

Prevalence of incomplete bladder emptying among elderly in convalescent wards: a pilot study

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ABSTRACT

Objectives. To determine the prevalence of various degrees of incomplete bladder emptying in elderly patients admitted into a convalescent hospital and to determine the reasonable cut-off value of post-void residual (PVR) volume, to use as a trigger for further investigations and interventions, based on the relationship between PVR and the liability to urinary tract infection (UTI).

Methods. A total of 119 consecutive patients admitted into two convalescent wards in August 2004 were included. Patients without urinary catheter on admission were screened within 48 hours using an ultrasonic bladder scanner to estimate PVR immediately after micturition. Also, a urine sample was sent for routine microscopy and culture within 48 hours of admission. Medical records were reviewed for any UTI before and up to 4 weeks after admission.

Results. Approximately 22% patients were found to have an estimated PVR of more than 100 mL and in 9.2% it exceeded 400 mL (for which immediate catheterization was carried out).

Conclusions. Screening of all patients on admission for raised PVR is recommended to identify the hidden problem early and to prevent subsequent complications. There was increased risk of UTI when the PVR was more than 100 mL. This appeared to be a reasonable and practical cut-off value for elderly patients that should prompt further investigation and possible intervention.

Key words: Aged; Bladder; Urinary incontinence; Urinary retention; Urinary tract infections; Urination disorders

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This study was supported by the Tung Wah Group of Hospitals Research Fund.

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INTRODUCTION

Urinary retention and recurrent urinary tract infections (UTI) are commonly encountered problems in elderly patients admitted to hospitals for various reasons. Incomplete bladder emptying (IBE) is a closely related problem and a post-void residual (PVR) urine volume of >150 mL has been defined as chronic urinary retention in some centres.¹⁻³ Availability of non-invasive method for estimating PVR enables screening and identification of IBE.^{4,5} Published prevalence rates of IBE ranged from 11 to

56%, depending on the study design and cut-off value of abnormal PVR.^{1,6-9} There is still no consensus on the upper limit of PVR^{10,11}; the cut-off value for designating PVR as abnormal is arbitrary and usually ranges from 50 to 200 mL.

This pilot study aimed to determine (i) the prevalence of various degrees of IBE in patients admitted into elderly wards in a convalescent hospital, and (ii) a reasonable and practical cut-off value of PVR, to trigger further investigations and interventions (based on the

TABLE 1
Patient characteristics

Patient characteristics*	All patients	Male	Female	p value
No.	119	63	56	-
Median age (inter-quartile range) [years]	77 (70-84)	73 (66-79)	83 (76-89)	<0.001
Median AMT score	7	9	5	<0.001
Median MFAC score	4	5	3	0.02
On diapers on admission	61/119 (51%)	25/63 (40%)	36/56 (64%)	<0.01
On Foley on admission	15/119 (13%)	2/63 (3%)	13/56 (23%)	0.001

* AMT denotes Abbreviated Mental Test, and MFAC Modified version of Functional Ambulation Categories

relationship between PVR volume and the risk of UTI).

METHODS

All 119 consecutive patients transferred from acute hospitals to two elderly wards (one male and one female) in a convalescent hospital in August 2004 formed the population of interest. Patients without urinary catheter on admission were screened within 48 hours with a portable, non-invasive, ultrasound bladder volume estimating device (BladderScan BVI 3000; Diagnostic Ultrasound Corporation, United States) to render a supine PVR value immediately or within 15 minutes post-micturition. The voided volume was also measured whenever possible. If the patient was on diapers, an enuresis alarm was attached to the diapers to catch the exact timing of micturition. If more than one PVR were measured on the same day, the lowest value was used.

A urine sample (mid-stream urine if possible, otherwise a catheterize-once urine sample) was also sent for routine microscopy and culture within 48 hours of admission, to screen for asymptomatic bacteriuria. Medical records were reviewed for any documented UTI up to 2 weeks before and up to 4 weeks after admission into the convalescent hospital. Urinary tract infection was defined as the presence of a positive urine culture for which there was antibiotic prescribing by the doctor-in-charge. Each diagnosis of UTI was not scrutinised further based on standard definitions, as many of the patients were unable to communicate symptoms, and had fever only. Similarly, asymptomatic bacteriuria was defined as positive urine culture result, for which no antibiotic was prescribed by the doctor-in-charge.

Each patient's mental status was assessed using the Abbreviated Mental Test (Chinese version, score 0-10). Mobility status was assessed by the Modified version of Functional Ambulation Categories score with the lowest score being 1 (bed bound) and highest score being 7 (outdoor walker).¹²

Statistical analysis was performed using the Statistical Package for Social Sciences Windows version 12.0 (SPSS Inc, Chicago [IL], United States). Ordinal data and continuous data with non-normal distribution were analysed by Mann-Whitney *U* test. 2x2 Categorical data were analysed by Pearson Chi squared test or Fisher's exact test. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 119 consecutive patients (63 male and 56 female) were studied. There were significant demographic differences between genders which were therefore analysed separately and are summarised in TABLE 1.

The reasons for having a urinary catheter on admission were: already having a long-term Foley before admission (n=3); development of acute urinary retention in the acute hospital (n=9); for monitoring urine output in the acute hospital (n=3, of whom 1 failed to be weaned off). Four others had a urinary catheter whilst in the acute hospital, which were removed before transfer to our convalescent wards.

FIGURE 1 shows the prevalence of different degrees of raised PVR in the study group. Prevalence of IBE depends on the cut-off values used (TABLE 2). Using a cut-off PVR value of 50 mL yielded a prevalence of 37%. When the criterion was relaxed to 100 mL, the

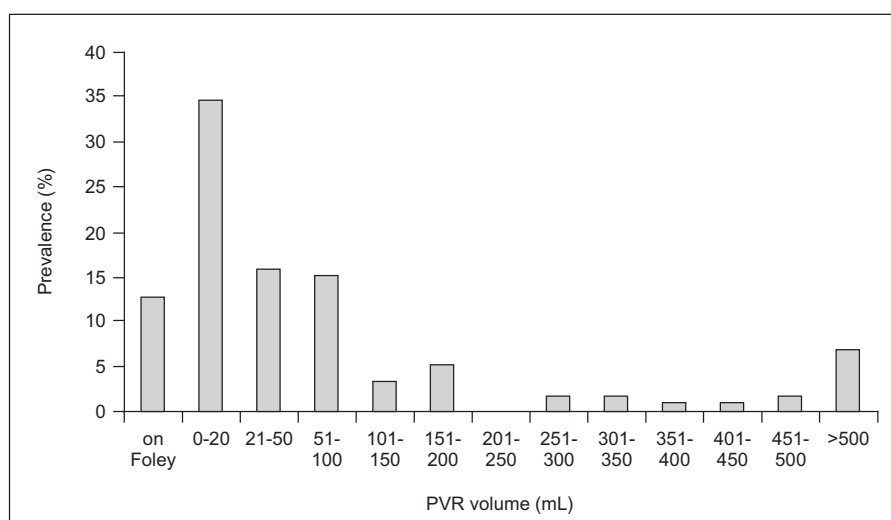


FIGURE 1. Prevalence of different degrees of raised post-void residual (PVR) volume

TABLE 2
Prevalence of incomplete bladder emptying based on different cut-off values of post-void residual (PVR) volumes

PVR volume (mL)	All patients (n=119)	Male (n=63)	Female (n=56)	p value
>50	44 (37%)	29 (46%)	15 (27%)	0.04
>100	26 (22%)	18 (29%)	8 (14%)	0.08
>150	22 (18%)	16 (25%)	6 (11%)	0.06
>200	16 (13%)	12 (19%)	4 (7%)	0.07
>400	11 (9%)	8 (13%)	3 (5%)	0.21

TABLE 3
Prevalence of urinary tract infections (UTI) and asymptomatic bacteriuria (AB) excluding those having urinary catheter before admission

	All patients (n=104)	Male (n=61)	Female (n=43)	p value
UTI	20 (19%)	8 (13%)	12 (28%)	0.06
AB	17 (16%)	6 (10%)	11 (26%)	0.02
Either UTI or AB	37 (36%)	14 (23%)	23 (53%)	0.001

prevalence was still high (22%). TABLE 2 indicates that the prevalence of IBE in males was about 2 folds that in females counterpart; though this difference usually did not show statistically significance (presumably due to the small sample size). Only 43% of the patients had the total voided volume measured, and therefore this parameter was not analysed in this study.

Patients already catheterized before admission into the convalescent hospital were excluded in the subsequent analysis of the prevalence of UTI and asymptomatic bacteriuria, since catheter-associated UTI was a different issue, and for the same reason UTI developing post-catheterization was not

counted. There were very high rates of UTI (19%) and asymptomatic bacteriuria (16%) among our patients, all of whom had no urinary catheter on admission (TABLE 3). Higher PVR values were associated with higher UTI rates (FIG 2 and TABLE 4).

DISCUSSION

Incomplete bladder emptying is not an uncommon problem in elderly patients but has not been the subject of many studies. Its prevalence in geriatric ward patients has been reported to be 34% (based on PVR volumes of >50 mL),⁶ 11% among patients admitted into a geriatric rehabilitation ward¹ and 56% in stroke rehabilitation ward patients⁷ (based on PVR

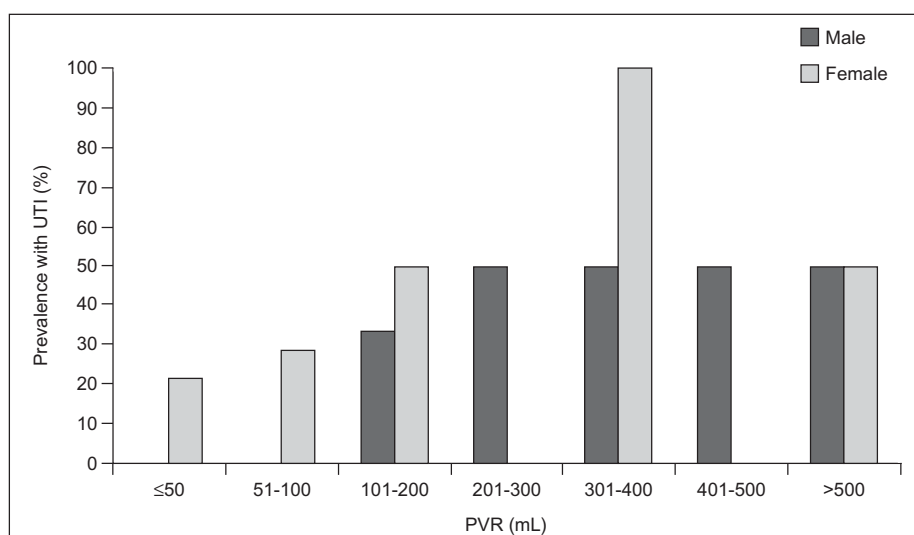


FIGURE 2. Prevalence of urinary tract infections (UTI) at different post-void residual (PVR) values (excluding those having urinary catheter before admission)

TABLE 4
Prevalence of urinary tract infections (UTI) at different post-void residual (PVR) values (excluding those having urinary catheter before admission)

PVR (mL)	All patients	Male	Female	p value
≤50	6/60 (10%)	0/32 (0%)	6/28 (21%)	0.01
51-100	2/18 (11%)	0/11 (0%)	2/7 (29%)	0.14
101-200	4/10 (40%)	2/6 (33%)	2/4 (50%)	1.00
201-300	1/2 (50%)	1/2 (50%)	0/0	
301-400	2/3 (67%)	1/2 (50%)	1/1 (100%)	1.00
401-500	1/3 (33%)	1/2 (50%)	0/1 (0%)	1.00
>500	4/8 (50%)	3/6 (50%)	1/2 (50%)	1.00
≤100	8/78 (10%)	0/43 (0%)	8/35 (23%)	0.001
>100	12/26 (46%)	8/18 (44%)	4/8 (50%)	1.00
	p<0.001	p<0.001	p=0.19	

volumes >150 mL × 2). The prevalence rates varied with the cut-off values for abnormal PVR volume and have ranged from 50 to 300 mL in different studies with diverse objectives. There is still no consensus on what value should be used and the quoted value in publications.^{10,11} In general, a PVR volume of ≤20 to 25 mL was considered normal, whilst a volume of 50 to 100 mL was considered as adequate bladder emptying and a value >100 mL warranting further investigation. A volume of 200 mL was regarded as the upper limit tolerable for not inserting a catheter, but according to some experts it would be termed chronic urinary retention.^{1,2}

In our study, we have assessed the prevalence of IBE using different PVR cut-off values. When the most commonly used cut-off (100 mL) was chosen, the IBE prevalence rate was 22%. After adding the

number of patients already having a urinary catheter before admission, the total prevalence rate for voiding dysfunction in patients admitted into elderly convalescent wards amounted to 34%, which is very high. Unexpectedly, 11 (9%) of our patients had PVR volumes >400 mL, for which immediate urinary catheterization was carried out. The latter patients were all on diapers and their enlarged bladders were overlooked, probably because they were experiencing overflow incontinence. There is therefore a need to screen PVR volumes in all elderly patients on admission to hospitals, so as to identify the hidden problem early and prevent complications.

In deciding the appropriate PVR cut-off value, we have to know the purpose of the test (e.g. to define normal or abnormal values, to define safe or unsafe values, to guide initiation of an intervention, or as a

guide to a treatment target [notably a PVR of 70 mL can be abnormal but safe]). The later three are more relevant determining factors in day-to-day clinical practice. Thus, the clinical consequences of excessive PVR volumes include increased risk of: UTI, obstructive uropathy, progression to frank acute retention, urinary stone formation, and disturbing symptoms which can even mimic an overactive bladder. An increased risk of UTI in patients with high PVR volumes has been reported in several studies^{3,13} though one paper did not find such an association.¹⁴

Our attempt to determine an appropriate cut-off value of PVR volume based on the risk of developing a UTI found that 100 mL seems to be the most reasonable and practical value (10% patients developed UTI if the PVR volume was ≤ 100 mL vs 46% if it exceeded 100 mL; $p < 0.001$). This phenomenon was even more marked in males (FIG 2 and TABLE 4). No male patients with PVR volumes ≤ 100 mL developed UTI while 44% with larger volumes did so ($p < 0.001$). The corresponding difference in female patients was not significant. Possible reasons include: small sample size (only eight had PVR volumes > 100 mL), the anatomically short female urethra and a urethral opening in close proximity to the anus (facilitating ascending infection by bowel flora, even in the absence of retention). This factor may have been especially important, as 64% of female patients were wearing diapers and it was not uncommon to find faeces adhering around the urethral opening. Stern et al¹³ reported that the mean PVR values for female patients without and with UTI were 33 and 70 mL respectively ($p < 0.0001$). Thus, a lower PVR cut-off value might be more appropriate for female patients.

Based on the mathematical model of bacterial growth inside the bladder,¹⁵ the risk of developing UTI depends on: the bacterial doubling time, the dilution ratio (total bladder volume before voiding divided by PVR volume), and the daily urine output rate. The total bladder volume before voiding can be calculated by summing the PVR volume and the voided urine volume. In the mathematical model, it is the dilution ratio rather than the absolute value of PVR that is important in determining the risk of UTI. However, there are difficulties in determining the voided volume in elderly patients, many of whom are in diapers and cognitively impaired. Weighting the diapers before and after urination (pad test) may

be used if there is no bowel contamination. However, adopting such practices will add considerably to the work of overstretched nursing staff.

The causes of IBE have not been extensively studied as very few patients have undergone urodynamic study in the first week of admission. In our experience, many patients have impaired detrusor contractility, acontractile bladders, or outflow obstruction (males with benign prostate hypertrophy). Whether the aetiology of the underactive detrusor muscle is central or peripheral is still a mystery. Constipation is frequently an accompaniment, suggesting a common pathophysiology for both. In some patients excessive PVR volumes may also be due to poor urination posture (e.g. supine position of patients wearing diapers), or poor effort voiding and even ceasing to void after hearing the sound of an enuresis alarm.

Variation of PVR values in an individual may also affect the results. Repeated measurements are advisable before considering interventions.^{10,11} Studies have shown a diurnal change in PVR volume; higher values usually occur in the morning.¹⁶⁻¹⁸ It is not known whether we should use the highest value or lowest value or mean value of PVR. We used the lowest PVR value when repeated measurements were available, as this was considered the best performance by the patient, but there is no consensus on this practice.

There is no published standard protocol or guideline for managing patients screened to have high PVR values. Follow-up interventions include: drug review to avoid medications which may impair detrusor function; treatment of constipation and faecal impaction; empirical treatment with cholinergic agents or α -blockers; Valsalva's and Crede's manoeuvres; double voiding manoeuvre; bladder stimulation exercises; intermittent and indwelling catheterization; urodynamic study. Further study is required to evaluate the effectiveness of these various choices. Multiple interventions may become necessary in elderly patients. The findings of this pilot study have many limitations, such as no standardised posture for voiding prior to determining PVR volumes. The findings also need to be confirmed in larger, more definitive studies, with improved methodology with a standardised definition of UTI.

CONCLUSION

One third of patients admitted into elderly convalescent wards were found to have some voiding dysfunctions. There is a need to screen all elderly patients for raised PVR volumes on admission to avoid missing urinary retention and IBE and prevent complications such as UTI and deteriorating renal function. A PVR volume of 100 mL appeared to be a reasonable and practical cut-off value for our elderly patients, above which further investigations and interventions should be considered and could also become the minimum goal to achieve with such interventions. Further studies with improved methodology and larger sample sizes are required to expand and confirm our findings.

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