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Predictive factors for the success of trial catheter removal for women with urinary retention

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Abstract

Objective: To investigate the outcome, determine the predictors for the success of, and evaluate the efficacy of pharmacokinetic therapy on trial catheter removal for women with urinary retention.

Methods: Inclusion criteria were female patients with acute urinary retention defined as painful, palpable, or percussive bladder, when the patient is unable to pass any urine, accompanied by postvoid residual (PVR) > 250 ml, and who underwent trial catheter removal between July 2009 and July 2019. Before trial catheter removal, alpha-blockers alone or alpha-blockers and parasympathomimetics (bethanechol or distigmine bromide) were used to facilitate spontaneous voiding in some cases.

Results: Fifty-nine of 104 (56.7%) women with urinary retention were catheter-free post trial. There was no significant difference between successful and non-successful trials in average age ($p = .392$), median ECOG (Eastern Cooperative Oncology Group) performance status ($p = .374$), diabetes mellitus ($p = .842$), dementia ($p = .801$), previous history of cerebrovascular events ($p = .592$), or intrapelvic surgery ($p = .800$). Oral medications were administered for 39/59 (66.1%) in the success group and 30/45 (66.7%) patients in the non-success groups ($p = .598$).

Serum albumin (3.2 ± 0.7 g/dl and 2.8 ± 0.8 g/dl, $p = .039$) and total protein values (6.5 ± 0.8 g/dl and 6.0 ± 1.0 g/dl, $p = .038$) at diagnosis of urinary retention were higher in the success group than the non-success group, respectively.

Multivariate logistic regression found that a serum albumin >3 g/dl was an independent predictor of successful trial catheter removal for women with urinary retention ($p = .030$, odds ratio [OR] 3.3, 95% confidence interval [CI] of OR 1.1–9.9). Age < 70 years old was a likely predictor of successful trial catheter removal ($p = .066$, OR 4.8, 95% CI of OR 0.9–25.0).

Conclusions: This is the first retrospective study to investigate the predictive factors for successful trial catheter removal in women with urinary retention. A serum albumin value >3 mg/dl at diagnosis of urinary retention was a significant independent predictor of catheter-free status after trial catheter removal, and age < 70 years-old was a possible contributor. There was no evidence that oral medication contributed to catheter-free status.

KEYWORDS
trial catheter removal, urinary retention, women

1 | INTRODUCTION

Acute urinary retention is defined as a painful, palpable, or percussive bladder, when the patient is unable to pass any urine.[1,2] In women, detrusor underactivity (DUA) is commonly believed to be the main cause for urinary retention. Although the prevalence of urinary retention and DUA among women has not been fully investigated,[3-6] a previous urodynamic study for lower urinary tract symptoms (LUTS) demonstrated that 13.3% of women aged over 65 years were classified as having DUA.[7]

Fewer studies investigated urinary retention in women[6,8,9] than in men,[10-14] and no curative options are currently recommended for women with urinary retention in either the European Association of Urology (EAU) or the American Urological Association (AUA) guidelines. Meanwhile, Japanese clinical guidelines for female LUTS described oral alpha-blockers and parasympathomimetics as limited pharmaceutical agents with very low clinical evidence.[15] Long-term implantation of urinary catheters commonly used for the management of urinary retention can lead to low quality of life and urinary tract infections,[16] and trial catheter removal is a good option to avoid those complications. However, the efficacy of trial catheter removal for urinary retention in women has not been studied, and real clinical evidence has yet to be accumulated.

This study aimed to investigate the outcome of trial catheter removal for women with acute urinary retention and determine the predictors for the success of trial catheter removal. This study also evaluated the efficacy of oral alpha-blockers and parasympathomimetics on trial catheter removal for women.[9]

2 | METHODS

2.1 | Study population

Inclusion criteria were female patients who presented with acute urinary retention defined as a painful, palpable, or percussive bladder, when the patient is unable to pass any urine,[2] accompanied with post-void residual (PVR) > 250 ml[9] measured by ultrasound or computed tomography imaging. Consecutive patients who underwent trial catheter removal between July 2009 and July 2019 were enrolled and retrospectively analyzed in this study. The study protocol (IRB [institutional review board] number YKH20-73), waiving the requirement for written informed consent, was approved by the institutional ethics committee of Yokosuka Kyosai Hospital. Informed consent was obtained in the form of an opt-out option on the Yokosuka Kyosai Hospital website. The study was conducted in accordance with the principles set out in the Declaration of Helsinki and all local regulations.

Treatment and trial catheter removal indications are described here. After diagnosis of urinary retention, a transurethral catheter was inserted to drain the residual urine from the bladder. Following at least 1 week of urethral catheter use, trial catheter removal was performed. Prior to catheter removal, drug treatment with alpha-blockers alone or a combination of alpha-blockers and parasympathomimetics (bethanechol or distigmine bromide) were used to facilitate spontaneous voiding in some cases, as determined by physicians. After instillation of warm saline (200–300 ml or until the first desire to void), the urinary catheter was removed, and residual urine was measured after the first void or 6 h later. The trial was defined as non-success if the PVR was >150 ml (previously defined as PVR > 100–250 ml[9,13]) or the patient experienced difficulty emptying their bladder with abdominal discomfort or pain, and a transurethral catheter was reinserted.

The patients' characteristics including age, ECOG (Eastern Cooperative Oncology Group) performance status (PS), body mass index, blood test parameters at diagnosis of urinary retention, and comorbidities were retrospectively compared according to the outcome of trial catheter removal. Multivariate regression models were used to find the predictors of successful trial outcome and evaluate the impact of any medication on trial outcome.

2.2 | Statistical analysis

Statistical analysis was performed using SPSS software (version 22; SPSS Inc., Chicago, Illinois). Paired and unpaired *t* tests were used, as appropriate, to compare clinical continuous variables. The chi-square test was used as appropriate to compare qualitative variables. Continuous variables are presented as mean and standard deviation (SD), and qualitative variables are presented as percentages. p values <.05 were considered significant. The cutoff points for continuous values were measured on the basis of receiver operating characteristic (ROC) curve analysis. For multivariate analysis, a logistic regression model with stepwise analysis was used.

3 | RESULTS

Among 104 women with urinary retention, 59 (56.7%) became catheter-free (Table 1). When they were diagnosed with urinary retention, 3/59 (5.1%) patients in the success group and 2/45 (4.4%) patients in the non-success group had received oral medications for LUTS. The main reason for urinary retention was acute medical illness in both groups.

There were no significant differences in average age (75.3 ± 11.9 and 77.3 ± 12.0 years old, $p = .392$) or median PS (1 in both groups, $p = .374$) between the success and non-success groups, respectively

TABLE 1 Comparison of characteristics and urinary volume information of patients with successful and non-successful outcome of trial catheter removal

	Total	Success	Non-success	*p* value
Number of patients	104	59	45	
Age (years)	76.3 ± 12.0	75.3 ± 11.9	77.3 ± 12.0	0.392
BMI (kg/m^2)	21.7 ± 4.3	21.9 ± 4.5	21.4 ± 4.1	0.623
ECOG performance status				
0	8 (7.7%)	6 (10.1%)	2 (4.4%)	0.374
1	71 (68.3%)	39 (66.1%)	32 (71.1%)	
2	13 (12.5%)	9 (15.3%)	4 (8.9%)	
3	12 (11.5%)	5 (8.5%)	7 (15.6%)	
4	0	0	0	
Past history				
Diabetes mellitus	29 (27.9%)	16 (27.1%)	13 (28.9%)	0.842
Dementia	22 (21.2%)	13 (22.0%)	9 (20.0%)	0.801
Cerebrovascular event	21 (20.2%)	13 (22.0%)	8 (17.8%)	0.592
Intrapelvic surgery	31 (29.8%)	17 (28.8%)	14 (31.1%)	0.800
Cause of urinary retention				
Acute medical illness	57 (54.8%)	33 (55.9%)	24 (53.3%)	0.792
Postoperative	13 (12.5%)	9 (15.3%)	4 (8.9%)	0.130
Cardiovascular event	8 (7.7%)	6 (10.1%)	2 (4.4%)	0.475
Infection	12 (11.5%)	5 (8.5%)	7 (15.6%)	0.263
Fracture	6 (5.8%)	4 (6.8%)	2 (4.4%)	0.935
Cerebrovascular event	8 (7.7%)	2 (3.4%)	6 (13.3%)	0.501
Oral medicine at diagnosis of urinary retention				
None	80 (76.9%)	46 (78.0%)	34 (75.6%)	0.842
Urapidil	2 (1.9%)	1 (1.7%)	1 (2.2%)	
Distigmine bromide	2 (1.9%)	1 (1.7%)	1 (2.2%)	
Urapidil and Distigmine bromide	1 (1.0%)	1 (1.7%)	0	
Oral medicine for catheter removal trial				
None	35 (33.7%)	20 (33.9%)	15 (33.3%)	0.598
Urapidil	41 (39.4%)	25 (42.4%)	16 (35.6%)	
Urapidil and Bethanechol chloride	27 (26.0%)	13 (22.0%)	14 (31.1%)	
Urapidil and Distigmine bromide	1 (1.0%)	1 (1.7%)	0	
Residual urine volume at diagnosis of urinary retention (ml)	485.7 ± 78.7	411.4 ± 73.0	583.0 ± 84.3	0.126
Residual urine volume at catheter removal trial (ml)	166.7 ± 19.2	98.2 ± 12.9	256.6 ± 25.5	<0.001
Voided volume at catheter removal trial (ml)	93.0 ± 11.9	128.4 ± 13.6	46.7 ± 10.0	<0.001

Note: Continuous values are represented as mean ± standard deviation (SD).
Abbreviations: BMI, body mass index; ECOG, Eastern Cooperative Oncology Group.

(Table 1). The presence of diabetes mellitus ($p = .842$), dementia ($p = .801$), previous cerebrovascular events ($p = .592$), or intrapelvic surgery ($p = .800$) was not different between the success and non-success groups. Oral medications for trial catheter removal aiming to achieve catheter-free status were administered for 39/59 (66.1%) and 30/45 (66.7%) patients in the success and non-success groups, respectively ($p = .598$).

The residual urine volume at diagnosis of urinary retention was higher in the non-success group (583.0 ± 84.3) than in the success group (411.4 ± 73.0), but this was not significant ($p = .126$, Table 1). The voided volume at the time of trial catheter removal was significantly higher in the success than in the non-success group ($p < 0.001$).

Blood tests at diagnosis of urinary retention showed that the serum albumin (3.2 ± 0.7 and 2.8 ± 0.8, $p = .039$) and total protein values (6.5 ± 0.8 and 6.0 ± 1.0, $p = .038$) were higher in the success group than the non-success group, respectively (Table 2). There were no significant differences in serum values including creatinine, white

TABLE 2 Comparison of blood test results in patients with successful and non-successful outcome of trial catheter removal

	Success	Non-success	*p* value
Number of patients	59	45	
Total protein (g/dl)	6.5 ± 0.8	6.0 ± 1.0	0.038
Albumin (g/dl)	3.2 ± 0.7	2.8 ± 0.8	0.039
AST (U/L)	24.5 ± 12.4	22.1 ± 8.7	0.342
ALT (U/L)	17.7 ± 12.0	17.6 ± 13.5	0.970
ALP (U/L)	298.8 ± 246.8	232.8 ± 93.9	0.192
BUN (mg/dl)	19.6 ± 9.4	18.2 ± 14.1	0.595
Creatinine (mg/dl)	1.1 ± 1.3	1.0 ± 1.2	0.691
CRP (mg/dl)	1.6 ± 2.4	3.1 ± 5.3	0.092
White blood cells (10^3/μl)	6.9 ± 2.4	6.8 ± 3.4	0.952
Neutrophils (%)	67.7 ± 11.7	64.8 ± 15.3	0.366
Hemoglobin (g/dl)	10.7 ± 1.7	10.5 ± 2.0	0.525
Platelets (10^3/μl)	252.2 ± 104.8	280.2 ± 112.5	0.236
Blood sugar (mg/dl)	142.1 ± 75.2	131.6 ± 62.9	0.652

Note: Continuous values are represented as mean ± standard deviation (SD).
Abbreviations: ALP, alkaline phosphatase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; CRP, C-reactive protein.

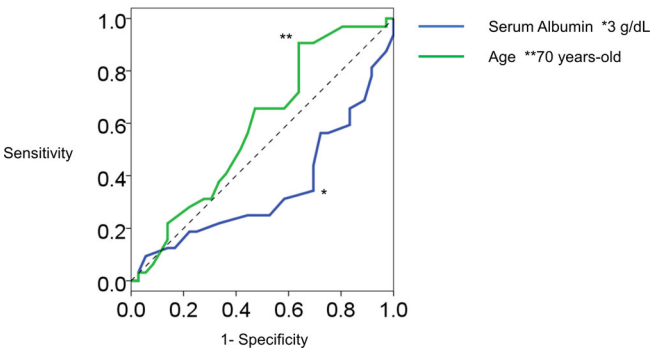

FIGURE 1 Receiver operating characteristic (ROC) curve of serum albumin and patient's age as predictors of successful trial catheter removal for women with urinary retention. ROC curve analysis showed that the cutoff values of albumin and age were 3.0 mg/dl and 70 years old, respectively

blood cell, neutrophil, hemoglobin, or platelet count between the success and non-success groups.

ROC curve analysis indicated that the cutoff points of serum albumin and patients' age for successful trial catheter removal were 3 g/dl and 70 years, respectively (Figure 1). The area under the ROC curve for serum albumin and patients' age were 0.648 and 0.603, respectively. The multivariate logistic regression model demonstrated that a serum albumin value >3 g/dl was a significant independent predictor of successful trial of catheter removal for women with urinary retention ($p = .030$, odds ratio [OR] 3.3, 95% confidence interval [CI] of OR 1.1–9.9) (Table 3). Age < 70 years was a likely predictor of success for trial catheter removal ($p = .066$, OR 4.8, 95% CI of OR 0.9–25.0; Table 3). Oral medication usage, PS, and medical history did not predict the outcome of trial catheter removal for women with urinary retention (not significant, see Table 3).

4 | DISCUSSION

This is the first study to investigate the predictors of catheter-free status after trial catheter removal for women with urinary retention. We found that a serum albumin value >3 mg/dl at diagnosis of urinary retention was a significant independent predictor of catheter-free status after trial catheter removal. Although an age < 70 years was also a possible contributor (without reaching statistical significance), PS, diabetes mellitus, dementia, and previous cerebrovascular events or intrapelvic surgery had no influence on the outcome of trial catheter removal. The secondary outcome of this study was to assess the efficacy of oral medications for the treatment of urinary retention. We found no evidence that these medications are beneficial in this regard.

Albumin is a major serum protein and usually represents a patient's overall nutritional status and liver function. Hypoalbuminemia in adults is defined as an intravascular albumin level <3.5 g/dl. Potential mechanisms for hypoalbuminemia include decreased synthesis (liver disease, protein malnutrition), increased tissue catabolism (sepsis), renal loss (nephrotic syndrome), gastrointestinal loss (protein-losing enteropathy), or a change in distribution (sequestration).[17,18] Hypoalbuminemia was reported to be associated with overactive bladder in patients with liver cirrhosis.[19] Also, hypoalbuminemia is a well-known risk factor for mortality and other poor outcomes in various clinical settings, including wellness promotion,[20] admission to hospital,[21] and even treatment of coronavirus disease 2019.[22] Similar observations have been made in the surgical patient population, where hypoalbuminemia has been predictive of the need for

TABLE 3 Multivariate logistic regression model predicting successful outcome of removal of a urinary catheter

	p value	OR	95% CI of OR	
			Lower	Upper
Initial model				
Constant	0.005	0.0		
Residual urine volume at diagnosis of urinary retention	0.472	1.0	1.0	1.0
Age, cutoff 70 years	0.022	8.0	1.3	47.6
Diabetes mellitus	0.770	0.8	0.2	3.4
Cerebrovascular event	0.339	0.5	0.1	2.0
Dementia	0.159	0.4	0.1	1.5
Intrapelvic surgery	0.964	1.0	0.3	4.3
PS, cutoff 2	0.824	1.2	0.3	4.8
Albumin, cutoff 3 g/dl	0.023	4.2	1.2	14.4
Intake of oral medicine for trial	0.669	1.0	1.0	1.0
Final model				
Constant	0.005	0.0		
Albumin, cutoff 3 g/dl	0.030	3.3	1.1	9.9
Age, cutoff 70 years	0.066	4.8	0.9	25.0

Abbreviations: CI, confidence interval; OR, odds ratio; PS, ECOG (Eastern Cooperative Oncology Group) performance status.

reoperation, a prolonged hospital stay, wound complications, renal failure, gastrointestinal dysfunction, and mortality.[23-25] However, the pathophysiology behind these relationship remains to be elucidated.[26] Albumin might serve as a nutritional marker, such that hypoalbuminemia represents poor nutritional status in patients who go on to experience poor clinical outcomes. Also, albumin is known to be a negative acute phase protein, and as such hypoalbuminemia might represent increased inflammatory status for the patient, which potentially leads to poor outcomes. This study demonstrates the relationship between hypoalbuminemia and the outcome of trial catheter removal and suggests that a catheter removal trial should be performed for women with a serum albumin value >3 mg/dl.

Meanwhile, we hypothesized that aging, PS, diabetes mellitus, dementia (as these patients have a higher risk of neurogenic bladder than the general population), and previous cerebrovascular events were possible candidates to predict the outcome of trial catheter removal. Indeed, a previous study investigating urinary retention in elderly women undergoing rehabilitation found that diabetes mellitus and poor PS were prognostic factors for recovery failure from urinary retention.[9] Surprisingly, contradicting our hypotheses and the above-mentioned study, none of the factors we suggested had an effect on the outcome of trial catheter removal. These findings suggest that even a low PS and a potential neurogenic bladder are not exclusion criteria for trial catheter removal, at least in patients with serum albumin values >3 mg/dl and age < 70 years.

The parasympathomimetic agents, bethanechol and carbachol, have previously demonstrated variable effects on DUA. A previous study indicated that bethanechol enhanced bladder wall stiffness and sensory perception.[27] Another study demonstrated that bethanechol reduced the bladder sensory threshold in women with DUA.[8] Given the questionable efficacy of parasympathomimetic agents in treating DUA and dose-dependent systemic adverse events, including fatal overdose, the use of those drugs is limited.[28] This study found that parasympathomimetics showed no beneficial effects on achieving catheter-free status.

Alpha-adrenoreceptor antagonists are another agent which may be beneficial for women with DUA as they may reduce bladder outlet obstruction via alpha-receptors in the bladder neck and proximal urethra.[29] A recent meta-analysis found that alpha1-blocker therapy was more effective than placebo in reducing LUTS, but there were no beneficial effects of alpha1-blockers in maximum uroflow rate or PVR when compared to placebo.[30] Our findings suggest that alpha1-blocker therapy in women with LUTS may not improve the outcome of a catheter removal trial.

This study has a few limitations, such as the retrospective study design, being conducted in a single center, and having a relatively small number of subjects. However, urinary retention in women is not common, and 10 years of medical records were reviewed to obtain our patient cohort. In most cases, invasive urodynamic studies, including cystometry and pressure flow studies, were not performed mainly because patients did not want invasive tests or the PS was low. The background of this cohort had some heterogeneity, and we believed the multivariate analysis could control for confounding effects in this study.

5 | CONCLUSIONS

A serum albumin value >3 mg/dl at diagnosis of urinary retention was a significant independent predictor of catheter-free status after trial

catheter removal. Age <70 years was found to be a possible predictive factor of successful trial catheter removal. There was no evidence that the use of oral alpha-blockers contributed to the success of trial catheter removal.

AUTHOR CONTRIBUTIONS

Hiroki Ito, Masato Takanashi, Takeshi Fukazawa, Risa Shinoki, and Tadashi Tabei: experiment conception and design. **Masato Takanashi, Hiroki Ito, Takeshi Fukazawa, Masato Takanashi, Risa Shinoki, and Tadashi Tabei:** data collection. **Hiroki Ito, Masato Takanashi, Takashi Kawahara, and Kazuki Kobayashi:** data analysis. **Hiroki Ito, Masato Takanashi, Tadashi Tabei, Takashi Kawahara, and Kazuki Kobayashi**: data interpretation. **Masato Takanashi, Hiroki Ito, and Kazuki Kobayashi:** manuscript writing. All authors read and approved of the final manuscript.

CONFLICTS OF INTEREST

None.

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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