Impact of Urinary Catheterization on Geriatric Inpatients with Community-acquired Urinary Tract Infections

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Background: Urinary tract infections commonly cause hospitalizations in community-dwelling geriatric populations. Our aim was to understand the impact of urinary catheterization on geriatric inpatients with community-acquired urinary tract infections (CAUTIs).

Methods: Retrospective analyses were performed using electronic discharge summaries in a rural community hospital of northeastern Taiwan in 2004. We screened data with ICD-9-CM codes and performed chart reviews on inpatients aged ≥65 years with CAUTIs.

Results: A total of 294 subjects who experienced CAUTIs were enrolled; 114 subjects had urinary catheterization and the other 180 did not. The mean frequency of admission was 1.2 times (range, 1–4 times); 251 subjects were admitted only once. We reviewed and enrolled 348 records of CAUTIs. Subjects with urinary catheterization showed significantly more advanced age, more female predominance, higher immobility ratio, and more frequent admissions than those without urinary catheterization ($p < 0.05$). Records of urinary catheterization showed that subjects had longer hospital stays, higher pathogen isolation after culture, and less comorbid pyelonephritis than subjects without urinary catheterization ($p < 0.05$). The distribution of infecting microorganisms differed insignificantly between the 2 groups ($p = 0.077$). Female gender, hospitalization > 2 times, age ≥ 75 years, immobility, hospital stay > 7 days, and low prevalence of comorbid pyelonephritis served as significant predictive variables for urinary catheterization in subjects with CAUTIs.

Conclusion: For geriatric inpatients, urinary catheterization must be evaluated cautiously before being performed. The impact of urinary catheterization on the distribution of microorganisms in CAUTIs was shown to be insignificant. [*J Chin Med Assoc* 2007;70(6):236–240]

Key Words: community-acquired infections, geriatrics, urinary catheterization, urinary tract infections

Introduction

Urinary tract infections (UTIs) commonly cause hospitalization in community-dwelling geriatric populations. Local researchers had noticed and focused on microorganisms resistant to commonly-prescribed antibiotics in populations with community-acquired urinary tract infections (CAUTIs).[1] With increased geriatric populations and their underlying chronic diseases, genitourinary problems are more complicated in geriatric patients than in younger patients. Urinary catheterization, including transient and long-term indwelling catheters, has often been considered a "final solution" for those with intractable urinary incontinence or retention. However, the complications of urinary catheterization have been widely discussed by Western researchers, and attention should be paid to these complications, especially among geriatric populations.[2,3]

The impact of urinary catheterization on the community-dwelling geriatric population in Taiwan is still unclear. Our study aimed to understand the

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characteristics and the impact of urinary catheterization on geriatric inpatients with CAUTIs.

Methods

Retrospective and descriptive analyses were performed in our study. We collected electronic files of discharge summaries in a rural community hospital from January 1, 2004 to December 31, 2004 under the approval of the institutional clinical ethics committee. Established in 1896, this rural community hospital is the oldest healthcare facility in northeastern Taiwan. It is located in I-Lan County, a rural region in which the geriatric population accounts for 11.54% of the total population. Over 4,000 people depended on long-term healthcare services here at the end of 2004.[4] Affiliated with a tertiary medical center since 2001, the rural community hospital includes 42 attending physicians and provides outpatient services of over 30,000 visits per month, and inpatient services for over 1,000 admissions (around 10,000 person-days) per month. Electronic files of discharge summaries are written with Total Hospital Information Management System (THIMS, Solomon Solutions Service Ltd., 2002, Taipei, Taiwan). We collected the data, analyzed inpatients aged ≥65 years, and reviewed admission records that had related International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes of urinary tract infections. The related ICD-9-CM codes were classified into 4 clusters: (1) infections of the kidneys (range, 590.00 to 590.90); (2) urinary cystitis (range, 595.00 to 595.90); (3) urethritis (range, 597.00 to 597.89); and (4) unspecified UTI (599.00). We also rechecked related information by reviewing electronic discharge summaries, such as urinary catheterization or not, comorbid diabetes mellitus or not, comorbid urolithiasis or not, comorbid cancers or not, immobility status or not, comorbid pyelonephritis or not, and details of infectious microorganisms identified.

Urinary catheterization, including transurethral and suprapubic catheterization through cystostomy, was defined as indwelling urinary catheters before admissions. Subjects who had indwelling urinary catheters before admission were listed as "subjects with urinary catheterizations", that is, the study group. In contrast, similar to subjects without indwelling urinary catheters, subjects who received indwelling urinary catheters after admissions were listed as "subjects without urinary catheterizations", that is, the control group. UTIs in our study were considered as symptomatic infections, such as fever or dysuria, and evidence of increasing white blood cells in urine routine exams. Admission records of patients with CAUTIs were defined as those admission records having UTIs derived while inpatients were living at home, and that revealed no evidence of nosocomial infections. Immobility status describes bedbound subjects who suffered significant mobility defects from physical illnesses such as stroke, head or spinal injury, and certain arthropathies. Comorbid urolithiasis included stones of both upper and lower urinary systems. Comorbid cancers included both genitourinary and non-genitourinary malignancies. The definition of comorbid pyelonephritis was that records showed evidence of pyelonephritis-related symptoms/signs, such as pain or tenderness over costovertebral angle, and positive imaging findings. Inpatients who were sent from other institutions (including nursing homes and other healthcare facilities) or who suffered from nosocomial infections were excluded from this study. We did not enroll subjects' mortality data because of complexities and the incomplete status of subjects' life records. For instance, the results of hospitalization may be "transferal" or "discharge against medical advice", but not all data described a better prognosis than "expired".

General data were expressed as mean ± standard deviation (SD). Independent t test, χ^2 test, and trend χ^2 test were performed using SPSS version 11.0 (SPSS Inc., Chicago, IL, USA). The odds ratio (OR) and 95% confidence interval (CI) of dependent variations were expressed via multivariate logistic regression analyses. A p value of less than 0.05 (2-tailed) was considered as a significant difference.

Results

A total of 294 subjects aged ≥65 years had suffered from CAUTIs and had been hospitalized, and 348 admission records during the year 2004 were reviewed; 114 subjects had urinary catheterization and 180 did not. The subjects' mean frequency of admission was 1.2 ± 0.5 times (range, 1–4 times). Of the 348 admission records, subjects with urinary catheterization accounted for 153 admission records, and subjects without urinary catheterization accounted for the other 195 admission records. The demographic characteristics of enrolled subjects and admission records are listed in Tables 1 and 2. Subjects with urinary catheterization showed significantly more advanced age, greater female predominance, higher immobility ratio, and more frequent admissions than those without urinary catheterization ($p<0.05$). Distribution of comorbid diabetes mellitus, urolithiasis and cancers differed insignificantly between the 2 groups. Admission records of patients with urinary catheterization showed that

Table 1. Demographic characteristics of 294 geriatric inpatients with community-acquired urinary tract infections*

	Subjects		$p^{\dagger}$
	With urinary catheterization ($n=114$)	Without urinary catheterization ($n=180$)	
Mean age (yr)	78.2±7.0	75.8±6.7	0.004
Sex (male/female)	25/89	59/121	0.048
Immobility status (yes/no)	45/69	41/139	0.003
Comorbid diabetes (yes/no)	57/57	71/109	0.091
Mean frequency of admission (times)	1.4±0.7	1.1±0.3	<0.001

**Data are presented as mean±standard deviation or n; †independent t test and χ^2 test.*

Table 2. Demographic characteristics of 348 admission records of geriatric inpatients with community-acquired urinary tract infections*

	Records		$p^{\dagger}$
	With urinary catheterization ($n=153$)	Without urinary catheterization ($n=195$)	
Mean hospital stays (d)	16.0±12.8	8.7±6.0	<0.001
Pathogen isolation after culture (positive/negative finding)	98/55	101/94	0.023
Comorbid urolithiasis (yes/no)	8/145	20/175	0.112
Comorbid cancers (yes/no)	18/135	16/179	0.280
Comorbid pyelonephritis (yes/no)	3/150	18/177	0.005

**Data are presented as mean±standard deviation or n; †independent t test and χ^2 test.*

Table 3. Characteristics and distributions of microorganisms in 348 admission records of community-acquired urinary tract infections*

	Records†	
	With urinary catheterization	Without urinary catheterization
Single microorganism	82 (53.6)	90 (46.2)
Proteus	5 (3.3)	6 (3.1)
Escherichia coli	37 (24.2)	37 (19.0)
Klebsiella	9 (5.9)	10 (5.1)
Pseudomonas	11 (7.2)	8 (4.1)
Yeast or fungus	10 (6.5)	3 (1.5)
Streptococcus/Staphylococcus	4 (2.7)	14 (7.1)
Other bacteria	6 (3.9)	12 (6.2)
≥2 microorganisms	16 (10.5)	11 (5.6)
No pathogen isolated after culture	55 (35.9)	94 (48.2)
Total admission records	153 (100)	195 (100)

**Data are presented as n (%); †p=0.077 by trend χ^2 test.*

they had significantly longer hospital stays, less comorbid pyelonephritis, and higher rates of positive urine cultures than patients without urinary catheterization ($p<0.05$).

The characteristics and distribution of microorganisms in all 348 admission records are listed in Table 3. Distribution of infectious microorganisms differed insignificantly between the 2 groups ($p=0.077$).

The predictive variables of urinary catheterization in geriatric inpatients with CAUTIs are listed in Table 4. Female gender (OR, 1.883; 95% CI, 1.036–3.423), hospitalization >2 times (OR, 8.556; 95% CI, 1.839–39.802), age ≥75 years (OR, 1.750; 95% CI, 1.075–2.849), immobility (OR, 2.493; 95% CI, 1.435–4.329), hospital stay >7 days (OR, 2.957; 95% CI, 1.811–4.829), and low prevalence of comorbid pyelonephritis

Table 4. Predictive variables associated with urinary catheterization in subjects with community-acquired urinary tract infections

	Coefficient	OR	95% CI	*p*
Female	0.633	1.883	1.036–3.423	0.040
Hospitalization > 2 times	2.147	8.556	1.839–39.802	0.006
Age ≥ 75 yr	0.560	1.750	1.075–2.849	0.024
Immobility	0.913	2.493	1.435–4.329	0.001
Hospital stay > 7 d	1.084	2.957	1.811–4.829	< 0.001
Low prevalence of comorbid pyelonephritis	1.626	5.082	1.469–17.583	0.010

OR = odds ratio; CI = confidence interval.

(OR, 5.082; 95% CI, 1.469–17.583) served as significant predictive variables for urinary catheterization in subjects with CAUTIs (all $p < 0.05$).

Discussion

The indications for urinary catheterization in medical care are well known, including: (1) total urinary retention; (2) urinary incontinence with wounds or skin defects; (3) urinary incontinence in terminal patients; (4) urine sampling or monitoring patients' urine output; and (5) adjuvant management for surgical operations or anesthetics.[5,6] However, inadequate use of urinary catheterization is still inevitable, even in developed countries such as the United States.[7] In our study of CAUTIs, we found that subjects with urinary catheterization had many significantly different characteristics from those without urinary catheterization, such as advanced age, female predominance, immobility status, and frequent admissions. In a previous Italian study, researchers found a positive relationship between urinary catheterization and comorbid diabetes mellitus.[8] One Singaporean study revealed that comorbid diabetes mellitus correlated negatively with the therapeutic effect of intermittent urinary catheterization.[9] In contrast, comorbid diabetes mellitus, which often induces neurogenic urinary bladder and overflow incontinence, differed insignificantly between subjects with and without urinary catheterization in our study. Similar insignificance between comorbid diabetes mellitus and urinary catheterization was also reported from the Middle East.[10] By reviewing subjects' admission records, we also found that subjects with urinary catheterization had longer hospital stays than those without urinary catheterization. We considered that subjects with urinary catheterization had more complicated health status than those without urinary catheterization, and the impact of comorbid diabetes mellitus played an insignificant role in the decision to catheterize or not.

Interestingly, subjects with urinary catheterization had significantly higher pathogen-isolating rates (64.1% *vs.* 51.8%) and lower ratios of comorbid pyelonephritis (2.0% *vs.* 9.2%) than those without urinary catheterization in our study. The ratios of comorbid urolithiasis were lower in subjects with urinary catheterization than those without urinary catheterization (5.2% *vs.* 10.3%) but did not achieve statistical significance ($p = 0.112$). Our results differed from previous American studies, which reported positive relationships between urinary catheterization and pyelonephritis.[11,12]

Pathogen-isolating rates reflected the indication of indwelling urinary catheters, which was the immediate and convenient way to collect urine samples from subjects before prescribing antibiotics. In Taiwan, prescription of empirical antibiotics is so common that more and more resistant strains of microorganisms have been found in patients with CAUTIs.[1] Empirically prescribed antibiotics also interrupt the results of cultures if culture samples are collected late. We considered that immediate sample collection for cultures, such as intermittent urinary catheterization, helped to improve pathogen-isolating rates.

The relatively high prevalence of comorbid pyelonephritis in subjects without urinary catheterization may reflect characteristics of geriatric health problems, such as underestimation and ignorance, especially among community-dwelling elders and their families.[13] It is logical that delayed treatment of CAUTIs may cause pyelonephritis or other bacteremic status. Among subjects with urinary catheterization, either they or their caregivers may be alerted about managing the condition immediately if catheters or bags show an abnormal appearance, such as turbid urine or precipitating substances. In our study, comorbid urolithiasis was significantly positively correlated with comorbid pyelonephritis (OR, 7.286; 95% CI, 2.656–19.964; $p < 0.001$). Thus, comorbid urolithiasis had similar results to comorbid pyelonephritis.

Distribution of isolated microorganisms differed insignificantly between subjects with and without urinary

catheterization. We considered that the sampling caused insignificance of microorganisms' distribution in our study. We enrolled subjects with CAUTIs to exclude coefficient factors, and the characteristics of community-acquired infection appeared to be highly homogeneous. This phenomenon also explained why urinary catheterization had such a small impact on distribution of microorganisms in subjects with CAUTIs.

Frequent admissions (>2 times) served as the most significant risk factor for urinary catheterization in our study. This result was compatible with research from the United States, which revealed that urinary catheterization increased the risks of re-hospitalization and mortality.[3] Our study revealed that urinary catheterization also correlated significantly to some risk factors such as female gender, advanced age (≥75 years), immobility, and long hospital stays (>7 days). Western literature reviews reported that subjects with urinary catheterization should have voiding conditions evaluated regularly if indwelling catheters are necessary. Regular changing and cleaning of urinary drainage systems should be performed actively to prevent infection.[14] Intermittent urinary catheterization and silver alloy hydro gel-coated catheters are recommended by Western researchers to reduce UTIs and promote patients' quality of life.[15,16] The care of geriatric patients who have undergone urinary catheterization requires close and cautious attention, especially if they have comorbidities or any of the risk factors above.

The limitations of our study include factors related to the limits of retrospective analyses, such as not being able to evaluate subjects' nutritional status, including parameters such as serum albumin level, body mass index, and measurement of mid-arm and calf circumferences. The actual counts of subjects with CAUTIs may be underestimated, and asymptomatic CAUTIs cannot be excluded entirely by retrospective screening with ICD-9-CM codes. Selection bias, such as immobility and advanced age, may exist in subjects with urinary catheterization, especially in those undergoing home care.[17] In addition, we did not distinguish between simple and complicated UTIs, which has been discussed by local researchers.[18] Further prospective studies of the impact of urinary catheterization on all types of UTIs are indicated.

In conclusion, urinary catheterization must be evaluated and managed cautiously before being performed in geriatric patients due to catheter-derived risk factors, such as high re-hospitalization rates and long hospital stays. The impact of urinary catheterization on distribution of microorganisms in CAUTIs was shown to be insignificant in our study.

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