

Risk Factors for Complicated Urinary Tract Infection (cUTI) due to Pseudomonas

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UPDATED ABSTRACT

Background: Treatment of cUTI due to Pseudomonas is challenging because of the organism's propensity to form biofilms and its intrinsic and acquired resistance to many antibiotics. Our objective was to identify risk factors for Pseudomonas as the causative pathogen among hospitalized patients with cUTI.

Methods: We conducted a retrospective cohort study of cUTI among adult inpatients at an academic medical center from May 1, 2009 – December 31, 2013. Pregnant patients or those without microbiology data were excluded. cUTI was defined as catheter-associated UTI (CAUTI); acute pyelonephritis; UTI in patients with uropathy or other urinary tract functional abnormality (UT abnormality), urogenital/anorectal surgery, urinary calculi, quadriplegia/paraplegia, spinal cord injury/disorder, kidney transplant, or end-stage renal disease; or UTI in males. Chi-square and Fisher's exact tests were used for bivariable analysis; forward stepwise multivariable logistic regression with $p < 0.25$ entry and $p < 0.05$ stay criteria was used to identify independent predictors of pseudomonal cUTI.

Results: Among 2,039 patients included in the cohort, 141 (6.9%) had pseudomonal cUTI. Bivariable analysis showed that patients with history of 1st/2nd generation cephalosporin use, multiple sclerosis (MS), quadriplegia/paraplegia, UT abnormality, or male sex (all $p \leq 0.05$) were more likely to have pseudomonal cUTI whereas those with acute pyelonephritis were less likely to have pseudomonal infection ($p < 0.01$). In the multivariable regression model, acute pyelonephritis (OR: 0.3, 95% CI: 0.1 – 0.8), male sex (OR: 1.9, 95% CI: 1.3 – 2.8), presence of urinary stoma (OR: 5.1, 95% CI: 2.4 – 11.0), 1st/2nd generation cephalosporin use (OR: 2.0, 95% CI: 1.4 – 2.9), MS (OR: 2.8, 95% CI: 1.3 – 6.3) and quadriplegia/paraplegia (OR: 2.7, 95% CI: 1.7 – 4.5) were identified as independent predictors of pseudomonal cUTI.

Conclusion: Patients with a urinary stoma, a history of 1st/2nd generation cephalosporin use, and certain comorbidities associated with voiding problems or increased catheterization may be more likely to develop pseudomonal cUTI, however, those with acute pyelonephritis may be at reduced risk. While further work is needed to verify these risk factors and their mechanism for conferring risk, valid predictors may be useful to identify which cUTI patients should receive empiric anti-pseudomonal agents.

BACKGROUND

- Definitions for cUTI vary but all focus on identifying difficult to treat infections and increased risk of adverse morbidity/mortality outcomes
- cUTI due to Pseudomonas is especially challenging due to
 - Organisms' affinity for forming biofilms on devices
 - Intrinsic resistance to many antibiotics
 - Rise in prevalence of multidrug resistance

OBJECTIVE

To identify risk factors for Pseudomonas as the causative pathogen for hospitalized patients with cUTI

METHODS

Study Design

- Retrospective cohort of hospitalized patients with cUTI admitted to an academic medical center between May 1, 2009 and December 31, 2013
- Pregnant patients and those without microbiology data excluded
- Each eligible patient allowed to enter the cohort once

Data Collection and Definitions

- Medical records and clinical data collected electronically from a research data warehouse
 - UTI and other conditions determined by ICD-9 diagnosis code, surgeries and procedures from ICD-9 and CPT procedure codes
- cUTI defined as catheter-associated UTI; acute pyelonephritis; UTI in patients with uropathy or other urinary tract functional abnormality (UT abnormality), urogenital/anorectal surgery, urinary calculi, quadriplegia/paraplegia, spinal cord injury/disorder, kidney transplant, or end-stage renal disease; or UTI in males

Statistical Analysis

- Student's t, chi-square, and Fisher's exact tests used for bivariable analysis
- Forward stepwise multivariable logistic regression with $p < 0.25$ entry and $p < 0.05$ stay criteria used to identify important predictors of pseudomonal cUTI

Table 1. Characteristics of patients by presence of pseudomonal cUTI

Characteristic	Pseudomonal cUTI (n=141)	Non-pseudomonal cUTI (n=1898)	P-value ^a
Mean age in years (SD)	60.4 (15.5)	60.8 (17.0)	0.833 ^b
Male sex, n (%)	98 (69.5)	1046 (55.1)	0.001
Comorbidities, n (%) ^c			
Acute pyelonephritis	3 (2.1)	180 (9.5)	0.003
Uropathy or other UT abnormality	39 (27.7)	348 (18.3)	0.006
Urinary calculi	8 (5.7)	134 (7.1)	0.533
Quadriplegia/paraplegia	23 (16.3)	116 (6.1)	<0.001
Spinal cord injury/disorder			
Spina bifida	2 (1.4)	43 (2.3)	0.766 ^d
High-risk spinal cord injury	0 (0.0)	6 (0.3)	>0.999 ^d
Other spinal cord injury	2 (1.4)	36 (1.9)	>0.999 ^d
Kidney transplant	5 (3.6)	84 (4.4)	0.622
End stage renal disease	9 (6.4)	138 (7.3)	0.694
Multiple sclerosis	8 (5.7)	48 (2.5)	0.053 ^d
Catheter-associated UTI	54 (38.3)	635 (33.5)	0.241
Diabetes	45 (31.9)	646 (34.0)	0.608
Antibiotic use in past 30 days, n (%)			
Ampicillin/amoxicillin	10 (7.1)	81 (4.3)	0.117
Fluoroquinolone	31 (22.0)	403 (21.2)	0.833
1st/2nd generation cephalosporin	54 (38.3)	473 (24.9)	0.001
Trimethoprim-sulfamethoxazole	10 (7.1)	90 (4.7)	0.213
Catheter associated UTI, n (%)	54 (38.3)	635 (33.5)	0.241
Recent urinary tract disruption, n (%) ^e			
Urogenital/anorectal surgery	9 (6.4)	92 (4.9)	0.417
Instrumentation	2 (1.4)	51 (2.7)	0.580 ^d
Stent	5 (3.6)	31 (1.6)	0.098 ^d
Stoma	10 (7.1)	36 (1.9)	0.001 ^d
Device	2 (1.4)	17 (0.9)	0.382 ^d

^aChi-square test except where indicated otherwise; ^bpooled t-test; ^cpatients could have multiple diagnoses; ^dFisher's exact test; ^erecent defined as being documented in the 7 days preceding hospitalization or during admission and before urine collection for microbiology.

RESULTS

- Retrospective cohort included 2,039 patients
 - Predominantly white (88%), non-Hispanic (94%), and male (56%)
 - Pseudomonas was the cause of infection in 7% of cUTI
- Table 1 presents patient characteristics stratified by pseudomonal vs. non-pseudomonal cUTI
 - Patients with UT abnormality, quadriplegia/paraplegia, multiple sclerosis, urinary stoma, and 1st/2nd cephalosporin use (all $p \leq 0.05$) were more likely to have pseudomonal cUTI
 - Patients with acute pyelonephritis were less likely to have pseudomonal infection ($p \leq 0.05$)
- Table 2 displays predictors of pseudomonal cUTI from the multivariable regression model
 - Acute pyelonephritis, male sex, presence of urinary stoma, 1st/2nd cephalosporin use, MS, and quadriplegia/paraplegia were significant independent predictors of pseudomonal cUTI

Table 2. Independent predictors of pseudomonal cUTI from multivariable regression

Predictor	Odds Ratio	95% CI
Male sex	1.89	(1.29 – 2.76)
Acute pyelonephritis	0.25	(0.08 – 0.81)
Urinary stoma	5.08	(2.35 – 10.98)
History 1st/2nd gen. cephalosporin use	2.01	(1.40 – 2.90)
Multiple sclerosis	2.81	(1.26 – 6.26)
Quadriplegia/paraplegia	2.74	(1.66 – 4.52)

CONCLUSIONS

- Identification of predictors of cUTI caused by Pseudomonas could serve to better guide empiric therapy selection
- Male sex, presence of a urinary stoma, history of 1st or 2nd generation cephalosporin use, multiple sclerosis, and quadriplegia/paraplegia were all identified as significant independent predictors of cUTI caused by Pseudomonas, while patients with acute pyelonephritis were less likely to have cUTI due to Pseudomonas
- Further work is needed to validate these findings and identify how predictors can best inform practice

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