

Urinary tract infection in hospitalized patients in internal medicine of a university hospital

Infecção do trato urinário em pacientes internados em clínica médica de um hospital universitário

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ABSTRACT

Objective: The aim of this study was to evaluate the incidence and the factors related to catheter-associated urinary tract infection in adults who were hospitalized in the internal medicine service, and to identify catheter utilization rates, frequency of the register of order of insertion and removal, adequacy of use in terms of indication, and catheter vesical length of permanence. **Method:** This is a prospective cohort study conducted at a university hospital in Minas Gerais. Univariate analyses were performed using the chi-squared test or Fisher's exact test for categorical variables, and the non-parametric Mann-Whitney test for numerical variables. **Results:** In ten months, 1121 patients were admitted, 63 (5.6%) of these used the vesical catheter, being 880 urinary catheters/day. The incidence of catheter-associated urinary tract infection was 31.7%. The results showed positive associations between the occurrence of urinary tract infection with the length of permanence and time of use of the vesical catheter. **Conclusion:** The use of urinary catheters should be limited to carefully selected patients, followed by a safe insertion and maintenance, and removed promptly, when no longer required, in order to ensure patients' safety.

KEYWORDS: Healthcare-associated Infection; Urinary Infections; Urinary Catheterization

RESUMO

Objetivo: Avaliar a incidência e os fatores associados à infecção do trato urinário associados ao Cateter Vesical em adultos internados em clínica médica, bem como identificar a taxa de utilização, frequência do registro do pedido de inserção e retirada, adequação do uso em termos da indicação e do tempo de permanência do Cateter Vesical. **Método:** Trata-se de uma coorte prospectiva desenvolvida em um hospital universitário de Minas Gerais. Análises univariadas foram realizadas através do teste Qui-quadrado ou teste exato de Fisher para variáveis categóricas e teste não paramétrico de Mann-Whitney para variáveis numéricas. **Resultados:** Durante dez meses foram internados um total de 1.121 pacientes, desses, 63 (5,6%) fizeram o uso do Cateter Vesical, correspondendo a 880 Cateter Vesical/dia. A incidência de Infecção do Trato Urinário associada ao Cateter Vesical foi de 31,7%. Os resultados identificaram associações positivas entre ocorrência de infecção do trato urinário com o tempo de permanência hospitalar e tempo de uso do Cateter Vesical. **Conclusão:** A conduta frente à indicação de uso do Cateter Vesical deve ser criteriosa, desde a avaliação da recomendação, inserção, manutenção e a sua retirada o mais brevemente possível, garantindo a segurança do paciente.

PALAVRAS-CHAVE: Infecção Hospitalar; Infecções Urinárias; Cateterismo Urinário

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INTRODUCTION

The urinary tract is the most common area of infection in health care. Most of the urinary tract infections (UTI[s]) acquired in a hospital come from urinary tract instrumentation or catheterization, which is the precipitating cause¹.

Among patients with bacteriuria, 10% to 25% develop UTI symptoms and 1% to 4% develop sepsis secondary to a UTI².

Catheter-associated urinary tract infections (CA-UTI[s]) are responsible for a large reservoir of nosocomial pathogens, often with multidrug-resistant microorganism profiles. Therefore, finding effective measures to prevent these infections through new technologies is important³.

A vesical catheter (VC) is an important resource in health care; however, its use is frequently excessive and, once inserted, it often remains in place for much longer than necessary⁴.

A single catheterization is associated with a risk of 1% to 2% of developing a UTI and the cumulative risk rises to 5% for each day of use⁵.

With this in mind, indications for vesical catheterization are limited to cases of acute urinary retention or vesical obstruction, diuresis control in critically ill patients, postoperative urological surgeries or involving structures adjacent to the genitourinary tract, long-term surgeries, surgeries in which diuresis control is necessary in incontinent patients with sacral or perineal ulcers, terminal patients or patients with a long period of bed immobilization due to trauma to the spine or pelvic girdle⁶.

There is evidence that the catheter is more appropriately indicated when the physician registers the insertion request in the medical record⁷.

Considering vesical catheterization as the main UTI-triggering factor¹, this study proposed to investigate the following research question: What is the CA-UTI incidence in adult patients hospitalized on internal medicine wards?

The aim of this study was to evaluate the incidence and the factors related to CA-UTIs in adults hospitalized on an internal medicine ward, and to identify the catheter utilization rate, frequency of the physician registering the order of insertion and removal, adequacy of use in terms of indication, and VC permanence.

METHOD

This was a prospective, cohort study developed at a general university hospital in north Minas Gerais. This hospital treats high complexity patients; it has two intensive care units (ICU) - one neonatal/pediatric and one adult, and an emergency and urgency sector. It contains 186 beds exclusively for Unified Health System patients, of which 64 are internal medicine, including care of patients with acquired immunodeficiency syndrome, tuberculosis and mental disorders, for the entire region north of Minas Gerais and south of Bahia.

Data were collected with a semi-structured tool in a prospective follow-up of eligible patients. The study included 63 adult patients hospitalized on the internal medicine wards who underwent vesical catheterization for more than 24 hours during 10 months, from September 2012 to July 2013. Patients on the internal medicine wards, who were using a VC where the insertion had occurred in another sector of the hospital, were excluded from the study.

All patients were treated daily until discharge. The dependent variable was the occurrence of a CA-UTI, the independent variables were data on sex, age, use of a VC, permanence of the catheter and hospitalization, catheter change, insertion prescription, removal and indication of vesical catheterization, intercurrents during the procedure, uroculture results after VC insertion, antibiotic therapy pre- and post-insertion of the VC, diagnoses of other infections related to health care and the patient's evolution. Patients who underwent a new vesical catheterization after an interval of more than seven days were considered new cases, based on the national criteria of infections related to health care².

During the research, we evaluated the adequacy of VC utilization in relation to the indication and length of permanence, using the criteria defined by the *Guideline for prevention of catheter-associated urinary tract infections 2009*⁶.

Patients using a VC were evaluated for the actual need for the catheter, based on the recommendations for use described by the Centers for Disease Control and Prevention guideline⁶, and permanence according to the following criteria: patients with acute urinary retention or vesical obstruction; critically ill patients with a need for rigorous diuresis control; patients submitted to urological surgeries or involving structures contiguous to the genitourinary tract, long-term surgeries, surgeries in which diuresis control is necessary and postoperative patients of urological surgeries up to 24-48 hours; incontinent patients with sacral or perineal ulcers; patients with a long period of immobilization in a bed due to trauma of the pelvic girdle or spinal column; terminal patients, in order to provide comfort.

We considered inappropriate use of a VC to be: vesical catheterization as a substitute for nursing care; use in incontinent patients; use to obtain urine for examinations in patients with spontaneous diuresis; when a condom was not used as an alternative in men without urinary retention; prolonged postoperative period > 48 hours⁶.

The Medical and Statistical Archive Service of the hospital provided the data referring to the total number of patients hospitalized on the internal medicine wards during data collection.

Initially, we performed a descriptive analysis of all variables, investigated through frequency distribution tables and measures of central tendency and variability.

In the univariate analysis, Pearson's Chi-square test or Fisher's exact test was performed for the comparison of categorical variables. For



the numerical variables, the non-parametric Mann-Whitney test was chosen due to the asymmetric character of the studied variables. The strength of association between independent and dependent variables was expressed in relative risk estimates. In all analyses, a 5% level of significance was considered and the Statistical Package for Social Sciences version 18.0 software was used.

The research complied with the norms of Resolution N°. 466/12 of the National Health Council, which regulates human research and was approved by the Research Ethics Committee of the State University of Montes Claros, under opinion N°. 226,707/2013.

RESULTS

During the 10-month period, 1,121 patients were hospitalized on the internal medicine wards, of which 63 (5.6%) used a VC at some period of their hospitalization, corresponding to 880 VC-days. The CA-UTI incidence density was 22.7 per 1,000 VC-days.

The mean age of patients using a VC was 67.1 years (median 70; SD \pm 17.7 [16-95 years]). The mean length of hospitalization was 38.3 days (median 26; SD \pm 36.8 [5-202 days]). Regarding VC permanence, the mean time was 14.4 days (median 11; SD \pm 16.6 [1-110 days]).

Table 1 shows the main characteristics of the hospitalized patients.

To characterize the patients, according to the variables for the VC indication, UTI diagnosis and microbiological analyses, Table 2 presents the simple and percentage frequency of the descriptive analysis.

The CA-UTI rate was 31.7%; five (25%) patients who developed UTI had no indication for use of a VC, and for three (15%) patients, the physician's assistant did not prescribe a VC. A uroculture was performed in 100% of patients with a CA-UTI, of which, six (30%) were polymicrobial (with up to two microorganisms). Of the polymicrobial infections, 83.3% occurred in patients who used a VC for more than 14 days. In relation to the patients diagnosed with CA-UTI, 15 (75%) had previous treatments for other infections. Of the CA-UTIs, four (6.3%) were caused by multidrug-resistant microorganisms (100% *Klebsiella pneumoniae* in patients with previous antibiotic therapy). Of the patients with CA-UTI, 14 (22.2%) were treated for this infection. The most commonly-used antibiotic for the CA-UTI treatment was piperacillin + tazobactam (6.3%).

During the hospitalization, other infections related to health care were observed in 50% of patients with a CA-UTI.

Table 3 shows the comparison of patients with an occurrence of a UTI with the sociodemographic and clinical factors of the study.

According to the results in Table 3, there was a significant association between the UTI occurrence and the period of hospitalization and VC permanence. The patients with the highest UTI risk were those with more than 30 days of hospitalization, more than 21 days of VC permanence and those who had a VC replacement.

When distributing patients with and without UTI according to factors related to a VC, there was a significant association between the UTI occurrence and a VC replacement.

When analyzed in a continuous format (Mann-Whitney test), there were significant differences between mean hospitalization time ($p = 0.002$) and permanence time (VC = 0.040) of patients with and without UTI.

DISCUSSION

In this study, the incidence density of CA-UTIs was considered high. In studies performed in ICUs in the United States, incidence rates ranged from 3.1 to 7.4 per 1,000 VC-days⁸.

The results of this study did not show statistically significant differences between men and women for the development of UTIs. Despite this finding, the literature is clear in pointing out that UTIs are more frequent in women because of the short extension of the urethra and colonization of the periurethral region when compared to men⁹.

Table 1. Sociodemographic characteristics of the patients who used a vesical catheter. Montes Claros, MG, Brazil, 2012-2013.

Variables	n	%
Sex		
Female	32	50.8
Male	31	49.2
Age group		
< 20 years	1	1.6
31-40 years	8	12.7
41-50 years	1	1.6
51-60 years	9	14.3
> 61 years	44	69.8
Hospitalization permanence range		
Up to 7 days	4	6.3
8-14 days	9	14.3
15-30 days	28	44.4
> 30 days	22	35.0
Permanence range of the vesical catheter		
Up to 3 days	10	15.9
4-7 days	14	22.2
8-14 days	18	28.6
15-21 days	12	19.0
22-30 days	3	4.8
> 30 days	6	9.5
Vesical catheter replacement		
Yes	12	19.0
No	51	81.0
Prescribed vesical catheter insertion		
Yes	58	92.1
No	5	7.9
Registration of vesical catheter insertion in medical records		
Yes	30	47.6
No	33	52.4
Justification for vesical catheter insertion		
Yes	49	77.8
No	14	22.2

**Table 2.** Descriptive analysis of indication for insertion and prescription of catheter removal, diagnosis of urinary tract infection and uroculture results. Montes Claros, MG, Brazil, 2012-2013.

Variables	n	%
Indication for vesical catheter		
Adequate	49	77.8
Inadequate	14	22.2
Urinary tract infection associated with a vesical catheter		
Yes	20	31.7
No	43	68.3
Prescription of the vesical catheter removal		
Yes	42	66.7
No	12	19.0
Death	9	14.3
Uroculture execution		
Yes	27	42.9
No	36	57.1
Uroculture result		
Positive	20	74.1
Negative	7	25.9
Polymicrobial uroculture result		
Yes	6	30.0
No	14	70.0
Microorganism		
<i>Candida sp.</i>	3	15.0
<i>Enterococcus sp.</i>	3	15.0
<i>Escherichia coli</i>	5	25.0
<i>Klebsiella pneumoniae</i>	5	25.0
<i>Morganella morganii</i>	1	5.0
<i>Pseudomonas aeruginosa</i>	2	10.0
<i>Streptococcus sp.</i>	1	5.0
Multi-resistant microorganism		
Yes	4	20
No	16	80

Regarding age group, the variability^{10,11} has a higher frequency among the elderly, clearly related to their baseline condition, prostate obstruction, vesical calculus, catheterization and diabetes¹¹⁻¹⁴ and, mainly related to duration of catheterization and the use of antibiotic therapy for the underlying disease, considered to be statistically significant factors for UTI acquisition^{11,12}.

In this study, we verified that the catheter permanence time in the urinary tract was a triggering factor for the UTI occurrence. The high prevalence and wide-scale use of a urinary catheter turns UTIs into one of the most severe problems of hospitals and health services¹⁵. Permanence time is considered the main risk factor for colonization of catheters and subsequent associated infection, as well as the risk of biofilm formation¹⁶. The time required to form biofilm in the device depends on the microbial assembly and the type of material, but on average, a thick biofilm can be formed within 24 hours across the device surface¹⁷.

Thus, the catheter becomes an attractive substrate for bacterial colonization and biofilm formation, a highly structured,

organized community of cells that adhere to a solid substrate and are surrounded by an extracellular polysaccharide matrix. Biofilm formation gives microbial cells high resistance to antimicrobials and host defenses, and antiseptic protection, with profound clinical implications¹⁸.

Biofilm is the main risk factor for CA-UTI. About 65% to 80% of human infections are associated with its presence¹⁹.

In this investigation, the mean catheterization time was 14.4 days. There is evidence that a relatively short urinary catheterization period - on average 3.5 days - does not produce UTIs. The most effective mechanism to avoid a CA-UTI is using a VC for a shorter period of time¹⁸. Approximately 50% of the catheterized patients acquire infections after a short period (less than seven days). Patients with a long catheterization period (over 28 days) have a 100% chance of developing UTI¹⁶.

Research at a university hospital showed that the mean duration of having a VC was 6.8 days, which was higher in clinical patients when compared with surgical patients. The inadequate use of a VC was associated with a longer hospital permanence time of about three days¹².

There was an association of the UTI occurrence with the VC replacement. It should be emphasized that catheters should not be replaced routinely; they are recommended when there is drainage obstruction or system damage⁶. Urea hydrolysis caused by some microorganisms that produce urease creates an alkaline environment that contributes to the precipitation of magnesium and calcium ions to form crystalline biofilm. Thus, this favors the catheter encrustation and obstruction^{20,21}.

As for the type of system adopted, this study only found the closed system, taking into account the recommendations in the national and international guidelines. However, bacteria are often found and, although this does not translate into infection, there is an increased risk when they are present due to the greater possibility of access to the bladder during catheter manipulation. Among non-bacteriological hospitalized patients, 10% to 20% will present with a UTI after catheterization, with an increased risk from 3% to 10% for each day of catheter permanence with closed drainage systems¹⁶.

Other highlighted aspects related to the UTI occurrence refer to the catheterization method, the quality of care with catheter insertion and maintenance, and patient susceptibility^{15,16}.

Findings from this research showed that in most of the inserted VCs, there was an indication for insertion and a prescription (77.8% and 92.1%, respectively). A study carried out at another a university hospital showed that in 23.3% of the patients, vesical catheterization did not have a prescription and indication in the medical record. Among the clinical patients, a VC was considered inappropriate in relation to its indication in 29% to 47%, in relation to the time of use. The UTI occurrence was more frequent in patients whose VC was considered as not indicated when compared to those patients in whom the VC was considered indicated¹².

**Table 3.** Comparison of the occurrence of urinary tract infection with sociodemographic and clinical factors of the patients. Montes Claros, MG, Brazil, 2012-2013.

Variables	Urinary tract infection - n (%)		Relative risk [IC95%]	p-value
	Yes	No		
Sex				
Female	11 (34.4)	21 (65.6)	1	0.649*
Male	9 (29.0)	22 (71.0)	0.92 [0.66;1.29]	
Age group				
< 40 years	3 (33.3)	6 (66.7)	1.05 [0.38;2.91]	0.999*
41-60 years	3 (30.0)	7 (70.0)	0.94 [0.33;2.67]	
> 61 years	14 (31.8)	30 (68.2)	1	
Hospitalization time				
Up to 14 days	1 (7.7)	12 (92.3)	1	0.030**
15-30 days	8 (28.6)	20 (71.4)	1.29 [0.98;1.71]	
> 30 days	11 (50.0)	11 (50.0)	1.85 [1.18;2.88]	
Permanence of the vesical catheter				
Up to 3 days	2 (20.0)	8 (80.0)	1	0.049**
4-7 days	3 (21.4)	11 (78.6)	1.02 [0.67;1.54]	
8-14 days	5 (27.8)	13 (72.2)	1.11 [0.73;1.69]	
15-21 days	3 (25.0)	9 (75.0)	1.07 [0.68;1.67]	
21 days	7 (77.8)	2 (22.2)	3.60 [1.32;12.70]	
Vesical catheter replacement				
Yes	7 (58.3)	5 (41.7)	2.29 [1.17;4.47]	0.040**
No	13 (25.5)	38 (74.5)	1	
Evolution				
Discharge	15 (36.6)	26 (63.4)	1	0.260*
Death	5 (22.7)	17 (77.3)	0.82 [0.59;1.13]	

* Chi-square; ** Fisher exact test

In this study, 32% of the CA-UTI was associated with VCs. Another study showed that CA-UTI episodes are associated in 80% of vesical catheterizations²².

Evidence indicates that the most significant factors in the appearance or absence of a UTI relate to frequency of use, prevention of traumas at insertion and permanence time of the urinary catheter, and the use of aseptic techniques when maintaining the closed urine drainage system⁷. For that matter, a UTI becomes an iatrogenic condition caused by urinary catheterization⁷.

In this investigation, the main microorganisms that caused UTIs are gram-negative, such as *E. coli* in 25% of the patients. Another study had similar results, in which the most common etiological agents found in CA-UTIs were *E. coli* (50%), *Enterobacter sp.* (10.5%), *Pseudomonas aeruginosa* (10.5%) and *Enterococcus sp.* (10.5%)²³. The microorganisms involved in the onset of the CA-UTI usually come from the patient's endogenous intestinal microbiota.

Thus, in order to reduce the CA-UTI incidence, several measures, mainly directed at the insertion technique, the drainage system, the catheter type and daily care in the VC maintenance, have been indicated. Among all the recommended measures, avoiding the use of a VC, and removing it as soon as possible, are the most relevant^{4,7,24}.

An important limitation of this study concerns the external validity of the results. As it was a specific population, the representativeness may be compromised and, likewise, the generalization of the findings to the general population.

FINAL REMARKS

This study identified that the incidence of CA-UTIs was 31.7%. We identified the hospital permanence time, length of time of catheterization and replacement of the VC as factors associated with the occurrence of CA-UTIs.

The conduct regarding the use of a VC should be judicious, from the assessment of indication, insertion, maintenance and its removal as soon as possible, to ensure patient safety.

The results of this study reaffirm the importance of CA-UTIs as a health problem, not only in the ICU but also in internal medicine units. Our results contribute to support other studies on the prevention of CA-UTIs, reaffirming the importance of control measures.

The Hospital Infection Control Service should define and monitor the risk factors for the occurrence of UTIs and propagate the control measures among professionals.

All references need to be numbered to relate to the body copy



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Conflict of Interest

The authors report no conflict of interest with peers, institutions, political or financial in this study.



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