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RESEARCH ARTICLE (ORIGINAL)

Catheter-Associated Urinary Tract Infections and Urinary Retention in Acute Stroke Patients

Infeção Associada ao Cateter Vesical e Retenção Urinária na Pessoa com AVC Agudo

Infección Asociada al Catéter Urinario y Retención Urinaria en el Paciente con ACV Agudo

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Abstract
Background: In people with acute stroke on bed rest, urinary retention (UR) and bladder emptying disturbances occur.
Objectives: To determine the prevalence of UR and the incidence of catheter-associated urinary tract infections (CAUTI) in patients with stroke on bed rest.
Methodology: A quantitative, exploratory-descriptive, and cross-sectional study conducted in a Stroke Unit of a Portuguese hospital. UR was defined as a residual bladder volume ≥ 400 mL. The diagnosis of CAUTI was based on the criteria set by Clinical Guideline No. 019/2015 of the Directorate-General of Health (*Direção-Geral da Saúde*).
Results: A sample of 54 participants, of whom 22.2% presented at least one episode of UR. The incidence of CAUTI was 25.9%. Among patients with CAUTI, 35.7% presented UR. An odds ratio of 2.62 was observed (95% CI: 0.67–10.24; $p = 0.261$).
Conclusion: The 25.9% incidence of CAUTI is concerning. Although a higher occurrence of UR was observed among patients with CAUTI, no statistically significant association was demonstrated. Bed rest may influence the decision regarding early urinary catheter removal.

Keywords: urinary catheterization; catheter-associated urinary tract infections; urinary retention; stroke

Resumo
Enquadramento: Em pessoas com acidente vascular cerebral (AVC) agudo em repouso no leito, verifica-se a ocorrência de retenções urinárias e esvaziamentos vesicais.
Objetivos: Determinar a prevalência de retenção urinária (RU) e a incidência de infeções associadas a cateter vesical (IACV) em pessoas com AVC em repouso no leito.
Metodologia: Estudo quantitativo, exploratório-descritivo e transversal, realizado numa Unidade de AVC de um hospital português. A RU foi definida como volume vesical residual ≥ 400 mL. O diagnóstico de IACV baseou-se nos critérios da Norma Clínica n.º 019/2015 da Direção-Geral da Saúde.
Resultados: Amostra de 54 participantes, dos quais 22,2% apresentaram pelo menos um episódio de RU. A incidência de IACV foi de 25,9%. Dos doentes com IACV, 35,7% apresentaram RU. Observou-se um *odds ratio* de 2,62 (IC95%: 0,67–10,24; $p = 0,261$).
Conclusão: A incidência de 25,9% de IACV é preocupante. Embora se observe maior ocorrência de RU entre doentes com IACV, nenhuma associação estatisticamente significativa foi demonstrada. O fator repouso no leito pode influenciar a decisão de desalgaliação precoce.

Palavras-chave: cateterismo urinário; infeções urinárias associadas a cateter; retenção urinária; acidente vascular cerebral

Resumen
Marco contextual: En personas con accidente cerebrovascular (ACV) agudo en reposo en cama, se producen retenciones urinarias y trastornos del vaciado vesical.
Objetivos: Determinar la prevalencia de la retención urinaria (RU) y la incidencia de infecciones asociadas al catéter vesical (IACV) en personas con ACV en reposo en cama.
Metodología: Estudio cuantitativo, exploratorio-descriptivo y transversal, realizado en una Unidad de ACV de un hospital del norte de Portugal. La RU se definió como un volumen vesical residual ≥ 400 mL. El diagnóstico de IACV se basó en los criterios de la Norma Clínica n.º 019/2015 de la Dirección General de Salud (*Direção-Geral da Saúde*).
Resultados: Muestra de 54 participantes, de los cuales el 22,2 % presentó al menos un episodio de RU. La incidencia de IACV fue del 25,9 %. De los pacientes con IACV, el 35,7 % presentó RU. Se observó una *odds ratio* de 2,62 (IC 95 %: 0,67–10,24; $p = 0,261$).
Conclusión: La incidencia del 25,9 % de IACV resulta preocupante. Aunque se observa una mayor ocurrencia de RU entre los pacientes con IACV, no se demostró ninguna asociación estadísticamente significativa. El factor reposo en cama puede influir en la decisión sobre la retirada precoz de la sonda vesical.

Palabras clave: cateterismo urinario; infecciones urinarias asociadas a catéter; retención urinaria; accidente cerebrovascular

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Introduction

Healthcare-associated infections (HAIs) are a major concern across clinical practice settings. They are particularly relevant to the care of critically ill patients, who undergo multiple invasive clinical procedures throughout the management of their complex disease processes (Regulamento n.º 124/2011 da Ordem dos Enfermeiros, 2011).

Catheter-associated urinary tract infections (CAUTI) are among the most prevalent HAIs in healthcare organizations (Direção-Geral da Saúde, 2022). Several cases have been identified in a Stroke Unit, which reported a CAUTI rate (CAUTI rate = Number of CAUTI/ Total number of urinary catheter-days × 1,000) of 15.9 per 1,000 catheter-days in 2024 (Grupo de Coordenação Local do Programa de Prevenção e Controlo de Infeção e Resistência a Antimicrobianos, 2025).

Clinical Guideline no. 019/2015, dated December 15, 2015, and updated on August 29, 2022, entitled *"Feixe de Intervenções" para a prevenção da infeção urinária associada a cateter vesical* (Bundle of interventions for the prevention of catheter-associated urinary tract infection; Direção-Geral da Saúde, 2022), establishes that the possibility of urinary catheter removal should be assessed daily and that the catheter should be removed as soon as possible. It also defines the indications recognized by the Portuguese Directorate-General of Health (DGS) for urinary catheter insertion and continued use.

This guideline has already been implemented in the Stroke Unit, where the need for continued urinary catheterization is assessed daily, and catheters are removed as soon as possible. This practice has shown that the nursing diagnosis of urinary retention (UR) is frequently identified in patients with acute stroke who are on bed rest after catheter removal. When UR occurs, common interventions include bladder emptying and insertion of a new urinary catheter. These interventions are directly associated with CAUTI.

The reflection on clinical practice has raised several questions, particularly whether removing urinary catheters as soon as possible is associated with UR in patients with acute stroke on bed rest, and whether the incidence of CAUTI is higher among patients with acute stroke who develop UR. Given the clinical problem identified and the evidence gap described, it is necessary to determine the extent to which UR and CAUTI coexist among patients with acute stroke on bed rest to inform appropriate nursing interventions.

Accordingly, this study aims to determine the prevalence of UR among patients with stroke on bed rest and the incidence of CAUTI among those with UR who are on bed rest. It also aims to reflect on the nursing care provided in this context.

Background

In patients with acute stroke, the systematic review by Westendorp et al. (2011), as cited by Westendorp et al. (2022), concluded that up to 30% of patients with stroke develop an infection, with urinary tract infections (UTI) being among the most common, occurring in up to 10% of hospitalized patients.

More recently, Jitpratoom and Boonyasiri (2023) reported that 3% to 40% of patients with acute stroke develop a UTI, while Li et al. (2025) found an incidence of UR of 10.98%. Zhang et al. (2024) identified stroke as a major risk factor for UR.

Alongside these findings, bed rest is part of standard care for patients in the acute phase of stroke and may generally range from 0 to 36 hours (Silver et al., 2023), as it may promote improved intracerebral blood perfusion and prevent inadequate cerebral blood flow when the carotid and/or vertebral arteries are compromised.

Rubi et al. (2022) reported that CAUTI are highly prevalent among hospitalized patients with impaired mobility and functional dependence. In the upright position, gravity moves urine from the renal pelvis to the bladder and from the bladder to the urethra. In patients on bed rest, incomplete bladder emptying may occur, resulting in residual urinary stasis and, consequently, an increased risk of bacteriuria; this is even more common among individuals older than 65 years (Givler & Givler, 2023). Indeed, according to Zhang et al. (2025), prolonged bed rest is the strongest predictor of UTI because it is associated with immobility-related urinary stasis, UR, and urinary catheter use.

CAUTI are defined as UTI that occur in patients with an indwelling urinary catheter, based on standardized clinical and microbiological criteria (European Centre for Disease Prevention and Control, 2023; Direção-Geral da Saúde, 2022). UR is the inability to spontaneously empty the bladder, with an accumulation of residual urine typically exceeding 400 ml (Manaila et al., 2024).

Healthcare-related factors, such as failure to use aseptic techniques during both urinary catheter insertion and maintenance, as well as the material from which the device is made, may be associated with an increased risk of CAUTI (Direção-Geral da Saúde, 2022). Therefore, aseptic techniques are essential for reducing the risk of CAUTI. Other relevant factors include poor perineal hygiene, fecal incontinence, and incomplete bladder emptying (Rubi et al., 2022).

Li and Yan (2025) found that patients with ischemic stroke are at higher risk of CAUTI if they undergo more than two catheterizations or have an indwelling catheter for more than six days. After 30 days of catheter use, CAUTI prevalence is extremely high (Association for Professionals in Infection Control and Epidemiology, 2025).

This topic has not been systematically investigated at the national level in Portugal, and evidence on the association among early catheter removal, UR, and CAUTI incidence specifically among patients with acute stroke on bed rest remains scarce. This evidence gap underscores the need for further research to inform clinical decision-making in nursing in this context.

Research question

What is the prevalence of UR and the incidence of CAUTI associated with early catheter removal in patients with acute stroke who are on bed rest?

Methodology

A quantitative, observational, exploratory-descriptive, cross-sectional study was conducted in a Stroke Unit of a Local Health Unit in northern Portugal.

The study population comprised hospitalized patients diagnosed with acute stroke at the healthcare institution. A nonprobability convenience sampling method was used. The sample included all patients who met the inclusion criteria and consented to participate in the study.

The inclusion criteria were a clinical diagnosis of stroke and admission to the Stroke Unit, the presence of an indwelling urinary catheter at admission or its insertion within the first 48 hours of hospitalization, and prescribed bed rest. The exclusion criteria were a medical diagnosis of UTI at admission and death during hospitalization.

A data collection form was developed by the research team to standardize data collection. The form included age, sex, hospitalization-related data, stroke characteristics, urological history, presence of an indwelling urinary catheter, UR, bed rest, signs and symptoms of UTI, UTI diagnosis, and antibiotic therapy prescription. Before data collection began, the form was pretested with 10 patients whose characteristics were consistent with those of the study sample. The researchers reported no difficulties completing the form, and no modifications were deemed necessary.

Data were collected over an eight-month period, from November 2023 to June 2024.

For this study, UR was defined as the inability to spontaneously empty the bladder, with a residual urine volume ≥400 ml, assessed by intermittent catheterization. CAUTI was diagnosed according to the criteria established in DGS Clinical Guideline no. 019/2015, updated on August 29, 2022, which adopts the North American Centers for Disease Control and Prevention/National Healthcare Safety Network (CDC/NHSN) criteria revised in 2019 (Gould et al., 2019). The lack of a portable bladder ultrasound device in the unit was a methodological limitation for the objective assessment of postvoid residual urine volume. Accordingly, after removal of an indwelling urinary catheter and in the absence of signs and symptoms of UR, a maximum period of 12 hours was established before nursing intervention when UR was suspected. An empirical protocol was adopted, under which intermittent urinary catheterization was performed for the first three episodes of UR, with the reinsertion of an indwelling urinary catheter considered at the third episode.

The fundamental rights of human participants, as established in applicable codes of ethics, were respected. The study was approved by the Ethics Committee and the Board of Directors of the healthcare institution where it was conducted (Protocol No. 54/2023). Written informed consent was obtained from all participants or their designated family representatives.

Data were analyzed using IBM® SPSS Statistics, version 26.0. Descriptive analyses were conducted for continuous variables, including absolute and relative frequency distributions, measures of central tendency and dispersion, and the corresponding minimum and maximum values. The cross-sectional design of the study precludes establishing causal relationships or confirming the temporal sequence of the variables analyzed. The sample size limits the feasibility of multivariable analyses with sufficient statistical power. Therefore, the findings should be interpreted cautiously.

Results

During the data collection period, 57 patients diagnosed with stroke were admitted to the study healthcare unit, underwent urinary catheterization either at admission or within the first 48 hours, and were prescribed bed rest. Of these, three patients declined participation, leaving a final sample of 54 patients, of whom 30 were male (55.56%). Most participants were over 65 years old (72.22%) and had no prior urological conditions (n = 46; 85.19%; Table 1).

Table 1

Sample characteristics (N = 54)

Variable	*n*	%	*M*	*SD*
Age (years)				
45-65	15	27.78		
66-85	33	61.11	72.78	10.83
> 86	6	11.11		
Gender				
Female	24	44.44		
Male	30	55.56		
Prior urological conditions				
No	46	85.19		
Yes	8	14.81		
Benign prostatic hyperplasia	6	11.11		
Prostate adenocarcinoma	1	1.85		
Malignant neoplasm of the bladder	1	1.85		

Note. *N* = Total sample size; *n* = Subsample size; *%*= Percentage; *M* = Mean; *SD* = Standard deviation.

Among stroke types, ischemic stroke was the most common (*n* = 39; 72.22%), with the most events involving the left middle cerebral artery (*n* = 17; 31.48%) and the right middle cerebral artery (*n* = 11; 20.37%).

Regarding urinary catheterization, the procedure was performed within the first hours after stroke in most patients (*n* = 49; 90.74%), with most catheter insertions occurring in the Emergency Department (*n* = 46; 85.19%). The mean duration of catheterization was 3.67 days (*SD* = 2.52; Table 2).

Table 2

Urinary catheterization

Variable	*n*	%	*M*	*SD*
Day (after admission to the Healthcare Unit)				
D0	49	90.74		
D1	3	5.56	0.15	0.53
D2	2	3.70		
Location				
Emergency Department	46	85.19		
Stroke Unit	9	14.81		
Duration of catheterization (in days)				
D0-D3	33	61.11		
D4-D6	15	27.78		
D7-D9	3	5.56	3.67	2.52
D10-D12	3	5.56		

Note. *n* = Subsample size; % = Percentage; *M* = Mean; *SD* = Standard deviation; *D* = Day.

After urinary catheter removal, 22.22% (*n* = 12) of participants experienced at least one episode of UR. Two patients (3.70%) had two episodes of UR, while seven patients (12.96%) had three episodes and subsequently underwent reinsertion of an indwelling urinary catheter.

Regarding the urine volume obtained during intermittent catheterization, 14 procedures (50.00%) yielded volumes between 500 and 1,000 ml, while eight procedures (14.81%) yielded volumes greater than 1,000 ml (Table 3).

Table 3

Urinary retention

Variable	*n*	%		*n*	%
Urinary retention			**Urinary recatheterization**		
No	4212	77.78	No	3	5.56
Yes		22.22	Yes	7	16.67

Volume 1st UR (ml)			**Volume 2ª RU (mL)**			**Volume 3ª RU (mL)**		
400-499	3	5.56	400-499	1	1.85	400-499	2	3.70
500-999	4	7.41	500-999	6	11.11	500-999	4	7.41
>1000	5	9.26	>1000	2	3.70	>1000	1	1.85

Note. n = Subsample size; % = Percentage; *UR* = Urinary retention.

On average, participants remained on bed rest for about 6 days (*M* = 6.24). Of the 12 patients (22.22%) who experienced at least one episode of UR, eight were on bed rest when the retention occurred.

Signs and symptoms consistent with CAUTI were observed in 17 participants (31.48%), with most cases occurring within the first 6 days (*n* = 13; 76.47%) after urinary catheterization at the start of hospitalization. CAUTI was diagnosed in 14 patients (25.93%), all of whom received antibiotic therapy (Table 4).

Table 4

Catheter-associated urinary tract infections (CAUTI)

Variable	*n*	%	*M*	*SD*
Presence of signs and symptoms				
No	37	68.52		
Yes	17	31.48		
Start of signs and symptoms (days following catheterization)				
D0-3	4	7.41		
D4-6	9	16.67	5.29	2,62
D7-9	4	7.41		
Diagnosis of CAUTI				
No	40	74.07		
Yes	14	25.93		
Antibiotic therapy prescription				
No	40	74.07		
Yes	14	25.93		
Intravenous route	13	24.07		
Oral route	1	1.85		

Note. n = Subsample size; % = Percentage; *M* = Mean; *SD* = Standard deviation; *D* = Day; CAUTI = Catheter-associated urinary tract infections.

Among the 14 patients diagnosed with CAUTI, five (35.7%) had previously experienced at least one episode of UR, compared with seven of the 40 patients without CAUTI (17.5%) who experienced UR. The odds ratio (OR) was 2.62 (95% CI: 0.67–10.24), with no statistically significant association (Fisher's exact test, $p = 0.261$; Table 5).

Table 5

Catheter-associated urinary tract infections x Urinary retention

		CAUTI [n (%)]		
		No	Yes	Total
Urinary Retention [*n* (%)]	No	33 (61.11%)	9 (16.67%)	42 (77.78%)
	Yes	7 (12.96%)	5 (9.26%)	12 (22.22%)
	Total	40 (74.07%)	14 (25.93%)	54 (100%)

Note. CAUTI = Catheter-associated urinary tract infections; *n* = Subsample size; % = Percentage.

Discussion

Among the participants in this study, 14.81% had a history of urological conditions, namely benign prostatic hyperplasia and malignant neoplasm of the bladder. This represents a potential confounding factor for findings related to UR and CAUTI and should therefore be considered when interpreting the results.

UR is a common complication after acute stroke, with reported prevalence ranging from 29% to 56% (Chiu et al., 2024). In the present study, the prevalence of UR was 22.22% (*n* = 12). Most episodes occurred within the first 72 hours after catheter removal (*M* = 2.42), highlighting a critical period for monitoring this nursing phenomenon. In this study, an empirical 12-hour waiting period was established before bladder emptying in the absence of signs or symptoms of UR. After intermittent catheterization, urine volumes greater than 500 ml were observed in 50.00% (*n* = 14) and greater than 1,000 ml in 28.57% (*n* = 8) of the sample. These findings indicate markedly elevated bladder volumes. Ideally, bladder urine volume should remain below 400–500 ml to reduce the risk of vesicoureteral reflux and substantial detrusor muscle distension, both of which may hinder patient recovery (Manaila et al., 2024).

Notably, bladder volume monitoring ultrasound devices were unavailable at the study healthcare unit. Portable bladder ultrasonography has been identified in the literature as an important tool for preventing UR and reducing unnecessary catheterizations (Manaila et al., 2024). Therefore, its absence represents a clinically relevant limitation of this study.

Bed rest may also play an important role, as eight of the 12 patients (66.67%) who experienced UR were confined to bed at the time of the event. The mean duration of strict bed rest in this study was 6.24 days, further supporting the role of bed rest as a potentially associated factor.

The *Guideline for prevention of catheter-associated urinary tract infections* (2019) from the North American CDC/NHSN, updated in 2019 and still in use, reports that among catheterized patients, bacteriuria occurs at a rate of 3% to 10% per day of catheterization and may occur in approximately 11% of patients within 24 hours after urinary catheter removal (Gould et al., 2019). In the present study, patients remained catheterized for a mean of 3.67 days (*SD* = 2.52), corresponding to a potential bacteriuria rate ranging from 11.01% to 36.7%.

In the present study, CAUTI was identified in 14 patients (25.93%), a higher proportion than reported in the literature. For example, Chiu et al. (2024) reported UTI rates of 10% to 19% among patients with stroke, while Jankovic et al. (2025) more recently reported a mean UTI prevalence of 19% in the same population.

It is important to acknowledge that bladder emptying procedures and reinsertion of an indwelling urinary catheter might have influenced the CAUTI rate observed in this study.

The findings showed a higher frequency of UR among patients diagnosed with CAUTI (35.7%) than among those without CAUTI (17.5%), corresponding to an OR of 2.62. These findings suggest a possible association between CAUTI and UR. However, the association did not reach statistical significance (p = 0.261), which may be attributable to the small sample size, particularly the CAUTI subgroup (*n* = 14), resulting in wide confidence intervals and limited statistical power. Thus, although the findings indicate a possible trend, studies with larger samples are needed to confirm this relationship and better establish its clinical relevance.

Intravenous antibacterial therapy was prescribed for 13 patients (92.86%) with CAUTI, with treatment lasting 7 to 14 days. This approach may prolong hospital stays and increase healthcare-related costs, and it carries risks of adverse effects, drug interactions, and antimicrobial resistance.

Conclusion

The findings of this study showed a prevalence of UR of 22.22% and an incidence of CAUTI of 25.93% among patients with acute stroke on bed rest, both of which are clinically relevant in this context.

A higher frequency of UR was observed among patients with CAUTI, with an OR of 2.62. However, this association was not statistically significant (95% CI: 0.67–10.24; p = 0.261), so the findings should be interpreted with caution.

The lack of additional resources, such as ultrasonography for bladder volume monitoring, may have limited early detection of UR.

Although Clinical Guideline no. 019/2015 recommends removing the urinary catheter "as soon as possible," patients with acute stroke on bed rest are at increased risk of

UR due to both stroke-related neurological impairment and functional factors associated with bed rest. In this population, maintaining the catheter until mobilization begins may therefore warrant consideration, provided that each case is assessed individually.

These factors may partly explain the relatively high CAUTI incidence (25.93%) observed in this study compared with rates reported in the literature, with potential consequences including antibacterial therapy, prolonged hospitalization, and increased healthcare costs.

The clinical issue examined in this study poses a dilemma for nurses. On the one hand, UR is an adverse event because urinary stasis increases the risk of bacteriuria, and excessive bladder volumes may cause harm. On the other hand, bladder emptying procedures and reinsertion of an indwelling urinary catheter may increase the risk of CAUTI. Therefore, individualized assessment is required to support clinical decision-making that best addresses each patient's needs.

As a result of this study, a continuous quality improvement project in nursing care will be developed to address the identified clinical problems.

Future studies with larger samples, prospective designs, and access to portable bladder ultrasonography are needed to confirm the observed associations and to establish evidence-based protocols for managing UR and preventing CAUTI in patients with acute stroke.

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