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Clinical Efficacy of Low-Intensity Extracorporeal Shock Wave Therapy for Male Lower Urinary Tract Symptoms: A Retrospective Pilot Study

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ABSTRACT

Objective: To evaluate the efficacy and safety of low-intensity extracorporeal shock wave therapy (Li-ESWT) using the Morenova system in men with lower urinary tract symptoms (LUTS), including chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS), and to identify pretreatment factors associated with post-treatment symptom severity.

Methods: This retrospective single-center study included 61 men treated with Li-ESWT. The treatment was administered once weekly for six consecutive weeks. Symptom severity was assessed before and one month after treatment using the International Prostate Symptom Score (IPSS), Overactive Bladder Symptom Score (OABSS), Benign Prostatic Hyperplasia Impact Index (BII), and National Institutes of Health Chronic Prostatitis Symptom Index (NIH-CPSI). Multivariable linear regression analysis was performed to identify pretreatment factors independently associated with the post-treatment NIH-CPSI total score after adjustment for baseline NIH-CPSI.

Results: Significant improvements were observed in total IPSS (from 11.1 to 7.3), OABSS (from 3.8 to 2.8), BII (from 4.9 to 2.7), and NIH-CPSI (from 11.8 to 7.0) (all $p < 0.001$). Notably, pain improved significantly in patients with baseline pain (from 4.1 to 1.8, $p < 0.001$). Post-micturition dribbling improved in approximately one-third of patients. Higher PSA and lower baseline OABSS were independently associated with lower post-treatment NIH-CPSI scores after adjustment for baseline NIH-CPSI. No adverse events were observed.

Conclusions: Li-ESWT was associated with improvements across voiding, storage, pain, and QOL domains, with no adverse events observed. These findings suggest that Li-ESWT may have potential as a treatment option for male LUTS, although prospective controlled studies are needed to confirm its efficacy.

1 | Introduction

Low-intensity extracorporeal shock wave therapy (Li-ESWT) has garnered attention as a promising non-invasive treatment in urology and is widely used for the treatment of erectile dysfunction (ED) [1]. The European Association of Urology guidelines recommend Li-ESWT in combination with phosphodiesterase type 5 (PDE5) inhibitors as one of the first-line treatments for vascular ED [2]. The "Guidelines for the Clinical Practice for Male Sexual Dysfunction" co-edited by the Japanese

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Urological Association and the Japanese Society for Sexual Medicine and published in Japan for the first time in 2025, also positions Li-ESWT as a second-line treatment for vascular ED. To date, the mechanisms underlying ED improvement through Li-ESWT have been extensively evaluated in both experimental and clinical studies. We have previously reported the efficacy and safety of Li-ESWT for Japanese patients with ED [3, 4]. Generally, Li-ESWT exerts anti-inflammatory, angiogenic, and neuromodulatory effects through mechanisms such as enhanced nitric oxide signaling, increased expression of angiogenic factors, improved microvascular perfusion, and modulation of inflammatory pathways [5–7]. These effects are thought to gradually improve microvascular blood flow in the corpus cavernosum, thereby contributing to improved erectile function.

More recently, perineal Li-ESWT targeting the prostate has gained attention for chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS) [8, 9]. Its anti-inflammatory, angiogenic, and neuromodulatory effects may improve CP/CPPS symptoms [10]. CP/CPPS reduces quality of life (QOL) and is difficult to treat [11]. Several clinical studies have reported improvements in pain, urinary symptoms, and QOL following Li-ESWT in patients with CP/CPPS [12–15]. Furthermore, as the pathophysiology of lower urinary tract symptoms (LUTS), regardless of CP/CPPS, involves complex interactions between inflammation, pelvic microvascular dysfunction, and nerve sensitization [16–18], the indications for Li-ESWT are expanding to include not only CP/CPPS but also other voiding disorders. Although there have been reports of symptom relief for OAB [19, 20], comprehensive evaluations of Li-ESWT in patients with heterogeneous LUTS, including nocturia, weak urinary stream, and post-micturition dribbling, remain limited. LUTS is highly prevalent among older men and is a major cause of reduced QOL and increased healthcare utilization worldwide [21]. For BPH, first-line α-blockers or PDE5 inhibitors can be combined with antimuscarinics or β3 agonists for persistent OAB symptoms, or with 5α-reductase inhibitors for large prostates; however, some patients obtain insufficient benefit. Previous Li-ESWT studies have largely focused on single entities such as CP/CPPS or OAB, leaving heterogeneous LUTS populations insufficiently studied.

Furthermore, we explored pretreatment factors associated with post-treatment NIH-CPSI scores.

2 | Materials and Methods

2.1 | Subjects

This retrospective study included 61 men who underwent Li-ESWT between April and October 2025 for LUTS, including symptoms associated with BPH and CP/CPPS. Li-ESWT was administered to patients aged 20 years or older who reported some form of LUTS. Li-ESWT was not administered to patients with suspected active urinary tract infection, a PSA level ≥ 2.5 ng/mL when prostate cancer could not be adequately excluded, prostate surgery within the preceding 6 months, or suspected neurogenic bladder. Data on age, comorbidities, and history of pharmacological treatment for LUTS were collected from medical records. Comorbidities identified included hypertension, hyperlipidemia, diabetes mellitus, prostatitis-related symptoms (e.g., perineal discomfort), and mental health issues. Medications used to treat LUTS included α-1 blockers, PDE5 inhibitors, 5-α reductase inhibitors, and anticholinergics; no patient was receiving a β3-adrenoceptor agonist. Concomitant medications were not discontinued or changed during the Li-ESWT treatment period. LUTS included several symptoms such as frequency, urgency, nocturia, weak urine stream, interrupted flow, straining, and post-micturition dribbling. Symptom severity was assessed using validated questionnaires such as the International Prostate Symptom Score (IPSS), Overactive Bladder Symptom

TABLE 1 | Background characteristics of the 61 patients.

Age (years)	57.8 ± 1.4	(34–83)
Total cholesterol (mg/dL)	199.9 ± 4.1	(138–302)
Triglyceride (mg/dL)	141.0 ± 10.4	(26–493)
HbA1c (%)	5.7 ± 0.1	(4.9–7.4)
PSA (ng/mL)	0.74 ± 0.05	(0.13–2.5)
Total testosterone (ng/mL)	6.0 ± 0.3	(1.2–13.5)
Comorbidities (duplication)		
Hypertension (*n*, %)	6	(9.8%)
Hyperlipidemia (*n*, %)	2	(3.3%)
Diabetes mellitus (*n*, %)	6	(9.8%)
Prostatitis (Perineal discomfort) (*n*, %)	2	(3.3%)
Mental problems (*n*, %)	7	(11.5%)
Medication (duplication)		
α-1 blocker (*n*, %)	5	(8.2%)
PDE5 inhibitor (*n*, %)	27	(44.3%)
5α-reductase inhibitor (*n*, %)	4	(6.6%)
Anticholinergic agent (*n*, %)	1	(1.6%)
IPSS	11.1 ± 0.7	(2–22)
QOL index	4.3 ± 0.2	(0–6)
OABSS	3.8 ± 0.3	(0–11)
BII	4.9 ± 0.4	(0–13)
NIH-CPSI total score	11.8 ± 0.6	(1–23)
Pain score	2.0 ± 0.4	(0–9)
Voiding score	3.9 ± 0.3	(0–10)
QOL score	5.9 ± 0.3	(0–12)
SHIM	11.2 ± 0.9	(1–24)
EHS	2.6 ± 0.1	(0–4)

Note: Values are shown as mean ± standard error.
Abbreviations: BII, Benign Prostatic Hyperplasia Impact Index; EHS, Erection Hardness Score; IPSS, International Prostate Symptom Score; NIH-CPSI, National Institutes of Health Chronic Prostatitis Symptom Index; OABSS, Overactive Bladder Symptom Score; PDE5, phosphodiesterase 5 inhibitor; PSA, prostate-specific antigen; QOL, quality of life; SHIM, Sexual Health Inventory for Men.

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Score (OABSS), Benign Prostatic Hyperplasia Impact Index (BII), and National Institutes of Health Chronic Prostatitis Symptom Index (NIH-CPSI). The IPSS was used to assess the overall severity of LUTS, and the total score, voiding subscore, storage subscore, and QOL score were evaluated. CP/CPPS symptoms were assessed using the NIH-CPSI total score, pain domain score, and the voiding and QOL subscores. Changes in post-micturition dribbling were assessed using 5-point patient-reported scales in a subgroup of 39 patients who reported post-micturition dribbling at baseline (Table S1). Patients selected the response that best reflected their own perception of the change after treatment. No predefined quantitative or objective criteria were established to distinguish, for example, "reduction" from "slight reduction" or "improvement" from "slight improvement." Thus, the degree of change was determined solely by each patient's subjective perception. All symptom assessments were conducted prior to treatment initiation and one month after the final treatment session. Laboratory data were collected as part of routine clinical evaluations. Metabolic parameters included total cholesterol, triglycerides, and hemoglobin A1c (HbA1c). Urological and endocrine parameters included PSA and total testosterone. All blood samples were collected between 9:00

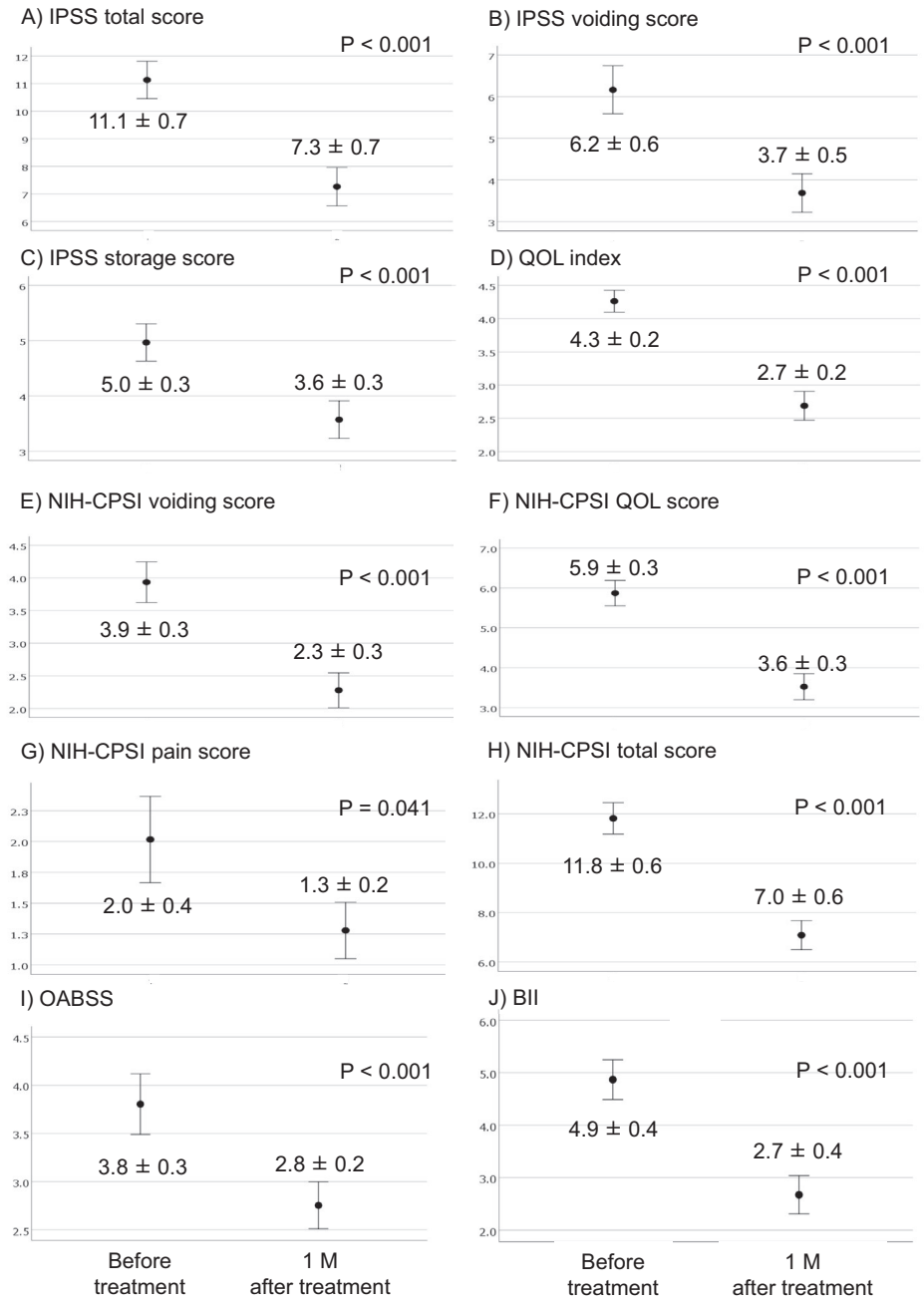


FIGURE 1 | Changes in patients' validated symptom scores following treatment with low-intensity extracorporeal shock wave therapy. (A) Total International Prostate Symptom Score (IPSS), (B) IPSS voiding subscore, (C) IPSS storage subscore, (D) IPSS quality of life (QOL) score, (E) National Institutes of Health Chronic Prostatitis Symptom Index (NIH-CPSI) voiding subscore, (F) NIH-CPSI QOL subscore, (G) NIH-CPSI pain subscore, (H) NIH-CPSI total score, (I) Overactive Bladder Symptom Score (OABSS), and (J) Benign Prostatic Hyperplasia Impact Index (BII). Values are presented as mean ± standard error. All comparisons showed significant differences by using paired analysis.

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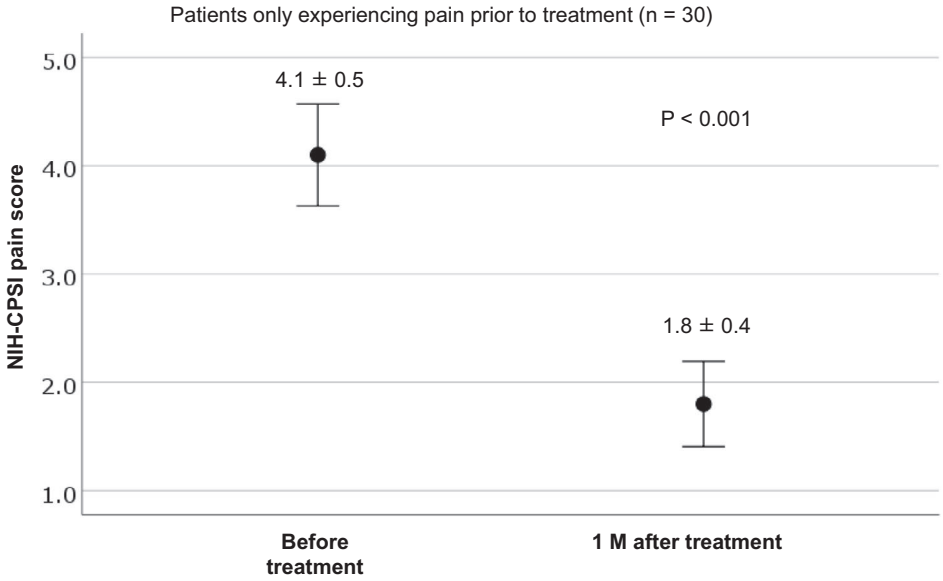


FIGURE 2 | National Institutes of Health Chronic Prostatitis Symptom Index (NIH-CPSI) pain scores before and after treatment in patients who reported pain prior to low-intensity extracorporeal shock wave therapy ($n = 30$). Values are presented as mean ± standard error. A significant reduction in pain score was observed ($p < 0.001$).

and 11:00 a.m. and analyzed at a certified external laboratory. Endocrine factors were measured using radioimmunoassay. All data were extracted from medical records via chart review.

2.2 | Therapy

Li-ESWT was performed using the Morenova system (Direx Systems GmbH, Wiesbaden, Germany). Treatment was administered with the patient in a seated position, and shock waves were delivered to the perineal region. Using this system, 1000 shock waves were delivered to each of two sites in the perineal region (total: 2000 per session) at an energy flux density of 0.09 mJ/mm^2, the focal depth to 80 mm, and pulse frequency of two pulses per second. Li-ESWT had already been introduced at our clinic for patients with CP/CPPS based on previously published clinical evidence and was provided as routine self-pay clinical care independently of the present study. The treatment cost was 3000 yen per session, and the standard treatment course consisted of six sessions administered once weekly for six consecutive weeks (18 000 yen in total). Before treatment, all patients received written information regarding the treatment, including its cost, and provided written informed consent for the treatment and for the potential future use and publication of their clinical data for research purposes. The present study was not a prospective interventional study, and Li-ESWT was not administered as part of a research protocol. Rather, this was a retrospective observational study in which existing clinical data were extracted from the medical records of patients who had received Li-ESWT as part of routine self-pay clinical care. No treatment, examination, or other intervention was added or modified for research purposes. The study protocol was reviewed and approved by the institutional ethics committee as a retrospective medical-record-based study. Following ethics committee approval, information regarding the study was publicly posted on our institutional website, and patients were provided with the opportunity to opt out of the use of their clinical data for this study. The MoreNova system used for Li-ESWT had been purchased by the clinic for routine clinical use before the present study, and neither the manufacturer nor the distributor provided financial support, equipment, research funding, or other support or involvement in the study. Because the decision to provide Li-ESWT was made independently of the research as part of routine clinical care and the present study involved only the retrospective analysis of existing medical-record data without any research-specific intervention, our pilot study was considered not to fall within the scope of the Clinical Research Act in Japan.

2.3 | Statistical Analysis

Continuous variables and questionnaire scores are presented as mean ± standard error (SE). Changes in clinical parameters before and after treatment were analyzed using paired *t*-tests. Multivariable linear regression analysis was performed to identify pre-treatment factors independently associated with the post-treatment NIH-CPSI total score, with the baseline NIH-CPSI score entered as a covariate. A lower follow-up score indicates fewer symptoms at follow-up. Using the post-treatment score, rather than a change or improvement-rate score derived from the baseline value, as the dependent variable avoids mathematical coupling between the outcome and baseline NIH-CPSI and mitigates regression-to-the-mean artifacts [22]. The level of statistical significance was set at $p < 0.05$. All analyses were performed using SPSS Version 24.0 (SPSS Inc., Chicago, IL, USA).

2.4 | Ethical Statement

Before treatment, all patients provided written informed consent for Li-ESWT and for the potential future research use and publication of their clinical data. The study protocol was approved

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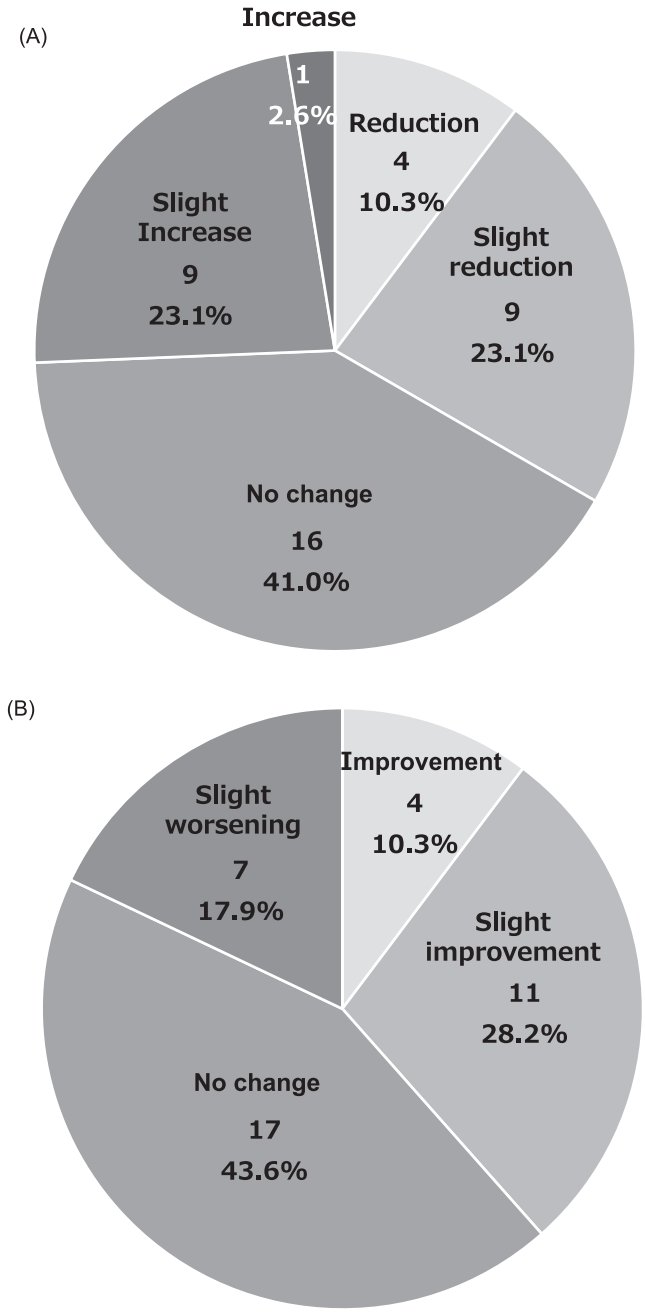


FIGURE 3 | Distribution of patient-reported changes in post-micturition dribbling among 39 patients who reported post-micturition dribbling at baseline. (A) Change in the frequency of post-micturition dribbling: Reduction, slight reduction, no change, slight increase, or increase. (B) Change in the amount of post-micturition dribbling: Improvement, slight improvement, no change, slight worsening, or worsening.

by the Regional Ethics Committee of Juntendo University (approval no. E24-0109).

3 | Results

The baseline characteristics of the 61 patients are shown in Table 1. Their mean age was 57.8 ± 1.4 years. The mean PSA level was 0.74 ± 0.05 ng/mL, and the mean total testosterone level was 6.0 ± 0.3 ng/mL. Six, two, and six patients had concomitant hypertension, hyperlipidemia, and diabetes, respectively. Only two patients reported severe perineal discomfort, and seven had a history of psychiatric consultations, including for sleep disorders. Existing treatments for LUTS included α-1 blockers in five, PDE5 inhibitors in 27, 5α-reductase inhibitors in four, and anticholinergic agents in one patient. Many patients had previously received treatment for ED, and a large number were taking PDE5 inhibitors; however, there was no change in the frequency of on-demand use during the Li-ESWT treatment period. The IPSS was 11.1 ± 0.7 (moderate symptoms), the OABSS was 3.8 ± 0.3 (mild symptoms), and the BII was 4.9 ± 0.4. The NIH-CPSI was 11.8 ± 0.6 and was assessed as indicating moderate symptoms. Changes in LUTS-related symptom scores before and after Li-ESWT are summarized in Figure 1A–J. The total IPSS score decreased significantly from 11.1 ± 0.7 to 7.3 ± 0.7 ($p < 0.001$). There were significant improvements in both the voiding subscore (from 6.2 ± 0.6 to 3.7 ± 0.5, $p < 0.001$) and storage subscore (from 5.0 ± 0.3 to 3.6 ± 0.3, $p < 0.001$). The QOL score also decreased significantly from 4.3 ± 0.2 to 2.7 ± 0.2 ($p < 0.001$). Significant improvements were observed in the NIH-CPSI domains, including the voiding score, QOL score, and pain score. The total score of the NIH-CPSI also decreased significantly from 11.8 ± 0.6 to 7.0 ± 0.6 ($p < 0.001$). The OABSS decreased from 3.8 ± 0.3 to 2.8 ± 0.2 ($p < 0.001$), and the BII decreased from 4.9 ± 0.4 to 2.7 ± 0.4 ($p < 0.001$), indicating a reduction in symptom burden and an improvement in disease-related QOL. Among the 30 patients with baseline pain, the NIH-CPSI pain score decreased from 4.1 ± 0.5 to 1.8 ± 0.4 ($p < 0.001$; Figure 2). Regarding post-micturition dribbling, 10.3% of patients reported a reduction in frequency and 23.1% reported a slight reduction, resulting in an improvement rate of 33.4%. Furthermore, 10.3% reported an improvement in the amount of dribbling and 28.2% reported a slight improvement, resulting in an improvement rate of 38.5% (Figure 3). Thus, a subset of patients reported subjective improvement in post-micturition dribbling after Li-ESWT. Finally, multivariable linear regression analysis was performed to identify pre-treatment factors independently associated with the post-treatment NIH-CPSI total score after adjustment for baseline NIH-CPSI. Higher PSA was independently associated with a lower post-treatment NIH-CPSI score (coefficient, −2.996; 95% CI, −5.629 to −0.364, $p = 0.026$), whereas higher OABSS was associated with a higher post-treatment NIH-CPSI score (coefficient, 0.612; 95% CI, 0.137 to 1.087, $p = 0.013$). Thus, higher PSA and lower OABSS were associated with better symptom status at follow-up. Baseline NIH-CPSI was positively associated with the post-treatment NIH-CPSI score (coefficient, 0.295; 95% CI, 0.060 to 0.530, $p = 0.015$) (Table 2). No adverse events were observed during or after treatment.

4 | Discussion

In this retrospective pilot study, Li-ESWT delivered using the Morenova system was associated with significant improvements in multiple LUTS-related symptom scores, including measures of voiding, storage, pain, and QOL. Among LUTS, CP/CPPS is recognized as one of the most challenging conditions to treat, and various pharmacological treatments have

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TABLE 2 | Pretreatment factors associated with the post-treatment NIH-CPSI total score after adjustment for baseline NIH-CPSI.

	Non-standardizing coefficient	*t*	*p*	95% CI	
				Lower	Upper
(Constant)	3.913	0.568	0.572	−9.911	17.737
Age (years)	0.007	0.123	0.902	−0.106	0.120
PSA (ng/mL)	−2.996	−2.284	0.026	−5.629	−0.364
Triglyceride (mg/dL)	0.002	0.324	0.747	−0.012	0.016
HbA1c (%)	−0.420	−0.383	0.703	−2.620	1.780
Total testosterone (ng/mL)	0.176	0.878	0.384	−0.226	0.578
IPSS (baseline)	0.017	0.134	0.894	−0.243	0.278
OABSS (baseline)	0.612	2.584	0.013	0.137	1.087
NIH-CPSI (baseline)	0.295	2.517	0.015	0.060	0.530

Note: A lower post-treatment NIH-CPSI score indicates fewer symptoms at follow-up.
Abbreviations: CI, confidence interval; IPSS, International Prostate Symptom Score; NIH-CPSI, National Institutes of Health Chronic Prostatitis Symptom Index; OABSS, Overactive Bladder Symptom Score; PSA, prostate-specific antigen.

been attempted for it. A pilot placebo-controlled study showed that six weeks of antibiotic therapy with levofloxacin in men diagnosed as having CP/CPPS resulted in symptom improvement that was not significantly different from that with placebo at the end of treatment or follow-up [23]. It was reported that combination therapy with ciprofloxacin as an antibiotic and tamsulosin among the α-1 blockers did not substantially reduce symptoms in men with long-standing CP/CPPS who had at least moderate symptoms [24]. Only pollen extract as preparations derived from pollen grains that contain various allergens and proteins significantly improved total symptoms, pain, and QOL in patients with inflammatory CP/CPPS without severe side-effects, compared to placebo [25]. Although drug therapy alone has its limitations, a study in 2016 reported that combination therapy using α-1 blockers, anti-inflammatory drugs, and muscle relaxants, together with Li-ESWT, not only resulted in statistically significant improvements across all NIH-CPSI score categories but also led to a significant reduction in residual urine volume and a significant increase in maximum urinary flow rate [26]. Recently, various meta-analyses have shown the efficacy of Li-ESWT for CP/CPPS [12, 15, 27, 28]. In the present study, significant reductions in NIH-CPSI scores were observed following Li-ESWT. Furthermore, a re-evaluation limited to the 30 patients who had at least some NIH-CPSI pain score value at baseline showed a significant reduction in the NIH-CPSI pain score. CP/CPPS is a condition with a heterogeneous and multifactorial pathophysiology involving inflammation, pelvic ischemia, and nerve sensitization, and it remains a difficult disease to treat. The observed reduction in pain suggests that Li-ESWT may act on biological pathways common to both pain and urinary dysfunction.

More recently, the effects of Li-ESWT have been published not only for CP/CPPS but also for OAB. An interesting study showed that Li-ESWT ameliorates persistent storage symptoms and promotes QOL after transurethral prostate surgery for BPH, with comparable efficacy and better tolerance compared to the anticholinergic medication solifenacin [19]. The present study also clearly shows a significant improvement in OAB symptoms as assessed by the OABSS. Another clinically important finding is the improvement in post-micturition dribbling, a symptom that remains underrecognized and inadequately addressed in current treatment algorithms. The subjective improvement observed in a subset of patients raises the possibility that Li-ESWT may affect mechanisms relevant to post-micturition dribbling; however, we did not directly assess periurethral muscle function, blood flow, or neuromuscular mechanisms. Together with improvements in IPSS, OABSS, BII, and NIH-CPSI, these exploratory PMD findings suggest that Li-ESWT may have potential effects across multiple symptom domains and may become a new treatment option.

An energy flux density in this Li-ESWT session by Morenova was set to 0.09 mJ/mm^2 and the focal depth to 80 mm. With a focal depth of 80 mm, the focal area is 14 mm^2. Since the distance from the perineum area to the bladder neck is approximately 100 mm, the shock wave energy reaching the bladder neck is extremely minimal. Thus, it is believed to have virtually no adverse effects on the bladder. No previous studies of this kind have reported any deterioration in bladder function. In fact, no patients in the present study developed hematuria after treatment, and no adverse events—not only regarding bladder function but in any other respect—were observed with this treatment.

Pretreatment factors associated with post-treatment NIH-CPSI may also be clinically relevant. After adjustment for baseline NIH-CPSI and other covariates, higher PSA and lower OABSS were independently associated with a lower NIH-CPSI score at follow-up. In the sensitivity analysis excluding baseline NIH-CPSI, OABSS remained significantly associated with the post-treatment NIH-CPSI score, whereas the association with PSA remained similar in direction and magnitude but was no longer statistically significant. Thus, the OABSS association was more robust, whereas the PSA association should be interpreted with caution. These results suggest that patients with inflammatory

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or pain phenotypes rather than pure OAB may derive greater benefit from Li-ESWT, potentially facilitating patient stratification and treatment decisions. Because histological prostatitis can increase serum PSA through leakage [29], the PSA association may reflect asymptomatic or subclinical prostatic inflammation and support a potentially greater Li-ESWT effect in inflammatory phenotypes. Clinically, Li-ESWT is non-invasive and well tolerated, with no adverse events observed in this study. By targeting mechanisms such as ischemia and inflammation, it may also have biological effects persisting beyond individual sessions, although durability requires further investigation. These features warrant further evaluation of Li-ESWT as a potential adjunctive or alternative therapy for patients resistant to or intolerant of conventional drug therapy. The findings add to the literature on Li-ESWT as a regenerative therapy in urology. Although Li-ESWT has been more extensively studied for ED and evidence in LUTS remains limited and inconsistent, this study showed improvements across multiple LUTS domains in a real-world Asian population, which has been insufficiently examined previously.

Despite these strengths, several limitations must be acknowledged. Selection bias cannot be excluded given the retrospective design and patient selection criteria. Because this study used a retrospective, single-arm design, it is impossible to infer causality, and the placebo effect, which can be particularly significant in symptom-driven conditions, cannot be controlled. It has already been reported that the placebo effect is observed with considerable frequency in drug treatments for LUTS [30]. Thus, for Li-ESWT as well, the presence of a significant placebo effect cannot be ruled out. The sample size was small, and because the study was conducted at a single institution, external validity is limited. The follow-up period was relatively short, and the long-term durability of the observed effects remains unclear. Furthermore, objective functional parameters such as urine flow rate and post-micturition residual urine volume were not assessed. However, the consistency of improvements across multiple independent outcome measures and the consistency of changes across multiple symptom measures provide supportive, although exploratory, evidence for the observed clinical associations. Importantly, this study presents testable hypotheses for future research. Prospective randomized controlled trials are necessary to confirm efficacy, establish optimal treatment protocols, and evaluate long-term outcomes. Furthermore, mechanism-oriented studies incorporating imaging diagnostics and molecular biomarkers may further elucidate the pathways through which Li-ESWT exerts its effects. Overall, these findings provide a rationale for prospective studies evaluating whether Li-ESWT may have clinical effects across multiple LUTS domains.

In conclusion, Li-ESWT using the Morenova system was associated with significant improvements in multiple LUTS-related symptom scores, including measures of voiding, storage, pain, and QOL, with no adverse events observed. Exploratory analyses also identified pretreatment factors associated with post-treatment NIH-CPSI scores. Given the retrospective, single-arm design and short follow-up period, prospective randomized controlled studies are warranted to confirm these findings and determine the clinical role of Li-ESWT in the management of male LUTS.

Author Contributions

Haruhiko Wakita: investigation, writing – original draft. **Keisuke Ishikawa:** methodology, investigation, validation, writing – review and editing. **Yutaro Yoshino:** investigation, methodology, validation, writing – review and editing. **Nana Kumakubo:** writing – review and editing. **Yuta Anno:** investigation, methodology, data curation, validation. **Ayumu Taniguchi:** investigation, data curation, methodology, validation. **Yuka Uesaka:** investigation, methodology, validation, data curation. **Taiji Nozaki:** investigation, methodology, validation, data curation. **Masato Shirai:** investigation, methodology, validation, data curation. **Norichika Ueda:** investigation, methodology, validation, data curation. **Kentaro Takezawa:** investigation, methodology, validation, visualization, software, data curation, formal analysis. **Yasushi Miyagawa:** investigation, methodology, validation, visualization, formal analysis, data curation. **Taro Koyama:** supervision. **Akira Tsujimura:** conceptualization, methodology, software, data curation, investigation, validation, formal analysis, supervision, project administration, writing – review and editing.

Ethics Statement

The study protocol was approved by the Regional Ethics Committee of Juntendo University (approval no. E24-0109).

Consent

Written informed consent was obtained from all patients at their first visit to our institutions.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Changes in the frequency and amount of post-micturition dribbling.

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