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# Same-Day Discharge and Postoperative Functional Outcomes After Minimally Invasive Surgical Treatment for Benign Prostatic Obstruction: A Retrospective Single-Center Observational Study

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## Abstract

### Background

Minimally invasive surgical treatments (MISTs) for lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH) are increasingly offered as day-case procedures. We evaluated whether a planned same-day discharge pathway for MIST could be delivered in a UK tertiary center and described the functional outcomes recorded in the same patients.

### Methods

This retrospective single-center observational study was reported according to Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). It included men who underwent water vapor thermal therapy (WVTT), prostatic urethral lift (PUL), or temporary implantable nitinol device (i-TIND) on a planned same-day discharge pathway between November 2023 and March 2026. The primary outcome was same-day discharge, reported with exact 95% confidence intervals (CIs). Secondary outcomes were changes from baseline to the first postoperative outpatient review in the International Prostate Symptom Score (IPSS), IPSS quality of life (QoL) score, maximum flow rate (Q-max), and post-void residual volume (PVR), together with clinical response, defined separately as an IPSS reduction of ⩾3 points and as an IPSS reduction of ⩾30%. Paired t-tests and Wilcoxon signed-rank tests were used. Mixed-effects analyses (including one excluding catheter-dependent men) and the WVTT-only analysis gave consistent estimates.

### Results

Of 64 men, 58 (90.6%) underwent WVTT, five PUL, and one i-TIND; six (9.4%) were catheter-dependent before surgery. Same-day discharge was achieved in 61 of 63 men with recorded status (96.8%; 95% CI 89.0-99.6). Paired data were available for IPSS and QoL in 23, Q-max in 35, and PVR in 44 patients. At the postoperative review, IPSS had decreased from 23.5 ± 7.1 to 13.5 ± 7.7 (mean change -10.0; 95% CI -13.5 to -6.5) and QoL from 4.4 ± 0.8 to 2.8 ± 1.4 (-1.65; 95% CI -2.27 to -1.03). Q-max increased by 3.7 mL/s (95% CI 1.3 to 6.1), and median PVR fell from 87 to 19 mL (median change -41 mL; $p < 0.001$). An IPSS reduction of ⩾3 points was achieved by 17 of 23 men (73.9%). Mixed-effects and WVTT-only analyses gave consistent estimates.

### Conclusions

In this retrospective single-center study, a planned same-day discharge pathway for MIST was delivered for almost all men, and improvements in symptoms, QoL, and voiding parameters were observed among men with paired data at a first postoperative review whose timing was not recorded. These findings are descriptive and hypothesis-generating because follow-up was incomplete; postoperative medication use, complications, and unplanned healthcare use were not systematically documented, and there was no comparison group. Prospective studies with standardized, dated follow-up are needed.

**Categories:** Urology
**Keywords:** benign prostate enlargement, functional outcomes, minimal invasive and endourology, minimally invasive surgical technique (mist), prostatic urethral lift, same day discharge, temporary implanted nitinol device, water vapour thermal therapy

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## Introduction

Lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH) are among the most common reasons for urological referral in older men and substantially impair quality of life (QoL) [1,2]. First-line management consists of lifestyle measures and drug treatment. Surgery is reserved for men whose symptoms do not respond to, or who cannot tolerate, medical therapy, and for those who develop complications such as refractory retention [1]. Transurethral resection of the prostate (TURP) remains the reference procedure. Bipolar and monopolar TURP give similar symptom improvement, and bipolar TURP slightly reduces transurethral resection syndrome and the need for transfusion [3]. Resection still carries recognized morbidity, including bleeding and ejaculatory dysfunction, and traditionally requires an inpatient stay [1].

Minimally invasive surgical treatments (MISTs) aim to relieve obstruction with less morbidity [4]. Water vapor thermal therapy (WVTT) delivers convective thermal energy into the transition zone and median lobe, causing tissue necrosis and later resorption. In a randomized sham-controlled trial, it improved symptoms and flow rate compared with a sham procedure [5], and the surgical retreatment rate at five years was 4.4% [6]. Prostatic urethral lift (PUL) places permanent implants that hold the lateral lobes apart without removing tissue; it too was superior to a sham procedure in a randomized trial [7]. Temporary implantable nitinol device (i-TIND) is placed at the bladder neck and in the prostatic urethra and removed as an outpatient about five days later [8]. These procedures can be performed under local anesthesia or sedation [2]. After WVTT and PUL, erectile and ejaculatory function are preserved and, in some domains, improved compared with baseline [9]. Improvements in maximum flow rate (Q-max) and post-void residual volume (PVR) are generally smaller than after resection or laser procedures [1], and retreatment rates in real-world practice vary between modalities [10,11].

Same-day discharge is established after several endoscopic procedures for benign prostatic obstruction, including GreenLight photoselective vaporization in our own unit [12] and robot-assisted "Aquablation" in an ambulatory surgery center [13]. For MISTs, same-day discharge under local anesthesia has been shown to be feasible [14,15]. In routine NHS practice, however, day-case delivery is not universal. In national data from England, 85.3% of PUL procedures were performed as day cases [16], and several real-world WVTT series describe inpatient stays of two days or more [10,17]. Data on how reliably a planned same-day discharge pathway is delivered for MIST in a UK tertiary center and on the functional outcomes achieved therefore remain limited.

We aimed to evaluate whether a planned same-day discharge pathway for MIST could be delivered in routine practice and to describe the functional outcomes recorded in the same patients. The proportion of men discharged on the day of surgery was the primary outcome. Changes in International Prostate Symptom Score (IPSS), QoL, Q-max, and PVR between baseline and the first postoperative review, and the proportion of men achieving a clinically meaningful symptom response, were secondary outcomes. The study was not designed to establish safety because complications and unplanned healthcare use were not systematically recorded.

## Materials And Methods

### Study design and ethical approval

This was a retrospective, single-center, single-arm observational study with a before-and-after comparison of functional outcomes. It included men who underwent MIST for benign prostatic obstruction at King's College Hospital NHS Foundation Trust, London, UK, between November 2023 and March 2026. It is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [18]. Ethics approval was obtained from the Research Ethics Committee at King's College Hospital NHS Foundation Trust, London, UK (approval reference #25/LO/8711). Because the study was retrospective and used routinely collected clinical data, the requirement for individual written consent was waived. Data were de-identified before analysis, and the study was conducted in accordance with the Declaration of Helsinki.

### Data source and eligibility

Patients were identified from the departmental database of outlet obstruction procedures. The eligibility criteria are shown in Table *1*. When a patient had more than one MIST record, the first procedure was considered the index procedure. Duplicate entries were removed.

| Criterion type | Criterion |
|---|---|
| Inclusion | Men undergoing MIST (WVTT, PUL or i-TIND) for benign prostatic obstruction between November 2023 and March 2026 |
| | LUTS refractory to, or intolerant of, medical therapy, or catheter-dependent urinary retention secondary to benign prostatic obstruction |
| | Procedure scheduled on the planned same-day discharge pathway |
| Exclusion | Procedures other than MIST (TURP, bipolar TURP, photoselective vaporization of the prostate) |
| | Neurological disorder as the primary cause of LUTS |
| | Duplicate records, and repeat procedures in a patient already included |

**TABLE 1: Eligibility criteria**

BPH: benign prostatic hyperplasia; i-TIND: temporary implantable nitinol device; LUTS: lower urinary tract symptoms; MIST: minimally invasive surgical treatment; PUL: prostatic urethral lift; TURP: transurethral resection of the prostate; WVTT: water vapor thermal therapy

## Procedures

All procedures were performed by, or under the direct supervision of, consultant urologists. WVTT was delivered using the Rezūm™ system (Boston Scientific, Marlborough, MA, USA), PUL using the UroLift® system (Teleflex Incorporated, Wayne, PA, USA), and i-TIND using the iTind™ device (Olympus Corporation, Tokyo, Japan). The modality was chosen through shared decision-making, taking into account prostate anatomy and the patient's priorities. The anesthetic technique was chosen according to device requirements, comorbidity, and patient preference. Patients were scheduled for discharge on the day of surgery once standard discharge criteria had been met. Postoperative catheterization followed device-specific protocols, and trials without catheters were performed either by the patient at home, with written instructions, or in a nurse-led clinic.

## Outcomes and measurements

The primary outcome was same-day discharge, defined as discharge home on the calendar day of surgery. The secondary outcomes were changes between baseline and the first postoperative outpatient review in the IPSS (range 0-35), which incorporates the seven symptom items of the American Urological Association Symptom Index [19], the IPSS QoL item (range 0-6), Q-max measured by clinic uroflowmetry, and PVR measured by bladder ultrasound.

The date of the postoperative review was not recorded in the database, so the interval between surgery and follow-up assessment could not be determined for any patient. Postoperative values are therefore described as those recorded at the first postoperative outpatient review, without a defined time point. The IPSS symptom score and the QoL score were analyzed separately. Clinical response was defined in two ways: an IPSS reduction of ⩾3 points, the smallest change patients perceive as improvement [20]; and a reduction of ⩾30% from baseline. Symptom severity was classified as mild (0-7), moderate (8-19), or severe (20-35). An improvement of ⩾1 point in QoL was also reported.

Baseline variables were prostate volume, measured by transrectal or transabdominal ultrasound, preoperative catheter dependence, baseline LUTS medication, and the number of vapor injections (WVTT) or implants (PUL). Whether LUTS medications were continued, reduced, or stopped after the procedure was not recorded in the database. Complications, readmissions, and unplanned healthcare contacts were also not systematically recorded and were not analyzed as outcomes. Uroflowmetry results recorded as free text were converted into voided volume, Q-max, and PVR. A PVR recorded as >200 mL was entered as 200 mL, and one recorded as "low" was treated as missing. Events noted after surgery in the clinical record (repeat procedures, subsequent surgery, intermittent self-catheterization, and deaths) were extracted and are reported descriptively.

## Statistical analysis

Continuous variables are reported as mean ± standard deviation (SD) or median (interquartile range, IQR), depending on their distribution. Distribution was assessed with the Shapiro-Wilk test. Categorical variables are reported as numbers (percentages). Exact (Clopper-Pearson) 95% confidence intervals (CIs) are given for proportions. For same-day discharge, a worst-case sensitivity analysis treated the patient with missing discharge status as not discharged on the same day.

Change between baseline and the postoperative review was analyzed in patients with paired data using the two-tailed paired t-test. For each outcome, we report the mean change with its 95% CI, the SD of the change with degrees of freedom (df), and Cohen's dZ with an approximate 95% CI. The Wilcoxon signed-rank test (median change, IQR) was performed for all outcomes. Because the paired differences for PVR were not normally distributed, the Wilcoxon test is the primary analysis for PVR. With four functional outcomes, statistical significance was also assessed against a Bonferroni-adjusted threshold of 0.0125.

To assess the effect of missing follow-up data, baseline values were compared between patients with and without paired data (Mann-Whitney U test). Linear mixed-effects models with a random intercept for each patient were fitted using all available observations; these assume that data are missing at random. Men who were catheter-dependent before surgery have no baseline Q-max or PVR, and those with a postoperative value therefore contributed postoperative observations only to these models. Further sensitivity analyses excluded these catheter-dependent men, were restricted to WVTT, restricted the Q-max analysis to voided volumes of ⩾150 mL at both visits, and excluded the censored PVR value.

No a priori sample size calculation was performed. All eligible patients were included, and results are interpreted as estimates with their CIs. A p-value <0.05 was considered statistically significant. Analyses were performed in IBM SPSS Statistics for Windows, Version 25 (Released 2017; IBM Corp., Armonk, NY, USA).

# Results

## Participant flow and baseline characteristics

The database contained 98 procedure records. Twenty-nine non-MIST procedures were excluded, leaving 69 MIST records. Two duplicate entries were then excluded, along with three second procedures in patients already included: one WVTT repeated under general anesthesia after local anesthesia was not tolerated, one second PUL record, and one second i-TIND record. The analytic cohort comprised 64 men: 58 (90.6%) treated with WVTT, five (7.8%) with PUL, and one (1.6%) with i-TIND. One WVTT procedure was performed together with transperineal prostate biopsy.

Paired baseline and postoperative data were available for IPSS and QoL in 23 men (35.9%), Q-max in 35 (54.7%), and PVR in 44 (68.8%). For every outcome, six men could not provide baseline values because they were catheter-dependent before surgery. The remaining unpaired patients either had no recorded baseline value (IPSS and QoL, n = 11; Q-max, n = 6; PVR, n = 7) or had a baseline value without a postoperative value (IPSS and QoL, n = 24; Q-max, n = 17; PVR, n = 7). Ten men had no postoperative measurement of any kind (Figure *1*).

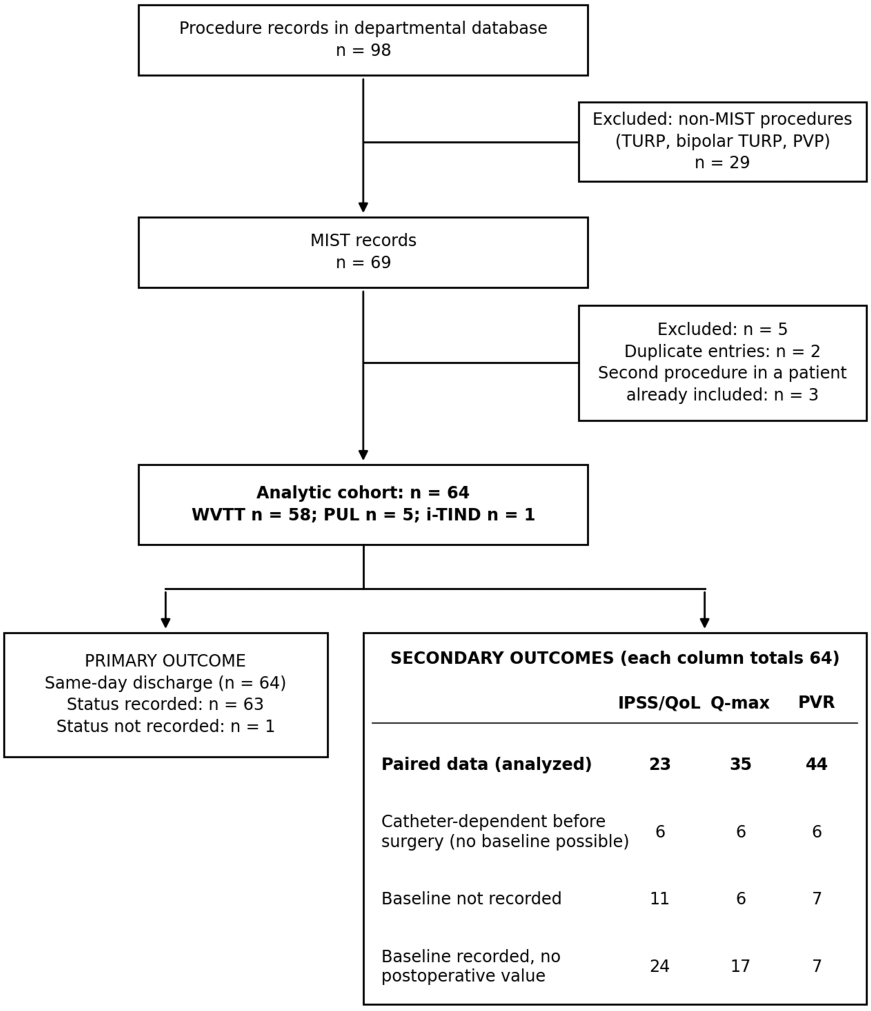



**FIGURE 1: STROBE flow diagram of patient selection and data availability**

i-TIND: temporary implantable nitinol device; IPSS: International Prostate Symptom Score; MIST: minimally invasive surgical treatment; PUL: prostatic urethral lift; PVP: photoselective vaporization of the prostate; PVR: post-void residual volume; Q-max: maximum urinary flow rate; QoL: quality of life; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology; TURP: transurethral resection of the prostate; WVTT: water vapor thermal therapy

Baseline characteristics are shown in Table 2. The mean prostate volume was 50.0 ± 18.0 mL (range 19-110). Six men (9.4%) were catheter-dependent before surgery. Of the 47 men with a baseline IPSS, 37 (78.7%) had severe symptoms, nine (19.1%) moderate, and one (2.1%) mild.

| Characteristic | All | WVTT | PUL | i-TIND |
|---|---|---|---|---|
| Prostate volume: patients with data, n | 63 | 57 | 5 | 1 |
| Prostate volume, mL, mean ± SD | 50.0 ± 18.0 | 50.4 ± 18.4 | 50.2 ± 10.3 | 25 |
| Prostate volume, mL, median (IQR) | 48 (39.5-60) | 48 (39-60) | 50 (40-59) | 25 |
| Prostate volume, mL, range | 19-110 | 19-110 | 40-62 | 25 |
| Preoperative catheter dependence, n (%) | 6 (9.4) | 6 (10.3) | 0 | 0 |
| LUTS medication: patients | 64 | 58 | 5 | 1 |
| Alpha-blocker, n (%) | 46 (71.9) | 43 (74.1) | 3 | 0 |
| 5-alpha-reductase inhibitor (n) | 12 (18.8) | 10 (17.2) | 2 | 0 |
| Antimuscarinic or beta-3 agonist (n) | 15 (23.4) | 13 (22.4) | 1 | 1 |
| No LUTS medication, n (%) | 13 (20.3) | 13 (22.4) | 0 | 0 |
| Vapor injections (WVTT) or implants (PUL), median (IQR) | NA | 5 (4-6) | 4 (3-6) | NA |
| IPSS: patients with data, n | 47 | 43 | 4 | 0 |
| IPSS score, mean ± SD | 24.4 ± 6.6 | 24.3 ± 6.7 | 24.8 ± 6.0 | NR |
| IPSS severity, mild (0-7), n | 1 | 1 | 0 | NR |
| IPSS severity: moderate (8-19), n | 9 | 8 | 1 | NR |
| IPSS severity, severe (20-35), n | 37 | 34 | 3 | NR |
| QoL: patients with data, n | 47 | 43 | 4 | 0 |
| QoL score, median (IQR) | 5 (4-5) | 5 (4-5) | 5 (4.75-5) | NR |
| Q-max: patients with data, n | 52 | 47 | 4 | 1 |
| Q-max, mL/s, median (IQR) | 9.7 (7.3-12.9) | 9.6 (7.2-13.0) | 9.5 (8.6-15.8) | 12.0 |
| Voided volume: patients with data, n | 51 | 46 | 4 | 1 |
| Voided volume, mL, median (IQR) | 226 (163-272) | 214 (161-266) | 303 (208-365) | 252 |
| PVR: patients with data, n | 51 | 46 | 4 | 1 |
| PVR, mL, median (IQR) | 87 (21-155) | 93 (19-157) | 46 (33-98) | 52 |

**TABLE 2: Baseline characteristics, overall and by modality**

Results for PUL and i-TIND are descriptive only because of the small numbers. No information was recorded for the i-TIND patient regarding baseline IPSS or QoL; data on the number of vapor injections or implants is not applicable (NA), as it only pertains to WVTT and PUL.

i-TIND: temporary implantable nitinol device; IPSS: International Prostate Symptom Score; IQR: interquartile range; LUTS: lower urinary tract symptoms; PUL: prostatic urethral lift; PVR: post-void residual volume; Q-max: maximum urinary flow rate; QoL: quality of life; SD: standard deviation; WVTT: water vapor thermal therapy; NA: Not Applicable; NR: Not reported

## Same-day discharge

Discharge status was recorded for 63 of 64 men. Sixty-one were discharged on the day of surgery (96.8%; 95% CI 89.0-99.6). The two men who stayed overnight and the one man whose discharge status was not recorded had all undergone WVTT. In the worst-case analysis, the same-day discharge rate was 61 of 64 (95.3%; 95% CI 86.9-99.0). All five PUL procedures and the i-TIND procedure were completed as day cases.

The clinical record noted one repeat WVTT under general anesthesia after local anesthesia was not tolerated, one second PUL procedure, one second i-TIND procedure, one subsequent TURP at another hospital, and one man who required intermittent self-catheterization. One man was recorded as deceased, but the timing and cause were not recorded. Of the six men who were catheter-dependent before surgery, four of the five with a known outcome were catheter-free at the postoperative review (Table *3*).

| Outcome | n/N | % | 95% CI |
|---|---|---|---|
| Same-day discharge, status recorded | 61/63 | 96.8 | 89.0-99.6 |
| Same-day discharge, worst case (missing status counted as not discharged) | 61/64 | 95.3 | 86.9-99.0 |
| Same-day discharge, WVTT[a] | 55/57 | 96.5 | 87.9-99.6 |
| Same-day discharge, PUL | 5/5 | 100 | 47.8-100 |
| Same-day discharge, i-TIND | 1/1 | 100 | Not estimable |
| Catheter-free at the first postoperative review among preoperatively catheter-dependent men who attended review (5 of 6)[b] | 4/5 | 80.0 | 28.4-99.5 |
| Recorded event: repeat procedure with the same device, patients | 3/64 | Not calculated[c] | Not calculated[c] |
| Recorded event: subsequent TURP, patients | 1/64 | Not calculated[c] | Not calculated[c] |
| Recorded event: intermittent self-catheterization, patients | 1/64 | Not calculated[c] | Not calculated[c] |
| Recorded event: recorded as deceased, patients | 1/64 | Not calculated[c] | Not calculated[c] |
| Complications, readmissions and emergency attendances[c] | Not recorded | Not applicable | Not applicable |

**TABLE 3: Same-day discharge and recorded postoperative events**

[a] One WVTT patient had no recorded discharge status. [b] One patient did not attend follow-up. [c] Postoperative events were taken from the clinical record and were not ascertained systematically, and the timing of events relative to the procedure was not recorded. Event rates were therefore not calculated, and the absence of a recorded event does not mean that no event occurred.

CI: confidence interval; i-TIND: temporary implantable nitinol device; PUL: prostatic urethral lift; TURP: transurethral resection of the prostate; WVTT: water vapor thermal therapy

## Functional outcomes

Postoperative LUTS medication use was not recorded, so the following changes are reported without adjustment for medication. Among men with paired data, IPSS, QoL, and PVR were lower, and Q-max was higher at the first postoperative review than at baseline (Table *4*). IPSS decreased by a mean of 10.0 points (95% CI -13.5 to -6.5; $t(22) = -5.86$; $p < 0.001$), a relative reduction of 42.6%, and QoL decreased by 1.65 points (95% CI -2.27 to -1.03; $p < 0.001$). Q-max increased by 3.7 ml/s (95% CI 1.3 to 6.1; $t(34) = 3.11$; $p = 0.004$). PVR fell from a median of 87 to 19 mL (median change -41 mL, IQR -102 to -11; Wilcoxon $p < 0.001$). All p-values remained below the Bonferroni-adjusted threshold of 0.0125.

| Outcome | n | Baseline, mean ± SD | Postoperative review, mean ± SD | Mean change (95% CI) | SD of change | t (df) | p | $d_z$ (95% CI) | Median change (IQR); Wilcoxon p |
|---|---|---|---|---|---|---|---|---|---|
| IPSS (0-35) | 23 | 23.5 ± 7.1 | 13.5 ± 7.7 | -10.00 (-13.54 to -6.46) | 8.18 | -5.86 (22) | <0.001 | 1.22 (0.68 to 1.76) | -12.0 (-17.0 to -2.5); <0.001 |
| QoL (0-6) | 23 | 4.4 ± 0.8 | 2.8 ± 1.4 | -1.65 (-2.27 to -1.03) | 1.43 | -5.53 (22) | <0.001 | 1.15 (0.63 to 1.68) | -2.0 (-2.0 to -1.0); <0.001 |
| Q-max, mL/s | 35 | 10.5 ± 5.8 | 14.2 ± 5.9 | +3.69 (1.28 to 6.11) | 7.03 | 3.11 (34) | 0.004 | 0.53 (0.17 to 0.88) | +2.8 (0.1 to 7.8); <0.001 |
| PVR, mL | 44 | 97.4 ± 98.7 | 31.5 ± 40.2 | -65.89 (-93.38 to -38.40) | 90.42 | -4.83 (43) | <0.001 | 0.73 (0.40 to 1.06) | -41.0 (-102.0 to -11.3); <0.001 |

**TABLE 4: Change in functional outcomes between baseline and the first postoperative review in patients with paired data**

The baseline and postoperative values are those of the patients with paired data for each outcome. The timing of the postoperative review was not recorded. Cohen's $d_z$ is expressed as a magnitude, and all changes are in the direction of improvement. PVR differences were not normally distributed (Shapiro-Wilk $p < 0.001$), so the median change and Wilcoxon test are the primary results for PVR.

CI: confidence interval; df: degrees of freedom; IPSS: International Prostate Symptom Score; IQR: interquartile range; PVR: post-void residual volume; Q-max: maximum urinary flow rate; QoL: quality of life; SD: standard deviation

## Clinical response and sensitivity analyses

Of the 23 men with paired IPSS data, 17 (73.9%; 95% CI 51.6-89.8) achieved a reduction of ⩾3 points, 15 (65.2%; 95% CI 42.7-83.6) a reduction of ⩾30%, and 10 (43.5%; 95% CI 23.2-65.5) a reduction of ⩾50%. Of the 17 men with severe symptoms at baseline, 13 moved to the moderate (n = 11) or mild (n = 2) category. Two men had a higher IPSS at the postoperative review than at baseline. QoL improved by at least one point in 19 of 23 men (82.6%; 95% CI 61.2-95.0).

Baseline values did not differ between patients with and without paired data for any outcome (all $p > 0.15$). Mixed-effects models using all available observations gave estimates consistent with the paired analyses (Table *5*). Catheter-dependent men have no baseline Q-max or PVR, and those with a postoperative value contributed observations only to these models (three men for IPSS and QoL, four for Q-max and five for PVR). When they were excluded, the estimates were similar: IPSS -10.5 (95% CI -13.4 to -7.6; 48 patients), QoL -1.70 (95% CI -2.19 to -1.21; 48 patients), Q-max +3.8 mL/s (95% CI 1.6 to 6.0; 54 patients) and PVR -64.8 mL (95% CI -89.8 to -39.9; 56 patients). Analyses restricted to WVTT were also consistent: IPSS -11.2 (95% CI -14.6 to -7.9; n = 21) and Q-max +4.1 mL/s (95% CI 1.5 to 6.7; n = 32). When Q-max was restricted to voided volumes of ⩾150 mL at both visits, the gain was 5.1 mL/s (95% CI 2.2 to 8.0; n = 22).

| Analysis | n | Estimate | 95% CI | p |
|---|---|---|---|---|
| Clinical response: IPSS reduction ≥3 points | 17/23 | 73.9% | 51.6-89.8 | Not applicable |
| Clinical response: IPSS reduction ≥30% | 15/23 | 65.2% | 42.7-83.6 | Not applicable |
| Clinical response: IPSS reduction ≥50% | 10/23 | 43.5% | 23.2-65.5 | Not applicable |
| Clinical response: severe at baseline, moving to moderate or mild, among men with severe baseline symptoms | 13/17 | 76.5% | 50.1-93.2 | Not applicable |
| Clinical response: QoL improvement ≥1 point | 19/23 | 82.6% | 61.2-95.0 | Not applicable |
| Mixed-effects model: IPSS, mean change | 51 | -11.2 | -14.1 to -8.3 | <0.001 |
| Mixed-effects model: QoL, mean change | 51 | -1.86 | -2.37 to -1.34 | <0.001 |
| Mixed-effects model: Q-max, mL/s, mean change | 58 | +4.0 | 1.9 to 6.2 | <0.001 |
| Mixed-effects model: PVR, mL, mean change | 61 | -59.0 | -85.5 to -32.4 | <0.001 |
| WVTT only: IPSS, mean change | 21 | -11.2 | -14.6 to -7.9 | <0.001 |
| WVTT only: QoL, mean change | 21 | -1.57 | -2.24 to -0.90 | <0.001 |
| WVTT only: Q-max, mL/s, mean change | 32 | +4.1 | 1.5 to 6.7 | 0.003 |
| WVTT only: PVR, mL, mean change | 40 | -68.0 | -96.8 to -39.1 | <0.001 |
| Q-max, voided volume ≥150 ml at both visits, mL/s, mean change | 22 | +5.1 | 2.2 to 8.0 | 0.001 |
| PVR, excluding the censored baseline value, mL, mean change | 43 | -66.7 | -94.8 to -38.5 | <0.001 |
| Baseline values, patients with vs. without paired data (Mann-Whitney U test, compared within each outcome) | 64 | No difference detected | Not applicable | All >0.15 |

**TABLE 5: Clinical response and sensitivity analyses**

Clinical response percentages are calculated among the 23 men with paired IPSS and QoL data (and, for the severity-shift row, among the 17 of these men with severe symptoms at baseline), not among all 64 men. The timing of the postoperative review and postoperative LUTS medication use were not recorded.

Mixed-effects models used all available observations and assume that data are missing at random: 74 observations from 51 patients for IPSS and QoL, 93 from 58 patients for Q-max, and 105 from 61 patients for PVR.

CI: confidence interval; IPSS: International Prostate Symptom Score; LUTS: lower urinary tract symptoms; PVR: post-void residual volume; Q-max: maximum urinary flow rate; QoL: quality of life; WVTT: water vapor thermal therapy

# Discussion

## Principal findings

In this cohort of 64 men treated with MIST, mostly WVTT, on a planned same-day discharge pathway, 96.8% were discharged on the day of surgery. Among men with paired data, IPSS had fallen by 10 points and QoL by 1.65 points at the postoperative review; Q-max had increased by 3.7 mL/s, and median PVR had fallen by 41 mL. Almost three-quarters of men achieved the smallest symptom improvement that patients perceive [20]. The mixed-effects, WVTT-only, and voided-volume sensitivity analyses all gave consistent results.

## Same-day discharge

The same-day discharge rate is similar to the 94.2% reported in a multinational MIST series performed under local anesthesia [14] and the 98% reported after aquablation in an ambulatory surgery center [13]. The aquablation setting differs from ours, so that comparison is contextual only. Our rate is higher than the 85.3% day-case rate for PUL in national data from England [16]. It also contrasts with real-world WVTT series in which patients were routinely admitted, with median or mean stays of two to three days [10,17]. These findings suggest that a planned day-case pathway for MIST, and WVTT in particular, can be delivered reliably in an NHS tertiary center.

Same-day discharge is not the same as safety after discharge, and this study was not designed to assess it. In the national PUL data, 12.0% of men attended an emergency department within 30 days [16], and urinary retention is a recognized early event after WVTT [11]. Complications, readmissions, emergency attendances, and unplanned contacts with primary or community care were not systematically recorded in our database, so we cannot report whether any occurred or whether the pathway transferred care to emergency or primary care services. Our results therefore show that the pathway could be delivered, but they do not establish that it was safe. Safety should be addressed in prospective studies with standardized, dated, and systematic recording of postoperative events.

## Functional outcomes in context

The mean IPSS reduction of 10.0 points (42.6%) from a baseline of 23.5 is similar in magnitude to the 11.2-point reduction from a baseline of 22 reported for the primary endpoint in the WVTT arm of the pivotal randomized trial [5], although the timing of our assessment is unknown and direct comparison is limited. It is also within the pooled range of 9.81 points at one month to 13.13 points at 12 months, as reported in a systematic review of ultra-minimally invasive treatments [4]. The German WVTT series reported a similar relative reduction of 50%, from a lower baseline of 19.3 [17].

The Q-max gain of 3.7 mL/s is of similar magnitude to the pooled estimates at one month (3.66 mL/s) and 12 months (4.14 mL/s) [4] and smaller than the 6.2 mL/s increase reported in the randomized trial [5]; because the timing of our assessment is unknown, these comparisons are indicative only. When the analysis was restricted to technically reliable flow tests (voided volume ⩾150 mL), the gain increased to 5.1 mL/s. This suggests that low voided volumes in routine clinics may lead to an underestimate of the flow improvement.

The PVR reduction was larger than the pooled 12-month estimate of -10.10 mL, which did not reach significance [4]. This is consistent with the high baseline PVR in our cohort. Overall, the pattern of symptom improvement with a more modest flow gain is consistent with the expected profile of MIST compared with resection or laser procedures [1], although this study cannot confirm it.

Most men had severe symptoms at baseline, which leaves more room for improvement and makes scores more susceptible to regression to the mean [21]. For this reason, the responder analysis and the shift in severity category may be more informative than the absolute change. Because the interval to review was not recorded and probably differed between men, we cannot say at what stage of recovery the changes were measured. Early reviews may include transient postoperative irritative symptoms and could understate the eventual benefit, whereas later reviews may capture a more settled result, so the paired changes represent an average over unspecified time points.

## Considerations beyond this study

Sexual function and durability were not assessed. After WVTT and PUL, erectile and ejaculatory function are preserved and, in some domains, improved compared with baseline [9]. The surgical retreatment rate after WVTT was 4.4% at five years in a randomized trial [6] and 5.7% in a real-world cohort [10]. Our database recorded one subsequent TURP and three repeat MIST procedures, but follow-up timing was not recorded and events were not captured systematically, so we cannot estimate retreatment rates.

## Strengths and limitations

This study uses real-world NHS data from all MIST procedures in the departmental database, and no patient was excluded because of outcome. The primary outcome was recorded for 63 of 64 men and is reported with exact CIs; symptom and QoL scores are reported separately with validated response thresholds, and sensitivity analyses were performed to examine the effect of the missing follow-up data, although they cannot fully remove its influence.

The study also has limitations. It was retrospective and single-center, and as a single-arm study without a comparison group, it does not allow the observed changes to be attributed to MIST alone; regression to the mean may also have contributed [21]. Modality was chosen by patient preference, so selection bias is possible. Because 90.6% of men received WVTT, the findings mainly reflect experience with this modality, and the PUL and i-TIND results are descriptive only.

Data completeness varied by outcome. The primary outcome was recorded for 63 of 64 men, whereas paired baseline and postoperative data were available for 23 men (35.9%) for IPSS and QoL, 35 (54.7%) for Q-max, and 44 (68.8%) for PVR. Men with paired data may have differed from those without, for example, in symptom severity or in their likelihood of attending review, so selection bias is possible, and its direction cannot be determined from these data. To examine this, we compared baseline values between men with and without paired data, which showed no differences, and fitted mixed-effects models using all available observations, which gave consistent estimates. These checks address measured characteristics only. The symptom and flow results are therefore presented as descriptive findings in the men with available data and should not be taken as an estimate for the whole cohort.

The date of the postoperative review was not recorded, so the interval between treatment and review is unknown and probably varied between men. Symptoms and flow measures after minimally invasive treatment continue to change over the weeks and months after the procedure, so the paired changes reflect an average over unspecified time points, and comparisons with time-specific published results are indicative only. The durability of the changes could not be assessed. Postoperative use of LUTS medication was also not recorded. If medication was continued, part of the improvement may reflect ongoing drug treatment, and if it was stopped, the benefit of the procedure may have been underestimated. We were unable to adjust for either possibility, so the functional results describe what was observed at the first review and do not isolate the effect of the procedure alone.

Complications, readmissions, and unplanned healthcare contacts were not systematically recorded, so the study shows that the same-day discharge pathway could be delivered but does not establish its safety. Age, comorbidity, catheter duration, and post-discharge re-attendance were also not recorded and could not be analyzed. Because there was no comparison with inpatient care, we cannot say whether outcomes after same-day discharge were equivalent to those after an inpatient stay.

Prospective studies with protocol-driven, dated follow-up, standardized recording of complications, healthcare utilization, and medication use, and longer observation are needed to confirm these findings.

## Conclusions

In this retrospective single-center observational study, a planned same-day discharge pathway for MIST was delivered for almost all men, most of whom were treated with WVTT. Among men with available paired data, improvements in symptoms, QoL, flow rate, and residual volume were observed at the first postoperative review. These findings are descriptive and hypothesis-generating because follow-up was incomplete and its timing was not recorded, postoperative medication use, complications, and unplanned healthcare use were not systematically documented, and there was no comparison group. Successful same-day discharge therefore should not be taken as evidence of safety or of equivalence to inpatient care. Prospective studies with standardized, dated follow-up and systematic recording of safety outcomes are needed.

## Additional Information

### Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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