



## Original Article

# Posttoilet rinsing predicts prolonged cystitis and antibiotic use in adult women with uncomplicated acute cystitis

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## ABSTRACT

**Objectives:** We retrospectively investigated whether the habit of posttoilet rinsing as a hygiene method is a predisposing factor for prolonged pyuria and extended antibiotic use in females with uncomplicated acute cystitis as well as analyzed the clinical characteristics. **Materials and Methods:** Adult female patients with urinary tract infections (UTIs) were retrospectively reviewed between October 2021 and September 2022 at a regional hospital in Taiwan. Patients with uncomplicated acute cystitis were included. Exclusion criteria included patients younger than 18 years of age, those with vaginal discharge or irritation, fever, functional or anatomical abnormalities of the genitourinary tract, an indwelling urinary catheter, hormone replacement therapy, pregnancy, or other complicated UTIs. The collected information included age, self-reported comorbidities, habits of posttoilet rinsing as a hygiene method, antibiotic use, urine analysis, and pathogens obtained in urine cultures. **Results:** In total, 823 women with UTI were identified. Of these, 133 were diagnosed with uncomplicated acute cystitis. Further, 35 patients had the habit of posttoilet rinsing (habit group; mean age, 60.54 ± 15.97 years). The control group included 98 patients without this habit (mean age, 53.26 ± 17.18 years) ( $P = 0.03$ ). The percentage of cases wherein cystitis resolved within 1 week was significantly higher in the control group (61.86%) compared to that in the habit group (25.71%,  $P = 0.0002$ ). The urine culture positivity rate between the control and habit groups was not significantly different (57.14% vs. 40.0%,  $P = 0.0812$ ). The posttoilet rinsing habit was the only predictor of prolonged cystitis and antibiotic use in both univariable and multivariable analyses. **Conclusion:** These results suggest that the habit of posttoilet rinsing may prolong the duration of uncomplicated acute cystitis.

**KEYWORDS:** *Acute cystitis, Female, Posttoilet, Rinsing*

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## INTRODUCTION

Uncomplicated acute cystitis has a relatively high incidence in adult women. Almost half of all women experience urinary tract infection (UTI) during their lifetime [1]. In a study on college-going women, the incidence of cystitis was 0.70 episodes per person-year [2]. Among postmenopausal women, the incidence rate was 0.07 episodes per person-year in another population-based study [3]. The recognized predictors included sexual intercourse, previous UTI, spermicide use, new sex partner, and a family history of UTI [2,4,5]. Notably, large case-control studies in young women have shown no significant associations of recurrent UTIs with delayed wiping patterns, douching, and the use of hot tubs [5]. Recent studies have suggested that different styles of posttoilet wiping were a potential risk of UTI in women, especially in middle-aged subgroups [6].

Altered vaginal microbial properties exhibit a potential protective role against pathogens during menstruation [7]. Douching products may be associated with epithelial disruption and inflammation [8]. A recent meta-analysis revealed that epithelial GAG replacement therapy may prevent recurrent UTIs [9]. These observations emphasize the relationship between the completeness of epithelial function and UTIs. Pathogenic bacteria may also reside in the rectal vault, colonize the vagina, and then ascend the urethra [10]. Hygiene practices, including posttoilet rinsing, are often adopted by women to maintain cleanliness and reduce discomfort. If stool remains in the perianal

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region after wiping, it can worsen the symptoms of hemorrhoids [11]. Modern bidet toilet seats have gained popularity in recent years since their invention in Japan in 1980. Bidet toilet seats provide convenience in posttoilet rinsing. However, the relationship between posttoilet rinsing and uncomplicated acute cystitis remains unclear. There are also concerns that this habit may spread peri-anal bacteria, leading to persistent pyuria and the need for prolonged antibiotic therapy.

In this study, we retrospectively investigate whether the habit of posttoilet rinsing acts as a predisposing factor for prolonged pyuria and extended antibiotic use in women with uncomplicated acute cystitis. By analyzing the clinical characteristics of adult female patients with uncomplicated acute cystitis, we aim to determine whether this common hygiene practice influences the clinical course of this condition.

## MATERIALS AND METHODS

This study was approved by the Ethical Committee of Cardinal Tien Hospital (approval number CTH-111-3-5-028) and was conducted in accordance with the Declaration of Helsinki. Given that the data used in this study were previously collected for clinical purposes and have been anonymized, the IRB determined that patient consent was not required. Adult female patients diagnosed with UTI were retrospectively reviewed between October 2021 and September 2022 at the urology department of a regional hospital in Taiwan. Only patients with uncomplicated acute cystitis were included in the study. Uncomplicated acute cystitis was defined as acute cystitis limited to nonpregnant women with no known relevant anatomical and functional abnormalities within the urinary tract or comorbidities [12]. A focused history of lower urinary tract symptoms (such as dysuria, frequency, and urgency) and the absence of vaginal discharge were required for diagnosis [13]. Exclusion criteria included patients younger than 18 years of age, those presenting with vaginal discharge or irritation, fever, the existence of functional or anatomical genitourinary tract abnormalities, an indwelling urinary catheter, hormone replacement therapy, pregnancy, or other complicated UTIs. Collected data included age, self-reported comorbidities, the presence or absence of post-toilet rinsing habit as a hygiene method, empirical antibiotic use, duration of antibiotic use, urine analysis (RBC and WBC count per high-power field under microscopy), pathogens identified, and antibiotic resistance spectrum from urine cultures. The posttoilet rinsing habit, as a hygiene practice, is defined as rinsing with or without detergent after defecation or urination. Once a patient adopts this habit, regardless of frequency, it is recorded as the presence of posttoilet rinsing. Bidet toilet seats, faucets, water pipes, irrigators, douches, and similar devices are considered rinsing methods. The definition of resolved cystitis included symptoms of recovery, no pyuria, and no further need for antibiotics. Patients with habits of posttoilet rinsing were classified as the “rinsing group” while the others were defined as the control group for subsequent analyses.

Statistical analyses were performed using SPSS Statistics (IBM, Armonk, NY, USA, version 24). Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to characterize the study population at the baseline. All clinical parameters in the demographics were compared between groups using the Chi-square test or Fisher’s exact test for categorical variables and the independent *t*-test for continuous variables. To determine significant predictors of UTI that were not resolved within 1 week, predictors of specific interest and those with marginal differences ( $P < 0.1$ ) were included in the multiple logistic regression model. All statistical assessments were two-tailed and considered statistically significant at  $P < 0.05$ .

## RESULTS

The clinical characteristics of the patients, divided into the rinsing and control groups, are shown in Table 1. The mean age of the control group was  $53.26 \pm 17.18$  years, while the mean age of the rinsing group was  $60.54 \pm 15.97$  years, with a significant difference between groups ( $P = 0.03$ ). A higher prevalence of elderly individuals favoring posttoilet rinsing was noted. The most prevalent comorbidities ( $>5\%$  in respective groups) were hypertension and diabetes. The mean RBC/HPF was  $13.69 \pm 28.01$  in the rinsing group and  $14.15 \pm 26.45$  in the control group, while the mean WBC/HPF was  $34.94 \pm 39.09$  in the rinsing group and  $40.42 \pm 39.74$  in the control group. There were no significant difference in comorbidities and in the RBC and WBC counts in urine analyses between the two groups.

As shown in Table 2, the mean duration of antibiotic use to cure the infection was significantly longer in the rinsing

**Table 1: Characteristics of the subjects (n=133)**

	Rinsing group (n=35), n (%)	Control group (n=98), n (%)	P
Age (years), mean±SD	60.54±15.97	53.26±17.18	0.0300
RBC (HPF), mean±SD	13.7±28.0	14.2±26.5	0.9297
WBC (HPF), mean±SD	35.0±39.0	40.4±39.7	0.4835
Comorbidity			
Hypertension	5 (14.29)	5 (5.10)	0.1276 <sup>a</sup>
Diabetes mellitus	5 (14.29)	8 (8.16)	0.3258 <sup>a</sup>
Coronary artery disease	0	1 (1.02)	1.0000 <sup>a</sup>
Hyperlipidemia	1 (2.86)	2 (2.04)	1.0000 <sup>a</sup>
Chronic kidney disease	1 (2.86)	0	0.2632 <sup>a</sup>
Thyroid disease	0	2 (2.04)	1.0000 <sup>a</sup>
Anxiety	0	2 (2.04)	1.0000 <sup>a</sup>
Insomnia	1 (2.86)	1 (1.02)	0.4585 <sup>a</sup>
Arrhythmia	2 (5.71)	0	0.0678 <sup>a</sup>
GERD	1 (2.86)	1 (1.02)	0.4585 <sup>a</sup>
COPD	1 (2.86)	0	0.2632 <sup>a</sup>
Lung cancer	1 (2.86)	1 (1.02)	0.4585 <sup>a</sup>
Cardiovascular disease	1 (2.86)	2 (2.04)	1.0000 <sup>a</sup>
Old stroke	0	1 (1.02)	1.0000 <sup>a</sup>
Peptic ulcer	0	1 (1.02)	1.0000 <sup>a</sup>
Myoma	0	2 (2.04)	1.0000 <sup>a</sup>
Behcet’s disease	1 (2.86)	0	0.2632 <sup>a</sup>

<sup>a</sup>Fisher’s exact test. GERD: Gastroesophageal reflux disease, COPD: Chronic obstructive lung disease, WBC: White blood cell, RBC: Red blood cell, SD: Standard deviation, HPF: High-power field

group ( $15.46 \pm 7.36$  days) compared to that in the control group ( $10.50 \pm 5.05$  days) ( $P = 0.006$ ). The percentage of cystitis resolved within 1 week after antibiotic treatment was significantly higher in the control group (61.86%) than in the rinsing group (25.71%,  $P = 0.0002$ ). There were no significant differences in empirical antibiotic use between the groups, except for cefixime, a third-generation cephalosporin, which was more commonly used in the rinsing group ( $P = 0.0246$ ).

As shown in Table 3, there was a slightly lower trend in the urine culture positivity rate in the rinsing group compared to that in the control group (40.0% vs. 57.14%,  $P = 0.0812$ ). There were no significant differences in the bacteria isolated from urine cultures between the two groups, with *Escherichia coli* (31.43% vs. 39.80%,  $P = 0.3803$ ) and *Klebsiella pneumoniae* (8.57% vs. 4.08%,  $P = 0.3790$ ) being the most common pathogens. There were also no significant differences in the percentage of the antimicrobial resistance spectrum of *E. coli* in both groups, as shown in Table 4.

Table 5 summarizes the univariable and multivariable analyses of predictors for prolonged cystitis and extended antibiotic use (cystitis not resolved within 1 week). Univariable analysis showed that the habit of posttoilet rinsing ( $P = 0.0003$ ) predicted prolonged cystitis. Age was

slightly higher in cases of prolonged cystitis ( $P = 0.0914$ ), but the difference was not significant. Multivariable analysis indicated that the habit of posttoilet rinsing was the only significant predictor of prolonged cystitis and extended antibiotic use ( $P = 0.0006$ ).

## DISCUSSION

This study confirms that posttoilet rinsing is associated with a prolonged course of uncomplicated acute cystitis. In the rinsing group, patients experienced a significantly longer duration of antibiotic use ( $15.46 \pm 7.36$  days) compared to that in the control group ( $10.50 \pm 5.05$  days). Further, the percentage of patients with cystitis resolution within 1 week was much lower in the rinsing group (25.71%) compared to that in the control group (61.86%), indicating a slower recovery process. These findings suggest that posttoilet rinsing habits may contribute to delayed recovery in women with acute cystitis. Uncomplicated acute cystitis is a common disease in women; this study examines the influence of posttoilet rinsing hygiene practices on uncomplicated acute cystitis. Our findings also showed that older female patients were more likely to engage in posttoilet rinsing. A questionnaire-based survey was conducted in a Japanese population, 55% of whom used bidet toilets either before or after defecation [14]. Previous literature suggests that use of the bidet toilet seats by pregnant women poses no clinical risk for preterm birth and bacterial vaginosis [15]. However, with the growing popularity of modern bidet toilet seats with posttoilet rinsing functions, larger prospective studies are needed to determine the full impact of rinsing, both with and without bidet toilet seats.

The empirical antibiotics recommended in guidelines typically range from 3 to 7 days [12]. The mean duration of antibiotic use appears to be longer than expected. This may be because the hospital is a regional facility, and its patient population may differ from that of the general community. In addition, the next clinic visit is often scheduled 7 days later, and follow-up surveillance is typically conducted at that time. In the current study, most patients received cefuroxime, a second-generation of cephalosporin, as the empirical antibiotic, without significant differences between groups. In the rinsing group, cefixime, a third-generation of cephalosporin, was used empirically at a higher proportion compared to that in the control group. We also noted that some patients received multiple antibiotics empirically, depending on physician preference. According to the guidelines for antimicrobial therapy of UTIs in Taiwan, antibiotics should be tailored to local epidemiology, and second-generation cephalosporins are permitted for initial treatment [16]. The prevalence and antimicrobial susceptibility of uropathogens have varied over the past decade. Cephalosporin susceptibility in *Escherichia coli* has dramatically declined since 2010. Between 2007 and 2017, cefuroxime susceptibility was only 77.01% for *Escherichia coli* and 73.98% for *Klebsiella pneumoniae* [17]. Despite this, the rinsing group had a significantly higher rate of prolonged cystitis. Interestingly, no significant difference was observed between the groups in the types of bacteria cultured

**Table 2: Clinical course and type of antibiotic use**

	Rinsing group (n=35), n (%)	Control group (n=98), n (%)	P
Duration of antibiotic use to cure (days), mean±SD	15.46±7.36	10.50±5.05	0.0006
Cystitis resolved within 1 week			
No	26 (74.29)	37 (38.14)	0.0002
Yes	9 (25.71)	60 (61.86)	
Antibiotic use			
Cephalexin	1 (2.86)	2 (2.04)	1.0000 <sup>a</sup>
Cefuroxime	31 (88.57)	91 (92.86)	0.4789 <sup>a</sup>
Augmentin	3 (8.57)	3 (3.06)	0.1864 <sup>a</sup>
Cefixime	8 (22.86)	7 (7.14)	0.0246 <sup>a</sup>
Baktar	0	0	-
Ciproxin	4 (11.43)	6 (6.12)	0.4542 <sup>a</sup>
Levofloxacin	1 (2.86)	0	0.2632 <sup>a</sup>

<sup>a</sup>Fisher's exact test. SD: Standard deviation

**Table 3: Urine culture results among groups**

	Rinsing group (n=35), n (%)	Control group (n=98), n (%)	P
Urine culture			
Negative	21 (60.00)	42 (42.86)	0.0812
Positive	14 (40.00)	56 (57.14)	
Bacterium			
<i>Escherichia coli</i>	11 (31.43)	39 (39.80)	0.3803
<i>Streptococcus agalactiae</i>	0	8 (8.16)	0.1098 <sup>a</sup>
<i>Proteus mirabilis</i>	0	3 (3.06)	0.5660 <sup>a</sup>
<i>Klebsiella pneumoniae</i>	3 (8.57)	4 (4.08)	0.3790 <sup>a</sup>
<i>Staphylococcus saprophyticus</i>	0	0	-
<i>Gardnerella vaginalis</i>	0	2 (2.04)	1.0000 <sup>a</sup>
<i>Enterococcus faecalis</i>	0	0	-

<sup>a</sup>Fisher's exact test

**Table 4: Antimicrobial resistance of *Escherichia coli* detected in urine cultures (n=50)**

Antimicrobials	Rinsing group (n=11)			Control group (n=39)			P
	R, n (%)	S, n (%)	I, n (%)	R, n (%)	S, n (%)	I, n (%)	
Linezolid							
Amikacin		11 (100.0)			39 (100.0)		-
Ampicillin	9 (81.82)	2 (18.18)	0	23 (58.97)	15 (38.46)	1 (2.56)	0.4439 <sup>a</sup>
Penicillin G							
Cefazolin	3 (27.27)	8 (72.73)		4 (10.26)	35 (89.74)		0.1697 <sup>a</sup>
Cefotaxime	3 (27.27)	8 (72.73)		3 (7.69)	36 (92.31)		0.1114 <sup>a</sup>
Cefuroxime	3 (27.27)	8 (72.73)	0	4 (10.26)	34 (87.18)	1 (2.56)	0.3590 <sup>a</sup>
Flomoxef		11 (100.0)	0		38 (97.44)	1 (2.56)	1.0000 <sup>a</sup>
Ceftazidime	0	10 (90.91)	1 (9.09)	2 (5.13)	35 (89.74)	2 (5.13)	0.7283 <sup>a</sup>
Ceftriaxone							
Cefoperazone sulbactam		11 (100.0)			39 (100.0)		-
Chloramphenicol							
Clindamycin							
Erythromycin							
Rifampicin							
Tetracycline							
Tigecycline		11 (100.0)			39 (100.0)		-
Ertapenem	1 (9.09)	10 (90.91)		0	39 (100.0)		0.2200 <sup>a</sup>
Imipenem		11 (100.0)			39 (100.0)		-
Gentamicin	0	11 (100.0)	0	8 (20.51)	30 (76.92)	1 (2.56)	0.3540 <sup>a</sup>
Sulfamethoxazole	4 (36.36)	7 (63.64)		12 (30.77)	27 (69.23)		0.7278 <sup>a</sup>
Oxacillin							
Teicoplanin							
Vancomycin							
Ciprofloxacin	5 (45.45)	6 (54.55)	0	11 (28.21)	25 (64.10)	3 (7.69)	0.5277 <sup>a</sup>
Levofloxacin	4 (36.36)	6 (54.55)	1 (9.09)	10 (25.64)	26 (66.67)	3 (7.69)	0.6638 <sup>a</sup>

<sup>a</sup>Fisher's exact test**Table 5: Predictors of prolonged cystitis**

	Duration of antibiotic use (days)		P	Multiple logistic regression	
	>7 days (n=64), n (%)	≤7 days (n=69), n (%)		OR (95% CI)	P
Rinsing after toilet			0.0003		
Control group	38 (59.38)	60 (86.96)		Reference	
Rinsing group	26 (40.63)	9 (13.04)		4.72 (1.94–11.49)	0.0006
Age (years), mean±SD	58.02±17.23	52.97±17.10	0.0914	1.01 (0.99–1.03)	0.4079
RBC (HPF), mean±SD	14.0±26.2	14.1±27.3	0.9875	1.00 (0.98–1.01)	0.6632
WBC (HPF), mean±SD	42.6±38.6	35.1±40.3	0.2737	1.01 (1.00–1.02)	0.1409
DM			0.8582		
Without DM	59 (90.77)	62 (89.86)		Reference	
With DM	6 (9.23)	7 (10.14)		0.63 (0.17–2.38)	0.4983

<sup>a</sup>Fisher's exact test. SD: Standard deviation, OR: Odds ratio, CI: Confidence interval, WBC: White blood cell, RBC: Red blood cell, DM: Diabetes mellitus, HPF: High-power field

or the antibiotic resistance spectrum of the *E. coli* isolates. The high ampicillin resistance rate in both groups (58.97% in the control group and 81.82% in the rinsing group) supported the statement of EAU guidelines, "Aminopenicillins are no longer suitable for empirical therapy because of worldwide high *E. coli* resistance" [12]. These results indicate the need for paying attention to the prolonged recovery of UTI in patients with the habit of posttoilet rinsing, rather than focusing solely on empirical antibiotic choices.

Sexual intercourse was considered one of the major risk factors of uncomplicated acute cystitis [18]. A dose-response effect was found for increasing levels of coital frequency [19].

A previous study showed no association with several factors, including the type of clothing worn and the volume of fluids consumed, which are commonly considered important [19]. In the current retrospective study, we did not record the frequency of sexual intercourse, which might be a source of bias in assessing the prolonged recovery of cystitis. However, during acute cystitis, sexual intercourse is typically discouraged by physicians. Diabetes and incontinence may also increase the risk of pyelonephritis [4]. We excluded the cases with existent functional abnormalities, including incontinence. We also performed multivariable analyses that included diabetes. However, in this study, diabetes was not found to be a predictor of prolonged cystitis.

Several mechanisms may explain the observed association between posttoilet rinsing and prolonged cystitis. Posttoilet rinsing results in the peri-anal spread of bacteria from the stool and increases the vaginal bacterial load. Perineal length is inversely proportional to the rate of recurrent UTI [20]. The use of bidet toilets has been linked with an increased incidence of bacterial vaginosis [21]. These studies suggest that posttoilet rinsing may result in bacterial translocation. Another potential explanation involves disruption of the natural microbiome of the vaginal and perineal regions. The vagina serves as a potential reservoir for infecting bacteria in the pathogenesis of UTI in women. Women with recurrent UTIs had more unique types of motile urinary bacterial strains [22]. The protective vaginal microbiota, *Lactobacillus* spp., plays a dynamic and often critical role in preventing UTIs [23]. Habitual use of bidet toilets aggravates vaginal microflora, either by depriving normal microflora or facilitating opportunistic infection with fecal bacteria [24]. Regular posttoilet rinsing may disrupt the balance of protective microbiota, making the vagina and urinary tract more vulnerable to colonization by pathogens. We did not record the frequency of UTIs before this episode. Recurrent UTIs are also an important issue and a potential direction for future research on the relationship between recurrent UTIs and hygiene practices. A prospective study would be required to evaluate the impact of educational interventions on hygiene practices.

According to the results of this study, physicians should consider hygiene habits such as posttoilet rinsing when managing acute cystitis. In women who use posttoilet rinsing, extended antibiotic therapy might be anticipated, and additional counseling on hygiene practices may be beneficial in promoting quicker resolution of cystitis. This study also raises the need for further investigation into the safety and effectiveness of posttoilet rinsing as a hygiene method, especially with the increasing adoption of bidet toilet seats. While these devices offer convenience, the potential adverse effects on urinary tract health warrant more attention in future research.

This study has several limitations, including its retrospective nature, lack of detailed data on other potential UTI risk factors, wiping styles, and insufficient information on the frequency, technique, or intensity of rinsing habits. Variation in empirical antibiotic use is another confounding factor in evaluating the duration of cystitis. Future studies can, thus, adopt prospective designs with more comprehensive assessments of hygiene and lifestyle factors to better understand the role of posttoilet rinsing in UTI development and its clinical course.

## CONCLUSION

This study highlights posttoilet rinsing as a significant predictor of prolonged cystitis in women with uncomplicated acute cystitis and suggests that rinsing habits may adversely affect the recovery course.

## Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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## Conflicts of interest

There are no conflicts of interest.

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