

# Quality improvement project: Optimal post-void residual urine volume to guide intermittent catheterization in hospitalised older persons with acute retention of urine

Jim Kim Hwa Lim, MRCP, Gek Kheng Png, M Nursing, Anna Liza Bantilan, BSc (Nursing), Anitah Rahmat, BSc (Nursing), Roslinda Slammat, BSc (Nursing), Rosida Abdul Hamid, BSc (Nursing), Jismy Theetaikochppu Jose, BSc (Nursing)

Department of Geriatric Medicine, Changi General Hospital, Singapore

## ABSTRACT

**Introduction:** There is no consensus on the optimal post-void residual urine volume (PVRU) as a cut-off value prior to performing intermittent catheterisation (IMC). We did a quality improvement project to determine a reasonable PVRU for use in the hospital setting.

**Materials and methods:** All patients admitted to the five geriatric medicine wards in a geriatric department over a 5-month period who developed acute retention of urine were included in the project. Patients who had hydronephrosis or were already on catheter for more than a week were excluded. Patients included were randomised to PVRU of 200 ml or 300ml. The male and female participants were randomised into separate groups. The primary outcome measures were success in weaning off IMC and the development of urinary tract infection (UTI). The secondary outcomes were the frequency of IMC required and the days needed to wean off IMC successfully.

**Results:** Both the 200 ml and 300 ml groups had equal success in weaning off IMC and were equally likely to be associated with UTI. However, the 200-ml group had more IMC done within the first 3 days (3.3, SD 2.4 vs 2.4, SD 1.6,  $p = 0.030$ ), but was weaned off IMC earlier (3.5, SD 1.7, vs 4.8, SD 2.3 days,  $p = 0.049$ ).

**Conclusion:** We conclude that PVRU of 200 ml or 300 ml are both reasonable cut-off values prior to performing IMC.

## KEYWORDS:

Post-void residual urine, intermittent catheterisation, weaning off catheter, urinary tract infection.

## INTRODUCTION

In our hospital, patients with acute retention of urine (ARU) are put on intermittent catheterisation (IMC) four times a day. Prior to every IMC, a post-void residual urine volume (PVRU) using a bedside bladder scan is performed.<sup>1</sup> PVRU is defined by the International Continence Society as the volume of urine left in the bladder at the completion of micturition.<sup>2</sup> This applies to both male and female patients.<sup>3</sup> If the PVRU is more than 200 ml, IMC will be performed, but

if the PVRU is less than 200 ml, IMC will be omitted. However, there is no consensus on the optimal PVRU as cut-off value and different doctors use different PVRU values.

Both IMC and in-dwelling catheterisation (IDC) can cause adverse effects, including urinary infection, bleeding, urethral stricture, and bladder stones.<sup>4</sup> Though IDC is more convenient for the nursing staff as no repeated catheterisation is required, IMC is preferred to IDC.<sup>5</sup> To insert an IDC only for the comfort of the nursing personnel is irresponsible.<sup>5</sup>

The risk of developing UTI is probably higher in IDC compared to IMC.<sup>6</sup> The patients on IMC will not need to lug along a tube with a bag wherever they go, hindering rehabilitation. Furthermore, when the bladder recovers, the residual urine volume gradually decreases and the frequency of IMC also reduces until IMC can be discontinued. If patients have a urethral stricture or urethral injury, both IMC and IDC cannot be used. Instead, suprapubic catheterisation will be needed.<sup>5</sup>

Catheterisation may introduce bacteria into the urinary bladder, but a high PVRU may predispose patients to UTI due to stasis. What is the optimal PVRU before IMC should be performed? There are no evidence-based guidelines on the optimal PVRU prior to performing IMC.

Bacteriuria is expected to develop in 26% (95% confidence interval, 23%–29%) in patients who have indwelling catheters inserted for 2–10 days. Among patients with bacteriuria, symptoms of UTI will develop in 24% (95% confidence interval, 16%–32%), and bacteremia from a urinary tract source will develop in 3.6% (confidence interval, 3.4%–3.8%).<sup>7</sup>

We did a quality improvement project to determine whether PVRU of 200 ml is comparable to 300 ml in the success in weaning off IMC and in the risk of developing UTI. We chose a higher PVRU value of 300 ml, rather than a lower value, to investigate whether fewer IMC could be done without causing more UTI or a delay in weaning off catheter.

This article was accepted: 04 September 2022

Corresponding Author: Jim Lim

Email: jimlim169@gmail.com

## OBJECTIVE

To investigate whether PVRU of 200 ml is comparable to 300 ml in:

1. Success in weaning off IMC
2. Incidence of UTI
3. Number of IMC done
4. Days required to wean off IMC

## MATERIALS AND METHODS

### *Inclusion Criteria*

All patients admitted to the five geriatric medicine wards in a geriatric department who developed ARU over a 5-month period, 22 October 2018 till 21 March 2019, were included in the project.

### *Exclusion Criteria*

The patients already on IMC or IDC (at least 1 week) preadmission or had hydronephrosis were excluded.

### *Ethical Consideration*

The Clinical Trials and Research Unit (CTRU) of our hospital was consulted regarding consent taking from the patients. Since IMC was done as part of the management of acute retention of urine, no consent was deemed needed.

### *Randomisation*

The patients were randomised at individual ward level to PVRU 200 ml or 300 ml using sealed envelopes. The male and female participants were assigned separately using two sealed envelopes.

### *Data Collection*

The demographics of patients collected were age, gender, living arrangement, length of stay, life expectancy, Abbreviated Mental Test score, Barthel Index score, and the presence of faecal impaction.

The patients enrolled into the project were subjected to PVRU four times a day using a bedside bladder scan done by the ward nurses trained in bladder scanning. If the PVRU was more than 200 ml, or 300 ml, depending on randomisation, IMC was performed.

Day 1 was counted as the day the patient was randomised and started on the study.

Definition of successful weaning off catheter. If two consecutive PVRU were 100 ml or less, the patient was deemed to be successfully weaned off IMC and the study was deemed completed. The day when it occurred was noted. However, the patients were monitored for symptoms of UTI for another 48 hours.

Definition of failure of weaning off catheter. If two consecutive PVRU were not less than 100 ml yet at the end of Day 8, then it was deemed as failed weaning off IMC and the study was also deemed completed. If the patients were discharged home or transferred to another hospital or facility before they had two consecutive PVRU of less than 100 ml, they were also considered as failed in weaning off IMC. If indwelling catheter was inserted for whatever reason, the patient was also deemed as failed in weaning off IMC.

The patients were monitored for signs and symptoms of UTI for at least 2 days after being weaned off IMC successfully. If the patients were discharged before that a phone call was made to enquire about symptoms of UTI.

Urine microscopy and urine cultures were collected in the patients who developed dysuria, suprapubic pain, loin pain or unexplained altered mental state or fever, or raised inflammatory markers (total white cell counts, C-reactive protein, procalcitonin).

### *Data Analysis*

For statistical calculations, t-test was used for continuous variables and Chi-square for noncontinuous variables.

## RESULTS

The comparison of patient characteristics between the two groups is shown in Table I. The success in weaning off catheter, the development of UTI and bacteremia, the day patients developed UTI, and the total number of IMC done in the first 3 days are shown in Tables II–V, respectively. The time taken for IMC to be weaned off was 3.5 days (SD 1.7) in the 200 ml group and 4.8 days (SD 2.3) in the 300 ml group,  $p$  value 0.049. The study was interrupted in both groups: 4 in 200 ml group and 7 in 300 ml group. The reasons for interruption were strict in-out fluid monitoring (IDC inserted), patients being unable to cooperate with IMC, the primary team doctors' preference (IDC inserted), discharge to another facility, and death.

Both 200 ml and 300 ml groups had equal success in weaning off IMC (56.5% vs 58.1%,  $p = 0.910$ ) and were equally likely to be associated with UTI (17.4% vs 29%,  $p = 0.322$ ). However, the 200-ml group had more IMC done in the first 3 days (3.3, SD 2.4 vs 2.4, SD 1.6,  $p = 0.030$ ), but achieved weaning off IMC earlier (3.5, SD 1.7, vs 4.8, SD 2.3 days  $p = 0.049$ ).

## DISCUSSION

From our project, we found that using PVRU of 200 ml or 300 ml did not significantly affect the likelihood of the success in weaning off IMC. More than 50% of the patients could be weaned off IMC by Day 4 in the 200-ml group and by Day 5 in the 300 ml group. These are very encouraging results, reaffirming the need for a trial to wean off catheters in all patients.

Using 300 ml as a cut-off may reduce the number of IMC required, thus saving nursing time. However, using 200 ml as a cut-off value may reduce the time taken to wean off IMC, thus potentially reducing the length of hospital stay.

Neither group was associated with a significantly higher incidence of UTI or bacteremia. The 300 ml group had a higher rate of UTI (9/31, 29.0%) compared to 200 ml group (4/23, 17.4%). However, 5 out of 9 UTI in the 300 ml group occurred at Day 1, suggesting that the UTI may be the consequence of ARU rather than the adverse effect of IMC.

Table I: Baseline characteristics of patients

Characteristics		200 ml group	300 ml group	p value
Number of patients		24	33	
Age		87 (SD 7.7)	88 (SD 7.8)	0.816*
Gender	Male	5	13	0.137**
	Female	19	20	
Living arrangement	Community	23	30	0.472**
	Institution	1	3	
Length of stay (days)		17 (SD16)	20 (SD10)	0.751*
Life expectancy < 1 year <sup>a</sup>	Yes	2	3	0.881**
	No	20 (2 missing)	26 (4 missing)	
Abbreviated Mental Test score		4.5 (SD 3.9)	3.9 (SD 3.7)	0.475*
Barthel Index score		12 (SD 6.0)	9.2 (SD 5.7)	0.768*
Faecal impaction	Yes	6	9	0.811**
	No	17 (1 missing)	22 (2 missing)	

#Some patients were given antibiotics for infections other than UTI.

\*T-test.

\*\*Chi-square.

Table II: Success in weaning off catheter

		200 ml group	300 ml group	p value
Successfully weaned off IMC	Yes	13 (56.5%)	18 (58.1%)	0.910**
	No	10 (1 missing)	13 (2 missing)	
Successfully weaned off IMC (after discounting those interrupted by IDC)	Yes	13 (68.4%)	18 (75.0%)	0.633**
	No	6	6	

#Some patients were given antibiotics for infections other than UTI.

\*T-test.

\*\*Chi-square.

Table III: Development of UTI and bacteremia

		200 ml group	300 ml group	p value
Developed UTI	Yes	4 (17.4%)	9 (29.0%)	0.322**
	No	19 (1 missing)	22 (2 missing)	
Developed bacteremia	Yes	2 (8.7%)	2 (6.4%)	0.756**
	No	21 (1 missing)	29 (2 missing)	
Antibiotic use #	Yes	13 (56.6%)	19 (61.3%)	0.724**
	No	10 (1 missing)	12 (2 missing)	

#Some patients were given antibiotics for infections other than UTI.

\*T-test.

\*\*Chi-square.

Table IV: Day patient developed UTI

Day of UTI	200ml group	300ml group
1	1	5
2	0	1
3	1	2
4	2	0
5	0	1
Total number of patients	4	9
Average day developing UTI	Day 3	Day 2

Table V: Total number of IMC done in first 3 days

Characteristics	200 ml group	300 ml group	p value
Total number of IMC done in first 3 days (not number of IMC per day)	3.3 (2.4)	2.4 (1.6)	0.030*

#Some patients were given antibiotics for infections other than UTI.

\*T-test.

\*\*Chi-square.

About half of the patients would have been weaned off IMC by Day 4. So, for better comparison, we compared the total number of IMC done in the first 3 days in both groups.

Our project was done in a real-life setting in the five geriatric medicine wards in a geriatric department. The patients were randomised at the ward level. The male and female participants were randomised separately as we thought that the success in weaning off catheter may be higher in females thus causing a bias in the results. Initially, we wanted to analyse the male and the female participants separately. However, as the numbers were fewer than expected, we combined the analysis.

The main weakness of our project is the small sample size. Also, day 1 may not be the exact day the patient first developed ARU as several days may have lapsed with IDC or IMC being started before randomisation was done. The use of two consecutive PVRU of less than 100 ml as the definition of success in weaning off catheter was arbitrary. If more stringent values were used, the success rate could have been lower. Also, we should have done randomisation at a single source rather than at the ward level. This could have avoided the chance of a marked difference in the number of men included in the study (5 men in the 200 ml group and 13 men in the 300ml group). The medications of participants were not recorded. It would be useful as medications with anticholinergic properties and alpha blockers, in males who may have prostatic hypertrophy, may affect the success in weaning off IMC.

## CONCLUSION

We conclude that PVRU of 200 ml or 300 ml are both reasonable cut-off values prior to performing IMC. However, further prospective randomised-controlled trials addressing the limitations of this project may provide a higher level of evidence to inform practice in the future.

## REFERENCES

1. Ballstaedt L, Woodbury B. Bladder post void residual volume. In: StatPearls (internet). Treasure Island (FL): StatPearls Publishing; 2022.
2. Haylen BT, de Ridder D, Freeman RM, Swift SE, Berghmans B, Lee J, Monga A, et al. An International Urogynecological Association/International Continence Society joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn.* 2010; 29(1): 4.
3. D'Ancona C, Haylen B, Oelke M, Abranches-Monteiro L, Arnold E, Goldman H, et al. The International Continence Society report on the terminology for adult male lower urinary tract and pelvic floor symptoms and dysfunction. *Neurourol Urodyn.* 2019; 38(2): 433-77.
4. Igawa Y. Catheterisation: possible complications and their prevention and treatment. *Int J Urol.* 2008;15: 481-5.
5. Evidence-based Guidelines for Best Practice in Urological Health Care Catheterisation. Indwelling catheters in adults Urethral and Suprapubic. European Association of Urology Nurses 2012.
6. Tenke P, Kovacs B, Bjerklund Johansen TE, Matsumoto T, Tambyah PA, Naber KG. European and Asian guidelines on management and prevention of catheter-associated urinary tract infections. *Int J Antimicrobial Agents.* 2008; 31 Suppl 1: S68-78.
7. Saint S. Clinical and economic consequences of nosocomial catheter-related bacteriuria. *Am J Infect Control.* 2000; 28: 68-75.
8. Downar J, Goldman R, Pinto R, Englesakis M, Adhikari NK. The "surprise question" for predicting death in seriously ill patients: a systematic review and meta-analysis. *CMAJ* 2017; 189: E484-93.