Original Research Article

A point prevalence study of catheter associated urinary tract infections among patients admitted in an university hospital

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ABSTRACT

Background: Urinary tract infections (UTIs) are the most common type of healthcare associated infection in acute care hospitals. Most involve urinary drainage devices, such as urinary catheter. The objective of this study was to investigate the prevalence of catheter-associated urinary tract infections in adult patients of a tertiary level university hospital.

Methods: The point prevalence study was conducted in one single day and included all adult patients admitted in medical, surgical wards and intensive care units. The Centre for Disease Control (CDC) criteria were adopted to classify the different type of UTIs.

Results: Out of a total of 497 adult inpatients, 94 patients had a urinary catheter for at least 48 hours. The prevalence of symptomatic urinary tract infection (SUTI) in this sample is 17%. *Escherichia coli* (31.2%), *Enterococcus faecium* (25.0%) and *Enterococcus faecalis* (12.5%) are the most common pathogens found.

Conclusions: The main isolated uropathogens in this study are Gram-negative and *Escherichia coli* remains one of the most frequent cause of UTIs in human. Gram-negative pathogens have multiple virulent factors responsible for their adherence to uroepithelium and urinary catheter positioning facilitates the transmission of these pathogens to urinary tract. Urinary catheterization is frequently used as solution to facilitate continence and maintain skin integrity in elderly patients. Urinary incontinence frequently is an example of inappropriate use of urinary catheter: for that reason, urinary catheter should be considered as the last option if other solution, like incontinence pads, are not indicated.

Keywords: Catheter-related infections, Infection control, Nursing care, Urinary tract infections

INTRODUCTION

Healthcare-associated infections (HAIs) are the most frequent adverse event in the healthcare facilities and represent a significant problem for patients' safety worldwide.[1] Only in the European Union (EU), the estimated number of HAI is 4.544.100 per year, leading directly to around 37.000 deaths and 16 million extra days of hospital stay.[2] HAIs' active surveillance is an essential component of infection control program and it is a fundamental way of reducing their frequency.[3] Urinary tract infections (UTIs) are the most common type of HAIs in acute care hospital.[4] All healthcare associated UTIs are caused by devices of the urinary tract: approximately 12-16% of adult patients have a urinary catheter during their hospitalization. Patients also have a 3-7% increased risk of acquiring a catheter associated urinary tract infection (CAUTI) each day of bladder catheterization.[5]

The point prevalence studies have been recently designed as a simple and economic way to evaluate the characteristics of HAIs and the antibiotics administration. This kind of studies are a useful tool for improving qualitative care standards in hospitals. All patients with a urinary device can benefit from active surveillance programs designed to identify the main risk factors for specific patients' categories or hospital departments.[6] The guidelines for prevention of catheter-associated urinary tract infections recommend to "use standardized methodology for performing CAUTI surveillance (category IB)" in order to identify the patients groups or units on which to conduct surveillance based on frequency of catheter use and potential risk of CAUTI.[7] The objective of this study was to investigate the prevalence of CAUTI in adult patients of a tertiary level university hospital in Italy.

METHODS

The Foundation IRCCS Ca' Granda Ospedale Maggiore Policlinico is the biggest research hospital in Italy with 900 beds and more than 36.000 hospitalizations per year (data 2018). This point prevalence study was conducted in one single day (6 November 2018) and included all adult patients admitted in medical, surgical, gynecological/obstetrical wards and intensive care units. The Center for Disease Control (CDC) criteria were adopted to classify the different type of UTIs and just symptomatic urinary tract infections (SUTI) were investigated, as summarized in Table 1.[8]

Inclusion criteria

- Adult patients (age >18 years old)
- Patients with a urinary catheter in place for at least 48 hours on the day of the study

Exclusion criteria

- Pediatric patients (age <18 years old)
- Patients with chronic urinary tract infection before the hospital admission
- Duration of catheterization less than 48 hours

Nurses received detailed instructions to collect all data required for the study, included indications for the management of urine samples, in accordance with the hospital protocol. Before the investigation, two nurses qualified in infection control were identified as monitors of the study. They conducted and checked all phases of the study, using case report form (CRF) for patient's data and to collect the occupancy rate for each ward included in the investigation.

The formal Ethic Committee issue was not deemed necessary according to the local regulation: in fact, the hospital committee of infection control periodically perform surveillance to collect epidemiological data and identify area for intervention. However, the study was authorized by the Director of Healthcare Professions Department. The study protocol did not change any aspect of the clinical practice.

Obtaining a sample of urine from urinary catheter

An aseptic no-touch technique had to be used to obtain a fresh urine sample. This procedure reduces the risk of cross infection thanks to the use of a sampling port on the catheter drainage bag tube.[9] About 10 ml of urine sample was aspirated from the sampling port under aseptic precautions, transferred to the vacuum tube (containing boric acid 1%) and sent to the laboratory immediately.

Statistical analysis

All collected data were analyzed using STATA Statistical Software (Release 16. College Station, TX). The demographic variables and the patients' characteristics were compared using two non-parameter tests: the Mann-Whitney's U test for the quantitative variables (duration of catheterization, hospital length of stay) and the Fisher's exact test for the qualitative variables (type of hospital admission and categories of diagnosis). A 95% test-based confidence intervals were computed for each estimate of interest and a $p \leq 0.05$ was considered significant. All the data were collected in Microsoft Excel and for each variable was calculated average, standard deviation, median and interquartile range.

RESULTS

Out of a total of 497 adult inpatients, 94 patients had a urinary catheter and were eligible (7 patients were excluded because of the duration of catheterization <48 hours). Bed occupancy rate in adult wards was 84.1%. The sample was represented by 41 male (43.6%) and 53 female (56.4%) patients, with an average age of 69.6(±19.8 SD) years old and a median length of stay of 8 days (Q1-Q3: 4-15 days). Medical patients had longer length of stay (median 11, Q1-Q3: 5-16 days) than surgical patients (median 6, Q1-Q3: 3-17 days) and their admission occurred mainly in emergency (74.5%). Other characteristics of the sample are summarized in Table 2. The urine vacuum tubes were analyzed according to the microbiological laboratory methods (ISO 15189 certification).

The urine samples results are shown in Table 3. In this table the results of urine culture with more than two species of organisms identified or at least one of which is a bacterium of $<10^5$ CFU/ml were not included; the urine culture classified as mixed flora, according to the criterium number 3 for the diagnosis of SUTI, were excluded too. All the 16 patients who fulfilled SUTI criteria showed hyperpyrexia as the only sign/symptom among those defined in Table 1.[8] The main indications for catheter positioning, codified by the European Association of Urology Nurses (EAUN), are listed in Table 4.[10]

Table 1: Criteria for SUTI (symptomatic urinary tract infection).

Catheter-associated urinary tract infection (CAUTI)
Patient must meet criteria 1, 2 and 3 below:
Criteria 1
Patient has an indwelling urinary catheter that had been in place for more than 2 consecutive days at the moment of data collection or removed the day before the day of the study.
Criteria 2
Patient has at least one of the following signs or symptoms:
- Fever (>38.0°C) — costovertebral angle pain or tenderness
- Suprapubic tenderness — urinary urgency or frequency^
^These symptoms cannot be used when catheter is in place.
Criteria 3
Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium of >10^5 CFU/ml (a urine specimen with "mixed flora" cannot be reported as a pathogen according to national healthcare safety network UTI criteria).

Table 2: Main characteristic of the samples.

Characteristic		CAUTI neg. (n=78)	CAUTI pos. (n=16)	p Value
Sex (male)		34(43.6%)	7(43.8%)	
Age (average, standard deviation)		68.8±21.1	73.3±11.9	
Type	Medical	50(64.1%)	11(68.7%)	0.333
	Surgical	28(35.9%)	5(31.3%)	
Admission	Emergency	69(88.5%)	11(68.7%)	0.667
	Elective	9(11.5%)	5(31.3%)	
Major diagnostic categories	Neurological	9(11.5%)	2(12.5%)	
	Respiratory	26(33.3%)	4(25.0%)	
	Cardiovascular	2(2.6%)	0(0.0%)	
	Renal or genito-urinary tract	12(15.4%)	3(18.7%)	
	Hematological	8(10.3%)	2(12.5%)	
	Gastroenteric	10(12.8%)	4(25.0%)	
	Pregnancy	4(5.1%)	0(0.0%)	
	Trauma	7(9.0%)	1(6.3%)	
Other characteristics		Median, IQR	Median, IQR	
Length of days		8(4-15)	15(8-25)	0.013
Days of urethral catheterization		6(4-14)	10(4-16)	0.687
Urine culture (positive growth)		4(9.3%)	16(100.0%)	

DISCUSSION

In this study, the prevalence of symptomatic urinary tract infection in adult patients is 17%. This value is comparable to others reported in similar studies; however, these results vary a lot depending on different studies variables such as diverse eligible criteria, research methods, techniques of catheterization and antibiotic prophylaxis.[11,12] *Escherichia Coli* was the Gram-negative pathogen most identified in the sample (31.2%): its presence was related to short and long-term period of urethral catheterization both. This result confirms that the majority of infections are caused by self-infection. In fact, the fecal flora represents a potential reservoir of infectious pathogens with an endogenous origin and urinary catheter positioning facilitates the transmission of gastro-intestinal microorganisms to urinary tract.[13] Literature showed that 66% of CAUTI is acquired with this mechanism.[14]

Elderly patients were the category most at risk of CAUTI (69.1% of patients with urinary catheter were over 65 years old) and urinary incontinence (44.6% of elderly patients had this indication for urethral catheter positioning).[15] Urinary incontinence management is an example of inappropriate use of urinary catheter according to the CDC 2009 (recommendation IB) : 68.7% of the patients with a positive urine culture had urinary incontinence as indication to the positioning of urinary catheter.[7] Urinary catheterization is frequently used as solution to facilitate continence and maintain skin integrity in elderly population. This invasive procedure

should be considered as the last resort if other solutions are not indicated such as incontinence pads.[16]

Table 3: Frequency of growth obtained from urine culture.

Growth	Frequency (%)
Klebsiella pneumoniae	2(12.5%)
Escherichia coli	5(31.2%)
Enterococcus faecium	4(25.0%)
Enterococcus faecalis	2(12.5%)
Providencia rettgeri	2(12.5%)
Acinetobacter baumannii	1(6.3%)

Table 4: Indications for urethral catheterization.

Indications	Frequency (%)
To facilitate continence and maintain skin integrity	33(35.1%)
Measurement of urinary output critically ill patients	16(17.0%)
Patients undergoing urological or genitourinary tract surgery	13(13.8%)
Use in the peri-operative of selected surgical procedures	9(9.6%)
Neurological patients with bladder voiding difficulties	7(7.4%)
Acute and chronic urinary retention	7(7.4%)
Other	9(9.7%)

The urinary catheter is often positioned without a specific indication and it is not promptly removed when is no longer needed.[17] The duration of catheterization is the most important risk factor for CAUTI development: the main prevention strategies for CAUTI are avoiding inappropriate insertion and reducing the catheterization time. Further risk factors include the female gender, the old age and the use of an open urine drainage circuit system.[18,19] In the study, patients with SUTI were mainly female (56.3%) and had a higher average age than patients without infection (73.3 versus 68.8 years, respectively); instead, all patients with urinary catheter had closed urine drainage circuit system. Furthermore, the duration of urinary catheterization in the sample was prolonged (>6 days) increasing the risk of developing a CAUTI.[5] The use of reminder or checklist to verify the real necessity of urinary catheter placing could help health-care professional in the daily evaluation of possible removal.[20,21] In fact, it appears that health-care professionals have a good perception of the infectious risk related to the assistance, but adherence to good practices is not often applied.[22]

The main limitation of this research are the study method and the sample size. Only patients suffering from SUTI (Symptomatic Urinary Tract Infections) were detected in this point prevalence study and other kind of CAUTI, such as ABUTI (Asymptomatic Bacteremic Urinary Tract Infections), were not considered. Moreover, the sample size has not a statistical significance but reflects the local hospital reality. The collected results may outline the basis for a point prevalence study on a wider population.

CONCLUSION

Surveillance systems are useful to monitor the epidemiology of healthcare associated pathogens and to evaluate and guide policies, at local level too. Urinary catheter positioning always represents a significant risk factor for HAI onset and its early removal is an effective measure to reduce the risk of UTIs. Urinary catheter should be placed only for diagnostic and therapeutic interventions and not as a substitute for nursing care.

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