analysis.[22] Although techniques may affect outcomes, Holmium Laser Enucleation of the Prostate (HoLEP) is widely recognized as a size-independent treatment.[28] Tamalunas et al found that while larger prostates require longer operating times, functional outcomes remain similar across sizes.[29] In a later study, the authors confirmed that HoLEP procedures took longer in patients with morbid obesity, likely due to their larger prostate sizes.[30] Differences between our findings and earlier studies may be due to surgical technique variations, patient selection, advances in instruments, and surgeons' evolving skills. Our study's methodology suggests a complex relationship between obesity and prostate surgery outcomes, indicating a need for further research to identify if customized approaches for certain BMI groups could be beneficial.

Our correlation analysis did not reveal any significant correlation between BMI and postoperative complications. Reasons for patients returning to the emergency room included acute urinary retention (AUR), hematuria, and UTI. The leading causes for undergoing surgery again within three months were refractory LUTS, checking bleeding, and cancer. Within twelve months, the leading causes were refractory LUTS, TRUS biopsy due to elevated serum PSA levels, and cancer. Postoperative complications classified by the Clavien-Dindo system showed no significant differences between groups (Table 4). Grade I complications occurred in 44 cases, mostly AUR (25 cases) or hematuria (19 cases). There were 6 grade II cases, including UTI (4 cases), pneumonia (1 case), and epididymo-orchitis (1 case) treated with antibiotics. Grade III complications occurred in 22 cases, including hematuria and AUR managed by cystoscopy (16 cases), bladder neck stricture managed by transurethral incision of the prostate (3 cases), and BPH requiring TURP (3 cases). Three patients developed grade IV complications (urosepsis) requiring ICU admission. No grade V complications were observed. This absence of correlation contrasts with some previous findings. Willder, J.M.et al and Mobley, D.et al indicated that higher BMI might increase the likelihood of reoperation and complications in BPH surgeries.[31,32] Moreover, Sener, N.C.et al suggested that metabolic syndromes playing a significant role in elevating complication risks in BPH surgeries.[33] On the other hand, McVary, K.et al found that Sildenafil daily could alleviate LUTS in BPH patients regardless of their BMI or the severity of symptom.[34] Similarly, Mosli, H.A.et al observed no significant increase in complications among higher BMI patients undergoing prostatectomy.[35] Supporting our findings, Pierce, H. et al's study on BPH patients undergoing PVP reported no significant differences in 30-day and 90-day postoperative complications, including hematuria, LUTS, AUR, UTI, and urinary incontinence, across normal-weight, overweight, and obese patients.[22] Our results reinforce the notion that BMI does not significantly influence the risk of perioperative and postoperative complications, suggesting that factors other than BMI might play a more pivotal role in determining surgical outcomes and complication rates.

Postoperative incontinence is a significant complication of prostate surgery. In a review article, Gacci et al reported a link between visceral obesity and incontinence following radical prostatectomy in obese men.[10] However, our study found no significant association between BMI and postoperative incontinence. This discrepancy may be attributed to differences in patient populations (BPH versus prostate cancer) and the use of different dependent variables (BMI versus waist circumference). Currently, the evidence regarding the impact of obesity on postoperative incontinence in BPH patients remains limited, underscoring the need for further research on this topic.

This study has several limitations. Firstly, due to Taiwan's unique ethnic diversity, we used Taiwan criteria to stratify patients into different weight groups, making it challenging to directly compare our results with international data. Secondly, our data included a small number of underweight patients, making it difficult to detect significant differences in statistical analysis. Thirdly, as this is a retrospective observational study, causal relationships between various variables cannot be confirmed. Future prospective studies are needed to validate the causal relationships between these variables.

Conclusion

In patients with BPH undergoing PVP, those with obesity tend to be younger and have larger PVs compared to their non-obese counterparts. Despite similar scores in the subjective IPSS, obese patients present with lower preoperative and postoperative PVR urine volumes. Conversely, patients without obesity show a more substantial improvement in PVR. PVP is confirmed as an effective surgical treatment for BPH, with significant PVR reduction observed in both groups following surgery. Interestingly, BMI does not have a notable effect on the intraoperative metrics or postoperative complications within this study. Further research on the impact of BMI on postoperative changes in storage LUTS and urinary incontinence in these patients is warranted and remains a valuable topic for exploration.

Abbreviations

5-ARI, 5-alpha-reductase inhibitor; AVR, Average flow rate; AUR, Acute urinary retention; BMI, Body mass index; BPH, Benign prostate hyperplasia; BPO, Benign prostatic obstruction; EHR, Electronic health records; HoLEP, Holmium Laser Enucleation of the Prostate; IPSS, International Prostate Symptom Score; IRB, Institutional Review Board; LUTS, Lower urinary tract symptoms; PFR, Peak flow rate; PSA, Prostate-specific antigen; PV, Prostate volume; PVP, Photoselective vaporization of the prostate; PVR, Post-void residual volume; TPV, Total prostate volume; TRUS, Transrectal Ultrasound of the Prostate; TURP, Transurethral resection of the prostate; TZV, Transition zone volume; UTI, Urinary tract infection; VV, Voided volume; WHO, World Health Organization.

Data Sharing Statement

All data generated or analyzed during this study are included in this published article.

Ethics Approval and Consent to Participate

This research has been carried out following the ethical guidelines outlined in the Helsinki Declaration (2013). Approval for this study was granted by the Institutional Review Board of Chang Gung Medical Foundation. (Number: 202200839B0). Since this is a retrospective study, no consent form is required, and all patient data is kept confidential.

Author Contributions

All authors contributed significantly to the reported work, whether through conception, study design, execution, data acquisition, analysis, interpretation, or a combination of these areas. Each author participated in drafting, revising, or critically reviewing the manuscript, provided final approval of the version to be published, agreed on the journal submission, and accepted responsibility for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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