Al-Azhar International Medical Journal

Volume 4 | Issue 6 Article 18

2023
Section: Urology

Recovery of Detrusor Function after Transurethral Prostatectomy in Patients with Benign Prostatic Hyperplasia and Underactive Detrusor: A Systematic Review and Meta-analysis

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How to Cite This Article

Ismael, Mahmoud; Ali, Mahmoud mohammed; and Mohammed, Hasan abdelazim (2023) "Recovery of Detrusor Function after Transurethral Prostatectomy in Patients with Benign Prostatic Hyperplasia and Underactive Detrusor: A Systematic Review and Meta-analysis," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 6, Article 18.
DOI: https://doi.org/10.58675/2682-339X.1861

META ANALYSIS

Recovery of Detrusor Function After Transurethral Prostatectomy in Patients with Benign Prostatic Hyperplasia and Underactive Detrusor: A Systematic Review and Meta-analysis

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Abstract

Purpose: **To determine the recovery potential of detrusor function in patients with symptomatic Benign Prostatic Hyperplasia (BPH) and Detrusor Underactivity (DU) who underwent transurethral prostatectomy.**

Materials and methods: **The author systematically performed an online search via PubMed, Embase, Google scholar, and databases of Cochrane Library for articles published till June 2022, the selected studies included Patients with symptomatic BPH with urodynamically confirmed DU who underwent transurethral prostatectomy, these studies are original articles published in English languish, randomized or nonrandomized, retrospective or prospective. Research that could not meet the aforementioned inclusion criteria, review articles, letters, experimental studies, and studies with inadequate data to estimate the results were all omitted.**

Results: **The author systemically reviewed 11 selected studies after a total of 4811 records were obtained, our meta-analysis showed relative recovery of detrusor function after Transurethral Prostatectomy in Patients with BPH and DU. However, further studies are needed regarding this subject.**

11 studies were included in this systematic review. Seven of these studies are retrospective studies, while the remaining four studies are prospective studies. 9 out of 11 studies reported transurethral prostate surgery (TURP) or TURP/transurethral prostate incision surgery (TUIP) as the standard intervention, 1 study with Holmium Laser Enucleation of the Prostate (HOLEP) and the remaining study used Photo Vaporization of the Prostate (PVP) as standard procedure. All studies included in the review reported Q max and postvoiding residual (PVR) as parameters for assessment pre and postoperatively, while Bladder Contractility Index (BCI), which is the most important parameter, was mentioned only in 2 studies with complete and satisfactory data. Some of the studies reported BCI as a preoperative assessment but had no post-operative data. We tried to contact some of the authors to collect the missing data, but got no response. Pressure of detrusor at Q max (Pdet at Qmax) was reported in 3 studies, International Prostatic Symptom Score (IPSS) in 9 studies, Quality of Life (QOL) in 7, and Voiding Effeciency (VE) and urinary bladder Compliance were reported only in 2 studies. The number of analyzed patients in our included studies ranged from 20 to 250 patients. Time of outcome evaluation was mostly at 12 months except for 2 studies, which were at 6 months and another study at 3 months.

Conclusions: **The meta-analysis results showed that patients with BPH and DU who underwent transurethral prostatectomy showed improvement of Uro-dynamic (UD) parameters postoperatively.**

Keywords: Urodynamic, Cystometry, Pressure flow study, Benign prostatic hyperplasia, Benign prostatic obstruction, Male LUTS, Detrusor underactivity, Underactive detrusor, Atonic bladder, Hypotonic bladder, Tran- surethral surgery, Transurethral resection, Incision, Vaporization, Ablation, Enucleation

Accepted 18 December 2022.
Available online 5 September 2023

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https://doi.org/10.58675/2682-339X.1861

1. Introduction

Detrusor underactivity (DU) is a common but poorly understood urologic problem. DU was defined by International Continence Society (ICS) as a decreased detrusor contraction strength and/or duration, leading to increased time for emptying of the bladder and/or failure of complete bladder evacuation.[1] Clinically, DU patients have impaired bladder completion and are unable to effectively contract the detrusor to completely empty their bladder in a typical amount of time.[2] Normal or diminished bladder sensation, a low or non-contractile detrusor, and poor sustained detrusor contraction, which result in a low maximum flow rate (Q max) and a large volume of postvoiding residual (PVR) urine, are urodynamic parameter findings in men with DU.[3]

DU is hypothesised to have multiple contributing factors. Age, bladder outlet obstruction (BOO), diabetes, spinal cord injuries, neurological traumas, and other neurologic disorders have all been linked to it.[4] DU can have a myogenic (i.e., detrusor muscle-related) or a neurogenic (i.e., connected to various neurological control mechanisms, including as afferent nerves, central neural circuits, and efferent nerves) aetiology.[5]

The diagnosis of DU is as often as possible established in patients of old age who are complaining of lower urinary tract symptoms (LUTS) either obstructive or irritative or patients presented by urinary retention. Resnick and colleagues reported that DU was detected in about two-thirds of elderly persons with urinary incontinence.[6] This condition of detrusor impairment may be accurately identified only by invasive urodynamic (UD), which can also diagnose the associated of DU and bladder outlet obstruction (BOO).[7]

Regarding the effects of DU on the results of transurethral prostatectomy, there are conflicting evidence. At short time follow-up, transurethral prostatectomy results in DU patients have been reported as satisfactory, but not in the long-lasting.[8] Transurethral incision of the bladder neck (TUIBN) improved voiding performance in female patients with DU, according to Jhang and colleagues.[9] According to a different study, males with DU who underwent transurethral prostate surgery (TURP) or transurethral prostate incision surgery (TUIP) had successful treatment outcomes.[10] As a result, certain patients may benefit from TURP for benign prostatic obstruction (BPO) with DU. Findings regarding the recovery of detrusor function following treatment, however, remain ambiguous.

To date, there are several studies regarding the detrusor function recovery after TURP for BPO, but the results were conflicting, and most of these studies have several limitations. We hypothesize that systematic review and meta-analysis may give a solid conclusion and stable results regarding the recovery potential for detrusor function after relief of BPO.

2. Materials and methods

2.1. Search strategy

We performed Online systematic searches on PubMed, Embase, google scholar and Cochrane Library databases. The key words for the search were as follows: [UDS (urodynamic, cystometry, or pressure flow study)], [BPH (benign prostatic hyperplasia, benign prostatic obstruction, or male LUTS)], [DU (detrusor underactivity, underactive detrusor, atonic bladder, or hypotonic bladder, and [transurethral surgery (transurethral resection, incision, vaporization, ablation, or enucleation)]. A manual search of relevant studies was also performed referring to review articles or original research articles on similar subjects.

We obtained Full copies of studies identified by the search that met our inclusion criteria, regarding the title, abstract and subject descriptors.

2.2. Study selection

Using the PRISMA flow diagram (Preferred Reporting Items for Systematic Reviews and Meta-Analyses),[11] three reviewers independently evaluated studies and reports. Prior to any data extraction, the quality of the included studies was assessed. Discussion among the reviewers was used to settle any differences that could have arisen.

2.3. Quality assessment

The three reviewers independently checked each selected study to minimize bias. All selected studies were assesed for their quality using the appropriate quality assessment tool (NHLBI tool).[12]

2.4. Data synthesis

The data that have been extracted met the criteria for the narrative synthesis of results and potential meta-analysis, and they contained almost all the information that was relevant to the review topic. When data are unclear or absent from the published

study, we additionally contacted the original authors to get the pertinent details.

2.5. Data analysis

For the statistical analysis we used RevMan statistical software. Continuous outcomes was pooled as mean difference (MD) or standardized mean difference (SMD) using the inverse variance method, and dichotomous outcomes were pooled as odds ratio (OR). The extent of heterogeneity was estimated with the I^2 measure, which describes the percentage of variation across studies due to heterogeneity. According to the I^2 value.

3. Results

In this systematic review, we searched online via PubMed, Web of Science, Google scholar, and Cochrane Central Register of Controlled Trials (CENTRAL) from their inception till July 2022. A total of 4811 records were obtained. After removing duplicates, 3114 unique records were screened by title and abstract. A total of 3046 trials were excluded due to ineligibility and 68 potentially eligible records were included for full-texts screening. Finally, 11 studies were included in the present systematic review and meta-analysis (Fig. 1).

Our study showed improvement of detrusor power post operatively and that DU is not a contraindication for intervention.

3.1. Quality of the included studies

We evaluated the quality of included studies using NHLBI tool for quality assessment[12] Table 1.

NHLBI tool for quality assessment[12]

3.2. Characteristics of the included studies

11 studies were included in this systematic review. Seven of these studies are retrospective studies, while the remaining four studies are prospective studies. 9 out of 11 studies reported TURP or TURP/TUIP as the standard intervention, 1 study with HOLEP and the remaining study used PVP as standard procedure. All studies included in the review reported Q max and PVRU as parameters for assessment pre and postoperatively, while BCI, which is the most important parameter, was mentioned only in two studies with complete and satisfactory data. Some of the studies reported bladder contractility index (BCI) as a preoperative assessment but had no postoperative data. We tried to contact some of the authors to collect the missing data, but got no response. Pdet at Qmax was reported in three studies, IPSS in nine studies, QOL in seven, and VE was reported in three studies and UB Compliance were reported only in two studies. The number of analyzed patients in our included studies ranged from 20 to 250 patients. Time of outcome evaluation was mostly at 12 months except for two studies, which were at 6 months and another study at 3 months. Tables 2 and 3.

3.3. Improvement of BCI

BCI which is the most important factor for evaluation of recovery of detrusor function showed improvement as reported in (Kau Han Lee and Kuo)[10] and (Shu-Yu Wu and Kuo),[21] which is consistent with our meta-analysis toward improvement postoperatively.

(95% CI = [1.92, 0.62], χ^2 = 4.7, I^2 = 79%, *P* value = 0.0001). Fig. 2.

3.4. Improvement of pdet qmax

Pdet Qmax also showed improvement as reported in (Kau Han Lee and Kuo)[10] and (Rubiao Ou E and colleagues)[19] and (Shu-Yu Wu and Kuo),[21] these results is consisting with this meta-analysis as regard improvement in this parameter.

(95% CI = [18.39, 12.1], χ^2 = 6.45, I^2 = 69%, *P* value = 0.0001). Fig. 3.

3.5. Improvement of Q max

All studies included showed improvement of Qmax, respectively over all pooled estimate was consistent with the majority of studies toward Qmax improvement.

(95% CI = [6.78, 5.98], χ2 = 72.75, I2 = 86%, P value = 0.0001). Fig. 4.

3.6. Improvement of PVR

All studies included showed improvement of PVR, these results matching with the analysis for the favor of improvement of PVR postoperatively, (95% CI = [177.06, 187.51], χ^2 = 572.3, I^2 = 98%, *P* value = 0.0001). Fig. 5.

3.7. Improvement of IPSS

IPSS as reported in all of the studies had significant improvement except (Kau Han Lee and Kuo)[10]

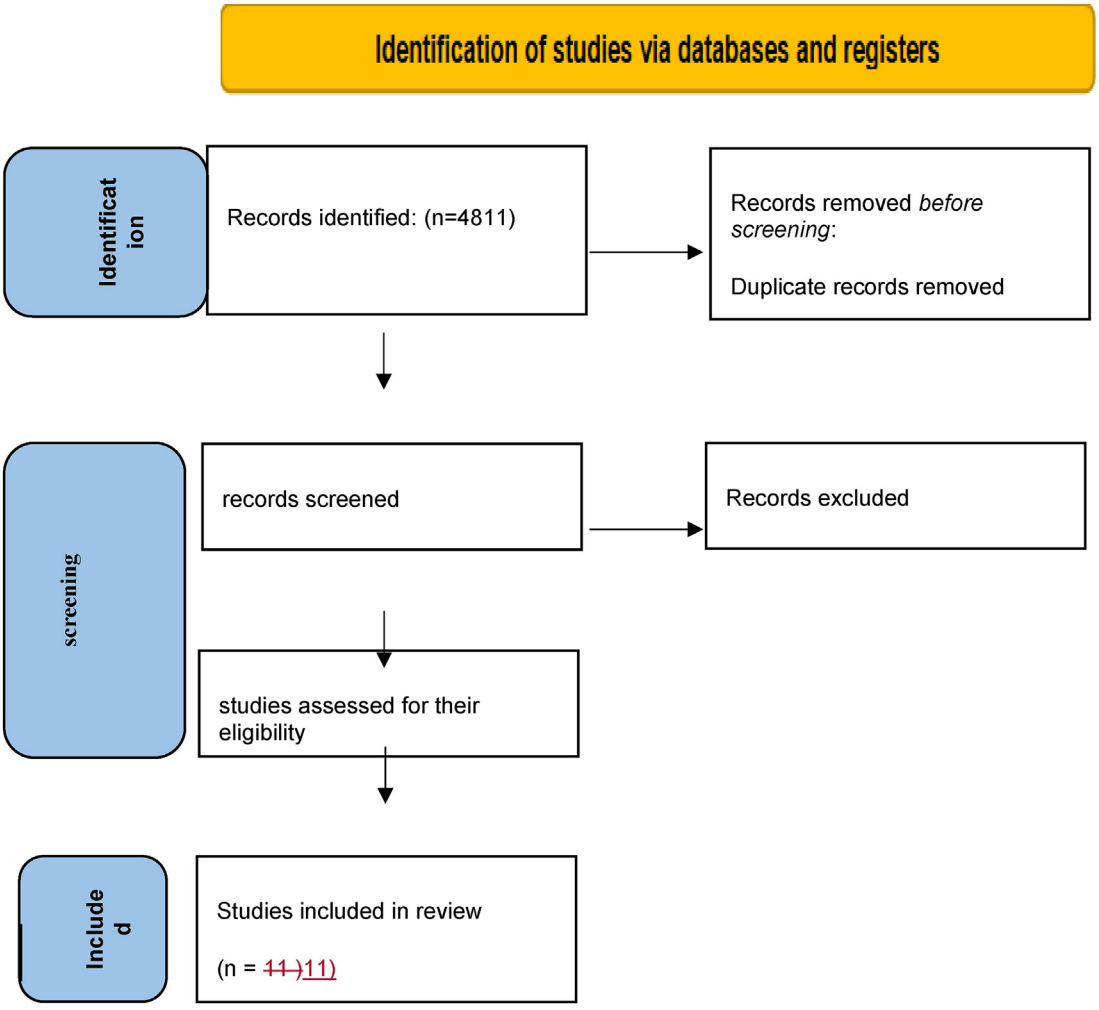

Fig. 1. PRISMA flow diagram.[11]

and (Shu-Yu Wu and Kuo)[21] which were not reported in this two studies as showed in this meta-analysis toward improvement of IPSS.

(95% CI = [8.43, 16.94], χ^2 = 473.29, I^2 = 98%, *P* value = 0.0001). Fig. 6.

Table 1. The risk of bias of all included records.

Quality assessment		
Study ID, Year	**Risk of bias**	**Percentage, grading**
Amy D. Dobberfuhl et al., 2019[13]	7/12	58% (fair)
Bonny Shah et al., 2021[14]	9/12	75% (good)
Dominique Thomas et al., 2018[15]	9/12	75% (good)
Kau Han Lee et al., 2019[10]	9/12	75% (good)
Min Chul Cho et al., 2017[16]	9/12	75% (good)
Myeong Jin et al., 2017[17]	8/12	66% (good)
Rubiao Ou E et al., 2011[18]	7/12	58% (fair)
Rubilotta E et al., 2020[19]	9/12	75% (good)
Sae Woong Choi et al., 2011[20]	9/12	75% (good)
Shu-Yu Wu et al., 2019[21]	9/12	75% (good)
Yan Zhu et al., 2021[22]	8/12	66% (good)

3.8. Improvement of QOL

Quality of Life (QOL) also showed recovery as reported in all studies except four studies which did not report QOL as a part of their assessment these studies are (Kau Han Lee and Kuo)[10] and (Myeong Jin and colleagues)[17] and (Rubilotta E and colleagues)[19] and (Shu-Yu Wu and Kuo),[21] consisting with our results regarding improvement of this parameter.

(95% CI = [2.66, 2.92], $\chi 2$ = 69.51, I2 = 91%, P value = 0.0001). Fig. 7.

3.9. Improvement of compliance

There were conflicting results regarding recovery of bladder compliance, (Kau Han Lee and Kuo)[10] reported improvement, on the other hand, (Rubiao Ou E and colleagues)[18] showed deterioration in the compliance of the UB. Heterogeneity was detected in this parameter meta-analysis with insufficient data in majority of included studies.

Table 2. Baseline characteristics of included studies 1.

Study ID	Year	country	Study design	Total study population	Type of intervention	Standard of DUA
Amy D. Dobberfuhl et al., 2019[13]	2019	USA	retrospective study	21	outlet de-obstruction procedure.	IPSS, QOL, Q max, PVRU
Bonny Shah et al., 2021[14]	2021	China	prospective study	20	TURP	Pdetmax, IPSS, QOL, Q max, PVRU
Dominique Thomas et al., 2018[15]	2018	India	prospective study	50	TURP	IPSS, QOL, Q max, PVRU
Kau Han Lee et al., 2019[10]	2019	Taiwan	retrospective study	60	TURP or TUIP	BCI, Pdetmax, Q max, PVRU
Min Chul Cho et al., 2017[16]	2017	Korea	retrospective study	250	HoLEP or TURP	IPSS, QOL, Q max, PVRU, VE
Myeong Jin et al., 2017[17]	2017	Korea	retrospective study	56	TURP	IPSS, Q max, PVRU
Rubiao Ou E et al., 2011[18]	2011	Italy	observational, prospective, comparative, nonrandomized study	23	TURP	IPSS, Q max, PVRU
Rubilotta E et al., 2020[19]	2020	Taiwan	retrospective study	48	TURP	BCI, Pdetmax, Q max, PVRU
Sae Woong Choi et al., 2011[20]	2011	Korea	retrospective study	132	PVP	IPSS, QOL, Q max, PVRU
Shu-Yu Wu et al., 2019[21]	2019	USA	prospective study	106	TURP or TUIP	IPSS, QOL, Q max, PVRU, VE
Yan Zhu et al., 2021[22]	2021	China	retrospective study	90	TURP	IPSS, QOL, Q max, PVRU

(95% CI = [9.08, 21.18], $\chi 2 = 4.66$, I2 = 79%, P value = 0.43). Fig. 8.

3.10. Improvement of VE

VE showed recovery as reported in Min Chul Cho and colleagues[16]

Rubilotta E and colleagues[19] and Shu-Yu Wu and Kuo[21]

(95% CI = [58.05, 6.99], $\chi 2 = 278.5$, I2 = 99%, P value = 0.01). Fig. 9.

4. Discussion

The proper selection of indications for BPH surgery has been a significant consideration for DU. Male patients with LUTS are more likely than female individuals to have an underlying DUA (11–40%) Thomas and colleagues, Jeong and colleagues.[8,23] However, some earlier research presented contentious findings regarding the efficacy of preoperative UD for excluding DU. Almost all of the studies included in this review reported a notable improvement in detrusor power.

BCI which is the most important factor for evaluation of recovery of detrusor function showed improvement as reported in (Kau Han Lee and Kuo)[10] and (Shu-Yu Wu and Kuo).[21] Pdet Qmax also showed improvement as reported in (Kau Han Lee and Kuo),[10] (Rubiao Ou E and colleagues)[18] and (Shu-Yu Wu and Kuo).[21]

Table 3. Patients characteristics.

Study ID	Median or mean age (yrs)	Time of outcome evaluation (months)	Compared outcome parameters					
			BCI	Pdet Qmax	Q max	PVR	IPSS	QOL
Amy D. Dobberfuhl et al., 2019[13]	72 ± 11	6.4	NA	NA	Available	Available	Available	Available
Bonny Shah et al., 2021[14]	69.44 ± 7.29	12	NA	NA	Available	Available	Available	Available
Dominique Thomas et al., 2018[15]	76.9 ± 9.12	12	NA	NA	Available	Available	Available	Available
Kau Han Lee et al., 2019[10]	44: 90	12	Available	Available	Available	Available	NA	NA
Min Chul Cho et al., 2017[16]	68.7 ± 7.65	12	NA	NA	Available	Available	Available	Available
Myeong Jin et al., 2017[17]	69.47 ± 6.57	6	NA	NA	Available	Available	Available	NA
Rubiao Ou E et al., 2011[18]	74.20 ± 7.93	12	NA	Available	Available	Available	Available	Available
Rubilotta E et al., 2021	63.37 ± 12.41	24.9 ± 30.5	NA	NA	Available	Available	Available	NA
Sae Woong Choi et al., 2011[20]	71.18 ± 7.87	12	NA	NA	Available	Available	Available	Available
Shu-Yu Wu et al., 2019[21]	74.4	24.9 ± 30.5	Available	Available	Available	Available	NA	NA
Yan Zhu et al., 2021[22]	40–88	3	NA	NA	Available	Available	Available	Available

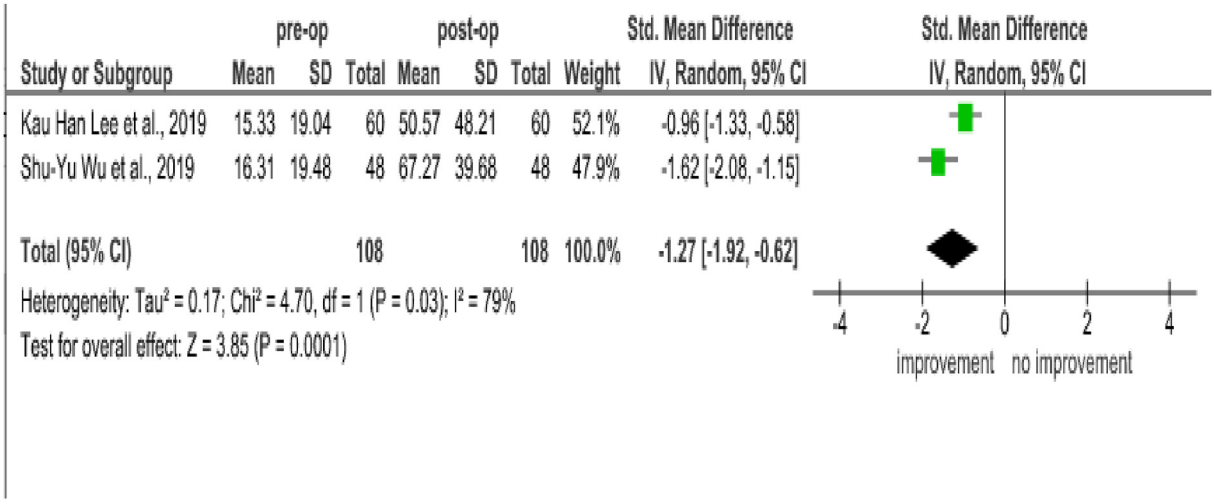

Fig. 2. Forest plot for BCI improvement.

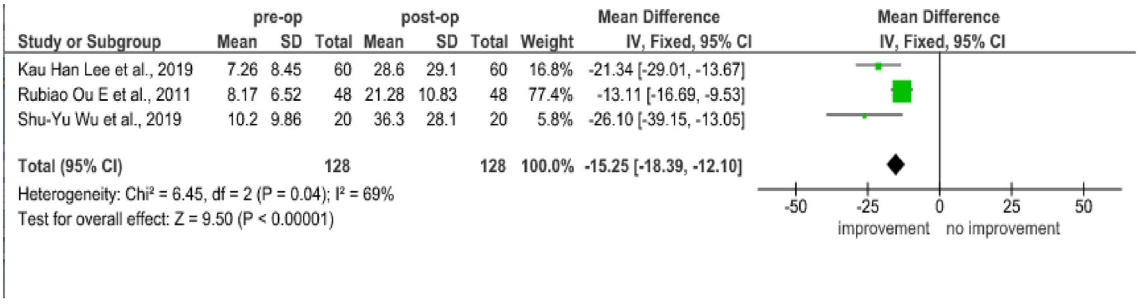

Fig. 3. Forest plot for Pdet Qmax improvement.

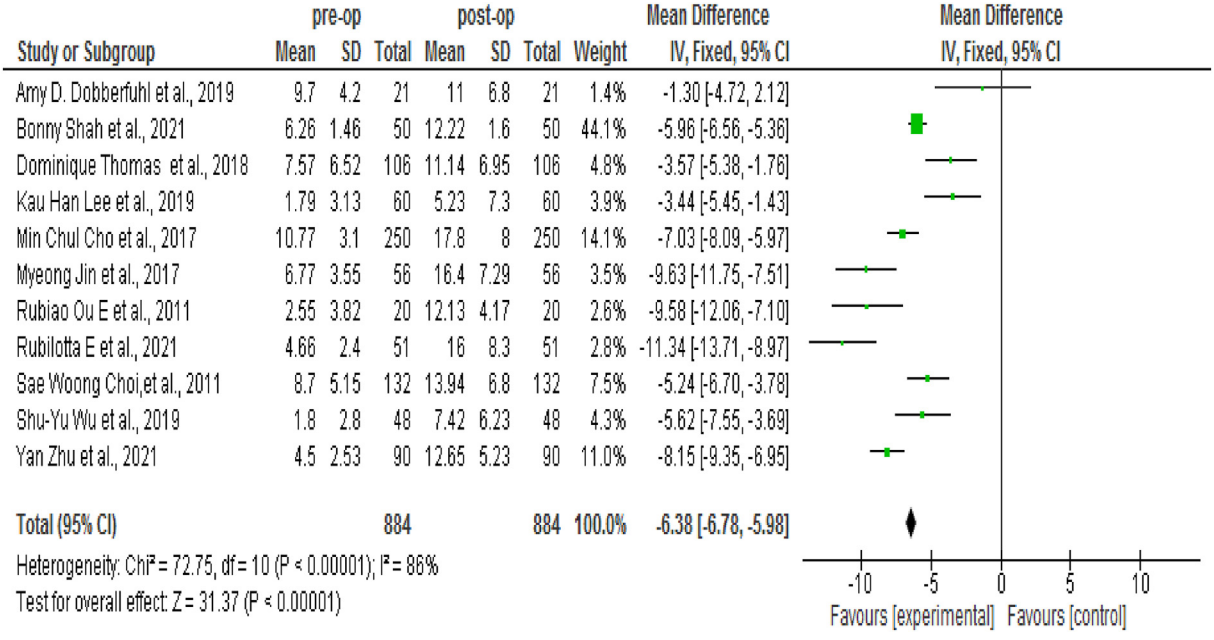

Fig. 4. Forest plot for improvement of Qmax.

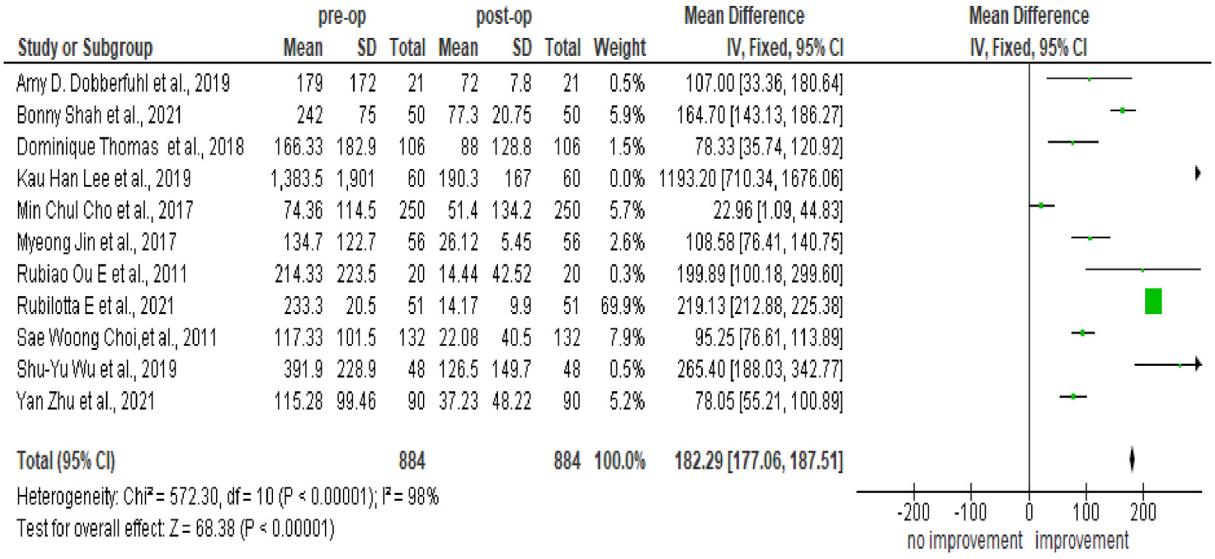

Fig. 5. Forest plot for improvement of PVR.

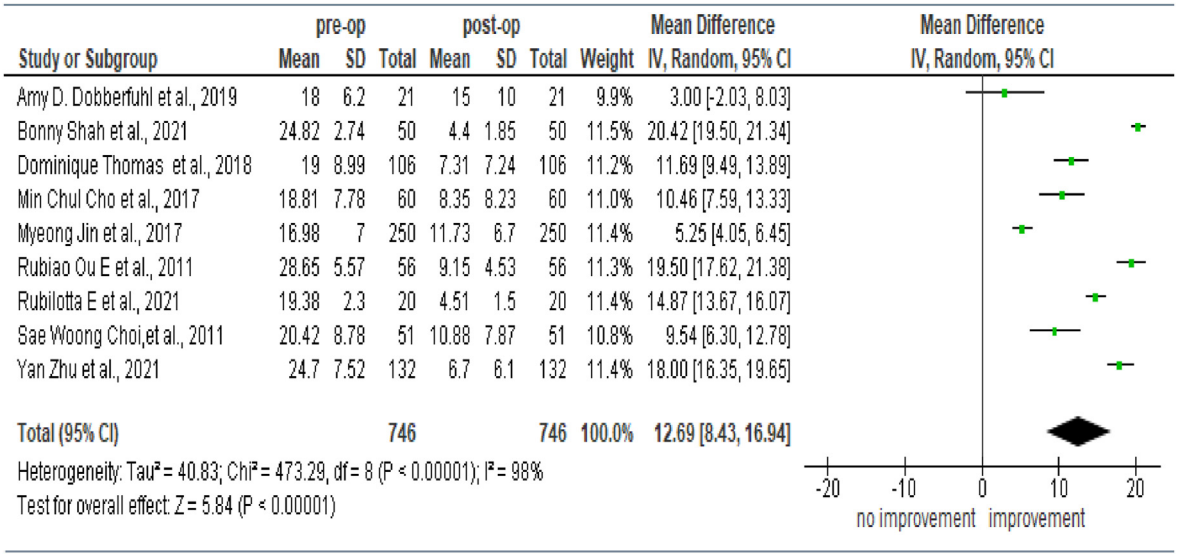

Fig. 6. Forest plot for improvement of IPSS.

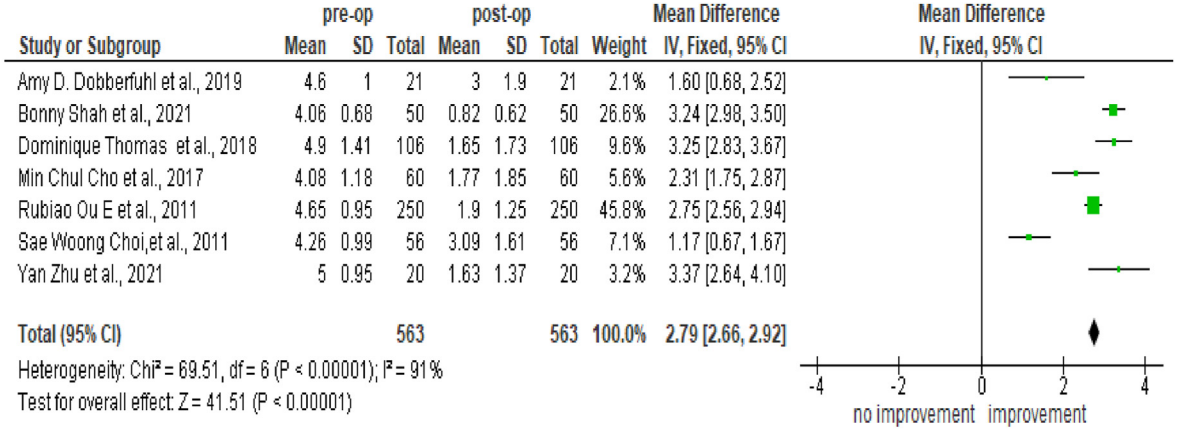

Fig. 7. Forest plot for improvement of QOL.

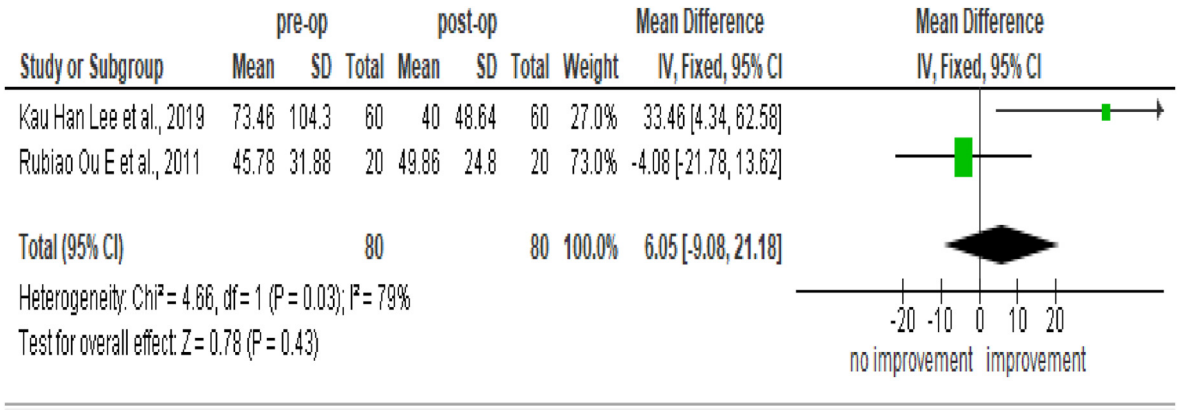

Fig. 8. Forest plot for compliance.

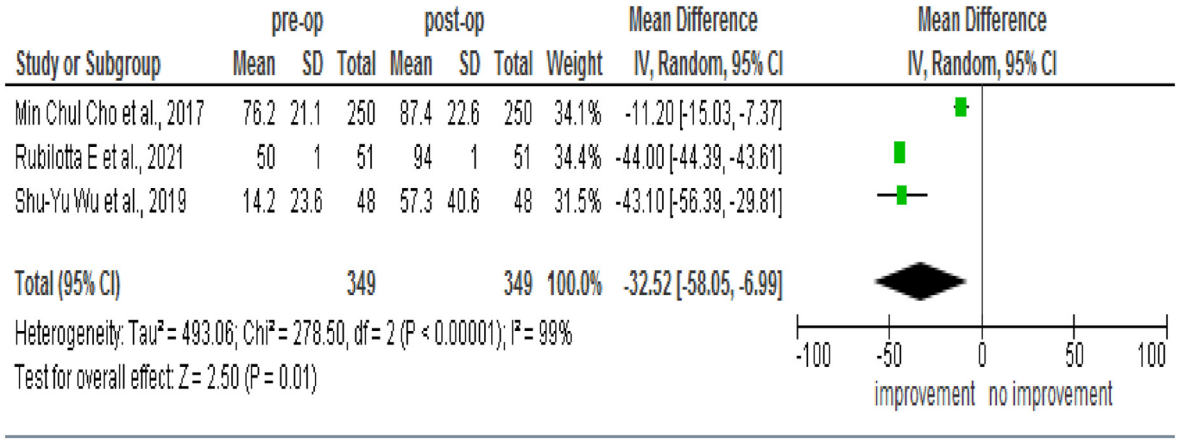

Fig. 9. Forest plot for improvement of VE.

All studies included showed improvement of Qmax and PVRU postoperatively.

IPSS as reported in all of the studies had significant improvement except (Kau Han Lee and Kuo)[10] and (Shu-Yu Wu and Kuo),[21] which were not reported in these two studies. QOL also showed recovery as reported in all studies except four studies which did not report QOL as a part of their assessment. These studies are (Kau Han Lee and Kuo)[10] and (Myeong Jin and colleagues)[17] and (Rubilotta E and colleagues)[19] and (Shu-Yu Wu and Kuo).[21] Improvement of compliance was controversial. (Kau Han Lee and Kuo)[10] reported improvement. On the other hand, (Rubiao Ou E and colleagues)[18] showed no improvement in the compliance of the UB.

VE showed improvement as reported in Min Chul Cho and colleagues[16] Rubilotta E and colleagues[19] and Shu-Yu Wu and Kuo.[21]

Management of BPO in patients with DU is considered an era of major controversy. There were conflicting results regarding the recovery of detrusor function, and return of spontaneous voiding.

Thomas and colleagues,[8] concluded that on the long term follow-up of urodynamic parameters there were no symptomatic or urodynamic improvement after TURP in patients with DU.[8]

Furthermore, Al-Hayek and colleagues[24] found that surgical relief of BOO does not lead to recovery of detrusor power, neither in men with normal nor impaired detrusor contractility. Also, Blatt and colleagues.[25] reported that DU patients have detrusor ultrastructural changes on biopsy, which in fact are predictive of failure to void after TURP.

On the other hand, in another study, urethral sphincter botulinum toxin A injection resulted in relief of BOO and consequently recovery of detrusor function in patients with DU Kuo.[26] Also, Jhang and colleagues[27] noted that appropriate treatment and bladder management in female patients with DU and chronic urinary retention may resume spontaneous voiding and detrusor function. In addition,

Lee and Kuo[10] found that Transurethral Bladder Outlet Surgery in patients with BPO and Non-neurogenic DU resulted in recovery of Voiding Efficiency and detrusor Function in the majority of Patients within 12 months after treatment.

Additionally, it was discovered that surgery can restore normal detrusor contractility and regain spontaneous voiding in patients with idiopathic DU who undergo TUI-BN Jhang and colleagues, Peng and Kuo.[27,28]

Surgery to treat bladder outlet resistance may also harm the detrusor contractility inhibitory effect brought on by sympathetic alpha-adrenergic hyperactivity in the bladder neck and prostatic urethra, making it easier for people with DU to urinate, either through abdominal straining or spontaneous voiding.[29,30] Previous studies utilizing animal models have demonstrated that the return of urinary bladder blood flow and detrusor muscle cellular function may be responsible for the functional recovery following bladder outlet surgery.[31]

According to Lee and Kuo patients with higher preoperative voiding detrusor pressure had a higher chance of recovering detrusor function (Pdet). This may be explained by the fact that patients with measurable Pdet had a higher chance of regaining adequate detrusor contractility since their detrusor function had not entirely diminished. Additionally, they discovered that DU patients with stronger bladder compliance may have a greater chance of regaining spontaneous urination as well as more effective voiding.[10]

In a systematic review done by Kim and colleagues[32] to study the effect of preoperative DU on transurethral surgery outcome, they found that the relationship between preoperative DU and transurethral surgery outcome parameters was not consistent but still had overall effects favoring the absence of DU being predictive factor of better postoperative cure. They concluded that DU positive group can experience symptom improvements after BPH surgery but less than that in DU negative group and also DU is not a contraindication for transurethral surgery.[32] Although some researchers reported that DU may affect surgical outcomes in BPH patients, these studies were limited by their retrospective designs and conflicting results Paick and colleagues, Blaivas and colleagues.[33,34] Masumori and collleagues noted that preoperative DU or detrusor overactivity (DO) have no impact on TURP outcome regarding QOL or IPSS Kim and colleagues.[32] In contrast, Paick and colleagues[33] reached a different opinion and concluded that patients with weak bladder contractility had less symptomatic and urodynamic improvement than those with normal or strong bladder contractility after transurethral prostatectomy.

Only detrusor a contractility, according to Blaivas and colleagues[34] was a poor predictor of TURP outcomes, while DU patients fared better than BOO males and achieved similar outcomes. Rubilotta and colleagues concluded that DU is not a contraindication for prostate surgery but they reported that obstructed patients had better improvement in outcome measures after surgery, due to the removal of the outlet obstruction. Therefore, patients with DU and bladder outlet obstruction are more suitable for *trans*-urethral prostatectomy obtaining the greater benefit from this intervention. Nevertheless, also unobstructed patients with concomitant DU had relevant improvement after reduction of the urethral resistance.[19]

Christopher et al. reported recovery of detrusor function in an underactive bladder after holmium laser enucleation of the prostate through postoperative urodynamic parameters as BCI, but the preoperative data were nonapplicable as most of the patients were with a contractile bladder, so we couldn't include this study in the review. However, the results of this study were consistent with our meta-analysis Mitchell and colleagues.[35]

Derek and colleagues also reported similar results to our review, although there was missing postoperative data for the meta-analysis, so this study was excluded.[36]

Sheng-Fu and colleagues[37] as well as the previous study reported recoverability of detrusor function but this study didn't use only *trans*-urethral prostatectomy as the only procedure but it also included medical treatment as part of intervention, so, this study was not eligible for the systematic review.

Min-Chul and colleagues reported improvement of UD parameters postoperatively regardless the detrusor contractility however, patients with DU had less improvement than normal detrusor contractility, also this study reported that in BPH patients with DU, the improvements in LUTS, urine flow rate, and bladder voiding efficiency after HoLEP might be greater than those after PVP.[38] However, this study did not mention postoperative data to be analyzed in our review, only *P* value numbers.

Mauricio and colleagues reported that in patients with BOO with or without DU there were improvement post *trans*-urethral prostatectomy regarding the symptoms in the mid term follow. However, patients with DU had a higher chance of failure to micturate after the surgical management and were more likely to not improve their QoL.[39] The results of this study were not included as well

because of the missing data and post-operative assessment using *P*-value.

According to Min-Chul and colleagues, patients with DU seem to maintain improved uroflowmetry values up to 5 years after PV or HoLEP. However, there was a decline in voiding symptoms and urine flow rate over the long-term follow-up. In terms of micturition symptoms and quality of life, patients with BPH and concurrent DU may benefit from HoLEP's more thorough excision of the prostatic adenoma and higher baseline bladder contractility.[39] This study couldn't be included as post-operative data was presented graphically and there were no available numbers for meta-analysis.

Deok and colleagues found notable recovery in the mean values of IPSS/QoL and PVR after TURP in patients with BOO and DU unresponsive to medical treatment. Although the BPH patients with normal detrusor contractility showed a better improvement than patients with DU, in conclusion, *trans*-urethral prostatectomy should be considered in men with BOO and DU who do not respond to medical treatment Han and colleagues.[40] This study was excluded in our systematic review as the eligible criteria wasn't available in this study.

4.1. Limitation of the current study

The study has some limitations as the lack of included randomized controlled trials (RCTs) due to the lack of published RCTs, included studies also showed lack of parameters for assessment of detrusor power as BCI which was reported only in two studies as pre and postoperative parameters.

Most of the studies did not determine the degree of DU so the recovery of detrusor power could not be assessed regarding the degree of underactivity but dealt with it as one group so we could not assess the degree of recovery severe, moderate and mild DU as a separate parameters.

4.2. Conclusions

Our meta-analysis results showed that patients with BPH and DU who underwent transurethral prostatectomy showed improvement of UD and uro-flowmetry parameters postoperatively and DU is not a contraindication for intervention. However, optimal recovery of DU for BPH patients who underwent trans urethral prostatectomy could not be accurately determined by this study. To clarify those, further studies including RCT or cost-benefit analyses are needed to be done in the future.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

None.

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