Research Square

Preprints are preliminary reports that have not undergone peer review. They should not be considered conclusive, used to inform clinical practice, or referenced by the media as validated information.

Postoperative Urinary Tract Infection Following Water Vapor Thermal Therapy

Thibaut Long depaquit

thibault.long-depaquit@intradef.gouv.fr

Department of Urology, Department of Urology, Hôpital d'Instruction des Armées Sainte-Anne, Toulon, France https://orcid.org/0000-0003-0344-2237

Arthur Peyrottes

Hôpital Saint-Louis

Alessandro Uleri

La Croix du Sud Hospital https://orcid.org/0000-0002-2392-2775

Iván Schwartzmann

Fundació Puigvert https://orcid.org/0000-0002-3361-934X

Marina Fernandez-Cisneros

Maxime Vallée

Luisella Pirozzi

Marco Domenico Salvaggio

Silvia Secco

ASST Grande Ospedale Metropolitano Niguarda https://orcid.org/0000-0002-4953-0091

Mathieu Coscarella

CHU Saint-Pierre/Universite Libre de Bruxelles (ULB) https://orcid.org/0000-0002-6448-2585

Serge Holz

Michael Baboudjian

Marc Fourmarier

Department of Urology, Centre Hospitalier du Pays d'Aix, Aix-en-Provence, France

---

Article

Keywords: Benign prostatic obstruction, Water vapor thermal therapy, Minimally invasive surgical therapy, Urinary tract infection, Outcome assessment

Posted Date: October 16th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11239233/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: There is **NO** conflict of interest to disclose.

Abstract

Purpose

Urinary tract infection (UTI) is frequently reported after water vapor thermal therapy (WVTT), but its true rate remains uncertain because expected postoperative irritative symptoms may mimic infection and standardized definitions have been lacking. We evaluated postoperative infectious complications after WVTT using a recently established international consensus definition of UTI.

Methods

This international multicentre cohort study included consecutive patients undergoing WVTT between January 2020 and December 2025. Prospectively collected clinical data were retrospectively analysed. Postoperative episodes considered clinically suspicious for infection were classified according to the consensus definition proposed by Bilsen et al. as confirmed, probable, possible, or no UTI. The primary endpoint was confirmed/probable UTI within 30 days.

Results

Among 278 patients, 58 (21%) experienced a postoperative episode considered clinically suspicious for infection. Application of the consensus definition identified 26 confirmed and three probable UTIs, corresponding to a 30-day confirmed/probable UTI rate of 10%. Postoperative antibiotics were prescribed in 61 patients (22%), of whom 33 (54%) did not fulfil criteria for confirmed/probable UTI. No statistically significant association was observed between preoperative bacteriuria and confirmed/probable postoperative UTI.

Conclusion

Standardized assessment identified confirmed/probable UTI in 10% of patients after WVTT, substantially fewer than clinically suspected infections. These findings highlight the value of standardized definitions for reporting postoperative UTI and guiding antibiotic use.

Introduction

Minimally invasive surgical therapies (MISTs) have become an established treatment option for male LUTS related to benign prostatic obstruction (BPO). Water vapor thermal therapy (WVTT, Rezūm™, Boston Scientific, Marlborough, MA, USA) is among the most widely adopted MISTs, providing durable symptom relief while preserving sexual function [1–3]. Its perioperative pathway continues to evolve toward treatment under local anaesthesia, ambulatory management, and catheter minimization [4].

Urinary tract infection (UTI) remains one of the most frequently reported adverse events after WVTT, although reported rates vary substantially across published studies [5, 6]. Importantly, the early postoperative period is frequently characterized by dysuria, urgency, and frequency, which may mimic UTI [7]. This diagnostic uncertainty may lead to unnecessary antibiotic treatment. Moreover, antibiotic regimens remain heterogeneous, with some WVTT protocols including several days of systematic postoperative therapy despite limited supporting evidence [7]. This variability is further compounded by the absence of standardized diagnostic criteria [8]. Postoperative infections have been defined using clinician diagnosis, microbiological findings, adverse event reporting, or study-specific definitions, limiting meaningful comparisons between studies. Recently, an international multidisciplinary Delphi consensus established a standardized reference definition of UTI for clinical research [9]. We therefore investigated whether applying this reference definition would change the estimated rate and classification of postoperative UTI after WVTT.

Materials and Methods

Study design and population

This international, multicentre cohort study was based on a retrospective analysis of prospectively collected data from consecutive patients undergoing WVTT for LUTS/BPO between January 2020 and December 2025. Preoperative urine culture was routinely performed, and bacteriuria was treated before the procedure according to antimicrobial susceptibility testing. Treatment and perioperative management, including antibiotic prophylaxis and postoperative catheterization, followed contemporary guidelines and local institutional practice. Routine postoperative antibiotic therapy was not used; postoperative antibiotic prescriptions and clinically suspected infectious episodes were recorded separately. Patients with < 30 days of follow-up or insufficient data to classify infectious outcomes were excluded.

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the French Urological Association (CERU-AFU; approval No. CERU_2025027).

Outcomes and adjudication

The primary endpoint was the 30-day rate of confirmed or probable UTI following WVTT. Secondary endpoints included clinically suspected postoperative infectious episodes, possible UTI, postoperative antibiotic prescription, and time to confirmed/probable UTI. The association between preoperative bacteriuria and confirmed/probable UTI was explored separately.

Participating centres prospectively recorded all postoperative events occurring within 30 days after surgery using a standardized electronic case report form (eCRF). Episodes considered clinically suspicious for infection by the treating physician were identified at each participating centre. For each

suspected episode, investigators recorded the clinical, laboratory, microbiological, and treatment data required for standardized classification.

Postoperative UTIs were classified according to the consensus definition proposed by Bilsen et al. [9]. Briefly, the consensus framework integrates urinary symptoms, systemic signs, pyuria, and microbiological findings to classify UTI according to the level of diagnostic certainty. Suspected episodes were subsequently classified as confirmed UTI, probable UTI, possible UTI, or no UTI using the predefined consensus algorithm. The classification criteria are detailed in Supplementary Table 1.

Statistical analysis

Continuous variables are presented as median (interquartile range [IQR]) and categorical variables as frequencies and percentages. The association between preoperative bacteriuria and confirmed/probable postoperative UTI was explored using Fisher's exact test, with odds ratios (ORs) and exact 95% confidence intervals (CIs). Given the descriptive objective of the study and the limited number of confirmed/probable UTI events, no multivariable modelling was performed. Statistical analyses were performed using R (version 4.2.2; R Foundation for Statistical Computing, Vienna, Austria). All statistical tests were two-sided, with $p < 0.05$ considered statistically significant.

Results

Study population

Between January 2020 and December 2025, 278 consecutive patients were included in the analysis. Median age was 63 years (IQR 58–68) and median prostate volume was 54 ml (IQR 45–70). Preoperative catheterization and bacteriuria were present in 23 (8%) and 26 (9%) patients, respectively. Median postoperative catheter duration was 7 days (IQR 4–7). Baseline demographic, clinical, and perioperative characteristics are summarized in Table 1.

Table 1
Baseline and perioperative characteristics

Characteristic	Overall (n = 278)
Age, *yr*	63 (58–68)
Prostate volume, *ml*	54 (45–70)
PSA, *ng/ml*	2.6 (1.5–4.2)
Prior urological surgery	42 (15)
Preoperative catheter	23 (8)
Antithrombotic therapy	38 (14)
Preoperative bacteriuria	26 (9.4)
Median lobe	152 (55)
Number of steam injections	6 (5–8)
Operative time, *min*	5 (4–10)
Catheter duration, *d*	7 (4–7)
Legend	
Data are presented as median with quartiles or frequency and percentage.	
IQR = interquartile range; PSA = prostate-specific antigen.	

Classification of postoperative infectious outcomes

Within 30 days after WVTT, 58 patients (21%) experienced a postoperative episode considered clinically suspicious for infection. Among these, 42 (72%) had a positive postoperative urine culture. Application of the consensus definition classified 26 episodes as confirmed UTI and 3 as probable UTI, corresponding to a confirmed/probable UTI rate of 10% (29/278). Six additional episodes fulfilled criteria for possible UTI, whereas 23 did not fulfil the consensus definition of postoperative UTI. Among patients with confirmed/probable UTI, 27/29 had a positive urine culture. Fever status was available for 16/29 patients, of whom 11 had fever > 38°C. Four patients had documented bacteremia and two had hypotension < 90 mmHg. Infectious complications included three cases of orchitis and one case of prostatitis. The median time to confirmed/probable UTI was 10 days (IQR 7–15) (Table 2).

Table 2
Thirty-day infectious outcomes according to the Bilsen consensus definition

Outcome	n (%)
Clinically suspected infection	58 (21)
Confirmed UTI	26 (9)
Probable UTI	3 (1.1)
Confirmed/probable UTI	29 (10)
Possible UTI	6 (2)
Median time to infection, *d*	10 (7–15)
Legend	
Data are presented as median with quartiles or frequency and percentage.	
IQR = interquartile range; UTI = urinary tract infection.	

Postoperative antibiotic prescription

Postoperative antibiotic therapy was prescribed in 61 patients (22%). Antibiotic prescription was therefore not strictly concordant with clinician-reported suspicion of infection, which was recorded in 58 patients. Among the 61 antibiotic-treated patients, only 28 fulfilled criteria for confirmed or probable UTI, whereas 33 did not. Conversely, one patient with confirmed/probable UTI did not receive antibiotic therapy. Overall agreement between postoperative antibiotic prescribing and consensus-defined infectious status was 244/278 (88%) (Table 3).

Table 3
Antibiotic prescriptions according to consensus-based UTI classification

Variable	n (%)
Postoperative antibiotic prescription	61 (22)
Antibiotics among confirmed/probable UTI	28/29 (97)
Antibiotics among patients without confirmed/probable UTI	33/249 (13)
Antibiotic prescriptions not associated with confirmed/probable UTI	33/61 (54)
Legend	
Data are presented as frequency and percentage.	
UTI = urinary tract infection.	

Preoperative bacteriuria and postoperative UTI

Preoperative bacteriuria was present in 26 patients (9%). The association with confirmed/probable postoperative UTI yielded an OR of 1.13 (95% CI 0.32–4.05; p = 0.7).

Discussion

This study is the first to apply the recently established reference definition of UTI to patients undergoing WVTT [9]. Two findings deserve emphasis. First, only approximately one-half of clinically suspected postoperative infectious episodes fulfilled criteria for confirmed or probable UTI. Second, postoperative antibiotic prescribing exceeded the number of confirmed or probable infections. Together, these findings highlight the impact of standardized outcome assessment on the measurement of postoperative infectious complications after MISTs.

Reported UTI rates after WVTT range from approximately 4% in the pivotal randomized trial [2] to more than 20% in subsequent prospective and real-world series [5, 10, 11]. A recent systematic review of MIST-related complications similarly highlighted UTI as a relevant adverse event following WVTT, while underscoring the heterogeneity of the available safety evidence [12]. Such variation probably reflects differences in outcome definitions and ascertainment, in addition to variation in patient populations and perioperative management. Indeed, postoperative infectious events have been reported as clinician-diagnosed UTI, culture-positive UTI, adverse events, or composite postoperative complications, often without clearly specified diagnostic criteria [13]. Our findings suggest that variation in outcome ascertainment may contribute to these discrepancies. Adoption of a common reference definition should therefore facilitate more reliable comparisons across future studies evaluating infectious outcomes after MISTs.

MISTs increasingly occupy an intermediate position between medical and surgical treatment for BPO, raising questions about how treatment success should be defined and which comparators are most appropriate [14]. Beyond durable symptom relief, contemporary MISTs aim to minimize treatment burden through office-based treatment, local anaesthesia, and reduced catheterization [15–18]. In this context, postoperative infection becomes a key outcome, as it may offset these benefits through antibiotic exposure and unplanned healthcare utilization. Although uncommon, severe infectious complications, including septic shock and fatal sepsis, have also been reported after WVTT [19].

More than one-half of postoperative antibiotic prescriptions occurred in patients without confirmed or probable UTI. This discrepancy highlights the difference between empiric treatment driven by postoperative symptoms and objectively defined infectious morbidity. Perioperative antibiotic prophylaxis and postoperative antibiotic treatment should, however, be considered separately. Our study was not designed to assess the efficacy or optimal regimen of prophylaxis. Recent expert consensus further highlights persistent uncertainty regarding peri-procedural infectious management, with no consensus supporting routine semen culture or antibiotic continuation throughout catheterization [20].

Conversely, our findings raise questions about prolonged postoperative antibiotic use in the absence of objective evidence of infection. Recognizing this distinction is particularly relevant when evaluating strategies to reduce unnecessary antibiotic exposure [21–23].

Several limitations should be acknowledged. First, although data were prospectively collected, the present analysis was retrospective and relied on the identification of clinically suspected infectious episodes at participating centres. Consequently, episodes not initially considered suspicious by the treating team may not have undergone complete infectious assessment. Second, antibiotic prophylaxis and postoperative antibiotic prescribing were not standardized across centres, reflecting real-world practice but introducing potential intercentre variability. Third, the limited number of confirmed or probable UTIs precluded robust assessment of independent predictors of infection. In particular, the study was not designed or powered to assess preoperative bacteriuria as a predictor of postoperative UTI, and bacteriuria identified before WVTT was treated before the procedure. Therefore, no conclusions regarding the role of preoperative urine culture can be drawn from these data. Finally, the Bilsen reference standard was developed for community-acquired UTI and has not been specifically validated in the early postoperative setting [9]. Its application after WVTT should therefore be regarded as an attempt to standardize outcome assessment rather than as a procedure-specific diagnostic standard.

Conclusion

Application of a standardized reference definition substantially modified the estimated rate of postoperative UTI following WVTT. These findings highlight the importance of distinguishing clinically suspected infection from confirmed infectious morbidity and support the adoption of harmonized outcome definitions in future studies evaluating minimally invasive surgical therapies.

Declarations

Conflict of Interest Statement:

None.

Source of Funding

None.

References

1. Elterman D, Bhojani N, Vannabouathong C, Chughtai B, Zorn KC. Large, Multi-Center, Prospective Registry of Rezūm Water Vapor Therapy for Benign Prostatic Hyperplasia. Urology 2022;165:261–7.
2. McVary KT, Gange SN, Gittelman MC, Goldberg KA, Patel K, Shore ND, et al. Minimally Invasive Prostate Convective Water Vapor Energy Ablation: A Multicenter, Randomized, Controlled Study for

the Treatment of Lower Urinary Tract Symptoms Secondary to Benign Prostatic Hyperplasia. J Urol 2016;195:1529–38.

3. Baboudjian M, Creta M, Pyrgidis N, Moris L, Duran MB, de Nunzio C, et al. Summary Paper on the 2026 European Association of Urology Guidelines on the Management of Non-neurogenic Male Lower Urinary Tract Symptoms. Eur Urol 2026;90:44–59.
4. Siena G, Sessa F, Cindolo L. Use of a Schelin Catheter for analgesia during Rezum treatment of the prostate. Prostate Cancer Prostatic Dis 2024;27:147–9.
5. Wolters M, Krastel M, Winkler T, Idais H, Mazdak M, Tezval H, et al. Real-world experience of water vapour therapy (Rezum) in patients with benign prostatic enlargement: a retrospective single-center study. Prostate Cancer Prostatic Dis 2025;28:160–6.
6. McVary KT, Gittelman MC, Goldberg KA, Patel K, Shore ND, Levin RM, et al. Final 5-Year Outcomes of the Multicenter Randomized Sham-Controlled Trial of a Water Vapor Thermal Therapy for Treatment of Moderate to Severe Lower Urinary Tract Symptoms Secondary to Benign Prostatic Hyperplasia. J Urol 2021;206:715–24.
7. Alcina EL, Arjona MF, Guzmán EF, Zuazu JR, Jochamowitz IS. Expert consensus on Rezūm™: Indications, surgical technique and postoperative care. BJUI Compass 2025;6:e491.
8. Bilsen MP, Jongeneel RMH, Schneeberger C, Platteel TN, van Nieuwkoop C, Mody L, et al. Definitions of Urinary Tract Infection in Current Research: A Systematic Review. Open Forum Infect Dis 2023;10:ofad332.
9. Bilsen MP, Conroy SP, Schneeberger C, Platteel TN, van Nieuwkoop C, Mody L, et al. A reference standard for urinary tract infection research: a multidisciplinary Delphi consensus study. Lancet Infect Dis 2024;24:e513–21.
10. Spinos T, Katafigiotis I, Leotsakos I, Grivas N, Zabaftis C, Ermidis D, et al. Rezūm water vapor therapy for the treatment of patients with urinary retention and permanent catheter dependence secondary to benign prostate hyperplasia: a systematic review of the literature. World J Urol 2023;41:413–20.
11. Siena G, Cindolo L, Ferrari G, Maruzzi D, Fasolis G, Condorelli SV, et al. Water vapor therapy (Rezūm) for lower urinary tract symptoms related to benign prostatic hyperplasia: early results from the first Italian multicentric study. World J Urol 2021;39:3875–80.
12. Lambertini L, Sandulli A, Coco S, Paganelli D, Cadenar A, Dell'Oglio P, et al. Complication rate across the minimally invasive surgical treatments (MISTs): where do we stand? A systematic review of the literature. Prostate Cancer Prostatic Dis 2025;28:639–51.
13. Cornu J-N, Zantek P, Burtt G, Martin C, Martin A, Springate C, et al. Minimally Invasive Treatments for Benign Prostatic Obstruction: A Systematic Review and Network Meta-analysis. Eur Urol 2023;83:534–47.
14. Baboudjian M, Nunzio CD, Elterman D, Creta M, Pyrgidis N, Moris L, et al. What is the Standard Comparator of Minimally Invasive Surgical Therapies (MIST) for Benign Prostatic Obstruction? Medical Versus Surgical Treatment. Eur Urol 2026:S0302-2838(26)02168-8.

15. Baboudjian M, Cornu J-N, Gondran-Tellier B, Fourmarier M, Robert G, Peyronnet B, et al. Pharmacologic and Surgical Retreatment After Office-based Treatments for Benign Prostatic Hyperplasia: A Systematic Review. Eur Urol Focus 2023;9:727–33.
16. Saibi Y, Long-Depaquit T, Fourmarier M, Uleri A, Campagna J, Bastide C, et al. Micro-costing analysis of Rezum™ therapy: comparing sedation and local anesthesia with the Schelin® catheter. World J Urol 2025;43:124.
17. Long-Depaquit T, Sordelli F, Charvet AL, Agüero C, Secco S, Sarrazin C, et al. Bladder drainage using the coreflow prostatic stent after REZUM therapy. World J Urol 2026;44:458.
18. Wirtzfeld N, Moretto S, Doizi S. Local anesthesia for Rezūm™: a narrative review of the literature. World J Urol 2025;43:252.
19. Cindolo L, Minore A, Schwartzmann I, Alejo AF, Imperatore V, Iossa V, et al. Water vapor thermotherapy and high-grade Clavien-Dindo complications: retrospective analysis of 10 cases. World J Urol 2026;44:392.
20. Secco S, Greco F, Pierella F, Tuzzolo P, Bevilacqua G, Scarciglia E, et al. Italian live Delphi consensus on indications, peri-procedural management, technique, and learning curve of convective water vapor thermal therapy (Rezum™) in men with LUTS/BPH. Urol J 2026;93:434–40.
21. Kranz J, Bartoletti R, Bruyère F, Cai T, Geerlings S, Köves B, et al. European Association of Urology Guidelines on Urological Infections: Summary of the 2024 Guidelines. Eur Urol 2024;86:27–41.
22. Cai T, Nesi G, Mazzoli S, Meacci F, Lanzafame P, Caciagli P, et al. Asymptomatic bacteriuria treatment is associated with a higher prevalence of antibiotic resistant strains in women with urinary tract infections. Clin Infect Dis Off Publ Infect Dis Soc Am 2015;61:1655–61.
23. Köves B, Cai T, Veeratterapillay R, Pickard R, Seisen T, Lam TB, et al. Benefits and Harms of Treatment of Asymptomatic Bacteriuria: A Systematic Review and Meta-analysis by the European Association of Urology Urological Infection Guidelines Panel. Eur Urol 2017;72:865–8.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementarytable1.docx